NEEA MARKET EFFECTS EVALUATIONS

Table 1. 2011 NEEA Market Effects Evaluations

Report Titl e	Program or Sector	Analysis Performed by	Study Manager	Study/Evaluation Type
NEEA Market Progress Evaluation Report #6: Evaluation of NEEA's Industrial Initiative	Industrial	The Cadmus Group	NEEA	Market Effects
Consumer Electronics Television Initiative Market Progress Evaluation Report	Residential	Energy market Innovations	NEEA	Market Effects
NEEA Market Progress Evaluation Report #3: 80 Plus	Commercial	Navigant Consulting	NEEA	Market Effects
2010 BetterBricks Market Progress Evaluation Report	Commercial	Research Into Action, Inc.	NEEA	Market Effects
Northwest Ductless Heat Pump Initiative 2010	Residential	Research Into Action, Inc.	NEEA	Market Effects
Ductless Heat Pump Impact & Process Evaluation: Lab-Testing Report	Residential	Ecotope, Inc.	NEEA	Market Effects
Northwest Ductless Heat Pump Pilot Project	Residential	Research Into Action, Inc.	NEEA	Market Effects
Northwest Residential Code Savings for Idaho, Montana and Washington	Residential	Ecotope, Inc.	NEEA	Market Effects
Long-Term Northwest Residential Lighting Tracking and Monitoring Study	Residential	KEMA, Inc.	NEEA	Market Effects

For NEEA reports, see the CD included at the back of this supplement.

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January 28, 2011
REPORT #E11-220

NEEA Market Progress Evaluation Report #6: Evaluation of NEEA's Industrial Initiative

Prepared by:
The Cadmus Group Inc. / Energy Services
720 SW Washington Street, Suite 400
Portland, OR 97205

Northwest Energy Efficiency Alliance
PHONE
503-688-5400
FAX
503-688-5447
EMAIL
info@neea.org

Table of Contents

Executive Summary **1**
- **Market Progress** 1
  - Progress in Market Penetration 1
  - Progress in Market Partner Support of CEI 1
  - Progress in Trade Association Support of CEI 1
- **Energy Savings** 2
- **Overall Accomplishments** 2
- **Future Direction of the Initiative** 3

1. Introduction **4**
- Market Progress Indicators 5
- Progress from 2004–2009 6
- Organization of Report 7

2. Evaluation Activities **8**
- Methodology Updates 9

3. Market Characterization **10**
- Food Processing Market 10
- Pulp and Paper 11

4. Energy Savings Analysis **12**
- Top-Down Savings Estimates 13
- Bottom-Up Savings Estimates 13
- Total Savings 14
- Pending Savings 15
- Annual Electricity Savings Relative to Consumption 15
- Analysis of Savings in Urban and Rural Areas 16

5. Target Audience Follow-Up Survey **18**
- Past TAFU Findings 18
- 2010 TAFU Findings 18
  - Measure and Savings Persistence and Additional Energy Projects 19
  - CEI Persistence 20

6. Nonparticipating Facilities Survey **25**
  - Awareness of Energy Management Practices and CEI 25

Implementation of CEI Elements 25
Technical Assistance Received from Outside Organizations 26
Plans for Energy-Efficient Upgrades 26
Nonparticipant Trends in CEI Awareness and Implementation Since 2004 26

7. Market Partner Survey 28
Regional Energy-Efficiency Policy 28
Energy Management Programs Outside of the Northwest 29
Market Partner and Utility 2010 Interviews 29
The Initiative's Impact on the Industrial Market 30
Initiative Relationship with Market Partners 31
Energy Management Program Offerings 31
Barriers to Offering an Energy Management Program 33
Recommended Future Directions for NEEA 34
MPI 6: Trade Association Promotion of CEI 34

8. Trade Ally Survey 36
CEI Elements Promoted by Consulting Firms 37
Awareness and Implementation Trends 37
NEEA's Future Role with Trade Allies 37

9. Review of ACE Model for Food Processing 39
Comparison of Food Processing Assumptions and Results of NEEA's ACE and Cadmus' Market Diffusion Models 39

10. Conclusions and Recommendations 42
Energy Savings 42
Market Progress 44
Progress in Trade Association Promotion of CEI 44
Trade Ally Promotion of CEI 44
Program Successes Through 2010 45
Future Direction of the Initiative 45

Appendix A. 2009 Energy Savings Memorandum 47

Appendix B. Additional Energy Savings Tables and Site Visit Reports 58

Appendix C. A Review of Market Effects (2005-2010) Memorandum 74

Appendix D. 2010 Survey Instruments 89

Industrial Initiative 2010 Participant Survey 90
Industrial Initiative Nonparticipant Survey 2010 100
Industrial Initiative Market Partner Survey 2010 113
Industrial Initiative Trade Ally Survey 2010 121

Appendix E. Survey Frequencies 134

2010 Target Audience Follow Up Survey Frequencies 135
2010 Nonparticipant Facility Frequencies 147
2010 Market Partner Frequencies 159
2010 Trade Ally Frequencies 166

Appendix F: Market Diffusion Model Methodology and Assumptions 173

Model Overview 174
Model Description 174
Data Development 179
Income 180
Technology Initial and Operating Costs 180
Energy Savings and Consumption 180
Incentives 180
Interest Rate 181
Reliability of Technology 181
Distribution of Vintages 181
Diffusion of Awareness 181
Market Expenditures 182
Diffusion of Energy Management 182
Potential Adopters of Energy Management 183
Market Diffusion Model Results 183
The Diffusion Model 183
Forecast Results 184

Executive Summary

This is the sixth Market Progress Evaluation Report (MPER) on the progress and accomplishments of the Industrial Initiative (the Initiative) of the Northwest Energy Efficiency Alliance (NEEA). The Initiative specifically focuses on Continuous Energy Improvement (CEI), which consists of several components integral to energy management. Cadmus has been the Initiative's independent evaluator since the program's 2004 inception. This MPER focuses on the food processing market and documents the findings from data collected during 2010 through site visits and interviews with industrial end users and market partners.

Market Progress

This report updates three of the Initiative's key market progress indicators:

- Market penetration;
- Market partner support of CEI;
- Trade association support of CEI.

Progress in Market Penetration

One of the Initiative's goals was to engage 13 percent of the large food processor market in CEI practices. Based on surveys of nonparticipating and participating facilities, 36 percent of the target market currently practices CEI. Data indicate an expanding sector, with the industry open to capital and non-capital approaches, including CEI, for improving energy efficiency and controlling energy costs. Data from the survey with participating facilities also indicate that these facilities have successfully integrated CEI into their corporate cultures, supported by evidence of persistence of capital improvement projects and operations and maintenance measures implemented with Initiative involvement. Cadmus also found the majority of the participating facilities practicing CEI attributed their decision to do so to NEEA, the Initiative, and/or the Initiative's implementation team.

Progress in Market Partner Support of CEI

Key aspects of the Initiative's implementation strategy include market partner support of CEI and encouraging partners' promotion of it. The most significant indication of market partners' progress has been recognition of CEI measures as energy-efficiency resources in the Northwest Power and Conservation Council's Sixth Power Plan. As a result, seven utilities interviewed in 2009 were considering developing their own energy management programs. In 2010, two of these utilities reported being in the process of developing such programs. Additionally, Energy Trust of Oregon (ETO) and Bonneville Power Administration (BPA) already had implemented energy management programs, which included CEI elements.

Progress in Trade Association Support of CEI

Northwest Food Processors Association (NWFPA), one of the Initiative's market partners, serves as a trade association for the food processing industry. As a result of the Initiatives' efforts in the food processing sector, in late 2008, the NWFPA established a goal for its members to reduce energy intensity by 25 percent in 10 years. To measure energy intensity reduction, NWFPA collected data from its members to establish baseline energy intensity for the year 2009, from which progress toward the energy intensity reduction goal can be measured. NWFPA also

conducts energy audits and tests implementation of energy management software systems at food processing facilities.

Energy Savings

The Initiative's original goal was to save 20 average MW (aMW) of energy region-wide by the end of 2009. Based on information available to date, Cadmus validated a total of 7.864 aMW of electric and 4,129,854 therms of gas savings from 2006 through 2009 in the food processing and pulp and paper sectors. Food processing measures accounted for nearly 72 percent of validated electric savings and 100 percent of natural gas savings.

As the savings potential from pulp and paper facilities was expected to be large, this sector was projected to make up the majority of the 20 aMW goal. However, total validated electric savings in the pulp and paper market were only 2.217 aMW by the end of 2009. Due to shortfalls in the pulp and paper sector, the Initiative did not achieve its electric savings goal. However, the food processing sector exceeded expectations by providing 5.646 aMW through the Initiative. This gave a total 7.864 aMW electric savings in food processing and pulp and paper combined.

Cadmus also estimated that food processing facilities practicing CEI can save an average of 3.07 percent of their electricity consumption per year, and 2.89 percent of their gas consumption per year.

As of January, 2011, an independent evaluation contractor has started the process of validating the 2010 energy savings. The 2010 validated energy savings will be available by March 2011.

Trade Ally Promotion of CEI

An additional measure of market change is trade ally promotion of CEI. Cadmus identified that at least six companies in the region provide energy management consulting services to industrial facilities. Findings from surveys with five energy management consulting companies in the region indicate that industrial facilities have become more aware of energy management practices and benefits due to: increased promotion and marketing; changes in environmental awareness and attitudes; and economic pressures to reduce their bottom lines. Additionally, more resources are available to the industry for obtaining information about energy management, and resources have improved since 2004. The result has been more facilities recognizing energy as a controllable expense, and a substantial increase in the number of facilities practicing CEI since 2004, when most respondents felt almost no facilities were managing energy.

Overall Accomplishments

The research conducted in 2010 shows the Initiative has succeeded in integrating energy management into food processors' business and manufacturing operations, with energy as a manageable cost for food processors, as evidenced by the following:

- Participating facilities have been pleased with the program, and the Initiative can disengage with these facilities, confident the facilities will continue practicing CEI.
- Nonparticipant and participant surveys revealed that 36 percent of the target market is practicing CEI, an increase from 13 percent in 2004.

- Trade ally and market partner interviews showed that awareness has increased regarding energy as a controllable cost and as an important factor in maintaining a competitive advantage. The availability and quality of software tools and training opportunities has also increased.
- Outside of the Northwest, the California Public Utilities Commission (CPUC) and Investor Owned Utilities (IOUs) have implemented energy management programs for industrial facilities, based on the Initiative's design.

Future Direction of the Initiative

Over the next four years, NEEA can build on this success by engaging a new group of participants. Cadmus found 35 percent of the target market practices energy management; however, only two facilities reported practicing CEI without help from NEEA, BPA, or ETO. Trade allies confirmed that very few if any facilities would begin practicing energy management without technical and financial help. This shows a continuing need to provide assistance to the food processing sector to further promote energy management adoption. Market partners and trade allies agreed NEEA continues to have a large role to play in this market. Despite energy management's economic benefits, many food processors remain reluctant to adopt CEI. This suggests a market gap NEEA and its market partners can help close with incentives, education and marketing.

1. Introduction

The Northwest Energy Efficiency Alliance (NEEA) designs and implements market transformation programs in Idaho, Montana, Oregon, and Washington. In partnership with local utilities and other market partners, NEEA's initiatives encourage market-wide adoption of energy-saving technologies and practices; NEEA's efforts target the residential, commercial, and industrial sectors.

Since early 2005, NEEA has implemented its Industrial Initiative (the Initiative, formerly known as the Industrial Efficiency Alliance or IEA), which focuses on market transformation in the industrial sector. The Initiative targeted the food processing and pulp and paper markets to encourage firms to adopt Continuous Energy Improvement (CEI), which comprises the following six key elements, into their management and operational practices:

- Having dedicated staff, including an energy champion;
- Tracking energy use;
- Setting energy reduction goals;
- Developing and routinely updating an energy management plan;
- The ability to quantify energy savings from energy-efficient equipment upgrades; and
- The ability to quantify energy savings from O&M improvements.

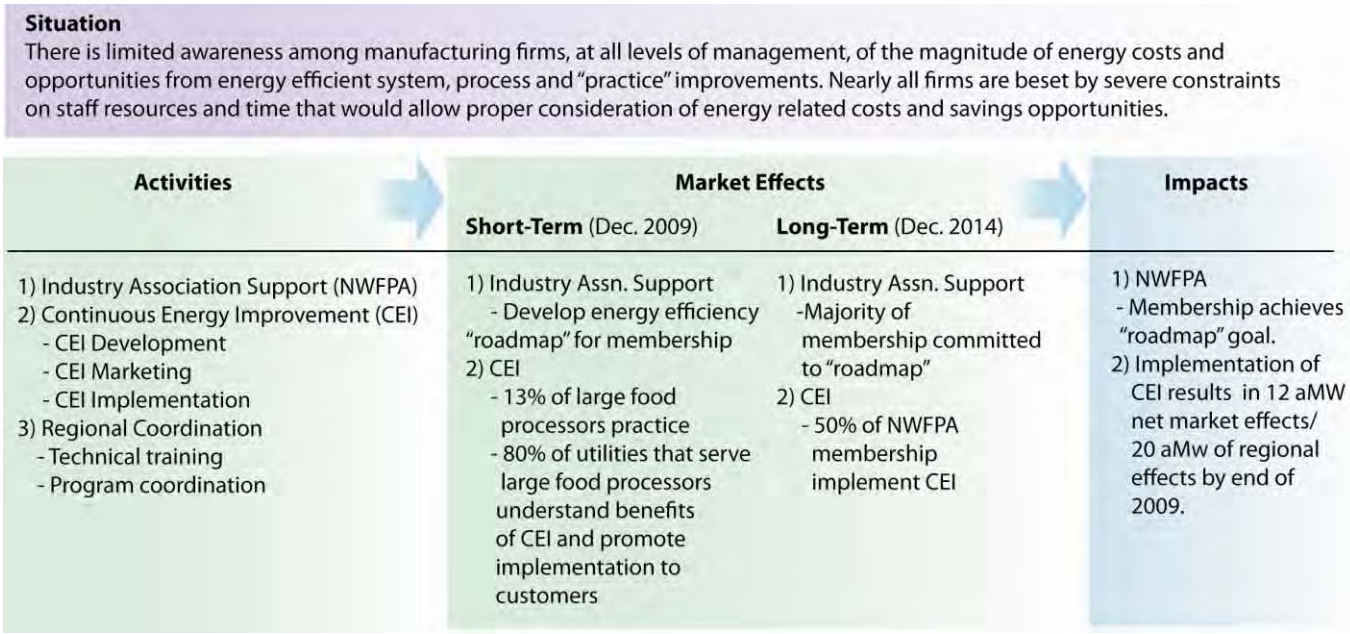
CEI aims to permanently integrate energy management into business systems —from corporate office to shop floor. As a program/product, CEI addresses organizational structures, people, manufacturing systems, and measurements as equally essential aspects of industrial energy management. While CEI leads to specific actions and energy-efficiency measures, the program's/product's emphasis is to position energy as an input into the manufacturing process, so it can be managed for maximum value. The Initiative categorizes facilities based on the following five CEI engagement stages:

- **Stage 1: Aware/Receptive/Interested.** The facility, having heard about the program, has expressed interest.
- **Stage 2: Engaged.** The facility has begun a business practice assessment process to identify specific opportunities.
- **Stage 3: Committed.** The facility has dedicated resources to work with the Initiative and to develop an action plan for energy management.
- **Stage 4: Practicing.** The facility is implementing the action plan and actively practicing energy efficiency.
- **Stage 5: Sustained Practicing.** The facility has implemented and continues to practice all CEI elements. The facility can continue practicing CEI without the Initiative's assistance.

Unlike NEEA's early market transformation efforts, which primarily focused on technology upgrades, this initiative is designed with a "holistic" approach, targeting end users, trade allies, and utilities to promote a whole-system strategy for improving energy efficiency. As such, the Initiative complements local utility incentive programs providing financial incentives for capital

projects. Figure 1.1 shows the Initiative's food processing logic model for 2009, which was also used in 2010. The Initiative is currently developing a new logic model to reflect its future goals.

Figure 1.1. Initiative 2009 Food Processing Logic Model



Since the Initiative's launch, Cadmus has been reporting evaluation findings in the form of five Market Progress Evaluation Reports (MPERs). The MPERs have documented the Initiative's development and maturation, including its many changes, challenges, and strategies used by NEEA to address these challenges. The MPERs have also reported on the Initiative's achievements, particularly energy savings and market transformation effects, as measured by the six Market Progress Indicators (MPIs) described below.

Market Progress Indicators

To monitor progress, NEEA set 5- and 10-year performance targets for the Initiative, as well as 33 key performance indicators (KPIs), at the program's outset. The initial performance indicators included a cumulative electricity savings target of 130 average Megawatts (aMW) by 2015, 35 percent of which (45 aMW) would be achieved in the first five years.

As the program evolved, the Initiative revised both the energy savings targets and various KPIs to more realistically reflect market conditions. The Initiative adjusted the savings target down to 20 aMW based on actual experience in the field and changing macroeconomic conditions. The Initiative also condensed the original 33 KPIs to six Market Progress Indicators (MPIs), which were considered better and more relevant measures of the Initiative's progress:

- MPI 1: The percentage of large food processing firms (as measured in terms of employment shares) and pulp and paper firms (as measured in terms of output capacities) implementing CEI.

- MPI 2: The percentage of industrial firms from non-targeted markets implementing CEI.
- MPI 3: The number of large (multi-facility) food processing or pulp and paper firms adopting CEI in plants or mills without Initiative involvement.
- MPI 4: The number of large food processing or pulp and paper firms adopting CEI in plants or mills outside the Northwest.
- MPI 5: The percentage of Northwest utility representatives promoting CEI as part of their energy-efficiency activities.
- MPI 6: Target markets' trade associations, such as the Northwest Food Processors Association (NWFPA), promoting CEI.

To date, progress measurement activities have focused on the more easily-tracked MPI 1, MPI 5, and MPI 6. This MPER reports progress on MPI 1, MPI 3, MPI 5, and MPI 6.

Progress from 2004–2009

Over the past five years, independent evaluation of the Initiative has indicated the pulp and paper market did not achieve the same success as the food processing market for a number of reasons:

- The pulp and paper industry had already trended toward decreasing energy intensity, perhaps indicating a higher awareness and knowledge of energy-efficiency practices.
- The economic downturn affected the pulp and paper industry, resulting in production curtailments and plant closures.
- Companies with headquarters outside the Northwest owned many regional mills, making it difficult for regional efforts to gain corporate buy-in for CEI.
- The absence of a strong regional association made it difficult to reach out to the region's mills in a consistent, continuous manner.

As such, the Initiative narrowed its focus in 2009 to the food processing industry.

The Initiative made notable progress in the food processing sector regarding MPI 1 (target market firms practicing CEI); MPI 5 (utility promotion of CEI); and MPI 6 (coordination with NWFPA). MPER #5 reported 20 percent of the food processing target market, as measured in terms of total employment, was implementing CEI, exceeding the Initiative's MPI 1 target of 13 percent of large food processors practicing CEI by December 2009.[1] Regarding MPI 5, the 2009 Utility Survey indicated almost all utilities understood CEI, and over half of the utility respondents promoted some version of CEI. Regarding MPI 6, the NWFPA has adopted aggressive energy intensity reduction targets for its members.

Having completed the five-year project, NEEA must now determine how best to build upon the Initiative's success as it develops its strategy for the next five years (2010–2014). Cadmus interviewed market partners, trade allies, and participating and nonparticipating food processing facilities to understand the current market for energy management and to obtain

[1] The market penetration percentage in the food processing market is defined in terms of the total number of employees at plants with 250 or more employees at an Engagement Stage of 3 or higher, relative to the total number of employees in the target market (41,765).

recommendations regarding NEEA's role in the future. This MPER reports on the findings of the surveys and recommendations on moving forward.

Organization of Report

This MPER is organized in 10 chapters:

- Chapter 1 is this introduction.
- Chapter 2 discusses this MPER's evaluation activities.
- Chapter 3 provides an overview of the food processing market.
- Chapter 4 summarizes energy savings achieved from the 2006–2009 projects.
- Chapter 5 discusses the results from past target audience follow-up surveys and compares to the results in 2010.
- Chapter 6 summarizes the results from the nonparticipant surveys and trends in the market since 2005.
- Chapter 7 discusses the results from the market partner interviews.
- Chapter 8 presents the findings from the trade ally interviews.
- Chapter 9 provides recommendations for revising assumptions made in the Initiative's cost-effectiveness (ACE) model.
- Chapter 10 presents conclusions and recommendations derived from research conducted for this MPER.

2. Evaluation Activities

Through six MPERs, Cadmus has documented evaluation of the Initiative's implementation for its first five years. Table 2.1 presents an overview of evaluation activities for each report. Reflecting different implementation stages as well as NEEA's reporting needs, each MPER differs slightly in scope and focus. MPER #6 updates energy savings and assesses the CEI diffusion to food processing facilities in the Northwest.

Table 2.1 Overview of Historical Evaluation Activities

Evaluation Activities	MPER#1 (Jun '06)	MPER#2 (Nov '06)	MPER#3 (Oct '07)	MPER#4 (Jul '08)	MPER#5 (May '09)	MPER#6 (Nov '10)
Review of Strategy and Assumptions	☑		☑	☑	☑	
Market Characterization	☑	☑	☑	☑	☑	☑
Process Evaluation (Staff Interviews)	☑		☑	☑		☑
Process Evaluation (Contractor Interviews)	☑	☑				☑
Market Progress Assessment (Target Audience Follow-Up Survey)		☑	☑	☑		☑
Market Progress Assessment (Market Partner Surveys)		☑		☑	Partial*	☑
Energy Savings Validation & Estimation (From Training)			☑	☑		
Energy Savings Validation & Estimation (From Business Practices Services)			☑	☑	☑	☑
Market Diffusion of CEI						☑

*Only three market partners and two trade allies/vendors were interviewed.

This report's findings and conclusions are based on data and analysis from three principal activities:

1. Document review and site visits in support of savings analysis.
2. Market assessment interviews with market partners, utilities, participating and nonparticipating food processing facilities, and trade allies (energy management consulting companies). Senior Cadmus staff with an understanding of the Initiative completed the interviews.
3. Assessment of the Initiative's projected savings, using a market diffusion model.

Table 2.2, on the following page, summarizes sample sizes and time frames for each data collection activity.

Table 2.2. Summary of Data Sources and Sample Sizes for MPER #6

Data Collection Activity	Number Targeted	Number Completed	Time Frame
Savings Analysis (Site Visits)			
Food Processing	15	8	February 2010
Pulp & Paper	3	1	February 2010
Market Assessment for CEI (Phone Interviews)			
Participating Food Processing Facilities	15	13	June/July 2010
Nonparticipating Food Processing Facilities	30	24	June 2010
Market Partner Surveys			
Regional Energy Policy Groups	1	1	February 2010
Market Partners	8	5	July 2010
Utilities	8	5	July 2010
Trade Ally Survey			
Energy Management Consulting Firms	6	5	July/August 2010

Methodology Updates

Cadmus modified the evaluation methods and focus over the last five years in line with the Initiative evolution in strategy and focus. From 2006 to 2008, Cadmus' engineers derived energy savings estimates for individual energy-efficiency measures after installation. Beginning in 2009, the implementation contractor, Ecos, took responsibility for developing estimates of energy consumption prior to implementation and for savings estimates after work completion at individual facilities. Cadmus' role shifted to working with the implementation contractor and facility staff to standardize savings estimation procedures and to validate final calculations.

As of MPER #5, Cadmus began validating gas savings in addition to electric savings as, on average, 60 percent of the energy used in food processing facilities was natural gas. In February 2010, Cadmus conducted site visits to validate electric and natural gas savings from projects reported as complete in NEEA's Industrial Tracking System (ITS).

Beginning with MPER #5, the focus of market characterization shifted to food processing, as this sector became the Initiative's primary target market. Past MPERs generally focused on summarizing facility characteristics and financial health. For MPER #6, interviews focused on changes in market awareness and CEI adoption within the food processing sector since 2004. The reasons for this focus in MPER #6 were the expectation that market characterization would not have changed significantly since a year ago, and additionally, NEEA was interested in the diffusion of CEI beyond facilities engaged with the Initiative, therefore, the 2010 interviews collected information specifically about market penetration.

MPER #6 also analyzes CEI's diffusion within the Northwest's food processing sector. Developments including the Council adding CEI elements to the Sixth Power Plan, and several market partners implementing programs similar to the Initiative, necessitated a different and more systematic approach to estimating the Initiative's impacts and market potential. To address this, and to compare such *ex ante* data with NEEA's Alliance Cost Effectiveness (ACE) model, Cadmus created a market diffusion model, which predicts the number of facilities likely to practice CEI from 2011 to 2015, and derives estimates of associated energy savings.

3. Market Characterization

MPER #1 reported on the initial industry characteristics, such as energy use, employment, and energy-efficiency opportunities. Building on the initial market characterization, MPERs #2, #3, and #4 presented market updates. In support of the 2008 market characterization update for MPER #5, Cadmus completed primary and secondary research, including interviews with utility representatives, market partners, and trade allies as well as a review of various industry publications, and regional and national newspapers.

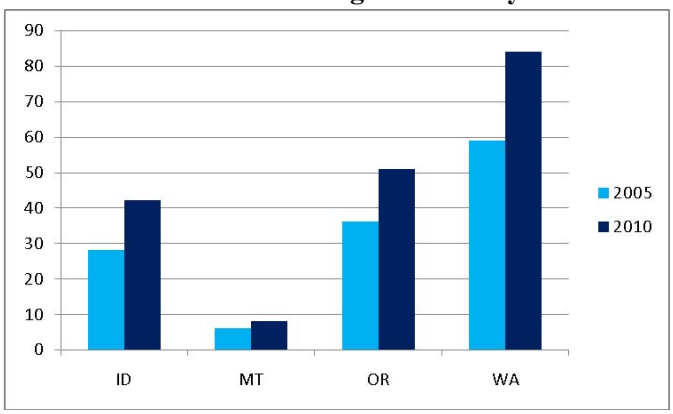
For this market characterization, Cadmus reviewed a population of 183 food processing facilities, which were affiliated with 59 different companies distributed throughout Washington, Oregon, Idaho, and Montana. Companies examined had at least 250 employees at all facilities located in the Northwest. Cadmus compared 2010 Dun & Bradstreet (D&B) data to 2005 data to determine changes in facility characteristics or the market. Cadmus also interviewed utility representatives, market partners, energy management consulting firms, and nonparticipating food processing facilities to determine CEI's diffusion within the food processing sector.

Food Processing Market

Overall, findings for the food processing market largely mirrored those from previous years: the market continues to grow, and facilities are open to improving their energy efficiency. Cadmus examined the data from D&B of 183 facilities across four states, an increase of 42 percent over the 2005 report (thus indicating the increase in the number of facilities within the target market between 2005 and 2010). Figure 3.1 shows changes in the number of food processing facilities with more than 250 employees by state.

Generally, the Northwest food processing sector grew from 2005 to 2010. Mean sales revenue increased during this period by 52.6 percent. Employees per facility, not including staff at corporate headquarters, stayed roughly the same during this period.[2] In 2005, the average employee count was 197; that number increased to 199 in 2010.

Figure 3.1. Number of Food Processing Facilities by State in 2005 and 2010



The 2008 market partner survey findings in MPER #5 suggested energy-efficiency investments were not a top priority for food processors, with only 2 of 11 respondents citing such investments

[2] Dun & Bradstreet Industry Sector Report, www.dnc.com. Accessed May 28, 2010.

as a high priority. In the 2010 nonparticipant survey, Cadmus found that all facilities interviewed had recently made energy-efficient improvements of some sort. As reported in MPER #5, the NWFPA has taken a formal and aggressive role in promoting energy efficiency to its members. Specifically, NWFPA aims to reduce member-wide energy intensity by 25 percent in 10 years and by 50 percent in 20 years. While participation in this initiative is voluntary, NWFPA plans to heavily promote energy reduction goals among members, and to devote considerable resources to assisting its members with energy-efficiency projects. Of 13 participant survey respondents, 12 reported awareness of NWFPA's energy reduction efforts, and five of 21 nonparticipants' surveys mentioned they first learned about energy management practices through the NWFPA.

In light of these developments and the Initiative's active collaboration with NWFPA, Cadmus anticipates the food processing market will be more open to investing in energy-efficiency improvements in future years than it was in 2008.

Pulp and Paper

MPER #5 reported large changes for the pulp and paper industry. Declining demand – especially for newsprint products – combined with higher prices for inputs and the general economic downturn has created a highly competitive environment. Cadmus found Northwest pulp and paper producers faced high rates of plant ownership turnover and layoffs. Most market partners interviewed in late 2008 likewise maintained that pulp and paper producers faced a highly turbulent market, with two interviewed market partners/trade allies considering the market to be in decline. Due to changes in this sector, Cadmus concentrated its MPER #6 research on the food processing sector.

4. Energy Savings Analysis

At the Initiative's beginning in 2004, program staff anticipated reaching a goal of 20 aMW electric savings by the end of the fifth program year. Starting in 2006, Cadmus conducted annual site visits to assess progress toward this goal. In addition to site visits conducted in February and March 2010, Cadmus evaluated facility-wide, or top-down, energy savings for several facilities, based on statistical models provided by NEEA. Top-down energy savings evaluations captured both validated measures and other energy-saving activities that were implemented but could not be quantified. Appendices A and B contain more detail on the energy savings validation methodology and results.

The 2010 savings validation effort consisted of two parts:

1. Review and validation of top-down (or facility-wide) energy savings claims; and
2. Validation of bottom-up (or measure-level) energy savings claims.

Table 4.1 and Table 4.2 detail the number of reports received and the number of top-down savings claims evaluated per the facilities' engagement stage in NEEA's Initiative.

Table 4.1. Distribution of Top-Down Electric Savings Claims, 2006 – 2009

Stage of Engagement	Total Number of Facilities Analyzed	Number of Facilities with 2006 Savings Claim (Electric)	Number of Facilities with 2007 Savings Claim (Electric)	Number of Facilities with 2008 Savings Claim (Electric)	Number of Facilities with 2009 Savings Claim (Electric)
Stage 3 - Committed	1	0	0	0	0
Stage 4 – Practicing*	6	0	3	3	1
Stage 5 – Sustaining*	11	1	2	5	5
Total	18	1	5	8	6

*At the time of site visit selection.

Table 4.2. Distribution of Top-Down Gas Savings Claims, 2006 – 2009

Stage of Engagement	Total Number of Facilities Analyzed	Number of Facilities with 2006 Savings Claim (Gas)	Number of Facilities with 2007 Savings Claim (Gas)	Number of Facilities with 2008 Savings Claim (Gas)	Number of Facilities with 2009 Savings Claim (Gas)
Stage 3 - Committed*	1	0	0	0	0
Stage 4 - Practicing*	6	0	0	0	0
Stage 5 - Sustaining*	11	1	2	6	6
Total	18	1	2	6	6

*At the time of site visit selection.

For the bottom-up analysis, Cadmus developed an inventory of 14 facilities reporting energy savings for measures installed through the Initiative by using a list of measures provided by the implementation contractor (Ecos). The six facilities reporting the highest amount of claimed electric savings were selected for site visits, and savings claims at the three additional facilities were validated by phone (in lieu of a site visit). Together, these nine facilities represented over 95 percent of total claimed energy savings. Table 4.3 presents the number of site visits and phone verifications Cadmus completed.

Table 4.3. Site Visit Disposition by Engagement Stage, 2010*

Stage of Engagement**	Number of Plants with Pending Savings Claim(s)**	Number of Completed Site Visits	Number of Completed Phone Verifications	Number of Facilities Not Selected for Site Visit or Phone Verification
Stage 3 - Committed	2	1	0	1
Stage 4 - Practicing	3	2	0	1
Stage 5 - Sustaining	9	3	3	3
Total	14	6	3	5

*Site visits occurred in early 2010 to validate savings for measures installed from 2006 through 2009.

**At the time of site visit selection, which occurred in January 2010.

Top-Down Savings Estimates

Table 4.4 presents gross and net top-down savings for 18 food processing facilities reaching Stage 3 or higher since 2006. Gross savings numbers capture all savings at the facility, including those arising from capital measures installed through the program. To prevent double-counting, Cadmus calculated net top-down savings by deducting validated bottom-up savings from the gross top-down claim for the same year. In the one case where validated bottom-up savings exceeded the top-down claim, top-down savings were not credited, but validated bottom-up savings were not decreased (see Appendices A and B for a detailed methodology and facility-level gross and net top-down savings).

Table 4.4. Top-Down Savings by Year, 2006–2009

Year	Gross Top-Down Savings (aMW)	Net Top-Down Savings (aMW)	Gross Top-Down Savings (therms)	Net Top-Down Savings (therms)
2006	0.242	0.220	73,666	73,666
2007	0.672	0.461	131,378	131,378
2008	0.913	0.563	967,701	967,701
2009	0.816	0.579	1,879,095	1,879,095
Total	2.643	1.823	3,051,840	3,051,840

Bottom-Up Savings Estimates

Table 4.5 and Table 4.6 present electric and gas savings validated during the 2010 site visits and phone verifications. Cadmus validated savings for projects completed in 2007, 2008, and 2009. Most validated savings occurred in 2009. Operations and maintenance (O&M) improvements accounted for the majority of savings validated during these verifications (see Appendix B for detailed facility-level savings data). Incented capital projects, which are measures for which the facility receives an incentive from other utility or market partner programs, accounted for 0.197 aMW. Unincented capital projects, or capital improvements that did not receive an incentive from any other program, made up the remainder of the savings.

Table 4.5. Electric Savings by Year—Validated by Site Visits and Phone Verification (February/March 2010)

Year	O&M (aMW)	Incented Capital (aMW)	Unincented Capital (aMW)	Total Electric Savings (aMW)
2007	0.075	0.101	0	0.176
2008	0.020	0.011	0	0.031
2009	1.239	0.085	0.038	1.362
Total	1.334	0.197	0.038	1.569

Table 4.6. Gas Savings by Year—Validated by Site Visits and Phone Verification (February/March 2010)

Year	O&M (therms)	Incented Capital (therms)	Unincented Capital (therms)	Total Gas Savings (therms)
2009	0	0	20,600	20,600
Total	0	0	20,600	20,600

Total Savings

Table 4.7 presents total validated electric savings, including net top-down savings. Through the end of 2009, CEI saved the region 7.864 aMW. This does not include pending savings.

Table 4.7. Total Validated Electric Savings (2006–2009)

Year	O&M (aMW)	Incented Capital (aMW)	Unincented Capital (aMW)	Net Top-Down (aMW)	Total Electric Savings (aMW)
2006	0.161	0.489	0	0.220	0.869
2007	0.329	0.227	0.285	0.461	1.303
2008	1.079	1.306	0.617	0.563	3.565
2009	1.324	0.186	0.038	0.579	2.126
Total	2.893	2.208	0.940	1.823	7.864

Table 4.8 presents total validated gas savings to date, including net top-down savings. Cadmus did not track gas savings until 2008. Savings reported for 2006 and 2007 were derived solely from top-down analyses.

Table 4.8. Total Validated Gas Savings (2006–2009)

Year	O&M (therms)	Incented Capital (therms)	Unincented Capital (therms)	Net Top-Down (therms)	Total Gas Savings (therms)
2006	n/a	n/a	n/a	73,666	73,666
2007	n/a	n/a	n/a	131,378	131,378
2008	68,750	0	988,664	967,701	2,025,115
2009	0	0	20,600	1,879,095	1,899,695
Total	68,750	0	1,009,264	3,051,840	4,129,854

Pending Savings

Pending savings refer to completed measures documented and flagged as ready for evaluation in NEEA's Industrial Tracking System (ITS) for facilities reaching Stage 3 or higher. Table 4.9 lists pending savings for facilities in the food processing and pulp and paper sectors as of August 12, 2010.

Table 4.9. Outstanding Pending Savings

Market	Outstanding Pending Electric Savings (kWh)	Outstanding Pending Electric Savings (aMW)	Outstanding Pending Gas Savings (therms)
Food Processing	5,521,724	0.630	227,512
Pulp & Paper	462,000	0.053	64,000
Total	5,983,724	0.683	291,512

Annual Electricity Savings Relative to Consumption

Cadmus validated energy savings and collected annual electricity and natural gas consumption data for 13 food processing facilities engaged with the Initiative. Relative savings for each facility were calculated using the following steps:

1. Dividing validated savings (which include net top-down savings and bottom-up savings) for each facility in each year by the facility's total consumption in that year.
2. Calculating weighted average total annual savings as a percentage of consumption across all facilities for all years.

Table 4.10 shows that over four years, food processing facilities practicing CEI achieved average electric savings of 3 percent of their annual consumption.

Table 4.10. Percent Electric Savings by Year, 2006–2009

Facility	2006	2007	2008	2009	Total
O-009	n/a	7.85%	8.57%	n/a	8.19%
W-028	No data available.				
O-007	n/a	5.73%	6.19%	5.85%	5.92%
O-005	9.89%	10.55%	10.82%	10.71%	10.48%
O-006	n/a	0.88%	0.19%	0.50%	0.52%
I-013	0.00%	0.00%	2.17%	0.00%	0.63%
I-016	n/a	0.00%	10.21%	0.00%	3.45%
I-009	4.72%	0.00%	7.16%	1.00%	3.27%
W-015	n/a	1.38%	1.91%	0.00%	1.13%
W-007	0.70%	0.00%	4.60%	32.50%	9.25%
W-023	No data available.				
I-007	n/a	0.00%	1.65%	0.00%	0.59%
I-012	n/a	0.75%	1.16%	3.70%	1.85%
O-004	n/a	3.19%	6.62%	3.71%	4.49%
O-008	n/a	16.26%	14.95%	26.14%	18.81%
Wtd. Avg	4.35%	1.68%	4.59%	2.57%	3.07%

Annual Gas Savings Relative to Consumption: As shown in Table 4.11, over two years, engaged food processing facilities achieved average gas savings of nearly 3 percent of their annual consumption. Gas savings were not tracked until 2008, so Cadmus calculated gas savings as a percentage of consumption only for 2008 and 2009. Facility data on production units per year were not available, so it was not possible to calculate the percentage change in energy intensity. However, food processing facilities interviewed in 2010 set goals ranging from a 2.5 percent to a 5 percent reduction in energy intensity per year, and 75 percent of respondents felt they were on track to meet their goals. Annual electricity savings as a percentage of consumption, in addition to validated natural gas savings, supported interview findings that facilities have been meeting their energy intensity reduction goals.

Table 4.11. Percentage Gas Savings by Year, 2008–2009

Plant	2008	2009	Total
O-009	0.00%	n/a	0.00%
W-028	No data available		
O-007	14.17%	13.06%	13.59%
O-005	13.23%	12.22%	12.70%
O-006	6.64%	6.10%	6.38%
I-013	3.13%	14.02%	7.11%
I-016	1.14%	0.00%	0.58%
I-009	0.56%	0.59%	0.57%
W-015	4.08%	0.00%	2.11%
W-007	1.71%	0.00%	0.86%
W-023	No data available.		
I-007	6.04%	0.00%	3.38%
I-012	0.45%	0.00%	0.23%
O-004	0.00%	0.00%	0.00%
O-008	0.00%	0.00%	0.00%
Wtd. Avg	**3.24%**	**2.48%**	**2.89%**

Analysis of Savings in Urban and Rural Areas[3]

NEEA requested a breakout of validated energy savings between urban and rural areas. To facilitate this analysis, NEEA provided Cadmus with a list of Rural Urban Continuum Codes (RUCC) by zip code, to which Cadmus matched individual facility zip codes. Table 4.12a shows that a majority of the savings (52 percent) were concentrated in urban areas. Savings in high rural areas represented 45 percent of total validated electric savings, while savings in low rural areas represented only 3 percent of the total. The concentration in urban and high rural areas reflects the concentration of engaged facilities in these areas (Tables 4.12b and 4.12c).

[3] NEEA used the Rural-Urban Continuum Codes (RUCC) developed by the United States Department of Agriculture, which assigns codes ranging from one to nine, based on counties' population size. Further information about the RUCC can be found in www.ers.usda.gov/Briefing/Rurality/RuralUrbCon. NEEA further segments the codes by Urban (codes one to three), High Rural (codes four to six) and Low Rural (codes seven to nine).

Table 4.12a. Total Validated Electric Savings (2006–2009) by Urban/Rural Designation

Year	Urban (aMW)	High Rural (aMW)	Low Rural (aMW)	Total (aMW)
2006	0.389	0.228	0.253	0.869
2007	0.672	0.630	0	1.303
2008	1.418	2.147	0	3.565
2009	1.615	0.512	0	2.126
Total	4.094	3.517	0.253	7.864

Table 4.12b. Number of Facilities with Validated Savings (2006 - 2009) by Urban/Rural Classification

Year	Urban (n)	High Rural (n)	Low Rural (n)	Total (n)
2006	2	1	2	3
2007	7	1	0	8
2008	9	4	0	13
2009	6	2	0	8

Table 4.12c. Annual Consumption (2006 - 2009) by Urban/Rural Classification

Year	Urban (aMW)	High Rural (aMW)	Low Rural (aMW)	Total (aMW)
2006	6.804	3.625	NA	10.429
2007	31.286	10.974	0.000	42.260
2008	32.158	11.142	0.000	43.301
2009	29.591	9.540	0.000	39.131
Total	99.839	35.282	0.000	135.121

5. Target Audience Follow-Up Survey

Cadmus has conducted annual Target Audience Follow-Up (TAFU) interviews with Initiative participants since 2006. The interviews were designed to: (1) collect participants' feedback regarding their involvement in the Initiative; and (2) determine the Initiative's role in participants' decisions to implement CEI at their plants. This survey addresses MPI 1, pertaining to participating firms implementing CEI. The research objectives of the 2010 TAFU differ slightly from those of past TAFUs, with 2010 focusing on determining the persistence of measures and processes implemented in previous years. Therefore, this chapter begins with a summary of past TAFU findings, followed by the findings of the 2010 TAFU.

Past TAFU Findings

In 2006, the Initiative classified 11 industrial plants (including two pulp and paper and nine food processing facilities) as Initiative participants, and Cadmus interviewed eight of these. Cadmus found the most important, overarching issues for industrial end users were staying competitive and reducing operating costs (including energy costs). Regarding energy management, six interviewees indicated they had formal energy management plans, and most interviewees indicated they held formal discussions on energy usage and CEI with staff.

One-half of participants mentioned that they track energy data, and most noted data was only discussed on a monthly or annual basis. Participants also indicated they valued the Initiative, and relied on the face-to-face meetings with Initiative staff to advance energy management within their firm. The 2006 TAFU results also indicated participants were not coordinating with their utilities, and the Initiative was not leveraging utility resources to spread the word about the Initiative.

By May 2009, participation in the food processing market had grown to 21 plants practicing CEI at Stage 3 (Committed) or higher. In interviews with 18 of these participants, Cadmus determined that some issues (such as the industrial end users' interests in staying competitive and reducing costs) had stayed constant since the first TAFU interviews. Industrial end users continue to face a tight market, where capital and time constraints limit a firm's ability to focus on energy efficiency.

However, the 2009 TAFU, which focused on the food processing market, revealed a markedly evolved participant profile. Of the 18 interviewed participants, the majority (15) indicated they had an "energy champion" or person in charge of energy management, an energy action plan, and some type of data tracking plan in place. More than half of the firms were able to quantify energy savings related to their capital and O&M efficiency projects. The Initiative also made progress in improving end user and utility relationships; all but one of the 2009 interviewees rated their relationship with their utility as good or very good, and eight interviewees noted that their relationships improved after engaging with the Initiative. Cadmus' surveys revealed that 15 of the 18 interviewed participants fully grasped the CEI concept and its value. Cadmus also found the majority of the facilities practicing CEI attributed their decision to do so to NEEA, the Initiative, and/or the Initiative's implementation team.

2010 TAFU Findings

The 2010 TAFU research objectives differed slightly from years past. Although the 2010 interviews continued to collect participants' feedback regarding their involvement in the

Initiative and the Initiative's role in their implementation of CEI, Cadmus, with direction from NEEA, designed the 2010 survey with several forward-looking objectives, specifically:

- Persistence of measures and processes implemented in previous program years;
- Projects participating facilities implemented on their own;
- Factors influencing a facility's decision to sustain CEI;
- Facilities' future plans for reducing energy consumption; and
- How NEEA's withdrawal may affect CEI persistence.

Appendix D contains the survey guide, and Appendix E contains the tabulated results.

Cadmus attempted to interview all food processing facilities engaged at Stage 3 (Committed) or higher. Based on engagement stages captured in the ITS database, the 2010 sample frame included 15 food processing facilities. As shown in Table 5.1, Cadmus interviewed 13 out of the 15 facilities. Coordination with the implementation contractor revealed two facilities were unable to complete the interviews due to pressing, time-intensive obligations at the plants. In all cases where interviews were completed, Cadmus interviewed the current energy champion. The interviewed participating facilities represent 9 percent of the target market by number of employees at the company level.

Table 5.1. TAFU Survey Disposition

Stage of Engagement	Engaged Facilities (n)	Interviewed Facilities (n)
Stage 3 – Committed	0	0
Stage 4 – Practicing	1	1
Stage 5 - Sustaining	14	12
Total	15	13

Measure and Savings Persistence and Additional Energy Projects

The persistence of both capital and O&M measures implemented through CEI is an important gauge of the Initiative's success, and an indication of whether CEI will continue as the Initiative disengages with these facilities. To accurately assess measure persistence, Cadmus generated a list of validated measures at each facility, and asked respondents whether each individual measure remained in place. As shown in Table 5.2, of 41 capital improvement projects implemented at the 13 plants where Cadmus interviewed contacts, no respondents identified projects no longer being in place. Out of 50 validated O&M measures, respondents identified only three measures no longer in place: two measures were abandoned to prevent damage to facility floors, and the third was removed because it limited capabilities during production. Five capital improvement measures and three O&M measures had an unknown status.

Table 5.2. Capital and O&M Measure Persistence

Type of Improvements	Validated Measures	Measures Still in Place	Measures No Longer in Place	Measures with Unknown Status
Capital Improvements	41	36	0	5*
O&M Improvements	50	44	3	3*

*Respondents were unfamiliar with these five capital and three O&M measures and did not know whether they remained in place.

In addition to a high rate of measure persistence, all interviewed facilities reported having installed energy-related projects in addition to the validated measures discussed above. These projects included: lighting retrofits, heat recovery projects, and refrigeration upgrades. Four respondents cited upper management as the motivating factor behind installing these measures. Other factors included: reducing the cost of the finished product or saving money on energy costs; gaining a competitive advantage; and environmental, operational, and safety benefits. This is indicative of the influence and adoption of CEI in these facilities.

While 9 of the 13 facilities received technical assistance for these projects, only two cited Initiative staff (including the implementation contractor, Ecos) as the source of assistance. This contrasts sharply with findings from the 2006 TAFU, which revealed facilities relied on face-to-face meetings with Initiative staff to advance energy management within their plants. Facilities credited internal engineering departments (three respondents) and equipment distributors (three respondents) most often as their technical resources. Cascade Energy Engineering provided support to two facilities, and the Association of Energy Engineers provided support to one facility. In addition, 10 facilities received an incentive for installing the additional measures, which suggests high utility involvement.

CEI Persistence

Several findings suggest CEI will persist after the Initiative disengages with the facilities. As shown in Table 5.3, the energy champions at all but two facilities could clearly articulate their energy intensity reduction goals. In addition, 10 of the facilities are participating in the NWFPA goal to reduce energy intensity by 25 percent over the next 10 years (Table 5.4).

Table 5.3. Facilities' Independent Energy Intensity Reduction Goals

Response	Frequency (n=13)
25% in 10 years*	4
5% per year for 5 years	1
5% per year (no duration)	2
3% per year (no duration)	4
No goals	1
Don't know	1

*All goals measured in energy use per unit of product.

Table 5.4. Participation in NWFPA's Energy Intensity Reduction Goal

Response	Frequency (n=13)
Yes	10
Maybe in the future	0
No, was not aware of goal	1
No, was aware of goal but not participating	2

Nine of 11 representatives of facilities with energy-intensity reduction goals felt they were likely or very likely to meet their goals. Table 5.5 presents reasons the facilities provided for meeting or not meeting their goals. Facility representatives expressing confidence about meeting energy reduction goals cited historical success, good management and employee support, and energy being a priority at their plants as reasons for their confidence.

Factors decreasing the likelihood of meeting energy reduction goals included changes in production processes (for example, shifting from freezing to canning, which is more energy-intensive), and the product mix.

Respondents reported several strategies for meeting their goals, which included: implementing O&M improvements (nine respondents), implementing capital projects (eight respondents), increasing employee awareness (six respondents), and tracking and monitoring energy use (one respondent).

Table 5.5. Factors Influencing Facilities‘ Likelihood of Reaching Goal*

Facility's Likelihood of Meeting Energy Intensity Reduction Goals	Factors Influencing Facilities' Likelihood of Reaching Goal						
	Good management support	Historical success	Energy is a priority	Employee/ team support	Efficiency depends on crops	Production process change	No Response
Not likely (n = 1)	0	0	0	0	0	1	0
Somewhat Likely (n = 1)	0	0	0	0	1	0	0
Likely (n = 3)	0	2	0	0	1	0	1
Very Likely (n = 6)	1	5	1	1	1	0	0
Total (n = 12)	1	7	1	1	3	1	1

*Multiple responses allowed

Results from the 2010 TAFU suggest most participating facilities have successfully integrated CEI into their business practices. Of the 13 plants Cadmus interviewed, 11 claimed successful integration of energy management into their business practices.

As shown in

Table 5.6, evidence cited of successful integration of CEI into business practices were increased employee awareness (six respondents), good management support (four respondents), and good support from plant staff (three respondents). Two respondents stated employee awareness still needed to increase.

Table 5.6. Evidence of Successful CEI Integration into Business Practices*

Success of Integration of CEI into Business Practices	Increased Employee Awareness	Good Management Support	Energy Is Now Considered On a Daily Basis	Energy Efficiency Always Considered for Capital Installations	Good Support from Plant Staff	Energy Has a Place at the Table Now	Realizing Consistent Energy Savings	Still Need to Increase Employee Awareness
Successful (n = 7	3	2	0	1	0	1	1	2
Very successful (n = 4)	2	1	1	0	2	0	0	0
Don't know (n = 2)	1	1	1	0	1	0	0	0
Total (n = 13)	6	4	2	1	3	1	1	2

*Multiple responses allowed. No respondent gave ratings of ―not successful" or ―somewhat successful."

Eleven facilities stated that energy projects installed through the Initiative provided benefits beyond energy savings. These included (among others): lower maintenance costs (three respondents); safety benefits (three respondents); increased productivity (three respondents); and increased technical knowledge (two respondents).

Twelve of 13 facilities reported using outside resources for assistance with energy projects. As shown in Table 5.7, no facilities reported complete reliance on Initiative staff or the program implementer (Ecos) for assistance with energy management projects, and three respondents reported they were not at all reliant on the Initiative or Ecos. Table 5.8 shows that only four interviewees stated they would approach Ecos first to talk about improving energy efficiency at their facilities, and five respondents stated they would approach their utilities first. Other reported sources of information included: BPA (one respondent); Cascade Energy Engineering (one respondent); and the Association of Energy Engineers (one respondent).

Table 5.7. Facility Reliance on Initiative Staff or Ecos for Assistance with Energy Management Projects*

Response	Frequency (n=13)
1 – Not at all reliant	3
2	3
3	5
4	1
5 – Completely reliant	0
Don't know	1

*Using a 5-point scale with 1 being ―not at all reliant" and 5 being ―completely reliant"

Table 5.8. Entity Facility Would Approach First to Talk About Improving Energy Efficiency**

Response	Frequency (n=13)
BPA	1
Utility: Idaho Power	3
Utility: Rocky Mountain Power	1
Utility: Portland General Electric / NW Natural	1
Energy consulting company: Cascade Energy Engineering	1
Ecos	4
Other: Association of Energy Engineers	1
No one outside of company staff	1

**Multiple responses allowed.

Cadmus asked facility representatives what would happen to energy management at their companies if Initiative support were no longer available. Table 5.9 shows that 11 facilities stated it would have no effect, and two facilities stated energy management would continue, but at a slower pace.

Table 5.9. What Would Happen to Energy Management at Facility If the Initiative Were to Disappear

Response	Frequency (n=13)
Continue as before	11
Continue, but at a slower pace	2

Table 5.10 shows that five facilities had all the resources they needed in-house for continuing to manage energy successfully, and four would tap into continued support from NWFPA and other external resources. Each of the following resources had one mention for ensuring continued successful management of energy: training; software tools; trade shows; vendors of energy-using equipment; and rebates for installing efficient equipment.

Table 5.10. Resources that Facilities Would Need to Continue Managing Energy Successfully

Response	Frequency (n=13)
Training	1
Capital / Rebates for installing efficient equipment	1
Trade shows / Communication with other facilities	1
Software tools	1
Vendors of energy-using equipment	1
Continued support from NWFPA/current external resources	4
Already have sufficient in-house resources	5

Note: More than one response allowed.

6. Nonparticipating Facilities Survey

This survey addresses MPI 3, which pertains to the number of facilities adopting CEI without Initiative involvement. To create a sample of eligible facilities not participating in NEEA's Continuous Energy Improvement program, Cadmus used information available from Dun & Bradstreet to define a target market of food processing facilities with at least 250 employees throughout all facilities within NEEA's territory (Washington, Oregon, Idaho, and Montana). Facilities engaged with NEEA and deemed to be practicing CEI at a Stage 3 (Committed) or higher level as of April 2010 were removed from this sample. From the remaining population of nonparticipating food processing plants, a sample of facilities was surveyed regarding their energy-efficiency activities and programs. In all, Cadmus completed 21 surveys with nonparticipating facilities, representing 16 different companies, resulting in an 85 percent confidence level with 15 percent precision (Table 6.1). The interviewed nonparticipants represent 31 percent of the target market by number of employees at the company level.

Table 6.1. Nonparticipant Population Size and Sample Disposition

Type of Company	Total Number*	Number Targeted	Number Interviewed
Food processing facilities with at least 200 employees across facilities located in the Northwest	161	30	21
Unique food processing companies	58	N/A	16

*Dun & Bradstreet records from 2010 show 192 food processing facilities in the Northwest from 59 unique companies with at least 250 employees across all Northwest facilities. Fifteen of these facilities are currently (as of April 2010) engaged with the Initiative, and have been removed from the sample. During survey calls, Cadmus found 14 of the remaining facilities were not processing facilities, and two of the facilities had closed. Cadmus also removed these 16 facilities (and one unique company) from the sample. Overall, this reduced the sample size to 161 facilities from 58 unique companies.

Senior Cadmus staff conducted the surveys to understand current perceptions of energy management and to estimate parameters needed for the market diffusion model. The survey goals were to determine:

- Awareness of energy management practices and CEI;
- Implementation of CEI;
- Assistance received in implementing recent energy-efficiency projects; and
- Plans for future energy-efficiency projects.

Appendix D contains the survey guide, and Appendix E contains tabulated results.

Awareness of Energy Management Practices and CEI

Of 21 nonparticipant facilities surveyed, 14 reported their facilities were either ―very" or ―somewhat" aware of energy management practices, with 17 reporting they first learned of energy-efficient operating practices more than three years ago. Just under half (10 of 21) of respondents reported having heard the term Continuous Energy Improvement or CEI.

Implementation of CEI Elements

Cadmus asked respondents a series of questions to evaluate whether they had implemented any key CEI elements in their facilities. The questions addressed:

- **Having dedicated staff, including an energy champion**. Cadmus asked respondents about management support for dedicated, full-time employee resources for energy management. Six out of 21 facilities reported total management support; another nine facilities claimed they had some support, and five reported little support. Only one respondent claimed management did not support a dedicated, full-time employee for energy management. Despite high levels of management support, only four facilities reported having a designated ―energy manager."
- **Tracking energy use**. All 21 facilities surveyed reported tracking their electricity and/or natural gas use. Of those who specified using either electricity and/or natural gas, 63 percent (10 respondents) did so by reviewing billing data, and six facilities used metering equipment. Fifteen facilities reported reviewing energy data monthly or more frequently.
- **Setting energy reduction goals**. Sixty-two percent (13 of 21) of respondents reported their facility set goals for reduction in energy usage or energy intensity.
- **Developing and routinely updating an energy management plan.** Twenty-four percent (5 of 21) of the facilities reported having developed an energy management plan that included both energy reduction goals and time frames; all these facilities reported periodically revisiting and updating their energy management plans.
- **Quantifying energy savings from energy-efficient equipment upgrades.** Eighty-six percent (18 of 21) of respondents have installed energy-efficient equipment upgrades in the last two years. Out of these, 61 percent (11 of 18) reported they quantified the amount of energy savings from their equipment upgrades.

Technical Assistance Received from Outside Organizations

Nineteen respondents reported receiving energy management technical assistance from an outside organization. The most common technical assistance source (for 13 respondents) was the facility's utility. Eight facilities received technical aid from equipment distributors, and six received assistance from the BPA, Cascade Energy Engineering, Strategic Energy Group, or Evergreen Consulting.

Plans for Energy-Efficient Upgrades

Cadmus also asked respondents about their policies for replacing worn-out equipment with high-efficiency upgrades. Five facilities reported having a specific policy in place to do this, and another nine reported they considered purchasing efficient equipment, but did not have a formal policy. Seven facilities reported they had different return on investment (ROI) requirements for energy-efficiency projects, compared to other capital improvements.

Nonparticipant Trends in CEI Awareness and Implementation Since 2004

The survey also sought to track awareness of energy management practices among nonparticipating facilities over time and to estimate the proportions of the market independently practicing CEI aspects without Initiative involvement.

As a measure of awareness, Cadmus used the percentage of facilities self-reporting as ―very" or ―somewhat" aware of energy management practices[4], as defined by NEEA. To determine how

[4] At the interview's start, respondents were read the following to ensure their understanding of energy management practices aligned with NEEA's definition: ―For the purposes of this survey, energy management practices includes

many facilities practiced CEI, Cadmus combined survey responses to ascertain whether facilities had implemented the necessary components to qualify as Committed (Stage 3) in the CEI process, regardless of whether they were familiar with CEI. This analysis indicated six nonparticipating facilities (25 percent) in the sample practiced CEI at a level of Stage 3 or higher. Of these, four reported receiving technical assistance from BPA or its program partners.

Cadmus compared 2010 nonparticipant survey results with findings from past NEEA survey projects and interpolated[5] across years to establish a time series of data showing trends in nonparticipant awareness and CEI practice back to 2005.

Table **6.2** shows yearly estimates of the two measures, first for nonparticipating facilities and then for the market as a whole. Engagement and awareness at the full market level was calculated by weighting the percent of participants and non-participants meeting the criteria according to the size of participant and nonparticipant populations in the overall market.

Table 6.2. Estimates of Energy Management Awareness and Implementation Levels in the Northwest Food Processing Market

	Implementation of CEI at Stage 3 (Committed) or Higher			Awareness of Energy Management Practices		
Year	Non-Participant Sample	Full Market Segment	Date of Surveys	Non-Participant Sample	Full Market Segment	Date of Surveys
2005	13%	13%	Summer 2005	59%	59%	Summer 2005
2006	12%	13%	Interpolation	54%	62%	Spring 2006
2007	11%	12%	Spring 2007	59%	68%	Spring 2007
2008	17%	20%	Interpolation	62%	70%	Interpolation
2009	23%	28%	Interpolation	66%	71%	Interpolation
2010	29%	36%	Summer 2010	69%	72%	Summer 2010

The data indicate a trend toward a greater awareness of energy management practices among facility managers and an increased willingness to take steps toward committing to CEI. Based on nonparticipant survey data, just over one-third of industrial food processors in the Northwest have engaged in energy-efficiency practices equivalent to Stage 3 of NEEA's CEI process, with the majority being facilities not actually participating in the CEI program. This trend can be credited to a combination of factors, including: successful implementation and growth of NEEA's Initiative and the CEI product; continued advocacy by other regional actors (NWFPA and the Council, etc.); and implementation of similar programs from Energy Trust of Oregon (ETO) and Bonneville Power Administration (BPA) – all of which started with NEEA's intervention in the food processing market.

activities such as purchasing efficient equipment, tracking your energy bills, efficient operating and maintenance practices and training your personnel in managing energy or to operate your equipment efficiently."

[5] Interpolation was calculated using this formula:

% year Y = % year X + (% year Z - % year X)*(year Y - year X)/(year Z – year X)

As an example, if there are two years in between, then the first year is multiplied by 1/3 and the second year is multiplied by 2/3:

% year 4 = % year 3 + (% year 6 - % year 3)*(1/3)

% year 5 = % year 3 + (% year 6 - % year 3)*(2/3)

7. Market Partner Survey

In addition to participant surveys, Cadmus conducted annual surveys of utilities and market partners (e.g., utilities, Bonneville Power Administration, Energy Trust of Oregon, Oregon Department of Energy, Washington State University Energy Extension Program, and Northwest Food Processors Association) to gain insights into their awareness of and response to the Initiative's presence and activities in the regional industrial market. In 2010, Cadmus interviewed the Council about regional energy-efficiency policies regarding CEI, and interviewed market partners and utilities about their promotion of CEI. The market partner survey additionally addresses MPI 5 on utility promotion of CEI and MPI 6 on promotion of CEI by trade associations.

Regional Energy-Efficiency Policy

Based on Cadmus' interview with the Northwest Power and Conservation Council, perhaps the Initiative's most far-reaching achievement has been earning recognition of CEI in the Northwest's Sixth Power Plan as an energy-efficiency measure with savings that can be validated. Prompted in part by research conducted under the Initiative, the Council decided in 2008 to investigate savings opportunities in industrial facilities. The resulting assessment found significant savings opportunities from energy optimization measures in addition to equipment upgrades. Consequently, the industrial supply curves for the Sixth Power Plan included savings from optimization activities, such as: demand-side assessment; proper design, sizing, and/or reconfigurations to match supply to demand; system "commissioning"; sustainable O&M; and supporting management practices.[6]

Energy optimization-type measure activities were grouped into three tiers of bundled measures for the Sixth Power Plan. In order of comprehensiveness, these bundles were: Plant Energy Management; Energy Project Management; and Integrated Plant Energy Management. Each tier was inclusive of all measures in the lower tiers. The "Integrated Plant Energy Management" savings level, which encompassed systematic systems management practices, was comparable to the end goal of NEEA's CEI program (Stage 5: Sustaining).

The Council estimated the regional 20-year achievable potential from these measures at 245 aMW, with a levelized cost less than $0.05 per kWh. This constituted about one-third of the projected total energy-efficiency potential in the industrial sector. Given this, BPA and ETO have already implemented their own energy management programs, based on the Initiative. Results from the 2009 utility survey showed at least seven utilities noted they were moving to adopt BPA's program or to develop their own.

[6] "System Optimization Measures Guide." Prepared for Charlie Grist. Strategic Energy Group. March 23, 2009.

Energy Management Programs Outside of the Northwest

Programs similar to the Initiative have also been implemented outside of the Northwest. A CEI program in California based on the Initiative's design began in 2009.[7] Additionally, the U.S. Department of Energy started the Save Energy Now LEADER program, seeking to reduce energy intensity by 25 percent over 10 years.[8]

Market Partner and Utility 2010 Interviews

The 2010 market partner interviews primarily sought to inform NEEA's understanding of CEI's diffusion in the industrial market, to forecast market penetration and energy savings, and to determine utilities' and trade associations' promotions of CEI. Specific goals included:

- Understand the Initiative's impact in the industrial market from the market partners' perspectives.
- Assess relationships between the Initiative's staff and market partners.
- Learn how many market partners offered programs similar to the Initiative. Determine components and goals for these programs, and NEEA's influence in their designs.
- Identify new directions for NEEA in the industrial market, and determine how NEEA can best work with the market partners in the future.

Appendix D contains the interview guide, and Appendix E contains the tabulated results.

Cadmus targeted 16 market partners for interviews, including eight utilities, five energy offices, and three other regional actors.[9] Cadmus successfully interviewed 10 market partners, including five utilities, two energy offices, and three other market partners (see Table 7.1). The utilities interviewed represented 67 percent of food processing facilities (or 30 percent of the food processing sector, by number of employees), and 41 percent of pulp and paper facilities (or 28 percent of the pulp and paper market by production). The five utilities represented a mix of rural and urban areas, with three serving mainly rural areas, two serving mainly urban areas. The key findings, shown below, are derived from the 10 completed interviews.

Table 7.1. Sample Disposition for Market Partner Interviews

Market Partner Type	Number Targeted	Number Declined	Number Interviewed
Utility	8	1	5
Energy Office	5	0	2
Other	3	0	3
Survey Total	**16**	**1**	**10**

[7] More information about the California CEI program can be found on the Pacific Gas and Electric Company (PG&E) website: http://www.pge.com/mybusiness/energysavingsrebates/rebatesincentives/cei/

[8] More information about the U.S. DOE Save Energy Now LEADER program can be found on their website: http://www1.eere.energy.gov/industry/saveenergynow/index.html

[9] This sample excludes the Northwest Power and Conservation Council, whose representatives were interviewed but were not asked the same questions as the other market partners.

The Initiative's Impact on the Industrial Market

Table 7.2 reports on market partners' perceptions about the industrial sector's level of awareness regarding energy management.

Table 7.2. Percentage of Industrial Customers Aware of the Opportunity to Save Energy Using Energy Management Practices

Response	Frequency (n = 10)	Spontaneous Comments (These were unsolicited comments made by respondents when answering the question asked)
25%	2	• Growing, around 25% • 25% of largest customers
50%	1	Within the larger facilities, approximately 50% are aware of opportunities for energy savings
75%	1	75% are aware, but it is hard for them to quantify savings, costs, or which opportunities are the most valuable
80%	1	
Almost 100%	1	Almost all are aware, but actual implementation varies by size. Larger facilities are much more likely to have an energy manager or someone who knows a little bit, like who to call or where to go for help. There is lots of help and training out there if they look for it. Small plants typically do not have anyone who can spend the time on energy
100%	1	
No numerical response	1	Just their largest customer (represents 10% of utility load)
Don't know	2	Don't know, but most know that how they run their equipment affects their bill. They tend to be pretty knowledgeable about these things. The larger issue is conveying the issue to everyone else

Table 7.3 shows the degree of interest that aware industrial customers have in integrating energy management practices. Though respondents' estimates of awareness levels ranged from 25 percent to 100 percent, in general, market partners reported large facilities being more aware than smaller facilities. They also reported that, though facilities were aware of the potential to save energy, they were not aware of the potential's magnitude. Some respondents thought the larger industrial facilities were more interested in implementing CEI than were small- to medium-sized facilities, and interest generally depended on the facility's culture.

According to one respondent, most facilities conscientiously assess whether implementing CEI would be worth the required energy savings accountability to receive an incentive. Another respondent said that without the incentive, industrial customers expressed much less interest. One respondent said many opportunities still existed for efficient equipment installations producing easily-verified energy savings; thus, energy management remained a secondary priority.

Table 7.3. Degree of Interest that Aware Industrial Customers have in Integrating/Adopting Energy Management Practices (using a 5-point scale with 1 being —not at all interested" and 5 being —very interested")

Response	Frequency (n = 10)	Spontaneous Comments (These were unsolicited comments made by respondents when answering the question asked)
1 to 2 (1 = not at all interested)	1	If no utility incentive, then 1-2.
3	1	• So many customers that have huge opportunities for capital investments, including EE. Energy efficiency equipment is the highest priority of those energy efficiency opportunities because the savings are quantifiable. Energy management (i.e. difficult to quantify) savings are second to that. • Because industrial programs are still fairly new, there is still low-hanging fruit for capital energy efficiency investments that customers are going to take advantage of first.
4	2	• Once industrial customers learn about CEI, they are very interested. However, for most facilities there is a real conscientious assessment about whether participation in a program is worth it. Many facilities do not want to be held to the expected 1,000,000 kwh savings goal in order to receive the incentive. • Large facilities are more interested, but it is not a priority
5 (Very Interested)	1	
No numerical response	2	Very few small facilities are aware of energy management.
No response	3	

Initiative Relationship with Market Partners

Cadmus asked market partners about their relationships with Initiative staff. Five of the seven market partners (representing 30 percent of the food processing market by number of employees) ranked their current relationship with NEEA as good or very good. Only one respondent reported their current relationship with NEEA as very poor due to NEEA's lack of follow-through and lack of communication about alternative ways to address their targeted industrial customers.

Eight of 10 market partner respondents said they were familiar with NEEA's Initiative and CEI, and two said they were somewhat familiar with the Initiative and CEI. Of 10 market partners interviewed by Cadmus, seven (representing 12 percent of the food processing market by number of employees) promote active energy management programs to their customers as part of their energy-efficiency offerings. Four of the five non-utility market partners were currently offering energy management incentives to their customers, and two utility market partners (representing 12 percent of the food processing market by number of employees) planned to implement energy management programs—one of which was to launch sometime in 2011 (the other did not specify a launch date).

Energy Management Program Offerings

Table 7.4 shows four market partners' reasons for offering energy management programs that provide incentives or technical support for measures beyond capital or equipment improvements.

Table 7.4. Reasons for Offering Energy Management Programs by Non-Utility Market Partners

Response	Frequency (n = 4)
CEI has been incorporated into the region's Sixth Power Plan	1
Industrial customers saw benefits from other programs, and expressed interest in having access to a program they could participate in	1
CEI provides a cost-effective means of achieving energy savings goals, and an effective way to achieve low-cost energy savings, with little capital outlay required for participants during a difficult economic period	1
The market partner is strongly committed to providing comprehensive services to industrial customers/sites, and formal planning to achieve comprehensive savings proved the best approach for this	1

Table 7.5 outlines the energy management program offerings of four market partners, including: primary program components; goals; incentives offered; and whether NEEA influenced the program's design.

Programs offered tend to be fairly new, with most beginning during 2009. Two market partners modeled their program designs directly on NEEA's CEI program, while a third designed its program to complement the Initiative. Three market partners reported quantitative, measurable energy savings goals for their programs, and provided incentives. The two market partners with program designs based on CEI regretted their inability to share NEEA's program branding, as doing so likely would have created additional progress toward transformation in the industrial market. In the words of one: *"NEEA wouldn't let us use the term „CEI' and we were forced to use other names. This was a huge mistake because it doesn't support market transformation."*

Two market partners had quantitative measurement and verification approaches for estimating energy savings for their programs, and three provided incentives directly to customers. Most incentive structures were based on a dollar amount per kWh or annual MW of energy savings, and were often paired with a cap at a percentage of participant project costs. Two respondents reported a measurement and verification approach analyzing changes in energy intensity (kWh consumption per unit output) as a key performance indicator of energy savings.

Table 7.5. Market Partner Energy Management Offerings

Market Partner	Energy Management Offerings and Components	Goals	Incentives Offered	Did NEEA Influence design?
BPA	Offers three programs, which started October 1, 2009: "Energy Project Manager Program": Provides funding for facility energy champions (18-month funding, facility must have savings of 1 million kWh/year to qualify); this program also has a goal-setting program, with incentives for meeting targets. "Track and Tune Program": Provides incentives for O&M measures. "High Performance Energy Management Program": Similarly to CEI, incorporates energy management into all aspects of business, incentives for O&M, capital projects, behavioral measures.	12 aMW goal in 2010, 15 aMW goal in 2011. Has savings targets in Sixth Power Plan, one-third of industrial savings goals are related to energy management.	Pays up to $2 million per aMW saved. Incentive is funding for a salaried Energy Manager position. Track and Tune is the lesser of $0.25/kWh or 70 percent of project costs. Interim progress payments are available.	Yes, the High-Performance Energy Management program was based on CEI.
ETO	Recruitment began January 2009 for "Industrial Energy Improvement." Supports a network of non-competing industrial facilities in sharing and implementing energy-saving strategies. A support role, it provides training, and focuses on network interactions. It also provides direct technical support through contractors between IEI sessions (very similar to CEI). Involves an Energy Information System aspect.	Not quantitative; creates capability to measure, track, and quantify savings through monitoring, targeting, and reporting (MT&R) analysis; creates full pipeline of capital projects, market transformation.	Offers incentives for anything they can analyze. O&M: $0.08/kWh, capped at 50 percent. IEI custom: $0.025/kWh, capped at 50 percent of cost. Direct meter-level savings vary from $0.001 to $0.02/kWh with caps.	Yes, program was based directly on CEI, plus capacity for incentives.
WSU	Conducts training on energy management programs, has incentives for implementation (and works with utilities to provide incentives).	Reduce energy intensity by 25 percent in 10 years.	Has $1 million to give away, at $100k or less per facility. Depends on the amount needed to reduce the facility's payback period to 1-2 years.	No.
NWFPA	"Baseline Project": Establishes baseline energy intensity to measure progress toward the energy intensity reduction goal. "Energy Assessment and Mapping": Conducting energy audits to educate facilities about appropriate energy-saving actions. "Access to Energy Data": Tests and tracks implementation of energy management software systems at food processing facilities.	25 percent reduction in energy intensity in 10 years among its members.	None.	Yes, NEEA is a program partner.

Barriers to Offering an Energy Management Program

For a variety of reasons, the remaining market partners did not actively administer their own energy management programs. As shown in Table 7.6, two respondents (representing 18 percent of the food processing market by number of employees) said their state's Public Service Commission required them to only offer cost-effective incentive programs that passed the total resource cost (TRC) test.

Other reasons mentioned for not offering an energy management program included: market partners having an insufficient number of industrial customers, specifically larger customers (two mentions). One respondent reported they did not offer a program because their customers had very diverse energy usage, staffing, structure, and products, making a program difficult to implement. Another market partner stated they lacked funding and staff to implement this type of program.

Table 7.6. Barriers to Offering an Energy Management Program

Response	Frequency (n = 4)
Insufficient number of industrial customers, who are diverse in their energy usage, staffing, structure, and products	1
Insufficient number of LARGE industrial customers	1
Very few large customers are interested	1
Market partner does not know how to quantify savings to perform the required TRC test	2
Market partner does not have funding and staff do not have time	1

Recommended Future Directions for NEEA

Cadmus asked market partners for input regarding the role NEEA should play moving forward. Specifically, they were asked about energy management software and the ISO 50001 standard.

- **Energy Management Software.** Three out of 10 respondents thought promoting energy-management software would serve as an effective strategy for promoting energy management practices. Another four respondents gave answers of ―Mildly/maybe/ possibly effective" to this question and pointed out that one standardized tool would not work for all facilities because of variability among customers.
- **ISO 50001.** Four out of 10 respondents thought promoting the ISO 50001 standard would be an effective use of NEEA's resources, but NEEA should not concentrate on it exclusively. One respondent thought a barrier existed because industrial customers did not want to make binding commitments. To overcome this barrier, NEEA could provide customers with information about obligations and costs to make them comfortable with the standard.
- **Training.** Request for technical training emerged as a consistent theme among market partners. Specifically, three of five applicable respondents said they would be interested in training on how to design energy management programs. One respondent mentioned training for process engineers on how to implement energy management practices. Others recommended NEEA continue technology-specific training. The two respondents who were not interested in a program design workshop would like information on how to measure and verify energy savings from CEI.

MPI 6: Trade Association Promotion of CEI

NWFPA, one of the Initiative's market partners, serves as a trade association in the food processing industry. Indicative of NEEA's success with this key food processing trade association, in late 2008, NWFPA established a goal for its members to reduce energy intensity by 25 percent in 10 years. To measure this reduction, NWFPA has implemented a number of data-collection and education-based programs:

- **Baseline Project**. NWFPA collected billing data from its members to establish 2009 baseline energy intensity, so progress can be measured toward the energy intensity reduction goal.
- **Energy Assessment and Mapping.** NWFPA conducts energy audits to educate facilities about energy-saving actions. NWFPA also seeks to determine which recommendations have been implemented and the reasoning behind the decisions.
- **Access to Energy Data.** NWFPA tests and tracks energy management software systems' implementation at food processing facilities. NWFPA also hopes to include training on software programs in their future budgets.

8. Trade Ally Survey

The trade ally survey for MPER #6 targeted a different group of companies than such surveys conducted in previous years, in which Cadmus had interviewed equipment dealers. Market partner surveys conducted in late 2009 revealed several market partners either offering programs with products similar to CEI, or considering such offerings. Like the Initiative, these programs used an implementation contractor who visited facilities and provided technical guidance and assistance. Therefore, Cadmus targeted regional energy management consulting companies, also defined as trade allies, to collect data on current, past and future demand for energy management consulting, and other inputs required for the development of the market diffusion model. The survey's goals included:

- Understand CEI elements marketed by trade allies and how they promote energy management.
- Understand trends in CEI awareness and market penetration over the last five years, and obtain trade ally adoption projections over the next five years.
- Identify CEI implementation barriers as well as influential factors.
- Identify how NEEA can best work with trade allies in the future.

Appendix D contains the interview guide, and Appendix E contains the tabulated results.

Cadmus interviewed five of the six (83%) regional consulting firms identified as promoting energy management in the industrial sector. These six firms are the only companies doing energy management consulting in the Northwest. Table 8.1 summarizes characteristics of energy management consulting groups within each firm.

Table 8.1. Summary of Interviewed Trade Ally Characteristics

Firm	Years in EM Consulting	Number of Employees Working on EM	Industrial Sectors Targeted													
			Food Products & Beverages	Wood Products	Paper Manufacturing	Computers and Electronic Manufacturing	Primary Metals	Misc. Manufacturing	Agriculture	Petroleum/ Chemicals	Industrial Machinery	Mining Minerals	Irrigation	Water/Wastewater	Cold Storage	States Served
1	5 to 6 years	35	x	x	x	x										OR, WA, ID, MT, Others, Canada
2	13 years	6		x		x	x									OR, Northern CA, TX
3	6 years	5-10	x		x											OR, WA, ID, MT, Others
4	13 years *	3						x								OR, WA, ID, MT
5	> 10 years	14	x	x			x		x	x	x	x	x	x	x	OR, WA, ID, MT, Others

*Less than 1 year in industrial sector

Respondents reported some industries proved more receptive to energy management than others. When asked to list three industries most receptive to energy management, four companies identified food products and beverages, and two companies identified wood products. Paper

manufacturing, computers and electronic manufacturing, primary metals, and petroleum/ chemicals were each mentioned once. Most companies Cadmus interviewed served a limited number of industries, making it difficult for them to identify those less receptive to energy management. Trade allies serving more than three industries identified high-tech industries, water/wastewater, paper manufacturing, and agriculture as the least-receptive industries.

CEI Elements Promoted by Consulting Firms

As shown in Table 8.2, trade allies interviewed promoted a number of CEI elements, including: tracking energy use, quantifying energy savings from measures, and several others.

Table 8.2. Elements of CEI Trade Allies Promote

CEI Element	Frequency (n= 5)
Energy audit	4
Analysis of energy intensity	4
Set energy reduction goals	4
Design energy plan to reach goals	4
Tracking energy use	5
Efficient equipment trainings	3
Efficient O&M practices trainings	3
Quantifying energy savings from measures	5
Visit facility regularly to update strategy and/or goals	4

Awareness and Implementation Trends

According to firms interviewed, industrial facilities' awareness of energy management practices and the number of industrial facilities practicing energy management have increased over the past five years. Facilities have generally become more open to energy efficiency, and awareness has increased regarding energy as a controllable cost and component of maintaining a competitive advantage. Software tools, training opportunities, and monetary incentives have also become more available. Factors driving these changes include: changes in environmental awareness and attitudes; facilities' interests in presenting themselves as "green"; NEEA's Initiative; increased marketing; incentives; increased visibility of energy; and prices of electricity or natural gas.

According to respondents from three firms, facilities expect to reduce their electric bills by 2 percent to 15 percent in the first one to two years following an energy management strategy's implementation. Cost estimates varied for the initial implementation of energy management. Annual dollar estimates ranged from $50,000 to $500,000 for the initial period. One respondent reported costs on a per-kWh basis, stating it cost $0.25 per kWh to implement CEI. After the initial implementation period, typical costs decreased to $20,000 per year (per two respondents), or $0.05 per kWh.

NEEA's Future Role with Trade Allies

Several barriers in the industrial sector slow adoption of energy management practices. While trade allies Cadmus interviewed generally felt NEEA effectively addressed these barriers, they identified several ways NEEA could continue to help facilities overcome potential hurdles:

- Raise facilities' interest and effectively communicate how they can participate.
- Communicate concrete results of implementing energy management strategies and changes necessary to realize these results.
- Continue to educate and gain support from upper management at facilities, as illustrated by the following comment by a trade ally:

  "I think that the effort needs to be to the higher upper management in corporations. Getting upper-level management to commit to energy management is the driving force. It happens much more effectively when you have high-level corporate sponsorship."
- Continue to explore other target markets. In the words of an energy management consultant interviewed:

  "Their focus on food processing and pulp and paper has been significant, but small manufacturing branching is good. They are headed down the right road and should continue to look at other markets."
- Create messaging about utilizing energy management to manage risk.
- Offer localized training on basic energy management concepts and energy tracking principles.
- Continue to offer the Initiative in regions not covered by BPA, ETO, or other utility programs.
- Standardize CEI components across all programs offered in the Northwest, so companies with facilities in different utility territories have the same or similar recommendations and goals, as illustrated by the following quote from an energy management consultant:

  "They should also get everyone together to standardize CEI. A company could have facilities in several territories and the practices at all facilities should all look the same, but may not because BPA may have different recommendations than NEEA or ETO."

Although NEEA's role may shift, high demand clearly exists for the services and support it is poised to provide.

9. Review of ACE Model for Food Processing

NEEA uses the Alliance Cost Effectiveness (ACE) model, a spreadsheet tool, to estimate the cost-effectiveness of its initiatives during the planning phase as well as to forecast future energy savings impacts..The model requires various inputs and assumptions about market growth, penetration rates, and savings rates, among other factors. The accuracy of the model's results depends on the quality and accuracy of these inputs.

Part of Cadmus' ongoing evaluation activities has included a periodic review of assumptions underlying the Food Processing ACE model. Cadmus conducted such a review in August 2010. To aid this review, NEEA provided Cadmus with a PowerPoint presentation detailing current assumptions used in the model. NEEA also provided an electronic copy of the most recent ACE model documenting the source and rationale behind most assumptions.

Because Cadmus last reviewed the ACE model in 2009, and the assumptions have not changed, Cadmus compared assumptions to inputs and results from the market diffusion model.

Comparison of Food Processing Assumptions and Results of NEEA's ACE and Cadmus' Market Diffusion Models

Cadmus developed a market diffusion forecast for energy management practices in Pacific Northwest large food processing facilities[10] to capture both programmatic and non-programmatic market effects and compare findings to the existing Alliance Cost Effectiveness (ACE) model assumptions. The forecast provides Cadmus' best estimate of shares of large food processing facilities that will, between 2011 and 2015, practice energy management at levels equivalent to or higher than the Initiative's Stage 3. To forecast the market's energy savings, the market share forecast was combined with validated estimates of gas and electric savings in food processing facilities engaged with NEEA. Appendix F details the data sources, diffusion model methodology and findings of the Cadmus model.

Table 9.1 compares the ACE and Cadmus diffusion model inputs and outputs. Most assumptions regarding energy management costs, electric savings rates and electricity consumption are similar between the two. The main differences related to the gas savings rate and facility consumption. Using verified consumption and savings data from engaged facilities, Cadmus estimated average annual gas savings of 2 percent to 4 percent between years one and five, and assumed savings would increase by 1 percent per year thereafter. In contrast, the ACE model assumes a significantly lower savings rate: the savings rate starts at 0 percent, grows at 1 percent per year, and caps at 5 percent after year six. Based on verified consumption data, Cadmus estimated annual gas consumption per facility was 2.2 million therms.[11] The ACE model assumes gas consumption three times greater (6.7 million therms). Cadmus' estimate of gas consumption is conservative, however, as it represents median gas consumption. Mean gas

[10] The forecast pertains to food processing facilities with 250 or more employees in the Pacific Northwest. Information about employment at food processing facilities was obtained from the Dun & Bradstreet database.

[11] Cadmus estimated facility gas and electric consumption by matching facility employment data from Dun & Bradstreet (2010) to engaged facilities. We calculated average gas and electric consumption per employee in engaged facilities. We then multiplied average consumption per employee in engaged facilities times the number of employees for all facilities in the target market. This resulted in an estimate of gas and electric energy use for each facility in the target market.

consumption in large food processing facilities has been almost 80 percent higher (3.9 million therms).

Table 9.1. Comparison of Food Processing ACE Model and Diffusion Model Assumptions and Results

Assumptions	NEEA ACE Model	Cadmus Diffusion Model
Cost to implement energy management (O&M portion only)	$75,000 in year 1	$75,000 in year 1
Cost to practice energy management after Year 1 (O&M portion only)	$75,000 in year 2 $15,000 per year after year 2	$50,000 in year 2 $30,000 per year after year 2
Facility % electric savings per year	0 percent in year 1; then an average of 3.7 percent per year for 5 years; total savings years 2-6 is 18.7 percent	2.2 percent in year 1; 3.6 percent in year 2; 2.8 percent in year 3; 3.3 percent in year 4; 3.0 percent in year 5; 1 percent savings thereafter; total savings in years 1-5: 14.9 percent.
Facility % gas savings per year	0 percent in year 1; 1 percent per year for 5 years; total savings in years 2-6 is 5 percent	3.2 percent in year 1; 2.5 percent in year 2; 2.9 percent in year 3; 2.5 percent in year 4; 2.5 percent in year 5; 1 percent savings thereafter; total savings in years 1-5: 13.6 percent.
Annual electricity consumption per facility (kWh) in 2009	16,329,643	15,397,921
Annual gas consumption per facility (therms) in 2009	6,666,831	2,228,514
Number of facilities in 2009	191	176
Outputs	**NEEA Ace Model**	**Cadmus Diffusion Model**
Average market adoption rate	5 percent per year	5.1 percent per year
Predicted market penetration in 2009	25 percent	32 percent
Predicted market penetration in 2015	55 percent	57 percent
Predicted electric savings in 2009 (cumulative)	5.6 aMW	8.2 aMW
Predicted gas savings in 2009 (cumulative)	4,129,854 therms (equivalent to 13.82 aMW)	10,676,603 therms (equivalent to 35.7 aMW)
Predicted electric savings for 2015 (cumulative)	29.2 aMW	32.8 aMW
Predicted gas savings projected for 2015 (cumulative)	13,718,321 therms (equivalent to 45.9 aMW)	38,329,171 therms (equivalent to 128.3 aMW)

The ACE and Cadmus models generate similar predictions. Between 2007 and 2015, the models predict similar market adoption rates, overall market penetrations, and electric savings. The Cadmus model predicts higher market penetration in 2009 than the ACE model, but modestly slower growth through 2015. The Cadmus model's predicted market penetration in 2015 is two percentage points higher than the ACE model's. Although the models have similar predicted

market penetrations, the Cadmus model predicts significantly higher gas savings in 2015. The ACE model's low gas savings rate assumption is largely responsible for this difference.

Cadmus is concerned about the ACE model assumptions regarding the annual gas savings rates and facility gas consumption. First, the gas savings rate appears to be too low (1 percent per annum up to 5 percent). The available data on savings rates in engaged facilities (2 percent to 4 percent) do not support this assumption. Second, the gas consumption assumption appears to be too high (6.6 million therms in 2009). Again, available data on gas consumption (2 to 4 million therms) do not support this assumption. On balance, the low savings rate appears to dominate the high average consumption, and the effect is that cumulative gas savings estimates in the ACE model are too low.

Cadmus recommends NEEA reconsider the gas savings and consumption assumptions in the ACE model. In particular, NEEA should consider increasing its estimate of annual gas savings rates, decreasing its estimate of facility gas consumption, or both. NEEA has now accumulated enough gas consumption and savings data from engaged facilities to refine its assumptions. This information could be combined with data from Dun & Bradstreet on employees in targeted facilities to develop more realistic assumptions.

10. Conclusions and Recommendations

In 2004, NEEA conceived the Initiative as a comprehensive effort to bring about a lasting change in industrial energy use by making energy management integral to how industrial firms decided to invest in new equipment and plan routine O&M.

As with all of NEEA's programs and initiatives, NEEA has contracted out an annual evaluation of the Initiative's progress since its inception. Results of this ongoing evaluation indicate the Initiative has largely achieved many of its initial goals in the food processing sector. The increased importance and value of energy management among industrial end users, trade allies, market partners and regional energy planners clearly demonstrate the success of the Initiative in the food processing sector.

Energy Savings

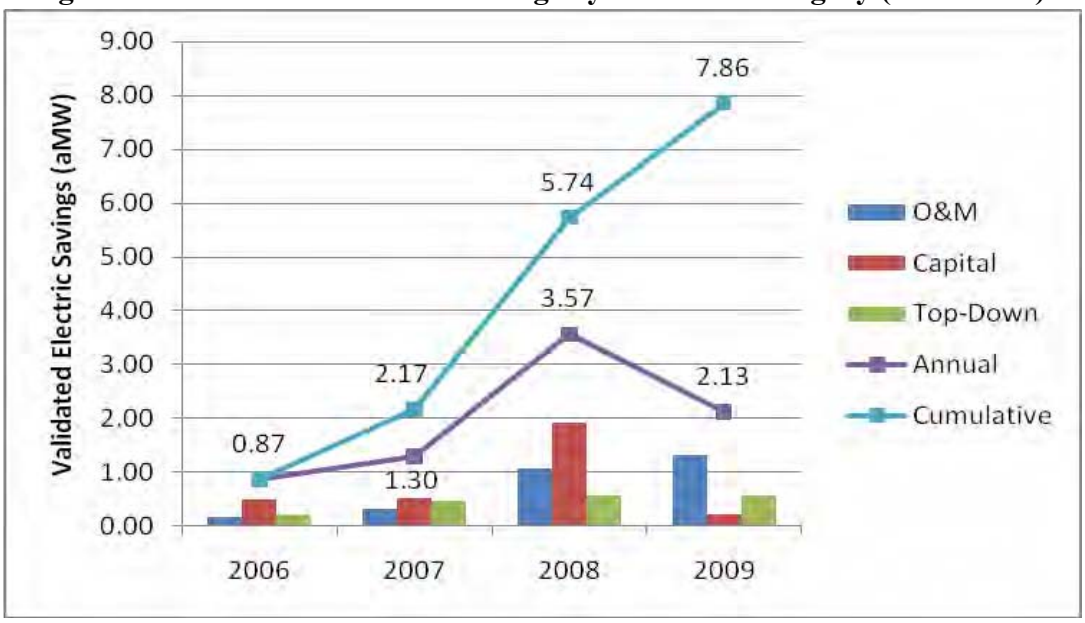
CEI implementation in participant firms has resulted in measurable electricity and natural gas savings due to improved O&M practices and capital investments induced by the Initiative. In 2009, Cadmus began evaluating facility-wide (top-down) energy savings claims to capture savings from behavioral changes as well as O&M and capital improvements not quantified at the measure level. To date, Cadmus has validated 5.646 aMW of electric savings at 26 food processing facilities and 2.217 aMW of electric energy savings at four pulp and paper facilities.[12] Additionally, Cadmus has validated over 4 million therms of natural gas savings at 12 food processing facilities. Results from 2006 through 2009 show that on average, food processing facilities achieved electric savings of 3.07 percent of their annual consumption and gas savings of 2.89 percent of their annual consumption when practicing CEI.

As Figure 10.1 illustrates, an upward trend in annual validated measure-level savings occurred from 2006–2008, with a drop in 2009. The 2009 decrease in validated savings was largely due to cutbacks in capital projects, most likely because of the general economic downturn. However, NEEA's Industrial Tracking System (ITS) lists several projects as completed, but not evaluated because of a lack of documentation or difficulty quantifying savings. Anecdotal information from site visits and surveys indicates a number of projects were completed at several plants, but were not documented through ITS. Evaluation of outstanding measures and accounting for undocumented projects will no doubt show appreciably higher savings for 2009.

Savings from improved O&M practices—the Initiative's mainstay—have steadily increased over time. For the first three program years (2006–2008), a majority of measure-level validated electric savings originated from capital projects. In 2009, however, O&M improvements accounted for 85 percent of validated measure-level savings. This shift provides further evidence of CEI's integration into the Northwest industrial market.

[12] Due to rounding, the sum of individual target market savings may not match total savings.

Figure 10.1. Validated Electric Savings by Year and Category (2006–2009)



The persistence of both capital and O&M measures implemented through CEI is an important gauge of Initiative success, and an indication of whether CEI will continue as the Initiative disengages with these facilities. Cadmus asked participants whether each individual measure installed since 2006 remained in place. Of 41 capital improvement projects about which Cadmus inquired, no measures were reported to have been removed. Out of 50 validated O&M measures about which Cadmus inquired, respondents identified only three no longer in place. These data show a high persistence rate for energy savings achieved through the Initiative. Additionally, the majority (11 out of 13) of facilities believed there would be no change in their CEI practices if the Initiative were to disengage with their facility. Participating facilities have successfully integrated CEI into their cultures, and are ready to disengage with the Initiative and continue practicing energy management on their own.

The Initiative's electricity savings fell short of the 20 aMW revised target. The difference between actual and target savings can be explained through four factors:

1. Unreported projects have potential savings, as have projects not yet validated.
2. The initial 20 aMW goal may have been aggressive, as the pulp and paper industry was expected to achieve the majority of this goal. The pulp and paper market has not been receptive to CEI, as the market is in decline. MPER #5 provided further details on this issue..
3. Evaluation methods used for validating savings do not account for all the Initiative's possible market effects. Because the Initiative is a market transformation program, Cadmus developed a market diffusion model to estimate Initiative impacts beyond facilities engaged with the Initiative. The model shows that at the end of 2009, 8.2 aMW of electricity savings and 10,676,603 gas therms savings resulted from all food processing facilities practicing CEI in the region.

Market Progress

Initiative management established six market progress indicators (MPIs). MPER #6 provides an update on the following MPIs: market penetration (the number of food processing firms implementing CEI); market partner promotion of CEI; trade association promotion of CEI; and the number of food processing firms implementing CEI.

Progress in Market Penetration

The Initiative's goal sought to engage 13 percent of the large[13] food processor market in CEI. As of 2010, an estimated 36 percent of target food processing facilities were practicing CEI. Data indicate an expanding sector, with the industry open to capital and non-capital approaches, including CEI, for improving energy efficiency and controlling energy costs. Data from the survey with participating facilities also indicate that these facilities have successfully integrated CEI into their corporate cultures, supported by evidence of persistence of capital improvement projects and operations and maintenance measures implemented with Initiative involvement. Cadmus also found the majority of the participating facilities practicing CEI attributed their decision to do so to NEEA, the Initiative, and/or the Initiative's implementation team.

Progress in Market Partner Promotion of CEI

Market partner support and promotion of CEI are key aspects of the Initiative's implementation strategy. The Initiative's most significant contribution to promoting energy efficiency in the region has been, perhaps, the influence it had on the Northwest Power and Conservation Council's decision to include continuous energy improvement as a measure in the Sixth Power Plan. This will almost certainly guarantee widespread adoption of energy management practices in utility-sponsored energy-efficiency programs. Further, inclusion of energy management measures in the Sixth Power Plan led other utilities to consider implementing their own programs, and the BPA and ETO began programs in 2009. Seven of the utilities interviewed in 2009 were considering developing their own energy management programs.

Progress in Trade Association Promotion of CEI

NWFPA, one of the Initiative's market partners, is a trade association in the food processing industry. In late 2008, the NWFPA established a goal for its members to reduce energy intensity by 25 percent in 10 years. To measure energy intensity reduction, NWFPA collects data from its members to establish baseline energy intensity for the year 2009 from which progress toward the energy intensity reduction goal can be measured. NWFPA also conducts energy audits and tests and tracks implementation of energy management software systems at food processing facilities. It hopes to include training on software programs in its future budget.

Trade Ally Promotion of CEI

An additional measure of market change is trade ally promotion of CEI. Cadmus identified that at least six companies in the region provide energy management consulting services to industrial facilities. Findings from surveys with five energy management consulting companies in the region indicate the market has changed drastically over the past five years. Industrial facilities

[13] NEEA defines large food processors as companies with at least 250 employees in the region.

have become more aware of energy management practices and benefits due to: increased promotion and marketing; changes in environmental awareness and attitudes; and economic pressures to reduce their bottom lines. Additionally, more resources are available to the industry for obtaining information about energy management, and resources have improved since 2004. The result has been more facilities recognizing energy as a controllable expense, and a substantial increase in the number of facilities practicing CEI since 2004, when most respondents felt almost no facilities were managing energy.

Program Successes Through 2010

The research conducted in 2010 shows the Initiative has succeeded in integrating energy management into food processors' business and manufacturing operations, with energy as a manageable cost for food processors, as evidenced by the following:

- Participant surveys revealed that facilities remain pleased with the program, and the Initiative can disengage with these facilities, confident the facilities will continue practicing CEI.
- Nonparticipant and participant surveys showed that 36 percent of target facilities[14] are practicing CEI, an increase from 13 percent in 2004.
- Trade allies reported facilities have generally become more open to energy efficiency, and awareness has increased regarding energy as a controllable cost and component of maintaining a competitive advantage. Availability and quality of software tools and training opportunities have also increased.
- The Northwest Power and Conservation Council's Sixth Power Plan included CEI as an energy-efficiency measure with savings that can be validated. This has led other regional entities to implement their own programs; they have based their program designs on the Initiative. ETO and BPA implemented programs in 2009, and other utilities are in the planning stages.

Future Direction of the Initiative

Over the next four years, NEEA can build on this success by engaging a new group of participants. Cadmus found 36 percent of the target market practices energy management; however, only two facilities reported practicing CEI without help from NEEA, BPA, or ETO. Trade allies confirmed that very few if any facilities would begin practicing energy management without technical and financial help. This shows a continuing need to provide assistance to the food processing sector to further promote energy management adoption. NEEA could engage with these facilities directly, or advise NWFPA or other entities on how to continue promoting energy management to food processors.

Market partners and trade allies agreed NEEA continues to have a large role to play in this market. Despite energy management's economic benefits, many food processors remain reluctant to adopt CEI. This suggests a market gap NEEA and its market partners can help close with incentives, education and marketing.

[14] More than 250 employees throughout all facilities within a company in the region.

Cadmus requested feedback from respondents on directions the Initiative should take in the future. The majority of trade ally and market partner responses focused on the bulleted suggestions below.

- **Energy Management Software.** Respondents thought promotion of energy management software would provide an effective strategy for promoting energy management practices, with the caveat that one standardized tool will not work for all facilities because of their variability. The tool must be user-friendly and easily integrated with other software used at a facility.
- **ISO 50001.** Most respondents thought promoting the ISO 50001 standard would effectively use NEEA's resources. One respondent thought a barrier exists because industrial customers do not want to make a binding commitment. To overcome this barrier, NEEA could provide customers with information about obligations and costs to make them comfortable with the standards. The respondent also suggested NEEA look at rules for small- and medium-size industries, where assessments have not been free, and projects have had a lower priority for federal funding.
- **Technical Training.** Requests for technical training were consistent among market partners. One respondent mentioned training for process engineers on how to implement energy management practices. Both market partners and trade allies recommended NEEA share more information on how to measure and verify CEI energy savings.
- **Program Implementation Workshop.** Market partners said they would be interested in participating in a workshop on how to design an energy management program. They suggested ETO and BPA participate in the workshop to discuss lessons learned.
- **Standardization of CEI in the Region.** As other market partners begin to implement their own energy management programs, CEI will need standardized components so companies with facilities in different utility territories will receive consistent recommendations and goals.

Appendix A. 2009 Energy Savings Memorandum

Date: **April 15, 2010**

To: **Rita Siong, Robert Russell, and NEEA**

From: **William Jones, Ashley Buckman, and Jim Stewart**

Re: **2009 Energy Savings Memorandum**

Introduction

The Cadmus Group, Inc. (Cadmus) is the independent evaluator of the Northwest Energy Efficiency Alliance (NEEA) Initiative (Initiative). The Initiative began in 2004 and set an electric savings goal of 20 aMW to be reached by the end of the fifth program year. This memo presents Cadmus' results of the energy savings validation work completed in March 2010 and also summarizes the savings validated during prior program years in order to determine if the Initiative five year goal was reached.

Cadmus validated energy savings at eight food processing plants and one pulp and paper facility in the states of Idaho, Oregon, and Washington. Through the Industrial Tracking System (ITS) database, Cadmus identified specific energy savings measures and their associated savings claims at facilities selected for site visits. Cadmus then conducted site visits and phone interviews to collect data to validate the savings claims. Simultaneously, Cadmus evaluated facility-wide energy savings for several facilities based on statistical models provided by NEEA. The facility-wide energy savings capture both the validated individual measures and the other energy savings activities that the facility implemented but was not able to quantify.

The following sections describe the research approach and calculation methodology, findings, and the team's conclusions. Incremental and total energy savings attributable to CEI are included. Detailed savings tables appear in the attached appendices.

Research Approach and Methodology

The savings validation effort consisted of two parts:

- Review and validation of top-down or facility-wide energy savings claims.
- Bottom-up or measure-level energy savings validation.

Top-Down Savings Methodology

NEEA performed a regression analysis of electricity and gas consumption for each facility participating in the CEI program and submitted a report describing the methodology, data, and results to Cadmus. The report included facility-level econometric analyses of electricity and gas consumption, which yielded an estimate of savings in each program year.

In general, the savings claims were based on OLS (ordinary least squares) regressions of facility weekly or monthly therm or kWh (kilowatt per hour) consumption on output, temperature, and program implementation trend or level variables. Cadmus reviewed the savings claims with these criteria in mind:

- **Model specification:** Does the model specification follow from the program theory, and can the savings effects be identified? Are any of the assumptions of classical regression theory violated? What factors are omitted from the model and could they be biasing the results?
- **Establish validity of base years:** Are the selected base years appropriate and representative? Are the results similar when the treatment years are measured against different baseline years? What is the optimal approach to select/establish a base period?
- **Data reliability:** Are the data reliable and accurate? If not, what are the sources, and how are the errors likely to impact the analysis?
- **Model estimation and inference:** Do the regression results, the overall fit (R2), regression estimates, and standard errors of estimated coefficients support the hypothesis of energy savings? Are the results reasonable and plausible?
- **Reasonableness of estimated parameters:** Are the savings estimates plausible? How large are the savings estimates in relation to overall energy usage?
- **Sensitivity and robustness checks:** Are the results sensitive to the assumptions of the model? For instance, are the results sensitive to the exclusion or inclusion of different independent variables? What is the effect of excluding one or more baseline or treatment years?

For some facilities, Cadmus identified issues regarding the validity of the claims and brought these issues to NEEA's attention. NEEA then revised the claims to address the concerns and resubmitted them for review and use in the analyses. This collaborative process improved the reliability of the savings claims.

Cadmus believes that the top-down savings claims reported in this memo satisfy the evaluation criteria listed above.

Table 2 and Table 3 detail the number of reports received and the number of top-down savings claims evaluated (using the criteria listed above) by the facilities' engagement stage in the NEEA Initiative.

Table 2: Distribution of Top-Down Electric Savings Claims

Stage of Engagement	Total Number of Facilities Analyzed	Number of Facilities with 2006 Savings Claim (Electric)	Number of Facilities with 2007 Savings Claim (Electric)	Number of Facilities with 2008 Savings Claim (Electric)	Number of Facilities with 2009 Savings Claim (Electric)
Stage 3 - Committed	1	0	0	0	0
Stage 4 – Practicing*	6	0	3	3	1
Stage 5 – Sustaining*	11	1	2	5	5
Total	18	1	5	8	6

*At time of site visit selection

Table 3: Distribution of Top-Down Gas Savings Claims

Stage of Engagement	Total Number of Facilities Analyzed	Number of Facilities with 2006 Savings Claim (Gas)	Number of Facilities with 2007 Savings Claim (Gas)	Number of Facilities with 2008 Savings Claim (Gas)	Number of Facilities with 2009 Savings Claim (Gas)
Stage 3 - Committed*	1	0	0	0	0
Stage 4 - Practicing*	6	0	0	0	0
Stage 5 - Sustaining*	11	1	2	6	6
Total	18	1	2	6	6

*At time of site visit selection

Site Visit (Bottom-Up Savings) Methodology

Using a list of measures provided by the implementation contractor (Ecos), Cadmus developed an inventory of 14 facilities with energy savings claimed through their participation in CEI. Time and budget constraints, however, limited the number of site visits Cadmus could perform to six, therefore the six facilities with the highest claimed electric savings were selected for site visits. With input from NEEA, it was determined that Cadmus could validate the savings claims at three additional facilities by phone (in lieu of an onsite visit). Together these nine facilities represented over 95 percent of the total claimed energy savings. Table 4 presents the number of site visits and phone verifications Cadmus completed.

Table 4: Site Visit Disposition by Engagement Stage

Stage of Engagement	Number of Plants with Pending Savings Claim(s)*	Number of Completed Site Visits	Number of Completed Phone Verifications	Number of Facilities Not Selected for Site Visit or Phone Verification
Stage 3 - Committed*	2	1	0	1
Stage 4 - Practicing*	3	2	0	1
Stage 5 - Sustaining*	9	3	3	3
Total	14	6	3	5

*At time of site visit selection

Cadmus collected updated savings claims and measure documentation from NEEA's ITS and created a detailed list of completed energy efficiency projects ready for evaluation. The implementation team greatly facilitated this work by populating ITS with the savings claims and measure documentation for each facility.

Cadmus then conducted phone interviews or site visits at all nine facilities to verify measure installations and the validity of the claimed savings. In some instances, the savings claims had to be recalculated before completing the energy savings validation.

Findings

Findings are presented below in the following order:

- Top-down savings analysis,
- Site visit (bottom-up) savings analysis,
- Realization rate calculation,
- Pending savings claims, and
- Total validated savings.

Top-Down Savings Analysis

Table 5 presents both gross and net top-down savings. The gross savings numbers capture all savings at the facility, including savings from measures installed as part of the CEI program. To prevent double counting, Cadmus calculated net savings as the total top-down claim less any validated bottom-up savings that align with the time frame of the top-down claim. In the rare case that validated bottom-up savings exceed the top-down claim, top-down savings are not credited, but the validated bottom-up savings are not decreased (see Appendix A for more detailed facility-level gross and net top-down savings).

Table 4: Top-Down Savings by Year, 2006-2009

Year	Gross Top-Down Savings (aMW)	Net Top-Down Savings (aMW)	Gross Top-Down Savings (therms)	Net Top-Down Savings (therms)
2006	0.242	0.220	73,666	73,666
2007	0.672	0.461	131,378	131,378
2008	0.913	0.563	967,701	967,701
2009	0.816	0.579	1,879,095	1,879,095
Total	2.643	1.823	3,051,840	3,051,840

Site Visit Savings Analysis

Table 6 and Table 7 present electric and gas savings validated during this round of facility site visits and phone verifications. Cadmus validated savings for projects completed in 2007, 2008, and 2009. The bulk of the savings validated occurred in 2009. Operations and maintenance (O&M) improvements account for the majority of the savings validated during this round of site visits and phone verifications (see Appendix B for detailed facility-level validation data).

Table 6: Electric Savings by Year - Validated by Site Visits and Phone Verification (February / March 2010)

Year	O&M (aMW)	Incented Capital (aMW)	Unincented Capital (aMW)	Total Electric Savings (aMW)
2007	0.075	0.101	0	0.176
2008	0.020	0.011	0	0.031
2009	1.239	0.085	0.038	1.362
Total	1.334	0.197	0.038	1.569

Table 7: Gas Savings by Year - Validated by Site Visits and Phone Verification (February/March 2010)

Year	O&M (therms)	Incented Capital (therms)	Unincented Capital (therms)	Total Gas Savings (therms)
2009	0	0	20,600	20,600
Total	0	0	20,600	20,600

Realization Rate Calculation

Cadmus Realization Rate Calculation

During a program evaluation, it is often not possible or desirable for an evaluator to validate energy savings claims at all facilities due to lack of budget or time. In these cases, there may be a need, however, to estimate the percent of claimed savings that are likely to be validated. This can be done by assuming that the sampled measures are representative of the unsampled measures and extrapolating the validated savings from sampled facilities. To do this, the evaluator calculates a realization rate or proxy value which is applied to the unvalidated savings claims.

For this evaluation round, however, Cadmus was unable to develop a proxy value. We decided that the population size (and therefore the sample size) was too small and that the facilities with the largest impact on the realization rate were atypical from the population of food processing and pulp and paper facilities. Therefore, it was not appropriate to apply the realization rate to the outstanding savings claims.

As part of the validation process, Cadmus reviewed each savings claim to determine whether it was a reasonable estimate based on engineering standards and the operating conditions at each facility at the time of project completion. In some instances, Cadmus's calculations of energy savings differed from the savings claim. Measures were then validated based on the adjusted savings calculations, not the original savings claim.

Table 8 displays the overall realization rate for each facility. The realization rate is the ratio, expressed in percent, between the engineer's facility-level validated savings and the total savings claimed for that facility. In most cases there was either no difference or less than a 5 percent difference between claimed and validated savings. For two facilities, however, there was a significant difference between the claimed savings and the engineer's validated savings (see the following subsection for discrepancy discussion). Since the overall realization rate was calculated using a weighted average, these two facilities had a significant downward impact on the realization rate.

Table 8: Realization Rate

Plant	Number of Measures Claimed	Number of Validated Measures	Total Claimed Savings (aMW)	Total Validated Savings (aMW)	Savings Realization Rate
O-011	1	1	2.100	0.832	39.6%
I-009	3	3	0.043	0.043	100.0%
I-012	6	6	0.201	0.195	97.3%
W-017	1	1	0.101	0.101	100.0%
O-005	3	3	0.205	0.103	50.4%
O-006	1	1	0.006	0.006	100.0%
W-007	5	4	0.274	0.265	96.7%
O-003	1	1	0.001	0.001	100.0%
O-008*	2	2	0.023	0.023	100.0%
Total	23	22	2.959	1.569	53.0%

*Two measures that were added after the decision to do phone verification are not included in table. They are reported as pending savings in Table 9 below.

Reasons for Savings Claim Discrepancies

Cadmus reduced the savings claim at facility O-011 by 60 percent for two reasons. First, the project occurred in several phases spanning 2005–2009. Since the facility was not involved in the Initiative until 2007, the savings which occurred as part of the initial phases (2005–2007) could not be included. Second, the facility has significantly reduced their operating hours over the past two to three years. Therefore, the validated savings reflect the operating hours at the time the project was completed.

Cadmus reduced the savings claim at facility O-005 by approximately 50 percent. Although minor adjustments were made to other savings claims evaluated at this facility, the majority of the difference can be attributed to a reduction in savings for a single measure, the condenser spray nozzle replacement. Cadmus recalculated the energy savings for this measure with a 15 psig average condensing pressure reduction, a much more conservative estimate than the 30 psig reduction previously used. The 15 psig average condensing pressure reduction is consistent with operating conditions described by the facility's refrigeration engineer. Further, Cadmus applied a more conservative estimate of break horsepower. These factors reduced the overall savings for this measure by about 57 percent.

Why Our Realization Rate Is Not a Good Proxy

Given the facility sample and the measures validated, Cadmus is reluctant to apply the realization rate presented in Table 7 to estimate the realized savings for any non-validated savings claims. To apply a proxy to the non-validated claims, a more rigorous statistical

methodology is necessary. The methodology we have used does not meet that standard for the following reasons:

- Cadmus selected the facilities for measure validation based on the size of the savings claim, not on a statistical representation of the facility population, so it would be impossible to suggest that they were representative of the expected savings for non-validated measures.
- The measures Cadmus validated may not have been representative of the entire population of energy savings measures. This was the first time in four years of validation that Cadmus had encountered a discrepancy between an energy savings claim and a validation.
- A small number of measures and facilities had an inordinate influence on the overall realization rate. Measures at seven of the nine facilities had greater than 95 percent of validated savings/claimed savings ratios, while measures at two of the nine facilities had low validated savings/claimed savings ratios (less than 55 percent). One of those two facilities had only one measure validated. Yet, because this single measure had a significant savings claim associated with it which was adjusted, this single measure significantly reduce the overall realization rate.
- The number of measures that Cadmus validated during this evaluation is a fraction of the total measures validated over the course of the program. We validated 22 measures, which represent approximately 15 percent of the total number of measures validated since 2006 (a total of about 150 measures).

Cadmus believes that in future energy savings validations we can calculate a proxy for claimed energy savings if we select facilities for site visits which are representative of the sample population. A realization rate representative of the population may then be extrapolated to all participants. Until such a proxy is calculated Cadmus does not believe it can justify altering any pending savings claims listed in Table 8.

Outstanding Pending Savings

As previously mentioned, time and budget constraints limited the number of site visits. Table 9 lists outstanding pending savings for facilities in the food processing and pulp and paper markets. Pending savings refer to completed measures that have been documented and flagged as ready for evaluation. Savings numbers are listed as claimed on ITS, with no adjustments applied.

Table 9: Outstanding Pending Savings

Market	Outstanding Pending Electric Savings (kWh)*	Outstanding Pending Electric Savings (aMW)	Outstanding Pending Gas Savings (therms)*
Food Processing	5,476,110	0.625	7,476
Pulp & Paper	462,000	0.053	64,000
Total	5,938,110	0.678	71,476

*Listed as Pending on ITS as of 3/2/2010. Represents facilities that have reached Engagement Stage 3 or higher.

Total Savings

Table 10 presents total validated electric savings, including net top-down savings. Through the end of 2009, CEI has saved the region 7.864 aMW.

Table 10: Total Validated Electric Savings (2006-2009)

	O&M (aMW)	Incented Capital (aMW)	Unincented Capital (aMW)	Net Top-Down (aMW)	Total Electric Savings (aMW)
2006	0.161	0.489	0	0.220	0.869
2007	0.329	0.227	0.285	0.461	1.303
2008	1.079	1.306	0.617	0.563	3.565
2009	1.324	0.186	0.038	0.579	2.126
Total	2.893	2.208	0.940	1.823	7.864

Table 11 presents total validated gas savings to date, including net top-down savings. As previously noted, Cadmus did not track gas savings until 2008. The savings reported for 2006 and 2007 are solely the result of top-down analyses.

Table 11: Total Validated Gas Savings (2006-2009)

	O&M (therms)	Incented Capital (therms)	Unincented Capital (therms)	Net Top-Down (therms)	Total Gas Savings (therms)
2006	n/a	n/a	n/a	73,666	73,666
2007	n/a	n/a	n/a	131,378	131,378
2008	68,750	0	988,664	967,701	2,025,115
2009	0	0	20,600	1,879,095	1,899,695
Total	68,750	0	1,009,264	3,051,840	4,129,854

Conclusions

While the energy savings validation Cadmus carried out for these nine facilities added to the total energy savings for which the Initiative is responsible, in certain cases the total validated energy savings differed from the savings claims. Cadmus believes, however, that the validations present an accurate picture of the actual savings at each of these nine facilities.

One area that Cadmus and NEEA will need to address in the future is the development of a proxy value that can be applied to estimate energy savings claims. The realization rate that Cadmus calculated does not meet the standard that is necessary to estimate adjustments to energy savings claims. In future energy savings validation work, Cadmus believes that it will be possible to calculate a proxy to estimate savings claims. Until then, the outstanding pending claims will remain unadjusted.

Appendix B. Additional Energy Savings Tables and Site Visit Reports

Table 12. Top-Down Electric Savings by Facility and Year (2006 - 2009)

Site ID	2006			2007			2008			2009			Total Validated Net Top-Down Savings (kWh)
	Top-Down Claim (kWh)	Validated Bottom-Up Savings (kWh)	Validated Net Top-Down Savings (kWh)	Top-Down Claim (kWh)	Validated Bottom-Up Savings (kWh)	Validated Net Top-Down Savings (kWh)	Top-Down Claim (kWh)	Validated Bottom-Up Savings (kWh)	Validated Net Top-Down Savings (kWh)	Top-Down Claim (kWh)	Validated Bottom-Up Savings (kWh)	Validated Net Top-Down Savings (kWh)	
O-008	0	n/a	0	0	n/a	0	157,505	300,488	0	447,027	199,500	247,527	247,527
O-009	0	n/a	0	650,334	0	650,334	650,334	413,156	237,178	0	n/a	0	887,512
O-005	2,120,141	196,700	1,923,441	2,120,141	922,840	1,197,301	2,120,141	241,987	1,878,154	2,120,141	1,504,798	615,343	5,614,239
I-011	0	n/a	0	0	n/a	0	700,432	41,783	658,649	1,804,960	0	1,804,960	2,463,609
I-013	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
I-016	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
W-002	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
W-017	0	n/a	0	1,065,256	882,000	183,256	1,597,884	1,201,556	396,328	0	n/a	0	579,584
I-009	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
W-015	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
I-012	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
O-004	0	n/a	0	366,738	40,000	326,738	366,738	701,556	0	366,738	0	366,738	693,476
O-003	0	n/a	0	0	n/a	0	721,608	603,252	118,356	721,608	218,852	502,756	621,112
O-004	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
W-007	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
O-007	0	n/a	0	1,684,272	0	1,684,272	1,684,272	39,420	1,644,852	1,684,272	150,394	1,533,878	4,863,002
O-006	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
I-007	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
Total kWh	**2,120,141**	**196,700**	**1,923,441**	**5,886,741**	**1,844,840**	**4,041,901**	**7,998,914**	**3,543,198**	**4,933,517**	**7,144,746**	**2,073,544**	**5,071,202**	**15,970,061**
Total aMW	**0.242**	**0.022**	**0.220**	**0.672**	**0.211**	**0.461**	**0.913**	**0.404**	**0.563**	**0.816**	**0.237**	**0.579**	**1.823**

Table 13. Top-Down Gas Savings by Facility and Year (2006 - 2009)

Site ID	2006			2007			2008			2009			Total Validated Net Top-Down Savings (therms)
	Top-Down Claim (therms)	Validated Bottom-Up Savings (therms)	Validated Net Top-Down Savings (therms)	Top-Down Claim (therms)	Validated Bottom-Up Savings (therms)	Validated Net Top-Down Savings (therms)	Top-Down Claim (therms)	Validated Bottom-Up Savings (therms)	Validated Net Top-Down Savings (therms)	Top-Down Claim (therms)	Validated Bottom-Up Savings (therms)	Validated Top-Down Savings (therms)	
O-008	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
O-009	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
O-005	73,666	0	73,666	73,666	0	73,666	73,666	0	73,666	73,666	0	73,666	294,664
I-011	0	n/a	0	0	n/a	0	308,178	0	308,178	794,151	0	794,151	1,102,329
I-013	0	n/a	0	0	n/a	0	272,142	0	272,142	701,289	0	701,289	973,431
I-016	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
W-002	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
W-017	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
I-009	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
W-015	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
I-012	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
O-004	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
O-003	0	n/a	0	57,712	0	57,712	57,712	0	57,712	57,712	0	57,712	173,136
O-004	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
W-007	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
O-007	0	n/a	0	0	n/a	0	225,838	0	225,838	225,838	0	225,838	451,676
O-006	0	n/a	0	0	n/a	0	30,165	0	30,165	26,439	0	26,439	56,604
I-007	0	n/a	0	0	n/a	0	0	n/a	0	0	n/a	0	0
Total (therms)	**73,666**	**0**	**73,666**	**131,378**	**0**	**131,378**	**967,701**	**0**	**967,701**	**1,879,095**	**0**	**1,879,095**	**3,051,840**

Table 14. Validated Electric and Gas Savings by Facility and Year (2006 - 2009)

				Validated Electric Savings (kWh)*					Validated Gas Savings (therms)*				
Site ID	Savings Year	Market	State	O&M	Incented Capital	Un-incented Capital	Top-Down	Electric Total	O&M	Incented Capital	Un-incented Capital	Top-Down	Gas Total
O-011	2009	PnP	OR	7,288,320	0	0	0	**7,288,320**	0	0	0	0	**0**
I-011	2008	FP	ID	0	0	0	658,649	**658,649**	0	0	0	308,178	**308,178**
I-011	2009	FP	ID	0	0	0	1,804,960	**1,804,960**	0	0	0	794,151	**794,151**
I-013	2008	FP	ID	0	0	0	0	**0**	0	0	0	272,142	**272,142**
I-013	2009	FP	ID	0	0	0	0	**0**	0	0	0	701,289	**701,289**
I-009	2009	FP	ID	190,409	0	184,977	0	**375,386**	0	0	20,600	0	**20,600**
I-012	2008	FP	ID	127,444	67,993	0	0	**195,437**	0	0	0	0	**0**
I-012	2009	FP	ID	869,760	501,960	144,185	0	**1,515,905**	0	0	0	0	**0**
W-017	2007	FP	WA	0	882,000	0	183,256	**1,065,256**	0	0	0	0	**0**
W-017	2008	FP	WA	0	0	0	396,328	**396,328**	0	0	0	0	**0**
O-005	2006	FP	OR	0	0	0	1,923,441	**1,923,441**	0	0	0	73,666	**73,666**
O-005	2007	FP	OR	659,154	0	0	1,197,301	**1,856,455**	0	0	0	73,666	**73,666**
O-005	2008	FP	OR	0	0	0	1,878,154	**1,878,154**	0	0	0	73,666	**73,666**
O-005	2009	FP	OR	77,913	169,177	0	615,343	**862,433**	0	0	0	73,666	**73,666**
O-006	2008	FP	OR	0	0	0	0	**0**	0	0	0	30,165	**30,165**
O-006	2009	FP	OR	50,400	0	0	0	**50,400**	0	0	0	26,439	**26,439**
W-007	2008	FP	WA	39,000	29,580	0	0	**68,580**	0	0	0	0	**0**
W-007	2009	FP	WA	2,251,296	0	0	0	**2,251,296**	0	0	0	0	**0**
O-004	2007	FP	OR	0	0	0	326,738	**326,738**	0	0	0	0	**0**
O-004	2009	FP	OR	0	0	0	366,738	**366,738**	0	0	0	0	**0**
O-003	2007	FP	OR	0	0	0	0	**0**	0	0	0	57,712	**57,712**
O-003	2008	FP	OR	10,860	0	0	118,356	**129,216**	0	0	0	57,712	**57,712**
O-003	2009	FP	OR	0	0	0	502,756	**502,756**	0	0	0	57,712	**57,712**
O-007	2007	FP	OR	0	0	0	1,684,272	**1,684,272**	0	0	0	0	**0**
O-007	2008	FP	OR	0	0	0	1,644,852	**1,644,852**	0	0	0	225,838	**225,838**
O-007	2009	FP	OR	0	0	0	1,533,878	**1,533,878**	0	0	0	225,838	**225,838**
O-009	2007	FP	OR	0	0	0	650,334	**650,334**	0	0	0	0	**0**
O-009	2008	FP	OR	0	0	0	237,178	**237,178**	0	0	0	0	**0**
O-008	2009	FP	OR	123,900	75,600	0	247,527	**447,027**	0	0	0	0	**0**
Total Savings Validated Feb. 2010				**11,688,456**	**1,726,310**	**329,162**	**15,970,061**	**29,713,989**	**0**	**0**	**20,600**	**3,051,840**	**3,072,440**
Total Validated Savings (2006-2009)				**Electric (aMW)****					**Gas (therms)****				
2006 Savings (Previously Validated)				0.161	0.489	0.000	0.000	**0.650**	n/a	n/a	n/a	0	**0**
2006 Savings (Validated 2010)				0.000	0.000	0.000	0.220	**0.220**	0	0	0	73,666	**73,666**
2007 Savings (Previously Validated)				0.254	0.126	0.285	0.000	**0.665**	n/a	n/a	n/a	0	**0**
2007 Savings (Validated 2010)				0.075	0.101	0.000	0.461	**0.637**	0	0	0	131,378	**131,378**
2008 Savings (Previously Validated)				1.059	1.295	0.617	0.000	**2.971**	68,750	0	988,664	0	**1,057,414**
2008 Savings (Validated 2010)				0.020	0.011	0.000	0.563	**0.595**	0	0	0	967,701	**967,701**
2009 Savings (Previously Validated)				0.085	0.101	0.000	0.000	**0.186**	0	0	0	0	**0**
2009 Savings (Validated 2010)				1.239	0.085	0.038	0.579	**1.941**	0	0	20,600	1,879,095	**1,899,695**
Total Validated Savings				**2.893**	**2.208**	**0.940**	**1.823**	**7.864**	**68,750**	**0**	**1,009,264**	**3,051,840**	**4,129,854**

* Presents savings validated during site visits, phone verifications and top-down analyses conducted Feb. 2010.

** Presents sum of savings validated during this round of site visits, phone verifications and top-down savings analyses and all previous site visit efforts.

Table 15. Total Validated Electric (aMW) and Gas (therms) Savings by Market (2006 - 2009)

	Validated Electric Savings (aMW)					Validated Gas Savings (therms)				
	O&M	Incented Capital	Unincented Capital	Net Top-Down	Total Electric Savings	O&M	Incented Capital	Unincented Capital	Net Top-Down	Total Gas Savings
Food Processing	1.457	2.005	0.361	1.823	**5.646**	68,750	0	1,009,264	3,051,840	**4,129,854**
Pulp & Paper	1.436	0.203	0.578	0	**2.217**	n/a	n/a	n/a	n/a	**n/a**
TOTAL*	**2.893**	**2.208**	**0.940**	**1.823**	**7.864**	**68,750**	**0**	**1,009,264**	**3,051,840**	**4,129,854**

*TOTAL = Aggregate of Food Processing and Pulp & Paper

Table 16. Annual Validated Electric (aMW) and Gas (therms) Savings by Market (2009)

	Validated Electric Savings (aMW)					Validated Gas Savings (therms)				
	O&M	Incented Capital	Unincented Capital	Net Top-Down	Total Electric Savings	O&M	Incented Capital	Unincented Capital	Net Top-Down	Total Gas Savings
Food Processing	0.492	0.186	0.038	0.579	**1.294**	0	0	20,600	1,879,095	**1,899,695**
Pulp & Paper	0.832	0	0	0	**0.832**	n/a	n/a	n/a	n/a	**n/a**
TOTAL*	**1.324**	**0.186**	**0.038**	**0.579**	**2.126**	**0**	**0**	**20,600**	**1,879,095**	**1,899,695**

*TOTAL = Aggregate of Food Processing and Pulp & Paper

Table 17. Adjustments to Annual Validated Electric (aMW) and Gas (therms) Savings by Market and Year (2006 - 2009) from 2010 Data Collection and Analysis Activities

	Validated Electric Savings (aMW)					Validated Gas Savings (therms)				
	O&M	Incented Capital	Unincented Capital	Net Top-Down	Total Electric Savings	O&M	Incented Capital	Unincented Capital	Net Top-Down	Total Gas Savings
Food Processing										
2006	0	0	0	0.220	**0.220**	0	0	0	73,666	**73,666**
2007	0.075	0.101	0	0.461	**0.637**	0	0	0	131,378	**131,378**
2008	0.020	0.011	0	0.563	**0.595**	0	0	0	967,701	**967,701**
2009	0.407	0.085	0.038	0.579	**1.109**	0	0	20,600	1,879,095	**1,899,695**
Food Processing Total	**0.502**	**0.197**	**0.038**	**1.823**	**2.560**	**0**	**0**	**20,600**	**3,051,840**	**3,072,440**
Pulp & Paper										
2006	0	0	0	0	0	n/a	n/a	n/a	n/a	n/a
2007	0	0	0	0	0	n/a	n/a	n/a	n/a	n/a
2008	0	0	0	0	0	n/a	n/a	n/a	n/a	n/a
2009	0.832	0	0	0	0.832	n/a	n/a	n/a	n/a	n/a
Pulp & Paper Total	**0.832**	**0**	**0**	**0**	**0.832**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**
TOTAL*	**1.334**	**0.197**	**0.038**	**1.823**	**3.392**	**0**	**0**	**20,600**	**3,051,840**	**3,072,440**

*TOTAL = Aggregate of Food Processing and Pulp & Paper

Table 18. Validated Electric (aMW) and Gas Savings (therms) in the Food Processing Market by Year (2006 - 2009)

Year	Validated Electric Savings (aMW)					Validated Gas Savings (therms)				
	O&M	Incented Capital	Unincented Capital	Net Top-Down	Total Electric Savings	O&M	Incented Capital	Unincented Capital	Net Top-Down	Total Gas Savings
2006	0.152	0.489	0	0.220	**0.860**	n/a	n/a	n/a	73,666	**73,666**
2007	0.286	0.114	0.272	0.461	**1.133**	n/a	n/a	n/a	131,378	**131,378**
2008	0.528	1.216	0.051	0.563	**2.359**	68,750	0	988,664	967,701	**2,025,115**
2009	0.492	0.186	0.038	0.579	**1.294**	0	0	20,600	1,879,095	**1,899,695**
TOTAL*	**1.457**	**2.005**	**0.361**	**1.823**	**5.646**	**68,750**	**0**	**1,009,264**	**3,051,840**	**4,129,854**

*TOTAL = Aggregate of All Years

Table 19. Validated Electric Savings (aMW) in the Pulp and Paper Market by Year (2006 - 2009)

Year	Validated Electric Savings (aMW)				
	O&M	Incented Capital	Unincented Capital	Net Top-Down	Total Electric Savings
2006	0.009	0	0	0	**0.009**
2007	0.044	0.113	0.013	0	**0.170**
2008	0.551	0.090	0.566	0	**1.206**
2009	0.832	0	0	0	**0.832**
TOTAL*	**1.436**	**0.203**	**0.578**	**0**	**2.217**

*TOTAL = Aggregate of All Years

Table 20. Total Validated Electric Savings (aMW) by Year (2006 - 2009)

Year	Validated Electric Savings (aMW)				
	O&M	Incented Capital	Unincented Capital	Net Top-Down	Total Electric Savings
2006	0.161	0.489	0	0.220	**0.869**
2007	0.329	0.227	0.285	0.461	**1.303**
2008	1.079	1.306	0.617	0.563	**3.565**
2009	1.324	0.186	0.038	0.579	**2.126**
TOTAL*	**2.893**	**2.208**	**0.940**	**1.823**	**7.864**

*TOTAL = Aggregate of All Years

Table 21. Validated Electric (aMW) and Gas (therms) Savings by State (2009)

State	Validated Electric Savings (aMW)					Validated Gas Savings (therms)				
	O&M	Incented Capital	Unincented Capital	Net Top-Down	Total Electric Savings	O&M	Incented Capital	Unincented Capital	Net Top-Down	Total Gas Savings
Oregon	0.946	0.129	0	0.373	**1.447**	0	0	0	383,655	**383,655**
Washington	0.257	0	0	0	**0.257**	0	0	0	0	**0**
Idaho	0.121	0.057	0.038	0.206	**0.422**	0	0	20,600	1,495,440	**1,516,040**
TOTAL*	**1.324**	**0.186**	**0.038**	**0.579**	**2.126**	**0**	**0**	**20,600**	**1,879,095**	**1,899,695**

*TOTAL = Aggregate of All States

Table 22. Site Visit Report - O-011

Company Information		Evaluation Information		CEI Information	
Company	O-011	Evaluation By	Randy McCall	Stage of Engagement	Stage 3 Committed
Location	OR	Evaluation Date	2/18/2010	Date Current Stage Reached	4/21/2008
NAICS Code	322			Date of Current Envinta	July 2007

Facility Details	
Description of Actions taken	
O&M Projects	1. Changed refiner plates to optimize performance
Capital Projects	None
Number of Employees	240
Product Manufactured	Newsprint and paper bag material
Production Process	Process is all off peak at current time; production scheduled afternoon in advance based on electricity rates
Production Trends	Currently operating at 56 hours per week, or 2900 hours/year
Metering in Place	Yes
Annual Operating Hours	2,900

Energy Use Details				
Annual Energy Use	*kWh*	336,000,000	*therms*	0
Energy Systems Breakdown	*Compressed Air*		*Motors*	
	Refrigeration		*Steam*	
	Gas		*Other*	
Types of Energy Used	*Electric*		*Gas*	
	Other			

Energy Savings	
O&M Savings	7,288,320 kWh
Capital Savings	None
Comments	1. Savings of refiner plate measure revised to reflect operating hours during 2009, and phases of the overall improvement in refiner plate energy use reductions.

Utility Information	
Utility Involved (Y/N)	No
Utility Name	Portland General Electric
Incentive Provided (Y/N)	No

Table 23. Site Visit Report - I-009

Company Information		Evaluation Information		CEI Information	
Company	I-009	Evaluation By	Randy McCall	Stage of Engagement	Stage 4 Practicing
Location	ID	Evaluation Date	2/8/2010	Date Current Stage Reached	9/11/2009
NAICS Code	311			Date of Current Envinta	November 2007

Facility Details

Description of Actions taken	
O&M Projects	1. Energy Efficient Lighting - Lighting Upgrade 2. High Efficiency Motors
Capital Projects	1. Upgraded to Opti-Sorts - to automatically separate defective product, defective product is no longer refrigerated. Compressed air- increases recovery ratios, Electrical & Steam. Part 1, kWh Savings
Number of Employees	278
Product Manufactured	French fries
Production Process	French fry production: cooking, freezing, packaging
Production Trends	Facility runs 24/7 - down for project for 30 days in 2009 (Sept. to Sept.); also 24hr shut down every three weeks
Metering in Place	Utility meter for facility only - no submetering by end use
Annual Operating Hours	7200

Energy Use Details

Annual Energy Use	*kWh*	40,087,621	*therms*	4,066,030
Energy Systems Breakdown	*Compressed Air*		*Motors*	
	Refrigeration		*Steam*	
	Gas		*Other*	
Types of Energy Used	*Electric*	40 percent	*Gas*	60 percent
	Other			

Energy Savings

O&M Savings	190,409 kWh
Capital Savings	184,977 kWh 20,600 therms
Comments	Other Projects: 1. Heat Exchange loops for Hot Cleaning Water and Preheating Wastewater 2. LED lighting for freezers

Utility Information

Utility Involved (Y/N)	Yes
Utility Name	Idaho Power Company
Incentive Provided (Y/N)	Yes

Table 24. Site Visit Report – 1-012

Company Information		Evaluation Information		CEI Information	
Company	I-012	Evaluation By	Randy McCall	Stage of Engagement	Stage 4 Practicing
Location	ID	Evaluation Date	2/9/2010	Date Current Stage Reached	9/23/2009
NAICS Code	311			Date of Current Envinta	October 2008

Facility Details

Description of Actions taken	
O&M Projects	1. Steam Condensate Improvements- improvement to their steam condensate system by routing the fryer condensate to the Low Pressure steam system rather than to boiler 2. Condenser Spray Nozzle Upgrade
Capital Projects	1. Air Compressor Retrofit, replace with VFD 2. Receiving Upgrade-upgrade pumps to electric motors and addition to rock trap system. 3. Cold grading upgrade- reducing the size of the motors and installing more advanced controls to cold grading process 4. Nebraska Boiler Shutdown Mode Controls - added controls that allow the boiler cycle in the 25-160 psi range during plant shutdowns resulting in 440 hours per year less run time on a pump and a fan.
Number of Employees	314
Product Manufactured	French fries, hashbrowns
Production Process	French fry and hashbrown processing: cooking, freezing, packaging
Production Trends	Flat 24/7 with shut down for 24hr clean up every three weeks
Metering in Place	No sub-metering of end uses
Annual Operating Hours	7100

Energy Use Details

Annual Energy Use	*kWh*	41,800,645	*therms*	3,915,290
Energy Systems Breakdown	*Compressed Air*		*Motors*	
	Refrigeration		*Steam*	
	Gas		*Other*	
Types of Energy Used	*Electric*	40 percent	*Gas*	60 percent
	Other			

Energy Savings

O&M Savings	997,204 kWh
Capital Savings	714,138 kWh
Comments	1. Savings estimate for steam condensate improvements measure revised for PF and efficiency. 2. Savings estimate for receiving upgrades measure revised for PF and efficiency. 3. Savings estimate for cold grading upgrade measure revised for PF and efficiency. 4. Savings estimate for Nebraska boiler measure revised for PF and efficiency. Other Projects: 1. Thermosyphon Oil Cooling for Refrigeration Compressors (proposed/planned for spring)

Utility Information

Utility Involved (Y/N)	Yes
Utility Name	Idaho Power Company

Incentive Provided (Y/N)	Yes

Table 25. Site Visit Report – W-017

Company Information		Evaluation Information		CEI Information	
Company	W-017	Evaluation By	Randy McCall	Stage of Engagement	Stage 4 Practicing
Location	WA	Evaluation Date	2/10/2010	Date Current Stage Reached	10/30/2009
NAICS Code	311			Date of Current Envinta	Unknown

Facility Details					
Description of Actions taken					
O&M Projects	None				
Capital Projects	1. Compressed Air Upgrade-Upgrade of Flow Control, 1 new vessel, and new compressor controls, Complete 5/8/2009				
Number of Employees	412				
Product Manufactured	French fries and potato products				
Production Process	French Fries are cut, fried, and frozen for packaging roughly 260 days per year; product is moved out of the facility quickly with approximately 5 days based on storage capacity and production rate.				
Production Trends	Continuous during processing season (24/7)				
Metering in Place	None				
Annual Operating Hours	7,200				
Energy Use Details					
Annual Energy Use		*kWh*	55,604,138	*therms*	8,048,470
Energy Systems Breakdown		*Compressed Air*		*Motors*	
		Refrigeration		*Steam*	
		Gas		*Other*	
Types of Energy Used		*Electric*		*Gas*	
		Other			
Energy Savings					
O&M Savings	None				
Capital Savings	882,000 kWh				
Comments	Additional Projects: 1. Spiral Freezer Belt Replacement with Plastic Belt 2. Boiler improvements including new fin tube feedwater economizer and additional direct contact condensing economizer 3. Fryer stack heat recovery (steam vapor from fryers) 4. New evaporative condenser for ammonia refrigeration system				
Utility Information					
Utility Involved (Y/N)	Yes				
Utility Name	Avista Utilities				
Incentive Provided (Y/N)	Yes				

Table 26. Site Visit Report – O-005

Company Information		Evaluation Information		CEI Information	
Company	O-005	Evaluation By	Randy McCall	Stage of Engagement	Stage 5 Sustaining
Location	OR	Evaluation Date	2/18/2010	Date Current Stage Reached	11/9/2009
NAICS Code	311			Date of Current Envinta	April 2006

Facility Details

Description of Actions taken	
O&M Projects	1. Replace Condenser Spray Nozzles 2. Refrigeration Tunnel Operation Reduction changed refrigeration tunnel start up time
Capital Projects	1. New Condenser for Brooks Cold Storage (BCS)- 2/19/2009-7/10/2009 - ETO.
Number of Employees	838
Product Manufactured	Frozen fruits and vegetables, canned fruits and vegetables
Production Process	Frozen, canned
Production Trends	Seasonal - full production during May-Nov; very limited rework Nov.-May
Metering in Place	No
Annual Operating Hours	3,700

Energy Use Details

Annual Energy Use	*kWh*	19,586,105	*therms*	69,712
Energy Systems Breakdown	*Compressed Air*	5%	*Motors*	5%
	Refrigeration	45%	*Steam*	45%
	Gas		*Other*	
Types of Energy Used	*Electric*	55%	*Gas*	45%
	Other			

Energy Savings

O&M Savings	737,067 kWh
Capital Savings	169,177 kWh
Comments	1. Savings for condenser spray nozzle measure revised to reflect more reasonable decrease in condenser lift. 2. Refrigeration savings portion of tunnel operation reduction measure revised because it was calculated too high.

Utility Information

Utility Involved (Y/N)	Yes
Utility Name	Portland General Electric
Incentive Provided (Y/N)	Yes

Table 27. Site Visit Report – O-006

Company Information		Evaluation Information		CEI Information	
Company	O-006	Evaluation By	Randy McCall	Stage of Engagement	Stage 5 Sustaining
Location	OR	Evaluation Date	3/1/2010	Date Current Stage Reached	10/21/2009
NAICS Code	311			Date of Current Envinta	February 2009

Facility Details

Description of Actions taken	
O&M Projects	1. Shift to 4 day work week during off-season, Completed 1/1/2009.
Capital Projects	None
Number of Employees	240
Product Manufactured	Frozen vegetables
Production Process	Processes a variety of vegables during the spring (incl. corn, green beans, peas and carrots), process consists of cleaning, sorting, cutting, blanching and freezing
Production Trends	28 weeks of production season (~7 months)
Metering in Place	No (utility metering only)
Annual Operating Hours	5,260

Energy Use Details

Annual Energy Use	*kWh*	10,859,280	*therms*	4,408,712
Energy Systems Breakdown	*Compressed Air*		*Motors*	
	Refrigeration		*Steam*	
	Gas		*Other*	
Types of Energy Used	*Electric*	56%	*Gas*	44%
	Other			

Energy Savings

O&M Savings	50,400 kWh
Capital Savings	None
Comments	None

Utility Information

Utility Involved (Y/N)	No
Utility Name	Umatilla Electric Cooperative
Incentive Provided (Y/N)	No

Table 28. Site Visit Report – W-007

Company Information		Evaluation Information		CEI Information	
Company	W-007	Evaluation By	Randy McCall	Stage of Engagement	Stage 4 Practicing
Location	WA	Evaluation Date	2/10/2010	Date Current Stage Reached	9/30/2009
NAICS Code	311			Date of Current Envinta	March 2008

Facility Details	
Description of Actions taken	
O&M Projects	1. Shut Down One Compressor (65hp). Reduce the use of 3 compressors to two by keeping the air system with minimal leaks 2. Replace Rotary Screen (Contra shear) with stationary screens 3. Energy efficient spray nozzle replacement to prep condensers for efficient operation
Capital Projects	1. Replace Metal Halide 400w with T5HO- 4 bulb lights. Replace 400w metal halide lights with energy efficient T50HO 4 bulb fluorescent fixtures
Number of Employees	187
Product Manufactured	Frozen vegetables
Production Process	Blanching, freezing and packaging
Production Trends	Season starts roughly June 1, and runs through about Dec 1; rework during off season
Metering in Place	Boiler feedwater, fresh & waste water, electric utility interval data, manual log for compressed air
Annual Operating Hours	7,400

Energy Use Details				
Annual Energy Use	*kWh*	28,968,960	*therms*	77,307
Energy Systems Breakdown	*Compressed Air*	35%	*Motors*	15%
	Refrigeration	50%	*Steam*	25%
	Gas		*Other*	
Types of Energy Used	*Electric*	70%	*Gas*	30%
	Other			

Energy Savings	
O&M Savings	2,290,296 kWh
Capital Savings	29,580 kWh
Comments	Other Projects: 1. Motor Replacement with pumps with VFD controls. Eliminated 5 each 10hp motors and replaced with 2 each 15hp pumps with VFD controls (documented and verified but not yet complete at time of site visit) 2. Hydraulic Room Controller - VFD

Utility Information	
Utility Involved (Y/N)	Yes
Utility Name	Grant County PUD

Incentive Provided (Y/N)	Yes

Table 29. Site Visit Report – O-003

Company Information		Evaluation Information		CEI Information	
Company	O-003	Evaluation By	Randy McCall	Stage of Engagement	Stage 5 Sustaining
Location	OR	Evaluation Date	3/4/2010	Date Current Stage Reached	12/3/2009
NAICS Code	311			Date of Current Envinta	February 2009

Facility Details					
Description of Actions taken					
O&M Projects	1. Shift to 4 day work week during off-season				
Capital Projects	None				
Number of Employees	628				
Product Manufactured	Vegetables				
Production Process	Canning and some freezing				
Production Trends					
Metering in Place					
Annual Operating Hours	3,300				
Energy Use Details					
Annual Energy Use		*kWh*	2,842,790	*therms*	475,683
Energy Systems Breakdown		*Compressed Air*		*Motors*	
		Refrigeration		*Steam*	
		Gas		*Other*	
Types of Energy Used		*Electric*	21%	*Gas*	79%
		Other			
Energy Savings					
O&M Savings	10,860 kWh				
Capital Savings	None				
Comments	None				
Utility Information					
Utility Involved (Y/N)	No				
Utility Name	Portland General Electric				
Incentive Provided (Y/N)	No				

Table 30. Site Visit Report – O-008

Company Information		Evaluation Information		CEI Information	
Company	O-008	Evaluation By	Randy McCall	Stage of Engagement	Stage 5 Sustaining
Location	OR	Evaluation Date	3/4/2010	Date Current Stage Reached	11/9/2009
NAICS Code	311			Date of Current Envinta	February 2009

Facility Details					
Description of Actions taken					
O&M Projects	1. Leak detection and repair program for 2008, Completed 12/2/2008.				
Capital Projects	1. Replace Joy compressor with a VFD compressor.				
Number of Employees	838				
Product Manufactured	Fruit products				
Production Process	Concentrate line, fruit flake line, formulated line, berry fresh pack in summer				
Production Trends					
Metering in Place					
Annual Operating Hours	3,700				
Energy Use Details					
Annual Energy Use		*kWh*	19,586,105	*therms*	69,712
Energy Systems Breakdown		*Compressed Air*		*Motors*	
		Refrigeration		*Steam*	
		Gas		*Other*	
Types of Energy Used		*Electric*	13%	*Gas*	87%
		Other			
Energy Savings					
O&M Savings	123,900 kWh				
Capital Savings	75,600 kWh				
Comments	None				
Utility Information					
Utility Involved (Y/N)	Yes				
Utility Name	Portland General Electric				
Incentive Provided (Y/N)	Yes				

Appendix C. A Review of Market Effects (2005-2010) Memorandum

The Industrial Sector Initiative:

A Review of Market Effects (2005-2010)

Prepared for
The Northwest Energy Efficiency Alliance

Prepared by
The Cadmus Group, Inc. / Energy Services
720 SW Washington Street, Suite 400
Portland, OR 97205
503-228-2992

May 17, 2010

Introduction

The Cadmus Group, Inc., (Cadmus) has been the third-party evaluation contractor for the Initiative of the Northwest Energy Efficiency Alliance (NEEA) since the Initiative was launched in 2005. Cadmus (formerly Quantec, LLC) has been tracking the implementation of the initiative and reporting its progress and accomplishments to NEEA through formal market evaluation reports (MPERs), *ad hoc* briefings, and memoranda.

In this report, Cadmus offers a brief account of the Initiative's progress and empirical market effects over the past five years. This report describes the original intent, strategic vision, goals, and the evolution of the Initiative from the perspective of an independent evaluator. It then identifies key options available to NEEA as it formulates a future direction and market strategy for the Initiative. Our purpose for this review is to provide additional perspective on the history of the Initiative and to offer a vantage point for NEEA as it evaluates alternative paths for the Initiative's future. The observations and conclusions in this report derive from existing evaluation data and documents, including MPERs, and recent informal interviews with the Initiative's implementation staff and conservation resources staff at the Northwest Power and Conservation Council (the Council).

Background

In July 2004, NEEA's board of directors approved funding for a five-year project designed to improve energy management practices and to stimulate demand for energy-efficient products and services in the Northwest's industrial sector. The result was the Industrial Efficiency Alliance (IEA), which was renamed the Initiative later.

NEEA was motivated to create the Initiative by market research that indicated the following:

1. There was significant potential for energy efficiency in the regional industrial market, and
2. There was little evidence of market development for industrial energy-efficiency products and services.

Potential for Energy Efficiency

NEEA noted that the industrial sector was a large regional economic driver and employer as well as a major energy consumer that had significant energy conservation potential. Data from the Northwest Power and Conservation Council (Council) indicated that industry consumed 27 percent of the region's non-DSI (direct service industry) electricity. The Council's forecasts also indicated industrial sector loads were expected to grow at an annual rate of nearly 1.6 percent through 2025. In addition, energy conservation potential studies had estimated that Northwest industries could achieve significant energy conservation (as much as 23 percent) at the end-use level.

Opportunities for Market Development

NEEA found little evidence of market development for energy-efficiency products and services in the industrial sector. In 2004, market transformation literature had shown that the industrial

sector appeared reluctant to invest in energy-efficiency improvements, even when such investments yielded returns that were similar to, if not higher than, other investments.

Strategic Goals of the Initiative

NEEA designed the Initiative to overcome or mitigate the market barriers that were believed to impede the adoption of good energy management practices in the sector. These barriers were primarily a lack of awareness and technical knowledge; a shortage of—and, in some cases, an absence of—a specialized network of trade allies; and an inadequate or non-existent delivery structure for energy-efficient products and services. The Initiative's strategic plan highlighted two goals:

1. Make energy management a more integral part of the process at the corporate and plant levels where decisions are made regarding facility expansions, improvements, and operations within targeted vertical markets. This change would create a natural demand for systems-oriented efficiency improvements.
2. Transform the market for industrial equipment and service suppliers so that they could better provide and actively promote systems optimization services and products to their end customers.

By working directly with firms and their trade allies, the Initiative aimed to foster a natural, market-based demand for system-oriented energy improvements with the goal of making continuous energy improvement (CEI) a routine part of management and operation for the Northwest's industrial firms. The Initiative designed a two-pronged intervention strategy consisting of (1) a vertical market-oriented approach, and (2) a cross-cutting systems-oriented approach.

Employing a Vertical Market Intervention Approach

The vertical market intervention incorporated a bottom-up (plant- and employee-level) component designed to stimulate demand at the plant level and a top-down (corporate-level) component designed to increase executive commitment, leadership, and financial resources that supported energy management. At the same time, demonstrations and case studies showcased tangible energy savings results from adopting energy-efficient products and technologies.

Employing a Cross-Cutting, System-Oriented Approach

The cross-cutting, systems-oriented market interventions aimed to build the necessary infrastructure to support market development for energy management products and services. NEEA relied on training and education to address a facility's technical needs for systems-oriented energy management. NEEA employed a concurrent effort related to channel management, encouraging trade allies to develop services that supported energy management needs. As with the vertical market counterpart, NEEA reinforced the concept of incorporating systems-oriented energy management by using demonstrations and case studies that exemplified energy saving results.

In 2006, the Initiative began revising its implementation strategy based on additional market research, new program logic models, and an internal assessment of implementation procedures. The revised strategy eliminated the cross-cutting component and instead began placing greater emphasis on more focused trainings. Accordingly, resources were diverted into developing more

industry-specific tools and staff support to better align the Initiative's products with specific market needs.

Measuring Performance

NEEA developed a set of key performance indicators (KPIs) to measure program impact and activity. These KPIs provided the principal link between implementation and the resulting market effects and, ultimately, energy savings. KPIs tracked progress on training, business practices, market coordination, channel management, and product and services development. Measurement data came from surveys (market partner, target audience and training follow-up), staff interviews, and site visits.

Industry-Specific Efforts

To narrow its focus, the Initiative targeted the pulp and paper industries and the food processing industries, due to their strong regional presence, large energy demand, broad economic contribution, differing corporate structure and plant sizes, and savings potentials.

- Pulp and paper, was characterized by a small number of vertically organized businesses (28) that produced 10 percent of all national pulp and paper sales.
- Food processing in the Northwest comprised numerous firms with a wide range of corporate structures and sizes and had the largest share of the region's industrial capital expenditure. This industry also benefitted from a strong and active local association, the Northwest Food Processers Association (NWFPA), which could serve as an effective conduit for marketing communications.

Together, the two industries accounted for nearly 20 percent of the Northwest's aggregate industrial electricity use. Much of this energy was expended on motor systems, facility lighting and HVAC, operations and maintenance, and refrigeration.

KPIs, Targets, and Progress

To monitor progress, NEEA set five- and ten-year performance targets for the Initiative as well as 33 KPIs at the outset of the program. The performance indicators included a cumulative electricity savings target of 130 aMW by 2015, of which 35 percent (45 aMW) would be achieved in the first five years.

As the program evolved over five years, the Initiative revised both the energy saving targets and various KPIs to reflect the market conditions more realistically. For example, as it became clear that the five-year 45aMW energy savings goal was not realistic, the savings target dropped to 20 aMW. Also, the Initiative condensed the original 33 KPIs to six Market Progress Indicators (MPIs) that were considered better measures of the Initiative's progress:

- MPI 1: Percent of large food processing firms (as measured in terms of employment share) and pulp and paper firms (as measured in terms of output capacity) that implement CEI.
- MPI 2: Percent of industrial firms from non-targeted markets that implement CEI.
- MPI 3: Number of large (multi-facility) food processing or pulp and paper firms that adopt CEI in plants or mills without Initiative involvement.

- MPI 4: Number of large food processing or pulp and paper firms that adopt CEI in plants or mills outside the Northwest.
- MPI 5: Percent of Northwest utility representatives that promote CEI as part of their energy efficiency activities.
- MPI 6: Trade associations in the target markets promote CEI.

The progress measurement activities to date have focused on MPI 1, MPI 5, and MPI 6 as these indicators are more easily tracked by the Initiative. For the 2010 MPER, Cadmus will collect and analyze data measuring progress on MPI 2, MPI 3, and MPI 4.

Current Situation

NEEA has completed the five-year project and is at a point now where it must determine how best to build upon the Initiative's success. As NEEA develops the strategy for the next five years (2010-14), they face a number of questions about the future direction of the program.

- Should the Initiative continue its current vertically oriented outreach program targeting new facilities/companies and industries but, perhaps, with more intensive energy management programs?
- Should the cross-cutting components be expanded to integrate current outreach efforts with knowledge transfer, training, and educational outreach?
- Should NEEA create new programmatic initiatives that leverage the market transformation effects for which the Initiative has been responsible?
- Should a hybrid approach be adopted that incorporates vertical and cross-cutting measures targeting the broader industrial market?

As NEEA grapples with these questions, it is instructive to consider the accomplishments and empirical market effects of the Initiative during its first years of operation.

Findings

The results of the independent evaluation of the Initiative over the past five years indicate different outcomes in the two target markets. While the food processing market showed success, as discussed in the next section, the pulp and paper market did not show the same progress due to a number of factors:

- First, Cadmus noted in MPER#1 that based on evaluation results, as well as national statistics available from the Department of Energy - Energy Information Administration, the pulp and paper industry had already shown a trend in decreasing energy intensity, perhaps indicating a higher awareness and knowledge of energy efficiency practices.
- Second, the industry was impacted by the economic downturn, which resulted in production curtailment and plant closures.
- Third, many regional mills are owned by companies with headquarters outside the Northwest, making it difficult to gain corporate buy-in for CEI.

- Finally, the absence of a strong regional association made it difficult to reach the regional industry in a consistent and lasting manner.

As such, the Initiative shifted their focus in 2009 to the food processing industry and backed away from actively pursuing pulp and paper participants. Due to this change in strategy, the evaluation also recently shifted focus to the food processing industry as well.

The Initiative has shown much more success with the food processing industry and has made progress with MPI1 (target market firms practicing CEI), MPI 5 (utility promotion of CEI), and MPI 6 (coordination with NWFPA). In MPER# 5 published in May 2009, Cadmus reported that nearly 20 percent of the food processing target market, as measured in terms of total employment, was implementing CEI, suggesting the Initiative would exceed its stated MPI 1 target of 13 percent of large food processors practicing CEI by December 2009.[15] In regards to MPI 5, the 2009 Utility Survey indicated that almost all utilities understood CEI and over half of the utility respondents promoted some version of CEI. In regards to MPI 6, the NWFPA has adopted aggressive energy intensity targets for its members.

The most compelling evidence of the Initiative's success in the food processing sector is found in (1) the response of the target audience and market partners to the Initiative, and (2) the impact of the Initiative on regional energy planning and policy. These results are summarized below.

Response of End-Users

Cadmus has conducted annual Target Audience Follow-Up (TAFU) interviews with Initiative participants since 2006. The interviews were designed to (1) collect participants' feedback regarding their involvement in the Initiative and (2) determine the Initiative's role in the participants' decisions to implement Continuous Energy Improvement (CEI) at their plants.

In 2006, the Initiative had 11 industrial plants (including two pulp and paper and nine food processing plants) classified as participants, and Cadmus interviewed eight of them. Cadmus found that the most important overarching issues for industrial end users were staying competitive and reducing operating costs, including energy costs. With respect to energy management, six interviewees indicated they had formal energy management plans, and most interviewees indicated they held formal discussions on energy usage and CEI with staff. Only half of the participants mentioned data tracking, and most noted that data tracking was only discussed on a monthly or annual basis. Participants also indicated that they valued the Initiative and relied on the face-to-face meetings with Initiative staff to advance energy management within their firm. The 2006 TAFU results also indicated that participants were not coordinating with their utility and that the Initiative was not leveraging utility resources to spread the word about the Initiative.

By May 2009, participation in the food processing market had grown to 21 plants that were practicing CEI at Stage 3 (Committed or higher). In Cadmus' interviews with 18 of these participants, Cadmus determined that some issues (such as the industrial end user's interest in

[15] The market penetration percentage in the food processing market is defined in terms of the total number of employees at plants with 250 or more employees at an Engagement Stage of 3 or higher, relative to the total number of employees in the target market (41,765).

staying competitive and reducing costs) stayed constant since the first TAFU interviews. Industrial end users continue to face a tight market, where capital and time constraints limit a firm's ability to focus on energy efficiency.

However, the 2009 TAFU, which focused on the food processing market, also revealed a markedly evolved participant profile. Of the 18 participants Cadmus interviewed, the majority indicated they had an energy champion, an energy action plan, and some type of data tracking plan in place. More than half of the firms were able to quantify energy savings related to their capital and operations and maintenance (O&M) efficiency projects. The Initiative also made progress in improving end user and utility relationships; all but one of the 2009 interviewees rated their relationship with their utility as good or very good, and eight interviewees noted that their relationships improved after engaging with the Initiative. Cadmus' surveys revealed that 15 of the 18 interviewed participants fully grasped the CEI concept and its value. Cadmus also found that the majority of the facilities practicing CEI attributed their decision to NEEA, the Initiative, and/or the Initiative's implementation team.

Impact on the Industrial Market

Cadmus' evaluation results also indicated that the Initiative has been successful in influencing and bringing about lasting changes in the Northwest's industrial energy-efficiency market. We specifically note the Initiative's influence in catalyzing the adoption of energy-tracking and goal-setting practices by the NWFPA. Due in part to the Initiative's regional work, energy efficiency has become a priority in the Northwest's food processing market, as the NWFPA launched a program in 2008 to set a goal of lowering energy intensity in the regional food processing industry by 50 percent over the next 20 years. While participation in the energy intensity reduction goals is voluntary, the NWFPA has devoted considerable resources to promote the program and to assist its members with energy efficiency. Recent reports indicate many of the association's member plants have volunteered data to help the NWFPA establish a baseline for energy intensity among its membership.

Utilities

In addition to participant surveys, Cadmus conducted annual surveys of utilities to gain insight on their awareness of and response to the Initiative's presence and activities in the regional industrial market. The first utility survey, conducted in 2006, highlighted a number of problem areas in the relationships between the Initiative, the regional utilities, and the market partner organizations. These problem areas included poor communication, a limited understanding of the Initiative's role, lack of familiarity with the Initiative's goals, and the perception that the Initiative was competing with utilities' own Demand Side Management (DSM) programs. Specifically, Cadmus found:

- Utility respondents reported the Initiative's directors did not make sufficient effort to coordinate the Initiative work with local utilities, resulting in general confusion among utilities and (in a few cases) strained relationships.

Several utilities noted they were not adequately informed about the goals and strategic intent of the Initiative and at least eight of 18 utilities noted they felt the Initiative was in direct competition to their programs.

- Only 40 percent of the respondents were familiar with the Initiative and its energy management offerings.

To address these challenges, the Initiative team (led by the Initiative's Utility Coordinator) made a concerted effort to shift its perspective to recognize utilities as a specialized target audience. The Initiative's revised approach paid off, as revealed in the next utility survey in 2007. Improvements were shown in increased familiarity with the Initiative, better communication, an appreciation of the Initiative's role in helping them to do their jobs, and a markedly more positive attitude toward their relationships with the Initiative.

Specifically, Cadmus' surveys noted the following:

- Utilities reported noticeable improvement in the communication between the Initiative and utilities, especially regarding the Initiative's direct contact and interactions with utility customers. Fourteen of the sixteen utility respondents (88 percent) regarded the quality of these communications as either ―good" or ―excellent."
- Fifteen of the 16 respondents (94 percent) no longer perceived the Initiative as being in conflict with utility conservation programs' goals and objectives.
- Over 80 percent of respondents reported being ―familiar" or ―very familiar" with the Initiative.

While overall relationships had improved by the 2007 survey, utilities still had limited understanding of the CEI concept, thus, the Initiative was tasked with increasing utility understanding and promotion of CEI among its utility partners.

Measurable transformation in the industrial energy management market was noted in 2008, when surveys revealed that nearly all interviewed utilities were familiar with CEI, and a majority was able to articulate the concept of CEI. Also in 2008, 37 percent of utility respondents reported they promoted the Initiative's CEI.

By the end of 2009, many of the public utilities and major investor-owned utilities in the region had begun offering products similar to CEI, particularly improved operation and maintenance practices, as part of their resource acquisition programs.

Training Activities

In addition to direct promotion of CEI among industrial end users and coordination with utilities, the Initiative has supported training events for four end-use systems: refrigeration, pumps, motors, and compressed air. After the 2007 and 2008 trainings, Cadmus conducted follow-up surveys to elicit feedback from attendees. Survey respondents overwhelmingly noted that the trainings increased awareness and knowledge of energy-efficiency opportunities. A majority of training attendees also reported that they implemented projects or made changes as a direct result of the trainings. In end-user and utility interviews, the Initiative's trainings were generally noted as a very useful and productive regional activity.

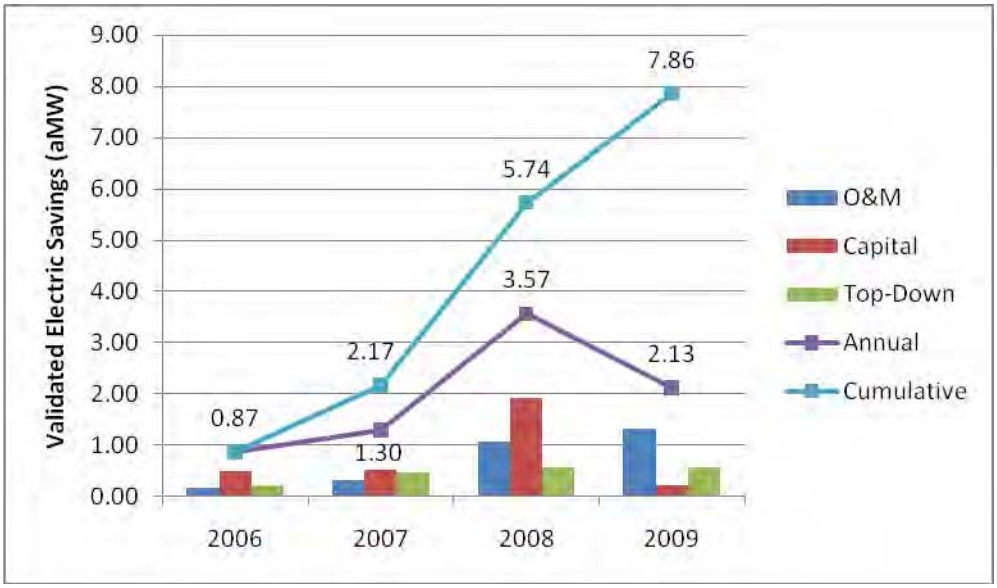
Energy Savings

The implementation of CEI among participant firms also resulted in measurable electricity and natural gas savings due to improved O&M practices and capital investments induced by the Initiative. Cadmus validated measure-level energy savings at participant plants from 2006 through 2009. In 2009, Cadmus also began evaluating facility-wide (top-down) energy savings

claims to capture savings from behavioral changes, as well as O&M and capital improvements that were not quantified at the measure level. To date, Cadmus has validated 5.65 aMW of electric savings at 26 food processing facilities and 2.22 aMW of electric energy savings at 4 pulp and paper facilities[16]. In addition, Cadmus has validated over 4 million therms of natural gas savings at 12 food processing facilities.

As **Figure 10.1** illustrates, an upward trend in annual validated measure-level savings occurred from 2006-2008, with a drop in 2009. The decrease in validated savings in 2009 was largely attributable to cutbacks in capital projects, most likely due to the general economic downturn. The records in the Initiative's tracking system (ITS) lists several projects that were completed but not evaluated because of a lack of documentation or the fact that savings were hard to quantify. Anecdotal information from site visits also indicates that a number of projects were completed at several plants, but were not documented through ITS. Evaluation of the outstanding measures and accounting for undocumented projects will no doubt show appreciably higher savings for 2009.

Figure 2. Validated Electric Savings by Year and Category (2006-2009)



Cadmus' validation results also showed that savings from improved operation and maintenance practices, which are the mainstay of the Initiative, have steadily increased over time. For the first three program years (2006-2008), a majority of validated electric savings originated from capital projects. In 2009, O&M improvements accounted for most of the validated savings. This shift is further evidence of the integration of CEI into the Northwest industrial market.

The evaluation results indicate the Initiative's electricity savings fell short of the revised target of 20 aMW. The variance between the actual and target savings is at least partly explained by three factors.

[16] Due to rounding, the sum of individual target market savings may not match total savings.

- First, as discussed earlier, are the potential savings from unreported projects and savings from projects which were reported but have not yet been validated.
- Second, there is reason to believe that the initial goal of 20 aMW might have been aggressive, particularly in the pulp and paper industry, for reasons already discussed in the Findings section above.
- More importantly, as we will discuss later in this document, the evaluation methods used for validating savings did not account for all possible market effects of the Initiative.

Regional Energy Efficiency Policy

The recognition in the Northwest's Sixth Power Plan of CEI as an energy-efficiency measure with savings that can be validated is, perhaps, the Initiative's most far-reaching achievement. Prompted in no small part by the results of the research conducted under the Initiative, in 2008 the Council issued an RFP to investigate the savings opportunities in industrial facilities. As anticipated by the Initiative, this assessment found that there are significant savings opportunities from energy optimization measures in addition to discrete equipment upgrades. As a result, the industrial supply curves for the Sixth Power Plan include savings from such optimization activities, including demand-side assessment; proper design, sizing, and/or reconfigurations to match supply to demand; system "commissioning"; sustainable O&M; and supporting management practices.[17]

The activities relating to energy optimization type measures were grouped into three tiers of measure bundles for the Sixth Plan. In order of comprehensiveness, these bundles are: Plant Energy Management, Energy Project Management and Integrated Plant Energy Management. Each higher tier is inclusive of all measures in the lower tiers. The "Integrated Plant Energy Management" level of savings, which encompasses systematic systems management practices, is comparable to the end goal of NEEA's CEI program (Stage 5: Sustaining).

The regional 20-year achievable potential from these measures was 245 aMW, with a levelized cost less than $0.05/kWh. This constitutes about one-third of the projected total energy-efficiency potential in the industrial sector. Given this, regional entities such as the Bonneville Power Administration (which has electricity savings targets tied to the Sixth Power Plan) have or will be developing programs to capture these savings. BPA's Energy Smart Industrial (ESI) program, launched in October 2009, has a large focus on capturing savings from energy management activities such as those historically promoted by the Initiative. Other utilities, particularly those under Washington I-937 rules, are also considering adoption of similar types of programs for their industrial customers. The results from the 2009 utility survey supported this trend, as at least seven utilities noted they are moving either to adopt BPA's or to develop their own program.

[17] From "System Optimization Measures Guide", prepared for Charlie Grist; Strategic Energy Group, March 23, 2009.

Initiative's Plans for the Future

The Initiative is now at a point where it must determine how best to proceed and build upon its success. NEEA faces fundamental questions about the future direction of the Initiative. As noted on pages 3 and 4 of this memo, the key questions are:

- Should NEEA continue its current, vertically oriented outreach program targeting new facilities/companies and industries, but with perhaps more intensive energy management programs?
- Should it expand its cross-cutting programs that integrate current outreach efforts with knowledge transfer, training and educational outreach?
- Should it create new program initiatives that capitalize on the market transformation trends for which the Initiative has been responsible?
- Should it create a hybrid that incorporates vertical and cross-cutting measures with the broader market transformation trends?

To address these issues, NEEA is considering a three-dimensional vehicle consisting of:

1. Collaborative Energy Strategies (CES)
2. Strategic Energy Management (SEM)
3. Regional Technical Services (RTS)

Each dimension has an important role to play in the Initiative's ability to continue to achieve effective and verifiable transformation of the industrial energy market. At the broadest level, CES brings together decision-makers in industry, utilities, and government entities to work together to devise strategies for improving energy efficiency across the industrial sector.

Next, SEM is designed to promote energy management by encouraging industrial firms to deploy a framework for documenting energy use, controlling energy costs and improving efficiency.

The third dimension is RTS, which relies on working with regional utilities to bring together industrial end users from across the region for exchange of technical information and training.

To date, the focus of the Initiative has been on CEI, which remains a major component of SEM. While NEEA needs to continue with certain elements of SEM, many utilities are (or are planning to) offer technical support and financial incentives for energy management practices. With a widespread adoption of CEI among utilities, the Initiative will have to shift its focus from CEI and concentrate instead on CES and RTS, activities that tap into NEEA's strengths and its unique position as an agent of market transformation in the Northwest's energy market.

In keeping with the Initiative's initial strategic intent, this shift will bring about a renewed emphasis on several critical services, which include the following:

- **Training and education** continues as an important NEEA role. Dissemination of information about energy-efficiency options and benefits (a previously identified market barrier) will remain as a necessary condition for adoption of energy-efficient options. Training and education can range from shop/facility level technical training to partnering with industry associations to develop curricula that can be disseminated across an industry. While awareness is increasing, there continues to be new technologies, equipment, and energy-efficiency concepts to be delivered to market participants at all levels.

- **Demonstrations/case studies** can continue to showcase energy management techniques and successful projects. While all investments are based on businesses' own risk profiles, providing examples of successful projects or demonstrating how investments in energy management can meets typical expectations for return on investment and help industrial firms overcome misperceptions concerning the value of energy efficiency.
- **Channel management** is another area that NEEA can help to extend the energy-efficiency market. The regional market infrastructure still lacks the expertise and number of service providers needed to support a developed market. Equipment dealers and support services (such as repair, installation, O&M) are needed, as are design, engineering, planning, and construction services to support the energy management market. NEEA should continue its role in communicating with manufacturers, professional and trade organizations, and labor organizations to provide information to and encourage development of the skills and the equipment for a well-functioning energy management market.
- **Utility partnering** will continue to be a critical service. In an increasingly resource- and energy-constrained world, utilities need support to help them slow (or possibly reverse) energy demand and consumption. Pressure is rising for utilities to implement conservation programs through mandated energy-efficiency targets similar to Washington's I-937 Initiative, renewable portfolio standard (RPS), and climate change regulations, which are forcing utilities to find new and innovative ways to influence energy consumption. Through the Initiative, NEEA can help utilities design and market superior products and programs by acting as a clearinghouse for information, research and development, and help in creating a much needed infrastructure for delivering CEI.
- **Trade ally and cross-industry collaboration** are already underway but the success of this effort could be expanded to other trade allies and industries. As it has done with the NWFPA, NEEA could identify and work with non-targeted industrial association, and the Initiative's CES would be an ideal platform for this purpose. NEEA could use CES to identify and coordinate outreach and intervention to trade allies and industries that are not familiar with the Initiative.

The main focus of these options is to reinforce and expand on the previous market transformation efforts of the Initiative. While NEEA has outlined a multi-dimensional platform that could be used to implement these options, successful market transformation requires NEEA to rethink and redeploy its resources in response to the emerging needs for energy information in the industrial sector.

Implications for Evaluation

As it evaluates alternative options for setting a future course for the Initiative, it is important for NEEA to consider appropriate methods for tracking the progress of the Initiative and measuring its performance, including how energy savings are measured. Currently, savings are validated through a two-part process. First, savings are estimated at the aggregate facility level, using a top-down, statistical modeling of energy demand. Second, measure-level impacts are validated through on-site inspection and expert evaluation. The difference between the two top-down and bottom up savings estimates represents energy savings attributable to behavior-based measures.

While the existing evaluation framework has enabled NEEA to gauge program impacts in participating facilities, it is not well suited for the evaluation of NEEA's efforts at transforming the industrial energy efficiency market. The current framework is based on methods designed for *ex post* validation of gross savings in resource acquisition programs. This method is less suitable for projecting the impacts of market transformation programs that focus principally on *ex ante* savings. The impact evaluation methods being used currently do not account for future indirect effects of the Initiative, including market diffusion within the target market, spillover to facilities in non-targeted markets and the adoption of CEI by utilities. Nor do these methods properly account for the energy saving impacts of other elements of the Initiative such as information and training. NEEA might be able to claim partial and indirect credit for the future energy savings of these activities given a different, more suitable evaluation framework.

A framework better suited for evaluating NEEA's market transformation efforts would be both forward-looking and broader in perspective, focusing on prospective indirect impacts in addition to direct impacts. A market diffusion model of industrial energy-efficiency measures and behaviors would better capture the true impacts of NEEA's industrial programs, including market diffusion within the target market, spillover into non-targeted markets and efforts at market transformation by other actors. Such a model would explicitly account for the dynamics of diffusion of information on energy-efficient options and practice. The model would also account for the profit-maximizing behavior by firms that are likely to lead to the adoption of energy-efficient practices. Such framework will allow NEEA to account properly for and claim credit for all savings attributable to the Initiative.

Conclusions

The Initiative was conceived by NEEA five years ago as a comprehensive effort to influence views on energy use and perceptions regarding energy efficiency among the Northwest's industrial firms. The Initiative aimed to bring about a lasting change in industrial energy use by making energy management integral to how industrial firms made their decisions about investing in new equipment and planned routine operation and maintenance.

As with all of NEEA's programs and initiatives, the progress of the Initiative was evaluated continuously for five years. The results of this on-going evaluation indicate the Initiative has largely achieved many of its initial goals in the food processing sector. This success is clearly demonstrated by the empirical evidence of change in attitudes and perceptions regarding the importance and value of energy management among industrial end users, trade allies, and market partners, particularly regional utilities. The most significant contribution of the Initiative to promoting energy efficiency in the region was, perhaps, the influence it had on the Northwest Power and Conservation Council's decision to include continuous energy improvement as a measure in the Sixth Regional Power Plan. This will almost certainly guarantee a widespread adoption of energy management practices in utility-sponsored energy-efficiency programs.

As NEEA charts a course for the Initiative's future, it needs to consider how to shift focus from direct marketing of continuous energy improvement to industrial end users, concentrating instead on broader market intervention strategies. These strategies include a renewed emphasis of education, training, research, development, and partnering with utilities to build an infrastructure for promoting and deployment of continuous energy improvement. These activities will be more difficult to monitor and their impacts will be more difficult to measure. To meet these

challenges, NEEA will also have to use methods better suited for measuring long-term market effects.

Appendix D. 2010 Survey Instruments

Target Audience Follow-Up (TAFU) Survey

Nonparticipant Survey

Market Partner Survey

Trade Ally Survey

Industrial Initiative 2010 Participant Survey

(MPER #6)

Research Objectives

The participant surveys will target food processing facilities. Cadmus will interview up to 15 program participants. The goals of the surveys are to gather information about:

- Persistence of measures and processes implemented in previous program years
- Future plans for reducing energy consumption
- Factors which influenced their decision to sustain CEI
- Projects which participating facilities have implemented on their own
- How the withdrawal of NEEA may affect CEI persistence

Results from previous surveys may be used to estimate the rate at which facilities reach Stage 3 or Stage 5. Cadmus will compile a list of facilities for interviews and submit it to NEEA for approval before contacting them.

Interviewer's Name: _____

Date: _____

INTERVIEWER: Fill in as much of the firmographics section as possible from database before conducting interview .

Introduction

i. Confirm Data [Enter Following Data Before Calling]
ii. Contact Name: _____
iii. Company: _____
iv. Phone Number: _____
v. NWFPA Member: Yes/No
vi. Year began engagement with NEEA: _____
vii. Level of engagement as of Jan 2010:_____

S. Screening

I would like to speak with [Contact Name]

Hello, my name is _____, and I am calling from The Cadmus Group on behalf of the Northwest Energy Efficiency Alliance or NEEA and the Northwest Food Processors Association (NWFPA). I believe [Ecos contact name] at Ecos let you know we would call. (If needed: This is not a sales call)

If same contact as in 2009: We are updating our 2009 study on how facilities engaged with NEEA's Industrial Initiative are managing their energy usage. We know we've contacted you a lot lately so we will try to make this quick. This will take approximately **20 minutes**. Do you have time to talk now or would another time be more convenient?

If different contact from 2009: This interview is part of our annual independent study of the Initiative and will update our 2009 study on how facilities are managing their energy use. This will take approximately **20 minutes**. Do you have time to talk now or would another time be more convenient?

Before we get started, I'd like to note that your responses are confidential and will only be reported in aggregate and individual facility responses will not be identified.

S1. According to our records your title is [TITLE]. Is this still correct?

S2. How do your job duties relate to energy use at your facility? **[THEY SHOULD ALL BE THE ENERGY CHAMPION, BUT WE ALSO WANT TO KNOW WHAT ELSE THEY DO]**

EM. Energy Management

The next few questions are focused on how your company manages energy.

[IF SAME CONTACT FROM 2009] Some of these questions are the same as last year, but we are asking them again because we want to be sure we have the most recent information.

[ASK IF NWFPA MEMBER]

EM0. NWFPA has a goal for their members to reduce energy intensity by 25% in 10 years. Is your facility taking steps to try to meet that goal?

1. Yes
2. Maybe in the future
3. No, was not aware of goal
4. No, was aware of goal but not participating –

-99. Don't Know

[ASK ALL]

EM1. What are your facility's specific goals (independent of the NWFPA goal) for reducing your energy intensity? **[BE SURE THEY INCLUDE A TIMEFRAME AND UNITS (E.G. PER POUND PRODUCTION]**

[IF THEY HAVE GOALS]

EM1a. What is your strategy to meet those goals?

EM2. How likely are you to meet the goal?

1. Not likely
2. Somewhat Likely
3. Likely
4. Very Likely

EM2a. What are the reasons for saying [INSERT RATING]?

[PULL LIST OF EQUIPMENT AND O&M MEASURES AND DATE INSTALLED FROM ITS AND FILL IN BELOW BEFORE CONDUCTING THE INTERVIEW]

The Industrial Initiative has provided us with a list of improvements you have made at your facility. [INTERVIEWER WILL REFER TO THE INDUSTRIAL INITIATIVE PROGRAM ACCORDING TO HOW THE RESPONDENT RECOGNIZES IT. THE INTERVIEWER WILL BE FAMILIAR WITH ALL OTHER NAMES OF THE INDUSTRIAL INITIATIVE AND NAMES OF PEOPLE INVOLVED.]

EM3a. We would like to go through a few of those changes to see if they are still in place.

Our records show that you have made several equipment upgrades including: [INSERT LIST BEFORE CONDUCTING INTERVIEW]

Are all of these still in place?

5. Yes **[GO TO EM4a]**
6. No **[GO TO EM3a1]**

-99. Don't Know **[GO TO EM4a]**

EM3a1. **[IF NO]** Which ones are no longer in place and what were the reasons for removing the equipment?

[FOR EM4 INSERT INDIVIDUAL O&M MEASURES]

Now I'm going to go through a couple of O&M improvements we have in our records.

EM4a. The first one I have down is [_____] in 200__. Is that change still in place?

7. Yes **[GO TO EM4b]**
8. No **[ASK EM4a1]**

-99. Don't Know **[GO TO EM4b]**

[IF EM4a = No]

EM4a1. What were the reasons for not continuing this activity? **[MULTIPLE RESPONSE; DO NOT READ]**

9. (Expensive to maintain)
10. (Do not have technical skills to maintain)
11. (Management did not support)
12. (Other priorities demand resources)

-77. (Other [SPECIFY: _____])

-99. (Don't know)

EM4b. The next one I have down is [_____] in 200__. Is that change still in place?

13. Yes **[GO TO EM4c]**
14. No **[GO TO EM4b1]**
-99. Don't Know **[GO TO EM4c]**

[IF EM4b = No]

EM4b1. What were the reasons for not continuing this activity? **[MULTIPLE RESPONSE; DO NOT READ]**

15. (Expensive to maintain)
16. (Do not have technical skills to maintain)
17. (Management did not support)
18. (Other priorities demand resources)
-77. (Other [SPECIFY: _____])
-99. (Don't know)

EM4c. The next one I have down is [_____] in 200__. Is that change still in place?

19. Yes **[GO TO EM4d]**
20. No **[GO TO EM4c1]**
-99. Don't Know **[GO TO EM4d]**

[IF EM4c = No]

EM4c1. What were the reasons for not continuing this activity? **[MULTIPLE RESPONSE; DO NOT READ]**

21. (Expensive to maintain)
22. (Do not have technical skills to maintain)
23. (Management did not support)
24. (Other priorities demand resources)
-77. (Other [SPECIFY: _____])
-99. (Don't know)

EM4d. The next one I have down is [_____] in 200__. Is that change still in place?

25. Yes **[GO TO EM5]**
26. No **[GO TO EM4d1]**
-99. Don't Know **[GO TO EM5]**

[IF EM4d = No]

EM4d1. What were the reasons for not continuing this activity? **[MULTIPLE RESPONSE; DO NOT READ]**

27. (Expensive to maintain)
28. (Do not have technical skills to maintain)
29. (Management did not support)
30. (Other priorities demand resources)
-77. (Other [SPECIFY: _____])
-99. (Don't know)

Our records indicate that you have also completed these O&M projects: [INSERT LIST BEFORE CONDUCTING INTERVIEW]

EM5. Have you implemented any other energy related projects in addition to the ones we've discussed?

31. Yes **[GO TO EM5a]**
32. No **[GO TO EM6]**
33. -99. Don't know **[GO TO EM6]**

[IF EM5 = Yes]

EM5a. What other projects have you implemented? **[ASK THEM TO BE SPECIFIC; PROBE FOR O&M]**

EM5a1. What motivated you to implement these projects?

[IF EM5 = Yes]

EM5b. Did you receive technical assistance for any of these additional projects you mentioned?

34. Yes
35. No
-99. Don't know

[IF EM5b = yes to any]

EM5b1. Who provided assistance? **[DO NOT PROMPT, MULTIPLE RESPONSES POSSIBLE]**

1. NEEA/ Ecos
2. NWFPA
3. BPA/Cascade Energy Engineering/Strategic Energy Group/Evergreen Consulting
4. ETO
5. Utility: [SPECIFY:_____]
6. Equipment distributor/manufacturer
7. Energy consulting firm (e.g. Global Energy Partners, Fluid, others): SPECIFY
8. State energy agency (e.g. ODOE, WSU energy extension program, Idaho Dept of Energy Resources, Montana Dept of Environmental Affairs): [SPECIFY:_____]

-77. Other [SPECIFY: _____]

[IF EM5 = Yes]

EM5c. Did you receive a tax credit, incentive or rebate for any of the projects you mentioned?

36. Yes, tax credit (federal and/or state)
37. Yes, incentive or rebate
38. No
39. Don't know

[IF EM5c =2]

EM5c1. Who provided the incentive? **[DO NOT PROMPT]**

1. ETO
2. BPA
3. Pacific Power
4. Tacoma Power
5. Puget Sound Energy
6. Snohomish County PUD
7. Grays Harbor PUD
8. Idaho Power

-77. Other: [SPECIFY:_____]

-99. Don't know

[ASK ALL]

EM6. What information do you rely upon to tell you if a piece of equipment or O&M practice is energy efficient? **[IF NEEDED:** This could be written information or people or experience.**]**

40. Efficiency rating or label of equipment
41. Equipment dealer said it was efficient
42. Personal experience
43. Met utility rebate requirements
-77. Other: SPECIFY
-99. Don't Know

EM7. In your opinion, how successful has your facility been in integrating energy management into their business practices? **[READ OPTIONS 1-4]**

44. not successful
45. somewhat successful
46. successful
47. very successful
-99. Don't know **[GO TO EM8]**

EM7a. What are your reasons for saying [INSERT RATING]?

EM8. Has implementing energy management practices at the facility had an impact on employee perceptions about energy conservation?

1. Yes **[GO TO EM8a]**
2. No **[GO TO EM8a]**
-99. Don't know **[GO TO EM9]**

EM8a. Can you explain? **[IF EM8=yes, ask for examples]**

EM9. Have the energy projects that we've discussed provided benefits beyond energy savings?

1. Yes **[GO TO EM9a]**
2. No **[GO TO EM9a]**
-99. Don't know **[GO TO EM10]**

EM9a. Can you explain**? [IF EM9=yes, ask for examples]**

EM10. On a scale of 1 to 5, where 1 is not at all and 5 is completely, currently how much do you rely on Initiative staff or Ecos for providing assistance for energy management projects at your facility?

ID. Information Dissemination

[ASK ALL]

The next three questions focus on your interactions and communications regarding energy efficiency and behavioral change within and outside your company.

ID1. Outside of your company staff, who would you go to first to talk about improving energy efficiency at your facility? **[DO NOT READ RESPONSES. DO NOT ACCEPT Staff names without checking their affiliation and role].**

1. NEEA
2. NWFPA
3. BPA
4. ETO
5. Utility [SPECIFY:_____]
6. Equipment distributor
7. Energy consulting company [SPECIFY:_____]
8. State energy agency [SPECIFY:_____]
9. Trade Conference [SPECIFY:_____]
10. Ecos

-77. Other: [SPECIFY:_____]

ID2. Who else would you to talk about improving energy efficiency at your facility? **[DO NOT READ RESPONSES. DO NOT ACCEPT Staff names without checking their affiliation and role].**

1. NEEA
2. NWFPA
3. BPA
4. ETO
5. Utility [SPECIFY:_____]
6. Equipment distributor
7. Energy consulting company [SPECIFY:_____]
8. State energy agency [SPECIFY:_____ _____]
9. Trade Conference [SPECIFY:_____]
10. Ecos

-77. Other: [SPECIFY:_____]

ID3. How often do you discuss energy management techniques with colleagues at different facilities within your company? **[READ RESPONSES]**

1. Never
2. Rarely
3. Occasionally
4. Often
5. Very often

ID3. How often do you discuss energy management techniques with colleagues outside of your company? **[READ RESPONSES]**

1. Never
2. Rarely
3. Occasionally
4. Often
5. Very often

ID4. If the Industrial Initiative were to disappear, what would happen to energy management at your company?

ID4a. What resources would you need to continue managing energy successfully?

[END INTERVIEW] Thank you for your time. Do you have any questions?

Industrial Initiative Nonparticipant Survey 2010

MPER #6

Research Objectives

Conducting non-participant surveys will be a critical step in quantifying the impact of the Industrial Initiative on non-participating facilities. The surveys will be used to establish the timing and extent of adoption of CEI and other energy management practices in non-participating facilities. The surveys will target approximately 55 non-participating facilities in the food processing industry to achieve +/- 10 percent precision with 90 percent confidence. The surveys will cover the following topics:

- What are facilities' current perceptions of energy efficiency? Does their definition of energy efficiency and energy management coincide with NEEA's definition?
- Are the facilities aware of CEI practices? If so, how and when did they become aware?
- Are facilities implementing elements of CEI? If yes, why did they decide to implement CEI?
- Did they adopt CEI on their own? Or did they receive assistance? From whom did they receive assistance? What kind of assistance did they receive?
- Will the facilities consider energy efficient equipment and practices in their plans for plant upgrades? What sort of energy efficient improvements are they planning?

Interviewer's Name:

Date:

INTERVIEWER: Fill in as much of the firmographics section as possible from database before conducting interview.

Introduction

viii. Confirm Data [Enter Following Data Before Calling]
ix. Contact Name: _____
x. Company: _____
xi. Phone Number: _____
xii. NWFPA Member: Yes/No

S. Screening

Hello, my name is _____, and I am calling from The Cadmus Group, an energy consulting firm in Portland, Oregon. I am calling on behalf of the Northwest Energy Efficiency Alliance and the Northwest Food Processors Association to perform a study on energy practices at food processing facilities. This is not a sales call. I would like to speak with [Contact Name], or May I speak with [designated respondent] or with the person who is responsible for overseeing food processing equipment [food processing operations] for your facility?

IF REACH CORRECT PERSON: We are doing a study on how the food processing sector thinks about and uses energy. Your responses will benefit the food processors in the region by informing NEEA and NWFPA in how best to aid facilities in reducing energy use. Do you have some time to answer a few questions? Your responses will be kept strictly confidential and only reported in aggregate.

Timing: 15 minutes?

S1. Would you please tell me your title at (name of company)?

S1a. How long have you worked at (name of company)?

S2. What are some of your key responsibilities at the facility? [Probe for answers related to making decisions about equipment upgrades, production efficiency, energy efficiency, tracking energy, etc. If they say they track energy follow up with "how do you track energy?"]

S3. Which electric utility serves your facility?

AW. Awareness and Timing

For the purposes of this survey, energy management practices includes activities such as purchasing efficient equipment, tracking your energy bills, efficient operating and maintenance practices and training your personnel in managing energy or to operate your equipment efficiently. Before I continue, do you have any questions for me, particularly about the definition of "energy management practices?"

AW0. How aware is your facility about energy management practices, with 1 indicating not at all aware and 5 indicating very aware?

> AW0a. Can you explain why you gave that rating [Probe to get at what they know about energy efficient equipment and operating practices]?

[IF AW0 =1 (not aware) then terminate survey]

AW1. When did you first learn about energy efficient equipment?

1. 2010 (< 1 year ago)
2. 2009 (approximately 1 year ago)
3. 2008 (approximately 2 years ago)
4. 2007 (approximately 3 years ago)
5. Before 2007 (more than 3 years ago)

-99. Never learned about energy efficient equipment

AW2. When did you first learn about energy efficient operating practices, for example turning equipment or lights off when not in use, maintaining equipment so that it runs efficiently, checking for air leaks, etc

1. 2010 (< 1 year ago)
2. 2009 (approximately 1 year ago)
3. 2008 (approximately 2 years ago)
4. 2007 (approximately 3 years ago)
5. Before 2007 (more than 3 years ago)

-99. Never learned about efficient operating practices

AW3. How did you first learn about energy management practices? **[MULTIPLE RESPONSE; DO NOT READ]** *[DO NOT ACCEPT Staff names without checking their affiliation and role]*.

11. NEEA
12. NWFPA
13. BPA
14. ETO
15. Utility [SPECIFY:_____]
16. Equipment distributor
17. Energy consulting company [SPECIFY:_____]
18. State energy agency [SPECIFY:_____ _____]
19. Trade Conference [SPECIFY:_____]
20. Ecos
21. DOE

-77. Other: [SPECIFY:_____]

EM. Energy Management Practices

EM0. How active is your facility in managing energy use, with 1 indicating energy use is not managed and 5 indicating that energy use is very closely managed? [Again, for the purposes of this survey energy management includes purchasing efficient equipment, tracking your energy bills, efficient operating and maintenance practices and training your personnel in managing energy or to operate your equipment efficiently]

EM0a. Can you explain why you gave that rating [Probe to get at how they manage energy, what activities are you doing]?

[If answer to EM0 > 1]

EM0b. When did your facility begin to actively manage energy use?

1. 2010 (< 1 year ago)
2. 2009 (approximately 1 year ago)
3. 2008 (approximately 2 years ago)
4. 2007 (approximately 3 years ago)
5. Before 2007 (more than 3 years ago)

-99. Don't know

EM1. How would you rate the level of management support for dedicating FTE (Full Time Employee) resources to energy management? **[Read responses]**

1. No support
2. Little support
3. Some support
4. Total support

EM2. Does staff receive training on energy management?

1. Yes
2. No
-99. Don't Know

[if EM2 = YES]

EM2a. What types of energy management activities does the training typically involve? **[Read responses; multiple responses]**

1. Purchasing efficient equipment
2. Efficient operation of equipment
3. Tracking energy use
4. Setting energy reduction goals
5. Writing an energy management plan
6. Available technical resources (where to go for help)
7. Availability of financial incentives for projects

-77. Other: [SPECIFY:_____]
-99. Don't Know

[SKIP IF RESPONDENT SAID THEY ARE THE ENERGY MANAGER IN S1 OR S2]

EM3. Is someone at your facility a designated "energy manager"?

1. Yes
2. No
-99. Don't Know

Now I'd like to ask you about some practices that are often associated with energy management.

[SKIP IF THEY SAY THEY TRACK ENERGY IN S2]

EM4. Does someone at the company track electricity or natural gas use at your facility? Tracking energy use would include activities such as monitoring billing data or metering energy use of certain equipment.

1. Yes, both electricity and natural gas
2. Yes, just electricity
3. Yes, just natural gas
4. No **[GO TO EM4]**

-99. Don't Know **[GO TO EM4]**

[ASK ONLY IF EM4 IS Yes and if they do indeed track energy

OR if they said they track energy in S2 lead with "You noted that one of your responsibilities is to track energy use…]

EM4a. How is energy tracked? [**DO NOT READ RESPONSES; RECORD IF DIFFERENT FOR NATURAL GAS VS. ELECTRICITY**]

1. Review billing data
2. Meter energy use

-77. Other: [SPECIFY:_____]

-99. Don't Know

[IF EM4 = YES]

EM4b. How often is that information reviewed? [**DO NOT READ RESPONSES; RECORD IF DIFFERENT FOR NATURAL GAS VS. ELECTRICITY**]

1. Daily
2. Weekly
3. Monthly
4. Quarterly
5. Twice a year
6. Annually

-77. Other: [SPECIFY:_____]

-99. Don't Know

I'd like to ask you about your facility policies regarding energy efficiency, equipment replacement or energy project funding. Where facility practices or policies differ from the corporate practices, we would like to know what is happening at the facility.

EM5. Does your facility set energy reduction goals or goals to reduce energy intensity?

1. Yes
2. No

-99. Don't Know

[ASK IF NWFPA MEMBER]

EM6. Will your facility participate in NWFPA's goal for their members to reduce energy intensity by 25% in 10 years?

1. Yes
2. Maybe in the future
3. No

-99. Don't Know

EM7. Does your facility have an energy management plan? An energy management plan would consist of energy reduction goals to be reached within a certain timeframe and may also include a prioritized list of activities to be done to achieve those goals

1. Yes
2. No

-99. Don't Know

[IF EM7 = YES]

EM6a. Do you revisit your plan on a regular basis, or update it as operations change?

1. Yes, we update on a regular basis
2. Yes, we update as operations change
3. No

-99. Don't Know

I would now like to ask questions about actions that may have been taken at your facility to save energy.

EM8. Have you implemented any of the following actions in the past two years in order to save energy: **[READ LIST, RANDOMIZE ORDER.]**

Leak tag program / leak detection and repair (check for air leaks.)	Y / N / DK
Lighting reduction, turning lights off when not in use	Y / N / DK
Equipment operation schedule or turning equipment off when not in use	Y / N / DK
Equipment settings (decreasing temperature, pressure, motor speed)	Y / N / DK
Removing equipment	Y / N / DK
Equipment Maintenance	Y / N / DK
Production floor cleaning practices	Y / N / DK
Insulate pipes or tanks	Y / N / DK
Other: SPECIFY_____	Y / N / DK

[IF Y TO AT LEAST ONE ACTION IN EM8]

EM9. Have you observed energy savings from any of these actions?

1. Yes
2. No

-99. Don't Know

[IF Y TO AT LEAST ONE ACTION IN EM8]

EM10. Did you receive technical assistance for any of these actions?

1. Yes
2. No

-99. Don't Know

[IF EM10 = YES]

EM10a. Who provided the technical assistance?

1. NEEA/Ecos
2. NWFPA
3. BPA/Cascade Energy Engineering/Strategic Energy Group/Evergreen Consulting
4. ETO
5. Utility [SPECIFY:_____]
6. Equipment distributor/manufacturer
7. Energy consulting company [SPECIFY:_____]
8. State energy agency [SPECIFY:_____ _____]

-77. Other: [SPECIFY:_____]

-99. Don't Know

[IF NO TO ALL ACTIONS IN EM8]

EM11. What were the barriers to implementing any of these actions? **[MULTIPLE RESPONSE; DO NOT READ]**

1. (Too expensive to implement)
2. (Expensive to maintain)
3. (Do not have technical skills to implement)
4. (Cannot get approval from management)
5. (Not aware of the activities)
6. (Other priorities demand resources)

-77. Other: [SPECIFY:_____]

-99. (Don't know)

EM12. Over the past 2 years, have you installed, or are you currently installing, any equipment that you would consider energy efficient?

1. Yes, have installed energy efficient equipment over past 2 years
2. Yes, currently installing energy efficient equipment
3. Yes, both installed energy efficient equipment over past 2 years AND currently installing
4. No **[SKIP TO EM17]**

-99. Don't know **[SKIP TO EM17]**

[IF EM12 IS 1, 2, OR 3 (YES)]

EM13. What information do you rely upon to tell you if the equipment you are buying is energy efficient? **[If needed:** This could be written information or people or experience.**] [MULTIPLE RESPONSE; DO NOT READ]**

1. Efficiency rating or label of equipment
2. Equipment dealer said it was efficient
3. Personal experience
4. Met utility rebate requirements

-77. Other: [SPECIFY:_____]

-99. Don't Know

[IF EM12 IS 1, 2, OR 3 (YES)]

EM14. Have you quantified the amount of energy savings from these projects? **[DO NOT READ:** Here we want to know if they know the energy savings of each project, not just whether their bill decreased**]**

1. Yes
2. No

-99. Don't Know

[IF EM12 IS 1, 2, OR 3 (YES)]

EM15. What motivated you to install energy efficient equipment? **[MULTIPLE RESPONSE; DO NOT READ]**

1. Save energy and money
2. The equipment distributor or manufacturer recommended it
3. Recommended in an energy audit
4. Tax incentives or rebates

-77. Other: [SPECIFY:_____]

-99. Don't Know

[IF EM12 IS 1, 2, OR 3 (YES)]

EM16. Did you receive any financial incentives like tax credits, rebates or incentives from your utility or other institutions for these measures? **[MULTIPLE RESPONSE]**

1. Yes, Federal tax credit
2. Yes, State tax credit
3. Yes, Utility rebate or incentive
4. No

-99. Don't Know

[IF EM16 = 3]

EM16a. Which utility or institution provided the incentive? **[DO NOT READ; COULD HAVE MULTIPLE RESPONSE IF THERE WERE MULTIPLE MEASURES]**

9. ETO
10. BPA
11. Pacific Power
12. Tacoma Power
13. Puget Sound Energy
14. Snohomish County PUD
15. Grays Harbor PUD
16. Idaho Power

-77. Other: [SPECIFY:_____]
-99. Don't know

EM17. When considering energy efficiency projects versus other capital investments, is there a difference in the Return on Investment (ROI) requirements?

1. Yes
2. No

-99. Don't Know

EM18. Does your facility have a specific policy that says you should replace worn out equipment with high efficiency equipment? **[IF NEEDED:** high efficiency refers to equipment that is more efficient than what is considered standard efficiency or code at the time of purchase.**]**
[DO NOT READ]

3. Yes
4. No policy
5. No, but we have an informal policy **[DO NOT READ:** for example they consider efficient equipment when purchasing new equipment but don't necessarily purchase efficient option**]**

-99. Don't Know

EM19. Do your equipment dealers emphasize energy efficiency when explaining your equipment options?

1. Yes, always
2. Yes, sometimes
3. No, never

-99. Don't Know

AW4. Have you heard of the term Continuous Energy Improvement or CEI? If yes, how did you hear about CEI? What is your understanding of CEI?

> **[if needed: NEEA's definition of the Industrial Initiative and CEI]** The Industrial Initiative focuses on achieving market transformation in the industrial sector. It targets end users, trade allies, and utilities in an effort to promote a market-wide energy efficiency strategy. A main objective of the Initiative is to encourage industrial firms in the food processing sector to incorporate energy management practices into their management and operations. CEI is the integration of energy management into all aspects of business operations—from the corporate office to the shop floor. While CEI leads to specific behavioral changes and the adoption of energy efficiency measures, its core idea is to position energy as an input in production that can be managed.

[END INTERVIEW] Thank you for your time. Do you have any questions?

Industrial Initiative Market Partner Survey 2010

MPER #6

Research Objectives

The interviews will inform our understanding of the diffusion of CEI in the food processing market and the forecast of market penetration and energy savings. The goals of the interviews will be to:

- understand the impact of the Industrial Initiative in the industrial market from the market partner perspective;
- learn how many of the utilities are offering programs similar to the Industrial Initiative. Find out the components, goals, budget, and marketing strategies of these programs, and NEEA's influence in the design of the programs; and
- identify new directions for NEEA in the industrial market and how NEEA can best work with the utilities in the future. Among the directions that NEEA is considering are:

    - Training and education. NEEA can organize training and education, ranging from shop/facility level technical training to partnering with industry associations to develop curricula that can be disseminated across an industry.
    - Demonstrations/case studies. NEEA can showcase energy management techniques and highlight successful projects to overcome misperceptions concerning the value of energy efficiency.
    - Channel management. NEEA can continue communicating with manufacturers, professional and trade organizations, and labor organizations to provide information about and encourage development of CEI.
    - Utility partnering. Many utilities are mandated to meet energy-efficiency targets. Through the Initiative, NEEA can help utilities design and market CEI.
    - Trade ally and cross-industry collaboration. NEEA could identify and coordinate outreach and intervention to trade allies and industries that are not familiar with the Initiative.

Interviewer's Name:

Date:

Utility/Market Partner**:**	
Name**:**	
Title**:**	
Phone	Email:
Utility Engagement Status**:**	# of FP and PnP Facilities at Level 3 or higher:
# of FP Facilities:	Interviewed in 2009? Yes/No

S. Screening

Hello, my name is _____, and I am calling from The Cadmus Group, an energy consulting firm in Portland, Oregon. I am calling on behalf of the Northwest Energy Efficiency Alliance as part of the Industrial Initiative (or IEA) program evaluation. I would like to speak with [Contact Name]?

IF REACH CORRECT PERSON: We are evaluating the Northwest Energy Efficiency Alliance Industrial Initiative and would like to speak with you about energy management practices in industrial facilities in your utility's service territory. Our 2009 study found that many of the utilities were offering energy management programs. As a result, NEEA is shifting its focus in the industrial market. We are interested in hearing your thoughts on how NEEA should proceed and how it can best help your customers in implementing energy management practices.

Do you have some time to answer a few questions? Your responses will be kept strictly confidential and only reported in aggregate.

Timing: 30 minutes

Industrial Energy Management Program Offerings

[if the contact is the same from 2009 lead in with "Thanks for taking part in this survey again. Just for the record…]

PO1. Are you familiar with NEEA's Industrial Initiative and Continuous Energy Improvement, or CEI?

[For a respondent who answers "yes", ask them to explain their understanding of what the Industrial Initiative and CEI are.]

[If respondent answers "no" or if definition is different than NEEA's then explain what the Industrial Initiative and CEI are.]

The Industrial Initiative focuses on achieving market transformation in the industrial sector. It targets end users, trade allies, and utilities in an effort to promote a market-wide energy efficiency strategy. A main objective of the Initiative is to encourage industrial firms in the food processing sector to incorporate energy management practices into their management and operations. CEI is the integration of energy management into all aspects of business operations—from the corporate office to the shop floor. While CEI leads to specific behavioral changes and the adoption of energy efficiency measures, its core idea is to position energy as an input in production that can be managed.

[To all]

Throughout this survey we refer to energy management and CEI interchangeably. For the purposes of this survey, energy management and CEI are a self-sustaining management system based on the well-established principles of process management and continuous improvement. CEI helps companies permanently embed energy management into the four key areas of their operations – organizational structure, people, manufacturing systems, and measurement – to enable them to management energy as a controllable expense.

PO2. Does your utility actively promote **[still promote (if promoted energy management in 2009)]** energy management practices to your customers as part of your energy efficiency offerings?

[if "yes" to PO2, go to PO2a. If "no", go to PO4]

PO2a. Does your utility have budget to promote energy management? **[DO NOT READ: This is how we are defining if the utility has its own program]**

[If respondent answers "yes" to PO2a, go to PO3. If respondent answers "no", then go to PO2b.]

PO2b. How is your utility promoting energy management? **[Then go to PO4]**

[Ask PO3 if answer to PO2a was "yes"]
[This PO3 series is specifically for utilities. See page 8 for non-utility series]

PO3. I'd like to ask you a few questions about your utility's energy management program offerings.

PO3.a. **[If respondent answered "yes" to PO2]** Did your utility[will your utility (if no program yet)] use NEEA's program as a guide for developing your energy management program?

PO3.b. What are the program goals?

PO3.c. When did/will the program start and how long will it be offered?

PO3.d. What is the budget? **[note whether the budget is annual or overall]**

PO3.e. How much of the budget is/will be devoted to for marketing?

PO3.f. How is your utility marketing the program?

PO3.g. What industrial segments is the program targeting? **[large vs. small, food processing, chemicals, etc.]**

PO3.h. Does your program involve any of the following? **[Circle all that apply.]**

a. Trainings for customers
b. Demonstration projects
c. Technical forums
d. Energy audits
e. Other _____

PO3.i. Does the program offer incentives?

a. If yes, for what measures or practices?

b. If yes, what are the incentive amounts? **[focus on O & M]**

c. What measurement and verification approach does your organization take to estimate energy savings?

PO3.j. Are you working with a contractor to implement the program? If yes, who?

PO3.k. What are your reasons for offering an energy management program? **[Circle all that apply.]**

a. CEI has been incorporated into the region's 6th Power Plan
b. CEI is demanded by our industrial customers
c. CEI is a cost effective means of achieving our energy savings goals
d. Other _____

[If respondent answered "no" to PO2.]

PO4. What are your reasons for not offering a program that promotes CEI? **[energy management practices]**

a. Insufficient number of industrial customers
b. Insufficient interest by industrial customers
c. Utility staff lack knowledge about CEI practices to implement program
d. Utility lacks funding to implement program
e. Utility staff do not have time
f. Do not believe the program would be cost-effective
g. Other _____

Customer Attitudes and Interest in CEI

Next, I'd like to ask you several questions about your industrial customers' interest in energy management practices.

CA1. What percentage of industrial customers are aware of the opportunity to save energy using energy management practices?

CA2. In general, on a scale from 1-5 where 1 is not at all interested and 5 is very interested, how interested are the aware industrial customers in integrating/adopting energy management practices?

CA3. What percentage of industrial facilities would you estimate are practicing energy management strategies?

CA4. What percentage of industrial facilities do you think are practicing energy management on their own, i.e., without the assistance of NEEA or their utility?

[If > 0%]

Do you think these facilities are receiving technical assistance? If yes, do you know who is providing the assistance?

CA5. What has your utility's experience been in promoting energy management practices and other energy efficiency programs to industrial facilities? **[Have facilities been receptive? Leads into next question about barriers]**

Market Barriers to Adoption of Energy Management Practices

Now, I'd like to ask you a few questions about barriers to the adoption of energy management practices in industrial facilities.

MB1. What are some of the key barriers to customers adopting energy management? **[Check all that apply]**

a. Customers are not aware of energy management and opportunities for savings
b. Energy savings are not a priority or an interest
c. Customers lack capital or bank financing to implement energy management
d. Energy management is not perceived to be cost-effective
e. Customers lack technical skills to implement
f. Other_____

[If familiar with NEEA program (PO1 response was "yes")]

MB2. Do you think NEEA is effectively addressing these barriers?

MB2a. If not, why not?

MB3. What else could NEEA do to assist you or your customers in overcoming these barriers?

NEEA'S Current Relationships with Utilities

[Utilities Only for questions NF1 – NF3]

The next few questions are about NEEA's current relationship with your utility.

NF1. One a scale from 1 to 5 (1 being poor and 5 very good) how would you rate your **utility'**s current relationship with NEEA's Industrial Initiative (aka IEA) in particular?

1 2 3 4 5

[If < 3] What are your reasons for giving that rating?

NF2. On a scale from 1 to 5 (1 not at all helpful, 5 very helpful) how helpful do you consider NEEA's Industrial Initiative (IEA) and its offerings to be in your utility's efforts to promote EE to its industrial customers?

1 2 3 4 5

a. What elements of the Industrial Initiative (aka IEA) support your utility's conservation efforts?

NF3. How is the NEEA's Industrial Initiative team communicating with you/your utility? Do you consider it effective?

NEEA's Future Work with Market Partners

Now, I'd like to ask you some questions about how NEEA can best work with your organization in the future.

[Utilities/ETO only]

NF4. If NEEA were to offer assistance or training in designing an energy management program, would your utility be interested in participating?

[All]

NF5. NEEA is considering encouraging facilities to utilize energy management software. Do you think this would be an effective strategy for promoting energy management practices?

NF6. Are you familiar with ISO 50001?

[if yes]

NF6a. Do you think that promoting the ISO 50001 standard would be an effective use of NEEA's resources? What are your reasons for saying that?

NF7. Is there other assistance that NEEA could provide to help promote energy management to your customers?

[END INTERVIEW] Thank you for your time. Do you have any questions?

Industrial Initiative Trade Ally Survey 2010

MPER #6

Research Objectives

The interviews will inform our understanding of the diffusion of CEI in the food processing market and the forecast of market penetration and energy savings. The goals of the interviews will be to:

- Determine the number of trade allies in the Northwest consulting on energy management practices;
- Understand what elements of CEI are being promoted by trade allies;
- Understand trends in awareness and market penetration of CEI over the last five years;
- Understand the factors that influence CEI adoption from the trade ally perspective;
- Understand how trade allies are marketing and promoting CEI;
- Obtain trade ally projections of future adoption of CEI;
- Understand the barriers to CEI adoption from the trade ally perspective; and
- Identify how NEEA can best work with the trade allies in the future.

The sample for the survey includes energy management consulting companies in the Northwest who work with industrial facilities.

•

Interviewer's Name:

Date:

Trade Ally**:**	
Name**:**	
Title**:**	
Phone	Email:

Hello, my name is _____, and I am calling from The Cadmus Group, an energy consulting firm in Portland, Oregon. I am calling on behalf of the Northwest Energy Efficiency Alliance as part of the Industrial Initiative program evaluation. I would like to speak with [Contact Name] OR [someone directly involved with industrial energy management consulting at your company].

IF REACH CORRECT PERSON: We are evaluating the Northwest Energy Efficiency Alliance (NEEA) Industrial Initiative and would like to speak with you about energy management practices in industrial facilities in the Northwest. Do you have some time to answer a few questions? Your responses will be kept strictly confidential and only reported in aggregate.

Timing: 30 minutes

AW1. Are you aware of the NEEA Industrial Initiative program?

1. Yes
2. No

[For a respondent who answers "yes", ask them to explain their understanding of what the Industrial Initiative and CEI are.]

[If respondent answers "no" or if explanation not correct, explain what the Industrial Initiative and CEI are.]

The Industrial Initiative focuses on achieving market transformation in the industrial sector. It targets end users, trade allies, and utilities in an effort to promote a market-wide energy efficiency strategy. A main objective of the Initiative is to encourage industrial firms in the food processing sector to incorporate energy management practices into their management and operations. Continuous Energy Improvement (CEI) is the integration of energy management into all aspects of business operations—from the corporate office to the shop floor. While CEI leads to specific behavioral changes and the adoption of energy

efficiency measures, its core idea is to position energy as an input in production that can be managed.

[To All]

NEEA began this program in 2005 and would like to know how interest in energy management has changed since then and what the interest may be over the next 5 years. We would also like to hear your thoughts on how NEEA could best help your company and your customers in implementing energy management practices in the future.

For the purposes of this survey, energy management practices includes activities such as purchasing efficient equipment, tracking energy usage, efficient operating and maintenance practices and training personnel in managing energy or to operate equipment efficiently. Before I continue, do you have any questions for me, particularly about the definition of "energy management practices?"

S. Screening

S1. Please indicate which of the following best describes your role at the company:

1. Owner
2. Business Manager
3. Engineer
4. Contractor
5. Sales Manager/Business Development

-77. (Other **[SPECIFY: _____]**)

S2. What is your primary area of responsibility?

1. Management
2. Sales and service
3. Design or Engineering
4. Planning

-77. (Other **[SPECIFY: _____]**)

[If respondent is NOT a consultant or engineer directly working with industrial facilities: Is there someone at your company I could speak with who is working directly with industrial facilities to make recommendations on energy efficiency improvements?]

S3. How long have you worked there?

[If < 1 year]

S3a. How long have you been working in the energy management industry?

[If < 1 year: Is there someone at your company I could speak with who is more familiar with industrial facility energy management practices?]

S5. What energy management related services does your company offer to industrial customers? **[Read Responses; Multiple Responses]**

1. Energy audit
2. Analysis of energy intensity (i.e. amount of energy to produce one unit of output)
3. Set energy reduction goals
4. Design energy plan to reach goals
5. Tracking energy use
6. Efficient equipment trainings
7. Efficient O&M practices trainings
8. Quantifying energy savings from measures
9. Visit facility regularly to update strategy and/or goals

-77. (Other [SPECIFY: _____])

S6. How long has your company been offering energy management consulting services to your customers?

S7. How many employees are working on energy management consulting for industrial facilities?

S8. Are these employees working on energy management consulting full-time or do they also work on other types of projects? **[Getting at FTE here, but these questions should be easier to answer than just asking about FTE]**

S9. Which market segments does your business serve for energy management consulting? **[DO NOT READ, prompt if needed]**

1. Agriculture
2. Food products and beverages
3. Textiles and apparel
4. Wood products
5. Paper mfg.
6. Printing and publishing
7. Petroleum/chemicals
8. Rubber and plastics
9. Nonmetallic mineral prod.
10. Primary metals
11. Industrial machinery
12. Computers and electronic mfg.
13. Electrical equipment
14. Transportation equipment
15. Furniture and fixtures
16. Misc. manufacturing
17. Commercial/Educational
18. Health Care
19. Mining/minerals
20. Irrigation
21. Water/Wastewater
22. Cold storage

-77. (Other **[SPECIFY: _____]**)

Customer Attitudes and Interest in CEI

Next, I'd like to ask you several questions about your industrial customers' interest in energy management practices.

CA1. In your estimation, what percentage of industrial customers is aware of the opportunity to save energy using energy management practices?

CA2. For the industrial customers that are aware of energy management, in general, on a scale from 1-5 where 1 is not at all interested and 5 is very interested, how interested are they in integrating/adopting energy management practices?

1 2 3 4 5

CA3. For the range of industries you serve, which three industries are typically MOST receptive to energy efficient options and/or a systems based approach? Please list the top 3 with the MOST receptive industry first.

[USE SAME LIST AS S5 to code segments]

1.
2.
3.

CA4. For the range of industries you serve, which three industries are typically LEAST receptive to energy efficient options and/or a systems based approach? Please list the bottom 3 with the least receptive industry first.

[USE SAME LIST AS S5 to code segments]

1.
2.
3.

CA5. What percentage of industrial facilities would you estimate are currently practicing energy management strategies?

CA5a. How does this compare to 5 years ago?

CA5b. How many of those are practicing energy management on their own, i.e., without technical or financial assistance from NEEA or their utility?

CA6. From your experience, what factors motivate industrial facilities to look at energy management? **[Multiple Response]**

1. Electricity prices
2. Natural gas prices
3. See or hear about other facilities doing it
4. Want to stay competitive

-77. (Other **[SPECIFY: _____]**)

CA6a. Which factor is most important?

CA7. In general, how important are energy costs to your industrial customers? **[Read responses]**

1. Not at all important
2. Not very important
3. Somewhat important
4. Very important

-99. Don't know/not sure **[DO NOT READ]**

CA8. What is the typical payback period that industrial facilities need to meet when considering energy projects? **[In years]**

Company Promotion of Energy Management

CP1. What activities has your company done over the past year to market energy management practices at industrial facilities? **[Read responses]**

1. Offer free or discounted energy audits
2. Offer trainings on energy efficient equipment
3. Offer trainings on efficient O&M practices
4. Offer trainings on quantifying energy intensity
5. Offer trainings on tracking energy use
6. Perform demonstration projects
7. Give presentations at conferences/trade shows
8. Have a table or booth at conferences/trade shows

-77. (Other **[SPECIFY: _____]**)

CP2. What marketing method or activity do you find to be most effective?

CP3. How many industrial facilities did you provide an energy management budget proposal or bid to over the past year?

CP4. What percent of those facilities accepted the proposal?

_____%

-99. Don't know/not sure **[DO NOT READ]**

CP5a. What percentage of their electric bill can an industrial facility expect to save during the initial (one to two) years? Does this rate of savings continue after the initial years? If not, how does it change?

CP5b. What is the cost per kWh to implement CEI during the first one to two years? Please include consulting fees, software costs, O&M practices upgrades costs, and employee training costs. **[will be compared to NEEA's estimate of $75k per year for the first two years (so $150k total)]**

CP5c. And how much does it cost an industrial facility per year to continue practicing energy management?

CP6. On average, how long are your contracts with industrial facilities who hire you for energy management consulting?

1. < 6 months
2. 6 months to 1 year
3. 1 – 2 years
4. 2 - 3 years
5. 3 – 4 years
6. 4 – 5 years
7. > 5 years

-77. (Other **[SPECIFY: _____]**)

CP7. Do you provide your industrial customers with software tools to track and measure energy use?

[if yes]

CP7a. Which software do you typically recommend that they use? **[multiple response]**

1. Energy Expert (Energy Worksite) from Northwrite
2. US DOE's Industrial Technologies Program Software Suite
3. Other **[Specify_____]**

CP7b. Do you choose the tool for them, or do they choose the tool themselves?

CP7c. In your experience, what is the most common software tool being used to track energy use?

CP7d. What are the top three features that you believe any software/spreadsheet tool needs to have to be effective? Please list the most important feature first, then the 2nd and 3rd most important.

CP8. What percentage of industrial facilities would you estimate continue improving energy efficiency on their own after the consulting contract has expired?

MT. Market Transformation Progress and Future

Next, I'd like to ask you several questions about energy management awareness and practices in the industrial sector over the last five years and what you expect the market to look like during the next five years.

MT1. In your opinion, has industrial facility awareness of energy management practices increased, decreased, or stayed the same over the last 5 years?

1. Increased
2. Decreased
3. Stayed the same

-99. Don't know/not sure **[DO NOT READ]**

MT2. In your opinion, has the number of industrial facilities practicing energy management increased, decreased, or stayed the same over the last 5 years?

1. Increased
2. Decreased
3. Stayed the same

-99. Don't know/not sure **[DO NOT READ]**

MT3. How have industrial facilities' perceptions of energy efficiency changed over the last 5 years?

MT4. Are there other ways the industrial market for energy management has changed over the last 5 years? **[Probe for availability of services, availability of training and information]**

MT5. What have been the drivers in the industrial market change? This could include people, groups, or market factors. **[Multiple Response; Do not prompt]**

1. NEEA's Industrial Initiative Program
2. Other utility energy efficiency programs **[SPECIFY:_____]**
3. Electricity or natural gas prices
4. Other facility costs increased
5. Changes in environmental awareness and attitudes
6. Facilities want to present themselves as "green"

-77. (Other **[SPECIFY: _____]**)

MT6. What percent of the industrial facilities that are not currently actively managing energy would you expect to begin managing energy over the next 5 years?

MT6a. **[If < 30%]** What are your reasons for saying that? **[OPEN END; DO NOT READ LIST]**

1. Energy costs are unimportant
2. Industrial facilities are already quite efficient
3. Industrial facilities have little interest
4. Industrial facilities will not pay the added up-front costs

-77. (Other **[SPECIFY: _____]**)

Market Barriers to Adoption of Energy Management Practices

Now, I'd like to ask you a few questions about barriers to the adoption of energy management practices in industrial facilities.

MB1. What are some of the key barriers to industrial facilities adopting energy management? **[Check all that apply]**

1. Industrial facility staff are not aware of energy management and opportunities for savings
2. Energy savings are not a priority or an interest
1. Industrial facilities lack capital or bank financing to implement energy management
2. Energy management is not perceived to be cost-effective
3. Industrial facility staff lack technical skills to implement
4. Lack of compatible equipment

-77. (Other [SPECIFY: _____])

MB2. Do you think NEEA or other energy efficiency programs are effectively addressing these barriers?

MB2a. What are your reasons for saying that?

MB4. What else could NEEA or other energy efficiency programs do to assist you or your customers in overcoming these barriers?

MB5. Has the current economy had an impact on industrial facilities' interest in energy management?

1. Yes
2. No

-99. Don't know/not sure **[DO NOT READ]**

[If MB1 = 1]

MB1a. How has it impacted interest?

NEEA's Future Work with Your Company

Now, I'd like to ask you some questions about how NEEA can best work with your company in the future.

NF1. Are you familiar with the upcoming ISO 50001 standard?

[if yes]

NF1a. What percent of your clients or prospective clients do you think will seek ISO 50001 registration over the next five years?

NF1b. Along with providing for registration for companies, ISO 50001 will have a certification program for field advisors. Are you or anyone in your company planning on becoming an ISO certified field advisor?

NF2. Is there any assistance that NEEA could provide to help promote energy management to your customers?

Firm Characteristics

F1. Do you provide sales/services in: **[CHECK ALL THAT APPLY]**

1. Oregon
2. Washington
3. Idaho
4. Montana
5. Outside of the Pacific Northwest

[if some outside of the NW]

F1a. What percent of your energy management projects are in the Northwest (Oregon, Washington, Idaho, and Montana)?

_____%

-99. Don't know **[DO NOT READ]**

F2. What percent of your industrial energy management projects are:

1. Existing facilities _____%
2. New construction _____%

-99. Don't know **[DO NOT READ]**

[END INTERVIEW] Thank you for your time. Do you have any questions or other comments?

Appendix E. Survey Frequencies

Target Audience Follow-Up (TAFU) Survey

Nonparticipant Survey

Market Partner Survey

Trade Ally Survey

2010 Target Audience Follow Up Survey Frequencies

Table 31. QS1. —According to our records your title is [TITLE]. Is this still correct?

Response	Frequency (n=13)
Energy Champion and Project Engineer	2
Energy Champion and Maintenance Manager / Supervisor / Planner	3
Energy Champion and Production Manager	4
Energy Champion and Store Room Supervisor	1
Energy Champion and Accounting Manager / Site Accountant	2
Energy Champion and Shift Manager	1

Table 32. QS2. —How do your job duties relate to energy use at your facility?"

Response	Frequency (n=13)
Manage Energy Team	10
Track and Monitor Energy Use	6
Implement, Manage or Develop Energy Projects	6
Organize Employee Awareness Activities	3

Note: More than one response allowed.

Table 33. QEM0. —NWFPA has a goal for their members to reduce energy intensity by 25% in 10 years. Is your facility taking steps to try to meet that goal?"

Response	Frequency (n=13)
Yes	10
Maybe in the future	0
No, was not aware of goal	1
No, was aware of goal but not participating	2

Table 34. QEM1. —What are your facility's specific goals (independent of the NWFPA goal) for reducing your energy intensity*?"

Response	Frequency (n=13)
25% in 10 years	4
5% per year for 5 years	1
5% per year (no duration)	2
3% per year (no duration)	4
Don't know	1
No goals	1

*Energy intensity measured as energy use per pound of product.

Table 35. QEM1a. —What is your strategy to meet those goals?"

Response	Frequency (n=12*)
Implement capital projects	8
Implement O&M improvements	9
Increase employee awareness	6
Track and monitor energy use	1

Note: Asked of those who responded that they have goals in QEM1. One respondent did not articulate specific goals, but was familiar with the energy reduction strategies of the facility and his responses are included in

Table 35. More than one response allowed.

Table 36. QEM2. —How likely are you to meet the goal?"

Response	Frequency (n=12*)
Not likely	1
Somewhat likely	1
Likely	3
Very likely	7

Note: Asked of those who responded that they have goals in QEM1. One respondent did not articulate specific goals, but was familiar with the energy reduction strategies of the facility and his responses are included in Table 36.

Table 37. QEM2a. —What are the reasons for saying [INSERT RATING]?"

Response	Frequency (n=12*)
Good management support	1
Historical success	7
Energy is a priority	1
Good employee / team support	1
Efficiency depends on crops	3
Changes in production process	1
No Response	1
Not Applicable	1

Note: Note: Asked of those who responded that they have goals in QEM1. One respondent did not articulate specific goals, but was familiar with the energy reduction strategies of the facility and his responses are included in Table 37. More than one response allowed.

Table 38. Crosstab of QEM2. —How likely are you to meet the goal?" and QEM2a. —What are the reasons for saying [INSERT RATING]?"

Facility's Likelihood of Meeting Energy Intensity Reduction Goals	Factors Influencing Facilities' Likelihood of Reaching Goal to Reach Goal						
	Good management support	Historical success	Energy is a priority	Employee/ team support	Efficiency depends on crops	Production process change	No Response
Not likely (n = 1)	0	0	0	0	0	1	0
Somewhat Likely (n = 1)	0	0	0	0	1	0	0
Likely (n = 3)	0	2	0	0	1	0	1
Very Likely (n = 6)	1	5	1	1	1	0	1
Total (n = 12)	1	7	1	1	3	1	1

Note: Note: Asked of those who responded that they have goals in QEM1. One respondent did not articulate specific goals, but was familiar with the energy reduction strategies of the facility and his responses are included in Table 38. One respondent did not provide a response to this question. More than one response allowed.

Table 39. QEM3a. —The Industrial Initiative has provided us with a list of improvements you have made at your facility. We would like to go through a few of those changes to see if they are still in place. Our records show that you have made several equipment upgrades including: [INSERT LIST]. Are all of these still in place?"

Response	Frequency (n=13)
Yes	36
No	0
Don't know	5
Not applicable	2

Note: Represents number of measures, except in the case of not applicable, which represents the number of plants with no validated capital projects. This question covered a total of 41 measures.

Table 40. QEM4a. —Now I'm going to go through a couple of O&M improvements we have in our records. The first one I have down is [_____] in 200__. Is that change still in place?"

Response	Frequency (n=13)
Yes	10
No	1
Don't know	1
Not applicable	1

Note: Represents number of measures, except in the case of not applicable, which represents the number of plants with no validated O&M projects. This question covered a total of 12 measures.

Table 41. QEM4a1. —What were the reasons for not continuing this activity?"

Response	Frequency (n=1)
It limited production capabilities	1

Note: Asked of those who responded "No" to QEM4a.

Table 42. QEM4b. —The next one I have down is [_____] in 200__. Is that change still in place?"

Response	Frequency (n=13)
Yes	11
No	0
Don't know	0
Not applicable	2

Note: Represents number of measures, except in the case of not applicable, which represents the number of plants with no validated O&M projects and plants with no additional validated O&M projects (i.e., all validated O&M measures were covered in previous questions). This question covered a total of 11 measures.

Table 43. QEM4c. —The next one I have down is [_____] in 200__. Is that change still in place?

Response	Frequency (n=13)
Yes	7
No	0
Don't know	1
Not applicable	5

Note: Represents number of measures, except in the case of not applicable, which represents the number of plants with no validated O&M projects and plants with no additional validated O&M projects (i.e., all validated O&M measures were covered in previous questions). This question covered a total of 8 measures.

Table 44. QEM4d. —The next one I have down is [_____] in 200__. Is that change still in place?

Response	Frequency (n=13)
Yes	5
No	0
Don't know	0
Not applicable	8

Note: Represents number of measures, except in the case of not applicable, which represents the number of plants with no validated O&M projects and plants with no additional validated O&M projects (i.e., all validated O&M measures were covered in previous questions). This question covered a total of 5 measures.

Table 45. QEM4d (additional). —Our records indicate that you have also completed these O&M projects: [INSERT LIST]. Are these measures still in place?"

Response	Frequency (n=13)
Yes	11
No	2
Don't know	1
Not applicable	10

Note: More than one response allowed. Represents number of measures, except in the case of not applicable, which represents the number of plants with no validated O&M projects and plants with no additional validated O&M projects (i.e., all validated O&M measures were covered in previous questions). This question covered a total of 14 measures.

Table 46. QEM4d1 (additional). —What were the reasons for not continuing this activity?"

Response	Frequency (n=2)
Removed to prevent damage to facility	2

Note: Note: Asked of those who responded "No" to QEM4d (additional).

Table 47. QEM5. —Have you implemented any other energy related projects in addition to the ones we've discussed?"

Response	Frequency (n=13)
Yes	13
No	0
Don't know	0

Table 48. QEM5a. —What other projects have you implemented?"

Response	Frequency (n=13)
Heat recovery	3
Lighting	3
Fans / Motors / Pumps / VFDs	3
Steam trap	3
Compressed air	1
Refrigeration	3
Alternative Fuels	1
Boilers	1
Less Equipment Use	1
Other	3

Note: More than one response allowed.

Table 49. QEM5a1. —What motivated you to implement these projects?"

Response	Frequency (n=13)
Upper management	4
Reduce cost of finished product, save money	3
Provides a competitive advantage	1
Low payback	1
Safety concerns	1
Environmental benefits	1
Operational benefits	1
Other	1
Don't know	1
No response	2

Note: More than one response allowed.

Table 50. QEM5b. —Did you receive technical assistance for any of these additional projects you mentioned?"

Response	Frequency (n=13)
Yes	9
No	1
Don't Know	2
No Response	1

Table 51. QEM5b1. —Who provided assistance?

Response	Frequency (n=9)
NEEA/ Ecos	2
NWFPA	0
Cascade Energy Engineering	2
ETO	0
Utility	0
Equipment distributor / manufacturer	3
Energy consulting firm	0
State energy agency	0
Other: Association of Energy Engineers	1
Other: Internal engineering department	3
Not applicable	4
Total	15

Note: Asked of those who responded "Yes" to QEM5b. More than one response allowed.

Table 52. QEM5c. —Did you receive a tax credit, incentive or rebate for any of the projects you mentioned?"

Response	Frequency (n=13)
Yes, incentive or rebate	10
No	1
Don't Know	1
Not applicable	1

Table 53. QEM5c1. —Who provided the incentive?"

Response	Frequency (n=10)
ETO	3
BPA	0
Pacific Power	0
Tacoma Power	0
Puget Sound Energy	0
Snohomish County PUD	0
Grays Harbor PUD	0
Idaho Power	3
Other: Grant County PUD	3
Other: Rocky Mountain Power	1
Don't Know	0
Not applicable	3
Total	13

Note: Asked of those who responded "Yes" to QEM5c.

Table 54. QEM6. —What information do you rely upon to tell you if a piece of equipment or O&M practice is energy efficient? [IF NEEDED: **This could be written information or people or experience.**]"

Response	Frequency (n=13)
Efficiency rating or label of equipment	8
Equipment dealer said it was efficient	4
Personal experience	1
Met utility rebate requirements	1
Other: Monitor energy use	2
Other: Internal engineering department	1
Other: Monitor / Measure equipment	2
Other: Self-education	1
Don't know	0
Total	20

Note: More than one response allowed.

Table 55. QEM7. —In your opinion, how successful has your facility been in integrating energy management into their business practices?"

Response	Frequency (n=13)
Not successful	0
Somewhat successful	0
Successful	7
Very successful	4
Don't know	2

Table 56. QEM7a. —What are your reasons for saying [INSERT RATING]?"

Response	Frequency (n=13)
Increased Employee Awareness	6
Good management support	4
Energy is now considered on a daily basis	2
Energy efficiency always considered for capital installations	1
Good support from plant staff	3
Energy has a place at the table now	1
Realizing consistent energy savings	1
Still need to increase employee awareness	2

Note: More than one response allowed.

Table 57. Crosstab of QEM7. —In your opinion, how successful has your facility been in integrating energy management into their business practices?" and QEM7a. —What are your reasons for saying [INSERT RATING]?"

Success of Integration of CEI into Business Practices	Increased Employee Awareness	Good Management Support	Energy Is Now Considered On a Daily Basis	Energy Efficiency Always Considered for Capital Installations	Good Support from Plant Staff	Energy Has a Place at the Table Now	Realizing Consistent Energy Savings	Still Need to Increase Employee Awareness
Not successful (n = 0)	0	0	0	0	0	0	0	0
Somewhat successful (n = 0)	0	0	0	0	0	0	0	0
Successful (n = 7)	3	2	0	1	0	1	1	2
Very successful (n = 4)	2	1	1	0	2	0	0	0
Don't know (n = 2)	1	1	1	0	1	0	0	0
Total (n = 13)	6	4	2	1	3	1	1	2

Table 58. QEM8. —Has implementing energy management practices at the facility had an impact on employee perceptions about energy conservation?"

Response	Frequency (n=13)
Yes	13
No	0
Total	13

Table 59. QEM8a. —Can you explain?"

Response	Frequency (n=13)
Employee awareness has increased	13
Employees are taking steps to save energy	3
Would still like to see employee awareness continue to increase	4

Note: More than one response allowed.

Table 60. QEM9. —Have the energy projects that we've discussed provided benefits beyond energy savings?"

Response	Frequency (n=13)
Yes	11
No	1
No response	1

Table 61. QEM9a. —Can you explain?"

Response	Frequency (n=12)
Additional energy benefits	1
Increased technical knowledge	2
Lower maintenance costs	3
Extended product life	1
Environmental benefits	1
Safety benefits	3
Increased productivity	3
Less waste	1
Water savings	1
Other	1
Can't think of any additional benefits	1

Note: Asked of those who responded to QEM9. More than one response allowed.

Table 62. Crosstab of QEM9. —Have the energy projects that we've discussed provided benefits beyond energy savings?" and QEM9a. —Can you explain?"

	Additional energy benefits	Increased technical knowledge	Lower maintenance costs	Extended product life	Environmental benefits	Safety benefits	Increased productivity	Less waste	Water savings	Other	Can't think of any additional benefits
Yes (n = 11)	1	2	3	1	1	3	3	1	1	1	0
No (n = 1)	0	0	0	0	0	0	0	0	0	0	1
Total (n = 12)	1	2	3	1	1	3	3	1	1	1	1

Note: More than one response allowed.

Table 63. QEM10. —On a scale of 1 to 5, where 1 is not at all and 5 is completely, currently how much do you rely on Initiative staff or Ecos for providing assistance for energy management projects at your facility?"

Response	Frequency (n=13)
1	3
2	3
3	5
4	1
5	0
Don't know	1

Table 64. QID1. —Outside of your company staff, who would you go to first to talk about improving energy efficiency at your facility?"

Response	Frequency (n=13)
NEEA	0
NWFPA	0
BPA	1
ETO	0
Utility: Idaho Power	3
Utility: Rocky Mountain Power	1
Utility: Portland General Electric / NW Natural	1
Equipment distributor	0
Energy consulting company: Cascade Energy Engineering	1
Trade conference	0
Ecos	4
Other: Association of Energy Engineers	1
No one outside of company staff	1

Table 65. QID2. –Who else would you to talk about improving energy efficiency at your facility?"

Response	Frequency (n=13)
NEEA	0
NWFPA	0
BPA	0
ETO	1
Utility: Intermountain Gas	1
Utility: Grant County PUD	2
Utility: Idaho Power	1
Utility: Portland General Electric	1
Utility: Umatilla Electric Cooperative	1
Equipment distributor	3
Energy consulting company: Cascade Energy Engineering	1
State energy agency: DOE	1
Trade conference	0
Ecos	1
Other: WSU / OSU	2
Other: Energy West	1
Other: Engineering staff within Company	3
Other: Other Company staff	1
No one	1

Note: More than one response allowed.

Table 66. QID3. –How often do you discuss energy management techniques with colleagues at different facilities within your company?"

Response	Frequency (n=13)
Never	0
Yearly	0
Biannually	0
Quarterly	6
Monthly	5
Bimonthly	0
Weekly	1
Other: Daily	1

Table 67. QID3a. –How often do you discuss energy management techniques with colleagues outside of your company?"

Response	Frequency (n=13)
Never	1
Yearly	1
Biannually	0
Quarterly	2
Monthly	1
Bimonthly	2
Weekly	1
Other: Every two months	1
Other: Quarterly to biannually, depending on activities	1
Other: Not on a regular basis	1
Other: Rarely	2

Table 68. QID4. –If the Industrial Initiative were to disappear, what would happen to energy management at your company?"

Response	Frequency (n=13)
Continue as before	11
Continue, but at a slower pace	2

Table 69. QID4a. –What resources would you need to continue managing energy successfully?"

Response	Frequency (n=13)
Training	1
Capital / Rebates for installing efficient equipment	1
Trade shows / Communication with other facilities	1
Software tools	1
Vendors of energy using equipment	1
Continued support from current external resources	4
Already have sufficient in-house resources	5

Note: More than one response allowed.

2010 Nonparticipant Facility Frequencies

Table 70. QS1. —What is your title at (name of company)?"

Response	Frequency (n=21)
Engineering Manager	5
Plant Manager	9
VP of Operations	2
Maintenance Manager	2
Operations Manager	1
Other	2

Table 71. QS1a. —How long have you worked at (name of company)?"

Response	Frequency (n=21)
<5	3
5-10	1
11-15	2
16-20	1
21-25	1
25+	1
No response	12

Table 72. QS2. —What are some of your key responsibilities at the firm?"

Response	Frequency (n=21)
Capital projects	3
Facility management	5
Maintain machinery	2
Product production	4
Energy review	4
Track water use	1
Track energy	6
Meter electricity	1
Manage operations	9
Equipment upgrades	6
Energy mgmt	2
Other	1

*Multiple responses were allowed.

Table 73. QS3. —What electric utility serves your facility?"

Response	Frequency (n=21)
PGE	2
Chelan PUD	1
City of Tacoma	1
Pacific Power	4
Idaho Power	4
Puget Sound Energy	2
Franklin PUD	1
Avista	1
Seattle City Light	1
Grant County PUD	1
No response	3

Table 74. QAW0. —How aware is your facility about energy management practices?"

Response	Frequency (n=21)
1 (Not Aware)	0
2	3
2.5*	1
3	2
3.5	1
4	4
5 (Very Aware)	10

*Some respondents answered with a range (e.g. "3 or 4"). In these cases, responses were tabulated as the median between the two responses (e.g. 3.5).

Table 75. QAW0a. —Can you explain why you gave that rating?"

Response	Frequency (n=21)
Tracking Energy	4
Not a priority	3
EE equipment upgrades	4
Look to improve production efficiency	1
Energy audit	4
Energy team meetings	1
It's a key performance indicator	1
Purchase natural gas on the market	1
Attentive to energy costs	6
Could do more	2
Don't always have the budget for it	3

*Multiple responses were allowed.

Table 76. Crosstab of —How aware is your facility about energy management practices?" and QAW0a. —Can you explain why you gave that rating?"

Awareness Rating	Tracking energy	Not a priority	EE equipment upgrades	Look to improve production efficiency	Energy audit	Energy team meetings	It's a key performance indicator	Purchase natural gas on the market	Attentive to energy costs	Could do more	Don't always have the budget for it
1 Not aware (n=0)	0	0	0	0	0	0	0	0	0	0	0
2 (n=3)	1	2	0	0	0	0	0	0	0	1	0
2.5 (n=1)	0	0	0	0	0	0	0	0	0	1	1
3 (n=2)	1	1	0	0	0	0	0	0	0	0	0
3.5 (n=1)	0	0	0	0	1	0	0	0	0	0	1
4 (n=4)	0	0	1	0	1	0	0	1	1	0	0
5 Very aware (n=10)	2	0	3	1	2	1	1	0	5	0	1
Total (n = 21)	4	3	4	1	4	1	1	1	6	2	3

*Note: Multiple responses were allowed.

Table 77. QAW1. —When did you first learn about energy efficiency equipment?"

Response	Frequency (n=21)
2010 (< 1 year ago)	0
2009 (approximately 1 year ago)	1
2008 (approximately 2 years ago)	0
2007 (approximately 3 years ago)	1
Before 2007 (more than 3 years ago)	19

Table 78. QAW2. —When did you first learn about energy efficiency operating practices?"

Response	Frequency (n=21)
2010 (< 1 year ago)	0
2009 (approximately 1 year ago)	2
2008 (approximately 2 years ago)	0
2007 (approximately 3 years ago)	2
Before 2007 (more than 3 years ago)	17

Table 79. QAW3. —How did you first learn about energy management practices?"

Response	Frequency (n=21)
NEEA	2
NWFPA	5
BPA	1
ETO	0
Utility	3
Equipment distributor	3
Energy consulting company	5
State Energy Office	0
Trade Conference	2
Ecos	0
DOE	1
Other	12

*Multiple responses were allowed.

Table 80. QEM0. —How active is your facility in managing energy use?"

Response	Frequency (n=20)
1 (Not Active)	0
2	2
3	9
3.5	4
4	0
5 (Very Active)	5

*Some respondents answered with a range (ex., "3 or 4"). In these cases, responses were tabulated as the median between the two responses.

Table 81. QEM0a. —Can you explain why you gave that rating?"

Response	Frequency (n=20)
Other things are higher priority	3
Could do more	9
Have done several projects lately	6
Have several projects planned	1
Track energy	7
Need to control energy costs	2
No capital for EE improvements	1
Don't have the staff	1
Perceived to not have control over energy use	2
No response	1

Table 82. Crosstab of QEM0. —How active is your facility in managing energy use?" and QEM0a. —Can you explain why you gave that rating?"

Response	Other things are higher priority	Could do more	Have done several projects lately	Have several projects planned	Track energy	Need to control energy costs	No capital for EE improvements	Don't have the staff	Perceived to not have control over energy use	No response
1 Not Managed (n=0)	0	0	0	0	0	0	0	0	0	0
2 (n=2)	0	2	1	0	1	0	0	0	0	0
3 (n=9)	2	3	0	1	3	0	1	1	0	0
3.5 (n=4)	1	2	2	0	1	0	0	0	1	0
4 (n=0)	0	0	0	0	0	0	0	0	0	0
5 Very Closely Managed (n=5)	0	0	2	0	2	2	0	0	0	1
Total (n = 20)	3	7	5	1	7	2	1	1	1	1

*Note: Multiple responses were allowed.

Table 83. QEM0b. —When did your facility begin to actively manage energy use?"

Response	Frequency (n=21)
2010 (< 1 year ago)	0
2009 (approximately 1 year ago)	0
2008 (approximately 2 years ago)	1
2007 (approximately 3 years ago)	4
Before 2007 (more than 3 years ago)	14
Don't Know	2

Table 84. QEM1. —How would you rate the level of management support for dedicating Full Time Employee resources to energy management?"

Response	Frequency (n=21)
No support	1
Little support	5
Some support	9
Total support	6

Table 85. QEM2. —Does staff receive training on energy management?"

Response	Frequency (n=21)
Yes	16
No	5

Table 86. QEM2a. —What types of energy management activities does the training typically involve?"

Response	Frequency (n=16)
Purchasing efficient equipment	14
Efficient operation of equipment	15
Tracking energy use	10
Setting energy reduction goals	6
Writing an energy management plan	1
Available technical resources (where to go for help)	10
Availability of financial incentives for projects	13
Other	2

Table 87. QEM3. —Is someone at your facility a designated "Energy Manager'?"

Response	Frequency (n=21)
Yes	4
No	17

Table 88. QEM4. —Does someone at the company track electricity or natural gas use at your facility?

Response	Frequency (n=21)
Yes, both electricity and natural gas	14
Yes, just electricity	2
Yes, just natural gas	0
No	0
Yes, but did not specify between electricity and natural gas	5

Table 89. QEM4a. —How is energy tracked?"

Response	Frequency (n=21)
Review billing data	10
Meter energy use	6
Other	1
Don't know	1
No response	6

*Note: Multiple responses were allowed.

Table 90. Crosstab of "Does someone at the company track electricity or natural gas use at your facility?" and "How is energy tracked?"

	Review Billing Data	Meter Energy Use	Other	Don't Know	No Response
Yes, both electricity and natural gas (n = 14)	9	6	0	1	1
Yes, just electricity (n = 2)	1	0	1	0	0
Yes, just natural gas (n = 0)	0	0	0	0	0
No (n = 0)	0	0	0	0	0
Yes, but did not specify between electricity and natural gas (n = 5)	0	0	0	0	5
Total (n = 21)	10	6	1	1	6

*Note: Multiple responses were allowed.

Table 91. QEM4b. "How often is that information reviewed?"

Response	Frequency (n=21)
Daily	2
Weekly	2
Monthly	11
Quarterly	1
Annually	1
Other	1
Don't Know	3
No response	5

*Note: Multiple responses were allowed.

Table 92. QEM5. "Does your facility set energy reduction goals or goals to reduce energy intensity?"

Response	Frequency (n=21)
Yes	13
No	8

Table 93. QEM6. "Will your facility participate in NWFPA's goal for their members to reduce energy intensity by 25% in 10 years?"

Response	Frequency (n=21)
Yes	7
Maybe in the future	3
No	2
Don't know	7
No Response	2

Table 94. QEM7. —Does your facility have an energy management plan?"

Response	Frequency (n=21)
Yes	5
No	15
No Response	1

Table 95. QEM6a. —Do you revisit your plan on a regular basis, or update it as operations change?"

Response	Frequency (n=5)
Yes, we update on a regular basis	4
Yes, we update as operations change	1

Table 96. QEM8. —Have you implemented any of the following actions in the past two years in order to save energy?"

Response	Frequency (n=21)
Leak tag program / leak detection and repair (check for air leaks.)	16
Lighting reduction, turning lights off when not in use	17
Equipment operation schedule or turning equipment off when not in use	19
Equipment settings (decreasing temperature, pressure, motor speed)	17
Removing equipment	9
Equipment Maintenance	19
Production floor cleaning practices	11
Insulate pipes or tanks	17
New equipment fuel switching	1
Updating hydraulic pump system	1
Steam and compressed air systems, condensate recovery	1
Replace lights	1
Energy audits	1
Replaced pulp drying using old conventional drums that used 200 tons of coal a day with steam dryers	1
Total Product Management- has an energy component	1
Boiler efficiency, oxygen trim, heat recovery, economizers	1
Ongoing review	1

*Note: Multiple responses were allowed.

Table 97. QEM9. —Have you observed energy savings from any of these actions?"

Response	Frequency (n=21)
Yes	14
No	4
Don't Know	2
No Response	1

Table 98. QEM10. —Did you receive technical assistance for any of these actions?"

Response	Frequency (n=21)
Yes	19
No	2

Table 99. QM10a. —Who provided the technical assistance?"

Response	Frequency (n=19)
NEEA/Ecos	3
NWFPA	2
BPA/Cascade Energy Engineering/Strategic Energy Group/Evergreen Consulting	6
ETO	1
Utility	13
Equipment distributor/manufacturer	8
Energy consulting company	3
Other	6
Don't know	1

*Note: Multiple responses were allowed.

Table 100. QEM11. —What were the barriers to implementing any of these actions?"

Response	Frequency (n=21)
Too expensive to implement (Includes too long of ROI)	15
Cannot get approval from management	2
Lack of knowledge	1
Other priorities demand resources	3
Other	5
No Barriers	1

*Note: Multiple responses were allowed.

Table 101. QEM12. —Over the past 2 years, have you installed, or are you currently installing, any equipment that you would consider energy efficient?"

Response	Frequency (n=21)
Yes, have installed energy efficient equipment over past 2 years	12
Yes, currently installing energy efficient equipment	0
Yes, both installed energy efficient equipment over past 2 years AND currently installing	6
Don't Know	1
No response	2

Table 102. QEM13. —What information do you rely upon to tell you if the equipment you

are buying is energy efficient?"

Response	Frequency (n=21)
Efficiency rating or label of equipment	6
Equipment dealer said it was efficient	14
Personal experience	2
Met utility rebate requirements	2
Other	9
No Response	2

*Note: Multiple responses were allowed.

Table 103. QEM14. —Have you quantified the amount of energy savings from these projects?"

Response	Frequency (n=18)
Yes	11
No	6
No response	1

Table 104. QEM15. —What motivated you to install energy efficient equipment?"

Response	Frequency (n=18)
Save energy and money	15
The equipment distributor or manufacturer recommended it	1
Recommended in an energy audit	1
Tax incentives or rebates	4
Other	9
No Response	1

*Multiple responses were allowed

Table 105. QEM16. —Did you receive any financial incentives like tax credits, rebates or incentives from your utility or other institutions for these measures?"

Response	Frequency (n=18)
Yes, Federal tax credit	1
Yes, State tax credit	3
Yes, Utility rebate or incentive	14
No	1
Don't know	1

*Multiple responses were allowed

Table 106. QEM16a. —Which utility or institution provided the incentive?"

Response	Frequency (n=16)
ETO	1
BPA	3
Pacific Power	1
Puget Sound Energy	1
Grays Harbor PUD	1
Idaho Power	5
Other Utility	4
No Response	2

*Multiple responses were allowed.

Table 107. QEM17. —When considering energy efficiency projects versus other capital investments, is there a difference in the Return on Investment requirements?"

Response	Frequency (n=21)
Yes	7
No	13
No response	1

Table 108. QEM18. —Does your facility have a specific policy that says you should replace worn out equipment with high efficiency equipment?"

Response	Frequency (n=21)
Yes	5
No policy	7
No, but we have an informal policy	9

Table 109. QEM19. —Do your equipment dealers emphasize energy efficiency when explaining your equipment options?"

Response	Frequency (n=21)
Yes, always	8
Yes, sometimes	10
No, never	2
Don't know	1

Table 110. QAW4. —Have you heard of the term Continuous Energy Improvement or CEI? If yes, how did you hear about CEI? What is your understanding of CEI? ?"

Response	Frequency (n=21)
Yes	10
No	11

Table 111. QAW4. —Have you heard of the term Continuous Energy Improvement or CEI? If yes, how did you hear about CEI? What is your understanding of CEI? " – Individual responses for those answering —Yes"

Responses (n = 10)
(We) heard through NEEA, it helps manage (our) energy as a controllable expense
Yes, this was part of the kaizen blitz- you're never done- you're not all knowing- have to keep looking at the issues. It goes right along with continuous process improvement. ETO was the sponsor of the kaizen blitz- I think the technique came from Toyota- it's Japanese for continuous improvement.
Yes heard about it during training 2 years ago during energy efficiency spree, with SEG
(We've) used it as part of their corporate culture.
Heard about it through the NEEA seminar given here in Sunnyside in April or May, It's a continuous process to become more energy efficient.
Don't remember, maybe NEEA. It is the application of continuous improvement processes specific to energy, re-examine process from energy standpoint
Yes- have been involved in lean manufacturing and CEI continuously- it means to essentially keep up- good enough is never good enough.
Yes have heard of this from the NWFPA- NEEA within the past three years- have our own internal program- Continuous Improvement Program- covers Energy, Environmental, Safety- everything important. (The CEI definition would be) to make you aware of and continually look for energy efficient opportunities.
Yes. I heard about it through publications. My understanding of it is to always look for better ways to use energy more efficiently.
Yes I heard about it through the Corporate office- they brought up CEI at last April's staff meeting. CEI is just continually trying to reduce energy and fuel use- it also reduces our costs.

Note: n = 1 for each response above.

2010 Market Partner Frequencies

Table 112. QPO1 —Are you familiar with NEEA's Industrial Initiative and Continuous Energy Improvement, or CEI?"

Response	Frequency (n=10)
Yes	8
Somewhat	2
No	0

Table 113. QPO2 —Does your utility actively promote [still promote (if promoted energy management in 2009)] energy management practices to your customers as part of your energy efficiency offerings?"

Response	Frequency (n=10)
Yes	7
No	3

Table 114. QPO3a —Did your utility [will your utility (if no program yet)] use NEEA's program as a guide for developing your energy management program?"

Response	Frequency (n=6)	Verbatim
Yes	3	• Yes, It was hard work designing the three components of energy management program. The design was based on CEI and we give a lot of credit to NEEA for program design. We wanted to use CEI brand in our program offerings but NEEA refused. We believe that NEEA missed an opportunity here • Definitely, the content was straight out of CEI. We also pay incentives (which NEEA can't do). The cost to launch was minimal, because content was already developed by NEEA. NEEA wouldn't let us use the term "CEI" and so we were forced to use other names. We believe this was a huge mistake because it isn't market transformation.
No	3	• Will be based on the BPA program • Will be based on the BPA program • Program was around before NEEA's program

Table 115. QPO3b —What are the program goals?"

Response (n=4)
Reduce energy use by 25% in 10 years
No quantitative goal. Program goal is to achieve measurable energy intensity reductions through behavior change
12 aMW goal in 2010, 15 aMW goal in 2011.
Reduce energy intensity by 25% over 10 years

Table 116. QPO3i —Does the program offer incentives?"

Response	Frequency (n=4)
Yes	3
No	1

Table 117. QPO3ia "If yes, for what measures or practices?"

Response (n=3)
Everything that saves energy that they can analyze.
Equipment upgrades and O&M; leak tag programs, O_2 on boilers, process heating and steam areas is what they like to focus on
Energy Management

Table 118. QPO3ib —If yes, what are the incentive amounts?"

Response (n=3)
• O&M $0.08 cents/kWh capped at 50% of cost. Custom measures $0.025/kWh capped at 50% for measure life • IEI $0.02 cents/kWh capped at 50% • Self-direct gets $0.001 cents kWh capped on cost. Kaizen blitz gets $00.008 cents/kwh capped at cost
$100k or less
• One aspect offers funding for a salaried energy manager position • Other aspect offers $0.25/kWh or 70% of project cost (whichever is lowest)

Table 119. QPO3k —What are your reasons for offering an energy management program?"

Response	Frequency (n = 4)
CEI has been incorporated into the region's Sixth Power Plan	1
Industrial customers saw benefits from other programs, and expressed interest in having access to a program they could participate in	1
CEI provides a cost-effective means of achieving energy savings goals, and an effective way to achieve low-cost energy savings, with little capital outlay required for participants during a difficult economic period	1
The market partner is strongly committed to providing comprehensive services to industrial customers/sites, and formal planning to achieve comprehensive savings proved the best approach for this	1

Table 120. QPO4 —What are your reasons for not offering a program that promotes CEI?"

Response	Frequency (n = 4)
Insufficient number of industrial customers, who are diverse in their energy usage, staffing, structure, and products	1
Insufficient number of LARGE industrial customers	1
Very few large customers are interested	1
Market partner does not know how to quantify savings to perform the required TRC test	2
Market partner does not have funding and staff do not have time	1

Note: More than one response allowed.

Table 121. QCA1 —What percentage of industrial customers are aware of the opportunity to save energy using energy management practices?"

Response	Frequency (n = 10)	Verbatim
25%	2	• Growing, around 25% • 25% of largest customers
50%	1	• Within the larger facilities, approximately 50% are aware of opportunities for energy savings
75%	1	• 75% are aware, but it is hard for them to quantify savings, costs, or which opportunities are the most valuable
80%	1	
Almost 100%	1	• Almost all are aware, but actual implementation varies by size. Larger facilities are much more likely to have an energy manager or someone who knows a little bit like who to call or where to go for help. There is lots of help and training out there if they look for it. Small plants typically do not have anyone who can spend the time on energy
100%	1	
No numerical response	1	• Just their largest customer (represents 10% of utility load)
Don't know	2	• Don't know, but most know that how they run their equipment affects their bill. They tend to be pretty knowledgeable about these things. The larger issue is conveying the issue to everyone else

Table 122. QCA2 —In general, on a scale from 1-5 where 1 is not at all interested and 5 is very interested, how interested are the aware industrial customers in integrating/adopting energy management practices?"

Response	Frequency (n = 10)	Verbatim
1 to 2 (1 = not at all interested)	1	• If no utility incentive, then 1-2.
3	1	• So many customers that have huge opportunities for capital investments, including EE. Energy efficiency equipment is the highest priority of those energy efficiency opportunities because the savings are quantifiable. Energy management (i.e. difficult to quantify) savings are second to that. Because industrial programs are still fairly new, there is still low-hanging fruit for capital energy efficiency investments that customers are going to take advantage of first
4	2	• Once industrial customers learn about CEI, they are very interested. However, for most facilities there is a real conscientious assessment about whether participation in a program is worth it. Many facilities do not want to be held to the expected 1,000,000 kwh savings goal in order to receive the incentive • Large facilities are more interested, but it is not a priority
5 (Very Interested)	1	
No numerical response	2	• Very few small facilities are aware of energy management.
No response	3	

Table 123. QNF1 —On a scale from 1 to 5 (1 being poor and 5 very good) how would you rate your utility's current relationship with NEEA's Industrial Initiative (aka IEA) in particular?"

Response	Frequency (n=7)
5	1
4	4
3	1
2	0
1	1

Table 124. QNF4 —IfNEEA were to offer assistance or training in designing an energy management program, would your utility be interested in participating?"

Response	Frequency (n = 5)	Verbatim
Yes	3	• Yes, they would like to see how the other programs are designed so that they can roll out their own program.
No	2	• No because they can't quantify savings/costs and conduct the Total Resource Cost test. NEEA could offer this to their customers, but because [Market Partner] is restricted by the Commission, they can't offer programs that they can't prove are cost-effective up front. • No, not until either a) NEEA comes up with a proven method for quantifying energy savings; or b) PUC accepts energy savings that are less quantifiable (i.e., energy management). The PUC does a prudency review of all of the [Market Partner] expenses. If any money is being spent that is not prudent, then they get penalized for spending ratepayer dollars that aren't cost-effective.
No response	0	

Table 125. QNF5 —NEEA is considering encouraging facilities to utilize energy management software. Do you think this would be an effective strategy for promoting energy management practices?"

Response	Frequency (n = 10)	Verbatim
Yes	3	• [MARKET PARTNER] has done a lot of training in this area. DOE has a comprehensive software suite; always the need for training; tool user groups would be useful.
Maybe/Mildly/ Possibly	4	• Most customers tend to have some sort of system, it's more a matter of seeing what needs to be added to it. Doesn't think there is one software everyone can use. • Maybe, trick is that it has to be software that the utility can also make use of and communicate back and forth with utility/NEEA/customer. • Possibly, it depends on software. There has been a lot of time and money trying to get their MT&R to work, when it's just a simple regression analysis. Good for smaller commercial where they have one product. • It is kind of applicable but it is one more piece of software that the facility would have to learn to use and it does not directly monitor the system.
Don't Know	1	• Don't know, but not likely because most supply customers are not interested because it's not cost-effective or tangible for them.
No	0	
No response	2	

Table 126. QNF6 —Are you familiar with ISO 50001?"

Response	Frequency (n = 10)
Yes	8
No	0
No response	2

Table 127. QNF5a —Do you think that promoting the ISO 50001 standard would be an effective use of NEEA's resources? What are your reasons for saying that?"

Response	Frequency (n = 10)	Verbatim
Yes	4	• Yes, but they shouldn't focus on it exclusively because not everyone will do it • Yes, NEEA could focus on specific customers that would be open to it. Wouldn't suggest that it would be a great tool for broad promotion. • Definitely, it is a great concept and one of the ways to address the group of willing customers. I think ISO 50001 is better than CEI. • Yes, DOE is putting together documents to standardize pieces of ISO 50001. When a large facility signs up, assessments are free (DOE is focused on larger facilities); NEEA should look at rules for small and medium size industries where assessments are not free. NEEA could provide local support to get plants to participate in the federal programs. The barrier is that plants do not want to make a commitment they see as binding. NEEA could get them comfortable with it by explaining their obligations and the potential costs.
No	2	• Only applicable to larger customers • Hard to prove energy savings
Possibly	1	
Don't Know	1	
No response	2	

Table 128. QNF7 —Is there other assistance that NEEA could provide to help promote energy management to your customers?"

Response	Frequency (n = 10)	Verbatim
More collaboration with utilities	2	• Right now it's just the utilities sharing info. Would like NEEA to set up a collaboration so that other utilities can learn from those programs in order to do their own • I would like to NEEA to share more about how they verify and measure savings. Need to find a way to share NEEA's story about how to measure energy savings from CEI.
Trainings and demonstrations	2	• I would like to see trainings for energy management for process engineers - how to set it up, how to measure, how to manage it • I would like NEEA to provide demonstrations for new technologies
Promote investigation of widget-based opportunities	1	
Investigate how to change corporate culture	1	
RTF review and approval of measure savings	1	• NEEA should take measures to the RTF, but not by themselves. They need to do it with some input.
Collateral materials for broader marketing	1	
More field staff working directly with facilities	1	
None	2	
No response	1	

Note: More than one response allowed.

2010 Trade Ally Frequencies

Table 129. QS5 —What energy management related services does your company offer to industrial customers?"

Response	Frequency (n=5)
Energy audit	4
Analysis of energy intensity	4
Set energy reduction goals	4
Design energy plan to reach goals	4
Tracking energy use	5
Efficient equipment trainings	3
Efficient O&M Practices trainings	3
Quantifying energy savings from measures	5
Visit facility regularly to update strategy and/or goals	4
Other: Identifying projects and opportunities	1

Note: More than one response allowed.

Table 130. QS9 —Which market segments does your business serve for energy management consulting?"

Response	Frequency (n=5)
Agriculture	1
Food products and beverages	3
Textiles and apparel	0
Wood products	3
Paper manufacturing	3
Printing and publishing	0
Petroleum / Chemicals	1
Rubber and plastics	0
Nonmetallic mineral products	0
Primary metals	2
Industrial machinery	1
Computers and electronic manufacturing	2
Electrical equipment	0
Transportation equipment	0
Furniture and fixtures	0
Miscellaneous manufacturing	1
Commercial / Educational	0
Health Care	0
Mining / Minerals	1
Irrigation	1
Water / Wastewater	1
Cold storage	1

Note: More than one response allowed.

Table 131. QCA1 —In your estimation, what percentage of industrial customers is aware of the opportunity to save energy using energy management practices?"

Response	Frequency (n=5)
30%	1
50%	1
70%	2
Most	1

Table 132. QCA2 —For the industrial customers that are aware of energy management, in general, on a scale from 1-5 where 1 is not at all interested and 5 is very interested, how interested are they in integrating/adopting energy management practices?"

Response	Frequency (n=5)
1	0
2	2
3	1
4	1
5	0

Note: One respondent did not provide numerical response, but said: "Most would be interested in adopting improvements, but don't necessarily know how to go about it. Usually interested because energy is one of the top expenses." Response not coded above.

Table 133. QCA3 —For the range of industries you serve, which three industries are typically MOST receptive to energy efficient options and/or a systems based approach? Please list the top 3 with the MOST receptive industry first."

Response (n=5)
1. Food products and beverages (Food Distribution) 2. Paper mfg. (Pulp & Paper) 3. Food products and beverages (Food Processing)
1. Food products and beverages (Food Processing)
1. Food products and beverages (Food Processing)
1. Wood products 2. Computers and electronic manufacturing 3. Primary metals
1. Petroleum/chemical 2. Food processors 3. Wood products

Table 134. QCA4 —For the range of industries you serve, which three industries are typically LEAST receptive to energy efficient options and/or a systems based approach? Please list the bottom 3 with the least receptive industry first."

Response (n=2)
1. High tech industries (ex. silicon wafer manufacturing, micro processor manufacturing)
1. Water / wastewater because they are risk averse 2. Paper mfg. (Pulp & Paper) 3. Agriculture

Table 135. QCA5 —What percentage of industrial facilities would you estimate are currently practicing energy management strategies?"

Response	Frequency (n=5)
1%	1
20%	1
50%	1
Don't Know	1
No response	1

Table 136. QCA5a —How does this compare to 5 years ago?"

Response (n=3)
More than 5 years ago – it would've been zero or 0.1% back then.
Up from 10%.
It has increased. I'd say it was 30% five years ago.

Table 137. QCA5b —How many of those are practicing energy management on their own, i.e., without technical or financial assistance from NEEA or their utility?"

Response	Frequency (n=4)
Probably none	1
Not many	1
10%	1
25%	1

Table 138. QCP5a —What percentage of their electric bill can an industrial facility expect to save during the initial (one to two) years? Does this rate of savings continue after the initial years? If not, how does it change?"

Response (n=5)	Frequency (n=5)
2%	1
10%; It increases	1
15%; Sustains and improves but then plateaus	1
Don't know	2

Table 139. QCP5b —What is the cost per kWh to implement CEI during the first one to two years? Please include consulting fees, software costs, O&M practices upgrades costs, and employee training costs."

Response (n=3)	Frequency (n=5)
$50,000 - $500,000	1
25 cents per kWh	1
$60,000	1

Table 140. QCP5c —And how much does it cost an industrial facility per year to continue practicing energy management?"

Response	Frequency (n=3)
$20,000	2
5 cents per kWh	1

Table 141. QMT1 —In your opinion, has industrial facility awareness of energy management practices increased, decreased, or stayed the same over the last 5 years?"

Response	Frequency (n=5)
Increased	3
Decreased	0
Stayed the same	0
Don't know / not sure	2

Table 142. QMT2 —In your opinion, has the number of industrial facilities practicing energy management increased, decreased, or stayed the same over the last 5 years?"

Response	Frequency (n=5)
Increased	4
Decreased	0
Stayed the same	0
Don't know / not sure	1

Table 143. QMT3 –How have industrial facilities' perceptions of energy efficiency changed over the last 5 years?"

Response	Frequency (n=5)
There is awareness that energy has a cost and that that cost is controllable.	1
They are more open to it now	2
No response	2

Table 144. QMT4 –Are there other ways the industrial market for energy management has changed over the last 5 years?"

Response	Frequency (n=5)
Economic pressure to reduce costs, new technologies and practices, new resources and the resources that were around five years ago have improved. Also NEEA's program has improved a lot.	1
There are more training opportunities and incentives available for energy management.	1
There are more energy management software solutions available	1
No response	2

Table 145. QMT5 —Wht have been the drivers in the industrial market change? This could include people, groups, or market factors."

Response	Frequency (n=4)
NEEA's Industrial Initiative Program	1
Other utility energy efficiency programs	0
Electricity or natural gas prices	1
Other facility costs increased	0
Changes in environmental awareness and attitudes	2
Facilities want to present themselves as "green"	2
Other: Increased marketing	1
Other: Utility, state and federal incentives.	1
Other: Energy is more visible now than 5 years ago	1

Note: More than one response allowed.

Table 146. QMB1 —What are some of the key barriers to industrial facilities adopting energy management?"

Response	Frequency (n=5)
Industrial facility staff are not aware of energy management and opportunities for savings	2
Energy savings are not a priority or an interest	2
Industrial facilities lack capital or bank financing to implement energy management	2
Energy management is not perceived to be cost-effective	0
Industrial facility staff lack technical skills to implement	2
Lack of compatible equipment	0
Other: Lack of employee time	2
Other: The ability to effectively market the opportunity	1
Other: Outside parties like [CONTRACTOR] and NEEA being able to deliver a compelling message for the facility to do energy management	1
Lack of upper management support or direction	1
Other: Lack of a dedicated resource (an empowered energy champion),	1
Other: Lack of a strategic plan	
Other: Not everyone who has an impact on energy use is engaged	1
Other: Structure not in place to support ongoing tracking and management of KPIs	1
Other: Capital often used for other priorities (financial benefits are not always fully understood)	1
Other: Information about projects is often coming from vendors who are biased – they need an unbiased source of information	1
Other: O&M practices are not what they need to be – equipment not running efficiently	1
Other: Facility managers may not have tools to sell project to their executive team	1
Other: Unwillingness to change	1

Note: More than one response allowed.

Table 147. QMB2 —Do youthink NEEA or other energy efficiency programs are effectively addressing these barriers?"

Response	Frequency (n = 5)	Verbatim
Yes	3	
Somewhat	2	• The NEEA program helps because there is a platform, but doesn't affect decisions at plant level. • I think all programs could do a better job of communicating the concrete results that have occurred from the facilities that have done energy management and explain what changes have been made to realize these changes.
No	0	

Table 148. NF2. —Is there any assistance that NEEA could provide to help promote energy management to your customers?"

Response	Frequency (n = 5)
Raise facilities' interest and effectively communicate how they can participate.	1
Communicate concrete results of implementing energy management strategies and changes necessary to realize these results.	1
Continue to educate and gain support from upper management	1
Continue to explore other target markets	2
Create messaging about utilizing energy management to manage risk	1
Offer training on basic energy management concepts and energy tracking principles	2
Continue to offer the Initiative in regions not covered by BPA, the ETO, or other utility programs.	1
Improve ability to quantify savings	1
Promote ISO 50001 activities	1
Promote energy management software	1
Standardize CEI in the region	1
Coordinate efforts with utility incentive programs	1

Appendix F: Market Diffusion Model Methodology and Assumptions

This appendix describes the theoretical model underlying the market diffusion curve and the development of data inputs for populating and calibrating the model.

Model Overview

The market diffusion of an energy-efficiency measure depends on awareness of the measure and the perceived benefits of its adoption. Cadmus modeled both the diffusion of awareness and adoption of energy management practices in the Pacific Northwest. Cadmus used a Bass model, which has its roots in epidemiological models of disease transmission, to model the diffusion of awareness of energy management practices. In the Bass model, diffusion of awareness is a function of word-of-mouth transmission, as adoption is assumed to depend solely on whether one has knowledge of the measure. In the model, NEEA's efforts at marketing the Industrial Initiative and CEI increase the rate at which awareness of energy management grows in the population of food processors.

While measure awareness is necessary for adoption, it is not sufficient in and of itself. A measure's probability of adoption, conditional on awareness, is a function of adoption's economic benefit and other, noneconomic factors, such as potential adopters' tastes. Cadmus modeled an adoption decision using a probabilistic, rank-probit approach, taking into account the discount rate; the cost of implementing energy management; the value of the expected energy savings; and economic incentives.

Model Description

We begin by modeling the pecuniary value of two competing technologies: one that is energy efficient (EE) and promoted by NEEA, and the other which is the next-best alternative (A). The pecuniary value of a new technology is the net present value of the stream of pecuniary benefits, less costs, over the course of the technology's lifetime. We assume the technology is a strict necessity (e.g. ,light, heat, refrigeration, etc.); without it, income (Y) for households or firms would be zero. This implies EE or A will be used in each period.

Each individual unit of an EE or A technology is assumed to have an uncertain lifespan, which we model as a probability that the technology does not fail and have to be replaced (q). We let the probability of replacement increase with the age (a), years of service, of the technology.

Borrowing a clever mathematical apparatus from discrete dynamic programming, we can recursively specify the expected net present value of a new EE technology (with the expectation of replacing it, when it fails, with another EE technology):

$$V_{EE,a=1} = \left[Y - OC_{EE} \right] - IC_{EE} + \beta \left[(1 - q_{EE}) V_{EE,1} + q_{EE} V_{EE,a=2} \right]$$
$$V_{EE,a>1} = \left[Y - OC_{EE} \right] - \beta \left[(1 - q_{EE}) V_{EE,1} + q_{EE} V_{EE,a+1} \right]$$

Where

V_{EE},a = the pecuniary value of a unit of EE technology in the ath period of its life (i.e., a = 1 when it is new)

Y = time-invariant (expected) income (revenue)

OC_{EE} = the total costs operating while using a unit of the EE technology

IC_{EE} = the initial cost of getting a unit of the new EE technology

β = time-invariant discount factor: 1/(1 + interest rate)

1 - q_{EE}(a) = probability of a unit of the EE technology failing in the ath period of its life

After recursive substitution and gathering like terms, we arrive at:

$$V_{EE,a} = -1\{a=1\}IC_{EE} + (Y - OC_{EE})\left[1 + \beta q_{EE}(a) + \beta^2 q_{EE}(a)q_{EE}(a+1) + \beta^3 q_{EE}(a)q_{EE}(a+1)q_{EE}(a+2) + \cdots\right] + \\ + V_{EE,1}\left[\beta(1-q_{EE}(a)) + \beta^2 q_{EE}(a)(1-q_{EE}(a+1)) + \beta^3 q_{EE}(a)q_{EE}(a+1)(1-q_{EE}(a+2)) + \cdots\right]$$

Letting the sum in first bracketed term be denoted as S_q(a) and second as S_{1-q}(a):[18]

$$S_{q,EE}(a) = 1 + \beta q_{EE}(a) + \beta^2 q_{EE}(a)q_{EE}(a+1) + \beta^3 q_{EE}(a)q_{EE}(a+1)q_{EE}(a+2) + \cdots$$
$$S_{1-q,EE}(a) = \beta(1-q_{EE}(a)) + \beta^2 q_{EE}(a)(1-q_{EE}(a+1)) + \beta^3 q_{EE}(a)q_{EE}(a+1)(1-q_{EE}(a+2)) + \cdots$$

Substituting in and solving for the pecuniary value of a unit of the EE technology yields an intuitive equation for the present value of the technology for any later vintage:

$$V_{EE,a>1} = (Y - OC_{EE})S_{q,EE}(a) + V_{EE,1}S_{1-q,EE}(a)$$
$$V_{EE,1} = -IC_{EE} + (Y - OC_{EE})S_{q,EE}(1) + V_{EE,1}S_{1-q,EE}(1)$$

These expressions suggest an intuitive interpretation of the S terms. S_q is the sum of the discounted stream of probabilities of accruing revenue without replacing the technology, and S_{1-q} is the sum of the discounted stream of probabilities of the technology failing, and thus having to be replaced and started over with a new technology. Manipulating the second equation to solve for the present value of the technology when it is new, we obtain:

$$V_{EE,1} = \frac{1}{1 - S_{1-q,EE}(1)}\left[(Y - OC_{EE})S_{q,EE}(1) - IC_{EE}\right]$$

[18] Note that because Sq(a) and S1-q(a) sum over bounded monotone sequences, each has a finite sum. Hence, time-invariant probabilities exist that would generate the certainty equivalent of each of these two sums.

We can combine these two equations for the present value of the device to give a general equation that works for every vintage:

$$V_{EE,a} = (Y - OC_{EE})\left[S_{q,EE}(a) + \frac{S_{q,EE}(a)S_{1-q,EE}(a)}{1-S_{1-q,EE}(a)}\right] - \frac{IC_{EE}}{1-S_{1-q,EE}(a)}\left[S_{1-q,EE}(a) - \delta_{a>1}\right]$$

Note that other than the subscripts, these equations are the same for the alternative device A. Assuming the customer plans to stick with the same device, it is optimal to wait until that device fails to replace it because it postpones the initial cost of a new device (and, hence, discounted by the interest rate in pecuniary value):

$$V_{EE,1} < V_{EE,a}$$

The customer's objective is to pick a technology that maximizes the net present value of the future stream of income, plus an idiosyncratic term that represents the customer's relative tastes for the EE technology, and a term (D) that captures deviations from linearity due to risk aversion and/or behavioral heuristics. The idiosyncratic term is included because some customers do not care for the non-energy attributes of energy-efficient technologies (e.g., the color of light produced by CFLs), while others derive satisfaction from reducing their impact on the environment.

A customer with an age a technology of type A will switch to an E type if:

$$V_{EE,1}(\beta, p_{EE}, IC_{EE}, OC_{EE}, Y) + D(a, IC_{EE}) + \varepsilon \geq V_{A,a}(a, \beta, p_A, OC_A, Y)$$

Given that taste for the EE device is unobserved by the statistician, the probability that a customer with an age a technology of type A will switch to a type E technology is given as:

$$\Pr(Switch_{TO}EE_{FROM}A|a) = \Pr(\varepsilon \geq V_{A,a}(\cdot) - V_{EE,1}(\cdot) - D(\cdot)|A,a)$$

The unconditional probability of switching from A to EE is then:

$$\Pr(Switch_{TO}EE_{FROM}A) = \sum_a \Pr(\varepsilon \geq V_{A,a}(\cdot) - V_{EE,1}(\cdot) - D(\cdot)|A,a)\Pr(A,a)$$

By specifying a parametric family of distributions for ε, we specify an estimable functional form for the parameters, describing the probability that a customer switches to the EE technology.[19] Looking carefully at the economic model shows there are many reasons why a customer may not switch to the EE technology:

1. The existing type A technology is too valuable to scrap because it is too new.
2. The incentive (e.g., NEEA's subsidization of IC) may be too low to justify the additional expense of the EE technology, despite the reduced operating costs.
3. Interest rates may be too high, given the reliability of the technology, to make it worthwhile.
4. A distaste for the EE technology.

To nest this economic model in a standard Bass diffusion model, which is actually an application of an epidemic model to technological diffusion, we make a few additional assumptions. First, we make the standard assumption that once a customer decides to switch to the EE technology, they never switch back. Second, we assume there is imperfect information in the market, hence a customer with a type A technology can only switch to the EE technology if they are fully aware of it.

We model this uncertainty in a highly stylized manner: the customer is either completely aware of the EE technology, its quality, and its price (net of incentive), or they are completely unaware. Hence, the possible information sets are $I_0 = \{A\}$ and $I_1 = \{A,EE\}$. The above probability for switching from A to EE, conditional on a, can be reformulated as:

$$\Pr(Switch_{TO}\, EE_{FROM}\, A \mid a, I_1) = \Pr(\varepsilon \geq V_{A,a}(\cdot) - V_{EE,1}(\cdot) - D(\cdot) \mid A, a)$$
$$\Pr(Switch_{TO}\, EE_{FROM}\, A \mid a, I_0) = 0$$
$$\Pr(Switch_{TO}\, A_{FROM}\, EE \mid a, I_1) = 0$$
$$\Pr(Switch_{TO}\, A_{FROM}\, EE \mid a, I_0) = 0$$

Letting N denote the number of customers aware of the EE device and P denote the entire population of customers.

[19] Either the generalized logistic distribution or the Gumbler/Gompertz/Fisher-Tippett/Extreme Value distribution would work, as both have unbounded support and permit right-skewedness, which a priori theory would suggest is the proper shape of the distribution. The simplest implementation would be the logistic distribution. The LogLogistic/Fisk distribution, a special case of the Burr distribution, would also work, but its support has a lower bound at 0.

The time path of the diffusion of awareness is described by a generalization of the logistic function:[20]

$$N_t = \frac{P}{\left[1 + e^{\frac{\alpha_o + \alpha_1 M - t}{\tau}}\right]^{\sigma}}$$

Here, σ denotes the speed of the diffusion of awareness, τ pins down the initial awareness, and α covers the timing of the diffusion of awareness, which may be affected by the cumulative marketing expenditures (M) promoting the EE technology.[21] We can take this measure of awareness and the probability of switching given awareness, and produce the difference equation describing the evolution of market share:

$$S_{t+1} = S_t + \left[\frac{N_t(t) - PS_t}{P}\right] \sum_a \Pr(switch_{TO} EE_{FROM} A | a, I_1) \Pr(A, a; t)$$

Although this may appear to be a simple, linear, first-order difference equation, that appearance is deceiving because of the implicit evolution overtime of the distribution of existing stock of type A devices. Hence, the model's output is designed to be regularly computable, rather than to produce closed-form mathematical solutions. Nonetheless, we can show the outputted time path will be a well-behaved sigmoid. Moreover, this model reduces to the classic Bass model when the following two conditions are met:

1. σ=1, so awareness follows the logistic function.
2. The unconditional probability of switching to an EE device from a type A device is 1, all who are aware of the EE device.

Note that, unlike the common Rank (or Probit) models of diffusion, we have the flexibility of choosing to model the customers' relative taste as stable over time, independently changing, or evolving at random with some persistence (although this last case gets rather complicated).

[20] Note this is the continuous-time solution for a (generalized) logistic differential equation, just written as if it were discrete, even though time here is modeled as discrete. The logistic difference equation was not used because it generically suffers from chaotic cycling around the continuous-time solution. A sufficient, but not necessary, interpretation is awareness propagates in continuous time while device replacements evolve in discrete time.

[21] Although awareness is spread via contact, a la the Bass model, marketing expenditures can be seen as increasing the number of contacts—in this context, it would not be interpreted as an effect on the number of people interacted with but rather the probability of discussing the EE device during the interaction.

Data Development

In the model, the following parameters must be calibrated or estimated to make the model fully operational:

Model Inputs (e.g. Parameters, Exog Variables)	Description	Source for Identification
Y	Income (net revenue)	Dun and Bradstreet Food Processor Facility Data
OC	Technology operating costs	NEEA Ace Model assumptions and interviews with facilities, trade allies, and market partners
IC	Technology initial costs	NEEA Ace Model assumptions and interviews with facilities, trade allies, and market partners
Energy savings (V_A, V_{EE})	Energy savings in facilities practicing energy management	Energy savings verification data
Incentives (V_{EE})	Incentives from NEEA and other market partners	NEEA program data and interviews with market partners
R	Interest rate	Standard economic source
q (a)	Reliability of technology, decaying with age	NEEA program participation data and interviews with facilities, market partners, and trade allies
Pr(A,a)	Distribution of age of stock of existing type A technology	Assume probability of adoption does not depend on facility vintage
Σ	Maximum speed of diffusion of awareness, increasing in marketing budget	Interviews with NEEA and market partner staff
τ	Timing of maximum speed of diffusion of awareness, improving with marketing budget increases	Interviews with NEEA and market partner staff
α	Controls level of awareness at time 0	Surveys of food processing facilities
$D(a,IC_{EE})$	Deviations from linearity due to risk aversion and behavioral heuristics as a function of vintage and initial costs	Estimation of conditional probability of switching using historical estimate of market diffusion data
μ_ε	Mode of distribution of relative taste for EE device	Estimation of conditional probability of switching using historical estimate of market diffusion data
v_ε	Dispersion of distribution of relative taste for EE device	Estimation of conditional probability of switching using historical estimate of market diffusion data

Income

Cadmus estimated the pre-tax income of a typical large food processing facility using revenue data from Dun and Bradstreet and information about pre-tax income for publically traded food processing companies.

Technology Initial and Operating Costs

Technology initial and operating costs are a representative food processing facility's costs of implementing energy management in year one and in subsequent years. Cadmus developed assumptions about annual facility operating costs using information from NEEA's ACE model and interviews with market partners and trade allies. Cadmus assumed the costs of implementing energy management are: $75,000 in year 1, $50,000 in year 2, $30,000 in year 3, with costs in subsequent years increasing at an annual inflation rate of 2.5 percent.

Energy Savings and Consumption

Energy savings are an input in the calculation of the net present value of adopting energy management. The model assumes that in the adoption decision plant managers only take into account expected energy savings from O & M-related energy management practices. They do not take into account expected savings from capital projects, which are a by-product of energy management and might be harder to quantify.

Cadmus estimated O & M energy savings and facility consumption using validated energy use and savings data from food processing facilities engaged with NEEA. Cadmus used conservative estimates of electric and gas consumption equal to the median annual energy consumption of large food processing facilities in the target market (15,397,921 kWh and 2,228,514 therms). Cadmus estimated facility gas and electric consumption by matching facility employment data from Dun and Bradstreet (2010) to engaged facilities. We then calculated average gas and electric consumption per employee in engaged facilities. Then we multiplied average consumption per employee in engaged facilities by the number of employees in facilities in the target market. This resulted in an estimate of gas and electric energy use for each facility in the target market.

Using the verified savings data, we estimated facility electric savings from energy management to be 2.2 percent in year 1; 3.6 percent in year 2; 2.8 percent in year 3; 3.3 percent in year 4; 3.0 percent in year 5; and 1 percent savings, thereafter. We estimated annual electric and gas savings from O & M projects as 50 percent of energy management electricity savings. We estimated facility gas savings from energy management to be: 3.2 percent in year 1; 2.5 percent in year 2; 2.9 percent in year 3; 2.5 percent in year 4; 2.5 percent in year 5; and 1 percent savings, thereafter. We estimated that annual gas savings from O & M projects were 25 percent of all energy management gas savings.

Electric and gas savings in the report include savings from both O & M and capital projects.

Incentives

Incentives are another input in the calculation of the net present value of energy management. Cadmus estimated the annual money incentives available to food processors between 2005 and 2015. We relied on program budget data from NEEA and interviews with market partners to estimate incentives.

NEEA does not offer incentives directly to food processing facilities. Instead, it contracts with energy consultants and engineers to work with participating facilities to implement CEI. NEEA's payments to consultants and engineers can, however, be viewed as an indirect incentive to facilities. We counted such payments as monetary incentives, because they covered all or some of a facility's implementation costs. In calculating incentives for energy management, Cadmus assumed that NEEA did not engage with new facilities after 2009 but continued to engage with existing participants.

After 2009, incentives were available from several market partners including Energy Trust of Oregon, BPA, Northwest Food Processors Association, and Washington State University. Cadmus collected data about incentives offered in 2010 and subsequent years from surveys of market partners conducted for the 2010 MPER.

To estimate the incentive available to the average large food processing facility, Cadmus mapped the facilities in Dun and Bradstreet to the service territories of the market partners. We then calculated the total incentive available to each facility and then averaged the total incentives.

Interest Rate

The interest rate is used in the calculation of the firm's discount rate. We used an estimate of a typical large food processors weighted average cost of capital in place of the interest rate.

Reliability of Technology

The reliability of technology refers to a technology's probability of failure as a function of its vintage. Cadmus used information about measure persistence from participant facility surveys to estimate the reliability of technology. As this information showed a very high level of persistence for O & M measures, Cadmus assumed the probability of failure was zero for all vintages.

Distribution of Vintages

Cadmus assumed that the vintage of a facility did not affect the probability of adopting energy management.

Diffusion of Awareness

Cadmus estimated the historical diffusion of awareness of energy management practices. Cadmus used surveys of nonparticipating food processing and other industrial facilities in 2005, 2006, 2007, and 2010 for this purpose. Cadmus first established a definition of awareness of energy management (see the main text). We then reviewed the survey instruments to identify questions that could be used in measuring awareness. Cadmus then selected appropriate questions that appeared in each of the surveys to generate a consistent series of awareness over time. Next, we established a set of criteria based on the answers to the awareness questions for establishing whether a facility was aware. Finally, we classified individual facilities as aware or unaware of energy management based on their survey responses. Cadmus assumed that facilities engaged with NEEA or practicing energy management independently or with another partner were aware. Cadmus then estimated a weighted average of awareness in the market using the estimates of awareness among engaged and non-engaged facilities. We interpolated values for 2008 and 2009.

Cadmus then selected parameters for the awareness equation to match the historical pattern of awareness.

Market Expenditures

In the model, marketing expenditures accelerate the diffusion of awareness. Cadmus collected data from NEEA about its marketing expenditures between 2005 and 2009 and expected marketing expenditures between 2010 and 2015. We also collected data about the planned marketing expenditures of market partners between 2010 and 2015.

The parameters of the awareness equation imply that approximately $250,000 in marketing expenditures accelerates the growth of food processing facility awareness by one year.

Diffusion of Energy Management

Cadmus also developed an estimate of the historical diffusion of energy management practices equivalent to CEI Stage 3 or higher. This series was used to calibrate the model's forecast of the diffusion of energy management between 2010 and 2015.

Cadmus estimated the historical market diffusion of energy management for facilities engaged with NEEA and those not engaged. For facilities engaged with NEEA, Cadmus relied on NEEA's Market Progress Indicator History, which tracks engagement levels for all facilities that were or are participating in the program. For facilities not engaged with NEEA, Cadmus estimated the percentage practicing energy management using surveys from 2005, 2007, and 2010.[22] Cadmus identified questions that could be used to gauge the level of engagement and that appeared in each survey. If a facility tracked energy use, had an energy plan in place, and had an energy champion or gave staff energy management responsibilities, Cadmus classified the facility as practicing energy management. (Using information about specific energy management measures and activities in food processing facilities from the 2010 survey, Cadmus found a strong correspondence between our classification of facilities practicing energy management and energy management practices reported by facilities.) Cadmus then constructed a market energy management penetration series by weighting the series for the engaged and non-engaged facilities.

Cadmus calibrated the forecast of the market diffusion of energy management practices in a series of steps. First, we generated a forecast and ~~"b~~ackcast" (predicted values in the historical period) assuming that a food processor's decision to adopt energy management depended only

[22] A concern was whether nonparticipating facilities that responded to our survey were representative of the population of nonparticipating facilities. For example, facilities practicing energy management may have been most likely to respond to our survey, which would bias our estimate of the percentage of nonparticipating facilities practicing energy management. We used information in Dun and Bradstreet about facility characteristics to assess whether our completed sample suffered from survey response bias. Using a variety of specifications, we regressed whether a facility responded to our survey on the facility's location (state), revenues, number of employees, and NWFPA membership status. Significance of the regressors would suggest the presence of selection bias. The only variable that was significant in some regressions was NWFPA membership. NWFPA membership increased the probability of responding to our survey by approximately 20 percent. However, NWFPA membership was not significant in regressions that controlled for number of employees and sales. Though NWFPA is promoting energy efficiency, facilities do not join NWFPA for that reason, therefore Cadmus concluded that the nonparticipant sample did not suffer from survey non-response bias.

on awareness and the economic benefit of adoption. We selected parameters of the market diffusion equation to minimize the sum of squared deviations between the predicted values and the historical values. Cadmus then compared the predicted series in the historical period to the actual historical series. If there was a discrepancy, Cadmus adjusted the μ parameter, which accounts for tastes for energy efficiency, until we achieved a satisfactory fit between the predicted and historical series. We then used these parameters as starting values in solving for parameters of the market diffusion equation that minimized the sum of squared deviations.

Potential Adopters of Energy Management

To construct historical series of awareness and market diffusion and to generate a market diffusion forecast, it was necessary to develop historical and forecast series of the number of large food processing facilities in the Pacific Northwest. Cadmus relied on Dun and Bradstreet data from 2005 and 2010 for this purpose.

Cadmus started with the population of food processing facilities in the Dun and Bradstreet database. Most food processing facilities had three digit primary NAICs codes of 311, but some had primary NAICs codes in the following ranges 111-115, 424, and 493. We then filtered out facilities belonging to food processors with fewer than 250 employees in the Pacific Northwest, as this is the market that the Initiative is targeting. Finally, we manually filtered out some facilities that did not appear to be food processing facilities such as small bakeries with fewer than five employees.

Market Diffusion Model Results

Cadmus developed a market diffusion forecast for energy management practices in Pacific Northwest large food processing facilities[23] to capture market effects and compare findings to the existing Alliance Cost Effectiveness (ACE) model assumptions. The forecast provides our best estimate of shares of large food processing facilities, between 2011 and 2015, that will practice energy management at a level equivalent to or higher than the Initiative's Stage 3. To forecast the market's energy savings, the market share forecast was combined with validated estimates of gas and electric savings in food processing facilities engaged with NEEA.

The Diffusion Model

Using an Excel-based model it designed and built, Cadmus generated market diffusion and energy savings forecasts. The model can forecast market penetration and energy savings for a wide variety of energy-efficiency measures, and program planners can use it to predict impacts of incentive and marketing expenditure changes on market share.

The model makes several assumptions. First, it assumes potential energy management (e.g., CEI) adopters must be aware of energy management practices before they can adopt them. By "aware," we mean a potential adopter must understand energy management's basic concepts and adoption's benefits and costs.[24] Second, the model assumes, conditional on awareness, the

[23] The forecast pertains to food processing facilities with 250 or more employees in the Pacific Northwest. Information about employment at food processing facilities was obtained from the Dun and Bradstreet database.

[24] Cadmus used surveys of food processing facilities between 2005 and 2010 to estimate awareness of energy management practices among food processors. We attempted to use similar questions in the surveys to develop a consistent series on awareness. See Appendix G for more details.

probability a food processing facility will adopt energy management is an increasing function of adoption's economic benefits. For example, the probability would increase if energy prices or facility production were to rise. Third, the model assumes adoption's probability increases depending on a facility's taste for energy efficiency. Economists have observed energy-efficiency measures diffuse at a slower rate than economic theory predicts. Firms often do not adopt energy-efficiency practices, despite their large economic benefits. This phenomenon is known as the "Energy Efficiency Paradox".[25] To account for facility managers' energy efficiency tastes, the model incorporates a behavioral parameter. In fitting the model, Cadmus uses this parameter to bridge any gaps between the model's adoption forecast, based on economic factors, and actual adoption during a historical period.

To forecast energy management's market diffusion, Cadmus populated the model with: basic data about numbers of potential adopters; energy use with and without energy management; costs of implementing energy management; NEEA and market partner incentive amounts and marketing expenditures; gas and electric rates; and other economic adoption drivers, such as discount rates and facility net incomes. In developing these inputs, Cadmus relied on Initiative program data, including: validated energy savings data from engaged facilities; past and current MPER surveys of participants, nonparticipants, and market partners; and Dun and Bradstreet data on food processing facilities.

Cadmus also calibrated the model to fit adoption patterns observed before 2010. Calibration involved selecting parameter values governing the growth rates of awareness and market diffusion. Using MPER survey data, Cadmus developed historical estimates of awareness and energy management market share for use in estimating the model parameters. Cadmus then selected parameters for awareness and market penetration equations minimizing sums of squared deviations between values predicted by the model and historical values. Appendix G contains more details about the data development and calibration process.

Forecast Results

Using the model, Cadmus generated a market penetration forecast for energy management practices in large food processing facilities for 2010 to 2015. The forecast included facilities engaged with NEEA or another market partner as well as facilities practicing energy management without the assistance of a market partner. The forecast's main assumptions included the following:

- Numbers of food processing facilities would grow very modestly between 2010 and 2015.[26]
- Food production would continue at historical levels, and energy use in food processing facilities would remain at historical levels in the absence of energy-efficiency measures.
- Retail prices for electricity and gas in food processing facilities would remain the same as those in the Council's Sixth Power Plan forecast.

[25] Jaffe, Adam B., and Robert N. Stavins, 1994. The Energy Paradox and the Diffusion of Conservation Technology. Resource and Energy Economics 16, 91-122.

[26] Globalwise, June 10, 2009. Economic Performance of the Northwest Food Processing Industry: Trends and Analysis from the Benchmark Data.

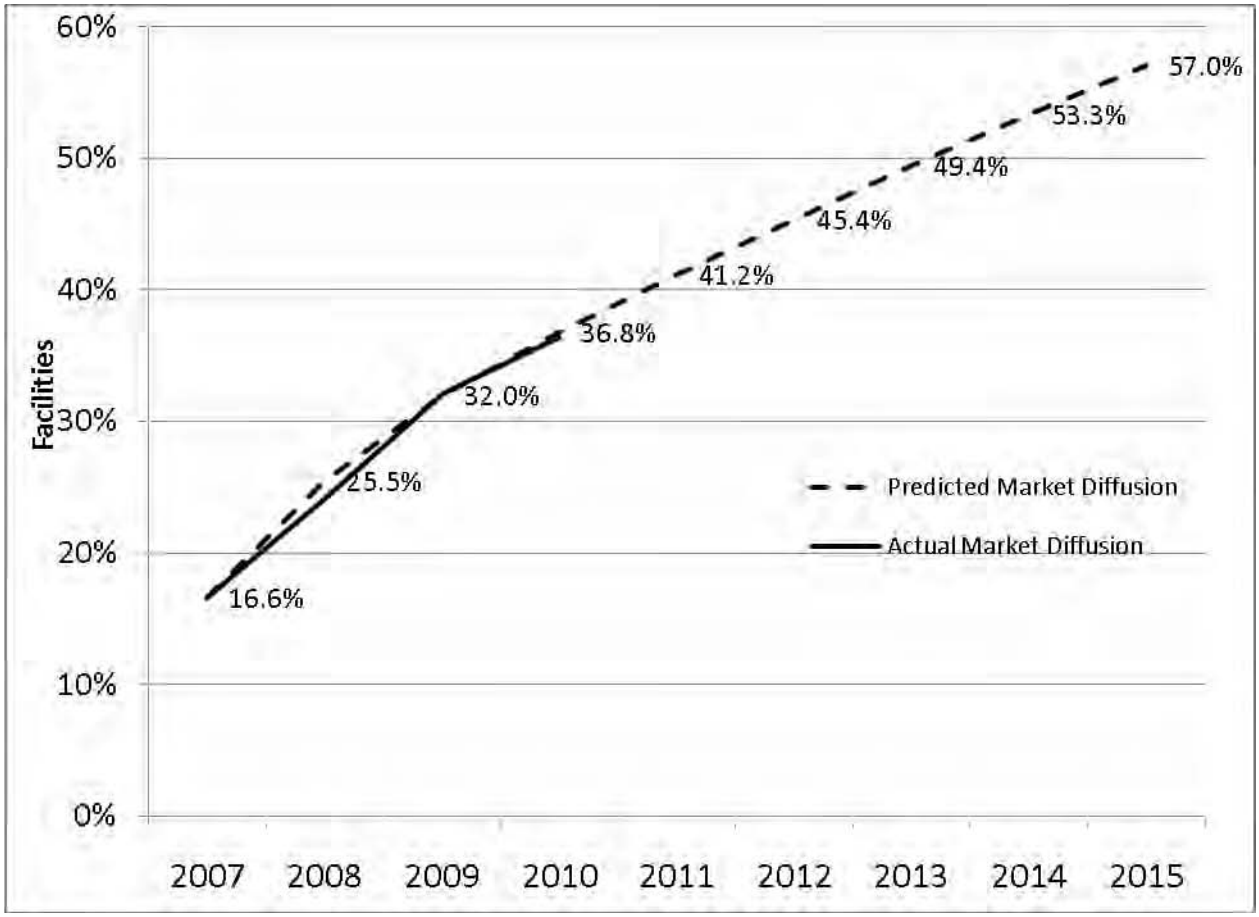
- NEEA would not engage directly with new food processing facilities; however, it would continue to promote adoption of energy management practices in the food processing industry by: sponsoring training and other education efforts; expanding the supply of vendors; engaging with the NWFPA; and providing technical solutions.[27]
- Other market partners, such the BPA and its partner utilities, and ETO, would promote adoption of energy management practices through their own programs, using marketing and incentives.[28]
- Attrition would not occur in facilities practicing energy management. Once a facility adopted energy management, it would practice energy management indefinitely.
- Savings degradation would not occur from energy management over time.

Figure 10.3 shows our estimate of energy management's historical market diffusion, and our forecast of diffusion between 2010 and 2015. In the historical period, our estimates show the energy management market in food processing facilities has grown rapidly. At the beginning of 2007, just 17 percent of facilities practiced energy management at an engagement level of Stage 3 or higher. Three years later, in 2010, market penetration climbed to 36 percent. This growth averaging 31 percent per year was driven by NEEA's marketing and education efforts, and direct engagement with food processing facilities. It was also driven by growth in energy management's adoption by facilities not engaged with NEEA.

[27] NEEA's Food Processing Market Logic Model, 2010-2014 and NEEA's Industrial Sector Strategy for 2010–2014.

[28] Based on information from 2010 interviews with market partners.

Figure 10.3. Cumulative Market Diffusion of Energy Management in Large Food Processing Facilities through 2015



Cadmus forecasts the energy management market in food processing facilities will grow from 33 percent in 2010 to 57 percent in 2015. The annual average growth rate in food processing facilities practicing energy management will be slower than in the past, but will remain high (9 percent). Cadmus believes this forecast is reasonable, given BPA's entry, its partner utilities, and other market partners in the market; the growth in the number and capabilities of trade allies; expectations of increasing prices for electricity and natural gas; and industrial energy management goals in the Council's Sixth Power Plan.

The slight concavity (bending) of the market diffusion curve in Table 6.1 reflects a slowing in the growth rate of awareness about energy management over time, and a relatively high level of initial awareness (approximately 60 percent in 2005). Also, despite significant economic benefits of adopting energy management, the model predicts the probability of adoption, conditional on awareness, as relatively low.

Table 10.149 reports energy savings forecasts for both electricity and gas from energy management adoption in large food processing facilities. For electricity, we report annual MWh and aMW of savings.

Table 10.149. Forecast of Market Diffusion and Energy Savings

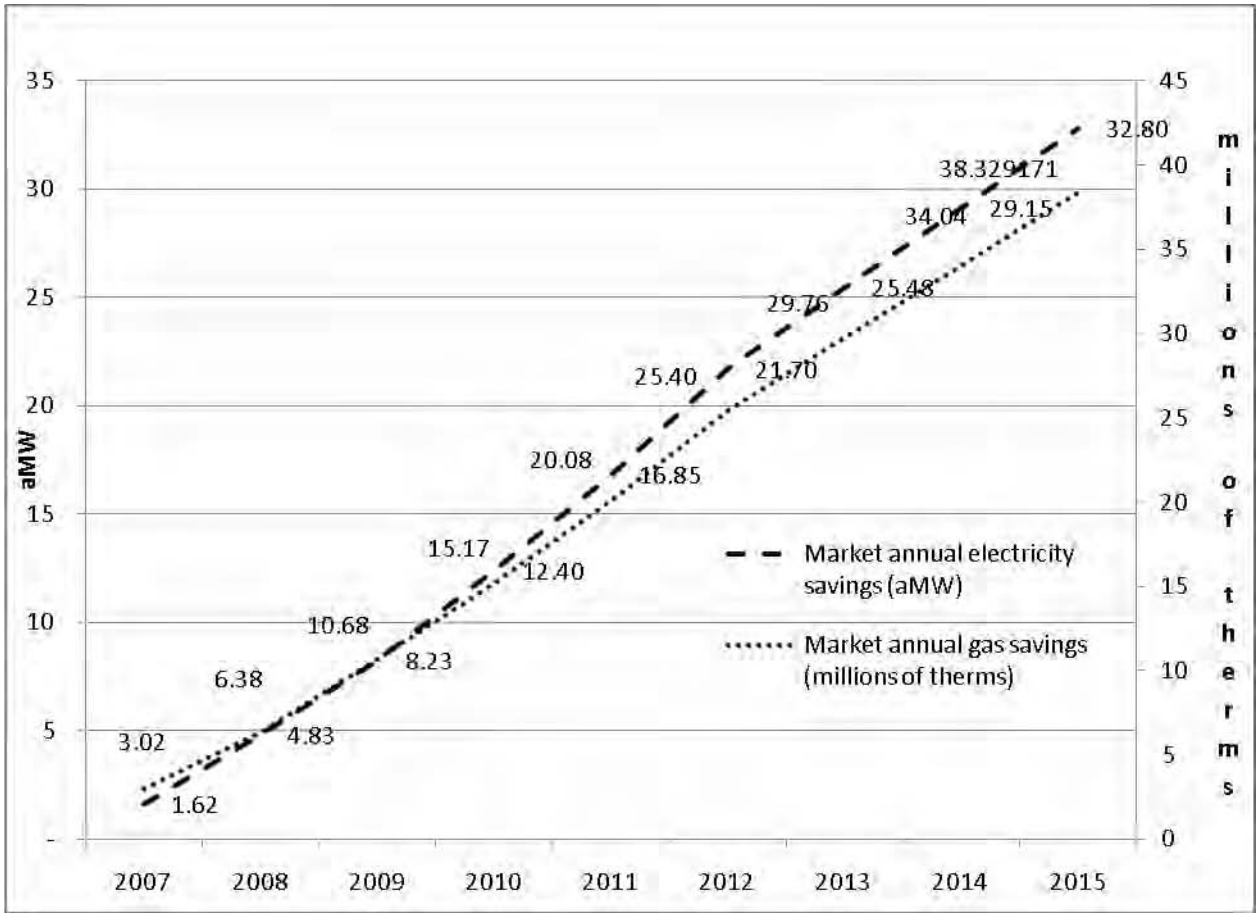
Year	Historical Market Saturation	Predicted Market Saturation	Market Annual Electric Savings (MWh)	Market Annual Savings (aMW)	Market Annual Gas Savings (millions of therms)
2007	16.6%	16.6%	14,170	1.6	3,020,727
2008	24.1%	25.5%	42,278	4.8	6,377,096
2009	32.1%	32.0%	72,117	8.2	10,676,603
2010	36.4%	36.8%	108,638	12.4	15,165,193
2011		41.2%	147,572	16.8	20,076,344
2012		45.4%	190,108	21.7	25,404,197
2013		49.4%	223,233	25.5	29,759,871
2014		53.3%	255,355	29.2	34,041,736
2015		57.0%	287,313	32.8	38,329,171

* Energy savings realized at food processing facilities. The estimates of electricity savings do not include line losses.

Cadmus forecasts annual electricity savings from energy management-related O&M and capital projects will grow approximately from 100,000 MWh in 2010 to 287,000 MWh in 2015. This growth directly mirrors that of energy management adoption in food processing facilities over this time, as depicted in Figure 10.3. The market is expected to achieve 32.8 aMW of savings by 2015. We forecast gas savings will grow from approximately 15,200,000 therms in 2010 to nearly 38,300,000 therms in 2015.

Figure **10.4** depicts predicted growth in aMW and therm savings between 2007 and 2015.

Figure 10.4. Forecast of Cumulative aMW and Therm Savings from Energy Management in Large Food Processing Facilities



November 22, 2011
REPORT #E11-230

Consumer Electronics Television Initiative Market Progress Evaluation Report

Prepared by:
Energy Market Innovations, Inc.
83 Columbia Street, Suite 303
Seattle, Washington 98104

Northwest Energy Efficiency Alliance
PHONE
503-688-5400
FAX
503-688-5447
EMAIL
info@neea.org

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TABLE OF CONTENTS

EXECUTIVE SUMMARY **1**
Program Description and Theory of Transformation 1
Summary of Conclusions 1
MPIs Covered in This Report 3
Strengths of the Initiative 4
Recommendations 4

1. INTRODUCTION **1**
1.1. Initiative Description 1
Initiative Qualification Criteria *1*
Market Transformation Overview *2*
Key Initiative Activities and Stakeholder Roles *3*
1.2. Initiative Logic Model 4
Logic Model Structure *4*
Program Outcomes *6*
1.3. Initiative Goals and Market Progress Indicators 6

2. EVALUATION ACTIVITIES **8**
2.1. Initiative Data Review 8
ACE Model and Assumptions *9*
Initiative Logic Model *9*
2.2. Primary Data Collection 10
In-Depth Interviews *10*
Focus Groups *11*

3. MARKET CHARACTERIZATION FINDINGS **12**
3.1. Television Retailer Market 12
3.2. Television Market Assortment Schedule 13
3.3. External Influences on Energy Use in Televisions 14
ENERGY STAR *14*
Technological Changes *16*

4. PROGRAM FINDINGS **17**
4.1. Tracking Data Review 17
Urban Versus Rural Units *19*
4.2. Findings from Primary Data Collection 19
Indirect Influence of Incentives *19*
Unquantifiable Effect of Incentives *20*
Emphasis on ENERGY STAR *20*
Energy Efficiency as a Consumer Buying Criterion *20*
Effect of Marketing and Training *20*
Influence on ENERGY STAR Specifications *20*
4.3. Examples of NEEA Program Influence 21
4.4. Logic Model Review 21
Consistency of Initiative Logic *21*
Influence on National Retailers *22*
Influence on Manufacturers *22*
Importance of Consumer Facing Marketing *22*

Televisions That Consume No More Than 108 Watts *23*

5. ACE MODEL REVIEW FINDINGS 24

5.1. ACE Model Structure 24

5.2. Total Regional Savings 25

Key Findings for the Calculation of Total Regional Savings *25*

5.3. Natural Occurring Baseline Savings 26

Calculating the Naturally Occurring Baseline Market Share (NOBMS) *26*

Areas of Uncertainty in the NOBMS Allocation Shares *28*

6. CONCLUSIONS AND RECOMMENDATIONS 30

6.1. Conclusions 30

Key MPIs *30*

Additional Conclusions: *33*

6.2. Recommendations 35

Update the Initiative Program Theory and Logic Model *35*

Revise Initiative MPIs and Update ACE Model Assumptions *35*

Improve the ACE Model and Baseline Assumptions *36*

Consider a Codes and Standards Approach *36*

Determine the Applicability of Evaluation Findings to Other Products *37*

Recommended Data Collection Activities for MPER 2 ..... *37*

LIST OF FIGURES

Figure 1-1: NEEA Incentive Specification Levels 2
Figure 1-2. Key Critical Paths in the NEEA Television Initiative Logic Model 5
Figure 3-1: Television Sales and Marketing Schedule 14
Figure 3-2: Average UEC of Televisions in the Northwest 15
Figure 3-3: ENERGY STAR Specification Levels 16
Figure 4-1: Northwest Market Share by Tier 17
Figure 5-1: ACE Model Savings Structure 24
Figure 6-1: 2010 Market Share and NOBMS by Tier 31
Figure 6-2: Comparison of ENERGY STAR and NEEA Criteria 33

LIST OF TABLES

Table 1-1: NEEA Initiative Energy Efficiency Tiers and Associated ENERGY STAR Levels 2
Table 1-2:Outcomes and MPIs from the Initiative Logic Model 7
Table 2-1: Summary of Evaluation Activities 8
Table 2-2: In-Depth Telephone Interviews 11
Table 3-1: Initiativie Retailer Participant Type and Market Share 13
Table 4-1: Tier and Screen Size Bin Combinations Consuming 108 Watts or Less 18
Table 4-2: Market Share of Televisions Consuming 108 Watts or Less in 2010 18
Table 4-3: 2010 Northwest Television Sales by RUCC Code 19
Table 5-1: Allocation Shares of Total Regional Savings 27
Table 5-2: Allocation Shares by Market Actor 27
Table 6-1: 2010 Market Shares of Initiative-Qualifying Televisions in the Northwest 31
Table 6-2: 2010 Average Market Shares and NOBMS 32

EXECUTIVE SUMMARY

This report summarizes the results of the first Market Progress Evaluation Report (MPER) of the Consumer Electronics Television Initiative implemented by the Northwest Energy Efficiency Alliance (NEEA). This MPER not only provides the first insight into the progress of this initiative with a specific focus on 2010, but also reviews select information from as far back as the initiation of the program in 2009. The report additionally provides recommendations for future program years.

Program Description and Theory of Transformation

NEEA launched the Consumer Electronics Television Initiative ("Initiative") in September of 2009 in order to capture energy savings in the consumer electronics market in the Northwest. The design of this Initiative is based on the Business and Consumer Electronics (BCE) program implemented by California utilities and is intended to achieve energy savings by accelerating the adoption of more energy-efficient televisions in the Northwest. The Initiative provides incentives to retailers for the sale of energy-efficient consumer electronics products in an effort to encourage increased stocking of energy-efficient products at the retail level, thereby leading to increased sales of these energy-efficient products to consumers. Through the Initiative, NEEA also provides in-store retailer training and marketing tools for retailers to promote more energy-efficient televisions. NEEA works closely with other BCE programs to strengthen product qualification criteria, harmonize program elements, and to increase the collective influence of utility energy efficiency programs on the electronics market. NEEA and its BCE partners are also contributing stakeholders to the U.S. EPA ENERGY STAR® program, working to enable more stringent energy efficiency specifications which are the basis for the Initiative qualification criteria.

The Initiative is primarily focused on large national retailers and therefore is able to cover over 80% of the market with only nine participating retail partners. These partners include six national retailers, two "buying groups" that purchase collectively for smaller independent stores, and one regional Northwest chain with locations concentrated in a single state. In order to stay ahead of the fast-moving market, NEEA increases the rigor of its qualification criteria on a yearly basis. The qualification criteria include different "Tiers" which are progressively more stringent in energy efficiency requirements and are based on the ENERGY STAR specifications and test procedures. In 2010, NEEA provided a two-level incentive structure with a lower incentive for ENERGY STAR 4 televisions and a higher incentive for ENERGY STAR 5 televisions.

Summary of Conclusions

The initial design of this initiative followed a very logical and rational market transformation program model. In order to transform the television market, NEEA and its BCE partners employed targeted financial incentives, a strategy that experienced reasonable success in other product markets. In this instance, however, external market forces were considerably different than in other markets. A closer look at the dynamics of the television market and changes experienced in recent years indicates that it may have been difficult for any program to influence this market significantly and that the Initiative may not be fully achieving the expected impact.

The television market has experienced tremendous shifts since January 2008, including a greater than 60% decline in power density through the end of 2010. This shift started before NEEA began its initiative. Although stakeholders indicate that the NEEA Initiative has helped to contribute to this shift,

the exact level of influence of the NEEA initiative among all the various factors influencing this market is very difficult, if not impossible, to identify or quantify.

Given the level of program activity, in a less dynamic market one might logically expect to see a dramatic market lift of energy-efficient units within the Northwest compared to other states. However, data made available for this evaluation do not indicate a clear or dramatic difference in the market share of energy-efficient units sold in the Northwest as a result of the program. Although the absence of a clearly identified and substantial market lift could result from inadequate data or measurement techniques, this absence brings into question the extent of the impact that program incentives are having upon retailer stocking patterns in the Northwest.

The specific aspects of the television market that limit both the influence and measurability of the Initiative program design on the Northwest market include:

1. The rapid degree of innovation in energy-efficient display technology, especially the current adoption of LED backlight technology;
2. The market shift of sales to large national retailers (including online retailers);
3. The annual product refresh cycle for televisions;
4. The strong influence of the federal ENERGY STAR program on manufacturers.

The pace of technology evolution for flat screen technologies has been very fast. Since the start of this initiative, consumers have continued to abandon older CRT-based televisions at a rapid pace in favor of flat screen technology. More recently, the combined effects of increased consumer demand, manufacturer response to the Version 5 ENERGY STAR specification levels, and price drops in LED technology have all enabled a shift toward more energy-efficient LED backlight models. These shifts have resulted in a substantially more energy-efficient product due to market forces outside of utility program incentives.

The second factor is the market shift in sales channels from small local retailers to large national retailers. The large national retailers that now make up well over 80% of the consumer retail market do not typically vary their product mix on a local or regional level. The result of this is that regional incentives mostly work to affect the national assortment of products of these retailers. NEEA incentives, acting in concert with incentives from other utilities across the country, including BCE partners in California and Nevada and utilities in other areas such as DTE Energy, National Grid, NYSERDA, Energy Efficiency Vermont, etc., help influence the product mix of these national retailers. However, it is difficult to parse out the effect of the NEEA Initiative from among all of these market forces. Based on interviews with retailers and manufacturers, the incentives are not considered to be a leading factor in discussions between national buyers and international sellers, but often serve as a “tie-breaker” between two similar products. Also, in order to increase cost effectiveness of these programs with economies of scale, the actual incentive dollars are given to retailer headquarters, which means the Initiative does not provide direct incentives to local retail locations to increase sales of energy-efficient televisions. Locally, the influence of the Initiative incentives is higher among smaller local and regional stores; however, these stores are difficult to reach in a cost effective manner and are only a small part of the market that is likely to continue to shrink in future years. However, this may create an opportunity for evaluation in future years.

A third factor, the annual product refresh cycle for televisions, creates a substantial barrier to the ability of utility programs to influence this market. Each spring, retailers discount the previous year’s models heavily in order to clear inventory for the new models for the current year. The product assortment (or the particular mix of models the retailer will offer over the year) is often chosen in the summer or fall of the previous year and final orders are typically placed at or around the yearly Consumer Electronics Show

in January. Because of this yearly refresh, the increase in market share of new energy-efficient products happens rapidly over the course of roughly three months and then stays relatively static the rest of that year. For this reason, utility programs need to finalize incentive criteria and levels the previous summer in order to have an impact on the product assortment of retailers, or up to 18 months in advance in order to influence the designs of manufacturers.

The fourth factor is the strength of the U.S. Environmental Protection Agency (EPA) ENERGY STAR products branding effort. The EPA has been active in promoting energy efficiency in televisions since 1998, and began a new focus on active power consumption in 2005. Manufacturers indicated the importance of the ENERGY STAR brand and their desire to meet the specifications for as many of their products as possible. As the EPA has responded to the rapid changes in the market, they have continually increased the stringency in these specifications, which has driven down the unit energy consumption (UEC) of these products over time. While NEEA and the other BCE utility program sponsors have been very actively involved in supporting and attempting to influence the level of energy efficiency required by the specifications, the US EPA has been largely responsible for leading the negotiations with manufacturers to create the progressively more stringent specifications. In this context, it was not possible to discern NEEA's distinct contribution to more stringent specifications.

MPIs Covered in This Report

Based upon the revised logic model for this program, EMI identified a set of Market Progress Indicators to be assessed through this evaluation. Because the research priorities identified by NEEA for this first MPER for the Television Initiative focused on market actors and short-term outcomes, the MPI's reflect this priority. These indicators show that the market for televisions has shifted markedly over the past four years, with per-unit energy use declining significantly. NEEA qualification levels were typically more stringent than the ENERGY STAR specifications, but the direct impact of this stringency upon the change within the market cannot be quantified.

Key MPIs and related findings covered in this MPER include:

1. **Market share of Initiative-qualified televisions compared to the Natural Occurring Baseline Market Share (NOBMS).** The market share of all televisions that meet any tiers of the Initiative (equivalent to the market share of Tier 1) grew from 42% in 2009 to 78.7% in 2010. At the end of 2010, market shares were 88%, 83%, 23.8%, and 3.8% for Tiers 1, 2, 3, and 4, respectively. Because the development of the natural occurring baseline market share was not transparent, the NOBMS is not verifiable through this evaluation. Therefore, this evaluation did not result in an independently verified comparison of the market share of initiative-qualified televisions to a naturally occurring baseline.
2. **Market share of televisions that consume 108 Watts or less.** The market share percentage of all televisions consuming 108 watts or less grew from 27.5% in January 2010 to 52.8% in December 2010.
3. **Stringency of the Initiative specification levels compared to ENERGY STAR.** The evaluation found that, since program inception, the NEEA qualification levels were either equal to or more stringent than the ENERGY STAR specifications that were currently in place, depending on the time of year. The NEEA qualification levels were typically more stringent than those of ENRGY STAR at the start of the year, when they took effect. ENERGY STAR specification levels then became equal to NEEA qualification levels when new ENERGY STAR specifications took effect in the middle of the year. The NEEA qualification criteria for the higher incentive were always more stringent than ENERGY STAR.

4. **Quarterly reporting of initiative data.** The implementation contractors provided NEEA reports on the implementation and progress of the program on a quarterly basis - at a minimum - including monthly progress reports toward key goals and deliverables, and sales of initiative qualified televisions by zip code.

Strengths of the Initiative

This evaluation found several strengths of the Initiative, all of which have made a positive contribution to efforts to decrease the energy use of televisions. These include:

1. Use of incentives to gain credibility for NEEA and secure a "seat at the table" with retailers and manufacturers;
2. The collection of television market data that would not otherwise be possible;
3. Reinforcing the collective influence of financial incentives to retailers.

The financial incentives provided to retailers, and the fact that NEEA was "bringing money to the table," likely helped build the credibility of the organization among both retailers and manufacturers. This credibility then provided a foundation for engaging in dialogue with manufacturers, working with retailers on marketing campaigns, and encouraging the EPA to increase the stringency of equipment specifications.

A second strength of this initiative is the data collection processes and protocols that were implemented for the program. This includes both data purchased from NPD and data collected through contractual obligations with retailers. The availability of these data has enabled planners, evaluators and stakeholders to track the market much more closely that otherwise would have been possible. Absent such data, it would be very difficult to track this market in terms of energy efficiency or estimate the magnitude and timing of market shifts in energy-efficient televisions.

It is also apparent that the number of different utilities providing incentives to national retailers is sizeable enough to have some influence on national retailers, likely encouraging them to increase their assortment of energy-efficient televisions. At the very minimum, the presence of incentives acts as an important "tie-breaker" between traditional and more energy-efficient products that are otherwise similar. However, national retailers interviewed for this analysis were not able to indicate the quantitative effect of these collective incentives. In addition, even if retailers could reliably quantify the extent to which they were influenced by collective utility incentives, the effect of the NEEA Initiative specifically cannot be precisely determined uniquely from all other utilities with similar programs.

Recommendations

EMI developed six primary recommendations from this evaluation. These were:

1. **Update the Initiative program theory and logic model.** EMI recommends that NEEA review the core program theory and work to ensure that the logic model for this Initiative reflects the complexity of the market dynamics and the key critical paths towards energy savings.
2. **Revise Initiative MPIs and update ACE model assumptions.** EMI recommends that NEEA develop new MPIs that are mapped directly to the updated Initiative logic model. The evaluation efforts of this program will be enhanced by the development of MPIs that are linked more closely to the critical paths in the logic model.
3. **Improve the ACE model and baseline assumptions.** EMI recommends that NEEA improve the estimate of the market baseline and update the ACE model assumptions to better reflect the market and program logic. NEEA may want to consider evaluating the baseline and savings on

the average UEC of the television market, as this may be less challenging to forecast and track than the specific market share of each Initiative tier.

4. **Harmonize the timing of criteria revisions with ENERGY STAR.** EMI recommends that NEEA time new qualification criteria with new ENERGY STAR specifications taking effect. This step would ensure NEEA criteria are always more stringent than the ENERGY STAR specification and could help drive the market to higher levels of energy efficiency.
5. **Consider a codes and standards approach.** NEEA may want to consider focusing energy savings goals on the long-term development of television standards in Northwest states.
6. **Determine the applicability of evaluation findings to other products.** EMI recommends that NEEA not assume the results of this evaluation are fully applicable to other consumer electronics products, and perform product-specific research where needed to determine the effectiveness of this program theory to these other products.

1. INTRODUCTION

The NEEA Consumer Electronics Initiative ("Initiative") is intended to achieve energy savings by accelerating the adoption of more energy-efficient televisions, computers, and monitors in the Northwest. The Initiative provides incentives on the sale of energy-efficient products to consumer electronics retailers in an effort to increase the stocking of energy-efficient models at the retail level, which, in turn, should lead to greater sales of these products to consumers. Through the Initiative, NEEA also provides marketing tools for retailers to promote more energy-efficient televisions and provides in-store retailer training. NEEA works closely with other BCE programs to strengthen qualification criteria, harmonize program elements and to increase the collective influence of utility energy efficiency programs on the electronics market. NEEA and its BCE partners are also contributing stakeholders to the U.S. EPA ENERGY STAR® program to enable more stringent energy efficiency specifications which are the basis for the Initiative criteria.

1.1. Initiative Description

In 2008, Pacific Gas and Electric (PG&E) and Sacramento Municipal Utility District (SMUD) launched a joint Business and Consumer Electronics (BCE) pilot program to promote energy-efficient televisions, computers, and monitors. This mid-stream program provided incentives to consumer-electronics retailers in an effort to increase the stocking of energy-efficient products.

Early in 2009, NEEA decided to launch a complementary program in the Northwest based on the BCE program. Realizing that the consumer electronics market evolves rapidly, NEEA moved quickly to secure utility funding and begin negotiations with electronics retailers. By September, NEEA had signed contracts with retailers and had begun to pay incentives for the sale of energy-efficient televisions, computers, and monitors. In 2010, the Initiative was added to the NEEA portfolio of core programs for the 2010 – 2014 funding cycle. Later, San Diego Gas and Electric (SDG&E), Southern California Edison (SCE) and Nevada Energy joined the BCE program, expanding the market coverage of the affiliated programs to approximately 11% of the national market[1]. In addition, a number of other utilities and public benefit organizations, such as DTE Energy, National Grid, NYSERDA, National Grid, and Energy Efficiency Vermont, have similar retailer-focused television initiatives.

Initiative Qualification Criteria

Originally, the BCE program defined an energy-efficient television as one that used 15% less energy than the U.S. EPA ENERGY STAR Version 3 television specification. This qualification is known as "ENERGY STAR 3+15%", or simply "ES 3+15%". In the process of creating the Initiative, NEEA worked with other BCE sponsors to specify ENERGY STAR 3+30%, a more rigorous standard for energy-efficient televisions. ENERGY STAR 3+30% requires energy use in active power mode to be 30% less than the ENERGY STAR 3 specification. As the ENERGY STAR program released a series of increasingly rigorous specifications, NEEA, in partnership with BCE, continued to increase the stringency of its own qualification criteria. The different energy efficiency qualification criteria are referred to as "tiers" in the Initiative. The four defined Initiative Tiers are shown below in Table 1-1.

[1] Draft NEEA 2010 Implementation Report

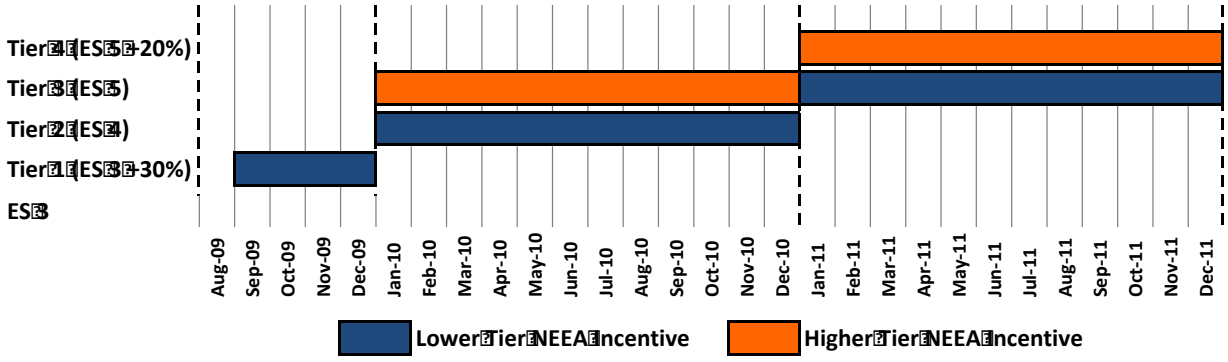
Table 1-1: NEEA Initiative Energy Efficiency Tiers and Associated ENERGY STAR Levels

Initiative Tier	ENERGY STAR Level
Tier 1	ENERGY STAR 3+30%
Tier 2	ENERGY STAR 4
Tier 3	ENERGY STAR 5
Tier 4	ENERGY STAR 5+20%

Source: NEEA staff interviews and background documentation.

To stay ahead of the fast moving market, NEEA increases the rigor of its qualification criteria on a yearly basis. Starting in 2010, NEEA began giving incentives at two different levels – one incentive level for a less stringent tier (Tier 2) and a higher incentive amount for a more stringent tier (Tier 3). In 2010 ENERGY STAR 4 televisions qualified for the lower tier NEEA incentive and ENERGY STAR 5 televisions qualified for the higher tier incentive. Both of these sets of criteria were implemented as NEEA tiers prior to taking effect as ENERGY STAR qualification levels (ENERGY STAR 4 took effect in May of 2010 and ENERGY STAR 5 is planned to take effect in September of 2011). In January of 2011, NEEA transitioned from giving incentives for Tier 2 and Tier 3 televisions to giving incentives for Tier 3 and Tier 4 televisions. Also in 2011, NEEA increased the incentives for models with screens larger than approximately 50" because of the "progressive energy efficiency" wattage cap of 108 Watts for these televisions in the ENERGY STAR 5 specification[2]. Figure 1-1 illustrates the progression the NEEA qualification criteria since the inception of the program.

Figure 1-1: NEEA Incentive Specification Levels



Source: NEEA staff interviews and background documentation.
Note: "ES" refers to specific ENERGY STAR levels, with +XX% indicating that the requirement is to use XX% less active power than the particular ENERGY STAR specification referenced.

Market Transformation Overview

The Initiative aims to motivate market transformation in the Northwest television market so that eventually only energy-efficient models are available in the region. To increase the market share of energy-efficient products, NEEA targeted market transformation through multiple channels. Although the Initiative could not work with every retailer, it was able to offer incentives to retailers covering over 80% of the regional television market. This was thought to be enough to push the entire market towards

[2] The measurement of screen size is approximate because the ENERGY STAR criteria are based on screen area rather than diagonal screen size. The actual wattage cap of 108 Watts is for televisions greater than 1068 square inches – equivalent to a 50" television with a 16:9 aspect ratio.

energy efficiency, in part by driving manufacturers to produce more energy-efficient televisions in response to increased demand from Northwest retailers. By influencing retailers to stock more energy-efficient televisions in their product assortments, the Initiative aims to increase the number of energy-efficient models available to consumers, making them more likely to purchase energy-efficient models. The Initiative also provides point-of-purchase (POP) marketing materials for retailers to identify the models that meet the Initiative requirements and provides retailer training so that retailer sales staff can identify these models and explain the significance to customers. In addition, by working with national energy efficiency programs, such as ENERGY STAR, the Initiative seeks to further influence manufacturers towards the increased production of energy-efficient models. Driving energy-energy efficiency in these ways, the Initiative should affect the entire Northwest market and also increase availability of energy-efficient models at retailers that are not participating in the Initiative. According to this market transformation strategy, eventually the market should shift to a point where most available models are energy-efficient, at which point it would be possible to lock in gains with state or national energy efficiency standards.

Key Initiative Activities and Stakeholder Roles

A variety of stakeholders collaborated to design, coordinate, and implement the Initiative through 2010. Key stakeholders included NEEA staff, third-party implementation contractors, participating retailers, partner utilities in the BCE program, and NEEA funding utilities. The activities of these stakeholders are described below.

- **NEEA Implementation Staff.** NEEA implementation staff is responsible for the central roles of managing and coordinating the implementation of the program among many key stakeholders, contractors and other partners. These key roles include: Initiative design and the development of Initiative criteria, managing the implementation contractors, determining and revising (as needed) incentive allotments to retailers, tracking and reporting the savings and cost-effectiveness of the Initiative, and collaborating with other utilities and programs.
- **QDI Strategies (Implementation Contractor).** The primary roles of QDI are general administration and planning for the Initiative, retailer recruiting, maintaining relationships with market actors (e.g., retailers and manufacturers), and delivering and maintaining point-of-purchase (POP) materials and training to retailers. A subcontractor to QDI, Premium Retail Services, executes POP placement and training.
- **Energy Solutions (Implementation Contractor).** The main role of Energy Solutions is to provide a safe house for data submitted by retailers. As an independent aggregator, Energy Solutions is able to compile these data and independently and confidentially pass them on to NEEA. In collecting and analyzing the data, Energy Solutions also does product model matching with the ENERGY STAR qualified product list to determine which models should receive incentives, and monitors and reports information on market share based on Initiative data and other market data. Energy Solutions also maintains the BCE website (an online database into which retailers upload their sales data) and provides program data to inform future program design and incentive qualification levels.
- **Participating Retailers.** The participating retailers offer Initiative-qualified televisions at retail locations in the Northwest. The retailers provide all their sales data in the Northwest to NEEA and receive incentives for models sold that meet the Initiative qualification criteria.
- **Partner BCE Utilities.** The partner utilities (such as PG&E, SMUD, Southern California Edison [SCE], and Nevada Energy) run similar versions of the BCE program in their own service territories. They primarily interact with the NEEA Initiative through weekly meetings to coordinate on program strategy, qualification criteria and feedback on national programs such as ENERGY STAR.

- **NEEA Funding Utilities.** The utilities that are funders of NEEA do not always participate directly in the program, but are able to report savings from the Initiative. Some utilities also provide supplemental marketing of the program, such as social media, special events, bill inserts, etc. NEEA utilities can also run pilot marketing programs or have additional consumer-facing rebate or incentive programs for energy-efficient televisions.

1.2. Initiative Logic Model

The core logic of the Television Initiative is to leverage retailers to increase the adoption of energy-efficient televisions. The Initiative provides incentives directly to retailers for the sale of more energy-efficient Initiative-qualified televisions. The Initiative also works to support the development of more stringent energy efficiency specifications and standards for televisions. This is accomplished through participating in industry conversations and by leveraging the sales data that are collected by the program.

A secondary focus of the Initiative is to increase awareness of energy-efficient product offerings among consumers and retail staff. Program marketing efforts include the placement of POP materials to identify Initiative-qualified models, a website promoting energy-efficient televisions[3], social media outreach, display videos at participating retailers, and training retail staff to promote qualifying products. These marketing efforts are meant to help consumers and retailer sales associates identify the Initiative-qualified televisions that are either as energy-efficient or more energy-efficient than the ENERGY STAR specification in effect at the time.

Logic Model Structure

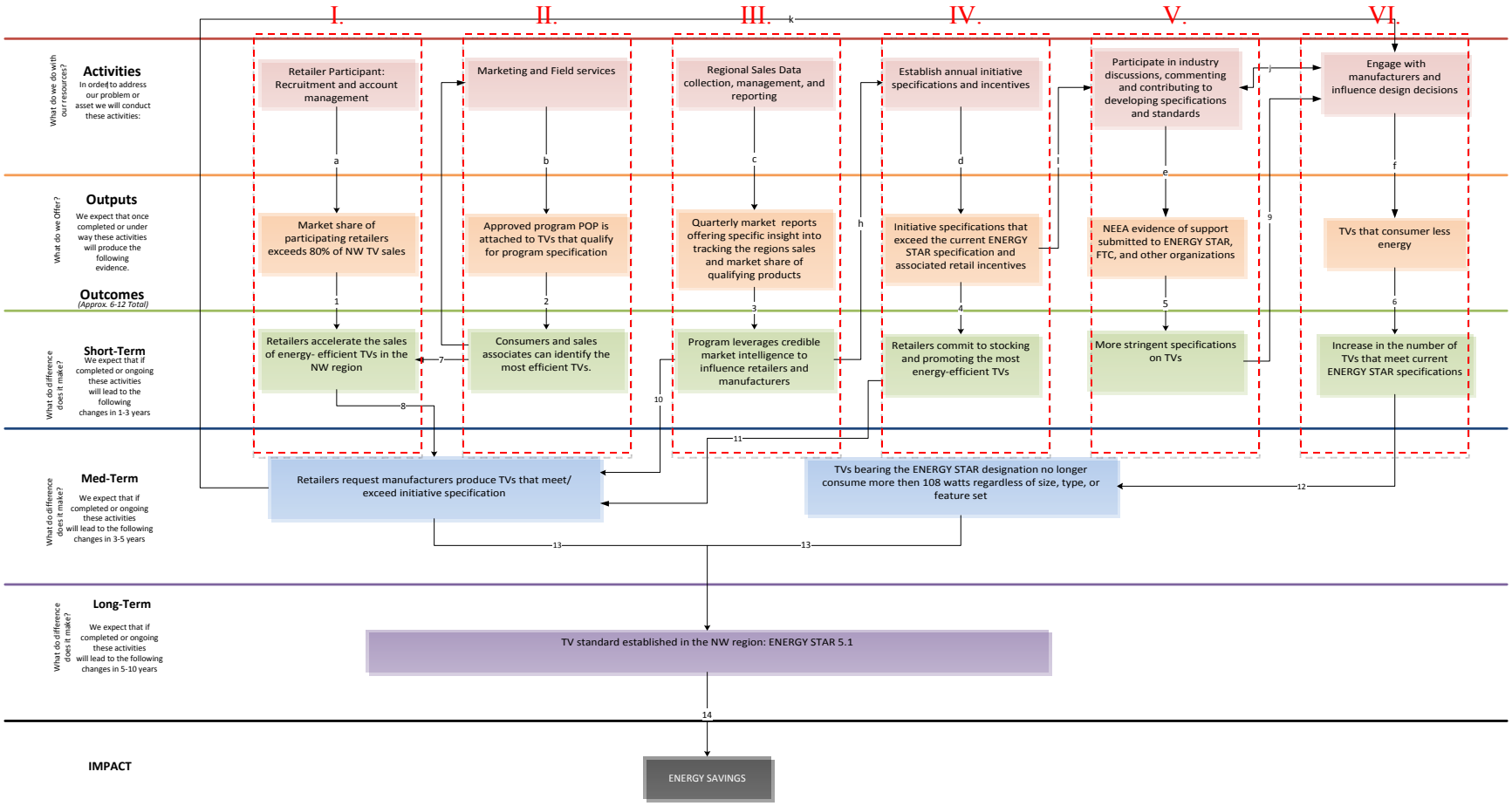
A logic model is a graphical representation of program activities, outputs of these activities, and intended outcomes. NEEA created a logic model for the Television Initiative, show below as Figure 1-2. Overlaid on the original logic model, EMI has included Key Critical Paths within the model. These paths group key program activities with their direct outcomes and intended effects, and are a useful way to organize the multiple channels of program impact. The Key Critical Paths are:

I. **Recruiting Retailers –** Recruiting retailers to participate in the Initiative;
II. **Marketing and Field Services–** Providing tools for retailers to market to consumers and training retail sales staff to allow easy identification of Initiative-qualified televisions;
III. **Leveraging Initiative Data –** Collecting retailer data and leveraging that data for other activities and outcomes;
IV. **Developing Initiative Specifications and Incentives –** Creating Initiative specifications and incentive levels for retailers and manufacturers;
V. **Contributing to the Development of Other Programs –** Working with other energy-efficient initiatives (e.g., CEE, ENERGY STAR, etc.) to further drive the energy efficiency of televisions;
VI. **Engaging Manufacturers –** Engaging manufacturers to produce more energy-efficient televisions.

Figure 1-2, below, shows the logic model and its key critical paths.

[3] www.energyenergy-efficientelectornics.org

Figure 1-2. Key Critical Paths in the NEEA Television Initiative Logic Model



Program Outcomes

The Consumer Electronics Television Initiative is a market transformation initiative, which aims to increase the overall energy efficiency of the entire television market in the Northwest. The Initiative creates energy savings by increasing the market share of energy-efficient televisions in the Northwest. Program theory holds that Initiative incentives drive retailers to stock a larger number of Initiative-qualified televisions. With greater demand from retailers, manufacturers will produce televisions that are more energy-efficient, and with a larger in-store availability of energy-efficient televisions, Northwest consumers will be more likely to purchase energy-efficient televisions. Concurrently, NEEA has also been supporting the ENERGY STAR program and helped push for the program to move up the effective date for ENERGY STAR 5 so that, starting September 30th, 2011, all ENERGY STAR labeled televisions will consume 108 Watts or less. In the long term, the Initiative has a goal of increasing the market share of ENERGY STAR 5 televisions to the point where this specification can be used as a basis for a mandatory energy efficiency standard in the Northwest, which would lock in substantial long-term energy savings.

1.3. Initiative Goals and Market Progress Indicators

For the first MPER of this initiative, EMI identified the key outcomes and Market Progress Indicators (MPIs) from the Initiative logic model, which is shown in Table 1-2. Because this is the first MPER of the program, EMI focused on the key linkages in the program logic regarding the influence of the program on market actors and on short-term outcomes. EMI did not cover consumer marketing efforts (e.g., POP) or the long-term energy savings from the establishment of a Northwest standard.

Table 1-2: Outcomes and MPIs from the Initiative Logic Model

MPI	Outcomes Covered	Covered in MPER #1
Market share of initiative-qualified televisions compared to the NOBMS	Retailers accelerate the sales of energy-efficient televisions in the Northwest region	YES
	Increase in the number of televisions that meet current ENERGY STAR specifications	
	Retailers commit to stocking and promoting the most energy-efficient televisions	
	Retailers request manufacturers produce televisions that meet/exceed Initiative specification	
Market share of televisions that consume 108 Watts or less.	Televisions bearing the ENERGY STAR designation no longer consume more than 108 watts regardless of size, type, or feature set	YES
Quarterly reporting of initiative data.	Program leverages credible market intelligence to influence retailers and manufacturers	YES
Stringency of the Initiative specification levels compared to ENERGY STAR	More stringent specifications on televisions	YES
The percent of qualifying televisions are correctly merchandised with program POP	Customers and store personnel can identify the most energy-efficient televisions	NO
ENERGY STAR 5.1 goes into effect as a NW standard	Television standard established in the Northwest region: ENERGY STAR 5.1	NO
Achieve energy-savings forecasted on the ACE model and NWCC Plan	Impact: Energy Saving	NO

2. EVALUATION ACTIVITIES

To complete this MPER, EMI conducted a thorough review of data from the Initiative and also collected primary data consisting of in-depth interviews and focus groups with Northwest television purchasers. Table 2-1 provides a high-level summary of the evaluation activities that were completed for this report.

Table 2-1: Summary of Evaluation Activities

Initiative Data Review Activities	Primary Data Collection Activities

• Initiative documentation
• Logic model (Version 10) and accompanying documentation
• Initiative tracking data
  ○ BCE Incentives online database
  ○ Salesforce.com online database
• ACE Model and Assumptions Memo
• Natural Occurring Baseline Market Share (NOBMS) Memo
• Summary of Methods Used to Analyze Television Sales Data Memo
	• In-Depth Interviews with:
	  ○ Program staff
	  ○ Implementation contractors
	  ○ Participating utilities
	  ○ One partner utility
	  ○ Other energy-efficient television program managers
	  ○ Participating retailers
	  ○ Television manufacturers
	• Focus groups with recent (Q4 2010) Northwest TELEVISION purchasers

2.1. Initiative Data Review

This section contains an overview of the primary and secondary Initiative data reviewed during this evaluation. EMI reviewed primary data from participating retailers and third-party data assembled by the implementation contractors in the evaluation of this initiative.

Retailer Sales Data

EMI had direct access to the BCE Incentives database,[4] the database of NEEA Initiative participant sales data. The database gives the user the ability to view and export participant data in several formats.

EMI reviewed this data in comparison to the qualified products list from CEE.[5] This data set contains both Initiative-qualified and non-qualified sales for most retailers, but one retailer did not include non-qualified sales. Due to the fact that this data set covers only program participants and is missing data from non-participating retailers in the Northwest, NEEA purchased NPD market share data for televisions in the region so that regional progress toward market transformation could be tracked and evaluated.

Energy Solutions Dataset

To calculate key MPIs, such as the market share of different Initiative Tiers and the percentage of televisions that consume 108 Watts or less, EMI used the Energy Solutions dataset, which uses third-party data to cover the entire Northwest market. Energy Solutions combined program participant data with

[4] www.bceincentives.com
[5] http://www.cee1.org/resid/rs-ce/files/Energy-efficientTelevisionsList.pdf

purchased NPD data to construct a dataset that covers the entire region. EMI used this combined data as it was received. A review of some of the key assumptions used to generate this combined data set are included in the ACE model review in Section 5.

Examples of NEEA Program Influence

To help determine the influence of the Television Initiative on retailers, manufacturers, and other programs, EMI reviewed a number of different data sources. The first data sources were email communications provided by NEEA staff. These communications were with retailer partners, BCE partners, other Television energy efficiency program managers, Federal Trade Commission (FTC) stakeholders, etc. EMI also reviewed the BCE salesforce.com online database that catalogs communications with stakeholders. In this case, EMI focused on the "Market Transformation Report," which included information that was tagged as supporting the influence of NEEA in the transformation of the Television market. Lastly, EMI visited the ENERGY STAR product development archives and reviewed public comments on the ENERGY STAR specifications from NEEA, either in collaboration with other BCE partners or CEE.

ACE Model and Assumptions

To assess the ACE model structure and assumptions, EMI reviewed the ACE model spreadsheet and inputs, and accompanying documentation, including the paper that outlines the key assumptions. The ACE model is a very detailed model with a large number of inputs, assumptions and complex calculations. The focus of this activity for the evaluation was the validity and transparency of the key assumptions used in the model. For this reason, EMI reviewed the model structure and assumptions on a high level and did not do a detailed review to confirm the actual calculations performed by the model.

EMI received the most recent version of the ACE Model and its supporting documentation on March 17, 2011. This update consisted of the following resources:

1. **ACE Model for Televisions.** The Alliance Cost Effectiveness Model for the Initiative;
2. **Energy Star Televisions ACE Model Assumptions Paper.** An overview of the ACE model assumptions and calculations;
3. **QDI Calculation of the Northwest Television Market Size**. Supporting spreadsheet detailing the assumed quantities of televisions sold in the Northwest;
4. **6th Power Plan Consumer Electronics Assumptions**. The NWPCC 6th Power Plan supporting data, for reference to the television market assumptions;
5. **Aggregated Data From Energy Solutions**. This spreadsheet combines participant tracking data and NPD data to allow calculation of market shares and unit energy consumption (UEC) by tier.

Additional documentation supporting the ACE Model and its assumptions included:

1. **Northwest Television Naturally Occurring Baseline Market Share Estimation Results**. This memo from ECONorthwest calculates the NOBMS by assigning allocation shares for increases in the market shares of energy-efficient televisions to different actors;
2. **Summary of Methods Used to Analyze Television Sales Data**. The December 9, 2010 memo from Energy Solutions describing their aggregation and analysis of the market data.

Initiative Logic Model

To assess the Initiative logic model, EMI broke down the model into three distinct elements, as described below:

1. **Key Critical Paths.** Key Critical Paths are vertical paths that clearly link the key Initiative activities to the key important short-term outcomes. These critical paths clearly link the key activities to the key short-term outcomes through an identifiable and measurable output;
2. **Medium- and Long-Term Outcomes**. Longer term outcomes are often the result of a number of the key critical paths and therefore are analyzed separately from the key critical paths;
3. **Secondary Linkages**. These linkages are not related to the key critical paths and include horizontal linkages (which link activities or outcomes together) and reverse linkages where a program outcome feeds back into an activity, for example.

To concentrate this evaluation effort, EMI focused on the assessment of the key critical paths and medium- and long-term outcomes, as these are the most important elements of the Initiative logic early in an initiative. The labeling of linkages and accompanying notes are also important in helping to communicate the details of the Initiative logic; however, an effective illustration of the Initiative logic model should be clear enough to communicate the key logic of a program on its own – with the notes being available for those interested in a higher level of detail. To concentrate this effort, the EMI analysis focused on the ability of the illustrated model to communicate the main Initiative logic on its own.

2.2. Primary Data Collection

The main primary data collection for this evaluation consisted of in-depth interviews and focus groups with Northwest television purchasers in Q4 of 2010. This section includes a brief summary of these data collection activities. Appendix D contains the full data collection instruments for these activities.

In-Depth Interviews

In-depth interviews were conducted with a number of stakeholders, including program staff, participating and partner utilities, participating retailers, and television manufacturers. In-depth interviews were conducted between January and May 2011. Interviews were designed in an open-ended format to allow the evaluation team to probe into issues specific to the perspectives of each of the respondents. Common themes were identified among in-depth interview respondents with respect to the functioning of the energy-efficient television market, the influence of the Initiative on manufacturing and sales of high-energy efficiency televisions, and suggestions for improvements in the Initiative, if any. Table 2-2 shows the number of interviews conducted with each type of stakeholder.

Table 2-2: In-Depth Telephone Interviews

Interview Target	Sample Size
NEEA Staff	3
Implementation Contractors	2
NEEA Participating Utilities	2
Partner Utilities	1
Other Programs	2
Participating Retailers	6
Manufacturers	5
Total	**21**

Focus Groups

To ensure that the focus groups captured responses from different subsets of the Northwest Market (i.e. west and east of Interstate 5), one focus group was conducted in Seattle, WA and one was conducted in Spokane, WA. Both groups were conducted in January 2011, and each group lasted 90 minutes.

All focus group participants had recently purchased a new television at a participating retail chain. Participants were screened so that half of the participants in each group had knowingly purchased an ENERGY STAR-qualified television, and the other half were not sure if their new television was ENERGY STAR-qualified or not. This enabled EMI to learn from the experiences and opinions of those who may have used ENERGY STAR as a purchasing criterion as well as those who may not have been familiar with the brand. Furthermore, EMI concentrated on recruiting participants who had purchased a new television within the last three months of 2010 to ensure the purchases took place after new marketing materials were introduced in the participating retail stores in October 2010. Fourteen of the sixteen respondents purchased their television in October through December, and one each purchased a television in September and August. Key characteristics of focus group respondents' television purchases are summarized in Appendix C.

Focus group respondents were asked to comment on and discuss a variety of topics that explored experiences with purchasing a new television and the influence of energy efficiency and the NEEA program on their purchase decisions. The focus group moderator began each topic with an initial discussion question, and then asked follow-up questions and probed into particular topics or issues that arose. There were also two activities that took place approximately mid-way through the discussion questions for each group. For the first activity, respondents were asked to rank-order the top five television features they considered when deciding which television to purchase. For the second activity, respondents were shown an example of the marketing sticker used in participating retail stores and were asked to report whether they had seen the sticker used in the store where they purchased their television. For the focus groups, common themes were identified with respect to the functioning of the energy-efficient television market, the influence of the Initiative on sales of high-energy efficiency televisions, and suggestions for improvements in the Initiative, if any. The analysis of focus groups focused specifically on identifying themes related to consumer decision-making and usage of televisions, as well as awareness of energy efficiency with respect to televisions and awareness of the NEEA Initiative marketing materials. Themes were identified both within each group and across groups to examine similarities and differences that are present within and between the Seattle and Spokane markets.

3. MARKET CHARACTERIZATION FINDINGS

This section describes important elements of the television market external to the Initiative, and focuses on three key aspects of the television market that are critical to understanding how the NEEA Television Initiative interacts with this market:

1. The breakdown of retailer types in the market;
2. The yearly assortment schedule for retailers;
3. The external market influences that continually drive the energy efficiency of televisions.

3.1. Television Retailer Market

The television retailer market can be divided into three main retailer types pertinent to the NEEA Television Initiative:

- **Large national retailers.** Often referred to as "big-box" retailers, these are chain stores with a large national presence and a corporate headquarters that is often found outside of the Northwest. These stores are typically very large retail spaces found in urban or suburban areas.
- **Small local/regional independent retailers.** These are local stores or regional chains contained entirely or mostly within the Northwest. These stores typically are much smaller than the large national retailers and are independently owned. In many rural areas, these may be the only local option for purchasing a television, although small independent retailers can also be found in urban and suburban areas.
- **Retail buying cooperatives.** Retail cooperatives are national purchasing groups consisting of many independent stores. By pooling their collective buying power, member stores are able to have a significant influence in the market and secure better pricing from manufacturers.

These three different retailer types have a few key differences. First, the national retailers typically pick their television assortment on a national basis, varying their assortment for a particular store only by store size (larger stores typically get a greater number of television models) and income demographics in the surrounding area. Therefore, individual stores or regions typically do not receive a different assortment of televisions based on criteria such as energy efficiency. In contrast, local and regional retailers, including those that are part of a buying cooperative, have a much greater say in the particular models they carry.

National chains have additional factors that prevent individual stores from emphasizing energy efficiency. The incentives paid as part of an initiative such as the NEEA Television Initiative go to the company corporate headquarters, not to the local stores, so the local store managers and/or staff may not even be aware of the incentives. Additionally, staff turnover in national retail chains is often very high (50% a year or higher), making it very difficult to train sales employees of national chains to promote program offerings.

According to NEEA estimates, the national retailers participating in the Initiative make up roughly 84% of the retailer television market in the Northwest. Table 3-1 shows the main retailer participants in the Initiative including the retailer type and market share.

Table 3-1: Initiative Retailer Participant Type and Market Share

Retailer	Retailer Type	Market Share[a]
Costco	National	26%
Best Buy	National	22%
Wal-Mart	National	21%
Sears	National	8%
Sam's Club	National	4%
Kmart	National	3%
Brandsource and Nationwide[b]	Cooperatives	3%
Vann's	Local	1%
Non-participants[c]	Mixed	12%
Total		**100%**

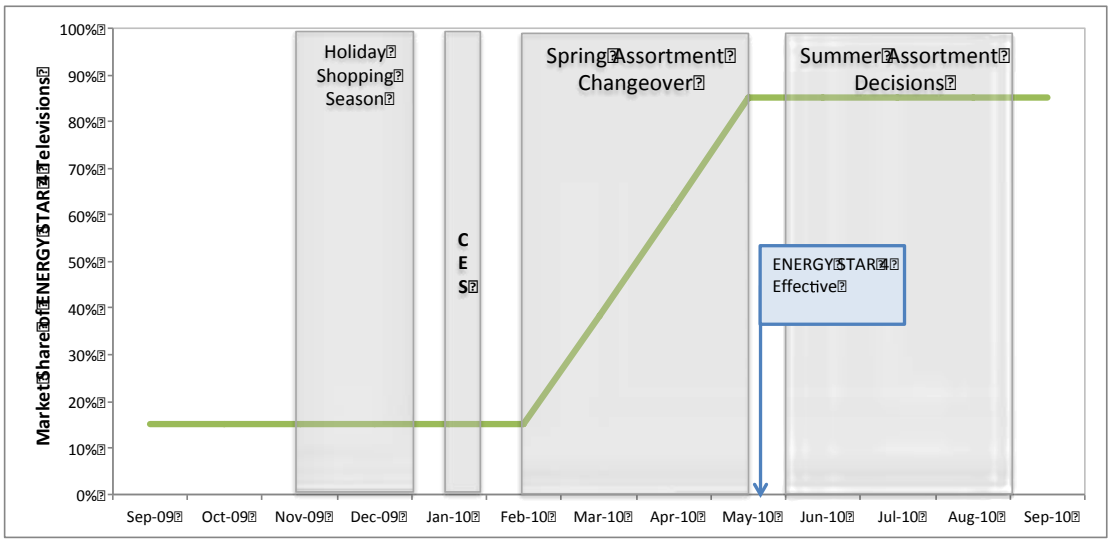
a. Market share data is from the NEEA 2010 Consumer Electronics Implementation Report
b. Together Brandsource and Nationwide represent 78 independent retailers throughout the NW
c. e.g., Target, Video Only, Fred Meyer, small retailers, etc.

3.2. Television Market Assortment Schedule

The television market typically operates on a fixed, and therefore predictable, yearly sales and marketing schedule, as new product lifetimes are often a year or less. A description of each stage of the product cycle is given below, followed by Figure 3-1, which shows the typical schedule and the rapid increase in market share of ENERGY STAR 4 televisions in the spring of 2009.

1. **Spring assortment changeover.** In the spring months the major retailers typically go through their main assortment changeover, when new models are introduced and old models go on closeout to clear the inventory for new models. This assortment changeover typically ends in May or June and after this changeover, the assortment typically stays the same until the following spring.
2. **Summer assortment decisions.** During the summer months, conversations will begin between retailers and manufacturers for the following year. During this phase retailers will start making initial plans for their assortment for the following year, and manufacturers will begin to decide which models/designs to emphasize for the following year based on retailer requirements.
3. **Holiday shopping season.** The holiday shopping season (end of November through December) drives high retailer sales volumes. During this time there is typically a very large volume of television sales. Program data analyzed from three participating retailers shows that roughly 30% of sales come during the holiday shopping season. In addition, high sales continue through January leading up to the Super Bowl in early February.
4. **Consumer Electronics Show (CES).** CES is the premier electronics show in the U.S. Around this time, many retailers make final decisions about the assortment for the rest of the year and place orders with the manufacturers.

Figure 3-1: Television Sales and Marketing Schedule



Source: NEEA TV Baseline Aggregation Analysis (Version 5) and stakeholder interviews (assortment schedule)

As Figure 3-1 illustrates, television assortment decisions start in the summer of the previous year. In order for any programs or specifications to truly affect these decisions, they ideally must be established and communicated prior to assortment planning for the following year.

3.3. External Influences on Energy Use in Televisions

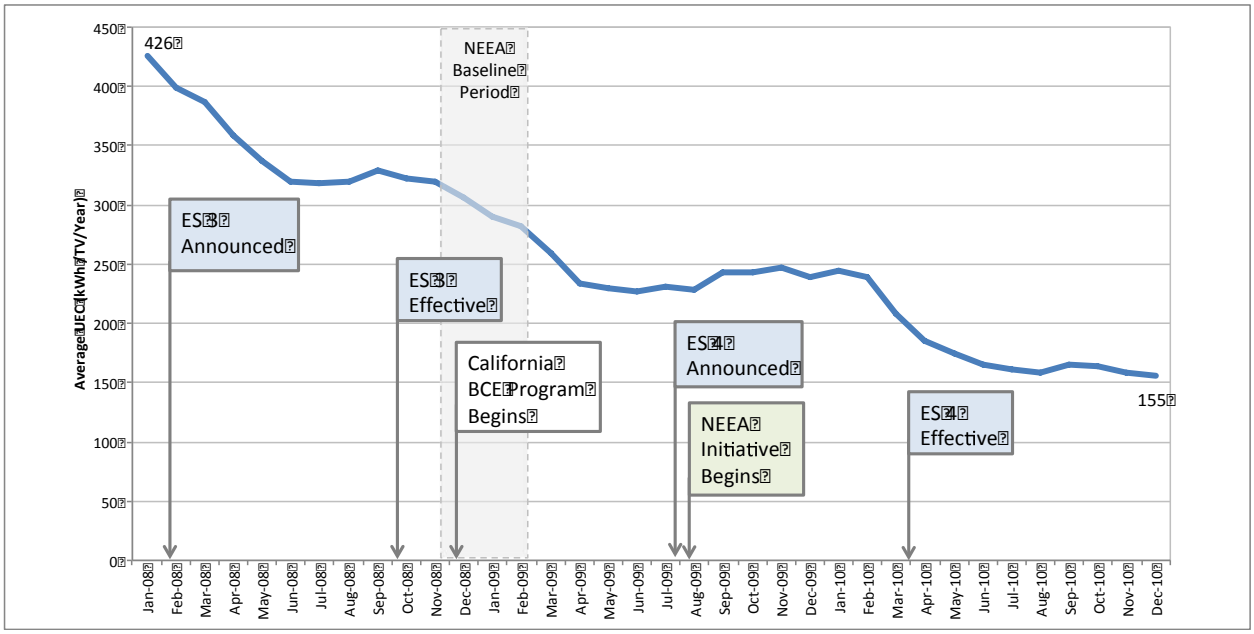
The two largest drivers of greater energy efficiency in this market identified by stakeholder interviews and data review were the rapid pace of new technology development and the EPA ENERGY program specifications.

ENERGY STAR

The ENERGY STAR 3 specification, the first specification covering active power use, was finalized and officially announced in February of 2008. Following this specification, there was a rapid decrease in television UEC (see Figure 3-2), and energy efficiency became a major focus of manufacturers in 2009. A rapid increase in the number of products that met the Version 3 specification caused EPA to quickly develop another set of specifications (Versions 4 and 5) to maintain the relevance of the ENERGY STAR label for televisions.

Manufacturers and retailers place a high level of importance on meeting the ENERGY STAR specifications. The desire to meet ENERGY STAR causes rapid shifts in television technology as manufacturers change designs to meet the specifications. The importance of ENERGY STAR is supported by the analysis of market share data, which shows significant upward jumps in the market share of ENERGY STAR models in the spring assortment changeover following a new ENERGY STAR specification level taking effect. EMI expects to see a similar jump in the qualification of ENERGY STAR 5 televisions in Spring 2012 as a result of the new specification that is planned to take effect in September 2011.

Figure 3-2: Average UEC of Televisions in the Northwest



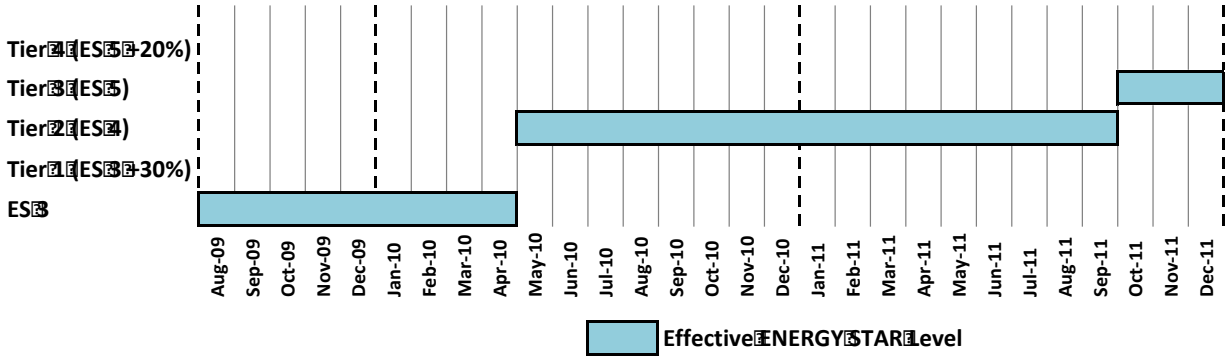
Source: NEEA TV Baseline Aggregation Analysis (Version 5)

The relevant ENERGY STAR criteria in effect during the Initiative implementation are summarized below and illustrated in Figure 3-3.

- **ENERGY STAR 3.** The ENERGY STAR 3 specification took effect on November 1, 2008, well before the beginning of the NEEA Initiative, and stayed in effect until May 1, 2010.
- **ENERGY STAR 4.** The ENERGY STAR 4 specification took effect on May 1, 2010, and will stay in effect until September 30, 2011.
- **ENERGY STAR 5.** The ENERGY STAR 5 specification will take effect on September 30, 2011 (moved forward from May 1, 2012), and will stay in effect until a new Version 6 specification is developed and becomes effective[6].

[6] Specification development for ENERGY STAR 6 for televisions was officially announced in April of 2011.

Figure 3-3: ENERGY STAR Specification Levels



Source: ENERGY STAR Product Development Website (www.energystar.gov/productdevelopment)

Technological Changes

The energy use of televisions is continually affected by yearly technological changes and this trend will likely continue into the future. Foremost among these recent changes has been the introduction and increased adoption of more energy-efficient LED backlight technology for LCDs. LEDs have gained popularity because of their better picture quality and lower energy use. The ENERGY STAR 5 specification has helped increase the adoption of LED televisions, as manufacturers indicated that a large portion of qualified ENERGY STAR 5 televisions use LED backlight technology. A rapid increase in the number of LED backlit models in 2011 is expected to bring this technology more into the mainstream compared to 2010.

In addition, there are a number of power management technologies in the market that could further reduce the energy use of televisions in the short-term, such as:

- Automatic Brightness Control (ABC), which decreases the brightness on a television in low light conditions. Many large televisions meeting the ENERGY STAR 5 specifications are using ABC to get down to the required levels;
- Occupancy sensors that sense whether or not actual viewers are present, and can turn off the display while maintaining audio when no one is actually watching the television.

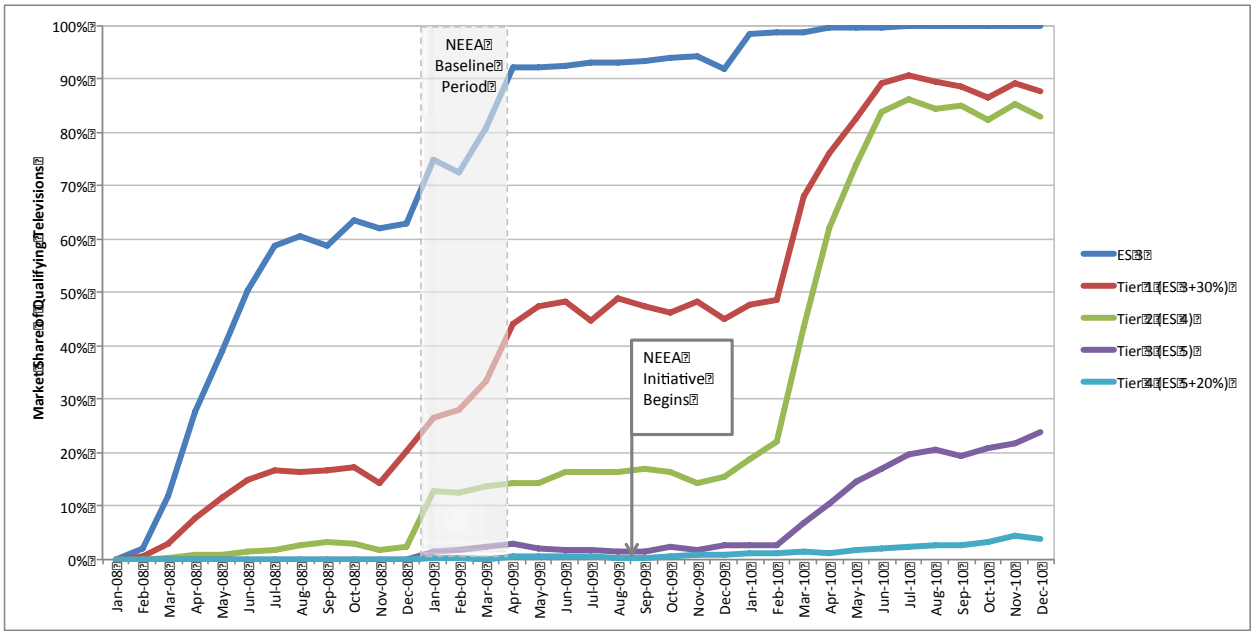
4. PROGRAM FINDINGS

The main activities in this evaluation were the review of available Initiative data and the collection of primary data from key stakeholders and consumers. This section summarizes the most important findings from these activities that lead to conclusions about the influence of the Initiative on the market. It also provides important context and information that feed into the two most critical activities of this evaluation: the logic model review (Section 4.4) and ACE model review (Section 5). Additional findings from the primary data collection activities (Stakeholder Interviews and Focus Groups) can be found in Appendices B and C, and data collection instruments for these activities can be found in Appendix D.

4.1. Tracking Data Review

The dataset from Energy Solutions combines tracking data from program participants with additional sales data from NPD, and was used to analyze information on the market share of the different Initiative ties and the UEC of televisions in the Northwest. This data goes back to January of 2008 and shows a consistent rise in the market share of each Initiative tier, as shown in Figure 4-1.

Figure 4-1: Northwest Market Share by Tier



Source: NEEA TV Baseline Aggregation Analysis (Version 5)

To give the proper context, the NEEA baseline period (Q1 2009) and the beginning of the Initiative (September 2009) are labeled on the graph. It is important to note that the market shares shown are cumulative, meaning that the Tier 1 market share includes all units that meet the Tier 1 qualification criteria, including the televisions in the more energy-efficient Tiers 2, 3 and 4.

Due to the television market assortment schedule (discussed in Section 3.2), the market share of each tier increased dramatically between February and June each year, and then remained relatively flat the rest of the year. This data shows a substantial increase in the market share of Initiative-qualifying televisions at

every Initiative Tier in 2010. The largest increase in 2010 was for the ENERGY STAR 4 (Tier 2) level. This specification was officially announced by ENERGY STAR in September 2009 and took effect shortly after the spring assortment changeover in May 2010. This level was used as the lower tier NEEA incentive for 2010. As a result, by the end of 2010 the market share of televisions qualifying for the lower tier NEEA incentive reached over 80%. Thus, NEEA was paying incentives for the vast majority of the television market. In 2010, the market share of ENERGY STAR 5 televisions also increased, going from close to zero in 2009 to over 20% by the end of 2010. These televisions qualified for the higher tier NEEA incentive in 2010, and were paid a higher incentive amount due to the increased difficulty of meeting this specification.

This yearly increase in market share of energy-efficient televisions has led to an increase in the market share of televisions that consume 108 Watts of active power or less, an important MPI for the NEEA Initiative. All ENERGY STAR 5 televisions will consume less than 108 watts or less, due to the absolute consumption cap; however, many smaller televisions at lower tiers also consume less than 108 watts. Table 4-2 shows the different combinations of Initiative tier and screen size bins that consume 108 watts or less.

Table 4-1: Tier and Screen Size Bin Combinations Consuming 108 Watts or Less

Screen Size Range (Inches)	Max Screen Area ($Inch^2$)[7]	Max Active Power for Tier 1 (ES 3 +30%)	Max Active Power for Tier 2 (ES 4)	Max Active Power for Tier 3 (ES 5)	Max Active Power for Tier 4 (ES 5 +20%)
<32	438	83.7	77.5	54.8	43.8
33-35	523	95.7	87.8	62.0	49.6
36-39	650	113.4	103.0	72.6	58.1
40-46	904	170.8	133.5	94.0	75.2
41-49	1026	191.3	148.1	104.2	83.3
50-60	1538	273.7	209.6	108.0	86.4
>60	>1538	>273.7	>209.6	108.0	86.4

Source: EMI analysis

The market share of ENERGY STAR 5 televisions was 23.8% at the end of 2010. When the total number of televisions consuming 108 Watts of active power or less are taken into account, the market share of televisions consuming 108 Watts or less is higher, amounting to 53% in December 2010. Table 4-3 summarizes these results along with the relevant market shares in January 2010.

Table 4-2: Market Share of Televisions Consuming 108 Watts or Less in 2010

	January 2010	December 2010
Market Share of ENERGY STAR 5	2.8%	23.8%
Market Share of All Televisions ≤ 108 W	27.5%	52.8%

Source: EMI analysis

[7] Maximum screen area for each bin was calculated using the formula provided by Energy Solutions: Screen Area (In^2)=(Diagonal Screen Size)^2 x .4273. Energy Solutions. "Memorandum – Confidential. Summary of methods used to analyze TV sales data." 12/9/2010, p. 7.

Urban Versus Rural Units

Program tracking data show that 96% of the Initiative-qualified televisions were sold in urban RUCC (Rural Urban Continuum Classification) and just 4% were sold in rural RUCC classifications[8]. This shows a skew toward sales in urban areas, as estimates derived from 2010 US census numbers indicate that only 78% of households are found in urban areas in the Northwest.

While this shows a significant skew toward urban areas, this does not necessarily mean that the program does not reach customers in rural areas, as rural customers may drive to larger towns (i.e. more urban areas) to make significant purchases such as a new television. To confirm this market dynamic future evaluation efforts could include research into the purchasing behavior of rural customers.

Table 4-3: 2010 Northwest Television Sales by RUCC Code

RUCC Type	RUCC Code	2010 Television Sales	Percent of Total Sales	Percent of Rural/Urban Sales	Percent of Northwest Households
Urban	1	152,496	34%	96%	78%
	2	62,964	14%		
	3	138,563	31%		
	4	31,530	7%		
	5	41,607	9%		
Rural	6	11,571	3%	4%	22%
	7	4,916	1%		

Source: EMI analysis on data supplied by Energy Solutions on May 19, 2011

4.2. Findings from Primary Data Collection

This section provides a high-level summary of findings from primary data collection (e.g., in-depth interviews and focus groups) related to the influence the Initiative has on the sales and stocking of energy-efficient televisions in the Northwest. There are six main findings relating to the influence of this program on the market for energy-efficient televisions in the Northwest market. A summary of these high-level findings is found below. More detailed findings from primary data collection can be found in Appendices B and C.

Indirect Influence of Incentives

As discussed in Section 3.1, market actor interviews revealed that assortment at large national retailers is mostly done on a national basis with little regional variation. In addition, the incentives are given to the corporate headquarters of the large retailers, often located outside the Northwest, not to the regional or local stores. Some retailers went further, describing that the incentive dollars are often channeled into marketing efforts for energy-efficient televisions, and, thus, they are not seen as directly increasing the profitability or margin of the sales of these products in the Northwest. Because incentives are not going directly to regional retailer locations, the Initiative does not give a direct incentive for these retail locations to increase the sales or stocking of energy-efficient televisions in the region. These factors lead to the incentives having little direct effect on the Northwest market, though they do contribute to an overall incentive to the retailer on a corporate level. One retailer indicated that it was this "collective influence" of all utility incentives that affects their national assortment. Smaller local/regional retailers

[8] NEEA defines "urban" as RUCC codes 1-5, and "rural" as RUCC codes 6-9. No sales were recorded for RUCC codes 8 and 9, so the EMI analysis includes only RUCC codes 1-7.

are more directly affected by the incentives, but these retailers make up a small part of the market that participates in the Initiative.

Unquantifiable Effect of Incentives

As part of the research for the determination of allocation shares by ECONorthwest, retailers were asked directly how much their assortment had been influenced by the incentives. All but one retailer could not directly answer the question and did not give an estimate. The one retailer that was able to provide a rough estimate was a regional retailer operating only in the Northwest, and this retailer approximated that the program resulted in 5% more energy-efficient televisions on store shelves due to the Initiative.

Emphasis on ENERGY STAR

Retailers and manufacturers place a large amount of emphasis on the ENERGY STAR brand when talking about energy efficiency. Manufacturer interviewees noted that they want as many models as possible to meet the ENERGY STAR specifications so they are not "left out" by not having available ENERGY STAR product. One retailer also indicated that they had corporate targets to only stock ENERGY STAR qualified products. Retailers also emphasized their marketing efforts (e.g., shelf tags and circulars) around ENERGY STAR products.

Energy Efficiency as a Consumer Buying Criterion

Results of consumer-focused focus groups indicate that consumers still rank energy efficiency very low in importance when purchasing a new television. This result was also supported by retailer and manufacturer interviews where respondents noted that consumers are not demanding energy efficiency in televisions. More specifically, retailers indicated that consumers do not often ask about energy use or energy efficiency when purchasing a new television at a retailer location.

Effect of Marketing and Training

Evaluation activities were not designed to determine whether training and POP display materials were effective, though preliminary evidence indicated that there was limited awareness among consumers and that POP may not have been used in all retail locations consistently. One retailer indicated that though retailer staff were trained in energy efficiency, this training was primarily to allow them to answer questions if consumers had them, not to directly try and sell energy efficiency to the customer. Retail sales staff also have very little time to influence the decision of the television purchaser. Furthermore, since staff turn over is very high at retail locations, it is difficult to keep all staff trained. To more fully understand the effect of marketing and training, future evaluation efforts could include specific research in this area.

Influence on ENERGY STAR Specifications

Interviews with CEE, EPA, and partner utilities confirmed the positive effect NEEA staff had on influencing and supporting the strengthening of the ENERGY STAR specifications on which the Initiative qualification criteria are based. Because of the emphasis retailers and manufacturers put on ENERGY STAR, the strengthening of these specifications helps to push the market to new levels of energy efficiency. The direct role of NEEA in influencing these specifications is explored in further detail in the next section, Section 4.3.

4.3. Examples of NEEA Program Influence

Review of NEEA Initiative data revealed many ways in which NEEA efforts have helped influence the energy-efficient television market. These are included below.

- **Support for moving up of the ENERGY STAR 5 effective date.** NEEA took the lead on an official letter to the EPA in support of moving up the effective date of ENERGY STAR 5 due to the increasing market share of these televisions in 2010. This letter was also cosigned by PG&E and SMUD.
- **Support for the progressive energy efficiency requirement in ENERGY STAR 5.** NEEA submitted a letter to CEE to oppose the lack of support from CEE for the progressive energy efficiency requirement for ENERGY STAR 5 (i.e. the wattage cap on televisions over approximately 50" in size).
- **Contribution of information to the FTC labeling effort.** NEEA contributed information to the Collaborative Labeling and Appliance Standards Program (CLASP) on experiences working with retailers on POP material that was used in support of the FTC label for televisions.
- **Motivating manufacturers to qualify models with ENERGY STAR.** Utility incentives such as the BCE incentives and other similar initiatives can motivate manufacturers to list products on the ENERGY STAR qualified products list because retailers can only collect incentives for the sale of models that qualify through ENERGY STAR. The Salesforce.com database included one specific example in the form of a communication where a participating retailer pressured a manufacturer to list products with ENERGY STAR so the retailer could collect incentives on those models through the BCE program;
- **Changing business practices of retailers.** There was also some anecdotal evidence from retailers indicating that they had changed business processes in response to the program, though these examples were not specific on what changes were made due to the program.

4.4. Logic Model Review

A primary goal of this evaluation was to review the Initiative logic model that illustrates and explains how the Initiative activities result in energy savings. Overall, the final version of the Initiative logic model reviewed by EMI (v10) was well organized and well documented. The illustrated model is well developed with clear Key Critical Paths, and Medium- and Long-Term Outcomes. All linkages are also clearly labeled and described in accompanying documentation. However, this research has revealed some potential inconsistencies between the Initiative logic as indicated in the model and the effect of the Initiative on the market.

Consistency of Initiative Logic

Through the study of three different versions of the logic model over the course of the evaluation, it is apparent that the Initiative began without a clearly articulated logic model documenting the intended effects of Initiative activities. As a result, the Initiative logic (or at least the expression of that logic) has shifted over time, with no corresponding change in Initiative activities. This is an indication that there was not a direct linkage between the Initiative logic and implementation activities, which can result in Initiative activities not effectively leading to the intended outcomes of the Initiative.

A number of stakeholders interviewed through this evaluation effort articulated the goal and logic of the Initiative as increasing the availability and sales of energy-efficient televisions through incentives to retailers and marketing to customers. However, this logic does not seem to be clearly expressed in the

logic model itself. It seems that this logic would be encapsulated in the critical logic paths the evaluation team has labeled the "Recruiting Retailers" path and the "Developing Initiative Specifications and Incentives" path, neither of which emphasize the role of incentives. For example, in the short-term output from the Recruiting Retailers path ("Retailers accelerate the sales of energy-efficient Televisions in the NW region") it is not clear how retailer recruitment in and of itself accelerates the sales of energy-efficient televisions in the Northwest. In the Developing Initiative Specifications and Incentives path, the establishment of annual Initiative specifications and incentives is linked to retailers committing to stocking and promoting the most energy-efficient televisions. However, it is not clear from the implementation of the Initiative that retailers are actually "committing" to stocking "the most energy-efficient Televisions," but rather that they should be motivated to stock more energy-efficient televisions because of the payments of incentives.

A more clear and consistent expression of this logic through the logic model would help future stakeholders and evaluators to understand the program rationale, and would ensure that the role of key activities (such as the payment of incentives) are clearly linked to their intended outcomes.

Influence on National Retailers

Evaluation activities found that some linkages identified in the logic model may not be as strong as may be needed to achieve the desired Initiative outcomes. For example, the finding that most large national retailers do assortment on a national instead of regional level makes it difficult to affect the regional assortment of Initiative-qualified televisions. While NEEA, in combination with other similar program incentives, seems to be having some effect on this national market, this effect may be limited and is difficult to quantify at either a national or regional level. In addition, retailer and manufacturer interviews performed for this evaluation indicated that retailers have a number of considerations that are of higher importance than energy efficiency (e.g., price, features, ENERGY STAR qualification, etc.) and that the specifications can, at best, be a tiebreaker in manufacturing and stocking decisions. Because the Initiative relies on the influence of incentives on retailers to create energy savings in the Northwest, a weak linkage in the Initiative logic here creates a large risk to the Initiative achieving the intended outcomes of the Initiative.

Influence on Manufacturers

Another potentially weak linkage in the Initiative logic is the influence of retailers on manufacturers to request televisions that meet the Initiative qualification criteria. Interviews with retailers and manufacturers leave it unclear what direct or indirect influence NEEA has on manufacturers through this initiative. Manufacturers are mostly focused on fulfilling the requests of retailers and are highly motivated by meeting the ENERGY STAR specification level in effect, with limited focus on Initiative qualification criteria. It is important to note, however, that the allocation shares used in the ACE model (discussed in Section 5, below) do not include direct influence of NEEA on manufacturers as a driver of energy savings, so this is not emphasized as an important aspect leading to energy savings, though it is prominently displayed in the Initiative logic model.

Importance of Consumer Facing Marketing

While the Initiative logic model clearly includes an element of consumer marketing, NEEA implementation staff and contractors de-emphasized this element of the Initiative logic during initial conversations with EMI regarding the logic model. In addition, the Natural Occurring Baseline Market Share memo gives significant credit to NEEA marketing efforts for driving energy-efficient television sales in the Northwest. These findings indicate that there is a possible disconnect between the role of marketing in the Initiative logic (including the savings calculations) and the importance of marketing to implementation staff.

While initial evaluation research indicates that consumer facing marketing may have had limited effect late in 2010, a number of stakeholders interviewed for this evaluation spoke about the importance of driving this market from the consumer side, with the belief that retailers want to sell products that consumers want to buy, and manufacturers want to manufacturer products that retailers want to sell. While the ENERGY STAR brand is well recognized by consumers after many years of promotion and development of the brand, the marketing of units meeting the more stringent Initiative requirements may require more time to materialize. The limited evaluation research focused on marketing was conducted early in the Initiative (Q4 2010 and Q1 2011), so more extensive and continued research would be required to truly assess the influence of NEEA marketing efforts for this initiative.

Televisions That Consume No More Than 108 Watts

One of the medium-term outcomes of the Initiative logic model is: "Televisions bearing the ENERGY STAR designation no longer consume more then 108 watts regardless of size, type, or feature set." The ENERGY STAR Version 5 specification has an absolute wattage cap of 108 Watts, so once this specification takes effect in September 2011, this will already be achieved. While NEEA has been supportive of the ENERGY STAR 5 specification development and its taking effect 7 months ahead of the original schedule, the U.S. EPA performs the ultimate setting of levels. The primary role of the Initiative is to attempt to increase the market share of televisions that meet these specifications in the region. Therefore, it may be more appropriate for this outcome to emphasize the market share of televisions that consume no more than 108 Watts in the Northwest. For this reason, EMI has performed an analysis to determine the market share of televisions that consume no more than 108 watts as part of this evaluation.

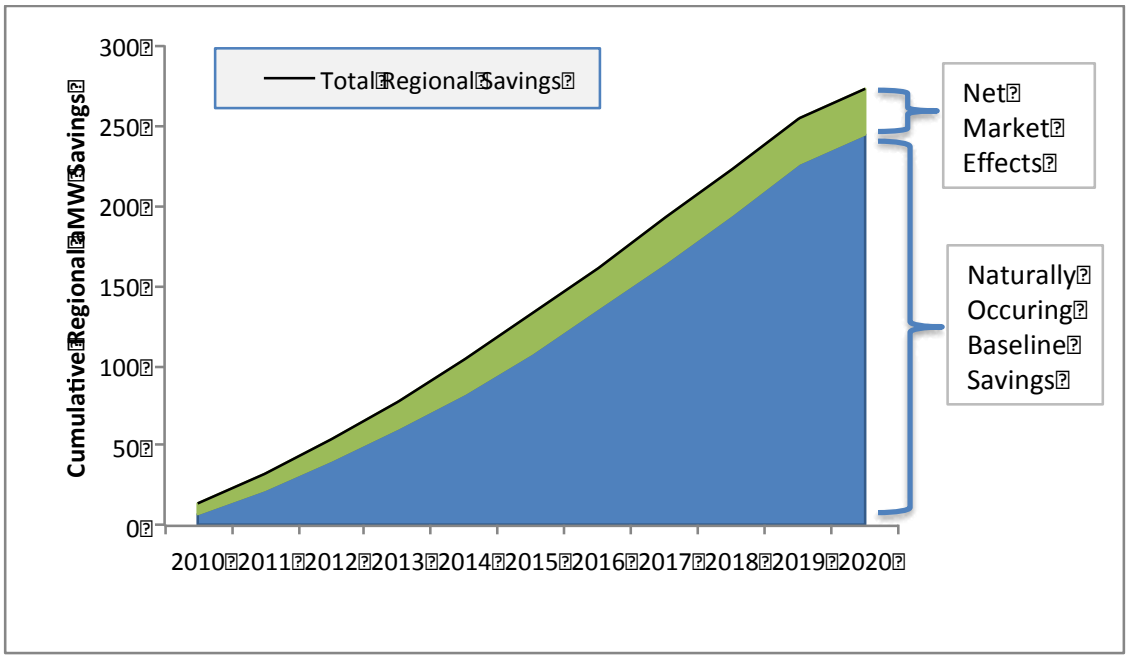
5. ACE MODEL REVIEW FINDINGS

EMI completed an in-depth review of the structure, inputs, and assumptions of the Alliance Cost Effectiveness (ACE) model for the Television Initiative. The ACE model review focused on evaluating the validity and transparency of key assumptions in the model.

5.1. ACE Model Structure

The ACE model estimates three key energy savings figures: Total Regional Savings, Naturally Occurring Baseline Savings, and Net Market Effects. Net Market Effects, or total Average Megawatt (aMW) savings attributable to the Initiative, represent the contribution of the NEEA Television Initiative to Total Regional Savings through increased market share of energy-efficient televisions and decreases in UEC. The Net Market Effects are calculated by subtracting the Naturally Occurring Baseline Savings from the Total Regional Savings. Figure 5-1 shows the ACE model estimates of Total Regional Savings, Naturally Occurring Baseline Savings, and Net Market Effects.

Figure 5-1: ACE Model Savings Structure



Source: NEEA Televisions Initiative ACE Model (Version 6)

The full ACE model review examined all of the key assumptions that feed into the calculation of these three reported figures. Below, this report summarizes key findings for Total Regional Savings and Naturally Occurring Baseline Savings. Since Net Market Effects is a composite of these two figures, it does not require separate key findings.

5.2. Total Regional Savings

Total Regional Savings represent the movement of the entire Northwest television market towards energy efficiency. They are defined as the aMW savings of the Northwest television market due to increases in the market share of energy-efficient televisions and decreases in the average UEC of energy-efficient televisions within each energy efficiency tier. The ACE model estimates 2010 Total Regional Savings from the following key inputs:

- **Total televisions sold in the Northwest.** The total unit sales in 2010 of all televisions in the Northwest market;
- **Market share by Tier.** The average 2010 market share of each energy efficiency tier, weighted by screen size;
- **Incremental savings per television, by tier.** The average incremental kWh savings over the next lower tier for each television in a given tier. The incremental savings for Tier 1 is the total energy savings when compared to the assumed baseline Unit Energy Consumption (UEC).

Key Findings for the Calculation of Total Regional Savings

EMI evaluated each of these inputs, and all key assumptions comprising them, and key findings from this evaluation are listed below.

- **The baseline UEC values are inconsistent with the savings calculation.** Having qualifying units in the baseline UEC estimate invalidates the Total Regional Savings and creates the need for an adjustment to the NOBMS. A more transparent and accurate method would be to use the correct baseline UEC and an unadjusted NOBMS. This would also limit unforeseen effects that may carry through the model due to this artificial adjustment to the market share.
- **The estimation of Total Northwest Market size may be overstated.** A NEEA-sponsored consumer electronics study[9] indicates that Northwest has as few as 8.5% fewer televisions per capita than the national average. Because total television sales in the Northwest are directly proportional to the calculated Total Regional Savings and Net Market Effects, and because the Model assumes that televisions in the Northwest are purchased at the same rate as the national average, this potential overstatement may result in savings estimates that are too high.
- **Estimations of dataset coverage show inconsistencies.** The estimate for the market coverage of the participant dataset was calculated using 2009 sales data. It would be more accurate to compute this using updated 2010 sales data. Furthermore, differences in Initiative-qualified television market share between the NPD and program datasets could be analyzed to see if the weighting of different data sources should be altered to increase the validity of the model.
- **Some retailer sales data is missing.** Some retailers failed to report sales data for some months, and therefore Energy Solutions estimated sales for those missing months. As a result, the participant dataset is less accurate than it would have been with full reporting from retailers.
- **The portion of televisions sold to the commercial market is based on information from one manufacturer.** The validity of the commercial television market share could be increased by finding an independent data source or collecting data from more than one manufacturer.
- **Savings from non-qualified units are not accounted for.** The ACE model accounts for changes in market share and UEC for televisions over time, based on data collected by NEEA and its implementation contractors. However, the model only measures savings from changes in

[9] The Market for Energy Energy-efficient Electronics: Pre- Program findings on consumer perceptions and retail shelf stocking practices, Opinion Dynamics, November 1, 2010.

market share and UEC within the different energy efficiency tiers of the Initiative. The UEC and market share of the non-qualified units are also changing over time, which must be factored into the Total Regional Savings calculation. It is likely that the energy use of non-qualified televisions decreases as the whole market moves towards higher levels of energy efficiency, so there would be savings within the non-qualified units as well.

5.3. Natural Occurring Baseline Savings

The Naturally Occurring Baseline Savings are defined as the aMW savings of the Northwest television market that would have occurred in the absence of a NEEA initiative. The Naturally Occurring Baseline Savings are calculated with the same methodology as the Total Regional Savings, but use the assumed Naturally Occurring Baseline Market Share (NOBMS) instead of the actual market share in 2010. The NOBMS represents the change in the market share of energy-efficient televisions that is *not* attributable to NEEA.

Calculating the Naturally Occurring Baseline Market Share (NOBMS)

ECONorthwest, a NEEA evaluation contractor, developed a memo estimating the NOBMS since the program baseline period of the first quarter of 2009[10]. The output of this memo is the allocation of market shares to different market actors. The memo does not describe or forecast a true market baseline, but instead develops an estimate of what percent of Total Regional Savings are attributable to each market actor, including NEEA.

To estimate the allocation shares of the increase in market share for each tier, ECONorthwest conducted qualitative interviews with market actors[11], and then assigned quantitative estimates of the share of the overall market gains attributable to these different market actors. In this process, ECONorthwest assigned shares of the increase in market share to:

1. Program incentives from NEEA and other BCE sponsors
2. The ENERGY STAR brand and specifications
3. California appliance standards
4. Natural technology improvements
5. NEEA television retail promotions and consumer demand

Table 5-1 shows the values of these allocation shares as defined by ECONorthwest.

[10] "Northwest TV Naturally Occurring Baseline Market Share Estimation Results," ECONorthwest, March 17, 2011.
[11] EMI was present for most of these interviews, so as to be most energy-efficient with interviewees' time.

Table 5-1: Allocation Shares of Total Regional Savings

	BCE Incentives	ENERGY STAR	CA Appliance Standards	Technology	Retail Promotions
ES 3.0 +15%	34%	50%	0%	15%	0%
ES 3.0 +15% to +30%	30%	45%	0%	15%	10%
ES 3.0 +30% to ES 4.1	19%	26%	10%	35%	10%
ES 4.1 to ES 5.1	19%	26%	10%	35%	10%

Source: Natural Occurring Baseline Market Share Memo

The allocation shares give NEEA credit for the multiple market interventions, and therefore NEEA is assigned a share of the savings from a number of these buckets. In this analysis, NEEA is given credit for the following market interventions:

1. Direct incentives from NEEA to participating Northwest retail locations;
2. Influence on the ENERGY STAR program that resulted in stricter specifications;
3. Participating television retailer promotions.

Table 5-2 shows another breakdown of allocation shares by market actor, with total allocation for NEEA unbundled and shown separately.

Table 5-2: Allocation Shares by Market Actor

	NEEA Total	ENERGY STAR	Other BCE Sponsors	Technology	Appliance Standards	STAR Stakeholders
ES 3.0 +15%	0%	20%	54%	15%	0%	10%
ES 3.0 +15% to +30%	37%	18%	21%	15%	0%	9%
ES 3.0 +30% to ES 4.1	20%	11%	19%	35%	10%	5%
ES 4.1 to ES 5.1	20%	11%	19%	35%	10%	5%

Source: Natural Occurring Baseline Market Share Memo

EMI finds that the allocation share values are not transparently derived. While the memo transparently and qualitatively describes the influence of each actor in the market, there is a not a clear linkage between these descriptions and the specific numbers used as the allocation share for each actor.

NOBMS Adjustment

NEEA has multiple reporting requirements. To fulfill reporting requirements from the Northwest Power and Conservation Council, the ACE model uses a different baseline for television energy consumption. This baseline UEC includes qualifying televisions, instead of only including non-qualifying televisions as program theory dictates. This results in lower incremental kWh savings for Tier 1 televisions, which, in

turn, results in a lower value for both Total Regional Savings and Net Market Effects. To account for this inconsistency, NEEA adjusted the NOBMS to a level that results in the same Net Market Effects that would have occurred using a baseline of only non-qualifying units. After adjusting the NOBMS, the Net Market Effects are correct, but the Total Regional Savings are no longer valid.

While the end result of these calculations are the same as if the calculation was done with the non-qualifying baseline, the NOBMS adjustment adds another layer of complexity to the model and results in misleading and incompatible numbers being presented within the model (e.g., the Tier 1 market share and incremental savings). For these reasons, the NOBMS adjustment reduces the transparency of the ACE Model calculations.

Areas of Uncertainty in the NOBMS Allocation Shares

EMI analyzed these allocation shares by assessing the above assumptions in light of the other observations taken from this evaluation, and by comparing the allocation shares of certain market actors to assess whether or not they can be considered valid and transparent.

- **The allocation shares for NEEA and other market actors are not transparent.** Allocation shares from the NOBMS memo were not transparently devised and, as a result, their validity cannot be confirmed. An analysis of comparing allocation shares from key market actors revealed some possible discrepancies in what the NOBMS represents (e.g., national or regional) and areas where allocation to NEEA is potentially overstated.
- **It is not clear whether the estimated allocation shares are meant to be regional or national.** The allocation shares identified in the baseline memo contain possible conflicts in how they might affect the national and regional market. While these two markets are effectively identical, the allocation shares must be consistent and clear as to whether they address one or the other.
- **Potentially overstated results for NEEA in-store marketing materials.** The allocation shares for consumer-facing advertising for Tiers 1, 2, and 3 are 10%. However, this is not considered a consumer-facing program, and program implementers de-emphasize the role of consumer-facing marketing. Additionally, since this influence would only be in the NEEA territories, a 10% increase in the number of energy-efficient units sold would make a measurable difference in market share of these units in the Northwest over a national market, which has not yet been demonstrated. Further, additional evaluation research (i.e. market actor interviews, retailer and manufacturer interviews, focus groups) raised some concern that marketing materials were not being used uniformly and consistently across the service territory, and that they had limited influence on consumers. These observations imply that a 10% allocation to NEEA for these activities is a potential overstatement.
- **For Tiers 2, 3, and 4, the allocation for NEEA was nearly double the influence of the national ENERGY STAR program.** Manufacturers interviewed for this initiative reported that they were strongly influenced by the national ENERGY STAR program. ENERGY STAR has been working with manufacturers for more than a decade to develop test procedures, harmonize standards, develop technical specifications, develop a powerful, nationally recognized brand, and maintain a public database of qualifying televisions. NEEA relies on all these factors to run the Television Initiative. In addition, manufacturer interviews showed that the desire to meet the ENERGY STAR program specifications is high in importance to manufacturers, while the desire to meet Initiative specifications is secondary. While evidence indicates that NEEA has succeeded in supporting and influencing the ENERGY STAR program to create more strict specifications on an accelerated timeline, it seems to be a potential overstatement that NEEA should be allocated almost 20% of the success of the ENERGY STAR program. This is especially true because, this

allocation would have to be consistent across the country, as ENERGY STAR acts on the national market, not just the Northwest market.

- **The overall influence of NEEA was comparable to or greater than the California BCE program.** Retailer interviews revealed that some retailers feel the collective influence of utility specifications is what drives these retailers to alter stocking habits to meet incentives. While the BCE sponsors share specification levels, some sponsors, such as PG&E, pay significantly higher incentives than NEEA. Since the population of the Northwest is comparable to the population of the PG&E service territory, one might expect PG&E to have more influence than NEEA based on its equivalent market size and higher incentive levels. However, even the entire group of other BCE sponsors is assumed to have less influence than NEEA. Furthermore, for Tier 1 televisions, NEEA is allocated 90% of the credit for the effect of the incentives for this tier, compared with the 10% credit given to the other BCE sponsors. While the ability of NEEA to influence an increase in the specification to stricter criteria is certainly important, diminishing the efforts of the other sponsors to this extent does not seem reasonable, given the efforts and funding that went into promoting this specification level. The allocation of BCE incentives should also be clarified to whether this is applied to the national market or just the regional market.
- **The NOBMS adjustment reduces the transparency of the ACE Model and results.** The NOBMS adjustment reduces the transparency of the ACE model and eliminating this aspect of the calculation would increase the clarity of the model.

6. CONCLUSIONS AND RECOMMENDATIONS

High-level conclusions and recommendations have been constructed by synthesizing the findings from the various evaluation activities.

6.1. Conclusions

At the commencement of the Television Initiative in 2009, the television market had already begun to become steadily more energy-efficient due to advances in technology and the development of more stringent ENERGY STAR specifications. Because of the speed at which this market was moving, NEEA implemented the program very quickly, and did not lock down the full logic of the Initiative ahead of implementation, as demonstrated by the lack of an established logic model.

This first year MPER has concluded that there are a number of large risks to the success of this initiative. EMI found that the fundamental logic of the Initiative potentially overstates the influence the Initiative has on the market through key market actors such as retailers, manufacturers, and other energy efficiency program developers. While available evidence supports some influence on these market actors, this initiative is only one of many contributing forces focused on the large national retailers that make up the vast majority of the television market. These other contributing forces include: internal goals of retailers and manufacturers, other utility sponsored energy efficiency programs across the country, the EPA ENERGY STAR program, California statewide standards, the Federal Trade Commission, and others. Aside from these market actors, rapid technological advancement such as power management and LED backlights continue to drive down the energy use of televisions. The influence of the NEEA Initiative is therefore diluted among many national pressures towards more energy-efficient televisions, and the Initiative logic model and ACE model assumptions do not properly reflect this. In addition, although the evaluation collected anecdotal evidence that the Initiative is contributing to this decrease in television UEC, a robust method for parsing out the influence of one organization from the myriad of stakeholders in such a large, complex, and rapidly moving market is not apparent.

These factors strongly suggest that energy savings estimates from the ACE model are likely to be overstated. The extent of this overstatement is not known because of the difficulty in determining the correct allocation of savings attributable uniquely to the NEEA efforts, but if the influence of the Initiative is significantly overstated, this could pose a significant risk to the ultimate cost effectiveness of an initiative based on the current program theory.

Additional conclusions of this evaluation are found below.

Key MPIs

The following conclusions provide a description of the results of the analysis of the key MPIs for this evaluation, which were taken from the final (Version 10) logic model for this initiative. These key MPIs are:

1. Market share of Initiative-qualified televisions compared to the NOBMS;
2. Market share of televisions that consume 108 watts or less;
3. Stringency of the Initiative specification levels compared to ENERGY STAR;
4. Quarterly reporting of Initiative data.

1. Market Share of Initiative-Qualified Televisions Compared to the NOBMS

The market share of Initiative-qualified televisions grew in every Initiative Tier in 2010. The Market share of televisions that meet Tier 1 of the Initiative (the least stringent criteria) grew from 45.2% at the end of 2009 to 87.7% at the end of 2010. Breaking results down by tier, Table 6-1 shows the market share of the four Initiative tiers at the beginning of the Initiative, the end of 2009 and the end of 2010.

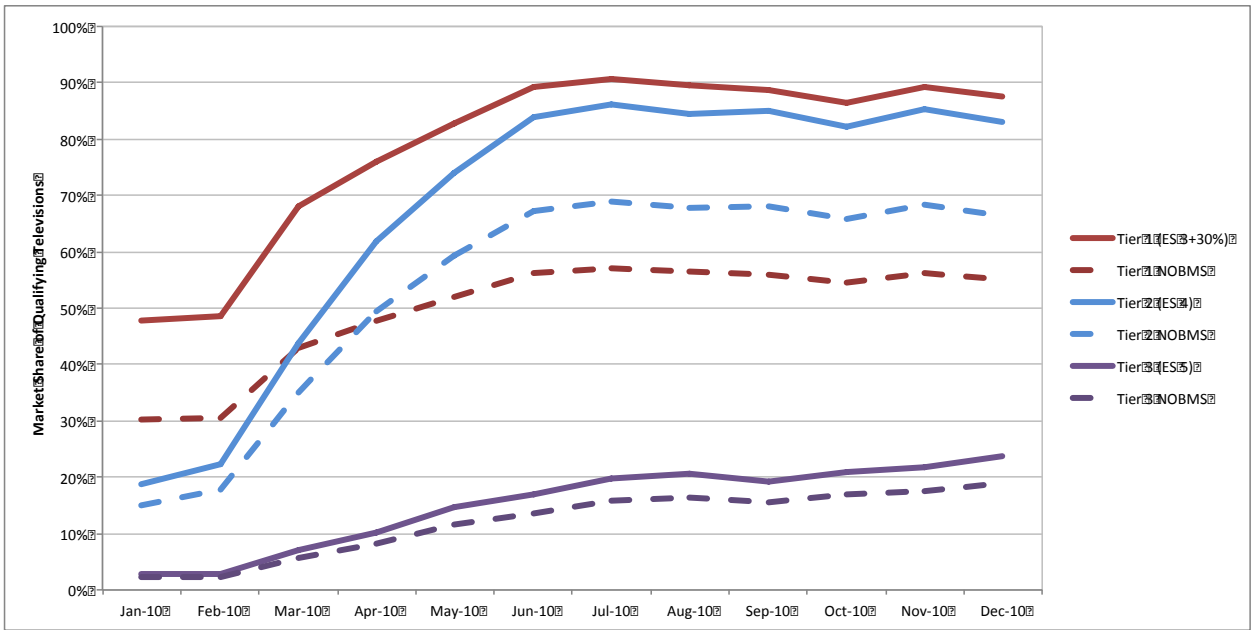
Table 6-1: 2010 Market Shares of Initiative-Qualifying Televisions in the Northwest

Initiative Tier	August 2009 (Pre-Program)	December 2009	December 2010	2010 Increase
Tier 1 (ES 3+30%)	48.9%	45.2%	87.7%	42.5%
Tier 2 (ES 4)	16.3%	15.6%	83.1%	67.5%
Tier 3 (ES 5)	1.6%	2.8%	23.8%	21.0%
Tier 4 (ES 5+20%)	0.4%	0.9%	3.8%	2.9%

Source: NEEA TV Baseline Aggregation Analysis (Version 5)

To examine the impact that NEEA had on these market changes, Figure 6-1 compares market shares by Tier with the NOBMS for each Tier over the course of 2010. Tier 4 had no NOBMS and therefore is not shown here. It is important to note that all NOBMS figures are based on the ECONorthwest allocation shares, which have not been independently verified and which may be overstated for the reasons indicated in Section 5.3.

Figure 6-1: 2010 Market Share and NOBMS by Tier



Sources: NEEA TV Baseline Aggregation Analysis (Version 5) and Natural Occurring Baseline Market Share Memo

The difference between Initiative-qualified market share and NOBMS is greatest in Tier 1 due to the larger allocation values determined by ECONorthwest. Table 6-2 shows the average 2010 market lift attributable to NEEA for Tiers 1 through 3.

Table 6-2: 2010 Average Market Shares and NOBMS

Initiative Tier	2010 Average Market Share[(a)]	2010 Average NOBMS[(a)]	2010 Net Market Lift
Tier 1 (ES 3+30%)	78.7%	49.6%	29.1%
Tier 2 (ES 4)	66.5%	54.1%	12.4%
Tier 3 (ES 5)	13.1%	12.0%	1.1%

Source: NEEA TV Baseline Aggregation Analysis (Version 5)
a.12 Month Average of 2010 NOBMS

While the market share of energy-efficient televisions did increase over the course of 2010, EMI was not able to confirm the validity of the NOBMS stated above, and therefore could not determine the direct effect of the NEEA Initiative separate from other market forces described in this report. Therefore, EMI could not determine the extent to which the market would have transformed in the absence of the NEEA Initiatives.

2. Market Share of Televisions that Consume 108 Watts or Less

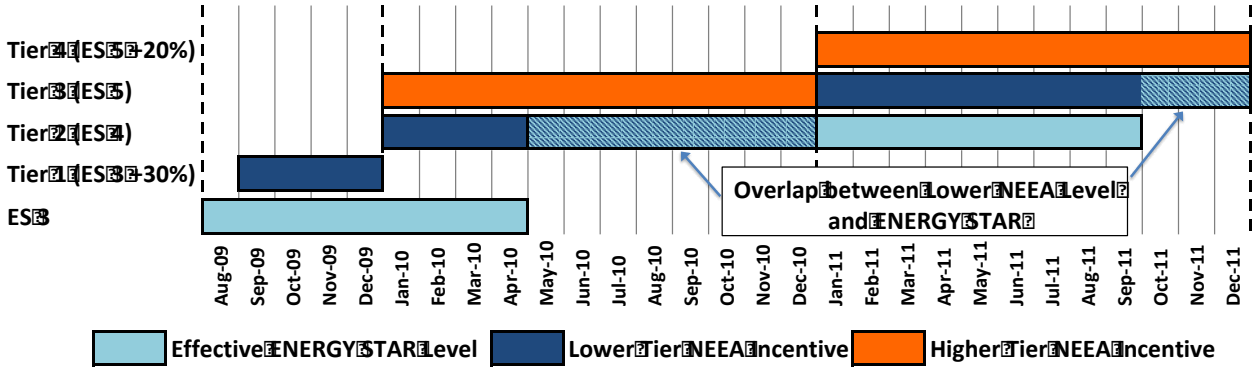
Another key NEEA MPI is the market share of televisions that consume 108 watts or less – the consumption cap for ENERGY STAR 5 (Tier 3) televisions. This absolute consumption cap in the ENERGY STAR 5 specification levels assure that all Tier 3 televisions consume 108 watts or less, and, in addition, many smaller televisions in Tiers 1 and 2 also consume 108 watts or less. Therefore, the total market share of all televisions that consume 108 watts or less is greater than the market share of Tier 3 alone. During 2010, the market share of televisions consuming 108 watts or less increased from 27.5% to 52.8%.

3. Stringency of the Initiative Specification Levels Compared to ENERGY STAR

While the higher tier NEEA incentive criteria were always more stringent than the ENERGY STAR qualification levels, the lower tier criteria were only equal to the ENERGY STAR levels at some points during the Initiative. This was a result of ENERGY STAR levels increasing mid-year, while the NEEA criteria are updated at the beginning of every calendar year. Having criteria that are equal to ENERGY STAR requires that the Initiative provide incentive payments to a large portion of the market once the market responds to the new ENERGY STAR standard, and therefore could decrease the cost effectiveness of the Initiative.

Figure 6-2 gives a graphical representation of the NEEA and ENERGY STAR qualification levels starting just before the Initiative began (August of 2009), and ending at the end of 2011.

Figure 6-2: Comparison of ENERGY STAR and NEEA Criteria



Source: ENERGY STAR Product Development Website; and NEEA staff interviews and background documentation.
Note: "ES" refers to specific ENERGY STAR levels, with +XX% indicating that the requirement is to use XX% less active power than the particular ENERGY STAR specification referenced.

4. Quarterly Reporting of Initiative Data

A variety of information was provided to NEEA by the implementation contractors on the implementation and progress of the program on a quarterly basis at a minimum. QDI provides a number of different reports to NEEA, including:

- Weekly updates of activities;
- Monthly reports of progress toward key goals and deliverables;
- Reports covering detailing visits and POP placement as needed;
- Reports from audits of POP placement.

Energy Solutions also indicated that they provide quarterly updates to NEEA with sales of Initiative-qualified televisions by zip code. While this progress indicator is present, it is not clear as to how the quarterly reporting leads to a change in the television market.

Additional Conclusions:

The following section provides additional conclusions of this research focused on the influence of the Initiative on market actors, the clarity and consistency of the Initiative logic model, and the transparency and validity of the ACE model assumptions. These conclusions were developed to answer specific evaluation questions developed during project scoping.

Influence of the Initiative on Market Actors

Review of NEEA Initiative data and primary data collection revealed many ways in which NEEA efforts have influenced market actors. The NEEA Initiative was one of many contributing forces that influenced the national retailers to stock and market energy-efficient televisions. Evidence of the influence of the NEEA Initiative found during this evaluation includes:

1. The collective financial incentives from many utilities influenced national retailers to stock more energy-efficient televisions;
2. NEEA-specific incentives had a more direct influence on smaller regional retailers that make up a small portion of the market to stock more energy-efficient televisions;
3. Incentives earn NEEA a seat at the table to collect market data from retailers and market to customers through retailers.

While the NEEA Initiative seemed to have some influence on national retailers, the influence of this initiative is diluted among the many different actors of the market. In addition, research indicated that

both the direct and indirect influence of the Initiative on manufacturers was limited, as discussions between national retailers and manufacturers do not prioritize energy efficiency and instead focus on other features and price. The main forces driving manufacturers to decrease the energy consumption of new designs are technological change (e.g., LED backlights) and the ENERGY STAR specifications.

NEEA was also actively involved in supporting more stringent energy efficiency specifications or programs. The main cases where NEEA helped influence the market are listed here and detailed in Section 4.3:

1. NEEA worked to implement higher-level qualification criteria and worked with California sponsors to harmonize to these specifications, as happened with the move from ENERGY STAR 3+15% to ENERGY STAR 3+30% in 2009.
2. BCE incentives motivated manufacturers to list products on the ENERGY STAR qualified products list, in order to collect incentives for these products.
3. NEEA took the lead on supporting the decision to move up the ENERGY STAR 5 effective date.
4. NEEA was a strong supporter of the progressive energy efficiency requirement (i.e. the 108 watt consumption cap) for ENERGY STAR.
5. NEEA contributed useful information to the Collaborative Labeling and Appliance Standards Program (CLASP) in support of the FTC label for televisions.

It is important to note that in many cases NEEA is working in collaboration with other organizations (e.g., CEE, other BCE sponsors) to leverage these organizations to increase the effective influence of these efforts.

Initiative Logic Model

EMI found that the logic model did not clearly articulate the main logic of the program, which dictates that the incentives lead to increased stocking and sales of Initiative-qualified televisions. This logic model could be altered to provide additional clarity and to more accurately reflect the observed effects of the Initiative. The logic of this initiative also changed over time, as EMI reviewed three different versions of the Initiative logic model over the course of the evaluation.

As indicated above, the Initiative incentives appear to have a limited effect on the regional assortments of televisions. Any influence on national retailers is on the national level, and therefore diluted among many market forces driving increased energy efficiency in televisions. In addition, these funds are channeled to the corporate level and are often funneled into energy efficiency marketing campaigns; corporate retailers indicated that they do not view the incentives as specifically increasing the profit margin on Initiative-qualified televisions in the Northwest.

Marketing to consumers is another area where program activities diverge from the logic model. While implementation staff de-emphasized the importance of the consumer-facing aspect of the program, this is a clear aspect of the Initiative logic model, and one of the main Initiative activities. Initial information gathered from the evaluation indicates that the consumer marketing aspect of the program may be having a limited effect, though NEEA had just begun a new marketing campaign and more in-depth research would be required to accurately assess the effect.

EMI found that other areas of the program logic were clear and consistent with the identified market effects. These areas include reporting of Initiative data, establishing annual specifications, and the contributions of NEEA to the development of more stringent specifications on televisions.

ACE Model Assumptions

There are a number of ACE model assumptions that pose a risk to the validity of the outputs of the ACE model. The highest risks identified in this research are listed here and discussed in detail in Section 5:

1. The NEEA allocation shares are potentially overstated.
2. The NEEA allocation shares are not transparent and therefore not verifiable. The selected baseline period may be underestimating the Initiative-qualified televisions on the market prior to Initiative implementation.
3. The estimation of total Northwest market size may be overstated.

The primary risk to the validity of the output of the ACE model is that the allocation shares are potentially overstated as discussed in Section 5.3. The ACE model could better reflect that the Initiative is focused primarily on large national retailers that are part of a national television market. Because of this, when assessing savings allocated to the Initiative in comparison to other market forces, NEEA is one of many contributing forces on a national basis. The NEEA influence is therefore diluted among all other regional, national, and international parties and drivers that affect the US market.

In addition, NEEA reports on consumer electronics have indicated that some demographics in the Northwest, such as televisions per capita and number of CRTs per capita, may differ from national averages. This likely leads to the overstatement of the Northwest market size and overstatement of total regional savings.

6.2. Recommendations

Over the course of this research EMI identified a number of primary recommendations that are described in this section. Prior to the completion of this report, NEEA had already begun to implement a number of changes to the Initiative, including an update of the program theory and logic model that includes a revision to the market progress indicators and ACE model assumptions. Future evaluation reports for this initiative will assess the results of these changes and estimate market progress accordingly.

Update the Initiative Program Theory and Logic Model

EMI recommends that NEEA review the core program theory and work to ensure that the logic model for this Initiative reflects the complexity of the market dynamics and the key critical paths towards energy savings. The development of a logic model is a useful tool for program designers, implementers, and evaluators, because it allows all stakeholders to come to a shared understanding of how a program will operate and how it will bring about change. Ideally this model is developed prior to program implementation. Through the course of this evaluation EMI has observed that different stakeholders have different expressions of the Initiative logic and that this logic has been changing over time. In this further development of the logic model, EMI recommends that NEEA focus on the difference between regional and national effects, the role of the incentives in bringing about market transformation, and the role and importance of consumer-faced marketing to the Initiative.

Revise Initiative MPIs and Update ACE Model Assumptions

EMI recommends that NEEA develop new MPIs that are mapped directly to the updated Initiative logic model. The evaluation efforts of this program will be enhanced by the development of MPIs that are linked more closely to the critical paths in the logic model. A separate MPI should be developed for all key critical paths in a way that measurement of that MPI will test the strength of that path in future

evaluations. Key MPIs to consider could be a metric for the relative influence of NEEA on retailers and a measurement of the average UEC of televisions in the Northwest market.

Improve the ACE Model and Baseline Assumptions

EMI recommends that NEEA improve the estimate of the market baseline and update the ACE model assumptions to better reflect the market and program logic. NEEA may want to consider evaluating the baseline and savings based on the average UEC of the television market, as this may be less challenging to forecast and track than the specific market share of each Initiative tier. EMI recommends that NEEA develop a detailed forecast of projected UEC going forward in the future and measure progress against this baseline. To determine this baseline, NEEA could look at the past national trends in UEC, which have shown a yearly 25% - 30% drop over the last few years during the assortment change over.

Further research into Northwest demographics could increase the transparency and validity of the ACE model assumptions. NEEA could identify more independent sources for information, or cross reference a number of different sources to tighten up some assumptions such as the percentage of televisions not sold in physical retail locations in the Northwest. NEEA could also perform more research to understand the effect of Initiative marketing materials such as surveys of Northwest residents that purchased televisions at participating retailers or mystery shopping visits to assess the placement of marketing materials. This information could be used to adjust the allocation shares for marketing materials, if applicable.

Harmonize the Timing of Criteria Revisions with ENERGY STAR.

EMI recommends that NEEA time the release of new qualification criteria with the dates when new ENERGY STAR specifications take effect. This step would ensure NEEA criteria are always more stringent than the ENERGY STAR specification and could help drive the market to higher levels of energy efficiency. By always keeping criteria more stringent than the ENERGY STAR specification in effect, NEEA will avoid paying incentives on large portions of the market due to the large increase in the number of qualified televisions after a new specification. This would ensure that retailers and manufacturers have to go above and beyond the ENERGY STAR criteria to receive incentives. If done effectively, this would accelerate the development of new ENERGY STAR specifications, and strengthen their criteria, by driving up the market share of televisions that are more energy-efficient than ENERGY STAR.

Consider a Codes and Standards Approach

NEEA may want to consider focusing energy savings goals on the long-term development of television standards in Northwest states. Because of the many market forces and dynamics, the average UEC for televisions was falling rapidly before the NEEA Initiative and is likely to continue falling into the future. There is still potential, however, for NEEA to influence the rate at which this change occurs. Utility programs often work in a leadership capacity to support the development and implementation of codes and such an approach may be warranted in the television market. A key advantage to this approach is the ability to evaluate this approach. An econometric forecast of expected *average* UECs could be developed for the television market (similar to average vehicle fleet efficiencies tracked by the Federal government), and NEEA could then establish an accelerated target for these average UEC levels, culminating in a regional standard for televisions. Long-term program evaluation would then be based upon this initial forecast of UECs in comparison to actuals, rather than tracking of market shares of various product tiers along the way toward the goal. Programmatic efforts would then focus on continued support of EPA in its work with manufacturers, but less on retailer and consumer market channels. In the near term, because of the rapid changes in the market, EMI recommends pushing for a standard that is more stringent than ENERGY STAR 5, such as the new ENERGY STAR 6 specification that is currently under development.

Determine the Applicability of Evaluation Findings to Other Products

EMI recommends that NEEA not assume the results of this evaluation are fully applicable to other consumer electronics products, and perform product-specific research where needed to determine the effectiveness of this program theory to these other products.

Recommended Data Collection Activities for MPER 2

There are a number of additional research tasks that EMI recommends NEEA consider for MPER #2 of this initiative.

1. **Interviews and Surveys with Market Actors.** For the second MPER, NEEA could perform additional interviews with market actors such as retailers and manufacturers to understand how attitudes towards the Initiative may have changed. In addition, NEEA may consider a short survey with key market actors to track any newly developed MPIs that cover the influence of the Initiative on these market actors over time.
2. **Survey of recent television purchasers and potential purchasers in the Northwest.** This could be performed in order to understand the true effect of the NEEA marketing efforts, and to determine what emphasis should be put on these activities in the future. This research could also be used to better understand aspects of the television market specific to the Northwest.
3. **Mystery shoppers.** This could be performed to understand the shelf-level saturation of Initiative-qualified televisions, to observe how well retailer staff is trained about Initiative-qualified televisions, and to confirm the correct placement of POP marketing materials. Comparisons to the initial NEEA market characterization reports could demonstrate key changes in the market since the inception of the Initiative.
4. **Survey of retailer sales staff.** This could generate information about trends in consumer buying criteria, the effect of initiative marketing criteria, staff turnover, and the use and satisfaction of retailer staff training.
5. **Perform comparison state analysis.** NEEA could focus research on determining exactly how the sales and market share of energy-efficient televisions in Northwest compare to a number of other target markets such as California, the Northeast, and areas without consumer electronics initiatives. This would help in forecasting and understanding how the Northwest market is different from other markets. For instance, the market share of energy-efficient televisions is likely affected by the mix of retailer types in the market (i.e. small local versus large national, electronics specialty stores versus general department stores). This could also offer a basis for future comparisons of regional data to other markets for any future Initiative strategy that may better affect the regional assortment or sales of highly energy-efficient televisions.

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Appendix B: DETAILED INTERVIEW FINDINGS

B.1 Retailer and Manufacturer Interviews

As part of the evaluation of the Northwest Energy Efficiency Alliance (NEEA) Consumer Electronics Initiative Television Program, EMI conducted interviews with six retailers participating in the Initiative and five manufacturers that produce qualifying televisions. Interviews were conducted in February 2011. These interviews were conducted to gauge retailer and manufacturer satisfaction with the Initiative, better understand the intricacies of the energy efficient television market, examine the Initiative influence on manufacturing and sales of energy-efficient televisions, and to identify suggestions for improvements in the Initiative, if any. This document provides a detailed description of the respondent sample selection and interview objectives, followed by a summary of the results of the interviews, and then conclusions and recommendations stemming from these findings.

Sample Selection

Retailer and manufacturer interviews were conducted in collaboration with ECONorthwest, who was simultaneously conducting market research to estimate the naturally occurring baseline market share of televisions in the Northwest. Interviews were scheduled and conducted simultaneously in order to decrease the amount of burden placed on manufacturers and retail partners. All interviews were conducted with individuals familiar with the NEEA Initiative and responsible for some aspect of utility programs and/or television design/purchasing for their companies.

Retailer Sample

As part of the collaborative effort, ECONorthwest attempted to contact ten of contacts from participating retailers provided by the implementer QDI. EMI was able to complete interviews with six of the representatives in collaboration with ECONorthwest. One additional interview was conducted by ECONorthwest only. Because the interview questions asked by ECONorthwest had a different focus, findings from this particular interview are not reflected in this analysis.

Manufacturer Sample

NEEA provided EMI with contacts for twelve manufacturers whose products are incentivized for the Program. EMI targeted and completed interviews with representatives of five manufacturers. The five manufacturers were selected by the implementer QDI, who recommended contacts who were likely to respond to an interview request.

Interview Analysis Objectives

The objectives of this analysis were to:

- Gauge retailer and manufacturer satisfaction with the Initiative;
- Understand distribution and sales channels of television manufacturers and retailers;
- Understand how the Initiative influences retailers and manufacturers;
- Determine influence of the Initiative on television manufacturing, stocking and sales practices;
- Identify trends in consumer demand, sales, and marketing practices;
- Understand how Initiative marketing materials are used and valued by retailers;
- Identify suggestions for improvements, if any.

Results

This section summarizes the key results with respect to the objectives listed above.

Retailer Satisfaction

Retailers were asked to report on their satisfaction with the Initiative overall, as well as with the performance of the implementers, QDI, Energy Solutions, and Premium Retail Services. Retailers were generally satisfied with the Initiative and implementers, although more than one respondent would like more transparency with respect to the incentive payment process. Retailers mentioned that they turn over all their sales data to Energy Solutions, who determines how many Initiative-qualified models were sold, and then determines the amount of the incentive payment.

Retailers are generally satisfied with the NEEA Initiative, but also have suggestions for improvements. Five out of the six retailer respondents were asked how satisfied they were with the NEEA Initiative, on a scale of 1 ("very dissatisfied") to 5 ("very satisfied"). Of the five responses, one gave a rating of 5 ("very satisfied"), three gave a rating of 4 ("somewhat satisfied"), and one gave a rating of 3 ("neither satisfied nor dissatisfied"). Reasons for a less than "5" rating were varied. One respondent wanted the incentive payment process to be more transparent. Another commented on the lower incentives offered by the NEEA Initiative compared to other programs. One respondent commented on the fact that the NEEA Initiative qualification criteria are different from the other programs, which makes it more difficult to participate effectively. Finally, one respondent expressed that he/she would like to have more of a sense of partnership and more regular communication with both NEEA and QDI.

Retailers are generally satisfied with the performance of QDI. Five retailer respondents also rated their satisfaction with the implementer, QDI. One gave a rating of 5 ("very satisfied"), stating that QDI has been extremely helpful because they have been involved in assembling all the utilities to participate in the various programs, making them a "one stop shop" for interfacing with energy-efficient television programs offered by different utilities. One retailer respondent gave a rating of 4 and the remaining three respondents gave a rating of 3. Reasons for lower satisfaction ratings included wanting more engagement with QDI and preferring to work directly with the utility rather than going through a third party implementer.

Retailers had less interaction with the implementers Energy Solutions and Premium Retail Services. Three retailers could comment on the performance of Energy Solutions, and none could comment on the performance of Premium Retail Services because some of the contacts had not had any personal interaction with the subcontractor Premium Retail Services. For Energy Solutions, one retailer respondent gave a rating of 4 and two gave a rating of 3. These respondents commented that they did not know how much incentive to expect, remarking that the incentive reimbursement process operated in a "black box." Another respondent commented that Energy Solutions was slow to respond to requests, and that changes in reporting had taken months to resolve. Another gave a rating of 4 rather than 5 because of the limitations and requirements with the sales data submission process. Specifically, this retailer commented on the fact that the retailer turns over the sales data to Energy Solutions and does not know how much of an incentive payment to expect each month, because that calculation is made by Energy Solutions, again hinting at the "black box" analogy.

Distribution and Sales Channels of Television Manufacturers and Retailers

The NEEA Initiative works to increase the adoption of televisions that exceed current ENERGY STAR specification in the Northwest. The Initiative rationale indicates that providing incentives to retailers will lead to increased sales of high-efficiency televisions to consumers, and that retailers will in turn influence manufacturers to produce more high-efficiency televisions. EMI examined the distribution and sales

channels of manufacturers and retailers to gauge the feasibility of this part of the Initiative logic and to determine if there are any barriers to the success of the Initiative.

Television distribution largely operates at a national, rather than a regional level. Large, national retailers tend to make assortment decisions (i.e., decisions about the mix of models to stock) that are identical for all store locations, regardless of region. Depending on physical store size, a store may stock fewer models, but the selection of models generally does not vary from region to region. However, if a particular store location is "selling through" all the stock of a particular model, that store could be replenished through their national distribution center. Regardless, there are not particular assortments that are used uniquely in the Northwest compared to other store locations. According to one manufacturer, one national retailer's database does not even allow regional assortment. This suggests that the ability of NEEA to influence the shelf level penetration of high efficient television in the Northwest is somewhat limited.

According to two retailer respondents, NEEA may be driving the national market. One respondent indicated that the retailer aims to make their high efficiency televisions consistent across the country. Although this retailer participates in utility programs across the country, the NEEA Initiative has more stringent standards. Thus, if the retailer chooses models that qualify for the NEEA incentives, they will by default qualify for incentives of other utility programs across the nation. This way, they can keep their assortment the same across the nation, and still qualify for incentives across all the different utilities. This retailer stated that although it seems that the NEEA Initiative is effective, it is not possible to quantify the amount of influence attributable to the Initiative. Another retailer stated that the West coast may be driving the East coast, or the entire nation, again because the standards for the West coast are more stringent, and the assortment decisions of retailers are made on a national level. However, this retailer emphasized that the assortments are based on the requests of the customers, rather than on energy efficiency criteria or utility incentives, which are very low on the list of priorities.

Program Influence on Retailers and Manufacturers

The Initiative logic states that NEEA incentives will influence the retailers to sell more high efficiency televisions to consumers. In turn, retailers are expected to leverage manufacturers to deliver high efficiency televisions. Thus, it is important to understand the ways in which the Initiative influences retailers, and the ways in which retailers can influence manufacturers.

Only two respondents, both large national retailers, spoke of being able to influence the manufacturer. One retailer mentioned that they have corporate goals to only stock ENERGY STAR-qualified products, and that the manufacturers know that efficiency is a criterion for them. This retailer has been able to influence manufacturers simply because of their size. However, the NEEA Initiative does not influence the products they carry because the Northwest is only a small part of their market; this retailer's assortment decisions are influenced more by their corporate goals about stocking ENERGY STAR-qualified products. At this time, their corporate goals are what is driving their assortment decisions. Another large national retailer mentioned that they could influence the manufacturer to produce more energy efficient products, but again mentioned that the NEEA incentives serve only as a tie-breaker between comparable models. One smaller regional retailer mentioned that they have no influence at all over the manufacturers.

The Initiative does not generally influence the manner in which retailers sell televisions. Because the primary determination of stocking of televisions is profit, more expensive models are pushed more, simply because they have a higher profit margin. Higher efficiency televisions tend to be more expensive, and thus have higher profit margins. Two manufacturers stated that the Initiative is essentially giving retailers "free money." Manufacturers claimed that retailers are still selling the same amount of energy

efficient televisions no matter what, and that retailers' focus is on profit; if there is a more profitable model that is less efficient, retailers will focus on selling that one. One retailer estimated that the NEEA Initiative has been responsible for a modest 5% increase in stocking and sale of high efficiency televisions.

Influence of the Program on Television Manufacturing

EMI asked retailers and manufactures to comment on the influence of the Initiative with respect to manufacturing, distribution, stocking, and sales to consumers. Most manufacturers noted that the NEEA Initiative does not impact the products that they manufacture.

Manufacturers stated that the large gains in efficiency have already been made, and that opportunities for new efficiency gains are modest. Manufacturer respondents argued that because television efficiency made large leaps in the transition from CRT to LCD, there is effectively less room to make large efficiency gains. One manufacturer commented that finding a way to remove old CRT televisions from use would be a greater opportunity for energy savings, because all new televisions are much more efficient. Another manufacturer added that while the market for energy efficiency is still growing, the demand is beginning to stabilize; only with a new technology would it be possible to continue to make substantial gains in efficiency.

Technology advances are not necessarily driven by potential gains in energy efficiency. One manufacturer stated that technology drives efficiency, rather than efficiency standards driving technology improvements. For example, manufacturers are driven to reduce the amount of heat produced by displays, not necessarily as a way to increase efficiency, but because heat has a negative impact on the lifespan on television components. The increased efficiency is considered a secondary benefit. This respondent also mentioned that flat screen televisions are more cost-effective to ship; therefore the movement away from the more bulky CRT screens has other benefits besides energy efficiency. The flat-screen technology allows the manufacturer to save on shipping costs, and also happens to be more energy efficient than a CRT television.

ENERGY STAR ratings have varying levels of influence on manufacturers in terms of energy efficiency. One manufacturer stated that ENERGY STAR drives sudden increases in efficiency, stating that manufacturers initially complained about the ENERGY STAR 3.0 standard, but then quickly went up to 85% compliance. This respondent continued to say that manufacturers do not want to be left out of the scramble to meet ENERGY STAR specifications. Another manufacturer stated that ENERGY STAR is a driving factor and helps the manufacturer communicate their energy savings. Yet another manufacturer stated that because televisions have already been produced when the ENERGY STAR specifications are announced, the manufacturers make minor revisions to the display settings <u>after</u> the models are already produced to meet the specifications.

One manufacturer noted that product design is influenced by the primary features that are included at a particular price point that the retailer is looking for. Although large retailers have the ability to bargain with manufacturers, the conversation generally revolves around features and price, rather than energy efficiency. Although manufacturers are interested in keeping up with efficiency, it is not a primary focus, as certain features are, such as internet connectivity or 3D displays.

Influence of the Program on Stocking and Sales

Both retailers and manufacturers noted that energy efficiency is not a primary determinant of manufacturing or stocking decisions, but rather serves as a "tie-breaker" when all else is equal.

Retailers choose their assortment prior to the announcement of NEEA incentive levels and qualifying models. Retailers stated that they need more lead time for the incentives to be truly influential, as they make assortment decisions at a time of year before the NEEA standards and incentives are known. There is a similar issue with the release of new ENERGY STAR specifications. According to one manufacturer, the design cycle is 18 months to 2 years, while ENERGY STAR announces their specifications 9 months in advance. Thus, when the ENERGY STAR specification is announced, the television models are already in production. One manufacturer mentioned that although major design changes are not possible at this point, minor alterations (such as adjusting default brightness levels) can be made to meet the specification. Manufacturers and retailers indicate that they cannot plan ahead if they do not know what the specifications and incentive levels will be when they are in the design process or placing orders for their assortment.

Both retailers and manufacturers stressed that energy efficiency and the NEEA incentives are a "tie-breaker." One manufacturer stated that the incentives can be used in negotiation with retailers. This manufacturer can bargain for a higher price for models for which the retailer will get incentives. However, efficiency is typically the last consideration. One large retailer noted that the NEEA incentives were a tie-breaker when deciding between two very similar models – one that qualified for the NEEA incentives and one that did not. All else being equal, they chose the model that qualified for incentives and informed the manufacturer of the reason why they did not choose their model.

Retail sales associates are not directly incentivized to sell high-efficient televisions. The NEEA incentives are not distributed directly to sales associates. Instead, retailers stated that the incentives tend to go toward advertising the incentivized products. Two smaller retailers indicated that sales staff are paid on commission, and because high-efficiency televisions tend to have higher profit margins, staff are coincidentally motivated to sell high-efficiency televisions. However, the big-box retailers do not pay their sales staff on commission; instead they are paid hourly.

Retail sales associates do not always highlight efficiency when selling to customers. Two retailers stated that their retail staff are trained by the retailer on energy efficiency in televisions. However, sales associates do not necessarily emphasize energy efficiency when they are speaking with customers. In most cases, sales associates only have a few minutes of the customer's time and they must choose a few points to make about the products the customer is considering. One retailer specifically stated that energy efficiency may or may not come up in conversation, depending on the customer. Another retailer stated that it is difficult to communicate the value of energy efficiency in televisions to the consumer because the monetary value of energy savings from an energy efficient television is relatively low for an individual television that the customer may be purchasing.

Value of Marketing Materials by Retailers

The NEEA Initiative is marketed to consumers inside participating retail locations. Point-of-purchase (POP) materials indicate which models qualify as high-efficiency (or "the best of ENERGY STAR"), and sales associates are trained to assist consumers in identifying high-efficiency televisions. The subcontractor Premium Retail Services is responsible for placing POP materials on the qualifying units in the stores, and for training retail sales associates. EMI asked retailer respondents to report the ways that the high-efficiency televisions are advertised and how satisfied they were with the NEEA marketing materials.

Although respondents generally thought the marketing sticker was effective, they nonetheless had suggestions for improvements. Four retailers were able to comment on the NEEA Initiative marketing materials, with one of these saying he/she had seen an electronic version of the marketing sticker only. One retailer respondent suggested that the marketing materials could be altered to fit into the cosmetic

design of televisions, or play into the desirability of consumer electronics. Another stated that the marketing materials do not include enough detail, and that the energy savings would ideally be quantified for the consumer. Likewise, another respondent stated that the new "Energy Forward" design is less than desirable because the "most efficient" claim has not been substantiated to his/her satisfaction.

NEEA marketing materials and retailer training may not be implemented among all retailers. Four of the six retailer respondents stated that the NEEA Initiative marketing materials are being used in their retail locations. However, none of the six respondents mentioned receiving training for their sales associates from the NEEA Initiative implementers. One manufacturer stated that he had specifically looked for the NEEA marketing materials at participating store locations and had not seen any displayed, and one retailer mentioned that they are not using the current NEEA Initiative sticker design, and they continue to use the old sticker design.

Trends in Consumer Demand, Sales, and Marketing Practices

Because the NEEA Initiative is a market transformation program, it is important to understand not only where the market is currently, but also where it is going. Thus, EMI asked retailers and manufacturers to comment on the particular television features or technologies that consumers are demanding, as well as to forecast what consumers may be demanding in the next year.

One retailer noted that energy efficiency is no longer a "trend" and that it is not emphasized by manufacturers. This retailer mentioned that energy efficiency was a big focus among manufacturers in 2009, and that manufacturers even had meters comparing the energy use of a new LCD television to that of an older tube television. Then, in 2010, manufacturers no longer emphasized energy efficiency; instead they emphasized 3D technology. This retailer mentioned that for 2011, manufacturers are emphasizing internet connectivity. Other retailers stated that while manufacturers still mention ENERGY STAR, it is not typically emphasized over other features.

Technology trends influence the retailer assortment of television models. Several retailers mentioned that the trend is toward LED televisions, along with 3D capability and internet connectivity. Because LED televisions tend to be more costly than their non-LED counterparts, there is a higher profit margin for LED televisions. Sales associated that are paid on commission tend to push the LED televisions due to the higher commission they would earn. An ancillary benefit to the retailer is that they are likely to earn NEEA incentives from LED televisions; however, the NEEA incentives are not the primary reason for selling LED televisions. Several retailers and manufacturers remarked that they expect the popularity of 3D televisions to increase in the near future. One retailer mentioned that 3D technology could drive consumers to purchase more efficient products sooner, because 3D televisions often have LED displays.

Consumer demand for energy efficiency is low. Both retailers and manufacturers noted that consumers are not demanding energy efficiency in televisions. However, one retailer respondent mentioned that consumers are becoming more aware of energy efficiency in televisions, partly in response to the NEEA marketing materials. Nevertheless, energy efficiency in televisions is not a customer priority.

Suggestions for Improvements

EMI asked both retailers and manufacturers to report what they view as the greatest strengths of the NEEA Program as well as what could be improved, or what they would most like to change.

Retailers and manufacturers both remarked on the differences between the NEEA Initiative and other utility programs. Two manufacturers remarked that the NEEA Initiative provides incentives that are lower than those from other utilities. One retailer mentioned that the NEEA standards and incentives are different from other utilities, and if all utilities adopted the higher NEEA standards, it would allow

retailers to more easily influence manufacturers. Another retailer commented that the NEEA incentives are the lowest of all of the utility programs, however, they also commented that NEEA offers a lot of resources compared to the other programs. The fact that NEEA standards and incentives are different from other utility programs means that it is more difficult for retailers to participate effectively, because their distribution operates at a national, not regional level. Likewise, it is difficult for manufacturers to keep up with all the different criteria across the programs, and manufacturer respondents suggested that consistency would help the programs be more effective.

Two of the five manufacturer retailers commented on the "unfairness" of the ENERGY STAR wattage cap. The ENERGY STAR 5.3 specification that will go into effect in September 2011 will require televisions to use no more than 108 watts in active mode, regardless of screen size. One manufacturer we spoke with indicated that the company produces a 75" television that uses 120 watts, and thus even though this large display television is quite efficient relative to others of it size, it will not meet the requirements for 5.1. Another manufacturer noted that they have a 55" plasma television that uses 119 watts, down from 400 watts in the past. One argument is that the specification should be based on watts per square inch, rather than placing an absolute cap on active mode energy use.

Retailers and manufacturers had various suggestions for improving the effectiveness of the Initiative. Two manufacturer respondents suggested that incentives to retailers may not be the opportunity for the most influence. This is because the incentive goes to the retailer at a corporate level, not the store-level or the sales associate who made the sale. These respondents also pointed out that a retailer might make more profit from an inefficient television than they would from the incentive for selling a more efficient television. Several respondents, both retailers and manufacturers remarked that the NEEA incentives are lower than those of other utilities and that the Initiative might have more influence if incentives were higher. One manufacturer suggested that the Initiative should focus on branding the NEEA specification and consumer-faced marketing materials and labeling of qualified products. This respondent also stated that the Initiative should provide incentives to the sales associate. One manufacturer suggested that the incentive could go to the consumer in the form of a mail-in rebate.

Conclusions

There are five primary conclusions stemming from the interviews conducted with manufacturers and retailers participating in the NEEA Consumer Electronics Television Program:

1. **Distribution of televisions is national, and the ability to affect just the Northwest market alone is limited.** However, there may be some opportunity to affect the national market. Because the NEEA Initiative criteria are more stringent compared to other utility program, stocking models that meet the NEEA standards means that retailers will meet the standards of all other programs in which they are participating. However, only two retailers mentioned that this is occurring, and it is unknown the extent to which all participating retailers are willing or able to stock high-efficiency models on a national level in order to meet the regional NEEA requirements.

2. **Incentives to retailers may not influence sales associates to sell Initiative-qualified televisions.** Incentives are not always considered additional profit for participating retailers, as the incentives are funneled into marketing the incentivized products. At some smaller retailers, sales associates are paid on commission, and so they are motivated to sell televisions with higher profit margins. These are often LED televisions, which are more expensive and higher efficiency. However, sales associates do not receive any of the NEEA Initiative incentives, and

thus the incentives themselves do not appear to motivate the sales associates to sell incentivized products.

3. **The ability of retailers to influence manufacturers is limited.** Very large national retailers mentioned that they have some influence. However, energy efficiency is generally considered a tie-breaker or a very low priority, rather than a primary feature to seek out. This limits the instances in which the NEEA Initiative incentives are motivating retailers with influence to press manufacturers to produce more high-efficiency models. Smaller independent or regional retailers have little to no influence over manufacturers.

4. **Marketing materials may not be used in all stores and sales associate training may not be occurring as intended.** If marketing materials are being used, the retailer and manufacturer respondents have not noticed them and are not aware of them. Without marketing stickers placed on qualifying products, it is likely that sales associates are unable or less able to identify qualifying products.

5. **Because manufacturers produce televisions and retailers choose their assortment far in advance of the ENERGY STAR specifications and NEEA Initiative qualification criteria, manufacturers and retailers cannot take these specifications into account.** In order to best influence which televisions are manufactured or chosen for assortment, the criteria must be known before the design process begins or the assortment decision is made. While manufacturers can always work on meeting the current specification in the next design cycle, there is no guarantee that another more stringent specification will be adopted before the next models are produced. From the perspective of the manufacturers, they are always playing "catch up," and the process is seen as unfair.

B.2 Other Energy-Efficient Television Programs

Two interviews were performed with national television energy efficiency programs to understand how NEEA collaborates with these programs and to understand the current state and the history of the energy-efficient television market in the U.S. These interviews were with the team leader of U.S. EPA ENERGY STAR product development and the Senior Program Manager from the Consortium for Energy Efficiency (CEE). Findings from these interviews are summarized below.

1. **NEEA involvement in national program development.** According to those interviewed, NEEA has had a definite presence in the ENERGY STAR and CEE programs. For ENERGY STAR, it was noted that NEEA staff were active in discussions and provided comments in combination with other organizations such as PG&E and SMUD. In particular, NEEA was noted to have weighed in especially strongly to move up the Version 5 effective date, as NEEA was the first to suggest this to the EPA in August of 2010. NEEA also offered data to the EPA to support this move, but the data was not used as the EPA already had supporting retailer data. The EPA respondent also indicated that they likely would not have been able to go forward with the progressive efficiency requirement in the Version 5 specification (i.e., the 108 watt cutoff for all televisions, regardless of size) without support from utilities such as PG&E and NEEA. For CEE, the respondent indicated that NEEA was very active in work on the Consumer Electronics Committee, which included providing comments to ENERGY STAR on specifications, and that this participation was valued. In particular, the CEE respondent indicted that NEEA had been

"very supportive" of the progressive efficiency requirement, and that the utilities had shared useful data on market share.

2. **Continued efforts to drive efficiency.** ENERGY STAR indicated that they plan to continue to push the energy efficiency of televisions with the development of more stringent Version 6 levels, which would potentially include stricter levels and alterations to the test method regarding Automatic Brightness Control (ABC). In addition they also announced a new ENERGY STAR "Most Efficient" pilot campaign[1] (officially kicked off May 5, 2011) to advance products in the market that are "truly superior" in energy efficiency (i.e. products even more energy efficient than ENERGY STAR levels). According to the interview respondent, the EPA plans to continue to increase the stringency of the specifications because of how quickly the television market continues to move, and there is some concern that the market share of qualified ENERGY STAR 5 televisions may be higher than desired going into 2012. CEE, as well, indicated that with the presence of the Version 4 and 5 specifications in the market there was no need for additional CEE levels at this time, but with the market getting more energy efficient, they were also considering developing more strict levels.

Harmonizing ENERGY STAR with NEEA specifications

NEEA also proposed to EPA that they harmonize the ENERGY STAR "Most Efficient" criteria with the NEEA ENERGY STAR 5 +20%, but the EPA respondent indicated that this level was too lenient for what they were trying to do with the pilot campaign, and EPA eventually released levels more stringent than the ENERGY STAR 5+20% levels.

B.3 Partner Utility

An interview was also performed with one of the partner utilities also running a BCE television program similar to the NEEA Initiative. This interview was performed to understand how NEEA collaborates with other utilities running similar initiatives and to understand barriers or lessons learned from similar initiatives.

1. **Coordination with NEEA and other programs.** The interviewee indicated that they worked closely with NEEA and talked to NEEA staff once a week. In addition, they worked every year to coordinate and set new specification levels for the incentives in order to stay harmonized. In addition, they would collaborate with NEEA and other utilities to offer feedback and support to ENERGY STAR and other programs. In one example of collaboration, they spoke of working with NEEA to propose to ENERGY STAR to move up the effect date of ENERGY STAR 5 from May 2012 to September 2011, which ENERGY STAR eventually did with utility support.
2. **Using market transformation for resource acquisition.** The partner utility respondent perceived NEEA Initiative as more of a market transformation effort, whereas the partner utility is using a "market transformation strategy to get resource acquisition". This partner utility program also gives higher incentive amounts due to the fact that they operate with different budgets and associated energy costs.
3. **Successes Influencing Retailers and Manufacturers.** The partner utility respondent indicated there have been big successes such as when retailers have indicated they have made changes to their stocking to meet the program, when retailers reach out to manufacturers to ask about ENERGY STAR, or when a manufacturer changes a panel to make a model more efficient.

[1] While sharing the same name, The ENERGY STAR "Most Efficient" pilot campaign is unrelated to the NEEA "Most Efficient" branding.

4. **Challenges with the speed of market movement, cost effectiveness and the ability to evaluate the program.** The partner utility respondent indicated that the biggest challenge is the speed at which the market moves, and that it is difficult to approve new levels in a timely manner to keep pace. The interview respondent also indicated that because the per-unit savings are small, cost-effectiveness of the program could be a problem, and that they were concerned that it will be difficult to evaluate the program.
5. **Pushing retailers beyond ENERGY STAR.** The respondent indicated that the program pushes retailers beyond the ENERGY STAR requirements to even more energy-efficient televisions, by having qualification levels that are more stringent than those of ENERGY STAR. The interviewee indicated, "I can't think of any reason they go beyond ENERGY STAR, except for these programs."
6. **Consumers are not focused on energy efficiency in televisions.** The respondent indicated that the focus of the program was on retailers, marketing and sales associate training, because energy efficiency was "six or seven" on the priority list of consumers. The respondent indicated that the energy efficiency message would not make a difference with the average consumer because the per unit energy savings are relatively low for energy-efficient televisions. This is why the program focuses on effectively increasing the profit margin on energy-efficient televisions for retailers.
7. **Moving the incentive schedule to coincide with the retailer market.** This interview respondent indicated that they switched their official specification update to the spring, instead of January 1, to coincide with the spring assortment change over. Because of this change, units that qualified the previous year would still qualify in early spring before they are replaced with the newer models in the assortment changeover.

B.4 Participating Utilities

The evaluation team conducted interviews with two participating utilities in the Northwest to understand the ways in which the NEEA participating utilities have been involved in the Initiative, as well as to get feedback from these stakeholders regarding the successes and challenges of the Initiative. Several key findings were identified in the interviews with participating utilities. There were a number of common themes across both interviews, as well as findings that were common to other data collection efforts for this evaluation.

1. **Supplemental marketing efforts of participating utilities.** NEEA implementation staff indicated that the role of participating utilities was largely to provide supplemental marketing support for the Initiative. Because utilities claim savings for the televisions sold in their territory, there is an incentive for the utilities to try and drive sales in their territory. One participating utility respondent had a number of examples of additional marketing their utility had done including press releases, Facebook announcements, bill inserts, promotions at special events, and inclusion on a home energy audit. This utility also had an additional local incentive for ENERGY STAR-qualified televisions. The other utility respondent indicated that they did some promotion of the energy-efficient televisions through "general marketing," but they mostly "leave it up to NEEA."
2. **Importance of Initiative data collection.** Both respondents indicated the access to local data on television sales and market share is one of the strengths of the Initiative. One mentioned that without this Initiative, "data from those big markets would be untouchable" for small utilities, as retailers would not give local utilities pertinent sales data. The other mentioned that they were

happy that they would be receiving quarterly savings results for this Initiative and that in most programs they do not get feedback that often.

3. **Focus on large retailers more prevalent in urban areas.** Both participating utility respondents expressed concern about the Initiative not reaching smaller retailers that are more prevalent in rural areas, and therefore that the Initiative is not equally representative across both urban and rural areas. One interviewee indicated that it was difficult for these retailers to provide the required data and that setting up the agreements with these smaller stores was difficult. This interviewee indicated that smaller stores would be more engaged, have less staff turnover (so training is more effective), and that these small stores should not be disadvantaged against larger stores by not being able to participate in the Initiative. In one case, the utility hired another contractor to try and reach out to smaller retailers in rural areas, in order to increase sales of energy-efficient televisions in rural areas. In this case NEEA allows these nonparticipating retailers to use the initiative POP, even though they are not given incentives and do not have their sales tracked by the Initiative. The other interviewee, while concerned about the lack of participation from these smaller stores in more rural areas, indicated that it may not be cost-effective to try and include these smaller retailers in the Initiative and that the influence that NEEA has on the market as a whole may also increase the efficiency of televisions stocked in these smaller stores as the efficiency of the entire market is pulled up by the Initiative.
4. **Opportunities for coordinating marketing efforts.** One utility respondent spoke of opportunities to coordinate marketing efforts or leverage the work from other programs. For example, many utilities run programs for other products through the same retailers that participate in the Television Initiative, and so utilities could train their staff to check television POP and train retailer staff about the Television Initiative while doing a store visit for a different program.
5. **Limited awareness of the effectiveness of the Initiative marketing materials.** Both interviewees indicated that they had limited awareness of what was happening at participating retailers with the POP and were not qualified to indicate whether it was effective. One retailer indicated that the materials might be effective in retail stores where the retailer education has been good, but that they had asked some sales associates about stickers in the associates' stores and the associates did not know what the stickers were for. This same interviewee also indicated that they had not heard that customers were ever asking for the Initiative-qualified televisions. Despite indicating a lack of awareness of their effectiveness, both utilities suggested providing better consumer-facing marketing, with better monitoring of POP materials and better sales associate training to raise recognition and awareness of the Initiative.

Appendix C: DETAILED FOCUS GROUP FINDINGS

As part of the evaluation of the Northwest Energy Efficiency Alliance (NEEA) Consumer Electronics Initiative Television Program, EMI conducted two focus groups in January 2011 with consumers who had recently purchased televisions. These focus groups were conducted in order to understand consumer decision-making and usage of televisions, as well as awareness of energy efficiency with respect to televisions and awareness of the NEEA Program marketing materials. This document provides a brief description of the NEEA Program, followed by a detailed description of the focus group objectives. This is followed by a summary of the results of the focus groups, and then by conclusions and recommendations stemming from these findings.

C.1 Program Overview

The NEEA Consumer Electronics Initiative began in July of 2009. To date, this initiative primarily aims to produce energy savings through the Television Program which aims to increase the market share of energy-efficient televisions (EETVs) in the Northwest. The Program offers incentives to retailers to promote the sale and stocking of EETVs in the northwest market, and also includes marketing materials to help promote EETVs to consumers. The Program is a result of a partnership with Pacific Gas and Electric (PG&E) and Sacramento Municipal Utility District (SMUD), utilities that launched a joint Consumer Electronics program covering televisions in 2008. NEEA joined this effort in mid-2009 and has continued the Program with progressively more stringent criteria. For 2009, NEEA offered incentives for televisions that met the ENERGY STAR® Version 3.0 television specification, but used 30% less energy than the Version 3.0 active mode requirements. Following the completion of new ENERGY STAR active mode levels in the fall of 2009, the 2010 NEEA Initiative began to offer incentives for the sale of televisions that meet the ENERGY STAR Version 4.1 active mode specifications. In 2011, the Program is offering incentives for televisions that meet the ENERGY STAR Version 5.3 specification.

The NEEA Initiative provides incentives directly to participating retailers for the sale of these more efficient models. The Initiative rationale is that the incentives to retailers will have a number of effects that lead to an increased market share of EETVs, and therefore, energy savings.

C.2 Focus Group Objectives

To ensure that the focus groups would capture responses from different subsets of the Northwest Market (i.e. west and east of Interstate 5), one focus group was conducted in Seattle, WA and one was conducted in Spokane, WA. Both groups were conducted in January 2011.

The objectives of the focus groups were to:

- Assess the prevalence of sales associates recommending energy-efficient televisions;
- Understand the terminology consumers use to discuss energy efficiency in televisions and measure the ability of consumers to identify energy-efficient televisions;
- Determine popular features sought after in television purchasing;

- Determine the extent to which energy efficiency is used as a purchasing criterion among consumers;
- Evaluate consumer awareness of specific marketing materials for the NEEA Program, and determine what influence these materials have on consumer purchase decisions;
- Assess if and how consumers typically configure their televisions, with a focus on brightness controls and other energy saving features;
- assess how usage of televisions among consumers (e.g., hours of use and types of use) is changing over time.

The remainder of this section describes the characteristics of the focus group respondents, followed by key results with respect to the research objectives listed above. Where appropriate, actual responses from focus group participants have been included in italicized text to illustrate the relevant results.

C.3 Focus Group Respondent Characteristics

All focus group participants had recently purchased a new television at a participating retail chain. Participants were screened so that half of the participants in each group had knowingly purchased an ENERGY STAR-qualified television, and the other half were not sure if their new television was ENERGY STAR-qualified or not. This enabled EMI to learn from the experiences and opinions of those who may have used ENERGY STAR as a purchasing criterion as well as those who may not have been familiar with the brand. Furthermore, EMI concentrated on recruiting participants who had purchased a new television within the last three months of 2010 to ensure the purchases took place after new marketing materials that were introduced in the participating retail stores in October 2010. The characteristics of focus group respondents are summarized in Table 0-1 below.

Table 0-1: Focus Group Respondent Characteristics

Characteristic	Frequency Seattle Group (N = 8)	Frequency Spokane Group (N = 8)
Gender		
Female	3	3
Male	5	5
Age Range		
25 – 34	3	1
35 – 44	3	4
45 – 54	1	1
55 – 64	1	2
Annual Household Income		
< $25k	-	1
$26k - $49k	1	3
$50k - $74k	2	2
$75k – 99k	2	1
100k - $124k	-	1
≥ $125k	3	-
Employment		
Full Time	8	7
Part Time	-	1
Month of Television Purchase		
August 2010	-	1
September 2010	1	-
October 2010	3	3
November 2010	3	2
December 2010	1	2
Knowingly Purchased an ENERGY STAR-Qualified Television?		
Yes	4	4
No/Not Sure	4	4

Note. All respondent characteristics are self-reported.

C.4 Results

This section summarizes results of the focus groups with respect to each of the objectives listed above.

Influence of Retail Sales Associates on Television Purchases

Rather than relying on sales associates to assist with purchase decisions, respondents reported that they tended to use websites or online reviews to help them narrow their choices before going into the store. Once they are in the store, the sales associate may assist them with deciding between a few particular options. However, the influence of the sales associates appears to be minimal, and it depends on the knowledge of the particular salesperson helping the consumer. Several respondents commented that sales associates tend to be very knowledgeable, but it can be "hit or miss."

Whereas the Seattle group tended to state that they did all of their research before making their purchase and either knew exactly which television they wanted or had narrowed down their options to a few models before going into the store, the Spokane group was more likely to research general characteristics online, go to the store with those in mind, then decide on the specific television in the store.

> *We did all our research online and then went to a couple of different stores to look at the models and then made our decision.*

> *I knew what I was looking for so I just went in and got it. I didn't talk to anyone.*

Consumer Terminology and Ability to Identify Energy-Efficient Televisions

Focus group respondents understood what is meant by "energy efficiency" in general, and they did not appear to use any other terms to refer to energy efficiency. However, when asked how they would identify an energy efficient television, respondents seemed less sure. Although respondents generally understand the concept of energy efficiency, they wanted more information to understand how efficiency specifically applies to televisions.

Some respondents commented on the television display (having a dimmer setting to make it more efficient) or the standby mode, and two respondents commented specifically on the heat produced by the displays of less efficient televisions. Respondents were not sure if their televisions were already energy-efficient when they came out of the box, or whether there was a setting that they needed to activate after they get them home.

> *A friend of mine, he likes to play games, and on a hot day, he says the room where he plays just heats up. And he has a plasma. They do throw off quite a bit (of heat) so they're using up quite a bit of electricity to create that heat.*

Respondents mentioned that they would be able to identify an energy efficient television by the ENERGY STAR logo; however, they also mentioned that they weren't sure exactly what the logo indicated – they were not sure how much money they should expect to save with an ENERGY STAR television compared to another comparable television. Several respondents commented that it would be easier to identify energy efficient televisions if they had a tag similar to that on refrigerators and other "white goods," indicating what the yearly cost of electricity would be for each television model compared to other similar non energy-efficient televisions.[2] Almost all respondents seemed to want the efficiency information quantifiable. Several also commented that if the energy savings were important, someone (e.g., manufacturer, retailer, etc.) would have mentioned it to them.

> *That would be more of an impact if it said something like, "This is what it's going to cost you." Or, "You'll save this much." Because anything about saving money, I'll pay attention to it.*

> *Why is it important to put (yearly energy cost) on refrigerators, but it is not important to put it on TVs? It's like they're not really concerned about it, so we're not either.*

Respondents also mentioned that there can be several stickers on televisions in the store, meaning that the prominence of the ENERGY STAR logo, or NEEA marketing stickers is diminished. Consumers indicated that they are overwhelmed by the amount of information presented on the televisions for sale.

[2] Manufacturer interviews indicated that the Energy Guide stickers that show estimated yearly energy cost will be required on all televisions by the Federal Trade Commission beginning May 2011.

I know that nowadays there are so many different programs that there just isn't the one sticker down there. You can have 6 or 7 stickers…

It's not like there's one and you're like "Oh, what does that say?"

Popular Features Sought After in Television Purchasing

The focus groups suggested that consumers are using their televisions for a great variety of activities, and this influences the features consumers look for when purchasing a television. Although respondents reported that they do not often use their televisions to watch broadcast television when it originally airs, they occasionally watch live local news or weather broadcasts. To watch television shows, they often use a DVR (digital video recorder) and watch it later when it is more convenient, which also allows them to skip over commercials. Many respondents reported using their televisions to stream content from the internet or with gaming consoles.

I wanted to make sure it had all the inputs that I needed to hook up my DVD players, and games and stuff. I wanted to make sure it had all those on the back.

To determine which features consumers consider most when purchasing a television, focus group respondents were asked to engage in a card-ranking task. The task involved sorting cards containing potential decision factors, including television features and other factors that may have influenced their purchase decision. Each respondent ranked his or her top five factors. Respondents were also asked to note which factors they did not consider at all when making their purchase decision.

Focus group respondents received index cards pre-printed the following potential decision factors:[3]

- Energy consumption
- Screen size
- Type of television (e.g., plasma, LED, LCD, HD)
- 3D or 3D-capable television
- Screen refresh frequency (e.g., 60 Hz, 120 Hz, 240 Hz)
- Screen resolution (e.g., 720p, 1080p)
- Television footprint
- Price of the television
- Inputs (e.g., HDMI, Component Inputs, PC Inputs, USB Inputs)
- Internet connectivity
- Interaction with a salesperson
- Warranty
- Picture quality

Each respondent received the same set of factors contained on the cards, although each respondent's stack was randomly sorted to rule out order effects.

Table 0-2 shows the number of respondents that ranked each of the factors in their top five, as well as the number of respondents who noted that a factor was not at all considered in their purchase decision. Price,

[3] There were also three blank cards that respondents could use to write in features they may have used but were not on the pre-printed cards, however no respondents used the blank cards to write in additional features.

screen size, type of television, picture quality, and screen resolution were the most common factors used by respondents to make their purchase decision.

Internet connectivity was also an important feature, especially for the Seattle focus group respondents where three respondents indicated it was one of the top five features considered. In Spokane, internet connectivity was not a top five feature for anyone, and it was on the list of unused features for three respondents. Additionally, the Seattle group reported wanting internet connectivity built into their television, whereas the Spokane group felt that built-in internet capability was less important and just plugged in their laptop when they wanted that feature.

Some features did not at all influence respondents' purchasing decisions. For example, respondents did not want a 3D or 3D-capable television, although they stated that their interest might increase in the future when the technology is improved. Interestingly, six out of the eight respondents in both focus groups said they did not at all consider their interaction with a sales person when deciding which television to purchase. Both energy consumption and television footprint were less likely to be considered by respondents of the Spokane group than respondents of the Seattle group.

Table 0-2: Factors Used by Respondents When Deciding Which Television to Purchase

	Number of Respondents Listed Factor in Top 5		Number of Respondents Listed Feature as "Not a Factor"	
Decision Factors	**Seattle Respondents (N = 8)**	**Spokane Respondents (N = 8)**	**Seattle Respondents (N = 8)**	**Spokane Respondents (N = 8)**
Price of Television	7	7	-	1
Screen Size	7	7	-	1
Type of Television	6	6	-	1
Picture Quality	4	7	-	-
Screen Resolution	5	5	-	-
Inputs	4	4	-	1
Screen Refresh Frequency	3	2	2	3
Internet Connectivity	3	-	-	3
Warranty	2	1	2	-
Interaction with Sales Person	-	1	6	6
3D or 3D-Capability	-	-	6	7
Energy Consumption	-	-	2	7
Television Footprint	-	-	2	6

Energy Efficiency As a Consumer Purchasing Criterion

Energy efficiency was not a purchase criterion for any focus group participants. As shown previously in Table 0-2, no respondents listed energy efficiency in their top five purchase criteria. Two respondents in the Seattle group and seven respondents in the Spokane group said that energy consumption was not at all a factor they considered when purchasing their new television. Respondents were primarily concerned that the picture looked good, and did not usually consider energy use with respect to televisions. While it was not a purchase criterion, most respondents wanted to know more about energy efficiency in televisions, and again, they wanted it quantified. Several respondents noted that it seems that all new television should be energy efficient, and this is an assumption that they made.

I thought that (energy efficiency) only had an impact with refrigerators and washer and dryers. I didn't think it had anything to do with a TV.

(Energy efficiency) was a big concern for me. I saw it on the (online) reviews. It wasn't like they went into it. It was more just a note in the review or in the information. But I just assumed--whether it's wrong or right--that just any TV out there today is energy efficient, so who cares?

Several respondents relayed the perception that energy efficiency televisions would impact the picture quality negatively. This suggests that for some consumers, not only is energy efficiency not a purchasing criteria, but energy efficiency in televisions is something to avoid.

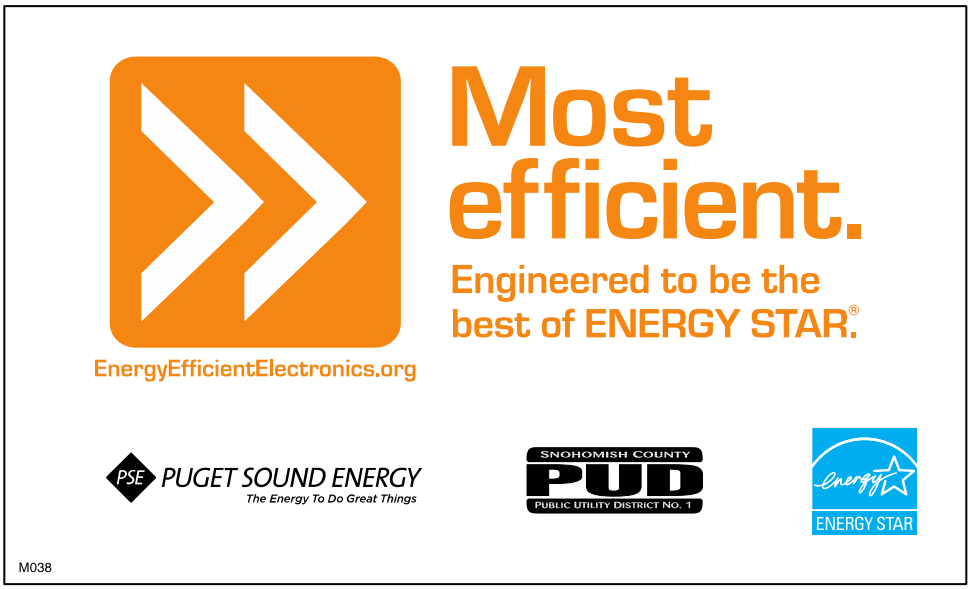
I pressed mine (an "energy efficiency button" on the remote control) one time and it made the picture dimmer. Another respondent: *That's why I don't use it.*

That's a little green button that I can hit and I can say, "Oh, I'm saving the planet, but my picture sucks. But I'm saving the planet." I don't want that.

Consumer Awareness and Influence of Marketing Materials for the NEEA Program

Marketing materials for the NEEA Television Program primarily consist of a 4" x 6" sticker placed on eligible televisions at participating retail locations. An example of the in-store marketing sticker is shown in Figure 0-1. Utility logos included on the stickers vary depending on the location of the retail store. In addition to the marketing sticker placed on eligible televisions, Costco locations also air an 18-second video advertising the Consumer Electronics Initiative's "Energy Forward" brand eights times per hour. NEEA also maintains a website[4], which allows users to locate participating retailers and provides a list of eligible products.

Figure 0-1: NEEA Television Program In-Store Marketing Sticker



The retailers where focus group respondents had purchased their new televisions are listed below.

[4] www.energyefficientelectronics.org/

Seattle:
- 5 purchased at Best Buy
- 3 purchased at Costco

Spokane:
- 2 purchased at Best Buy
- 2 purchased at Costco
- 4 purchased at Wal-Mart

No respondents recalled seeing marketing materials from the Program in the store when they were purchasing their television. However, in the Seattle group, five of the eight respondents had purchased their television at Best Buy, where a different form of the marketing sticker was used. In the Spokane group, both versions of the sticker (the Best Buy version and the newer version of the sticker which is shown at all other participating retailers) were shown to respondents, and none recognized either sticker or recalled seeing either of them in the store. Additionally, none of the five respondents who purchased their television at Costco recalled seeing the video advertising the "Energy Forward" brand.

Reactions to the marketing sticker were mixed. Respondents of both focus groups were shown the new marketing sticker and asked to comment on their reaction and interpretation. Respondents recognized the ENERGY STAR logo on the marketing sticker and suggested that that part of the sticker be made larger because that is a recognizable logo. The orange "Energy Forward" logo meant different things to different people. Some said it looked like a construction sign, while others said it looked like "fast-forward" or the button on a remote.

> *I think the "ENERGY STAR," the blue part, would be better because that's a recognizable logo.*

> *If it (the ENERGY STAR logo) was bigger, then it would stand out and I think we'd pay more attention to it. But something that tiny, I'm just going to look over it.*

> *We all look at that blue one (the ENERGY STAR logo) and we know what it means. (I am) not saying we care, but we know what it means. We look at this one (the Energy Forward logo), and we don't really know what it means. We don't know who's behind it…*

Again, respondents noted that they wanted energy efficiency quantified.

> *What does that mean, most efficient of what? How efficient? What's the difference between all the other televisions here?*

> *I feel like it's just not terribly quantifiable to me to be the best of ENERGY STAR. Does that mean it's 50% better than the average ENERGY STAR TV, does it mean it's… I don't know, what does that mean?*

In addition to the ENERGY STAR logo, the marketing stickers also contain the local utility logo(s). The meaning of the utility logo to focus group participants varied between the two groups. Seattle respondents said that the utility logo included on the marketing sticker lent credibility to the "best of ENERGY STAR" claim. One respondent also noted that the utility logo means that the advertising is "local," and this was a positive attribute. On the other hand, Spokane respondents indicated that the utility logo neither added nor detracted from the claim, adding that televisions are not the utility's area of expertise.

Seattle respondents:

> *It gives validity to it (the claim). Like, hopefully these three companies (NEEA, ENERGY STAR, and the utility) stand for energy efficiency. That's dependable. If they're putting their backing, then it must be something that matters…*

I think it just lends credibility.

Spokane respondents:

I don't have anything against (the electric utility) at all, but (the electric utility)… they're not a TV company or a reviewer, so that really doesn't do anything for me. They're just energy and power. So what do I care about that?

I don't think it's a positive or negative if (the utility name) wasn't on there. Or if it is on there, it's not going to make me buy the TV.

Respondents want education regarding energy efficiency to come from manufacturers, not from retailers. Participants of the Spokane focus group were asked from whom they would like to receive education on energy efficiency for televisions. Interestingly, customers noted that they would trust information from manufacturers, whereas they would be less likely to trust information from sales people. Retail sales staff were viewed as having ulterior motives, whereas manufacturers were seen as being more objective. Respondents also stated that they would need the information to come on a separate sheet, rather than buried in the manual, so that it stands out and is easily accessible. Again, respondents re-iterated that they would like to see cost savings, similar to that found on refrigerators.

I don't want it to be a sales tactic. Another respondent: *Yes. I'm not going to trust Wal-Mart.*

Participants of the Spokane group were also directly asked if the utility has a role in educating customers about energy efficient televisions. A few respondents indicated that the utility has a role, and that the utility is currently educating customers on the categories of household appliances that use the most energy. However, respondents questioned whether the energy savings for televisions would be large enough for the utility to have an interest.

I'm kind of wondering whether the cost savings would matter that much. Is it going to matter – 30 cents over a month – where, say, a refrigerator might save you $10 a month?

Consumer Configuration of Televisions

ENERGY STAR-qualified televisions are required to meet the specifications "out of the box." However, once consumers change the default settings, it is unknown whether the altered in situ settings continue to meet ENERGY STAR criteria. Therefore, focus group respondents were asked if they changed any of the settings, such as brightness, contrast, or standby mode, on their new televisions.

Television settings varied from person to person. Some respondents used the default settings that came with the television. Others experimented with the settings in an "unscientific" manner until they found a setting they liked. After finding this preferred setting, they would rarely or never change the setting again. Still others had determined different settings that would be ideal for different purposes (e.g., gaming, vs. watching a Blu-ray DVD), and they had these settings programmed so that they could easily select the setting they preferred based on the activity.

I just left mine on default. It looks fine the way it is unless there's sun glaring in or something. It's just set up the way it is.

I think the only thing I did was go in and figure out how to turn off the auto dim feature, the light sensitive feature. Because I felt like it got too dim.

Depending on the inputs, we might adjust things a little bit. But it's nothing with a lot of reason behind it. It's just "This looks better."

I dialed it in for three weeks. Back and forth and back and forth, trying to dial in the exact right flesh tones. Once I got the flesh tones, then I was good.

I locked mine in and it stays. …Unless you actually bump the menu button, my settings don't change.

We adjust before watching a Blu-ray, if we're doing something with Netflix, we may look at it and change the picture quality, or if this is too dark, we'll make the adjustments.

You have different modes. You've got your gaming mode, you've got your theater mode… you have five or six modes on the (television) that I have. Now if you set all that stuff initially, and then you can just click from user mode, to game mode, or movie mode.

Others commented on the "energy efficiency" settings and not knowing whether energy efficiency was automatic with an ENERGY STAR television, or whether they had to select a certain setting.

I think my TV has an ENERGY STAR setting on it if I'm not mistaken. I couldn't tell you what it's set to, but I think it's an option.

That (having to turn on an energy-efficiency features, as opposed to it being automatic on all ENERGY STAR TVs) defeats the purpose, we have to turn it on and I know we haven't turned anything on that's ENERGY STAR. I just assumed it was saving energy. I guess not.

Consumer Television Use Over Time

Focus group participants were asked to comment on how their television use has changed over the past ten years. Respondents commented on the many uses for their television now, compared to years past. For example, some respondents discussed the ability to use the television as a digital photo frame. Others stated that they now use their television to stream music instead of using a stereo. Respondents are watching less broadcast television, and their television use is much more diversified compared to a decade ago. Some respondents felt that they now spend more time using their televisions, but most respondents felt that the time they spend using their television has not necessarily increased, and some felt that it had decreased. However, despite the total amount of time spent using their television has stayed constant, all respondents agreed that the number of activities that involve the television has increased over time.

The SD card slot - I've used it a bit and it's nice to have, because you can just make it into a picture frame. Put a bunch of photos on it and run it in the background.

We game, I've used it as a monitor for work, it's like a little bit of everything. It's completely changed.

I got rid of my cable and just do Netflix and exactly what everybody else is saying, you stream the content to the TV, use the monitor for working on, you do a lot more with it.

One change that I've noticed in our family is for example after Christmas dinner we would always bring out the board games, play board games. Last several years, somebody brings out the Wii and we're like playing the Wii for the rest of the night. We're always doing something with it.

C.5 Conclusions and Recommendations

There are three primary conclusions stemming from the focus groups conducted for the NEEA Consumer Electronics Television Program:

1. Consumers need and want more information about energy efficiency in televisions. Although focus group participants knew generally what is meant by the phrase "energy efficiency," they were not sure what this meant specifically with respect to televisions. In fact, some respondents were surprised that ENERGY STAR applied to anything other than refrigerators and similar "white goods." Respondents were not sure if there is a specific setting or if ENERGY STAR televisions are energy efficient out of the box, but many held the belief that they would have to sacrifice picture quality for energy efficiency. Many respondents indicated that they changed the default settings after getting their new television home; it is unclear how this may affect the energy use of the television, compared to the ENERGY STAR specifications. Respondents of both groups expressed a desire to see the Energy Guide tags (detailing the annual energy cost to operate the television compared to similar models) or more information from manufacturers. Although respondents valued the opinions of sales associates who know a lot about televisions, they did not necessarily trust retailers to "sell" energy efficiency.

EMI recommends that NEEA pursue efforts to educate consumers on energy efficiency with respect to televisions. Although the Energy Guide tags will be required on all televisions beginning in May 2011, consumers do not appear to be aware of how their alteration of default settings can potentially override any energy savings they could otherwise expect. Focus group participants indicated that they would like to receive this information along with their new television, as a separate sheet of paper, rather than being contained in the manual where it might get overlooked.

2. The NEEA Program marketing materials and sales associate recommendations may not influence a great number of consumers. Most of the focus group participants had conducted a great deal of research online prior to going to a physical storefront to make their specific television selection. Twelve out of sixteen focus group participants indicated that they did not rely on a retail sales associate to make their purchase decision. Furthermore, none of the focus group participants recognized the marketing sticker or remembered seeing the "Energy Forward" video in Costco stores. One reason for this could be that there are a number of stickers displayed on the front of televisions for sale, and consumers may be overloaded by information in the store. However, when asked to comment on the marketing stickers, respondents indicated that the ENERGY STAR logo was more recognizable and meaningful than the Energy Forward logo. No focus group respondents used "energy efficiency" as a criterion when deciding which television to purchase, and consumers appear to be much more interested in other television characteristics such as screen size and picture quality when shopping for a television. However, the impact of the sticker cannot be fully determined based on two focus groups alone. Further research needs to occur to conclusively determine the impact of the sticker.

EMI recommends that NEEA systematically assess the impact of the in-store marketing materials, including whether they are being used as planned at all store locations, and NEEA should consider re-evaluating the marketing channels that this Program relies on to transform the market and produce energy savings. No respondents recalled seeing any of the marketing materials displayed in the store. Given respondents' understanding of, and significance placed on, the ENERGY STAR, Energy Forward, and utility logos, NEEA should consider evaluating the use, placement, and prominence of these logos for the in-store marketing materials. Furthermore, most respondents conducted research online prior to entering the store, and generally did not rely on a sales associate to make their purchase decision. Another way to increase consumer awareness may be to promote the energyefficientelectronics.org website, as many

respondents indicated that they had conducted online research prior to going to a retail location to purchase their new television.

3. Television use is greatly diversified. Although the amount of time spent watching live broadcast television appears to have decreased, televisions are now used for many more activities. Respondents use their televisions in a variety of ways, including streaming internet, viewing digital photos, gaming, using a DVR to record shows to watch later, and even listening to music. Some respondents indicated that although their use of television over time has diversified, the amount of time spent using the television has not changed. However, other respondents indicated that their use of the television has increased or decreased over the last ten years.

EMI recommends that NEEA continue to monitor televisions usage patterns over time. Although the focus group results are unclear as to whether hours of television use have increased in the last ten years, the variety of ways that consumers are using their televisions does appear to be increasing. Monitoring changes in the usage patterns of televisions (including hours of use) is important for determining the energy consumption and potential savings of televisions.

Appendix D: DATA COLLECTION INSTRUMENTS

D.1 Interview Guides

NEEA Staff and Implementation Contractors

Interview Objectives:

- Understand roles of staff and contractors involved in Initiative implementation.
- Understand details of Initiative implementation.
- Understand the Initiative theory and logic.
- Determine successes, challenges, and potential risks to the success of the Initiative.

Interviewees:

- NEEA: Mardi Cino / Lisa Watson / Stephanie Fleming
- QDI: Pat Kilroy
- Energy Solutions: Alex Chase

Note:
This interview guide is comprehensive in that it allows for discussion on a number of topics with various Initiative staff. Therefore, there will be sets of questions that will be more fully explored with some individuals than with others. The depth of the exploration with any particular respondent will be guided by the role that individual plays in the Initiative's design and operation.

INTRODUCTION

Hello my name is _____ from Energy Market Innovations. As you may know, we are evaluating NEEA's Consumer Electronics Initiative Television Initiative, and as part of that evaluation, we are speaking with program staff/implementation contractors to understand the details of the program and learn, from your perspective, what is going well and what may need to be improved.

1.1. To start, will you please explain your role and scope of responsibilities with respect to the NEEA Television Program?

- How long have you held this position?
- Have your role and responsibilities changed over time? [If so:] How?

2. PROGRAM IMPLEMENTATION

2.1. What is the role of [NEEA / QDI / Energy Solutions] in the implementation of the NEEA TV Program?

- Probe for particular activities:
  - Program energy efficiency criteria development
  - Retailer recruitment
  - Tracking incentives and/or sales data
  - Marketing activities
  - Retailer training
  - Maintain Salesforce database
  - Developing program criteria

2.2. How does [NEEA / QDI / Energy Solutions] interact with program stakeholders?

- Probe for particular Stakeholders:
  - Retailers
  - Manufacturers
  - Participating utilities
  - Partner utilities

3. PROGRAM THEORY

3.1. Please describe the state of the energy-efficient television market prior to the program implementation.

3.2. Please describe the key goals and intended outcomes of the program. Note that we'll also ask about secondary goals so please focus on the primary goals.

- Are there any secondary goals? If so, please describe?

3.3. Please describe how this program brings about market transformation and produces energy savings.

3.4. What are the key barriers to consumers investing in energy-efficient televisions?

- How does this program address these barriers?

4. PARTICIPATING UTILITIES [FOR NEEA PROGRAM STAFF ONLY]

4.1. What role do participating utilities play in this program?

4.2. Do the utilities claim savings in association with this program?

- [If so:] How does this occur?
- Does NEEA claim savings? [If so:] How does this occur?

4.3. How many Northwest utilities are currently participating? Which utilities are participating?

4.4. What role do the Northwest utilities play in the overall program?

- How does NEEA engage with these utilities?
- How does NEEA help these utilities in achieving any goals related to TVs?

4.5. Has program staff reached out to additional utilities to increase participation?

- Why or why not?
- Are there other Northwest utilities that are currently not participating, but have shown interest in partnering with NEEA on this program?

5. RETAILER RECRUITMENT [QDI ONLY]

5.1. How does retailer recruitment occur?

5.2. Once a potential retail participant is identified, how are contract negotiations conducted?

- What specifics does this involve (e.g., incentive levels, marketing requirements, data reporting requirements, access to data, etc.)?
- Who is the negotiation with (e.g., national or store-level staff)?

5.3. I understand that the goal is to recruit retailers that are responsible for 80% of the market share of television sales in the Northwest. Has this 80% goal been met?

- What is the plan for recruitment moving forward?
- Will recruitment continue once the 80% goal has been met?
- What do you see as the greatest barriers to retailer participation?
    - How can these barriers be addressed?

6. ACCOUNT MANAGEMENT [QDI ONLY]

6.1. Please describe the various account management activities. In other words, what activities occur in order for the implementation team to maintain its relationships with the retailer participants?

7. MARKETING ACTIVITIES [QDI ONLY]

7.1. Please explain how the program is marketed to consumers.

- In-store signage, placing marketing materials,
- Video,
- Collateral, etc.

7.2. Who is responsible for the key marketing activities?

- Who develops and delivers marketing materials?
- How are marketing materials customized for individual utility service territories?

7.3. How many stores in total have received marketing materials?

- How many visits do you typically make to a store?
- How frequently are stores provided with marketing materials?

7.4. How are marketing activities monitored?

- How is the success of marketing activities measured?
- What specific quality assurance processes do you use?

7.5. What do you perceive is the level of satisfaction among retailers with respect to the marketing materials?

8. SALES ASSOCIATE TRAINING [QDI ONLY]

8.1. Please describe the sales associate training.

- What are the goals of the sales associate training?
- Are there regular or one-time trainings?
- How many trainings do sales associates typically have per year?
- What topics are covered?

8.2. How do you determine whether training and marketing materials are being used by the retail staff?

- Is the Salesforce.com database used to track this?

8.3. Who is responsible for the key activities?

- Who develops and provides the training?
- Is training standard across retailers, or does it vary?
    - If so: How does it vary?

8.4. How are retailer training activities monitored?

- What metrics are used for success of retailer training?

8.5. What do you perceive is the level of satisfaction among retailers with respect to the training?

9. INCENTIVES [QDI ONLY]

9.1. Are retailers generally satisfied with incentive levels?

- Why or why not?

9.2. Are incentives effective at influencing retailers to sell more energy-efficient televisions?

- Why or why not?

10. DATA TRACKING

10.1. How does QDI / Energy Solutions collect sales data from the retailers?

- How often are data collected? Are retailers timely in submitting their sales data?
- How is the accuracy of retailer sales data assessed?
- Do retailers submit data for non-qualifying units as well?

10.2. Please describe the QDI / Energy Solutions process for submitting data and updates to NEEA.

- How often are data updates submitted to NEEA? Market share updates?
- What information is contained in these updates?
- Is information for both qualifying and non-qualifying units submitted?

- How is the accuracy of the data assessed?

10.3. Please describe the incentive payment process.

- How are incentives calculated?
- How often are incentives paid to the retailers?
- Are incentives ever paid late?

11. PROGRAM EFFICIENCY CRITERIA

11.1. What is the current efficiency criteria used for the NEEA Television Program?

- Do they meet or exceed current ENERGY STAR level?
- Do criteria only cover active mode power, or does the specification cover other ENERGY STAR criteria?

11.2. Is there currently any intent to modify these levels?

- If so: How would they be changed? When?

11.3. How frequently are the efficiency criteria reviewed?

- What are the procedures for review? Who is involved?

11.4. What information/metrics are used to determine if the criteria need to be revised?

- How is program data used to justify alterations?

12. PRODUCT ALLOCATION [IF TIME ALLOWS]

12.1. How is it ensured that program-qualified TVs will be available from manufacturers?

- Who is responsible for this, and how does the communication with manufacturers, if any, take place?

12.2. Have there been any issues or concerns regarding the availability of qualified products?

13. DETERMINATION OF KEY PROGRAM GOALS

13.1. How is market share defined and measured / calculated?

13.2. How are energy savings calculated for this initiative?

- How is incremental market share attributable to the program determined?
- How are Unit Energy Consumptions (UECs) calculated?
- Are you confident in the assumptions used for savings calculations? Are there any assumptions at risk of not being accurate? [Probe for knowledge of ACE model and assumptions]

13.3. Is the program meeting its stated goals?

14. RELATIONSHIP/COMMUNICATIONS WITH ENERGY STAR AND CEE

14.1. How do ENERGY STAR and CEE influence the NEEA criteria?

14.2. How does NEEA influence national/regional specifications, such as CEE and ENERGY STAR?

- How influential is NEEA in the development of these national specifications?

15. PROGRAM STRENGTHS AND AREAS FOR IMPROVEMENT

15.1. What do you see as the greatest strengths of the program?

15.2. What do you see as the greatest weakness of the program? What would you most like to change?

- What, if anything, is standing in the way of making those changes at this time?

15.3. What potential risks exist that might negatively affect the ability of the program to meet its goals?

- Funding? Staff resources?
- Technological advances? Changing political priorities?

16. END

16.1. Do you have anything to add? Is there anything I've forgotten to ask you about?

16.2. Finally, how do you feel you will benefit from our research? What would you like to learn from our research that would be truly valuable for you and your team?

Thank you very much for taking the time to assist us with this evaluation. If I have any additional questions, do you mind if I send you an email or give you a quick call?

Participating Retailers

Interview Objectives:

- Determine influence of the program on television stocking and sales practices.
- Identify trends in consumer demand, sales, and marketing practices.
- Gauge retailers' awareness and understanding of the NEEA program.
- Gauge retailer satisfaction with the program, and identify suggestions for improvements, if any.
- Determine approximate market share of energy-efficient televisions.
- Understand distribution and sales channels of television manufacturers and retailers.
- Understand how the program influences retailers and manufacturers.
- Understand how program marketing materials are used and valued by retailers.

Interviewees:
Ten corporate-level staff at participating retail chains. These contacts will be taken from contact lists provided by NEEA.

INTRODUCTION

Hello my name is _____ from Energy Market Innovations. As a reminder, this interview is being held regarding the BCE program (Business and Consumer Electronics) which provides monetary incentives for the sale of energy-efficient televisions in California and the Northwest. We are doing an evaluation of the role of the Northwest Energy Efficiency Alliance, or NEEA, in this program. NEEA is the major funder of this program in the Northwest, including Washington, Oregon, Idaho and Montana. Your input into this evaluation is important to help determine the effectiveness of the program to help justify future program operations. We are also trying to determine what is going well with the program and what may need to be improved.

1 CONTACT QUALIFICATIONS AND AWARENESS

1.1 To start, will you please explain your role and scope of responsibilities at [RETAILER NAME]?

- How long have you held this position?

1.2 What is your role at [RETAILER NAME] with respect to the NEAA Television Program?

- How do you typically interact with the program and its representatives?
- How long have you been involved with the program?

1.3 Can you briefly describe your knowledge of the NEEA Television program? What are the program goals? How does the program operate to achieve those goals?

1.4 Can you describe the different energy efficiency tiers and incentives and used by the NEEA program?

- What are the current tiers and incentives?

2 RETAILER OPERATIONS

2.1 Please describe the process for submitting sales data.

- Who submits, to whom, and when?
- What data are submitted and how often?

2.2 Please describe the process for receiving incentive payments.

- How often are incentive payments received?
- Typically how long is it between data submittal and when you get paid?
- Are there often disputes in the amount of the payment? In other words, are there often many products that you don't receive incentives for that you think you should have? Why do you think that is?

2.3 How does [RETAILER NAME] define energy-efficient televisions?

- What specification or power/energy usage is used for the definition?

2.4 Does [RETAILER] currently market televisions as being energy-efficient to customers?

- [If yes:] How? Is this increasing over time? When did you begin marketing them as energy-efficient?

2.5 Please describe program marketing materials used at your retail locations.

- What marketing materials are provided by NEEA?
- What marketing materials are developed by [RETAILER NAME]?

2.6 Do you think these materials are effective at promoting the sale of energy-efficient televisions?

- Do you have suggestions for making these materials more effective?

2.7 Are retail staff at your stores trained to mention energy efficiency as feature when selling TVs?

- To your knowledge do retail staff generally mention energy efficiency as a product feature?
- Does [RETAILER] encourage retail staff to do so? Do you see this increasing over time?

2.8 Are manufacturers currently marketing products to you as being energy-efficient?

- Do you expect them to?
- Have you seen this change lately?

2.9 Are energy-efficient TVs generally available through manufacturers?

- If not: Please explain.

2.10 Do you feel that the manufacturing and availability of energy-efficient TVs is influenced by this program?

- Why or why not?

2.11 Approximately what percentage of the televisions sold by [RETAILER NAME] in the Northwest in 2010 were energy-efficient?

- Is this different than in other markets? Nationally? In California?
- Has this changed over time? Increased? Decreased?

2.12 Do the individual stores typically buy differently for different regions or store locations, or does model assortment typically happen at a national level?

2.13 Do you find that particular store locations request or demand more energy-efficient TVs compared to other store locations?

- Which ones?

3 MARKET CHARACTERIZATION / EFFECTS

3.1 In your opinion, what particular television technologies or features are consumers demanding right now?

- Are there particular energy-efficient features that consumers want?
- Are there particular energy-efficient features that your organization plans to market more aggressively towards consumers?
- Are there technologies or features upcoming on the market that you think consumers will be demanding by the end of this year?

3.2 What impact do the current incentives have on encouraging your organization to *purchase and stock more* energy-efficient televisions in the Northwest market? Do you think more energy-efficient TVs are *purchased and stocked* in the Northwest as a result of the program?

- Do you think a different incentive level would be more effective?
- If yes, would you increase it or reduce it and by how much?

3.3 What impact do the current incentives have on encouraging your organization to *sell* energy-efficient televisions to its customers in the Northwest market? Do you think more energy-efficient TVs are *sold to customers* in the Northwest as a result of the program?

- Do you think a different incentive level would be more effective?
- If yes, would you increase it or reduce it and by how much?

3.4 Have you observed any differences between television sales patterns in the Northwest and nationally?

- What about similarities or differences between California and Northwest sales patterns?
-

3.5 How do you think that the NEEA TV program has influenced the manufacturing or design of energy-efficient TVs?

3.6 Over 2010, has demand for energy-efficient televisions:

- Increased,
- Decreased, or
- Remained approximately the same?

- Please explain.

3.7 Looking forward to 2011, do you think the manufacturing of energy-efficient TVs will…

- Increase,
- Decrease, or
- Remain approximately the same?

- Please explain.
- Do you think NEEA has influenced this change? If so, how?

3.8 Do programs such as the National ENERGY STAR program, or the *Consortium for Energy Efficiency, have influence on the types of televisions that are manufactured or sold?*

- How much influence? More or less influence than the NEEA program?

4 SATISFACTION

4.1 How satisfied are you with the NEEA program? Would you say you are:

Very satisfied,
Somewhat satisfied,
Neither satisfied nor dissatisfied,
Somewhat dissatisfied, or
Very dissatisfied?

- Please explain why you gave that rating.

4.2 How satisfied are you with the performance of the implementer QDI? They are responsible for setting up program contracting and other account management tasks. Would you say you are…

5. Very SATISFIED
4. Somewhat SATISFIED
3. Neither satisfied nor dissatisfied
2. Somewhat DISSATISFIED
1. VERY DISSATISFIED
98. Don't Know

- Please explain why you gave that rating.
- Probe to determine the extent of interaction/knowledge of work performed.

4.3 How satisfied are you with the performance of the implementer Energy Solutions? They are responsible for collecting sales data and making incentive payments. Would you say you are…

5. Very SATISFIED
4. Somewhat SATISFIED
3. Neither satisfied nor dissatisfied
2. Somewhat DISSATISFIED
1. VERY DISSATISFIED
98. Don't Know

- Please explain why you gave that rating.
- Probe to determine the extent of interaction/knowledge of work performed.

4.4 How satisfied are you with the marketing materials that NEEA has developed and placed in your participating stores? Would you say you are…

5. Very SATISFIED
4. Somewhat SATISFIED
3. Neither satisfied nor dissatisfied
2. Somewhat DISSATISFIED
1. VERY DISSATISFIED
98. Don't Know

- Please explain why you gave that rating.

4.5 How satisfied are you with the performance of the implementer Premium Retail Services? They are responsible for placing the marketing materials in participating the store locations.

- Probe to determine the extent of interaction/knowledge of work performed.

5 PROGRAM STRENGTHS AND AREAS FOR IMPROVEMENT [IF TIME ALLOWS]

5.1 What do you see as the greatest strengths of the NEEA program? What is working well?

- What do you see as the greatest weaknesses of the NEEA program? What would you most like to change?

6 END

6.1 Do you have anything to add? Is there anything I've forgotten to ask you about?

Thank you very much for taking the time to assist us with this evaluation. If I have any additional questions, do you mind if I send you an email or give you a quick call?

Participating Manufacturers

Interview Objectives:

- Determine influence of the NEEA television program on television manufacturing and sales.
- Identify trends in consumer demand, sales, and marketing practices.
- Gauge manufacturers' awareness and understanding of the NEEA program.
- Gauge manufacturer satisfaction with the program, and identify suggestions for improvements, if any.
- Determine approximate market share of energy-efficient televisions.
- Understand distribution and sales channels of television manufacturers and retailers.
- Understand how the program influences retailers and manufacturers.

Interviewees:
Five manufacturers involved in the program. These contacts will be taken from contact lists provided by NEEA and QDI.

INTRODUCTION

Hello my name is _____ from Energy Market Innovations. As a reminder, this interview is being held regarding the BCE program (Business and Consumer Electronics) which provides monetary incentives for the sale of energy-efficient televisions in California and the Northwest. We are doing an evaluation of the role of the Northwest Energy Efficiency Alliance, or NEEA, in this program. NEEA is the major funder of this program in the Northwest, including Washington, Oregon, Idaho and Montana. Your input into this evaluation is important to help determine the effectiveness of the program to help justify future program operations. We are also trying to determine what is going well with the program and what may need to be improved.

1. CONTACT QUALIFICATIONS AND AWARENESS

1.1. To start, will you please explain your role and scope of responsibilities at [MANUFACTURER NAME]?

- How long have you held this position?

1.2. What is your role at [MANUFACTURER NAME] with respect to the NEAA Television Program?

- How do you typically interact with the program and its representatives?
- How long have you been involved with the program?

1.3. Can you briefly describe your knowledge of the NEEA Television program? What are the program goals? How does the program operate to achieve those goals?

1.4. Can you describe the different energy efficiency tiers and incentives and used by the NEEA program?

- What are the current tiers and incentives?

2. MANUFACTURER OPERATIONS

2.1. How does [MANUFACTURER NAME] define energy-efficient televisions?

- What specification or power/energy usage is used for the definition?

2.2. Does [MANUFACTURER] currently market its televisions as being energy-efficient?

- [If yes:] How? Is this increasing over time? When did you begin marketing them as energy-efficient?
- [If yes:] What are examples of marketing televisions as energy efficient?

2.3. To your knowledge, are retailers currently marketing your products as being energy-efficient?

- Do you expect them to?
- Do you see this changing anytime soon? If so, how?

2.4. Approximately what percentage of the televisions sold by [MANUFACTURER NAME] in the Northwest in 2010 were energy-efficient?

- Is this different than in other markets? Nationally? In California?
- Has this changed over time? Increased? Decreased?

2.5. Do the retailers typically buy differently for different regions or store locations, or does model assortment typically happen at a national level?

3. MARKET CHARACTERIZATION / EFFECTS

3.1. In your opinion, what particular television technologies or features are consumers demanding right now?

- Are there particular energy-efficient features that consumers want?

- Are there particular energy-efficient features that your organization plans to market more aggressively towards retailers?
- Are there technologies or features upcoming on the market that you think consumers will be demanding by the end of this year?

3.2. Do you think retailers purchase more energy-efficient TVs in the Northwest as a result of the program?

- Do retailers request or demand more Energy-efficient televisions as a result of the program?

3.3. How do you think that the NEEA TV program has influenced the manufacturing or design of energy-efficient TVs?

3.4. Over 2010, has demand for energy-efficient televisions:

- Increased,
- Decreased, or
- Remained approximately the same?

- Please explain.

3.5. Looking forward to 2011, do you think the manufacturing of energy-efficient TVs will…

- Increase,
- Decrease, or
- Remain approximately the same?

- Please explain.
- Do you think NEEA has influenced this change? If so, how?

3.6. Do programs such as the National ENERGY STAR program, or the *Consortium for Energy Efficiency, have influence on the types of televisions that are manufactured or sold?*

- How much influence? More or less influence than the NEEA program?

4. PROGRAM STRENGTHS AND AREAS FOR IMPROVEMENT [IF TIME ALLOWS]

4.1. What do you see as the greatest strengths of the NEEA program? What is working well?

4.2. What do you see as the greatest weaknesses of the NEEA program? What would you most like to change?

5. END

5.1. Do you have anything to add? Is there anything I've forgotten to ask you about?

Thank you very much for taking the time to assist us with this evaluation. If I have any additional questions, do you mind if I send you an email or give you a quick call?

Utilities

Interview Objectives:

- Determine the role of participating utilities in the program.
- Determine how NEEA collaborates with partner utilities.
- Assess the effectiveness of marketing materials and efforts.
- Determine barriers to participation in the program.
- Determine satisfaction in the program from participating utilities.
- Examine successes and challenges thus far among participating Northwest utilities and partner utilities.
- Determine successes and challenges from partner programs.

Potential Interviewees:

- Partner Utilities (1)
  - PG&E (Sarah Bresko)
- Northwest Participating Utilities (2)
  - Energy Trust of Oregon
  - Northwestern Energy
  - Seattle City Light
  - Avista

Note:
This interview guide is comprehensive in that it allows for discussion with staff at both partnering and participating utilities. Therefore, there will be sets of questions that will be more fully explored with some individuals than with others. In particular, Section 2 is intended for participating Northwest utilities only, and Section 6 is intended for partner utilities (e.g., PG&E) only.

INTRODUCTION

Hello my name is _____ from Energy Market Innovations. As you may know, we are evaluating NEEA's Consumer Electronics Television Initiative, and as part of that evaluation, we are speaking with staff at [partner/participating/non-participating] utilities to understand the details of the program and learn, from your perspective, what is working well and what might be improved in the program.

1.1. To start, will you please explain your role and scope of responsibilities at [UTILITY]?

- How long have you held this position?

1.2. Please describe your role and scope of responsibilities in relation to the NEEA Consumer Electronics Television Initiative.

1.3. Can you briefly describe your knowledge of the NEEA Television program? What are the program goals? How does the program operate to achieve those goals?

1.4. Can you describe the different energy efficiency tiers and incentives used by the NEEA program?

- What are the current tiers and incentives?

2. PROGRAM PROCESSES [PARTICIPATING UTILITIES ONLY]

2.1. Please describe the role of [UTILITY] in administering this program.

- What activities does [UTILITY] perform in relation to this program?

2.2. Please explain the marketing activities for this program.

- E.g., in-store signage, POP information, video, etc.
- How are marketing activities monitored?
- How is the success of marketing activities measured?

- To your knowledge are marketing materials used consistently across your service territory? Is this consistent for both independent and big box retailers?

2.3. Do you think these materials are effective at promoting the sale of energy-efficient televisions?

- What suggestions do you have for making these materials more effective?

2.4. What successes and challenges have you encountered while participating in this program?

3. UTILITY COLLABORATION [PARTNER UTILITIES ONLY]

3.1. How does your program differ from the NEEA program, if at all?

3.2. How does your utility collaborate with NEEA on this program?

- What is the greatest value in this collaboration?
- How could collaboration be improved?

3.3. How do you collaborate with other partner/ participating utilities?

- What is the greatest value in this collaboration?
- How could the different program utilities better collaborate?
  - How do you see this helping the program?

3.4. Are there other stakeholders you would like to see join this effort?

- If so: Who and how would you like to see them involved?

3.5. What successes and challenges have you encountered while implementing this program?

3.6. What successes and challenges have you encountered working with NEEA?

4. PROGRAM INFLUENCE

4.1. What did the market for energy-efficient televisions [defined as televisions that meet the program criteria and are eligible for incentives, e.g., ENERGY STAR 4.1 and 5.1 in 2010] look like prior to the NEEA Program?

- What programs or legislation covered energy-efficient televisions?

- Were these programs effective in changing the television market?

4.2. What impact has the current program had on encouraging the *sale and stocking* of energy-efficient televisions in the market in 2010?

- Do you think more energy-efficient TVs are *purchased and stocked* in your service territory as a result of the program?
- Do you think a different incentive level would be more effective?
- If yes, would you increase it or reduce it? By how much?

4.3. What impact has the current program had on encouraging the *manufacturing* of energy-efficient televisions in 2010?

- Do you think more energy-efficient TVs are *manufactured* as a result of the program?
- Do you think a different incentive level would be more effective?
- If yes, would you increase it or reduce it and by how much?

5. BARRIERS TO PARTICIPATION

5.1. What do you think might prevent consumers from purchasing energy-efficient televisions?

5.2. What do you think might prevent additional retailers from participating in this program?

5.3. What, if anything, do you think might prevent additional utilities from participating in this effort?

6. SATISFACTION [PARTICIPATING UTILITIES ONLY]

6.1. How satisfied are you with the NEEA program? Would you say you are:

Very satisfied,
Somewhat satisfied,
Neither satisfied nor dissatisfied,
Somewhat dissatisfied, or
Very dissatisfied?

- Please explain why you gave that rating.

6.2. What do you perceive is the level of satisfaction with the program among retailers in your service territory?

- What, if anything, would make retailers more satisfied with the program?

6.3. Do you think sales of program-qualified televisions in 2010 have been:

About what you expected,
Greater than what you expected,
Lower than what you expected, or
Don't know?

- Why do you think that is?
- What could NEEA do to increase sales of energy efficient TVs moving forward? What could [UTILITY] do? Anything else that would help sales?

7. PROGRAM STRENGTHS AND AREAS FOR IMPROVEMENT [IF TIME ALLOWS]

7.1. What do you see as the greatest strengths of the NEEA program? What is working well?

7.2. What do you see as the greatest weaknesses of the NEEA program? What would you most like to change?

8. END

8.1. Do you have anything to add? Is there anything I've forgotten to ask you about?

Thank you very much for taking the time to assist us with this evaluation. If I have any additional questions, do you mind if I send you an email or give you a quick call?

Other Programs

Other Interview Objectives:

- Determine national trends the television market
- Determine the influence of NEEA on these other programs

Potential Interviewees:

- ENERGY STAR (Katharine Kaplan)
- CEE (Margie Lynch)

INTRODUCTION

Hello my name is _____ from Energy Market Innovations. As a reminder, this interview is being held regarding the BCE program (Business and Consumer Electronics) which provides monetary incentives for the sale of energy-efficient televisions in California and the Northwest. We are doing an evaluation of the role of the Northwest Energy Efficiency Alliance, or NEEA, in this program. NEEA is the major funder of this program in the Northwest, including Washington, Oregon, Idaho and Montana. Your input into this evaluation is important to help determine the effectiveness of the program to help justify future program operations. We are also trying to determine what is going well with the program and what may need to be improved.

1.1. To start, will you please explain your role and scope of responsibilities at [ORGANIZATION]?

- How long have you held this position?

1.2. Please describe your role and scope of responsibilities with respect to the NEEA Consumer Electronics Television Initiative.

1.3. Can you briefly describe your knowledge of the NEEA Television Initiative? What are the program goals? How does the program operate to achieve those goals?

1.4. Can you describe the different energy efficiency tiers and incentives used by the NEEA program?

- What are the current tiers and incentives?

2. BACKGROUND OF ENERGY STAR / CEE

2.1. Please describe the [ENERGY STAR / Consortium for Energy Efficiency] television program.

- Please describe how this program influences the energy-efficient television market?

2.2. What are the current [ENERGY STAR / CEE] criteria?

2.3. Is there currently any intent to modify these levels?

- If so: How would they be changed? When?

2.4. How frequently are the efficiency criteria reviewed?

- What are the procedures for review? Who is involved?

2.5. What information/metrics are used to determine if the criteria need to be revised?

- How is program data used to justify alterations?

2.6. How is NEEA currently engaged with the program?

2.7. How has NEEA been engaged in the past?

- What impact has NEEA had on impacting program specifications or timing?

2.8. Can you give one or more examples of a time when NEEA's support has been critical in supporting the program?

3. PROGRAM INFLUENCE

3.1. What did the market for energy efficient televisions [defined as televisions that meet the program criteria and are eligible for incentives, e.g., ENERGY STAR 4.1 and 5.1 in 2010] look like prior to the NEEA Program?

- What programs or legislation covered energy-efficient televisions?
- Were these programs effective in changing the television market?

3.2. Are retailer incentives effective at influencing retailers to sell more energy-efficient televisions?

- Why or why not?

3.3. What impact has the current program had on encouraging the *sale and stocking* of energy-efficient televisions in the market in 2010?

- Do you think more energy-efficient TVs are *purchased and stocked* as a result of the program?
- Do you think a different incentive level would be more effective?

- If yes, would you increase it or reduce it? By how much?

3.4. What impact has the current program had on encouraging the *manufacturing* of energy-efficient televisions in 2010?

- Do you think more energy-efficient TVs are *manufactured* as a result of the program?
- Do you think a different incentive level would be more effective?
- If yes, would you increase it or reduce it and by how much?

4. MARKET CHARACTERIZATION / EFFECTS

4.1. In your opinion, what particular television technologies or features are consumers demanding right now?

- Are there particular energy-efficient features that consumers want?
- Are there technologies or features upcoming on the market that you think consumers will be demanding by the end of this year?

4.2. In your opinion, what technologies are manufacturers currently focusing on?

- What do they plan to focus on in the future?

4.3. Do retailers and manufacturers currently market televisions as being energy-efficient to customers?

- [If yes:] How? Is this increasing over time?

4.4. Are energy-efficient TVs generally available from manufacturers?

- If not: Please explain.

4.5. Over 2010, has demand for energy-efficient televisions:

- Increased,
- Decreased, or
- Remained approximately the same?

- Please explain.

4.6. Looking forward to 2011, do you think the manufacturing of energy-efficient TVs will…

- Increase,
- Decrease, or
- Remain approximately the same?

- Please explain.
- Do you think NEEA has influenced this change? If so, how?

4.7. What are the key barriers to consumers investing in energy-efficient televisions?

- How does this program address these barriers?

5. PROGRAM STRENGTHS AND AREAS FOR IMPROVEMENT [IF TIME ALLOWS]

5.1. What do you see as the greatest strengths of the NEEA program? What is working well?

5.2. What do you see as the greatest weaknesses of the NEEA program? What would you most like to change?

6. END

6.1. Do you have anything to add? Is there anything I've forgotten to ask you about?

Thank you very much for taking the time to assist us with this evaluation. If I have any additional questions, do you mind if I send you an email or give you a quick call?

D.2 Focus Group Instruments

Focus Group Screener

INTRODUCTION: "Hi, I'm calling from _____(Consumer Opinion Services/Strategic Research Associates). We'd like to ask you a few quick questions to determine if you'd be eligible to participate in a paid focus group this month. The goal of the focus group is for the Northwest Energy Efficiency Alliance to better understand television purchase decisions in the Northwest. Do you have a couple of minutes?"

___No (**terminate,** or call back if so requested)
___Yes (continue)

Have you participated in any focus groups in the past three months?
___Yes (continue) ___No (**terminate**)

Have you purchased a new TV in the past 3 months (Hold if 6 months, we may expand criteria if necessary)?
___Yes (continue) ___No (**terminate**)

If yes: What month did you purchase your TV?
_____ Record month (continue if October (or July if expanding to six months) 2010 or later)

Where did you purchase your TV?
_____Second-hand [Specify source_____, e.g., individual on craigslist, from a friend, etc.] (**terminate**)
_____From a physical store [Specify retailer_____] (continue)
_____From an online store [Specify retailer _____] (continue)

Who in your household was primarily responsible for deciding which TV to purchase?
____I was the primary decision-maker (continue)
____I shared the decision-making responsibility equally with another person (continue)
____Someone else in my household was the primary decision-maker (ask if primary decision-maker is interested/available and go back to Question 1; otherwise, **terminate**)

Do you know if the new TV you purchased is Energy Star-rated [respondent must answer this question without going to look at the TV]?
____Yes, it is Energy-Star rated (continue to question 6)
____No, it is not Energy Star-rated (continue to question 6)
____I don't know if it is or not:
Did you purchase an energy-efficient TV?
___Yes (continue) ___No/Don't Know (continue)

Are you currently employed, either part-time or full time?
___No (**terminate**)
___Yes, full-time (continue to question 7)
___Yes, part-time:
How many hours per week do you currently work?
___ ≥ 24 hours/wk (continue)
___ < 24 hours/wk (**terminate**)

Have you ever worked in any of the following industries:
Electronics manufacturing?
___Yes (continue) ___No (**terminate**)

Electronics retail or electronics department?
___Yes (continue) ___No (**terminate**)

An electric utility?
___Yes (continue) ___No (**terminate**)

Have you ever worked for a company that specializes in energy efficiency (e.g., energy efficiency program implementation, energy efficiency engineering, energy efficiency consulting, or energy policy work)?
___Yes (continue) ___No (**terminate**)

Can you please tell me what the brand and model # of your new TV is? I can wait while you go look.
___Yes
Record brand (e.g., Sony, LG, etc.) _____ (continue)
Record model # _____ (continue)
___No (e.g., respondent is not at home or cannot currently access the TV)
Record reason and ask for a good time to call R back for the information_____
_____
_____
(continue)

What was your approximate annual income in 2010? Your best guess is fine.
$_____ Record amount (continue)

What is your age? Are you:
___ younger than 18
___ 18 – 24 (continue)
___ 25 – 34 (continue)
___ 35 – 44 (continue)
___ 45 – 54 (continue)
___ 55 – 64 (continue)
___ 65 or older (continue)

Record respondent's sex:
_____ female (continue) ____male (continue)

Could you be available to attend a focus group in (Seattle/Spokane) on (Tue, January 11/Wed, January 12) at 6:30pm? You would be compensated $100 for your time.
___No (**terminate**)
___Yes (continue)

IF COMPLETED: "Thank you for answering my questions. We will call you back in a few days to let you know if we would like you to participate in our focus group. In the mean time, please save the following time and date on your calendar: (Tue, January 11/Wed, January 12) at 6:30 pm. Have a nice day."

IF TERMINATED AT ANY POINT: "Thank you. Given our specific requirements, we're sorry to say that we won't be able to invite you to this round of focus groups. Have a nice day."

Focus Group Moderator Guide

Focus Group 1 (Seattle, WA) – Tue, Jan 11, 6:30pm

Consumer Opinion Services, Inc.
US Bank Centre
1420 Fifth Avenue, Suite #525
Seattle, WA 98101

Jerry Carter
206-241-6050

Focus Group 2 (Spokane, WA) – Wed, Jan 12, 6:30pm

Strategic Research Associates
25 W. Cataldo Avenue, Suite D
Spokane, WA 99201

Jennifer Gray
509-324-7882

Participant Recruiting Criteria

Each focus group consists of seven to eight recent television purchasers who were the primary decision maker for the purchase (i.e., those who decided on TV features). Approximately half of the participants will have knowingly bought an Energy Star TV. Participants are employed a minimum of 24 hours per week. No industry experts (e.g., anyone that has worked for an electronics manufacturer or retailer, no utilities, no EE professionals) will be participating in the groups. Additionally, none of the participants will have participated in any focus groups in the last 3 months. We are aiming for a mix of men and women, and a range of incomes.

Verification Of Screening Information

As participants sign in at the facility, verify:

- Recruit name
- Month of TV purchase
- Where purchased

- Who was the primary decision-maker regarding which TV to purchase

1 - If name does not match the screening information we have, the individual will not be allowed to participate in the focus group. A friend or relative is not allowed to sub for the person who was originally recruited.

For the three remaining criteria, a judgment call will be made as to whether to keep the recruit or send him/her home without participating. For example, we may choose to keep a recruit who purchased a TV at a non-participating retail chain – if we need that person to meet a group size of 8 participants.

2 - If month of TV purchase is different from the information we have, he or she will be allowed to participate if the TV was purchased in the last 6 months of 2010. If the TV was not purchased in the last 6 months of 2010, he or she will not be allowed to participate.

3 - If the store where purchased does not match, we will ask for clarification (e.g., we have "Best Buy," you said "Target" – which one is correct?). If the purchase was made at a non-participating retailer, we will not allow that person to participate in the group.

4 - The recruit should state that the decision regarding which TV to purchase was either 1.) his or her sole responsibility, or 2.) a responsibility they shared with someone else. If he or she says that someone else was the primary decision maker, the individual will not be allowed to participate in the focus group.

Statement Of Research Objectives

Primary Objectives

- Understand the terminology consumers use to discuss energy efficiency in televisions.
- Measure the ability of consumers to identify energy-efficient televisions.
- Monitor the prevalence of sales associates recommending energy-efficient televisions.
- Determine the extent to which consumer awareness of energy efficiency is a purchasing criterion.
- Evaluate consumer awareness of the television program's specific marketing materials, and determine what influence these materials have on consumer purchase decisions.

Secondary Objectives

- Assess how consumers' usage of televisions is changing over time – the types of usage of interest include: hours of use and types of use (e.g., broadcast, digital video recording, gaming, internet video or music streaming).
- Assess if and how consumers' typically configure their televisions, with a focus on brightness controls and other energy saving features.
- Determine popular features sought after in television purchasing.

Focus Group Timing

- Opening/Introductions/Ground Rules = 10 Minutes
- Questions = 75 - 90 Minutes
- Wrap-Up = 5 Minutes

Focus Group Introduction

MODERATOR: Hello and welcome. Thank you for taking the time to join our discussion. My name is Ellen Steiner. I have been contracted by the Northwest Energy Efficiency Alliance (NEEA) to conduct this focus group and will be the moderator this evening. NEEA is a non-profit organization that collaborates with more than 100 Northwest utilities to maximize energy efficiency and meet our future energy needs. This group should last for about one hour and 45 minutes.

You have all been selected because you recently purchased a new television. The purpose of the group is to understand the decision-making process for television purchases.

Has anyone ever been in a focus group before?

The first thing to keep in mind today is there are no right or wrong answers, just your experiences and opinions. Your opinion is the most valuable thing you can contribute to this group. Please be honest in your opinions and feel free to share your point of view even if it differs from what others have said.

The rules of group interaction are:

- Only one person may talk at a time.
- Responding directly to the comments of others is encouraged; responses do not necessarily have to be directed to me.
- All participants must contribute to the group, though each participant does not need to contribute to all questions.
- No participant or group of participants should dominate the group discussion.
- I may interrupt you while you are talking if we need to move on to another person or topic area or to assist the flow of discussion. No offense is intended.
- No smoking.
- Please turn off all cell phones.

Everything said here is confidential, which means that your names will not be associated with your comments. Also, I'd like to video record the proceedings. Many good ideas flow rather quickly in a focus group and a recording would help me catch all the thoughts and ideas that surface in these dynamic discussions? Do I have everyone's permission to record this session? [Thanks.] In addition, this focus group is being observed by representatives from the Northwest Energy Efficiency Alliance, who may send notes in occasionally if they want me to probe deeper into a particular statement or topic that comes up in our discussion this evening.

Does anyone have any questions before we begin?

Participant Introductions

First, let's give everyone the opportunity to introduce themselves. Please take 30-60 seconds to tell us your name, and describe what kind of TV you purchased, the size of the TV, and when you purchased the TV. Also tell us if this new TV is the one you use the most.

General Topic Discussion

TOPIC 1: Sales Associates' Recommendations

GOAL: Determine whether sales associates recommended energy-efficient televisions

TIME ALLOTMENT: 10 Minutes

- ⇨ **QUESTION – Did a sales associate help you in any way when you were deciding which new television to purchase?**
  - Probes:
    1. What did he/she help you with?
    2. Did the sales associate explain any of the TV features to you? [If so:] Which ones? What did he/she say?
    3. Did the sales associate point out which TVs are more energy efficient? [If so:] How did he/she explain this? What did he/she say?
    4. Did the sales associate recommend energy efficient TVs?
    5. How much time would you say the sales associate spent with you?

TOPIC 2: Consumer TV Terminology

GOAL: Understand the terminology consumers use to discuss specific television features, particularly energy efficiency.

TIME ALLOTMENT: 10 Minutes

- ⇨ **QUESTION – Say you purchased a TV that uses less energy than most other TVs. What words or phrases would you use to describe this type of TV?**

- ⇨ **QUESTION – Say you purchased a TV that you can use with an Internet connection. What words or phrases would you use to describe this type of TV?**

- ⇨ **QUESTION – Say that you purchased a TV that you can watch 3D content on. What words or phrases would you use to describe this type of TV?**

TOPIC 3: Identifying Energy-Efficient Televisions

GOAL: Understand the ability of consumers to identify energy-efficient televisions.

TIME ALLOTMENT: 10 Minutes

⇨ **QUESTION – What would you look for if you were trying to identify whether a TV is energy-efficient or not?**

- Probes:
    1. If you were shopping in a retail store, how would you find out which TVs are energy efficient?
    2. What aspects of a television would you say make it energy efficient?
    3. In what ways might some televisions use less energy than others?
    4. What are the characteristics or features of an energy-efficient television?

<u>TOPIC 4: TV Features</u>

GOAL: Determine the features that consumers look for when deciding to purchase a new TV.

TIME ALLOTMENT: 15 Minutes

⇨ **ACTIVITY – Television Features Card Ranking Activity**

- *Pre-make cards with the following TV features written on them:*
    - Energy consumption
    - Screen size
    - Type of TV (e.g., plasma, LED, LCD, HD)
    - 3D or 3D-capable TV
    - Screen refresh frequency (e.g., 60 Hz,120Hz, 240 Hz)
    - Screen resolution (e.g., 720p, 1080p)
    - TV Footprint
    - Price of the TV
    - Inputs (e.g., HDMI, Component Inputs, PC Inputs, USB Inputs)
    - Internet connectivity
    - Information provided by the salesperson
    - Warranty
    - Picture quality
- *Provide blank cards for participants to write additional TV features.*
- *Instruct participants to take the cards and determine if any of the features were important to them when they were shopping for a new TV. They can add any that they feel are missing.*
    1. Please think about the features you were looking for when you were shopping for a new TV. Please rank-order the cards with the five most important features that you considered when you decided which TV to purchase. After you have finished ranking the top 5 criteria, come up to this wall poster and tape the cards in their rank-order.

2. After you have ranked your top 5, please review the remaining cards and place an "X" through any features that you did **not** use when you were deciding which TV to purchase. That is, place an X through any features that were not at all important to you when you were shopping for a new TV.
3. [Single out a few participants and ask…] Why did you order your list this way?
4. [If "energy consumption" is on their list:] Why did you include "energy consumption"? Why did you rank it number _____?

TOPIC 5: Energy Efficiency as a Purchasing Criterion

GOAL: Determine the extent to which consumer awareness of energy efficiency is a purchasing criterion.

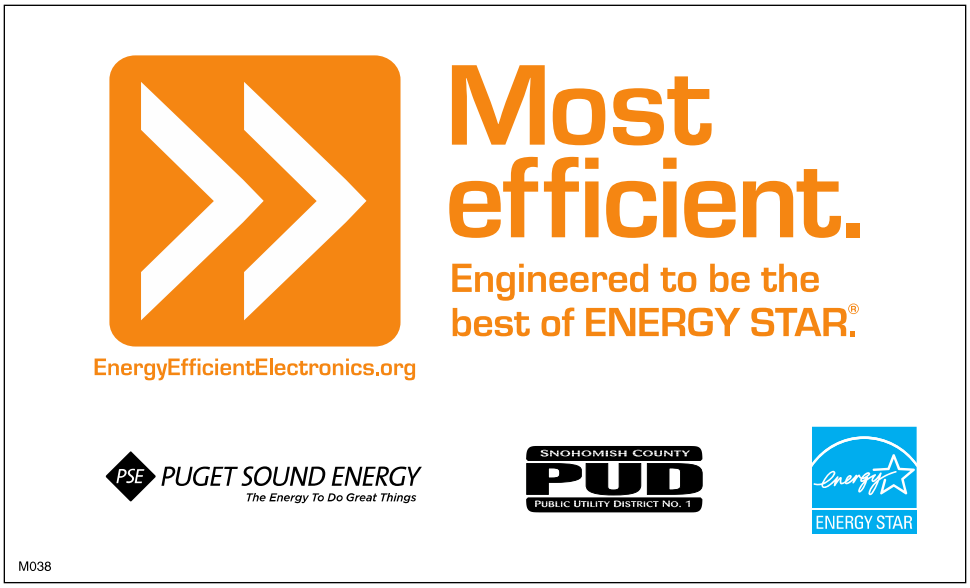
TIME ALLOTMENT: 10 Minutes

⇨ **QUESTION – How important was saving energy when you decided which new TV to purchase?**

- Probes:
  1. Was it important to you to purchase a television that is more energy efficient than other televisions?
  2. Did you consider how much energy your TV uses when you decided to purchase it?

TOPIC 6: Marketing Materials

VISUAL: Orient participants to the program marketing sticker.



GOAL: Evaluate consumer awareness of the program marketing materials, and determine whether these materials influenced consumers purchase decisions.

TIME ALLOTMENT: 15 Minutes

⇨ **QUESTION – Was this sign attached to any of the TVs for sale at the store where you purchased your TV?**

- Probes:
    1. How did/do you interpret this sign?
    2. Did the sales associate point out the signs to you? Did the sales associate explain what the sign means? [If so:] What did he/she say?
    3. Did this sign help you decide which TV to purchase? Why or why not?
    4. What sort of information did you see? [Do not probe directly on the video - if you don't hear it on first mention then ask directly:] Did you watch a video about energy efficient TVs in the store? What did the video contain? Was the information helpful/new to you? Did the video influence your purchase decision? [If so:] How so?
    5. Were there any pamphlets in the store to help you select an energy efficient TV? Did this influence your purchase decision? [If so:] How so?
    6. While you were in the store, were there any other ways to determine which TVs were more efficient than others?

TOPIC 7: Consumer TV Configuration

GOAL: Assess if and how consumers typically configure their televisions, with a focus on brightness controls and other energy-saving features.

TIME ALLOTMENT: 10 Minutes (If Time Allows)

⇨ **QUESTION – After you purchased your new TV, did you change any of the settings such as brightness, contrast, or standby settings?**

- Probes:
    1. [If so:] Why did you change the settings? [If not:] Why not?
    2. Are you using any energy-saving features that were included with your new TV? [If so:] Which energy-saving features are you using? [If not:] Why not?
    3. [If not:] What would prompt you to change the settings?

TOPIC 8: Consumer Use of Televisions

GOAL: Begin to assess how consumers' use of televisions is changing over time (e.g., hours of use, type of use)

TIME ALLOTMENT: 10 Minutes (If Time Allows)

⇨ **QUESTION – Thinking about how you currently use all the televisions in your home, how has your television use changed over the past few years?**

- Probes:
    1. Has the amount of time you spend using your TV(s) increased or decreased? [If so:] Why do you think that is?
    2. What types of things do you use your TV(s) for now, compared to a few years ago?

3. Compared to a few years ago, to what extent do you use your TV(s) to:
    - view live broadcast television programs?
    - view recorded television content?
    - view streaming video from the internet?
    - stream music from the internet?
    - use with a gaming console?
4. Do you use any televisions in your home for any other purpose that hasn't already been mentioned?

Closing

Well, that wraps things up. Thank you for coming this evening! I appreciate your candid and insightful thoughts. We will be using this information to help the Northwest Energy Efficiency Alliance assist consumers in identifying energy efficient televisions.

Your incentive payment will be paid in cash as you exit the facility.
Thanks again!

Report #E11-226

August 15, 2011

NEEA Market Progress Evaluation Report #3: 80 PLUS

Prepared by:

Navigant Consulting
1375 Walnut Street, Suite 200
Boulder, CO 80302

Northwest Energy Efficiency Alliance
PHONE
503-688-5400
FAX
503-688-5447
EMAIL
info@neea.org

Submitted to:

Rita Siong
Project Manager, Evaluation and Market Research
Northwest Energy Efficiency Alliance
421 SW Sixth Ave., Suite 600
Portland, OR 97204
503-688-5400
www.neea.org

Submitted by:

Navigant Consulting, Inc.
1375 Walnut Street, Suite 200
Boulder, CO 80302
303-728-2500

Primary Authors:

Stuart Schare
Jane Hummer
Greg Ekrem

Contact:

Stuart Schare,
Director
303-728-2504
stuart.schare@navigant.com

TABLE OF CONTENTS

Executive Summary **1**

Market Characterization 2

1. Introduction **5**

1.1 80 PLUS Program Overview 5

1.2 80 PLUS Program Logic Model 8

1.3 Terminology Used in the Report 10

2. Evaluation Activities **11**

2.1 Secondary Research 11

2.2 Reviews of Program Literature, including ACE and Logic Models 12

2.3 Interviews with Program Stakeholders and Implementers 12

2.4 Market Actor Interviews 12

3. Market Characterization **16**

3.1 PC and Server Markets 16

3.2 Energy-Efficient Power Supply Market 22

3.3 Summary of Market Characterization Findings 24

4. Market Progress Assessment **26**

4.1 Participation of Sponsors and Market Actors 28

4.2 Availability of 80 PLUS Certified Models 28

4.3 Inclusion of 80 PLUS in ENERGY STAR Specifications 29

4.4 Commercial End-User Awareness of 80 PLUS 30

4.5 Promotion of Efficient Power Supplies 31

4.6 Incremental Costs of 80 PLUS Qualified Power Supplies 33

4.7 80 PLUS Sales Trends and Market Share 34

4.8 Review of Logic Model Outcomes 42

4.9 Other Findings on OEM and SI Participation in 80 PLUS Program 43

4.10 Summary of Key Information Needs/Research Questions 44

5. Review of ACE Model Assumptions **46**

6. Conclusions and Recommendations **47**

6.1 Conclusions 47
6.2 Recommendations 49
Appendices 51
Appendix A: Bibliography 51
Appendix B: Market Actor Interview Guides 54
Appendix C: Market Actor Interview Results.....67
Appendix D: Secondary Research Memo.....110
Appendix E: ACE and Logic Models Review Memo 113

EXECUTIVE SUMMARY

The 80 PLUS program certifies energy-efficient power supplies for desktop personal computers (PCs) and servers. As a sponsor of 80 PLUS, the Northwest Energy Efficiency Alliance (NEEA) provides financial incentives to computer manufacturers for commercial sales of desktop PCs and servers incorporating 80 PLUS certified power supplies within the Northwest region. This is the third Market Progress Evaluation Report (MPER) on NEEA's 80 PLUS program. It updates the market progress indicators (MPIs) for the program and characterizes the personal computer (PC) market to assist NEEA in developing future plans for the program.

Market Progress

The 80 PLUS program has made strong progress in transforming the market for energy-efficient power supplies at the 80 PLUS Base (or equivalent) level. The EPA has credited NEEA and the 80 PLUS program with having a strong influence on the incorporation of 80 PLUS into the ENERGY STAR 4.0 specification, which has likely been the program's most significant direct influence to date on end-use customers' decisions to purchase energy-efficient power supplies. Another significant factor in market progress has been original equipment manufacturers' (OEMs) realization that efficient power supplies are higher quality and more reliable, which reduces their warranty costs.

80 PLUS has engaged the largest OEMs that produce commercial desktop PCs and has certified over 2,800 models of power supplies. More than 200 power supply manufacturers (PSMs) have certified 80 PLUS power supplies, and increased PSM competition has reduced incremental costs.

The market share of 80 PLUS was 0 percent in 2005, growing to at least 11 percent in 2008 (based on ENERGY STAR market share) to now stand at an estimated 37 percent of desktop PCs (including 80 PLUS or equivalent power supplies) sold in the U.S. in the first three quarters of 2010. The incorporation of 80 PLUS Bronze into the ENERGY STAR 5.0 specification has driven increased adoption of higher levels of 80 PLUS power supplies. Efficient power supplies will continue to transform the market, more through *greater penetration* of efficiencies in the lower 80-percent range than through significant *increases in the average efficiency* of those power supplies qualifying as "80 PLUS."

NEEA developed a total of 11 market progress indicators (MPIs) for the 80 PLUS program. The following summarizes progress in eight MPIs which are still key indicators of the success of the program.

- **Participation of Sponsors and Market Actors.** In 2010, there are five OEMs with certified units. PSMs with certified units rose from 19 in 2006 to 216 firms in 2010. Participating system integrators (SIs) dropped from 51 in 2008 to 37 participating SIs in 2010 as the program no longer incents non-ENERGY STAR (but still 80 PLUS) desktop PCs and servers; some of the smaller SIs cannot afford to produce ENERGY STAR certified equipment.

- **Availability of 80 PLUS Certified Models.** There has been tremendous growth in the availability of 80 PLUS certified models since program inception. The number of certified 80 PLUS power supplies grew from one in 2005 to more than 400 by 2007 and to more than 2,800 qualifying 80 PLUS power supply models in December 2010.

- **Inclusion of 80 PLUS in ENERGY STAR Specifications.** MPER #2 reported that in less than two years after the introduction of 80 PLUS, the ENERGY STAR 4.0 standard adopted 80 PLUS as part of its requirement; the EPA has credited NEEA and the 80 PLUS program with having a strong influence on that effort. Subsequently, after the introduction of the 80 PLUS Bronze, Silver, and Gold specifications, ENERGY STAR 5.0 adopted the Bronze level as its new threshold. The widespread acceptance of ENERGY STAR is allowing 80 PLUS to push higher efficiencies, resulting in a growing number of qualifying power supply models.

- **Commercial End-User Awareness of 80 PLUS.** MPER #1 reported that end-user awareness of and requests for 80 PLUS was just developing, and in MPER #2, it was increasing. Navigant's research shows that ENERGY STAR brand is far more recognizable to end-users than 80 PLUS. It is only some of the larger enterprise customers like universities and Fortune 500 companies that are more likely to request 80 PLUS. Overall, OEMs and SIs – not end-users – drive the market for energy efficient power supplies; consequently, OEMs and SIs see a need for enhanced customer education and possibly rebates for customers.

- **Decreasing Incremental Cost.** OEMs indicated that the incremental cost of an 80 PLUS power supply (estimated to be between $7 and $15 depending on the efficiency level) over a non-80 PLUS model was not a significant barrier to adoption, particularly on high-end machines. Interviewed OEMs described several non-energy benefits to 80 PLUS power supplies which help justify the additional cost, such as increased reliability, longer life, and reduced heat, which results in additional energy savings by reducing the need for air conditioning, particularly in data centers. Improving the reliability of the power supply also reduces warranty costs, which is a significant benefit to OEMs.

- **Sales of 80 PLUS PCs.** Power supplies in more than one in three desktop PCs are 80 PLUS certified or of equivalent efficiency. Sales of 80 PLUS certified (or equivalent) power supplies have been increasing over the past two to three years and are outpacing ENERGY STAR qualified desktop PCs and servers. This is because all ENERGY STAR qualified machines have an 80 PLUS certified or equivalent power supply but not all desktop PCs and servers using 80 PLUS certified power supplies are ENERGY STAR qualified. Most market actors expect general trends in 80 PLUS sales to continue.

Market Characterization

The PC market in the United States grew slowly during the 2008 – 2009 recession, but is starting to accelerate as companies upgrade aging stocks. Laptops represent an increasing share of the PC market, and now comprise more than 60 percent of all PC sales, while desktop PC sales remain relatively flat. However, desktops will remain a significant market. Market actors and industry analysts expect that a combination of the U.S. economic recovery, an increase in virtualization, cloud computing, and mobility will drive greater need for servers relative to desktops,

particularly in corporations. Power supply efficiencies continue to increase and tend to be higher for servers than for desktops.

Original equipment manufacturers (OEMs) are the greatest driver of energy-efficient power supplies in the market, strongly influencing both power supply manufacturers (PSMs) and commercial end-users. OEMs drive demand for 80 PLUS power supplies due to their recognition of the superior quality and increased reliability of these power supplies; PSMs manufacture the power supplies specified by OEMs. These PSMs then push system integrators (SIs) to adopt the same energy-efficient models that the PSMs are manufacturing for the OEMs. Commercial end-users have little direct influence on the efficiency of power supplies, and have little familiarity with the 80 PLUS label. However, their desire for the ENERGY STAR brand (which includes an 80 PLUS requirement) does influence OEMs' and SIs' decisions regarding the types of power supplies to include in their computers.

Recommendations

The market research findings discussed previously suggest a variety of new directions and program modifications that NEEA can adopt to further drive market transformation in the market for energy-efficient computer power supplies:

- **Promote 80 PLUS as a minimum standard.** A majority of PCs and servers still do not meet the 80 PLUS specifications. There does not appear to be any compelling reason *not* to use 80 PLUS or equivalent supplies since the incremental cost of achieving 80 percent power supply efficiencies is relatively low and the non-energy benefits appear to more than off-set the costs for many computer makers.

- **Incentives for higher levels of efficiencies.** As 80 PLUS Base becomes the *de facto* standard, the most cost-effective use of incentives is to encourage higher efficiency levels, with 80 PLUS Bronze at a minimum. NEEA may also wish to reconsider the decision to offer incentives only for ENERGY STAR qualified desktop PCs and servers and return to incenting any desktop PCs and servers with 80 PLUS power supplies, because changes in ENERGY STAR rules may lead to a drop in the availability of ENERGY STAR qualified machines.

- **Educate commercial end-users on:**

    - **The non-energy benefits of an 80 PLUS power supply.** NEEA can leverage the finding that end-users are already requesting ENERGY STAR-labeled machines by providing end-users with information and case studies about the non-energy benefits of utilizing an 80 PLUS power supply.

    - **Virtualization.** Although NEEA is not in the business of influencing customers' information technology decisions, the dissemination of information about virtualization's energy and functional benefits could indirectly result in higher average power supply efficiencies in the market by promoting increased (and more efficient) use of servers, which tend to have higher efficiency components including power supplies.

In addition to these program recommendations, Navigant recommends that NEEA update the list of MPIs and the program logic model to better reflect the program's current implementation strategy and goals, which have evolved since the program's inception in 2006.

1. INTRODUCTION

The 80 PLUS program certifies energy-efficient power supplies for desktop PCs and servers. As a sponsor of 80 PLUS, the Northwest Energy Efficiency Alliance (NEEA) provides financial incentives to computer manufacturers for commercial sales of PCs and servers incorporating 80 PLUS certified power supplies within the Northwest region.

The primary purpose of this third MPER is to update the market progress indicators (MPIs) identified in the first two MPERs. A related objective is to update NEEA's understanding of the market for energy-efficient power supplies—specifically, to improve understanding of the trends, status, and dynamics of the market for energy-efficient power supplies in PCs and servers in order to assist NEEA in developing future plans for the 80 PLUS program.

This market research report addresses the following topics:

1. **Market characterization:** recent trends and future outlook in the markets for commercial PCs and energy efficient power supplies;
2. **Market progress assessment:** The degree to which 80 PLUS has transformed the market for energy-efficient power supplies as measured by the MPIs;
3. **NEEA's Alliance Cost-Effectiveness (ACE) model:** an update of the ACE model assumptions based on findings from the market research; and
4. **Market intervention recommendations:** additional activities that can further drive market transformation in PC energy efficiency through increased use of efficient power supplies.

1.1 80 PLUS Program Overview

In 2002, the California Energy Commission, Pacific Gas & Electric Company, and the U.S. Environmental Protection Agency (EPA) commissioned Ecos Consulting and the Electric Power Research Institute to develop a power supply efficiency testing methodology. After this study, Ecos Consulting designed the 80 PLUS program to promote the use of energy-efficient power supplies in desktop PCs and servers. In 2004, NEEA became the first funder of the 80 PLUS program, which certifies energy-efficient power supplies and incents manufacturers to sell 80 PLUS certified power supplies with their desktop PCs and servers within sponsoring regions. Laptops are not covered by the 80 PLUS certification.[1]

The original 80 PLUS specification for desktop PC power supplies required 80 percent efficiency. Over the following years, the program added new certification levels to push the market toward higher efficiencies, labeled as Bronze, Silver, Gold, and Platinum. These additional levels provided manufacturers with further opportunities to differentiate their products in the marketplace. NEEA worked closely with the EPA to incorporate the 80 percent efficient

[1] Energy efficiency has long been a higher priority in laptop design than desktop PC design, as manufacturers have sought to reduce component sizes and heat, and increase battery life as much as possible. Nearly three-quarters of laptops sold in 2009 met the ENERGY STAR 5.0 specification, indicating that the market for energy efficiency in laptops has effectively been transformed (ENERGY STAR 2010).

power supply into the ENERGY STAR standard for desktop PCs. In 2007, the EPA adopted the 80 PLUS standard as part of the ENERGY STAR 4.0 requirements for desktop PCs. The latest ENERGY STAR 5.0 desktop PC specification, which went into effect in July 2009, requires an 80 PLUS Bronze equivalent power supply.

In January 2010, to focus the market on higher levels of efficiency, NEEA phased out incentives for 80 PLUS non-ENERGY STAR desktop PCs and servers, and now the 80 PLUS program offers incentives only for ENERGY STAR qualified desktop PCs and servers sold within the Northwest region.

Table 1 summarizes the minimum efficiencies required for 80 PLUS certification as well as the year the standards took effect and when they were incorporated into the ENERGY STAR requirements (if applicable).

Table 1. Summary of 80 PLUS Efficiency Certification Levels

80 PLUS Level	Minimum Efficiency for Desktops, Workstations, and Non-Redundant Servers	Minimum Efficiency for Redundant Servers	Year Introduced	ENERGY STAR Requirement
Base	80%	N/A	2004	July 2007-July 2009
Bronze	85%	85%	2008	July 2009-present
Silver	88%	89%	2008	N/A
Gold	90%	92%	2008	N/A
Platinum	92%	94%	2010	N/A

Note: Minimum efficiencies vary at different percentages of rated load; for simplicity of comparisons, this table specifies only the minimum efficiency at 50% of rated load.

N/A indicates that the ENERGY STAR requirement is not applicable.

Source: Ecos Plug Load Solutions website

There are several prominent certifications and labels related to energy efficiency in PCs and servers (including power supplies) besides 80 PLUS. Table 2 summarizes these certifications, most notably ENERGY STAR, and their relationship to the 80 PLUS power supply specifications. Each certification, including 80 PLUS, specifies a minimum power supply efficiency. The three non-80 PLUS certifications (ENERGY STAR 5.0, Climate Savers, and EPEAT) each require a minimum efficiency of 85 percent, equivalent to the 80 PLUS Bronze classification.

Table 2. Major Energy Efficiency Certifications for PCs and Servers

	80 PLUS	ENERGY STAR 5.0	Climate Savers Computing Initiative	EPEAT
Products Certified	Power supplies for PCs and servers	Desktops, laptops, small-scale servers, workstations, thin clients, and displays	Desktops, laptops, thin clients, workstations and servers	Desktops, laptops, workstations and displays
Power Supply Efficiency Requirement* (Desktop PCs and servers only)	Five certified levels for desktop, workstation, and non-redundant server applications: – Base (80%) – Bronze (85%) – Silver (88%) – Gold (90%) – Platinum (92%) Four certified levels for redundant server applications: – Bronze (85%) – Silver (89%) – Gold (92%) – Platinum (94%)	Minimum of 85% efficiency (80 PLUS Bronze equivalent).	Minimum of 85% efficiency (80 PLUS Bronze equivalent). Additional tiers of certification for desktops, workstations, and thin clients: – Bronze (85%) – Silver (88%) – Gold (90%) And for volume servers: – Silver (89%) – Gold (92%) – Platinum (94%)	Minimum of 85% efficiency (80 PLUS Bronze equivalent).
Additional Requirements	None	Standby power requirements, power management software. Laptops must meet ENERGY STAR external power adapter standard.	All products must be ENERGY STAR qualified.	All products must be ENERGY STAR qualified. Other requirements involve environmentally sensitive materials selection, product longevity, design for end of life, corporate performance, and packaging.
Sponsoring Organization	Multiple utilities, government agencies, and energy efficiency organizations including NEEA (see Section 4.1)	U.S. Environmental Protection Agency (EPA)	Broad coalition including computer industry companies (e.g., Google, Dell, Intel), utilities (e.g., PG&E), non-profits (e.g., World Wildlife Fund) and government agencies (e.g., ENERGY STAR)	Green Electronics Council (a part of the International Sustainable Development Foundation)
Sources (Technical Specifications Website)	http://www.plugloadsolutions.com/80PlusPowerSupplies.aspx	http://www.energystar.gov/index.cfm?c=computers.pr_crit_computers	http://www.climatesaverscomputing.org/tech-specs	http://www.epeat.net/criteria.aspx

* Minimum efficiencies vary at different percentages of rated load; for simplicity of comparisons, this table specifies only the minimum efficiency at 50% of rated load.

1.2 80 PLUS Program Logic Model

Table 3 presents NEEA's logic model for the 80 PLUS program as presented in MPERs #1 and #2 to reflect NEEA's theory of change in the power supply market. The short- and long-term outcomes presented in the logic model formed the basis of the MPIs, which NEEA has tracked since MPER #1 and for which Section 4 of this report provides an update. See Section 4.8 for a review of progress toward expected outcomes.

Table 3. Program Logic Model from MPER #2

Situation *The context and need that gives rise to an initiative*	**Inputs** *The resources, contributions, & investments made in response to the situation*	**Activities** *What you do with your inputs (lead to outputs)*	**Outputs** *The desired outputs (tools, materials, plans, etc.) from your activities (lead to outcomes)*	**Outcomes** **Short Term** *The results and benefits*	**Outcomes** **Longer Term** *The results and benefits*	**Impact** *Changes in the market resulting from the preceding outcomes*
Barriers: - Desktop computer power supplies are treated as a commodity, differentiated by price instead of performance. - No supply of more efficient power supplies. - No testing protocol to verify power supply efficiency. - Likely cost differential between conventional and efficient power supplies. - Existing ENERGY STAR efficiency standard for power supplies sets a very low bar for industry. - Commercial sector computer purchasers are unaware of power supply energy use. **Opportunities:** - Power supplies that are at least 80% efficient can provide 82 kWh/yr of cost-effective savings. - Participate in a national initiative that can help influence an upgrade to the ENERGY STAR specification for desktop computers.	**Initiative Lead (Ecos Consulting) for** - Project administration - Marketing - Incentive processing and tracking **Budget for:** - Marketing - Incentives - Incentive administration - Evaluation	**Develop and implement marketing plan, including** - General outreach to media outlets serving OEMs, SIs, power supply manufacturers and prospective purchasers - Providing content for manufacturers' communication channels - Developing materials for outreach by regional utilities **Develop and manage national initiative beginning in August 2004, including** - Meet with OEMs and SIs to explain benefits of 80 PLUS - Recruit power supply manufacturers - Develop a test protocol for power supplies - Test and certify power supplies - Receive and pay invoices of participating computer manufacturers - Secure participation of at least one other utility or energy organizations in the initiative - Update information on the initiative website - Share production and sales data with EPA **Evaluate progress of initiative**	**Marketing** - Marketing plan - Website is active - Marketing collateral developed for manufacturers, purchasers and utilities **Initiative** - Power supply testing protocols are developed - $5 incentive is offered to help bridge price differential between conventional and 80 PLUS power supplies - At least two OEMs and SIs contacted to participate in initiative - Power supply manufacturers submit units for testing and approval - At least one additional potential initiative sponsor contacted - At least one power supply manufacturer contacted **ENERGY STAR** - Participate in public process for developing revised specification - Assess need for any additional support once specification goes into effect **Evaluation** - RFP for evaluation contractor - Select contractor - Conduct MPERs	**Marketing** - Marketing materials generate inquiries from: - Power supply manufacturers - OEMs and SIs - Electric utilities - Large consumers ***(awareness)*** - Website usage increases over time ***(awareness)*** **Initiative Management** - Contractor posts and maintains power supply testing protocol on website - Contractor reimburses OEMs and SIs $5 for each qualifying PC sold in NW ($10 for each desktop server) **Response from computer industry:** - At least one major desktop PC OEM participates ***(availability)*** - At least one more power supply manufacturer offers and supplies qualifying product ***(availability)*** - OEMs and SIs deliver sales of at least 70,000 qualifying units before end of 2005 ***(market share/penetration)*** - Participating OEMs and SIs receive $5 incentive ($10 for desktop servers) for each qualifying unit sold in NW - Buy-down spurs OEM and SI sales of qualifying PCs **Support from other interested parties:** - At least one other major utility or energy efficiency organization provides greater than $1 million in support ***(availability)*** **ENERGY STAR** - EPA includes at least an optional power supply in its proposed revision to ENERGY STAR for computers by early 2005 ***(awareness)*** EPA finalizes the revised standard, to take effect in early 2006 ***(market share/penetration)***	- 75% or higher market share of 80 PLUS equipped PCs by 2010 - Industry will continue to embrace ENERGY STAR as a significant marketing advantage	- All PCs meet ENERGY STAR specification - NEEA and/or utility support not needed

OEM: Original equipment manufacturer (PCs); SI: systems integrator; PSM: power supply manufacturer

1.3 Terminology Used in the Report

There is a wide variety of terminology used in the computer industry. This report divides the products most relevant to this research into three broad classes: desktop PCs, laptops, and servers. For the purposes of this report, Navigant has adopted the following terms:

- **Desktop PCs** include any category of personal computer that is not portable. One subset of desktop PCs are **workstations**, which are powerful, high-end performance computers used primarily for technical or scientific applications. Both desktop PCs and workstations typically use the type of internal power supply that is applicable to the 80 PLUS program.

- **Laptops** include any category of personal computer that is portable and uses a traditional PC operating system, including notebooks, mini-notebooks, and netbooks. Some industry analysts include tablet computers in the laptop category, but Navigant refers to tablets separately (see definition below). Laptops primarily use external power supplies, which are not included in the 80 PLUS certification program.

    - **Notebooks** (also commonly referred to as laptops) are traditional laptop PCs that are powerful enough for most computing needs; **mini-notebooks** are smaller computers that retain all or nearly all the computing power of their full-sized equivalents.

    - **Netbooks** are small notebook computers designed primarily to access the internet; they typically run the Windows operating system, but do not have the computing power of a notebook necessary for running complex applications.

- **Servers**, in the hardware context, are powerful computers that link other computers or devices together to form a network. Common applications for servers in a business context are mail servers, file servers, database servers, and print servers.

Navigant refers to two other classes of computing products in the report, but these are not a primary focus of the research:

- **Tablets** are designed primarily for accessing the internet and other forms of media. They are similar to netbooks, but typically use a mobile operating system more akin to a smartphone than a traditional PC, although these mobile operating systems are becoming more advanced. Tablets usually have a touchscreen and no keyboard, and they often can charge via a power adapter or through a USB port on a computer. Some industry analysts consider tablets to be part of the laptop category, but for the purposes of this report, they are not included.

- **Thin clients** are the user interfaces for a virtualized PC in which all of the computing power, applications, and user data reside on a remote server, and the machine on the desk in front of the user is simply a display and input device. Thin clients can be either portable or stationary; also, some manufacturers use tablet computers as thin clients.

2. EVALUATION ACTIVITIES

The evaluation activities conducted for this third MPER included both primary and secondary research that provided a greater understanding of the 80 PLUS program and an update of the MPIs. Discussions with NEEA staff subsequent to the initial statement of work focused the research primarily on the *commercial* market for desktop PCs, laptop and servers. Evaluation activities began with secondary research on the commercial desktop PC and laptop markets. Navigant then conducted a review of program literature, including the ACE model, the logic model, and past MPERs for the 80 PLUS program. The team also contacted NEEA program staff and program implementers at Ecos Consulting for additional background on the program. The principal research activity consisted of interviews with relevant market actors including computer manufacturers (original equipment manufacturers, or OEMs), system integrators (SIs), power supply manufacturers (PSMs), and commercial end-users.

Table 4 summarizes the evaluation activities that have been conducted for the 80 PLUS program in the past two MPERs as well as in the current research effort summarized in this report.

Table 4. Overview of Historical Evaluation Activities

Evaluation Activity	MPER #1	MPER #2	MPER #3 (Current Research)
Secondary Research on PC and Server Market	✓	✓	✓
Review of Program Logic Model	✓	✓	✓
Review of Program ACE Model Assumptions	✓	✓	✓
Interviews with NEEA and 80 PLUS Program Staff	✓	✓	✓
Interviews with OEMs (participating & non-participating)	✓	✓	✓
Interviews with SIs (participating & non-participating)	✓	✓	✓
Interviews with PSMs (participating & non-participating)	✓	✓	✓
Interviews with Commercial End-Users		✓	✓
Interviews with EPA Staff	✓	✓	
Interviews with Program Sponsors (other than NEEA)	✓		

The following sections provide details on the evaluation activities undertaken by Navigant to meet NEEA's objectives.

2.1 Secondary Research

Navigant documented the evolution of the 80 PLUS program and the PC and server markets in general. The research focused on recent and anticipated trends in the PC market, with particular attention paid to corporate information technology (IT) trends and the emergence of the laptop as the dominant type of PC. Sources included:

- Industry analyst reports (e.g., Gartner, IDC, Forrester Research)
- Business news sources (e.g., *Forbes*, *Bloomberg Businessweek*)
- PC industry publications and websites (e.g., *PC World*, *CNET*, *Macworld*)
- Ecos Plug Load Solutions (80 PLUS) website

- ENERGY STAR website

NEEA received a memorandum containing key findings on September 2, 2010 (included in Appendix D). The secondary research also informed the development of the interview guides and provided a useful reality check on interviewees' responses. Navigant conducted additional secondary research after submission of the memo to obtain the most up-to-date sales estimates after the major industry analysts (e.g., Gartner) released their third quarter 2010 reports.

2.2 Reviews of Program Literature, including ACE and Logic Models

Navigant reviewed 80 PLUS program literature with the intent of understanding the assumptions of the program's cost-effectiveness calculations and identifying critical market and program progress indicators to update through the market actor interviews. The reviewed documents included:

- Prior evaluations of 80 PLUS programs, including the two previous MPERs completed for NEEA[2] as well as an evaluation for Southern California Edison
- NEEA's ACE model
- The 80 PLUS program logic model presented as an appendix to MPER #2

Navigant highlighted key outcomes in a memo to NEEA on October 4, 2010 (attached in Appendix E).

2.3 Interviews with Program Stakeholders and Implementers

Navigant interviewed two 80 PLUS staff members, Ryan Rasmussen (Program Manager) and Jason Boehlke (Channel Manager) of Ecos Consulting, to better understand the mechanics of the 80 PLUS program and to obtain contact information for select computer OEMs, SIs, and PSMs.

Navigant also conducted an interview with Andy Ekman, former program manager of NEEA's 80 PLUS initiative, to gain a better understanding of NEEA's involvement with the 80 PLUS program. Both interviews provided valuable insights into the development of the interview guides for computer OEMs, SIs, PSMs, and commercial end-users.

2.4 Market Actor Interviews

The four primary market actors interviewed by Navigant are as follows:

- ***Computer Original Equipment Manufacturers (OEMs):*** These companies manufacture computers and/or servers in high volume, and include popular brands such as Dell, Hewlett Packard (HP), Apple, and Lenovo.
- ***System Integrators (SIs):*** These companies purchase components from other manufacturers and assemble computers, typically for commercial applications. The IT

[2] Note that for brevity's sake throughout this report, the previous MPERs are referred to as ―MPER #1" and ―MPER #2." See the bibliography under ―Quantec" for full citations of the two reports.

industry interchangeably refers to SIs as computer manufacturers, although they normally do not manufacture their own component parts.

- ***Power Supply Manufacturers (PSMs):*** These companies manufacture the power supplies for personal computers, servers, and other electronic equipment. The manufacturing facilities are typically based in Asia with U.S. sales and distribution offices.
- ***Commercial End-Users:*** These are customers who purchase computer products for commercial purposes.

The nuance between SIs and computer OEMs is subtle, and at least one system integrator reported that they no longer manufacture ―white boxes" (PCs built from scratch with an unbranded ―shell" and components from different manufacturers) and had changed their business model to be an OEM reseller. For the sample of OEMs, the research excluded from consideration any OEM, such as Toshiba, that did not produce commercial desktop computers.

2.4.1 Sample Design

Secondary research and discussions with NEEA and Ecos Consulting staff helped to define the universe of market actors from which researchers selected interviewees (Table 5). The 80 PLUS website identified participating computer OEMs, SIs, and PSMs. Navigant identified large commercial end-users through the web site www.jobbankusa.com, which lists the largest employers by state for the states of Washington, Oregon, Montana and Idaho.

Table 5. Sample Design Summary

	OEMs	SIs	PSMs	Commercial End-users
Goal for Completes (n)	5	8	8	10
Targeted Job Title/ Role	Product, Power , Compliance Manager	VP, GM, Project Manager	Owner, US Sales Rep, Engineer	CTO, IT Manager
Sample Frame/ Source	Ecos contacts, list of computer OEMs from www.findouter.com website	Ecos contacts, list of participating companies from 80 PLUS website	Ecos contacts, list of participating companies from 80 PLUS website	List of large NW companies from www.jobbankusa.com website
Ecos-provided contacts	Dell, HP, Lenovo, Apple	CTL, Equus, Nor-tech	Delta, Liteon, Acbel, Chicony Power, FSP, Sea Sonic	None

Source: Navigant

Note: NEEA and Navigant established the initial goal of 10 commercial end-users based on the assumption that NEEA would be able to provide end-user contacts appropriate for an unbiased sample.

2.4.2 Survey Design

Navigant commissioned National Research Center, Inc. (NRC) to consult on interview guide design and best practices in market research interviews, particularly with regard to contacting non-participants and eliciting useful information from interviewees. In order to account for the potential language barriers associated with PSMs based mainly in China, Navigant specifically designed the PSM interview guide with few open-ended questions and carefully phrased

questions to reduce potential confusion for non-native English speakers. Ultimately, Navigant administered an online survey among the PSMs.

The following table illustrates NEEA's key information needs by anticipated data source, as specified in the original statement of work. Navigant used this table in the development of interview guides for the three groups of key market actors: OEMs and SIs, PSMs, and commercial end-users. See Appendix B for interview guides.

Table 6. Information Needs by Source

Information Needs/Questions	Anticipated Sources of Information				
	Secondary Sources	Interviews with OEMs	Interviews with SI's	Interviews with PSMss	Interviews with commercial end-users
Current commercial market size for 80 PLUS, ENERGY STAR, and non-80 PLUS desktops and servers	x	x	x	x	
Sales trends regionally and nationally for 80 PLUS and ENERGY STAR	x	x	x	x	
Impact of the economy on sales of PCs and laptops over past 2-3 years	x	x	x	x	x
Sales trends regionally and nationally for PCs vs. laptops	x	x	x	x	
Trends in manufacturing of power supplies	x			x	
Anticipated sales of PCs and laptops in next 1-2 years	x	x	x	x	x
Number of units of ENERGY STAR 5.0 sold where incentives are not claimed		x	x		
Cost to manufacture an ENERGY STAR 5.0 PC vs. 80 PLUS vs. standard PC		x	x	x	
Factors influencing purchase decisions for PCs vs. laptops		x	x		x

Source: NEEA

2.4.3 Survey Methodology

Navigant employed several strategies to interview market actors. Interviewers made introductory phone calls and sent emails to introduce the objectives of the call to potential computer OEM, SI, and commercial end-user interviewees. The team called all contacts a minimum of five times and left a minimum of three voicemails, if needed.

Researchers utilized an online survey tool to administer the survey to participating PSMs, partially due to the anticipated language barrier. The success of this approach led the team to

develop an online version of the interview guide for participating SIs who proved difficult to contact via phone.

The commercial end-user group also proved to be difficult to contact, perhaps due to the fact that these end-users by definition are non-participants in the 80 PLUS program and, based on the OEM and end-user interviews completed, do not view themselves as program stakeholders. Additionally, the high stature of the individuals targeted for interviews (e.g., Chief Technology Officers, Information Technology Managers, etc.) make them relatively difficult to reach with a cold call.

Three major employers in the Pacific Northwest participated in interviews. After exhaustive attempts to secure additional end-user interviews, Navigant relied on OEMs and SIs' perspectives to complete the assessment of commercial end-users' 80 PLUS awareness and purchasing preferences.[3]

A total of 21 market actor interviews contributed to the research findings, as summarized in Table 7. The five OEMs accounted for more than 60 percent of PC sales in the United States during the first three quarters of 2010, based on data from Gartner (2010) and on Navigant's conservative assumptions of the market share of smaller OEMs for which Gartner did not report data.

Table 7. Final Sample Disposition

Market Actor Group	Goal for Completed Interviews/Surveys (n)	Completed Interviews/ Surveys (n)
OEMs	5	5
SIs	8	5
PSMs	8	8
Commercial End-Users	10	3

[3] Prior to the commencement of the research, both NEEA and Navigant anticipated that OEM and PSM interviews would provide the most useful data for the analysis. Interview findings confirmed this belief, as OEMs indicated that they, not commercial end-users, drove decision-making regarding the use of efficient power supplies. Among the three commercial end-users interviewed, none had any familiarity with 80 PLUS.

3. MARKET CHARACTERIZATION

This section presents specific findings characterizing the markets for PC, servers, and efficient power supplies, organized as follows:

- Section 3.1: PC and Server Markets
- Section 3.2: Energy-Efficient Power Supply Market

Both secondary and primary research contributed to Navigant's understanding of each topic area. The secondary research was the primary source for characterization of the overall PC and server markets, and the primary research provided the majority of data and insights on energy-efficient power supplies.

The findings presented in this section address specific information needs identified in NEEA's statement of work, including:

- Current commercial market size for desktops and servers, including ENERGY STAR, 80 PLUS, and non-80 PLUS models;
- Impact of the economy on sales of PCs and laptops over past two to three years;
- Sales trends regionally and nationally for PCs vs. laptops;
- Anticipated sales of PCs and laptops in next one to two years;
- Factors influencing purchase decisions for PCs vs. laptops.

Section 4 of this report presents findings related to the MPIs.

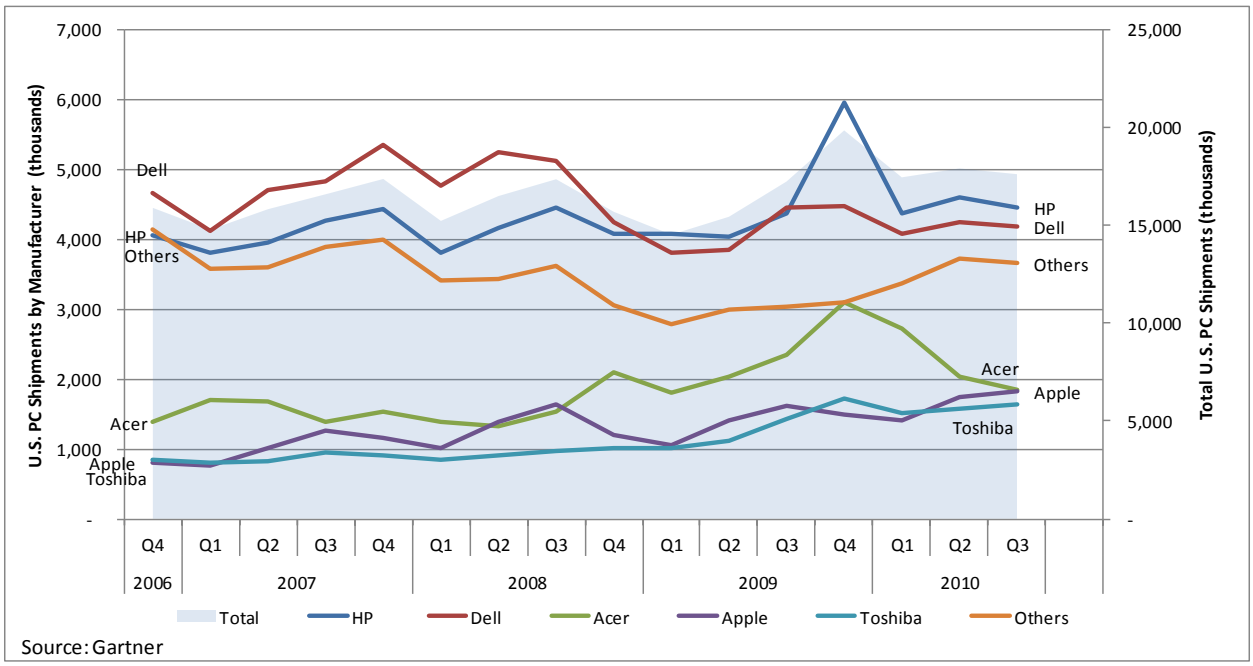
3.1 PC and Server Markets

This investigation of the markets for PCs, including both desktops and laptops, and servers in the United States is distinct from the discussion of efficient power supplies that follows in Section 3.2. The ―PC market" refers to sales of computers and servers themselves, whereas the market for efficient power supplies refers to the adoption of power supplies exhibiting efficiencies that meet or exceed the 80 PLUS standard. When supporting assertions about trends in *PC sales*, this report references data on *PC shipments* since shipment data are more readily available and represent a reasonable proxy for sales.

3.1.1 Overall U.S. PC Market Trends

The U.S. PC market has recovered from the lows experienced in late 2008 and early 2009, but growth is relatively slow. In fact, Gartner's most recent estimates of U.S. PC shipments show year-over-year growth of just 2.2 percent for the third quarter (Gartner 2010), while IDC's estimates show a slightly higher 3.8 percent year-over-year growth for the same time period. (IDC 2010) As demonstrated in Figure 1, the major OEMs have jockeyed for market share position in the past two years, with HP emerging with a narrow lead over Dell, Acer gaining and then losing significant market share, and Apple and Toshiba gaining steadily on the top three manufacturers.

Figure 1. U.S. PC Shipments, 4th Quarter 2006 through 3rd Quarter 2010



Calendar years 2008 and 2009 brought two years of reduced IT spending due to economic uncertainties, with one OEM noting that many companies have been trying to extend the lifespan of their PC hardware by several years: ―Corporations have gone from three year churn to a four-to-five year churn." But the corporate PC refresh cycle (companies updating stocks of PCs) may now be underway. One driver of the refresh cycle is the recent release of the Windows 7 operating system (Trefis Team 2010). According to Microsoft (as reported by Trefis Team), corporate PC sales grew 16 percent in the third quarter of 2010, compared to the same quarter the previous year. Further evidence that the corporate PC refresh cycle is underway in earnest is the major increase in sales that Lenovo experienced at the end of 2010, with a 69 percent improvement in unit sales from October to November; a major portion of Lenovo's PC product mix is the expensive, business-focused ThinkPad series (McIntyre 2010).

Apple is also gaining PC market share, with the popularity of iPods, iPhones, and iPads creating a ―halo effect" around the Apple brand, leading to increased sales of Mac computers. Apple achieved a 10.6 percent share of the U.S. PC market in third quarter 2010, propelling it to become the third largest PC manufacturer in the U.S (IDC 2010). The average price of a Mac laptop has also dropped over the past three years, and the Trefis Team expects this downward trend to continue (Trefis Team 2010). IDC's estimate of Apple's year-over-year growth in the third quarter of 2010 is 24.1 percent in the U.S. market, compared to 3.8 percent overall PC sales growth (IDC 2010). Not only is Apple gaining overall market share, but it is seeing significant gains in desktop PC market share with a 70 percent year-over-year increase in desktop PC sales from the first quarter of 2009 to the first quarter of 2010 (Foresman 2010). This may be partially due to Apple gaining more acceptance in the corporate world; a recent survey of enterprise IT professionals found that Apple's share of enterprise systems is expected to grow from 3.3 percent of all systems in 2009 to 5.2 percent by 2011, an increase of 57 percent in two years (Chartier 2010).

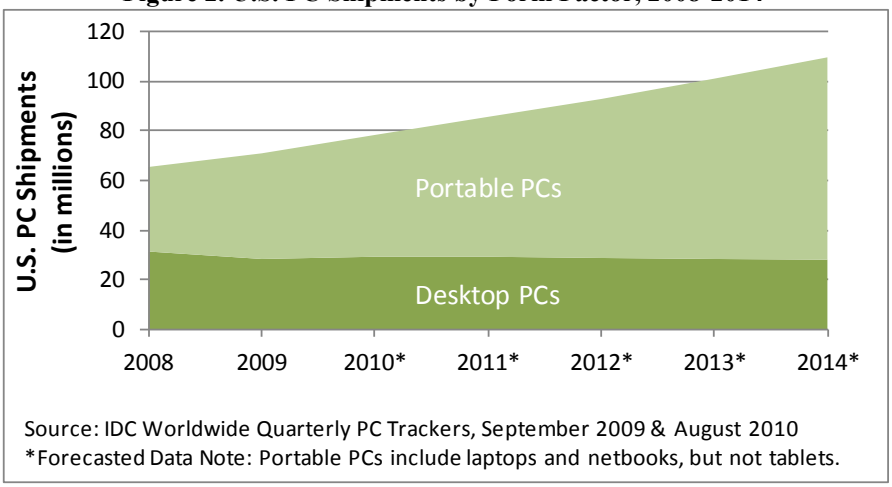
Worldwide, PC sales are growing more rapidly than in the United States, but not as briskly as previously projected. Gartner forecasts worldwide PC shipments to reach 352.4 million units in 2010, a 14.3 percent increase over 2009. The emerging markets, and not the US, are driving the majority of this growth. Gartner further expects that worldwide PC shipments in 2011 will reach 409 million units, a 15.9 percent increase over 2010. Both of these estimates are lower than Gartner's previous estimates of 17.9 percent growth in 2010 and 18.1 percent growth in 2011, due to expectations of weakened consumer demand attributed in part to growing interest in tablets such as the Apple iPad (Gartner 2010).

Finding #1**:** *The PC market in the United States grew slowly due to the 2008-9 recession, but is starting to accelerate as companies upgrade aging stocks.*

3.1.2 Sales Trends for Desktop PCs Compared to Laptops

Desktop PC sales have remained relatively flat, even as desktops' market share has declined steadily in recent years. The driver of this decline in market share is the steady growth in sales of laptops and other portable PCs since third quarter of 2008 (IDC 2010). Figure 2 illustrates the past and forecasted U.S. sales trends for desktop PCs and portable PCs through 2014. The data shows a slight increase in desktop PC sales from 2009 to 2010 (consistent with reports from interviewed OEMs) followed by minor decline in desktop PCs and significant growth in laptop and netbook[4] sales from 2011 through 2104 (IDC 2010).

Figure 2. U.S. PC Shipments by Form Factor, 2008-2014



Despite the current and projected dominance of laptops over PCs, recent trends suggest an uncertain market ahead. In particular:

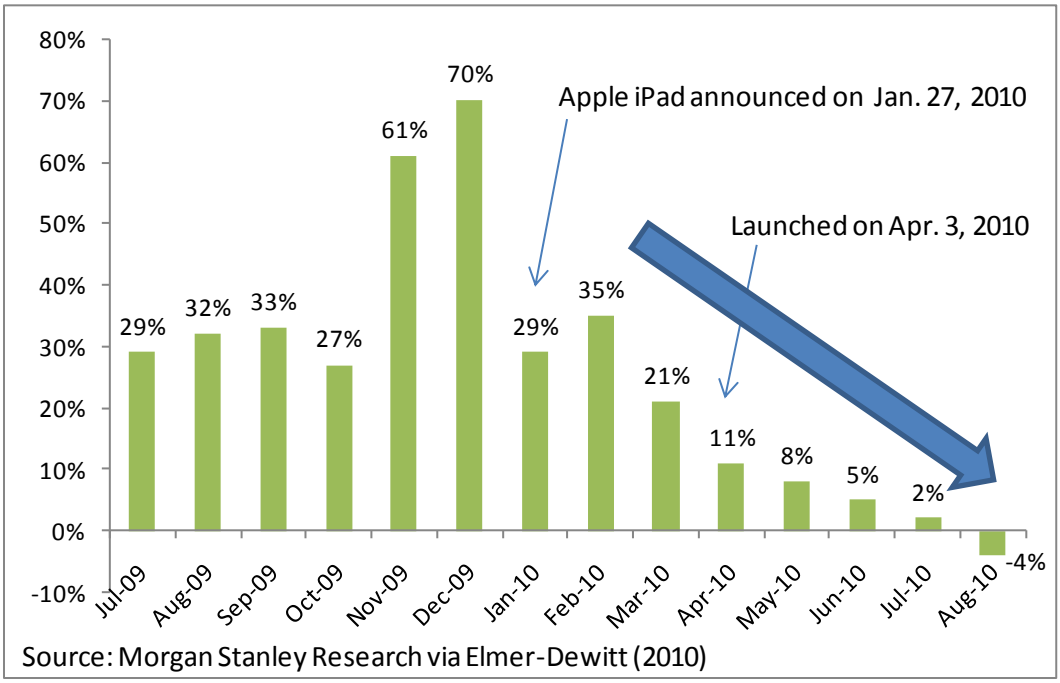
- **Major manufacturers report a recent increase in desktop PC sales.** Three of the interviewed OEMs and three of the interviewed SIs have actually observed growth in their desktop PC sales in recent quarters, most likely due to the corporate PC refresh cycle noted above as well as consumer preferences for the relatively lower priced

[4] Note that IDC does not currently include tablet computers in its forecasts for portable PC sales, although other analyst firms are starting to include them in similar estimates.

desktops during an economic decline.[5] One interviewee described seeing ―a spike in desktop sales" with relative price cited as a possible driver. This is likely a short-term trend due to lingering effects of the economic recession.

- **U.S. laptop PC sales growth has slowed in 2010.** According to Morgan Stanley research (as reported by Elmer-DeWitt), growth in U.S. sales of laptop PCs slowed significantly in 2010, and sales actually declined in August 2010 in a year-over-year comparison. Industry analysts, most notably Elmer-Dewitt (2010) attributed this decline partially to the introduction of the Apple iPad on April 3, 2010 and pending releases of similar tablet computers (e.g., new models recently announced by Samsung, Dell, and others), as people are unlikely to purchase both a tablet and a laptop computer in the same month. Elmer-Dewitt referred to this effect as ―tablet cannibalization." The decline in laptop sales growth can be observed in Figure 3, which notes that laptop sales growth began declining prior to the release of the iPad.

Figure 3. U.S. Retail Laptop Year-over-Year Unit Growth, July 2009-August 2010



Finding #2: *Sales of portable PCs are outpacing desktops, but desktops will remain a significant market.*

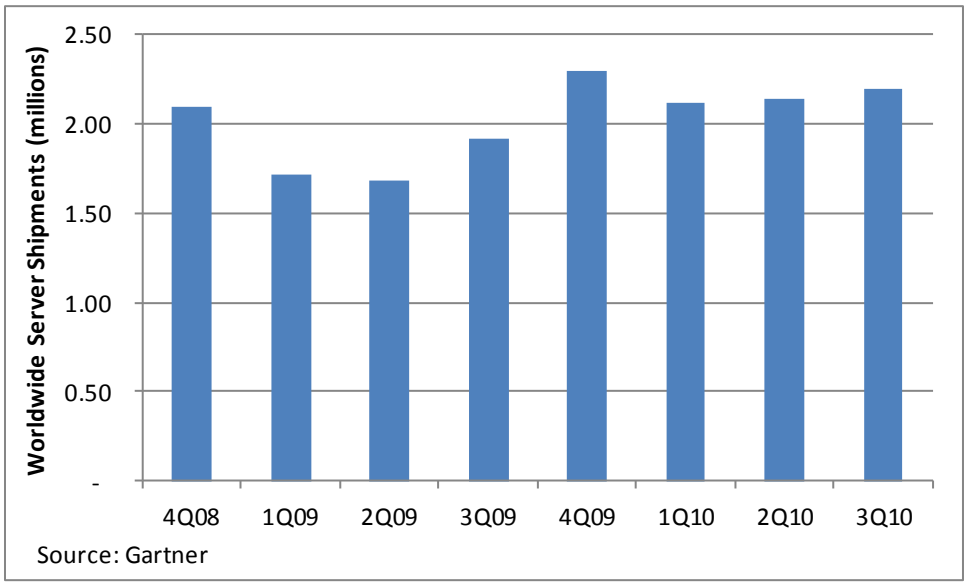
3.1.3 Server Sales Trends

Worldwide sales of servers are up significantly in 2010 over 2009 in year-over-year comparisons (Figure 4). Although unit sales figures are not available specifically for the U.S., Gartner attributes much of the growth to increased U.S. sales, and the interviewed OEMs indicated that their companies are seeing significant growth in U.S. server sales. During the economic

[5] See Appendix C-1 for full responses to the OEM/SI interview questions.

downturn, corporations delayed major IT infrastructure investments, and due to pent-up demand, as soon as the economic recovery began, U.S. server shipments increased dramatically. The trend toward desktop virtualization and cloud computing is also driving server sales, due to increased processing needs (Kovar 2010).

Figure 4. Worldwide Server Shipments, Q4 2008 through Q3 2010



Finding #3: *The U.S. economic recovery is driving increased server sales.*

3.1.4 Future Trends Expected to Impact PC Market

The major trends expected to influence the U.S. PC market in the next few years include virtualization, cloud services, and mobile computing. These concepts, defined below, could result in servers representing a greater share of the computer market in the coming years as well as a decline in the use of traditional desktop PCs in favor of laptops, tablets, and thin clients.

Virtualization is the concept that a person would not use an actual, physical computer but rather a keyboard and display that links through the internet or a network to a centralized processor. One OEM interviewed by Navigant plainly stated, ―Virtualization will kill the desktop as we know it." In other words, in the future as envisioned by this OEM, individuals will no longer have powerful computers sitting on their desks; rather, they will use a stripped-down display and input device (referred to as a ―thin client") as a window into a virtual computer that is likely located in an off-site data center. One physical server can host many virtual computers, and one physical server can actually host multiple virtual servers—for example, servers running different operating systems.

Cloud computing is closely connected to virtualization. The National Institute of Standards and Technology defines cloud computing as follows:

> *Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage,*

> *applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.* (Mell and Grance 2009).

Cloud computing is a service model, whereas virtualization is a technology. Virtualization enhances cloud computing, but the two can exist independently. One basic example of cloud computing is Google Docs, in which a web-based service provides a capability which would normally be fulfilled by software hosted on an individual's computer (*e.g.,* word processing or spreadsheet analysis). Many of the interviewed market actors and industry experts cited in this report foresee much more advanced deployments of cloud computing, in which individuals can perform complex tasks relying solely on the computing resources of "the cloud", not their physical machine.

Mobility is another broad trend which virtualization and cloud computing may enhance. Mobility is the consumers' expectation of being able to do what they want to do, when and where they want to do it. In part, this expectation may derive from the rapid proliferation of smartphones and their evolving capabilities, in which an iPhone or Android device functions more like a computer than a phone. U.S. consumers are growing accustomed to having their phones perform basic computing tasks and act as a gateway to their networks and the internet, wherever they are currently located.

Tablet computers fill a gap between the smartphone and the laptop computer, combining extreme mobility and a much larger display than a smartphone with adequate computing power for most needs. Observations about the market for tablets, and especially Apple's role in the emergence of this market, including the following:

- The market response to the introduction of the iPad has surprised many industry analysts, particularly with regard to the quick adoption of the iPad by executives and salespeople in the corporate world. In November 2010, Gartner lowered its 2011 forecast of traditional PCs (desktops and laptop PCs) sold worldwide specifically because of the introduction of the tablet, estimating that up to 10 percent of PC sales could be displaced by tablets by 2014. Apple has already achieved more than 95 percent of the tablet market within six months of releasing the iPad (Electronista 2010).

- A December 2010 survey of IT buyers found that 14 percent of corporate IT buyers intend to buy tablets in the first quarter 2011, and four out of five of those buyers intend to buy the iPad. Although only seven percent of corporations currently provide their employees with tablet computers, that number rose one percent in the four months since an August 2010 survey. (Dalrymple 2010)

- Apple will soon be facing competition in the tablet market, particularly in the corporate world. Other manufacturers see an opportunity for tablet computers combined with virtualization, cloud computing, and a desktop docking station to eliminate the need for separate computers, desk phones, mobile phones, and presentation devices for employees. Cisco recently announced an Android-powered tablet computer called the Cius which will fill all those needs for under $1000 and which could significantly disrupt the status quo in corporate IT purchasing. A significant shift toward virtualization and cloud computing would likely drive increased investment in servers and data centers. Desktop PCs would be obsolete for corporations making use of virtualization (Greenberg 2010).

There are a number of benefits to the use of tablets or thin clients combined with virtualization that are attractive to corporations. Employees working on thin clients have significantly less downtime due to PC failures because thin clients are solid state and thus have no spinning disks (fewer moving parts), and since all user data is stored on the server, no data is lost if the thin client does fail. IT staff can focus their efforts on maintaining the servers rather than troubleshooting individual PCs; this can result in an estimated 40 percent reduction in IT labor costs. Virtualization also has significant energy impacts: thin clients use 88 percent less energy than desktop PCs (Wenzel 2010).

Finding #4: *Market actors and industry analysts expect that virtualization, cloud computing, and mobility will drive greater need for servers relative to desktops, particularly in corporations.*

3.2 Energy-Efficient Power Supply Market

This section provides a brief overview of the energy-efficient power supply market with a focus on market dynamics between the major market actor groups (OEMs, SIs, PSMs, end users, NEEA, and ENERGY STAR). The findings include a characterization of OEMs' relative contribution to the overall market for 80 PLUS or equivalent power supplies. (Section 4: Market Progress Assessment provides analysis of the evolution of the energy-efficient power supply market through comparisons of MPIs over time.)

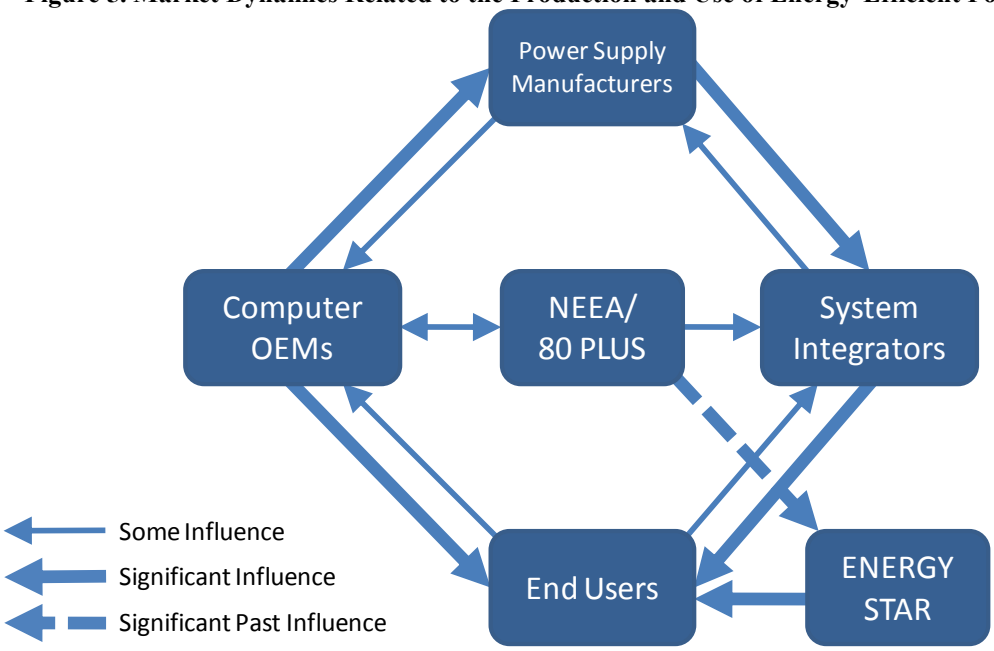
3.2.1 Energy-Efficient Power Supply Market Dynamics

The market for computer power supplies is comprised primarily of three sets of players: 1) PSMs, 2) computer makers, including OEMs and SIs, and 3) end-users. Figure 5 illustrates the major market dynamics of the market for energy-efficient power supplies as observed through Navigant's interviews and secondary research. The arrows denote the direction of market influences between the actors, and the thickness of the arrows represents the relative strength of that influence on the types of power supplies produced or used.

Navigant found that OEMs are the greatest driver of energy-efficient power supplies in the market, strongly influencing both PSMs and commercial end-users. SIs have a similar amount of influence on the commercial end-users that they serve, but SIs serve a relatively small share of the market and thus influence PSMs to a lesser degree than do OEMs. NEEA has an influence on OEMs and SIs due to the incentives provided for meeting 80 PLUS specifications. 80 PLUS works collaboratively with the OEMs to develop the technical specifications and consequently OEMs do influence the evolution of the program.

As illustrated in the diagram, end-users have little, if any, direct influence on the efficiency of power supplies. Commercial end-users do not appear to be familiar with the 80 PLUS label, although their desire for the ENERGY STAR brand (which includes an 80 PLUS requirement) does influence OEM and SI decisions regarding the types of power supplies to include in their computers. Note that the diagram displays influences on *decision-making* related to the manufacture and use of energy-efficient power supplies, not all possible interactions within a complex market. The absence of an arrow between NEEA/80 PLUS and PSMs indicates that the program does not directly influence PSMs in their choice of power supply efficiency; however, the program does interact with the PSMs by providing them with the 80 PLUS technical specifications and testing protocols.

Figure 5. Market Dynamics Related to the Production and Use of Energy-Efficient Power Supplies[6]



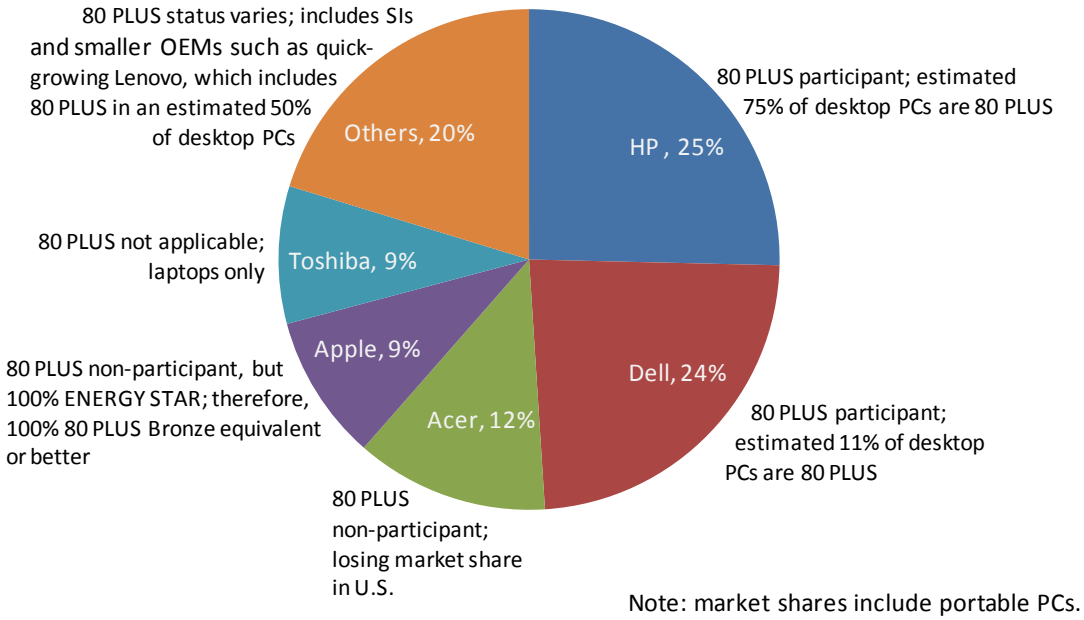
Source: Navigant.

3.2.2 Major OEMs' Use of Energy-Efficient Power Supplies

The following figure displays the major computer OEMs' share of the U.S. PC market in 2010 and their use of 80 PLUS (or equivalent) power supplies. This graphic illustrates the OEMs' commitment to energy-efficient power supplies in the context of their ability to impact the overall market. HP is a major market player, with a 25 percent share of the PC market and with an estimated 75 percent of HP's sales of desktop PC sales qualifying for 80 PLUS; thus, HP contributes significantly to the overall market share of 80 PLUS equivalent power supplies. Apple is a relatively small player, accounting for only nine percent of PCs sold; however, all of the company's PCs include an 80 PLUS Bronze equivalent power supply, so Apple also contributes greatly to the rise of 80 PLUS. Conversely, Dell sold nearly one quarter of the PCs sold in the U.S. in the first three quarters of 2010, but only 11 percent of the company's desktops included 80 PLUS power supplies, so they drive less of the 80 PLUS market activity than smaller Apple.

[6] Note that for purposes of simplicity, the inclusion of ENERGY STAR in this graphic was limited to its interactions with end users and the NEEA/80 PLUS program; this is not to imply that ENERGY STAR does not have interactions with other market actors, but those relationships were not a focus of this research.

Figure 6. U.S. PC Market Share for Major Manufacturers, with 80 PLUS Status, First through Third Quarters of 2010



Sources: Gartner 2010 (market share), Navigant OEM and program staff interviews (80 PLUS status)

3.3 Summary of Market Characterization Findings

The PC market in the United States continues to expand, despite a slowdown in growth during the recession in 2008 and 2009. Laptops represent an increasing share of the PC market, and now comprise more than 60 percent of all PC sales, while desktop PC sales remain relatively flat. In the long-term, trends toward virtualization, cloud computing, and mobility are expected to further increase the overall energy efficiency of commercial computing in the U.S. as thin clients and laptops are more energy-efficient than desktop PCs; these trends may also drive increased use of servers, which will account for a bigger portion of the potential energy savings for programs such as 80 PLUS going forward.

As part of its statement of work for this market research, NEEA requested that the research address specific areas of interest regarding commercial PC market size, sales trends, and other related market characterization topics. Table 8 provides a summary of findings for these key research topics related to market characterization. Analysis of additional topics requested by NEEA appear in Section 4.

Table 8. Summary of Key Information Needs/Research Questions Related to Market Characterization

Information Needs/Questions	High Level Findings
Current commercial market size for 80 PLUS, ENERGY STAR, and non-80 PLUS desktops and servers	The U.S. commercial desktop PC market, measured in 2009 sales, is approximately 17 million units. The total U.S. market for desktop PCs was approximately 28 million units, but commercial sales account for approximately 60 percent of the major OEMs' total PC sales, and that percentage may be higher for desktop PCs specifically. Data on server sales is more difficult to obtain as manufacturer sales are reported worldwide, not for the U.S. specifically.
Impact of the economy on sales of PCs and laptops over past 2-3 years	Although there were some quarters of declining sales in late 2008 and early 2009, the economic downturn mainly had the effect of slowing *growth* in the PC market over the past 2-3 years. Corporations did try to extend the life of their existing PCs and servers but corporate IT investment has rebounded in 2010.
Sales trends regionally and nationally for PCs vs. laptops	Desktop PCs will likely remain a sizeable market of approximately 25-27 million units sold in the U.S. per year, with a slight decrease in sales forecasted through 2014. Laptop sales have increased dramatically in recent years, a trend expected to continue.
Anticipated sales of PCs and laptops in next 1-2 years	Total U.S. PC sales projections are for approximately 90 million units in 2011 and 101 million units in 2012. Desktop PCs will account for roughly 29 percent and 26 percent of those sales, respectively.

Source: Navigant research and analysis

4. MARKET PROGRESS ASSESSMENT

The market progress assessment provides analysis of the evolution of the energy-efficient power supply market through comparisons of MPIs over time. This analysis is based on a combination of secondary and primary research conducted by Navigant, including interviews with major market actors (OEMs, SIs, PSMs, and commercial end-users). Secondary sources are cited within this section and in the bibliography in Appendix A, and the full results of all primary research can be found in Appendix C.

Navigant concludes that the 80 PLUS program has made strong progress in transforming the market for energy-efficient power supplies at the 80 PLUS Base (or equivalent) level. 80 PLUS has engaged the largest OEMs that produce commercial desktop PCs and certified over 2,800 models of power supplies that OEMs can choose from when specifying desktop PCs and servers. More than 200 PSMs have certified 80 PLUS power supplies, and increased PSM competition has reduced incremental costs.

The market share of 80 PLUS was 0 percent in 2005 (since there were no certified 80 PLUS models sold prior to 2005), growing to at least 11 percent in 2008 (based on ENERGY STAR market share). It now stands at an estimated 37 percent of desktop PCs (including 80 PLUS or equivalent power supplies) sold in the U.S. in the first three quarters of 2010. The incorporation of 80 PLUS Bronze into the ENERGY STAR 5.0 specification has driven increased adoption of higher levels of 80 PLUS power supplies. Research conducted for this study suggests that efficient power supplies will continue to transform the market, more through *greater penetration* of efficiencies in the lower 80-percent range than through significant *increases in the average efficiency* of those power supplies qualifying as ~~"~~80 PLUS".

As the main focus of the 80 PLUS program is desktop PC power supplies, Navigant considers the percentage of all desktop PCs sold in the U.S. that incorporate 80 PLUS (or equivalent) power supplies to be the best indicator of market adoption and market transformation.[1] Additionally, there is available data on desktop PC sales whereas there is no available source that Navigant is aware of that tracks the number of power supply models and power supply units sold.

Table 9 provides updates for each of the eleven MPIs identified for the 80 PLUS program in previous MPERs, and directs the reader to the subsection of this report that presents the current findings relevant to that MPI.

[1] Navigant's use of desktop PC sales to estimate 80 PLUS market share also excludes a secondary market for 80 PLUS, the replacement power supply market; however, Navigant believes this is a very small market in comparison to the desktop PC market, and it is not a focus of the 80 PLUS program strategy. Interviewed OEMs, SIs, and PSMs indicated that 80 PLUS (or equivalent) market share is likely significantly higher for servers than for desktop PCs, but there is little publicly available market data about U.S. server sales and thus Navigant was unable to estimate 80 PLUS market share for server power supplies.

Table 9. 80 PLUS Program Market Progress Indicators

Market Progress Indicator	MPER #1	MPER #2	Current Status	Relevant Report Section
Number of 80 PLUS program sponsors	12	13	6	Section 4.1: Participation of Sponsors and Market Actors
Computer OEMs with certified units	0	2	5	
Participating SIs	10	51	37	
Power supply manufacturing firms with certified units	19	65	216	
Certified power supply units	35	403	2,857	Section 4.2: Availability of 80 PLUS Certified Models
Power supply units being tested for certification	20	50+	90+	
80 PLUS specification included in ENERGY STAR specifications	Pending	Effective July 2007	80 PLUS Bronze required for ENERGY STAR 5.0 certification	Section 4.3: Inclusion of 80 PLUS in ENERGY STAR Specifications
End-users aware of and request for 80 PLUS	Just developing	Increasing due to OEM marketing push	Limited awareness and only occasionally requested; ENERGY STAR brand more in demand	Section 4.4: End-User Awareness
Promotion of 80 PLUS by PSMs and SI's	Increasing	Increasing	OEMs drive demand for 80 PLUS although PSMs do market to SIs.	Section 4.5: Promotion of Efficient Power Supplies
Decreasing incremental cost	Decreasing from initial estimates; estimated by most market actors to be $10-$20	Slowly decreasing from initial estimates; estimated by most to be $15 or more	Continuing to decrease for OEMs with increased availability; estimated by most interviewed market actors to be between $7 and $22 depending on level of efficiency; PSM costs may be rising due to demand for higher levels of efficiency	Section 4.6: Incremental Costs of 80 PLUS Qualified Power Supplies
Sales of 80 PLUS PCs	Increasing, but below goals	Increasing, but below goals	Increasing over past 2-3 years; estimated 80 PLUS market share is 37% of all desktop PCs sold in first three quarters of 2010	Section 4.7: 80 PLUS Sales Trends and Market Share

Source: MPERs 1 and 2, Navigant research and analysis. See relevant subsections for specific sources for each MPI.

4.1 Participation of Sponsors and Market Actors

The 80 PLUS program (now referred to as the Plug Load Solutions program on the program website) currently has six sponsoring organizations and utilities: NEEA, Energy Trust of Oregon, Efficiency Vermont, New Jersey's Clean Energy Program[7], Xcel Energy, and Ontario Power Authority. According to interviews with Ecos Consulting staff, the number of program sponsors has fluctuated over time, particularly since utilities (in contrast to NEEA) are often more focused on near-term resource acquisition than market transformation, and thereby sign on for shorter periods of program sponsorship. Ecos has observed a recent resurgence in utility interest in promoting energy-efficient electronics such as desktop PCs, servers, and set-top boxes, and expects to see sponsorship levels rise again in the near future.

There are currently five OEMs and 37 SIs that include 80 PLUS-qualified power supplies in their desktop PCs and/or servers. These OEMs and SIs can obtain 80 PLUS certified power supplies from 216 PSMs who manufacture at least one 80 PLUS certified model. (See Section 4.2 for more discussion about the availability of 80 PLUS certified power supplies.)

Table 10. Market Progress Indicators: Participation

Market Progress Indicator	MPER #1 Findings	MPER #2 Findings	Current Status
Number of 80 PLUS program sponsors	12	13	6
Computer OEMs with certified units	0	2	5
Participating SIs	10	51	37
Power supply manufacturing firms with certified units	19	65	216

Source: MPERs 1 and 2, Navigant review of Plug Load Solutions website.

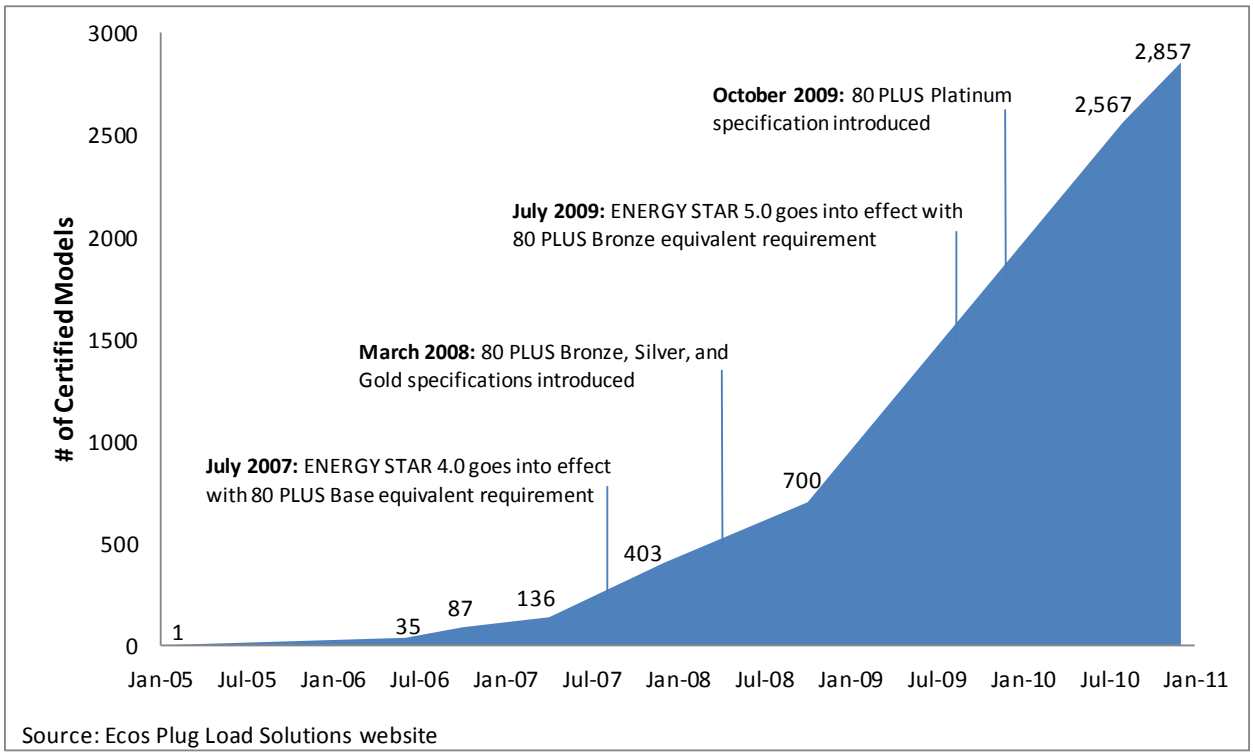
According to Ecos Consulting staff, the decline in the number of participating SIs observed in the preceding table is due to the evolution of the 80 PLUS program and the shift toward incenting ENERGY STAR (not just 80 PLUS) qualified products. The program no longer offers incentives for non-ENERGY STAR (but still 80 PLUS) desktop PCs and servers, and some of the smaller SIs cannot afford to produce ENERGY STAR certified equipment and thus have stopped participating in the program because they are not eligible for any incentives.

4.2 Availability of 80 PLUS Certified Models

When 80 PLUS began certifying power supplies in 2005, there was one certified power supply model. The number of certified 80 PLUS power supply options grew rapidly, to nearly 100 models within two years and to more than 400 by December 2007. As of December 2010, there were more than 2,800 qualifying 80 PLUS power supply models (Figure 7). Just in the four months that Navigant conducted its analysis and reporting, an additional 290 models became available.

[7] Note that the New Jersey program does not include desktop PCs or servers in its program, only ENERGY STAR televisions.

Figure 7. Number of Certified 80 PLUS Power Supply Models with Program Milestones



Finding #5: *The availability of certified 80 PLUS power supplies has grown significantly since 2005 (from one certified model in 2005 to more than 2,800 models in 2010).*

Table 11. Market Progress Indicators: Power Supply Availability

Market Progress Indicator	MPER #1 Findings	MPER #2 Findings	Current Status
Certified power supply units	35	403	2,857
Power supply units being tested for certification	20	50+	90+

Source: MPERs 1 and 2, Navigant review of Plug Load Solutions website.

4.3 Inclusion of 80 PLUS in ENERGY STAR Specifications

Less than two years after the introduction of 80 PLUS, the ENERGY STAR 4.0 standard adopted 80 PLUS as part of its requirement, and the EPA credits Ecos' research efforts as instrumental in that achievement (Quantec 2008). Subsequently, after the introduction of the 80 PLUS Bronze, Silver, and Gold specifications, ENERGY STAR 5.0 adopted the Bronze level as its new threshold.

The 80 PLUS certifications and ENERGY STAR specifications appear to be cross-promoting in a mutually reinforcing manner. It appears that as 80 PLUS is providing the standards for the ENERGY STAR brand, the widespread acceptance of ENERGY STAR is allowing 80 PLUS to push higher efficiencies, which results in a growing number of qualifying power supply models.

Table 12. Market Progress Indicators: ENERGY STAR

Market Progress Indicator	MPER #1 Findings	MPER #2 Findings	Current Status
80 PLUS specification included in ENERGY STAR specifications	Pending	Effective July 2007	80 PLUS Bronze required for ENERGY STAR 5.0 certification

Source: MPERs 1 and 2, Navigant review of ENERGY STAR website.

4.4 Commercial End-User Awareness of 80 PLUS

Among buyers of commercial desktop computers, the ENERGY STAR brand is more recognizable than the 80 PLUS brand. OEMs and SIs indicated that at least some of their customers recognize and request 80 PLUS qualified power supplies specifically when purchasing commercial desktop PCs, but the majority of interviewees indicated that customer more often request ENERGY STAR and that it is a more recognizable brand. [8] Although customers do not often request 80 PLUS explicitly, some of the larger computer OEMs reported that enterprise customers ultimately request 80 PLUS when they see it as a line item on a bid specification sheet under ―energy efficiency". One interviewed OEM stated that certain groups of commercial consumers are more likely to request 80 PLUS, including universities, Fortune 500 companies, and PC buyers in large enterprises in general.

Interviews with three large end-users[9] in the Pacific Northwest indicated no familiarity with 80 PLUS at all.[10] Each of the three companies interviewed indicated that they had *never heard of an 80 PLUS qualified power supply or the 80 PLUS program.* However, the individuals interviewed had all heard of ENERGY STAR qualified PCs and requested this specification in the course of their company's desktop computer purchasing activities. When asked for factors influencing desktop purchasing decisions, one end-user stated plainly, ―We look for the ENERGY STAR rating on desktop computers." OEM interview comments support his tendency, with one OEM surmising ―Probably somewhere around 90 percent of our customers demand that our products be ENERGY STAR qualified, particularly enterprise customers."

End-users indicated that while energy efficiency is valued, features and reliability are more valued when specifying commercial desktop PCs. End-users further indicated that they would seriously consider energy efficiency only after a machine meets the performance demands of the user. Among the related comments from end-users were the following:

- ―Energy efficiency it is important, but functionality is most important; energy efficiency is second after that."
- ―Wouldn't say [energy efficiency] is top priority, but it does factor in."

[8] See Appendix C-1 for full results of OEM and SI interviews, including verbatim responses.
[9] See Appendix C-3 for full results of end-user interviews, including verbatim responses.
[10] One possible explanation for the discrepancy between the end-users and the OEM perspective is that the interviewed OEM representatives may have a skewed view of how often 80 PLUS is specifically mentioned because of the nature of their role within the broader organization. Sales representatives may refer all customers who have questions about 80 PLUS or energy efficiency to the interviewees, since the interviewees are employees who focus on energy and sustainability issues. In other words, the interviewed OEM representatives may interact with only the most energy efficiency conscious PC purchasers.

Navigant concludes that OEMs and SIs—not end-users—drive the market for energy-efficient power supplies because they realize benefits of lower failure rates, lower warranty costs, and higher customer satisfaction with their products. However, consumer awareness of ENERGY STAR does indirectly drive some customer demand for 80 PLUS or equivalent power supplies.

Finding #6: *Commercial end-user awareness of 80 PLUS is limited, but the ENERGY STAR brand awareness creates demand for 80 PLUS specifications.*

Table 13. Market Progress Indicators: End-User Awareness

Market Progress Indicator	MPER #1 Findings	MPER #2 Findings	Current Status
End-users aware of and request for 80 PLUS	Just developing	Increasing due to OEM marketing push	Limited awareness and only occasionally requested; ENERGY STAR brand is more in demand

Source: MPERs 1 and 2, Navigant interviews with OEMs, SIs, and end-users.

4.5 Promotion of Efficient Power Supplies

The focus of the interviews conducted for this research centered on the market for PCs and servers and on the use of efficient power supplies. However, some respondents provided insights into their promotion of 80 PLUS or, more generally, into how continued transformation of the market for efficient power supplies might be fostered.

4.5.1 Promotion of 80 PLUS by OEMs, SIs, and PSMs

The interviewed OEMs strongly indicated that they drove the demand for 80 PLUS power supplies due to their recognition of the superior quality and increased reliability; they stated unequivocally that the PSMs manufacture the power supplies that they specify, not the other way around.[11] However, SIs indicated that PSMs do market 80 PLUS power supplies to them. OEMs may be influencing PSMs to start manufacturing more efficient power supplies, but then the PSMs push the SIs to adopt the same energy-efficient models that they are manufacturing for the OEMs. However, while participating OEMs and SIs may be increasingly adopting more efficient power supplies, the lack of end-user awareness of and demand for 80 PLUS may be limiting the total market share. OEMs and SIs alike believe that the 80 PLUS program could do more to educate end-use customers about the benefits of 80 PLUS.

Both OEMs and SIs indicated that providing customers with more information about the benefits and return on investment of energy efficiency would enhance sales of 80 PLUS certified power supplies, and that rebates paid to the customers rather than the manufacturers (or in addition) would also help. One interviewee said that "besides mandates", the biggest thing that would help achieve further market transformation for energy-efficient power supplies is "proof of return on investment." Another stated the need for "rebate programs available to customers and having resources available to customers [such as] consumer reports to promote highly efficient PCs."

The OEMs and SIs generally desire that consumers become more aware that an energy-efficient power supply not only saves energy, but is also simply a better, more reliable power supply. As

[11] See Appendix C-1 for full results of OEM and SI interviews, including verbatim responses.

one interviewee said, ―We need an awareness campaign. A bad power supply is the quickest way to break other components in your computer. Market the value of a good, cool high efficiency power supply to consumers."

Finding #7: *OEMs and SIs see a need for enhanced customer education and possibly rebates for customers.*

Table 14. Market Progress Indicators: Promotion

Market Progress Indicator	MPER #1 Findings	MPER #2 Findings	Current Status
Promotion of 80 PLUS by PSMs and SI's	Increasing	Increasing	OEMs drive demand for 80 PLUS although PSMs do market to SIs.

Source: MPERs 1 and 2, Navigant interviews with OEMs, SIs, PSMs, and end-users.

4.5.2 Future Actions to Promote Energy Efficient Power Supplies

Three of the interviewed OEMs and SIs indicated that a mandate (e.g., a federal efficiency standard) would be necessary to achieve 100 percent market share of 80 PLUS power supplies in the desktop PC market; among these OEMs, two indicated that 100 percent market share of 80 PLUS was an achievable near-term goal within their own product lines.[12] One respondent even proposed enacting ―legislation to require a level of energy efficiency for specific types of computer equipment." The OEMs seem to believe that a mandate is needed to ―bring up the rear" in terms of getting 80 PLUS into all desktop PCs. One indicated that ―80 percent is a downgrade at this point", and several noted the low quality of non-80 PLUS power supplies in terms of reliability and noise.

However, two of the interviewed OEMs also noted complications in their efforts to comply with energy efficiency requirements. Potential roadblocks include the OEMs' international presence and the patchwork of different regulatory mandates (as well as voluntary certifications) that they have to meet in various countries. One respondent expressed a strong desire to see an international efficiency standard developed, stating, ―What we're seeing now is that there's probably eight to ten emerging energy efficiency regulations that are currently ongoing on a global basis. Everyone has their own flavor on their energy efficiency requirements, and that poses an intriguing challenge to meet all those requirements. We are trying to convince the powers that be globally to harmonize on one specific standard." Another offered facetiously that desktop PCs would be covered with stickers ―like a NASCAR car" if they included labels for every environmental certification.

Two OEMs also caution against pushing too hard for 80 PLUS Platinum or higher levels of efficiency, particularly for desktop PCs (as opposed to servers) which cannot provide for a sufficient return on investment from these higher levels of efficiency at current incremental costs. One OEM stated, ―We are reaching the point of diminishing returns. Ninety percent average efficiency is a threshold to meet going forward, and we should declare victory at that point." Another stated, ―Ninety-four percent is the maximum efficiency without some new unknown technology."

[12] See Appendix C-1 for full results of OEM and SI interviews, including verbatim responses.

Finding #8: *Many OEMs support 80 percent as a mandated minimum efficiency standard, but also see barriers to higher standards.*

4.6 Incremental Costs of 80 PLUS Qualified Power Supplies

This section discusses the incremental costs of 80 PLUS qualified power supplies, with a focus on recent trends in incremental cost in Section 4.6.1 and a discussion of the non-energy benefits that increase the 80 PLUS value proposition and help OEMs justify the incremental cost in Section 4.6.2.

4.6.1 Trends in 80 PLUS Incremental Costs

Most of the interviewed OEMs indicated that the incremental cost of an 80 PLUS power supply over a non-80 PLUS model was not a significant barrier to adoption, particularly on high-end machines.[13] Low-end PCs are still using the low efficiency power supplies, primarily because it is important to some manufacturers to keep a $400 desktop in their product mix, and the incremental cost of integrating an 80 PLUS power supply would be more noticeable to commercial buyers at a $400 price point than for a $2000 high-end PC. Many of the interviewees could not estimate the incremental costs of an 80 PLUS power supply or only knew the incremental cost for one level of efficiency (*e.g.,* Base or Bronze). Based on the estimates that interviewees were able to provide, the incremental cost of an 80 PLUS power supply appears to be between $7 and $22 depending on the efficiency level (Table 15).

Table 15. Incremental Costs Observed by OEMs and SIs

80 PLUS Level	Incremental Cost Over Non-80 PLUS	Incremental Cost Over 80 PLUS Base
Base	$7	Not applicable
Bronze	$10	$4-6
Silver	N/A	$8-10
Gold	$22	N/A
Platinum	N/A	

Source: Navigant interviews of OEMs (n=2) and SIs (n=1)
N/A = estimate not available

Four of the interviewed OEMs and SIs noted that the increased availability of 80 PLUS models, with over 200 PSMs now offering certified models, has led to increased competition and thereby lowered costs. One suggested that costs had dropped because there are ―more models and manufacturers to choose from." Another simply said, ―Volume production always drops cost."

However, one system integrator noted that he did not expect 80 PLUS sales to increase beyond the current levels ―unless PSMs experience a decrease in cost to produce this type of technology…. Should this occur," he continued, ―our company will definitely take advantage of offering more energy-efficient products." It is likely that smaller SIs incur higher costs than the large OEMs which receive bulk discounts from the PSMs.

[13] See Appendix C-1 for full results of OEM and SI interviews, including verbatim responses.

Contrary to what the OEMs and SIs reported, most PSMs indicated that the cost to produce an 80 PLUS power supply has gone up over the last two years.[14] Four PSMs said incremental costs had increased, one said that costs remained the same, and one said that incremental costs had decreased in the past two years. The increased costs that PSMs are experiencing may be due to OEMs shifting to higher levels of efficiency.

Finding #9: *The incremental costs of using 80 PLUS equivalent power supplies are not a significant deterrent to OEMs, especially for high-end products.*

Table 16. Market Progress Indicators: Incremental Costs

Market Progress Indicator	MPER #1 Findings	MPER #2 Findings	Current Status
Decreasing incremental cost	Decreasing from initial estimates; estimated by most market actors to be $10-$20	Slowly decreasing from initial estimates; estimated by most to be $15 or more	Continuing to decrease for OEMs with increased availability; estimated by most interviewed market actors to be between $7 and $22 depending on level of efficiency; PSM costs may be rising due to demand for higher levels of efficiency

Source: MPERs 1 and 2, Navigant interviews with OEMs, SIs, and PSMs.

4.6.2 Impact of Non-Energy Benefits on Value of 80 PLUS

Six out of ten interviewed OEMs and SIs described several additional benefits to 80 PLUS power supplies—beyond energy efficiency—which help justify the additional cost.[15] These include increased reliability, longer life, reduced noise, and reduced heat, which results in additional energy savings by reducing the need for air conditioning, particularly in data centers.

Improving the reliability of the power supply also reduces warranty costs, which is a significant benefit to OEMs. According to one OEM, the warranty cost can account for up to half of the upfront cost of a PC; in other words, the warranty costs as much as the hardware. One of the interviewed SIs stated, ―A bad power supply is the quickest way to break other components in your computer." Several of the interviewees who focused on high-end PCs and servers had trouble estimating incremental costs over the non-80 PLUS power supplies because the non-80 PLUS power supplies are ―junk" that they would not buy anyway.

Finding #10: *Non-energy benefits (e.g., reliability and reduced warranty costs) help OEMs justify the incremental cost of 80 PLUS.*

4.7 80 PLUS Sales Trends and Market Share

This section characterizes past and anticipated future trends related to 80 PLUS sales, as well as the estimated market share. Note that while market share is not explicitly an MPI, it is one of the logic model outcomes and an input to the ACE model, and Navigant recommends that market share be added as an MPI for future evaluation efforts. Section 4.7.1 presents 80 PLUS sales trends over the past two to three years as reported by OEMs, SIs, and PSMs. Section 4.7.2

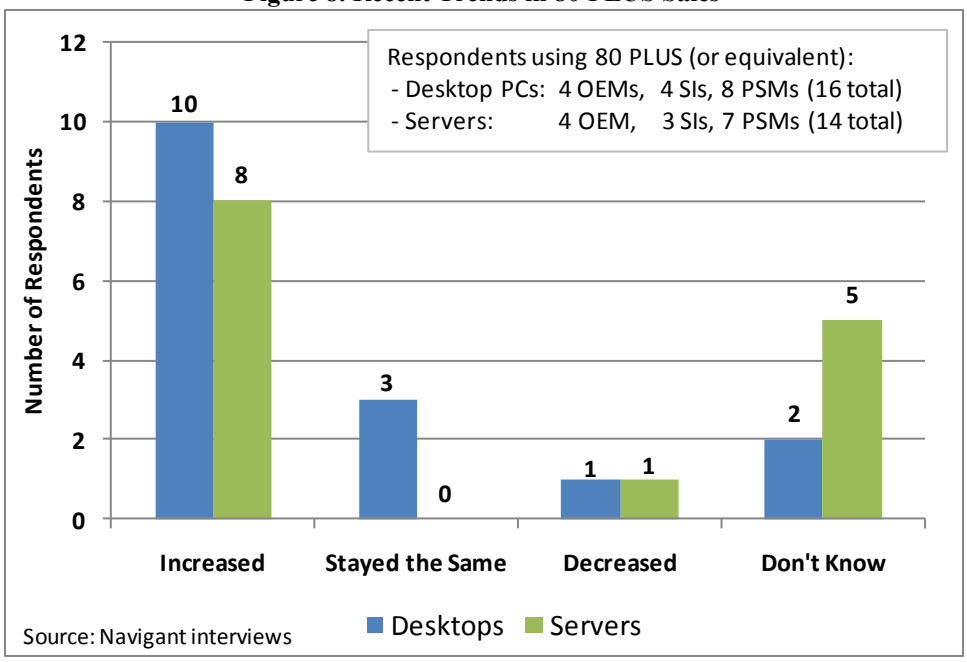
[14] See Appendix C-2 for full results of PSM interviews, including verbatim responses.
[15] See Appendix C-1 for full results of OEM and SI interviews, including verbatim responses.

estimates the current market share of 80 PLUS as a percentage of U.S. desktop PC sales. Sections 4.7.3 and 4.7.4 discuss the efficiency levels of energy-efficient power supplies used in desktop PCs and servers, respectively. Finally, Section 4.7.5 discusses anticipated future trends in 80 PLUS sales.

4.7.1 80 PLUS Sales Trends over Past Two to Three Years

Incorporation of efficient power supplies into desktop PCs and servers has increased recently according to almost of the OEM, SI, and PSM interviewees.[16] Ten of the fourteen interviewed market actors who were able to estimate 80 PLUS sales trends indicated that sales of desktop computers with 80 PLUS or equivalent power supplies increased over the past two to three years, and only one reported a decrease in use of 80 PLUS.

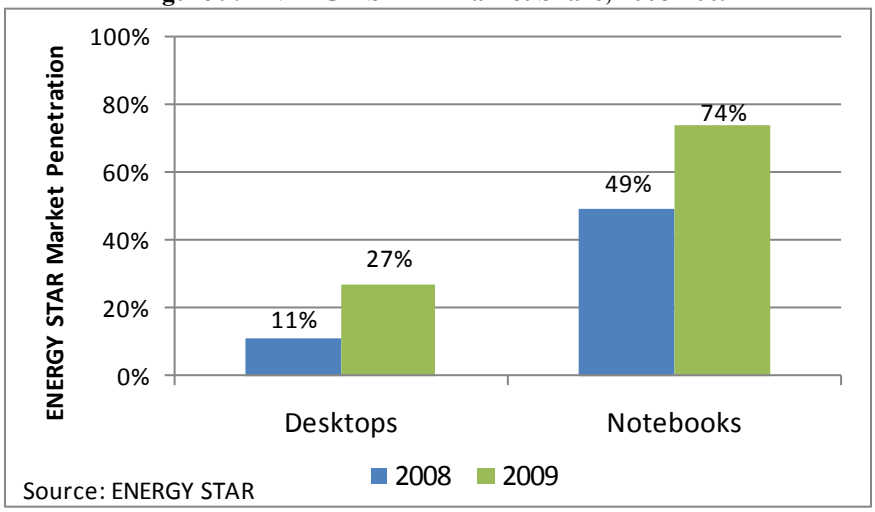
Figure 8. Recent Trends in 80 PLUS Sales



This trend is consistent with the expansion of computers branded with ENERGY STAR, which increased market share significantly between 2008 and 2009 for both desktop PCs and laptops. Market share for desktops more than doubled, to 27 percent in 2009, while the penetration of laptops increased by roughly half, to 74 percent (Figure 9).

[16] See Appendix C-1 for full results of OEM and SI interviews and Appendix C-2 for full results of PSM interviews.

Figure 9. ENERGY STAR Market Share, 2008-2009



Sales of 80 PLUS certified (or equivalent) power supplies are outpacing ENERGY STAR qualified desktop PCs and servers because all ENERGY STAR qualified machines have an 80 PLUS certified or equivalent power supply but not all desktop PCs and servers using 80 PLUS certified power supplies are ENERGY STAR qualified. One major computer OEM noted that they have their own line of energy-efficient machines that use 80 PLUS certified power supplies exclusively but are not ENERGY STAR qualified. According to this OEM, ―The sale of 80 PLUS power supplies is going up [while] ENERGY STAR is leveling off." 80 PLUS is an easy sale compared to ENERGY STAR due to the high cost and relative complexity of the ENERGY STAR requirements.

Finding #11: *80 PLUS sales have increased over the past two to three years, likely growing by more than 100% between 2008 and 2009 based on the growth in penetration of ENERGY STAR-qualified desktops, which require 80 PLUS.*

Table 17. Market Progress Indicators: 80 PLUS Sales

Market Progress Indicator	MPER #1 Findings	MPER #2 Findings	Current Status
Sales of 80 PLUS PCs	Increasing, but below goals	Increasing, but below goals	Increasing over past 2-3 years

Source: MPERs 1 and 2, Navigant interviews with OEMs, SIs, and PSMs, ENERGY STAR (2010).

4.7.2 80 PLUS Market Share

A power supply may be certified as having an efficiency greater than 80 percent even without receiving the ―80 PLUS" certification. For purposes of characterizing the market share of 80 PLUS power supplies, this report designates a power supply as ―80 PLUS" if there is sufficient evidence that the efficiency is at least equivalent to an 80 PLUS-certified model. Navigant considered sufficient evidence to be an alternate certification, such as ENERGY STAR, or compelling secondary research or responses to interviews conducted for this research. As the main focus of the 80 PLUS program is desktop PC power supplies, Navigant considers the

percentage of all desktop PCs sold in the U.S. that incorporate 80 PLUS (or equivalent) power supplies to be the best indicator of market adoption and market transformation.[17]

Through the interviews, OEMs and SIs estimated the percentage of their desktop PCs sold that include an 80 PLUS or equivalent power supply.[18] Navigant then multiplied those figures by an estimated number of desktop PC sales for each manufacturer to arrive at an estimate of the number of 80 PLUS certified power supplies used in desktop PCs sold in the U.S. during the first three quarters of 2010. The analysis proceeded as follows:

- The number of desktop PC sales by manufacturer was based on each manufacturer's share of the PC market, the overall percentage of PCs that are desktops (37 percent in 2010, according to IDC), and the fact that the fifth largest OEM (Toshiba) does not manufacture any desktop PCs.

- Navigant assumed that each manufacturer (including those that fall into the ―Others" category) has the same ratio of desktops to laptops for the purposes of this analysis, and the analysis assigned Lenovo a four percent share of the U.S. PC market, based on year-old Gartner estimates (Einhorn 2010).

- Each interviewee's 80 PLUS share of desktops was applied to their estimated U.S. desktop PC sales in 2010 (first through third quarter) to derive an estimate of more than seven million 80 PLUS units sold.

- Based on this analysis, **the weighted average market share of 80 PLUS in desktops sold in the U.S. in 2010 is roughly 37 percent of U.S. desktop PC sales.** This is reasonable in the context of EPA's estimate of a 27 percent market share of ENERGY STAR desktop PCs in 2009 (see above)—an estimate that accounts neither for 80 PLUS equivalent power supplies that are not ENERGY STAR labeled nor for any increase in market share achieved in 2010.

Table 18 presents 1) the detailed analysis and assumptions used to estimate 80 PLUS sales, 2) each manufacturer's share of 80 PLUS power supplies, and 3) the national 80 PLUS market share. By these estimates, HP accounts for more than half of the 80 PLUS equivalent power supplies sold in the U.S. in the first three quarters of 2010. Apple accounts for more than one-quarter, and Dell and Lenovo account for most of the remainder.

[17] Navigant's use of desktop PC sales to estimate 80 PLUS market share also excludes a secondary market for 80 PLUS, the replacement power supply market; however, Navigant believes this is a very small market in comparison to the desktop PC market, and it is not a focus of the 80 PLUS program strategy. Interviewed OEMs, SIs, and PSMs indicated that 80 PLUS (or equivalent) market share is likely significantly higher for servers than for desktop PCs, but there is little publicly available market data about U.S. server sales and thus Navigant was unable to estimate 80 PLUS market share for server power supplies.

[18] See Appendix C-1 for full results of OEM and SI interviews, including verbatim responses.

Table 18. 80 PLUS Market Share Estimates for U.S. Desktop Sales, 2010 Quarters 1-3

	US PC Shipments (Q1-3 2010) (in thousands) (A)	% Desktops (B)	# Desktops (in thousands) (C)	Share of 80 PLUS Equivalent (%) (D)	# 80 PLUS Equivalent (in thousands) (E)	Market Share of 80 PLUS Equivalent (%)
HP	13,434	41%	5,508	75%	4,131	56%
Dell	12,507	41%	5,128	11%	564	8%
Acer	6,605	41%	2,708	0%	-	0%
Apple	4,979	41%	2,041	100%	2,041	28%
Toshiba	4,700	0%	-	0%	-	0%
Lenovo	2,118	41%	868	50%	434	6%
Others	8,614	41%	3,532	5%	177	2%
Total	**52,956**	**34%**	**19,785**	**37%**	**7,347**	**100%**
Source and Assumptions	*Gartner for market share for top 5 OEMs and overall market; Lenovo estimated to have 4% market share, remainder in Others.*	*IDC (37% overall); after setting Toshiba to zero, assumed others had the equal percentages of desktops to total 37% of all U.S. PC sales.*	*Calculated by multiplying PC shipments by % desktops (Col. A * B)*	*Secondary research and Navigant interviews with OEMs and SIs. "Others" conservatively assumed to be 5%. Total is weighted average based on OEM market share.*	*Calculated by multiplying # desktops by % 80 PLUS equivalent. (Col. C * D)*	*Calculated by dividing # 80 PLUS equivalent by total (Col E div Total Col E)*

Finding #12: *Power supplies in more than one in three desktop PCs are 80 PLUS certified or of equivalent efficiency.*

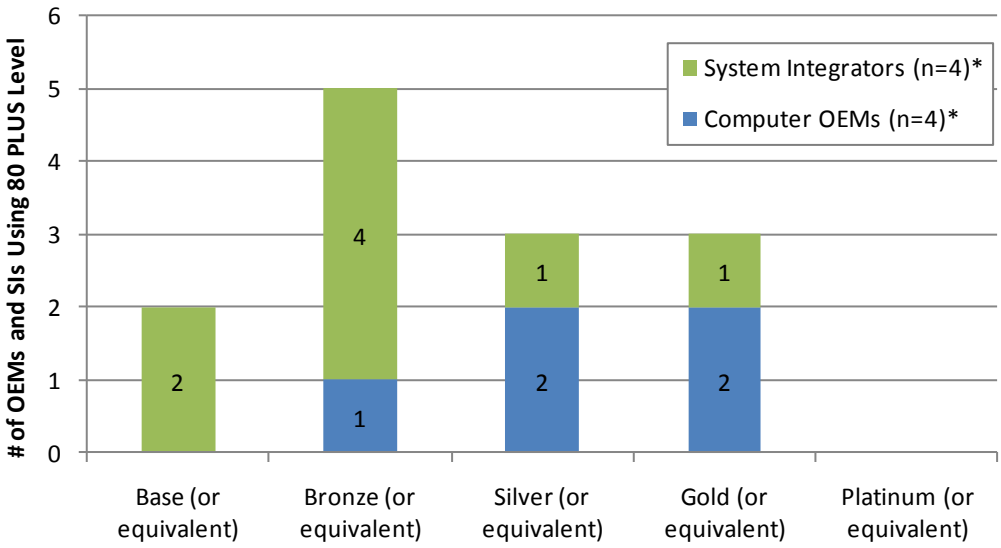
4.7.3 80 PLUS Levels in Use for Desktop PCs

Navigant found that a majority of the interviewed computer OEMs and SIs have moved beyond the 80 PLUS Base power supply and exclusively use higher levels in their desktop PCs.[19] The requirement of an 80 PLUS Bronze-equivalent power supply for ENERGY STAR 5.0 qualification has likely had a strong influence on the trend towards higher efficiency models. According to one of the OEMs interviewed by Navigant, "80 percent is a downgrade at this point."

Figure 10 summarizes the 80 PLUS levels in use in desktop PCs as reported by the interviewed OEMs and SIs. None of the interviewed OEMs use any 80 PLUS Base (or equivalent) power supplies. Although two of the interviewed SIs still use models at the 80 PLUS Base efficiency level, all SIs also use power supplies at the Bronze level or higher.

[19] See Appendix C-1 for full results of OEM and SI interviews, including verbatim responses.

Figure 10. 80 PLUS Levels in Use for Desktop PCs by OEMs and SIs



*Includes all interviewees that use 80 PLUS or equivalent power supplies in desktop PCs. Totals add to more than the sample size due to some respondents indicating that they use more than one level of 80 PLUS power supply.

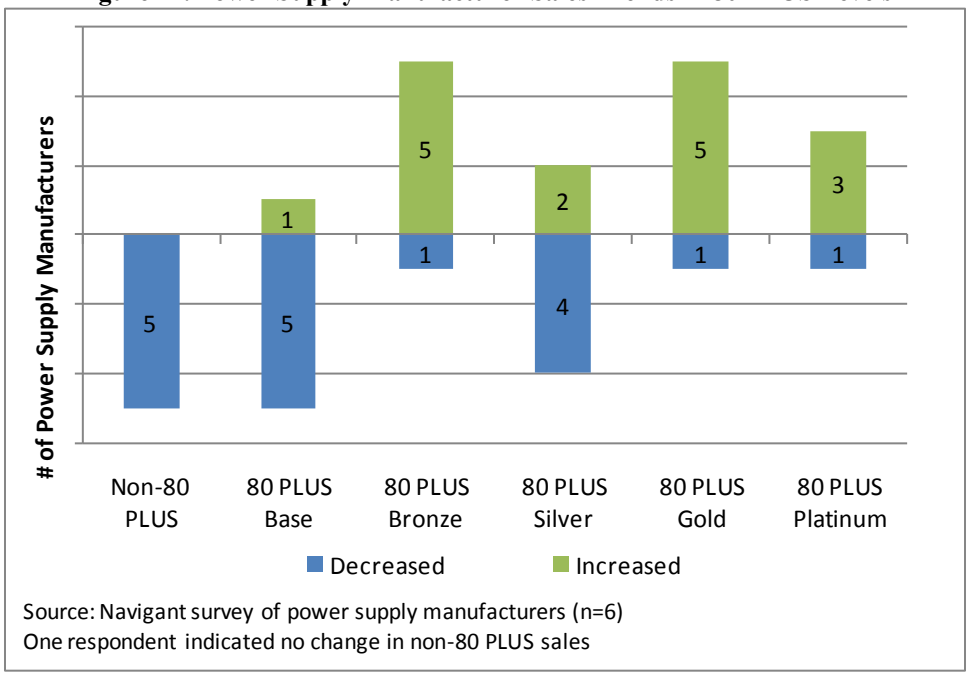
Source: Navigant interviews with market actors.

Despite the trend to move towards higher efficiency levels in desktop PC power supplies, not a single OEM or system integrator interviewed by Navigant incorporates the 80 PLUS Platinum level power supplies into their desktop PCs at this point. Two interviewees expressed concern that the return on investment of an 80 PLUS Platinum (92 percent efficient) power supply simply is not there in a desktop PC. One interviewee went so far as to say, ―Ninety percent average efficiency is a threshold to meet going forward, and we should declare victory at that point".

PSMs also report similar trends in the use of the various 80 PLUS levels of efficiency.[20] As shown in Figure 11, all surveyed PSMs reported that sales of non-80 PLUS power supplies had either decreased or stayed the same over the last three years, and only one PSM indicated an increase in 80 PLUS Base level. Essentially, there is a move away from non-80 PLUS and 80 PLUS Base models, and an increase in production of power supplies at the Bronze and Gold levels.

[20] See Appendix C-2 for full results of PSM interviews, including verbatim responses.

Figure 11. Power Supply Manufacturer Sales Trends in 80 PLUS Levels



Finding #13: *Typical "80 PLUS" efficiencies are increasingly higher than the 80 percent threshold.*

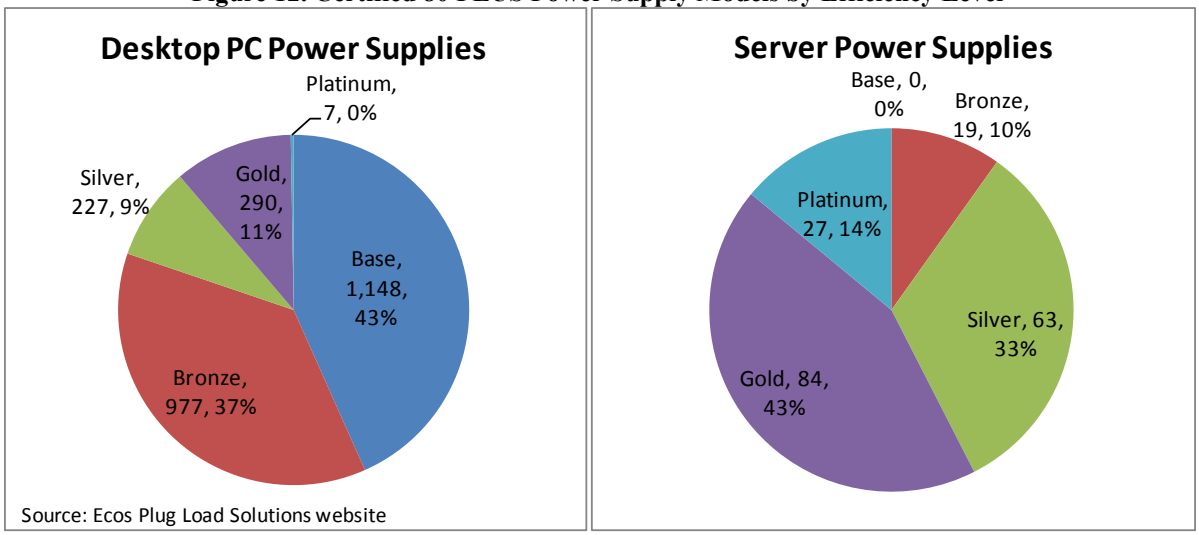
4.7.4 80 PLUS Levels in Use for Servers

The discussion in the previous finding noted that none of the nine OEMs or SI's interviewed used 80 PLUS Platinum power supplies for their desktop PCs.[21] Yet three of the PSMs indicated an increase in sales of Platinum-level power supplies. [22] A likely explanation for this apparent contradiction is that 80 PLUS Platinum is primarily used for servers, not PCs, since servers consume far more power than desktop PCs and the increased efficiency can provide significant cost savings.

Only seven (less than one percent) of the 80 PLUS-certified *desktop PC power supplies* are Platinum, compared to twenty-seven (14 percent) of the 80 PLUS-certified *server power supplies* are Platinum (Ecos 2010). As of December 2010, there were 2,843 power supplies models certified through the 80 PLUS program, manufactured by over 200 PSMs. The breakdown of 80 PLUS certified power supply models by efficiency level is displayed in , which demonstrates that the vast majority of certified power supplies for *desktop PCs* are 80 PLUS Base or Bronze, while the majority of certified power supplies for *servers* are Silver, Gold, or Platinum. These numbers represent the total number of available certified models at each efficiency level, not the actual sales; however, the figures may mirror the trend in sales as well.

[21] See Appendix C-1 for full results of OEM and SI interviews, including verbatim responses.
[22] See Appendix C-2 for full results of PSM interviews, including verbatim responses.

Figure 12. Certified 80 PLUS Power Supply Models by Efficiency Level



Finding #14: *Power supply efficiencies tend to be higher for servers than for desktops.*

4.7.5 Future 80 PLUS Trends

All but one of the computer OEMs and SIs interviewed for this research and who currently participate in the 80 PLUS program believe the trend of integrating 80 PLUS certified power supplies into their desktop PC and server products will continue into the future.[23] Two OEMs and one SI interviewee cited a 100 percent certification rate as a corporate goal for the coming two to three years. This view of the market for 80 PLUS was also supported by PSMs.[24] Of the seven PSMs who commented on anticipated future trends of 80 PLUS power supplies, six said they expect these trends to continue.

The market share of 80 PLUS is expected to continue rising, but it is less clear whether the efficiency levels of those 80 PLUS power supplies will also continue to increase in the next revision to the ENERGY STAR requirements for desktop PCs. While the ENERGY STAR 6.0 specification is expected to require an 80 PLUS equivalent, EPA has not yet indicated whether the efficiency level will be increased above the current level of Bronze (85 percent efficiency).

The largest source of anxiety with the new ENERGY STAR 6.0 specifications expressed by four of the computer OEMs and SIs interviewed concerned not the level of 80 PLUS equivalent that will be required, but rather a shift to a third party verification system from the current self-certification system. Specific information about the new requirements is not currently available, but market actors noted the following concerns:

- ENERGY STAR is becoming overly complicated.
- Costs associated with lab certification could shift SIs to reseller business model.

[23] See Appendix C-1 for full results of OEM and SI interviews, including verbatim responses.
[24] See Appendix C-2 for full results of PSM interviews, including verbatim responses.

- More stringent efficiency and testing requirements will result in fewer ENERGY STAR 6.0 PCs labeled.
- Corporate confidentiality issues interfere with third party certification of PCs.

One system integrator believed that an over-reaching 6.0 standard could erode the market share of ENERGY STAR labeled computers: ―The big concern is with ENERGY STAR 6.0 because of lab certification," he explained. ―We will see a shift to selling others' systems like Lenovo. ENERGY STAR certified machine sales could drop after a peak of 5.0. "

Finding #15: *Most market actors expect general trends in 80 PLUS sales to continue.*

4.8 Review of Logic Model Outcomes

The 80 PLUS program logic model outcomes have some variation from the MPIs (for instance, the MPIs do not include a target for 80 PLUS market share). After reviewing the program logic model, **Navigant recommends that NEEA update the 80 PLUS program logic model** to reflect the program's current implementation activities and past accomplishments and to set new progress indicators and targets for future program activities. Therefore, in addition to the MPIs summarized in the preceding sections, Navigant believes that it is important to include this separate chapter in MPER #3 for reviewing the logic model outcomes.

NEEA has already achieved and passed the milestones for many of the progress indicators specified in the logic model (which appeared in the first MPER and is at least five years old at the time of this report). Thus, NEEA should consider the program's current implementation strategies and identify achievable short- and long-term outcomes for the next 3-8 years. In particular, one major outstanding question that the logic model review calls attention to is: what is the program doing to increase demand for 80 PLUS power supplies among large commercial end-users? Table 19 summarizes the status of the expected short- and long-term outcomes specified in the program logic model based on the findings of the primary and secondary research.

Table 19. Status of 80 PLUS Program Logic Model Expected Outcomes

Expected Short-Term Outcomes	Status
Inquiries from PSMs, OEMs, SIs, electric utilities, and large consumers	*Partially achieved.* Significant number of OEMs, SIs, and PSMs are participating in the program. Inquiries from electric utilities not part of market research project. Large consumers do not appear to have significant awareness of 80 PLUS. See Sections 4.1 and 4.4 for relevant findings.
Increasing website traffic	*(Out of scope for market research)*
Accessible and up-to-date testing protocols available on website	*Achieved.* As of December 2010, the latest testing protocols dated 7/7/2010 are available on the Plug Loads Solution website.
Sales of at least 70,000 qualifying units before end of 2005	*Not achieved within specified timeline.* This sales goal and other metrics need revision/updating for the program going forward.
Participation from at least one major desktop PC OEM	*Achieved in 2007* with participation of HP and Dell, the two largest PC OEMs in the U.S. See Section 4.1 for relevant findings.
Buy-down spurs OEM and SI sales of qualifying PCs	Sales of qualifying PCs have increased, but linkage has not been established between the buy-down of 80 PLUS incremental costs and increased sales. See Sections **Error! Reference source not found.** and 4.7 for relevant findings.
Recruitment of at least one other major utility or energy efficiency organization to sponsor the program	*Achieved*. Program website lists six major energy efficiency organizations/utilities as sponsors: NEEA, Energy Trust of Oregon, Efficiency Vermont, New Jersey's Clean Energy Program, Xcel Energy, Ontario Power Authority. See Section 4.1 for relevant findings.
EPA includes power supply specifications in its revised ENERGY STAR standard for computers.	*Achieved in July 2007.* See Section 4.3 for relevant findings.
Expected Longer-Term Outcomes	**Status**
75% or higher market share of 80 PLUS-equipped PCs by 2010	*Not achieved.* Market share is estimated to be approximately 37% in 2010. See Section 4.7.2 for relevant findings.
Industry continuing to embrace ENERGY STAR as a competitive marketing advantage	*Achieved, with caveats.* End users have high familiarity with ENERGY STAR, but OEMs have significant concerns about ENERGY STAR's changing requirements for third party certification. See Sections 4.4 and 4.7.5 for relevant findings.

Source: NEEA 80 PLUS logic model (Expected Outcomes) and Navigant research (Status)

Navigant previously provided NEEA with a memorandum summarizing the preliminary review of the logic model and the ACE model (see Appendix E).

4.9 Other Findings on OEM and SI Participation in 80 PLUS Program

While the focus of this research was centered on the MPIs and logic model outcomes described in preceding sections, some OEM and SI interviewees also offered valuable insights into their decision to participate in the 80 PLUS program and the extent to which they submit incentive claims for qualifying product sales. This section presents those additional insights, which also relate to one of the market research questions presented in the next section.

The three participating OEMs believe that they submit claims for nearly all eligible sales in participating regions, although one interviewee noted that they had more difficulty tracking

Canadian sales.[25] Two of the five interviewed OEMs are non-participants, and therefore do not submit claims for 80 PLUS incentives. One of these non-participating OEMs indicated that his company based its decision not to participate in the program and claim incentives on two factors: a desire to protect their customer and sales data and the sense that energy efficiency is ―the right thing to do" and something they want to do without the program.

Among SIs, one of the five interviewed SIs stated that they were a non-participant (despite being listed on the 80 PLUS website as a participant), and another does not claim any incentives because ―our corporate responsibility directive considers providing 80 PLUS qualified systems as a necessary component of our corporate culture." Two others always submit incentive claims, and the fifth had previously done well with submitting all claims, but then lost the employee who was responsible for submitting claims and has not been able to keep up with the claims administration process since that time.

While the general consensus among the OEMs and SIs was that the 80 PLUS program is well administered and the incentive filing process is easy, one interviewee suggested that simple email alerts to participating OEMs and SIs if they missed a filing may help ensure that all qualifying sales are submitted for incentives. Several of the interviewed OEMs and SIs noted interesting uses for the incentives that they received from the 80 PLUS program, such as using the income to fund other environmental initiatives or directly passing the incentives back to the sales teams to reward them for selling PCs and servers with 80 PLUS certified power supplies.

4.10 Summary of Key Information Needs/Research Questions

As part of its statement of work, NEEA requested that the market research address specific areas of interest regarding the 80 PLUS program's progress, some of which are not specifically addressed by the MPIs. Table 20 provides a summary of findings for these key research topics related to market progress.

[25] See Appendix C-1 for full results of OEM and SI interviews, including verbatim responses.

Table 20. Summary of Key Information Needs/Research Questions Related to Market Progress Assessment

Information Needs/Questions	High Level Findings
Current commercial market size for 80 PLUS, ENERGY STAR, and non-80 PLUS desktops and servers	The ENERGY STAR market share for desktop PCs in 2009 was 27 percent according to EPA; this research estimates 80 PLUS (or equivalent) market share in 2010 at 37 percent. Although many interviewees were less knowledgeable about their companies' server sales (relative to PC sales), 80 PLUS market share for servers is likely significantly higher than for desktop PCs.
Sales trends regionally and nationally for 80 PLUS and ENERGY STAR	80 PLUS and ENERGY STAR have both seen significant growth in the past two to three years; both achieve greater market share on the coasts, but market actors are not able to provide more granular data on regional sales.
Trends in manufacturing of power supplies	PSMs report decreasing sales of non-80 PLUS and 80 PLUS Base power supplies and increasing sales of higher efficiency power supplies.
The number of units of ENERGY STAR 5.0 sold where incentives are not claimed	Nearly all qualifying PC sales by participating OEMs and SIs are claimed for incentives; however, non-participating Apple sells 100 percent ENERGY STAR 5.0 PCs, accounting for 5.5 million 80 PLUS equivalent PCs sold in 2009 for which incentives were not claimed.
The cost to manufacture an ENERGY STAR 5.0 PC vs. 80 PLUS vs. standard PC	Incremental costs were difficult for market actors to estimate, but OEMs report the incremental cost of an 80 PLUS power supply over a non-80 PLUS model to be between $7 and $22 depending on the efficiency level.
What are the factors influencing purchase decisions for PCs vs. laptops?	End-users are primarily seeking features, performance, and value; energy efficiency is a secondary concern but growing in importance. OEMs believe that 80 PLUS power supplies aid the performance of PCs and servers by improving reliability.

Source: Navigant research and analysis

5. REVIEW OF ACE MODEL ASSUMPTIONS

At the outset of this market research effort, Navigant conducted a review of NEEA's ACE model for the 80 PLUS program and submitted a memorandum summarizing the findings and recommendations resulting from that review. (See Appendix E for the memorandum, which also includes a discussion of the 80 PLUS logic model.) After completing the primary and secondary research described in the preceding sections, Navigant revisited the ACE model to determine if any changes were warranted based on the results of the research.

Navigant recommends that NEEA make the following adjustments to the ACE model:

- **Add additional tiers to reflect the different levels of 80 PLUS certification now available.** The current ACE model only calculates energy savings for two levels of efficiency: 80 PLUS Base and 80 PLUS Bronze/ENERGY STAR 5.0. Navigant found that most participating OEMs have shifted to using primarily 80 PLUS Silver and Gold power supplies in desktop PCs, which means that NEEA's ACE model may be underestimating energy savings from these more efficient power supplies.

- **Adjust 80 PLUS market share.** The ACE model forecasted 80 PLUS market share for 2010 to be 10.4 percent for Tier 1 (80 PLUS Base) and 5.4 percent for Tier 2 (ENERGY STAR 5.0) for a combined total of 15.8 percent. Navigant estimates the 80 PLUS market share to be approximately 37 percent of all desktop PCs sold in the U.S. during the first three quarters of 2010. The ENERGY STAR market share in 2009 was 27% of all desktop PCs sold, which is Navigant's recommended value for Tier 2 market share in 2010 (conservatively assuming that ENERGY STAR market share has held steady from 2009 to 2010). The Tier 1 estimate (the remainder of the 37% total market share estimated by Navigant) would remain at 10%.

- **Adjust Northwest share of total U.S. computer sales** to 4.24 percent based on latest U.S. Census population data; current estimate is 4.1 percent.

- **Update total 2010 U.S. computer sales** to 78.4 million units based on latest IDC estimates which include actual sales for first three quarters of 2010; ACE model currently forecasts 61.5 million computers sold in the U.S. in 2010, which is based on a 2009 IDC forecast.

- **Update laptop share of total U.S. computer sales** to 63 percent for 2010 based on latest IDC estimates; current ACE model estimate is 58 percent.

- **Revisit incremental cost of Tier 2 (Bronze)** based on findings in Section 4.3, and add incremental costs for 80 PLUS Silver and Gold (if the ACE model is modified to track each level of 80 PLUS separately). Due to the small sample size of market actors who were able to estimate incremental costs, Navigant recommends that NEEA make conservative adjustments to the incremental costs used in the ACE model.

Navigant did not find any compelling reason to modify the baseline market share assumptions that NEEA currently uses in the ACE model (approximately 10% in 2012 and 90% in 2018 for Tier 1 products).

6. CONCLUSIONS AND RECOMMENDATIONS

The market for commercial PCs and servers has continued to expand in recent years, particularly as the United States economy began to recover from the 2008-2009 recession. Alongside this market expansion, the efficiency of the computers sold has increased as well, owing in part to the introduction of the 80 PLUS power supply efficiency standard, which has become an integral part of the popular ENERGY STAR brand. Laptops have assumed a growing share of the market in recent years, leaving desktop PC sales to level off even as the overall PC market has grown.

The rise of laptops, which OEMs tend to design with higher efficiency components due to the demands of their mobile users, implies that the overall efficiency of PCs is increasing. At the same time, the continuing popularity—if not growth—of desktops suggests an opportunity for energy savings from additional improvements in the average efficiency of internal power supplies for desktop PCs. Similarly, the trend toward mobile computing and virtualization, powered by servers more than PCs, implies that efficient power supplies for servers will play a significant role in achieving additional energy savings from continuing efforts to promote the 80 PLUS specification.

These conclusions are from secondary research into the PC and server markets and from interviews with computer OEMs, SIs, PSMs, and commercial end-use customers. The broad objective of the research was to understand the trends, status, and dynamics of the market for energy-efficient power supplies in PCs and servers in order to assist NEEA's in developing future plans for the 80 PLUS program.

6.1 Conclusions

Major conclusions of this MPER coalesce around the two major market research efforts aimed at characterization of the PC and power supply markets and assessment of market transformation for efficient power supplies.

6.1.1 Characterization of the PC and Power Supply Markets

As discussed in Section 3.1, the recent economic downturn has slowed the growth of desktop PC, laptop, and server sales, but the market is slowly recovering. Leading the recovery are the sales of laptops and all types of portable computing devices, but the desktop PC remains a significant, if slightly decreasing, market segment and likely will continue to represent roughly one-third of all PC sales through 2014. Mobile computing and virtualization of desktop PCs, as well as cloud computing, will drive future trends in the market and may result in servers providing a greater share of computing power—and consuming a greater share of the electricity needed to power commercial computing.

The market for computer power supplies is comprised primarily of three sets of players: 1) manufacturers of power supplies, 2) their customers (i.e., computers manufacturers including OEMs and SIs), and 3) end users. OEMs exert the strongest influence on power supply efficiency, although the prominence of ENERGY STAR (which has adopted an 80 PLUS specification) means that end user preferences for the ENERGY STAR standard help to drive the penetration of 80 PLUS in the market.

6.1.2 Transformation of the Computer Power Supply Market

The 80 PLUS program has had a substantial effect on the market for energy-efficient power supplies for desktop PCs and servers and has made significant achievements related to nearly all MPIs. Ecos has credited NEEA with providing the early and sustained financial support that has made it possible for the 80 PLUS program to be continuously engaged in building relationships with industry groups and market actors, influence the development of ENERGY STAR specifications, and continually push the market toward ever-increasing levels of energy efficiency in power supplies.

- *Participation of Sponsors and Market Actors:* The 80 PLUS program has attracted the support of six sponsors and engaged five OEMs (including two that comprise more than 50% of U.S. PC sales), 37 SIs, and 216 PSMs in the manufacturing and sales of 80 PLUS qualified power supplies.

- *Availability of 80 PLUS Certified Models:* When 80 PLUS first hit the market in 2005, power supply efficiencies were commonly in the mid-60 percent range and there were few power supplies with efficiencies of 80 percent or greater, although comprehensive market data was not readily available at that time. Since that time, the number of certified 80 PLUS power supplies has grown to more than 2,800, with more than 90 additional models currently in testing.

- *ENERGY STAR Specification:* The current ENERGY STAR specification for desktop PCs requires the equivalent of 80 PLUS Bronze; EPA has credited NEEA and the 80 PLUS program with strongly influencing the inclusion of energy efficient power supplies in the ENERGY STAR specification.[26] The market share of ENERGY STAR desktop PCs grew from 11% in 2008 to 27% in 2009, providing a sizable market for 80 PLUS or equivalent power supplies.

- *Awareness and Promotion of 80 PLUS:* The one area in which the program has not demonstrated significant progress is end-user awareness of 80 PLUS power supplies. OEMs indicate that commercial end-users only occasionally request 80 PLUS power supplies. However, end-users are highly aware of ENERGY STAR, so the inclusion of the 80 PLUS Bronze standard in the ENERGY STAR specification has resulted in indirect end-user demand for 80 PLUS. Still, increased end-user awareness of the benefits of 80 PLUS (both energy and non-energy benefits) would likely lead to increased sales of 80 PLUS qualified desktop PCs and servers.

- *Incremental Costs:* Despite the incremental cost of manufacturing an 80 PLUS certified power supply, most OEMs and SIs do not find cost to be a barrier to adoption because non-energy benefits such as greater reliability, lower warranty costs, and overall customer satisfaction justify the additional cost. Incremental costs of 80 PLUS Base power supplies are decreasing somewhat due to increased availability and competition among PSMs, but as OEMs move to higher efficiency levels, they continue to see incremental costs associated with 80 PLUS power supplies.

[26] This finding was reported in MPER #2.

- *80 PLUS Sales:* Nearly all computer OEMs, SIs, and PSMs report growth in the market for efficient power supplies over the last three years, and these companies are adopting increasingly efficient models (e.g., 80 PLUS Gold instead of 80 PLUS Bronze). Roughly one-third of all desktop PC power supplies now meet or exceed the 80 PLUS specification. While Navigant considers this to be a significant market share, it should be noted that the logic model indicated that the program expected to reach 75% market share by 2010; this discrepancy may be due in part to the economic downturn which slowed overall computer sales and thus the turnover of older computers that do not meet 80 PLUS standards.

Note that some MPIs may no longer have a significant impact on the market progress; for instance, although the number of program sponsors has decreased since MPER #2, this does not appear to have had a detrimental effect because market share of 80 PLUS has continued to increase. The bullets listed above are focused on factors which demonstrate the extent to which the 80 PLUS program has transformed the market for energy-efficient power supplies. The next section on recommendations discusses areas in which the program can extend its influence and achieve further market transformation effects.

6.2 Recommendations

The success of 80 PLUS raises the question of how to best promote the continued, and increasing, efficiency of computer power supplies. Candidate policies include:

- **80 PLUS as a minimum standard.** While a market share of 37% percent is a significant accomplishment for the program, a majority of PCs and servers still do not meet the 80 PLUS specifications. The incremental cost of achieving 80 percent power supply efficiencies is relatively low and the non-energy benefits appear to more than offset the costs for many computer makers. As there do not appear to be any compelling reasons *not* to use 80 PLUS or equivalent power supplies, the time may be ripe for NEEA to promote 80 PLUS Base as a federal standard for minimum power supply efficiencies and to focus efforts on incenting power supplies that exceed the minimum 80 PLUS efficiency.

- **Incentives for higher levels of efficiencies.** If a greater share of computers could easily adopt the 80 PLUS standard, how efficient should they be? And how can NEEA help to promote industry practices to routinely *exceed* the 80 PLUS standard? An effective starting point may be to provide incentives only for power supplies that meet one of the higher 80 PLUS levels, such as Silver or Gold. As 80 PLUS Base becomes the *de facto* standard (and free ridership increases), the most cost-effective use of incentives is to encourage higher efficiency levels—80 PLUS Bronze at a minimum. Since ENERGY STAR already requires 80 PLUS Bronze, many computer makers are already targeting this level of efficiency. Thus, NEEA may achieve the best return on its investment by reserving incentives only for power supplies at the Silver level or higher.

- **End-user education.** In addition to standards and incentives, education is another vehicle for promoting efficient power supplies. The non-energy benefits are likely an influential driver of specification and purchasing decisions for OEM/SIs and end-users—but only for those who are aware of these benefits. It is not known how well-informed these two

market actor groups are regarding the non-energy benefits of efficient power supplies; but increasing the share of market actors who are knowledgeable and providing them with concrete information on specific financial and operational benefits could only serve to increase demand for—and ultimately the supply and sales of—efficient power supplies.

The market research findings discussed previously suggest a variety of new directions and program modifications that NEEA can adopt to further drive market transformation in the market for energy-efficient computer power supplies. *Recommended initiatives are as follows:*

1. **Promote 80 PLUS Base as a federal standard for power supply efficiency.** The majority of OEMs and SIs interviewed confirmed that they no longer use 80 PLUS Base level power supplies in their commercial desktop PCs, opting instead for 80 PLUS Bronze or higher levels when using 80 PLUS at all. With an 80 PLUS market share estimated at 37 percent, nearly two-thirds of the desktop PCs sold today do *not* have the equivalent of an 80 PLUS Base power supply built into them. Inclusion of the 80 PLUS Base specifications in federal regulations would require a relatively low-cost change in power supply production practices, and it would quickly produce significant energy savings. Just as NEMA Premium™ motor efficiencies, now a standard for many motors categories, were once a reach for motor manufacturers, 80 PLUS may now be sufficiently inexpensive and commonplace to justify inclusion of the related specifications in federal regulations.

2. **Provide incentives only for power supplies that exceed, not just meet, the 80 PLUS Bronze level.** Since ENERGY STAR already requires 80 PLUS Bronze, computer makers are rapidly adopting this level of efficiency. By making 80 PLUS Silver the threshold for incentives, NEEA would limit its support of free riders and would encourage computer makers to push the envelope of what is an affordable and beneficial investment in higher efficiency power supplies. This would necessitate a return to incenting based on 80 PLUS status rather than ENERGY STAR status, which may be a smart move for other reasons as well: upcoming changes in ENERGY STAR rules may lead to drop in the availability of ENERGY STAR qualified machines.

3. **Educate end-users on the non-energy benefits of an 80 PLUS power supply**. End-users already influence computer makers' decisions about sourcing power supplies by requesting ENERGY STAR-labeled machines. This influence could be stronger if NEEA provided commercial end use customers with information and case studies about the non-energy benefits of utilizing an 80 PLUS power supply, including quieter, cooler-operating power supplies that lower failure rates of internal desktop PC components and thus reduce warranty and repair costs.

4. **Promote virtualization through end-user education of both energy and functional benefits.** Virtualization of both desktops and servers has the potential to shift computer usage patterns and offer significant energy and cost savings. Although NEEA is not in the business of influencing customers' information technology decisions, the dissemination of information about virtualization's benefits could indirectly result in higher average power supply efficiencies in the market by promoting increased (and more efficient) use of servers, which tend to have higher efficiency components including power supplies.

APPENDICES

Appendix A: Bibliography

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Appendix B: Market Actor Interview Guides

Appendix B-1: Computer OEM/SI Interview Guide

Hi, my name is _____ with Navigant Consulting. We are not selling anything, but rather we are conducting an evaluation of the 80 PLUS power supply program for the Northwest Energy Efficiency Alliance (NEEA). We are generally interested in trends that your company is experiencing in the energy-efficient power supply market. We received your name and contact information from Ecos Consulting. This may take about 20-30 minutes. Is this a good time? **[IF NOT, SCHEDULE A CALLBACK.]**

Before we begin, I want to assure you that any information that you provide related to your company's sales of 80 PLUS products will remain confidential and will be presented in aggregate with the results of our other interviews to NEEA. There are no right or wrong answers.

Name:
Company:
Title:
What is your role at the company?
Contact info
Date/time of contact 1
Date/time of contact 2
Date/time of interview

Customer Awareness/Demand for 80 PLUS and ENERGY STAR PCs

1. What are the factors influencing commercial customers' purchase decisions for PCs?

   [WAIT FOR ANSWER THEN PROBE FOR SUCH THINGS AS INITIAL UPFRONT COST, LIFETIME COST OF OWNERSHIP, RELIABILITY, SAVINGS TO THE COMPANY? OR OTHER REASONS?]

   - Do these factors vary between desktop PCs and laptops?
   - What about servers?

     [Servers are a small part of the 80 PLUS market but we will probe for server responses throughout this guide]

   a. How important, if at all, is energy efficiency in commercial computer purchasing decisions?

2. What percent of the time do your company's commercial customers specifically request energy-efficient power supplies for desktop PCs?
   - What about servers?

     [PROBE FOR A PERCENTAGE OF CUSTOMERS IF POSSIBLE; APPROXIMATE PERCENTAGE IS OK]

3. In general, do you find that commercial customers who request energy-efficient power supplies identify particular programs or certifications?

   [IF YES PROBE FOR SPECIFICS]

a. How often, if ever, are 80 PLUS qualified PCs specifically requested?
   - How about ENERGY STAR 4.0 PCs?
   - How about ENERGY STAR 5.0 PCs?

   [PROBE FOR A PERCENTAGE OF EACH IF POSSIBLE, APPROXIMATE PERCENTAGE IS OK]

4. Do PSMs promote their 80 PLUS certified power supplies to your company? [PROBE FOR SPECIFIC TYPES OF PROMOTION]

PC Sales and Market Trends

[These questions cover unit sales and trends as a whole, not specifically 80 PLUS sales]

5. What has been the trend over the last 2 to 3 years for your company's sale of desktop PCs? [PROBE FOR INCREASE OR DECREASE AND TO WHAT DEGREE; APPROXIMATE PERCENTAGE IF POSSIBLE]
   - What about the trend for laptop sales?
   - What about the servers your company sells?

   a. Does your company expect these trends to continue for the next 1 to 2 years? [PROBE FOR PCS, LAPTOPS AND SERVERS.]

6. To what extent has the recent US economic downturn influenced the market for desktop PCs over the last 1 to 2 years?
   [This is an optional question already covered in the secondary research – see matrix]
   - How about on the market for laptops?
   - How about servers?

7. Does your company track sales of desktop PCs by customer type, for example commercial versus residential consumer?

   a. If so, what share are commercial sales versus consumer/residential sales?

   [PROBE FOR A PERCENTAGE OF EACH IF POSSIBLE; APPROXIMATE PERCENTAGE IS OK]

80 PLUS qualified PCs

[This section covers sales and trends of 80 PLUS qualified PCs and servers]

8. Does your company use 80 PLUS certified power supplies in the manufacture of its desktop PCs?
   - How about servers?

9. What has been the trend over the last 2 to 3 years for your company's sale of 80 PLUS qualified PCs?
   - What about the 80 PLUS qualified servers it sells?
     [PROBE FOR INCREASE OR DECREASE AND TO WHAT DEGREE; APPROXIMATE PERCENTAGE IF POSSIBLE]

   a. Do you expect these trends to continue for the next 1 to 2 years? (if the answer is no, probe to understand what the next 1 to 2 years' trends is expected to look like and the factors that contributed to such expected trends)
      [PROBE FOR PCS AND SERVERS.]

10. Can you describe any difference in national sales trends versus in the Northwest region specifically?
    [PROBE: DO YOUR SALES TO THE NORTHWEST HAVE A GREATER SHARE OF 80 PLUS QUALIFIED PCS AND SERVERS?]

ENERGY STAR qualified PCs and servers

[This section covers the share of PCs and servers that are 80 PLUS qualified or ENERGY STAR]

11. Approximately what share of the desktop PCs your company sells are 80 PLUS qualified?
    - What about ENERGY STAR 4.0?
    - What about ENERGY STAR 5.0?

    a. Does your company anticipate any changes to this share in the next 1 to 2 years?

       [PROBE TO UNDERSTAND WHAT CHANGES ARE ANTICIPATED, IF ANY]

       [PROBE FOR FUTURE SHARE OF 80 PLUS, ENERGY STAR 4.0 AND 5.0]

    b. Does your company foresee any erosion of the PC market by laptops or vice-versa, or will there be no erosion of one over the other?

       [PROBE FOR AN EXPLANATION]

12. Are you aware that 80 PLUS now certifies different levels of efficiency in power supplies (i.e., 80 PLUS base, bronze, silver, gold, and platinum)? (If the answer is no skip the remaining part of the question) Which types are most common in your commercial PC product mix?
    [PROBE FOR A PERCENTAGE OF EACH IF POSSIBLE; APPROXIMATE PERCENTAGE IS OK]
    - What about in servers?

13. Does your company always claim the incentives available for the sale of 80 PLUS qualified PCs and servers?
    [PROBE FOR PERCENTAGE OF SALES OF ENERGY STAR CERTIFIED PC AND SERVER SALES WHERE 80 PLUS INCENTIVES ARE NOT CLAIMED]

    a. What would need to change regarding the incentives program for you to submit more claims?

Incremental Costs

[This section covers the incremental costs of all levels of 80 PLUS power supplies]

14. Has the incremental cost of an 80 PLUS certified power supply changed over the last two years?
    [PROBE FOR INCREASED, DECREASED OR REMAINED THE SAME AS WELL AS DOLLAR AMOUNT OR PERCENT CHANGE]

    a. What factors have influenced this change?

15. We spoke earlier about the different levels of 80 PLUS power supply certifications. Can you give an approximate incremental manufacturing cost in $US for each of these levels?

    [PROBE FOR INCREMENTAL COST OF EACH LEVEL OVER A NON-80 PLUS MODEL – IF A DOLLAR FIGURE IS GIVEN ASK SOMETHING LIKE –WHAT PERCENTAGE INCREASE DOES THE ADDITIONAL $5 (USE AMOUNT INTERVIEWEE GIVES) FOR A BRONZE 80 PLUS POWER

SUPPLY REPRESENT?" PERCENTAGE INCREMENTAL COST IS ACCEPTABLE IF THEY CANNOT PROVIDE RESPONSE IN DOLLARS]

80 PLUS Base	____$
80 PLUS Bronze	____$
80 PLUS Silver	____$
80 PLUS Gold	____$
80 PLUS Platinum	____$

Looking Forward

[This section is a wrap up section time permitting as it is not linked to our metrics]

16. What do you think energy efficiency advocates, regulators, or others can do to increase the use of energy-efficient power supplies?
    a. What is a realistic goal in the next three years for the share of power supplies that are 80 PLUS certified?
17. What are the barriers to full adoption of 80 PLUS certified power supplies in the future?
18. Do you have any other comments on the market for energy-efficient power supplies that you would like to share?

If necessary would it be possible to speak with you again should I have any follow up questions?

Thank you very much for your time today, those are all of the questions I have.

Appendix B-2: Power Supply Manufacturer Survey

Name:
Company:
Title:
What is your role at the company?

1. How has the recent US economic downturn influenced your company's sales of power supplies over the last 1 to 2 years?

	Increased Sales	Decreased Sales	No Influence
Desktop PCs	☐	☐	☐
Servers	☐	☐	☐

Optional Comment:

2. In the next 1 to 2 years, does your company expect the number of power supplies manufactured for the following to increase, decrease, or remain the same?

	Increase	Decrease	Remain the Same
Desktop PCs	☐	☐	☐
Servers	☐	☐	☐

Optional Comment:

3. Over the past 3 years, what is the general trend in your company's sale of power supplies?

☐ Increased
☐ Decreased
☐ Remained the Same

Optional Comment:

4. Over the past 3 years, what is the trend in your company's sales of power supplies for the following:

	Increased	Decreased	Remained the same
Desktop PCs	☐	☐	☐
Servers	☐	☐	☐

5. If sales have increased or decreased, approximately what percentage does this change represent?

Desktop PCs (% change):
Servers (% change):

6. Does your company expect these trends to continue for the next 1 to 2 years?

	Yes	No
Desktop PCs	☐	☐
Servers	☐	☐

7. What are the key factors that make you believe that the trends will continue?

Desktop PCs:
Servers:

8. Does your company manufacture 80 PLUS certified power supplies for desktop PCs and servers?

☐ Yes - both desktop PCs and servers
☐ Yes - desktops, but not servers
☐ Yes - servers, but not desktops
☐ No - neither desktops nor servers

Optional Comment:

9. What has been the trend over the last 2 to 3 years for your company's sales of 80 PLUS certified power supplies for the following:

	Increased	Decreased	Remained the same
Desktop PCs	☐	☐	☐
Servers	☐	☐	☐

Optional Comment:

10. If increasing or decreasing, approximately what percentage does this change represent?

Desktop PCs (% change):
Servers (% change):

11 . Do you expect these trends to continue for the next 1 to 2 years?

	Yes	No
Desktop PCs	☐	☐
Servers	☐	☐

12. What are the key factors that make you believe that the trends will continue for the next 1 to 2 years?

Desktop PCs:
Servers:

13. Approximately what percent of your company's power supply sales for desktop PCs in 2009 were:

Non-80 PLUS (%):
80 PLUS Base (%):
80 PLUS Bronze (%):
80 PLUS Silver (%):
80 PLUS Gold (%):
80 PLUS Platinum (%):
Unknown (%):

14. Approximately what percent of your company's power supply sales for servers in 2009 were:

Non-80 PLUS (%):
80 PLUS Base (%):
80 PLUS Bronze (%):
80 PLUS Silver (%):
80 PLUS Gold (%):
80 PLUS Platinum (%):
Unknown (%):

15. Over the past 3 years, what is the trend in your company's sales of the following power supplies:

	Increased	Decreased	Remained the Same
Non-80 PLUS	☐	☐	☐
80 PLUS Base	☐	☐	☐
80 PLUS Bronze	☐	☐	☐
80 PLUS Silver	☐	☐	☐
80 PLUS Gold	☐	☐	☐
80 PLUS Platinum	☐	☐	☐
Unknown	☐	☐	☐

16. What are the key factors driving changes in your 80 PLUS qualified power supply sales?

[Open ended question]

17. How has the incremental cost of an 80 PLUS certified power supply changed over the last two years?

☐ Increased
☐ Decreased
☐ Remained the Same

Optional Comment:

18. What is the additional cost over a non-80 PLUS power supply (in rough $US) to manufacture an:

80 PLUS Base ($):
80 PLUS Bronze ($):
80 PLUS Silver ($):
80 PLUS Gold ($):
80 PLUS Platinum ($):

19. Do you have any other comments on the market for energy-efficient power supplies that you'd like to share?

Appendix B-3: End-User Interview Guide

Hi, my name is _____ with Navigant Consulting. We are not selling anything, but rather we are conducting research to understand the decision-making process of key people like yourself when it comes to corporate purchase of desktop PCs and laptops for the Northwest Energy Efficiency Alliance (NEEA). We are generally interested in trends that your company is experiencing in the energy efficient power supply market. We have selected your company because we feel you are a good representative of desktop computer purchasers in the Pacific Northwest. This may take about 20-30 minutes. Is this a good time? [IF NOT, SCHEDULE A CALLBACK.]

Before we begin, I want to assure you that any information that you provide related to your company's purchase of 80 PLUS products will remain confidential and will be presented in aggregate with the results of our other interviews to NEEA. There are no right or wrong answers.

Name:
Company:
Title:
What is your role at the company?
Contact info
Date/time of contact 1
Date/time of contact 2
Date/time of interview

Customer Awareness/Demand for 80 PLUS and ENERGY STAR PCs

1. What are the factors influencing your company's purchase decisions for desktop PCs?

   [WAIT FOR ANSWER THEN PROBE FOR SUCH THINGS AS INITIAL UPFRONT COST, LIFETIME COST OF OWNERSHIP, RELIABILITY, SAVINGS TO THE COMPANY? OR OTHER REASONS?]

   - Do these factors vary between desktop PCs and laptops?
   - What about servers?

   a. How important, if at all, is energy efficiency in your company's computer purchasing decisions?

   b. How would you know if a desktop PC is energy efficient?

      - What about a laptop?
      - What about a server?

2. Are you aware of the 80 PLUS performance specification for power supplies in desktop PCs?

   [THE 80 PLUS PROGRAM INDICATES A POWER SUPPLY SHOULD PROVIDE AT LEAST 80% EFFICIENCY OUTPUT RATE WITH STABILITY DURING 20%, 50% AND 100% LOADING FOR THE BASE MODEL, WITH EACH SUCCESSIVE MODEL, BRONZE, SILVER, ETC. HAVING GREATER LEVELS OF EFFICIENCY]

- What about servers?

a. If yes, how did you become aware of this performance specification?

[Servers are a small part of the 80 PLUS market but we will probe for server responses throughout this guide]

3. Are you aware of the ENERGY STAR qualification for desktop PCs?

   [POWER CONSERVATION REQUIREMENTS SET FORTH BY THE ENVIRONMENTAL PROTECTION AGENCY OF THE U.S. GOVERNMENT. IN ORDER TO DISPLAY THE ENERGY STAR LOGO, DEVICES (PCS, MONITORS, PRINTERS, ETC.) MUST USE LESS THAN 30 WATTS OF POWER WHEN INACTIVE & HAVE AN 85% EFFICIENT POWER SUPPLY (80 PLUS SILVER)]

   [PROBE FOR DIFFERENCES BETWEEN ENERGY STAR 4.0 AND 5.0]

   a. If yes, how did you become aware of this performance specification?

      - What about servers?

4. Does your company request or require 80 PLUS qualified desktop PCs from its vendors in the normal course of computer purchases? [IF YES, PROBE FOR DETAILS LIKE, THE REASONS FOR DOING SO, THE GOALS OF THE REQUIRING THESE PURCHASES, ETC.]

   - What about servers?

   a. What about ENERGY STAR qualified desktop PCs?

      [PROBE FOR DIFFERENCES BETWEEN ENERGY STAR 4.0 AND 5.0]

      - What about servers?

PC and Laptop Sales and Market Trends

[These questions cover unit sales and trends as a whole, not specifically 80 PLUS sales]

Instruction to Interviewers: Inform the respondent that the next series of questions will be about unit sales and trends as a whole, not specifically 80 PLUS sales.

5. What has been the sales trend over the last 2 to 3 years for your company's purchase of desktop PCs? [PROBE FOR INCREASE OR DECREASE AND TO WHAT DEGREE; APPROXIMATE PERCENTAGE IF POSSIBLE]

   a. By what percentage would you say that the purchase of desktop PCs has changed (decreased/increased) over the last 2 to 3 years?

      - What about the trend for laptop purchases? [PROBE FOR SPECIFIC PERCENTAGE CHANGE]
      - What about the trend for servers your company purchases? [PROBE FOR SPECIFIC PERCENTAGE CHANGE]

   b. What are the main causes of the changes (decrease/increase) in the purchase of desktop PCs?

      - What about laptops?
      - What about servers?

c. Does your company expect these trends to continue for the next 1 to 2 years?

[PROBE FOR PCS, LAPTOPS AND SERVERS.]

d. Does your company foresee any erosion of its desktop PC purchases by laptops or vice-versa, or will there be no erosion of one over the other?

[PROBE FOR AN EXPLANATION]

6. Has the recent US economic downturn influenced your company's purchase of desktop PCs over the last 1 to 2 years? If so, how? (probe)
[This is an optional question already covered in the secondary research – see matrix]

- How about the purchase of laptops?
- How about servers?

7. Does your company have locations outside of the Pacific Northwest region of the United States? If no, skip part a of this question.

a. Can you describe any difference in your company's national desktop PC buying trends versus in the Northwest region specifically?

[PROBE: DO YOUR PURCHASES IN THE NORTHWEST HAVE A GREATER SHARE OF 80 PLUS QUALIFIED PCS AND SERVERS?]

ENERGY STAR and 80 PLUS qualified PCs and servers

[This section covers the share of desktop PCs and servers that are 80 PLUS qualified or ENERGY STAR]

Instruction to Interviewers: Inform the respondent that the next series of questions will be about PCs and servers that are 80 PLUS qualified or ENERGY STAR.

8. Approximately what share of the desktop PCs your company buys are 80 PLUS qualified?

- What about ENERGY STAR?

[PROBE FOR DIFFERENCES BETWEEN ENERGY STAR 4.0 AND 5.0]

b. Does your company anticipate any changes to this share in the next 1 to 2 years? [PROBE TO UNDERSTAND WHAT CHANGES ARE ANTICIPATED, IF ANY]

[PROBE FOR FUTURE SHARE OF 80 PLUS, ENERGY STAR 4.0 AND 5.0]

Incremental Costs

9. Are you aware of any incremental costs associated with the purchase of 80 PLUS qualified desktop computers? [IF YES, PROBE FOR DETAILS, EXAMPLES, ETC.]

- What about servers?

10. Are you aware of any incremental costs associated with the purchase of ENERGY STAR certified desktop computers? [IF YES, PROBE FOR DETAILS, EXAMPLES, ETC.]

- What about servers?

11. Is your company willing to pay more for an 80 PLUS qualified desktop computer?
    a. Roughly how much more in $US per unit is your company willing to pay?
12. Is your company willing to pay more for an ENERGY STAR qualified desktop computer?

    [PROBE FOR DIFFERENCES BETWEEN ENERGY STAR 4.0 AND 5.0]

    a. Roughly how much more in $US per unit is your company willing to pay?

Looking Forward

13. What do you think would encourage your company to increase the use of energy-efficient power supplies?
14. What do you think energy efficiency advocates, regulators, or others can do to increase the use of energy-efficient power supplies?
15. Do you have any other comments on the market for energy-efficient power supplies that you would like to share?

If necessary, would it be possible to speak with you again should I have any follow up questions?

Thank you very much for your time today those are all of the questions I have.

Appendix C: Market Actor Interview Results

Appendix C-1: Computer OEM/SI Interview Results

1. What are the factors influencing commercial customers' purchase decisions for PCs?
[Open ended question – response categories assigned by interviewer based on verbatim responses]

	OEMs		SIs	
	#	%	#	%
Battery life	1	20%	0	0%
Energy efficiency/savings	3	60%	2	40%
ENERGY STAR certification	3	60%	0	0%
Environmental concerns	2	40%	0	0%
EPEAT certification	1	20%	0	0%
Features	1	20%	0	0%
Form factor	0	0%	1	20%
Low noise	0	0%	1	20%
Performance	0	0%	2	40%
Price/cost	1	20%	3	60%
Product aesthetics	0	0%	1	20%
Product quality	0	0%	1	20%
Reliability	1	20%	2	40%
Security	1	20%	0	0%
Warranty cost	1	20%	0	0%
Total	5	100%	5	100%

*Respondents can provide more than one response, so percentages may not sum to 100%.

OEM Verbatim Responses:

- A lot of it is based on ENERGY STAR and EPEAT registered, servers - n/a getting out of servers
- A majority of time working environmental stuff is ENERGY STAR validation, public sector requests ENERGY STAR, Disney for instance is very environmentally focused
- Don't sell traditional desktops - the reason folks go with us is desktop management business. Lots of failure in desktops and [our products] eliminate failure, virtualized desktops. Saves many, many hours in maintenance. Soft factors are power (huge) go from 100-200 watts to 4 watts on average, one customer documented 130k in utility costs per year. 22 year failure rate. 10-12 hour life on laptops.
- First and foremost, commercial customers demand that products are ENERGY STAR qualified. The customers are more knowledgeable and some of the environmental attributes being energy efficiency of IT equipment. There's enough info from the web and emerging sustainability programs, they are looking to reduce their energy footprint and one of the easiest ways to do that is to buy more efficient electronics. Most recognized is ENERGY STAR. Looking at product carbon footprint (end-to-end lifecycle analysis that covers how the materials are sourced) all the way to the usage and the biggest

SI Verbatim Responses:

- Energy savings is a big concern, more people cognizant of it. Used 80 PLUS to separate themselves.
- Price
- Price, perception of reliability, form factor, performance
- Primarily reliability, lots need the assurance that system won't go down or be replaced quickly, second is low hassle, don't need support, just want system to work correctly
- Some of the factors

contributor is energy and then the recyclability at the end of life. We get those end-to-end questions all the time.

- Number 1 is warranty cost. Warranty cost is as much as pc cost - upfront cost. Public purchases are influenced by perverse incentives. Large enterprise is feature driven, spec driven for large fleets, Sarbanes Oxley security, etc. Manageability of fleet. Costs around pcs, efficiency, software into and onto pc. "How much energy does this thing burn?" Looking to make PC sip energy when they are off and be efficient when in use.

include power efficiency, low noise, product performance, product aesthetics, product quality, and cost.

1. Do these factors vary between desktop PCs, laptops, and servers?

	OEMs		SIs	
Laptops	**#**	**%**	**#**	**%**
Yes	1	20%	2	40%
No	3	60%	2	40%
Don't Know	1	20%	1	20%
Total	5	100%	5	100%

	OEMs		SIs	
Servers	**#**	**%**	**#**	**%**
Yes	2	40%	3	60%
No	2	40%	2	40%
Don't Know	1	20%	0	0%
Total	5	100%	5	100%

OEM Verbatim Responses:

- Doesn't matter - education and government RFQs all ask for EPEAT and ENERGY STAR
- Energy efficiency is important across the board - we are keenly sensitive to that. 5-6 years ago, price and performance were the two most critical buying criteria, and now energy efficiency has creeped up very near the top of the purchasing decision tree. It comes down to how many kW you can save in the year.
- Not familiar for requirements of notebooks, doesn't know anything about servers, has tool for carbon calculator for products up to three years old to show $ and footprint, return on investment (ROI) calculator shows the difference to customers
- Our solution is 100% dependent on servers - absolutely continue power story into data center. We defined servers as most eco-friendly - power, cooling and performance and space in datacenter - we wins with this definition. Total cost of server is big metric. SWAP - space wattage and performance. Our products come in laptop format but they are just virtualized laptops going back to server
- Yes, laptop conversation is never about efficiency of laptop. $4 for a [laptop we produce] per year in energy, $7 maxed. Desktops are 30 - 100$ per year. Features y axis x axis is cost. Implicitly assumed that you can run all of the software needed. 9 different operating systems on servers 2 on a pc - really 1 windows on a pc. Many different versions of server operating systems is most important factor - does your server deliver the capabilities you are

SI Verbatim Responses:

- Form factor has more influence in laptops and perception of reliability in servers.
- No, it's hard to say - not many commercial laptops sold, niche is desktop. Definitely true that stability and reliability are most important - true with server even more than desktop
- There is a major shift to mobile devices fundamental shift industry wide for flexibility. Creating content is PCs niche, viewing content is mobile, energy savings is a big discussion with servers - very critical

looking for, then cost. Energy cost is $100's per year so energy costs are a big factor. Redundancy is important so there are multiple power supplies. Servers sit in the revenue stream of organizations - production servers. Least visibility into efficiency because they are so necessary, can't fail. Lower used servers place a higher value on efficiency low activity on all the time.

90+ power supplies in these.

- These factors do not vary between PCs, laptops or servers.

1a. How important, if at all, is energy efficiency in commercial computer purchasing decisions? [Open ended question – response categories assigned by interviewer based on verbatim responses]

	OEMs		SIs	
	#	%	#	%
Very important	2	40%	1	20%
Important	3	60%	1	20%
Not important	0	0%	3	60%
Total	5	100%	5	100%

OEM Verbatim Responses:

- Boiler plate at this point
- Facilities departments pay the bill Information Technology departments spend the money. Large enterprise is now mitigating their energy usage due to cost and availability
- Very high
- Very important - I get energy consumption questions all the time. Probably answered half a dozen or a dozen in the last week alone.

SI Verbatim Responses:

- At this time, we have seen that overall clientele do not consider energy efficiency as a factor. Larger clientele that operate data centers are more concerned as energy wastes affects their bottom line profits directly.
- Critical
- Heard it once or twice, but not often, fraction of a percent of people inquiring, secondary concern, nice if you can get it
- Important for public sector clients
- Somewhat
- Very little

2. What percent of the time do your company's commercial customers specifically request energy-efficient power supplies for desktop PCs? What about servers?

	OEMs		SIs	
Desktop PCs	#	%	#	%
0%	0	0%	2	40%
20%	1	20%	0	0%
50%	0	0%	2	40%
80%	1	20%	0	0%
90%	1	20%	0	0%
100%	0	0%	1	20%
No response	2	40%	0	0%
Total	5	100%	5	100%

Servers	OEMs		SIs	
	#	%	#	%
0%	0	0%	2	40%
40%	0	0%	1	20%
50%	0	0%	1	20%
90%	2	40%	0	0%
No response	3	60%	1	20%
Total	5	100%	5	100%

OEM Verbatim Responses:

- 80% of time. 90% servers
- Don't get specific requests just whole PC needs to be ENERGY STAR. All PCs are ENERGY STAR rated - 100% desktop are ENERGY STAR. Small enclosure designs make light, efficient power supplies necessary
- Equivalent to ENERGY STAR = 18%. We use 80 plus as a distinguishing point - two new 2700 power supplies on website are at platinum. ENERGY STAR doesn't help us out, only power supply uses energy. Efficiency is really energy in not ENERGY STAR rating. Ratcheting up power supply efficiency because that saves energy. 94% is max efficiency without some new unknown technology.
- Not necessarily power supplies, but ENERGY STAR - conservatively 30-40% of time
- Power supplies in general - one of our primary objectives is to qualify as many of our products to ENERGY STAR and the base requirement is 85% for desktop computers and notebooks - we try to stay ahead of the curve, and most of ours are somewhere between 88 to 90% in anticipation of more stringent ENERGY STAR requirements. We won't have any lag time or dead period where our products don't meet EStar requirements. We get the requests in two ways - probably somewhere in the 90th percentile of our customers demand that our products be EStar qualified, particularly enterprise customers. We also participate in the Climate Savers program and the basis of that program is also power supply efficiency. They are up at 85% at bronze level. Most of our products are bronze or silver. Climate Savers and 80 PLUS have the same rating system - we currently participating in the 80 PLUS program as well and probably over the last 8 to 9 months we have been qualifying all our power supplies. It's voluntary, it's an expense to do that, but it's something they ask for specifically.

SI Verbatim Responses:

- 1% or less for desktops - 1% also on servers - we tend to sell just a couple servers rather than many servers
- It is a line item when purchasing (always) - expected to have energy efficient power supplies. Don't even ask but puts in an 80 PLUS power supply, reliability is better and better experience. Rebates were a great incentive to get into 80 PLUS program. Sales reps were awarded rebates dollars as a sales incentive.

3. In general, do you find that commercial customers who request energy-efficient power supplies identify particular programs or certifications?

	OEMs		SIs	
	#	%	#	%
Yes – 80 PLUS and ENERGY STAR	2	40%	3	60%
Yes – 80 PLUS only	0	0%	0	0%
Yes – ENERGY STAR only	2	40%	0	0%
No, they don't request specific programs/certifications	1	20%	2	40%
Total	5	100%	5	100%

OEM Verbatim Responses:

- Definitely EPEAT and ENERGY STAR. Initially VA Tech University requested 80 PLUS specifically. "80% is a downgrade at this point."
- East and west coast it is 80 PLUS, middle asks how do you know it is efficient and we tell them about 80 PLUS and ENERGY STAR. Central United States just has not been brought up to speed on ENERGY STAR and 80 PLUS. I point people to 80 plus website.
- ENERGY STAR
- No. Our products are ENERGY STAR rated but customers don't care
- The big ones are ENERGY STAR, 80 PLUS, and Climate Savers computing initiative. Climate Smart is the one covers data centers. Started as a collaboration between Google and Intel, maybe 3-4 years ago.

SI Verbatim Responses:

- 80 PLUS, ENERGY STAR
- It is usually in bid requirements generally call out equally 80 PLUS and ENERGY STAR 50/50 split. No ENERGY STAR 4.0 any more
- Not sure that I would say yes, some recognize 80 PLUS but energy efficient is buzz word

3a. How often, if ever, are 80 PLUS qualified PCs specifically requested? What about ENERGY STAR 5.0?

	OEMs		SIs	
80 PLUS	#	%	#	%
0%	2	40%	1	20%
20%			1	20%
30%			1	20%
40%	1	20%		
50%			2	40%
No Response	2	40%		
Total	5	100%	5	100%

ENERGY STAR 5.0	OEMs		SIs	
	#	%	#	%
0%	1	20%	1	20%
30%			1	20%
50%			2	40%
100%	2	40%		
No Response	2	40%	1	20%
Total	5	100%	5	100%

OEM Verbatim Responses:

- 80 plus has only been around 3 years maybe…so they are still in the process of getting some notoriety and making a name for themselves. And it depends on the customer - large enterprise customers who have people who work specifically on their sustainability all are pretty much familiar with these programs. Maybe 35-40% of the market. They'll have multiple criteria in a big package and you'll want to be able check off as many boxes as possible. Everyone asks for ENERGY STAR - it's a base requirement. Some people do associate 80 PLUS with the ENERGY STAR.
- 80 PLUS was not specifically talked about when it was only one level, now that there is gold it is back in environmental messaging, people don't know the difference between ENERGY STAR and 80 PLUS - just know they want an energy efficient power supply. ENERGY STAR over 80 PLUS, ENERGY STAR is very consumer oriented.
- Frequently with fortune 500 companies, less so with fortune 1000 companies. Public procurement, university and city government, Poland and Brazil request 80 PLUS. Federal government customers request ENERGY STAR and EPEAT. We would like 80 PLUS to be accredited whether ISO or not. Likes that it is an independent third party and utilities trust them. Utilities are our biggest customer, not ENERGY STAR. No one buys to ENERGY STAR 4.0 no one asks for level specifically.
- Nobody has ever requested ENERGY STAR or 80 PLUS
- Typically all are requested to be ENERGY STAR

SI Verbatim Responses:

- ENERGY STAR is a more universally known brand than 80 PLUS. General customer knowledge is ENERGY STAR, PC buyer knows 80 PLUS
- Never 80 PLUS, ENERGY STAR is a more identifiable brand. Don't know breakdown of commercial vs. business - do lots of website sales and promote 80 PLUS and ENERGY STAR. Many customers probably answer their own questions about power usage

4. Do power supply manufacturers promote their 80 PLUS certified power supplies to your company?

	OEMs		SIs	
	#	%	#	%
Yes	0	0%	3	60%
No	5	100%	2	40%
Total	5	100%	5	100%

OEM Verbatim Responses:

- No - we have more than one vendor. We give them testing standards to make things, don't buy off-the-shelf supplies. At the end of the day we specify the power supply.

SI Verbatim Responses:

- Definitely. Pretty constant with Seasonic. Save $10-$15 to go to cheap power supply. Don't fail like non-80 PLUS power supplies.

- No, they pretty much build what you specify. The average energy efficiency of a desktop was 70% going down before ENERGY STAR 4. Millions of power supplies were being produced with no real energy criteria, basically built on cost. It was a real jolt for the industry. The transition was quite an adjustment for everyone but prices came down.
- Power supply manufacturers execute our designs
- We drive this. "Power supply manufacturers would quote 1950s technology!"
- Direct selling
- Power supply manufacturers do not promote their 80 PLUS power supplies to our company. But, we can locate typically within their respective websites if needed.
- Sales people do, but we make very deliberate purchases. 95% go out with same power supply, all certified by 80 PLUS - they don't advertise this to them anymore.

5. What has been the trend over the last 2 to 3 years for your company's sale of desktop PCs? [Open ended question – response categories assigned by interviewer based on verbatim responses]

Desktop PC Sales Trends	OEMs		SIs	
	#	%	#	%
Increased significantly	2	40%		
Increased	1	20%	3	60%
Stayed the same	1	20%	1	20%
Decreased	1	20%		
Decreased significantly	0	0%	1	20%
Total	5	100%	5	100%

Desktop PC Sales Percentage Change	OEMs		SIs	
	#	%	#	%
-30%	0	0%	1	20%
0%	1	20%	1	20%
+10%	0	0%	1	20%
+40%	0	0%	1	20%
+100%	1	20%	0	0%
+30% over last three quarters	1	20%	0	0%
Don't Know	2	40%	1	20%
Total	5	100%	5	100%

OEM Verbatim Responses:

- Desktops have been level or declining, laptops continue to rise. People like handheld devices. Desktops will not be as voluminous.
- All official numbers are at Gartner but could say every year since 2004 growth in the virtualized PC sales has doubled
- Overall up in volume but notebooks and tablets up more as a percentage of sales moving to more mobile, desktops not growing
- Up every year, growing in a declining market. This year we blew it out of water, IDC had to change numbers average is 1-2% growth but this

SI Verbatim Responses:

- Definitely flat at best
- Last couple of years seen pretty consistent growth bit of a dip in 08 & 09 but more like a plateau for them, overall sales increasing mostly desktops. 40% since 2008, 2008 was bottom of dip though. 10-15 % vs. 2007. We

year it is higher • We've seen quite a spike in desktop sales, and I'm not sure what the reason has been for that - one may be price, and also the energy efficiency and features have improved. 2-3 years ago, sales were pretty flat, but now the last 3 quarters has seen maybe a 30% spike in sales.	don't compete on $400 systems

5. What has been the trend over the last 2 to 3 years for your company's sale of laptops? What about servers? [Open ended question – response categories assigned by interviewer based on verbatim responses]

	OEMs		SIs	
Laptops	**#**	**%**	**#**	**%**
Increased significantly	0	0%	1	20%
Increased	3	60%	1	20%
Stayed the same	1	20%	1	20%
Decreased	0	0%	1	20%
Don't Know	1	20%	1	20%
Total	5	100%	5	100%

	OEMs		SIs	
Laptops Percentage Change	**#**	**%**	**#**	**%**
+30%	0	0%	1	20%
Don't Know	5	100%	4	80%
Total	5	100%	5	100%

	OEMs		SIs	
Servers	**#**	**%**	**#**	**%**
Increased significantly	1	20%	0	0%
Increased	1	20%	5	100%
Don't Know	3	60%	0	0%
Total	5	100%	5	100%

	OEMs		SIs	
Servers Percentage Change	**#**	**%**	**#**	**%**
+30%	0	0%	1	20%
+60%	0	0%	1	20%
Don't Know	5	100%	3	40%
Total	5	100%	5	100%

OEM Verbatim Responses:

- Don't know year over year
- Laptop sales continue to increase and server sales year over year are always higher. Server architecture over last three years has improved efficiency greatly. Blade servers now have platinum power supplies in them. The gamble is that customers are going to adopt high efficient power supplies – we will only get platinum power supplies for future power supplies in servers. We sell more servers year over year - 2014 all health records will be digital. 13% per year smart grid. Lots more mobile devises and a lot more servers.
- Laptops are the same. Server sales moving differently because of a recent acquisition. Moving away from volume sales into [redacted brand name] database servers all inclusive in a rack. Can't make these new servers fast enough.
- Our bread and butter has been notebook sales for a number of years - we sell millions - both consumer and commercial. That's the highest volume. Workspace in the average office is decreasing so that's trending toward laptops. We're just getting our feet with servers, and we're in the entry level market for those. 1u, 2u, rack mount systems, and also desktop format. We expect hopefully that our market share will grow over time.
- Up and continue, smaller lighter more efficient

SI Verbatim Responses:

- Laptops is greatly increasing now 50/50 split. Solid server, most growth is in servers, make lots of money on servers
- Stayed the same, shrunk as a percentage of business, sales numbers are the same

5a. Does your company expect these trends to continue for the next 1 to 2 years?

	OEMs		SIs	
Desktop PCs	**#**	**%**	**#**	**%**
Yes	5	100%	4	80%
No	0	0%	1	20%
Total	5	100%	5	100%

	OEMs		SIs	
Laptops	**#**	**%**	**#**	**%**
Yes	4	80%	3	60%
No	0	0%	1	20%
Don't Know	1	20%	1	20%
Total	5	100%	5	100%

	OEMs		SIs	
Servers	**#**	**%**	**#**	**%**
Yes	2	40%	5	100%
No	0	0%	0	0%
Don't Know	3	60%	0	0%
Total	5	100%	5	100%

OEM Verbatim Responses:

- We hope that servers will grow over time. Added

SI Verbatim Responses:

- 1-2 years would like to see consistent strength in

servers in the last year and half. Probably out of my area of expertise. Not sure what the market intelligence is. I'm certain the market will continue to thrive for the laptop business, and server business is thriving.

- Yes - healthcare, smart grid and mobility/cloud computing will drive laptop and server sales. Desktops are becoming more of niche markets, i.e. gaming, Photoshop, etc. Yes - trends continue due to smart grid, healthcare…
- Yes - we would hope so
- Yes. [Redacted brand name] and [Redacted brand name] servers are the new virtualization servers we have. [Redacted brand name] partnership with [Redacted brand name] to put them into the cloud. These are the most energy efficient servers on market.

desktops and servers increase. In 10 years desktops will decline

- no, virtualization will kill the desktop as we know it
- Totally. Desktop mobile cat's is out of bag, now companies buying notebooks, tablets, netbooks, iPads, iPhones and smartphones
- Yes, we expect these trends to continue. One reason is due to price pressure by larger PC manufacturers. The trend has been moving PCs towards a sort of devalued commodity of which our company has decided to not pursue. For servers, there is a significant interest in what we do. We differentiate ourselves by offering flexibility and world-class OEM/ODM capability.
- Yes. Competitive landscape

6. To what extent has the recent US economic downturn influenced the market for desktop PCs, laptops, and servers over the last 1 to 2 years? [Open ended question – response categories assigned by interviewer based on verbatim responses]

	OEMs		SIs	
Desktop PCs	**#**	**%**	**#**	**%**
Increased sales somewhat	1	20%	0	0%
Minimal influence	1	20%	1	20%
Decreased sales somewhat	2	40%	1	20%
Decreased sales significantly	0	0%	1	20%
Don't know/not applicable	1	20%	2	40%
Total	5	100%	5	100%

	OEMs		SIs	
Laptops	**#**	**%**	**#**	**%**
Minimal influence	2	40%	0	0%
Decreased sales somewhat	2	40%	1	20%
Don't know/not applicable	1	20%	4	80%
Total	5	100%	5	100%

	OEMs		SIs	
Servers	**#**	**%**	**#**	**%**
Minimal influence	1	20%	1	20%
Decreased sales somewhat	2	40%	2	40%
Don't know/not applicable	2	40%	2	40%
Total	5	100%	5	100%

OEM Verbatim Responses:

- For us it is hard to tell because we are picking up market share, price point is high
- Influenced our market in two ways. People look to us to save money - they are interested in the technology because of the down economy. But… lots of deals went away because of economy, not a loss but just an evaporated deal
- It wasn't necessarily volume part that was the hardest; was memory cost increases, budgets got smaller
- People are holding on to systems longer. Energy consumption is invisible at this point. The smart grid should reveal this to people. Pc will be used to process their smart grid data. Corporations have gone from 3 year churn to 4-5 year churn.
- We get business results on a quarterly basis and we have been outperforming in the US and international markets. Upward trends in our desktop sales.

SI Verbatim Responses:

- Customers are choosing configurations with lower ASPs, so units have increased while revenue is challenged
- Definitely causing people to be price sensitive, longer service life
- Hit low end of market really hard, high end business systems still needed high end hardware but limped along on old beater a little longer

7. Does your company track sales of desktop PCs by customer type, for example commercial versus residential consumer?

	OEMs		SIs	
	#	%	#	%
Yes	5	100%	3	60%
No	0	0%	2	40%
Total	5	100%	5	100%

	OEMs		SIs	
% Commercial	#	%	#	%
30%	0	0%	1	20%
50%	1	20%	0	0%
70%	2	40%	0	0%
90%	0	0%	1	20%
100%	1	20%	1	20%
Don't know	1	20%	0	0%
Not tracked	0	0%	2	40%
Total	5	100%	5	100%

OEM Verbatim Responses:

- No residential customers- largest customer is the federal government. Our servers are most secure in the world - classified networks everywhere.
- Education, government, all same product. Lots of commercial buyers buy from the store but this is a small portion of overall sales - mostly residential sales. Trying to be more enterprise friendly
- Track it separately then split it further between business like healthcare, education, etc. - split 50-50% but varies by quarter
- We do - we have two market segments: commercial customers that only buy our [redacted] brand and we also have consumer customers who have [redacted] brand that make into the commercial sector as well.
- Yes. Do not know share off top of head. We shoot for 50-50 split but consumer base is more like 30% residential and 70% commercial

SI Verbatim Responses:

- 50% education, k-12 and universities, government 15%, commercial 15%, reseller 20% to non-educational and & residential (10% each)
- commercial = 15%, public sector = 85%
- N/A
- No - guess would be 30% commercial is stab in the dark
- We do not track by customer type.

8. Does your company use 80 PLUS certified power supplies in the manufacture of its desktop PCs and servers?

	OEMs		SIs	
Desktop PCs	**#**	**%**	**#**	**%**
Yes	3	60%	4	80%
No – but meets technical specification	1	20%	1	20%
Don't know	1	20%	0	0%
Total	5	100%	5	100%

	OEMs		SIs	
Servers	**#**	**%**	**#**	**%**
Yes	2	40%	3	60%
No	0	0%	2	40%
Don't know	3	60%	0	0%
Total	5	100%	5	100%

OEM Verbatim Responses:

- I don't know. Our company claims to have energy efficient power supplies but I do not believe they are 80 PLUS certified
- No, but they meet the technical requirement
- Yes for desktops and workstation, not sure for servers. Most servers need to work 24/7 and they need to run cool, quiet - I think power supply efficiency has been in the 88-90% range for a while - those types of attributes have been in servers longer than desktops.
- Yes. Servers are more a la cart - servers we're looking at 80 PLUS

SI Verbatim Responses:

- No - neither desktop PCs nor servers
- Yes - 80 PLUS used in both desktop PCs and servers
- Yes - desktop PCs only, not servers
- Yes. 99.5% have 80 PLUS. Decision to make quiet computers this lends to 80 PLUS, high end power supply with low heat fit 80 PLUS. Servers - Yes, but not only like in desktops

9. What has been the trend over the last 2 to 3 years for your company's sale of 80 PLUS qualified desktop PCs? [Open ended question – response categories assigned by interviewer based on verbatim responses]

	OEMs		SIs	
Desktop PCs	**#**	**%**	**#**	**%**
Increased	2	50%	2	50%
Stayed the same	1	25%	2	50%
Don't Know	1	25%	0	0%
Total*	4	100%	4	100%

*Includes any respondent that sells 80 PLUS certified or equivalent desktop PCs.

OEM Verbatim Responses:

- Doesn't measure it other than for Ecos, more measure for ENERGY STAR
- Going up. Trying to reach 90%. Levels recently all were 84-85% before, now all are 88-89% efficiency
- Sale of 80 PLUS power supplies is going up. ENERGY STAR is leveling off. 80 PLUS is an easy sale. ENERGY STAR brand is harder to sell and cost and complexity is high. 80 PLUS is very straight forward ENERGY STAR is complicated.
- We only started certifying our power supplies to 80 PLUS last year - when the ENERGY STAR requirement changed, they started asking about 80 PLUS and so we saw that the additional costs of 80 PLUS certification is worth it. There's no category of our computers that you can't specify to be 80 PLUS.

SI Verbatim Responses:

- Due to the poor economic situation, clients (of all sizes) have begun requesting more efficient power supplies to save on operating costs.
- Majority of sales are 80 PLUS - 80% or more have 80 PLUS
- Yes, should get better, power factor should move to gold and platinum

9. What has been the trend over the last 2 to 3 years for your company's sale of 80 PLUS qualified servers? [Open ended question – response categories assigned by interviewer based on verbatim responses]

	OEMs		SIs	
Servers	**#**	**%**	**#**	**%**
Increased	1	50%	3	100%
Don't Know	1	50%	0	0%
Total*	2	100%	3	100%

*Includes any respondent that sells 80 PLUS certified or equivalent servers.

OEM Verbatim Responses:

- n/a
- No measure - few servers have 80 PLUS
- Not sure - our servers team is based in China.
- Trending up also.

SI Verbatim Responses:

- Same for servers
- Servers tend to be ventilated server rooms with integrated power supplies, if they have a modulated power supply then they use 80% - 80% 80 PLUS

9a. Do you expect these trends to continue for the next 1 to 2 years?

	OEMs		SIs	
	#	%	#	%
Yes	3	75%	4	100%
Don't Know	1	25%	0	0%
Total*	4	100%	4	100%

*Includes any respondent that sells 80 PLUS certified or equivalent desktop PCs and/or servers.

OEM Verbatim Responses:

- Our plans are to certify all our power supplies to the 80 PLUS protocol. We post that information on our website and position it as a very important attribute.
- Reaching point of diminishing returns on efficiency - 90% average efficiency is a threshold to meet going forward "declare victory at that point", that said still looking at other technology that doesn't grow size or double cost

SI Verbatim Responses:

- Yes eventually 100%

10. Can you describe any difference in national sales trends versus in the Northwest region specifically? [Open ended question – response categories assigned by interviewer based on verbatim responses]

	OEMs		SIs	
	#	%	#	%
All products have 80 PLUS, therefore no regional variations	1	25%	1	25%
No regional variations based on available data	1	25%	0	0%
Do not have regional sales data/can't comment	2	50%	3	75%
Total*	4	100%	4	100%

*Includes any respondent that sells 80 PLUS certified or equivalent desktop PCs and/or servers.

OEM Verbatim Responses:

- I'm sure there are some stats somewhere but not tracked. East and West coasts purchase more of our products
- It appears to be fairly uniform. We see multinational companies with presences across the US.
- No we track sales only to the level of North America and not finer
- The lens is viewed by business stack, not region. West coast and Northwest regions parallel each other and these trends migrate east.
- The only thing I can say is that most of participating utilities are in NW but cannot speculate on sales

SI Verbatim Responses:

- Can't really break it down that way
- Insufficient data to answer
- No, all power supplies are 80 PLUS

11. Approximately what share of the desktop PCs and servers your company sells are 80 PLUS qualified?

	OEMs		SIs	
Desktop PCs	**#**	**%**	**#**	**%**
6%	0	0%	1	25%
11%	1	25%	0	0%
50%	1	25%	0	0%
60%	0	0%	1	25%
75%	1	25%	0	0%
80%	0	0%	1	25%
99.5%	0	0%	1	25%
100%	1	25%	0	0%
Total*	4	100%	4	100%

*Includes any respondent that sells 80 PLUS certified or equivalent desktop PCs.

	OEMs		SIs	
Servers	**#**	**%**	**#**	**%**
30%			1	33%
90%	1	50%		
Don't Know	1	50%	2	67%
Total*	2	100%	3	100%

*Includes any respondent that sells 80 PLUS certified or equivalent servers.

OEM Verbatim Responses:

- 100%. Applying energy efficiency requirements to all devices, chargers, external power supplies, etc. displays 88-89% efficient displays. Right thing to do just do it
- Desktop pcs and workstations - bet 10-12% servers are 90%.
- Her mix was 75% 80 PLUS (45% of business) mainstream products 50-50 (35% of business), remainder is non-80 PLUS. ENERGY STAR goes down a tad bit from 80 PLUS numbers, good reasons to do an energy efficient power supply but not always ENERGY STAR - 5-10% less ENERGY STAR
- None
- Right now probably about 50%. A few months ago it was about 44%, and I would say it's at least 50% and going up. When we source power supplies, we buy thousands of them at a time, and for a while we work off our existing supplies.

SI Verbatim Responses:

- 30% servers
- 99.5% 80 PLUS, don't know ENERGY STAR

11. What share of the desktop PCs your company sells are ENERGY STAR 5.0 qualified?

Desktop PCs	OEMs		SIs	
	#	%	#	%
0%	0	0%	1	25%
50%	1	25%	1	25%
60%	0	0%	1	25%
68%	1	25%	0	0%
100%	1	25%	0	0%
Don't know	1	25%	1	25%
Total*	4	100%	4	100%

*Includes any respondent that sells 80 PLUS certified or equivalent desktop PCs.

OEM Verbatim Responses:

- 100% of [product name] are. All [product name] are ENERGY STAR 5.0 category A, EPEAT silver. Device is 98% recyclable. [product name] does not have an internal power supply only external.
- Less - we have a product line which is 80 PLUS but not ENERGY STAR, no one buys 4.0 ENERGY STAR. ENERGY STAR is down. ENERGY STAR program is a politically driven program. Lots in industry not real happy with ENERGY STAR. Top tier distinction is frustrating. Seriously concerned at the viability of program going forward.
- Once ENERGY STAR standard is changed it is ENERGY 5.0 or bust, 4.0 goes away
- Probably at that 50% level. We have some customers that buy just on price and performance. Gartner has done a similar study. Pretty much the industry average.

SI Verbatim Responses:

- 50% rebate for ENERGY STAR so that is trending up, all 5.0 now
- 99.5% 80 PLUS, don't know ENERGY STAR. Extra level of complexity to get $2 ENERGY STAR rebate - doesn't have independent ENERGY STAR compliant info

11a. Does your company anticipate any changes to this share in the next 1 to 2 years? [Open ended question – response categories assigned by interviewer based on verbatim responses]

	OEMs		SIs	
	#	%	#	%
No change anticipated to 80 PLUS or ENERGY STAR share	2	40%	1	20%
ENERGY STAR share *may* drop with new requirements	3	60%	1	20%
80 PLUS share *may* increase if costs drop	0	0%	1	20%
Don't Know/Not Applicable	0	0%	2	40%
Total	5	100%	5	100%

OEM Verbatim Responses:

- 80 PLUS up and ENERGY STAR down as ENERGY STAR is getting more complicated, 80 PLUS is superior to ENERGY STAR. The Electric Power Research Institute (EPRI) understands watts, etc. ENERGY STAR staff are not engineers.
- Depends on how this newly implemented program they have goes across. It's been a voluntary program, and we've been able to self-certify our products. Starting in January, it's third-party

SI Verbatim Responses:

- 100% 80 PLUS but big concerns with ENERGY STAR 6.0 because of lab certification, will see a shift to selling others systems like ours. ENERGY STAR certified machine sales could drop after a peak of 5.0
- We do not anticipate changes unless

certification. Now it's gonna cost companies to be ENERGY STAR certified. Customers will still demand it, so it'll be interesting to see what the industry goes through.

- Major concern with ENERGY STAR is requirements with features that can't be revealed with new levels (company confidentiality issues). If everything goes well continue at 100%. High quality displays i.e. require more power so if displays are in new ENERGY STAR 6.0 specification it could bump them out
- No - key tenet is power friendly
- No. The EPA doesn't want more that 25% of shipments to be ENERGY STAR 6.0, when technology catches up EPA makes it harder

power supply manufacturers experience a decrease in cost to produce this type of technology. Should the costs to manufacture energy efficient power supplies decrease, there should be additional & improved product offerings from those manufacturers. Should this occur, our company will definitely take advantage of offering more energy efficient products.

11b. Does your company foresee any erosion of the PC market by laptops or vice-versa, or will there be no erosion of one over the other? [Open ended question – response categories assigned by interviewer based on verbatim responses]

	OEMs		SIs	
	#	%	#	%
No erosion anticipated	2	40%	0	0%
Desktop PC market will be eroded by laptops	2	40%	3	75%
Desktop PC market will be eroded by virtualization	1	20%	0	0%
Don't Know	0	0%	1	25%
Total*	5	100%	4	100%

*Includes any respondent that sells 80 PLUS certified or equivalent desktop PCs.

OEM Verbatim Responses:

- Desktops will hang on. There was a period in the past that it was significantly eroded. Now we have a desktop computer with a footprint that's not much bigger than the laptop, just not mobile. We've conquered those hurdles and maintained hurdles.
- IDC predicted notebooks taking over but year over year we prove that wrong - past experience would say no
- Virtualization will erode traditional desktop - we hope to erode the traditional PC market
- Yeah definitely
- Yes, people like portability and cloud computing will help with performance issues

SI Verbatim Responses:

- Long term yes, laptops will erode PC sales. Once upon a time video games and editing machines needed to be desktops, now you can get by- niches still require desktops, lots of people make buying decisions on what they could possibly do so desktops are still relevant, 5-10 years you will see lots of mobile devises
- We do foresee an erosion of the PC market by laptops. Today's and near future laptops possess significant processing power, storage and memory capacity/performance, and improved graphic/video capability. These factors contribute to many companies and individuals choosing to replace their PC with a more mobile solution.
- Yes, will continue to see it. Don't claim tier one notebook sales only own brand. Just started claiming monitors

12. Are you aware that 80 PLUS now certifies different levels of efficiency in power supplies (i.e., 80 PLUS base, bronze, silver, gold, and platinum? Which types are most common in your commercial PC product mix?

	OEMs		SIs	
	#	%	#	%
Yes	4	100%	4	100%
Total*	4	100%	4	100%

*Includes any respondent that sells 80 PLUS certified or equivalent desktop PCs and/or servers.

	OEMs		SIs	
Levels Most Commonly in Use*	#	%	#	%
Base	0	0%	2	50%
Bronze	1	25%	4	100%
Silver	2	50%	1	25%
Gold	2	50%	1	25%
Platinum	0	0%	0	0%
Total*	4	100%	4	100%

* Respondents can indicate more than one level of 80 PLUS in use, so responses do not add to 100%.
**Includes any respondent that sells 80 PLUS certified or equivalent desktop PCs.

OEM Verbatim Responses:

- Primarily bronze and silver levels. Not sure if we have a gold level one certified.
- We use 80 PLUS qualified power supplies to differentiate our levels of product. I.e. high end [redacted brand name] servers have gold power supplies while the [different model of same brand] servers have a silver power supply. Only using gold, no bronze or silver left, soon will have platinum
- Yes - silver to gold range. High in the silver just miss gold lots of time apply 80 PLUS requirements to 100v in Japan

SI Verbatim Responses:

- Most common are bronze (30%) and base (40%), same with servers, others are miscellaneous categories
- Yes - mainly bronze 80% 10% gold 10% silver

13. Does your company always claim the incentives available for the sale of 80 PLUS qualified PCs and servers?

	OEMs		SIs	
	#	%	#	%
Yes	2	67%	2	50%
No	1	33%	2	50%
Total*	3	100%	4	100%

*Includes any participating respondent that sells 80 PLUS certified desktop PCs and/or servers.

OEM Verbatim Responses:

- Any time we can – [name redacted] in San Francisco represents them with PG&E, etc. We send data to [name redacted] and Ecos.
- n/a. No systems and policy with zip code requirements of customers.

SI Verbatim Responses:

- Always
- Never
- No, wish we did - lost

Collecting money for something we are doing anyway
- Not a participant
- The basis of the program is that once a month I provide our IT folks with a listing of all the qualified products and I get a query that's generated to data mine all the sales in all the targeted states and I provide that info to Ecos. The rebate money is used to further the other environmental programs we have.
- Yes, only as good as their reports but try to always claim incentives. Can't capture customer created SKUs, capturing Canada is hard

employee handling it and ball got dropped but plan on redeeming again, goal is to always redeem.

13a. What would need to change regarding the incentives program for you to submit more claims? [Open ended question – response categories assigned by interviewer based on verbatim responses]

	OEMs		SIs	
	#	%	#	%
No changes needed	2	40%	2	40%
Expand program to more regions	1	20%	1	20%
Send email reminders to submit missing claims	0	0%	1	20%
Give rebates directly to customers, not OEM/SI	1	20%	0	0%
Not applicable/non-participant with no suggestions	1	20%	1	20%
Total	5	100%	5	100%

OEM Verbatim Responses:
- Ecos side - nothing. Internally reporting isn't perfect, we just don't have the time, rebates have actually gone up substantially since I got there
- Logistics of data collection at zip code level. How do you cash check, etc. - roll back into process??? Would suggest faster pick up of energy efficient incentives to customer directly, not OEM. Let Ecos know models that qualify and give customer a $20 rebate for buying it regionally. Great incentive to choose higher energy efficiency. Take rebate at retail outlet
- More programs would mean more incentives claimed. West coast has best programs.
- Not a participant

SI Verbatim Responses:
- Nothing will need to change as our corporate responsibility directive considers providing 80 PLUS qualified systems as a necessary component of our corporate culture.
- Only paid on certain zip codes would like to see that grow thinks it is a great program win/win
- Roadblocks and challenges getting systems set up and configured initially - no complaints after set up. Maybe some notification of no claim received - send me an email when I don't claim

14. Has the incremental cost of an 80 PLUS certified power supply changed over the last two years?

	OEMs		SIs	
	#	%	#	%
Increased	1	25%	0	0%
Stayed the same	1	25%	1	25%
Decreased	2	50%	2	50%
Don't Know	0	0%	1	25%
Total*	4	100%	4	100%

*Includes any respondent that sells 80 PLUS certified or equivalent desktop PCs and/or servers.

OEM Verbatim Responses:

- Any time you do a step up in efficiency, there's an initial cost associated with that. It's much less now than that initial bump with ENERGY STAR 4. When Climate Savers started, they provided a roadmap of what efficiency levels had to be over a timeline and we started planning for those incremental steps. The initial feedback from our suppliers was that those expenses would be significant, but the expenses haven't been as bad as they/we thought. They are bidding not just for our company but for the market. Early on they said incremental costs of $8-10 to go to 80%, then to 85% it went to $4, now we're looking at maybe $4. It depends on how many you buy.
- Never really had non-80 PLUS power supplies , costs have not gone up that much - efficiency up and cost level. Our power supplies cost lots more, the delta is pretty significant. Don't know actual dollar amounts.
- Up
- Yes, cost is mitigating but cost will never be what old power supply was. Volume is driver. Gold is $15 more, base is $7 more. Target efficiency or rating base on flagship product or not, etc.

SI Verbatim Responses:

- If anything it has gone down, difficult to get initially, more choice and rebates help.
- Seen no price change this year, does not have data back farther than that. Have had a fixed cost for a long time
- Stayed the same, maybe a $2 decrease

14a. What factors have influenced this change? [Open ended question – response categories assigned by interviewer based on verbatim responses]

	OEMs		SIs	
	#	%	#	%
No change	1	25%	1	25%
Volume production/economies of scale	2	50%	0	0%
Increased PSM competition	1	25%	1	25%
Don't Know	0	0%	2	50%
Total*	4	100%	4	100%

*Includes any respondent that sells 80 PLUS certified or equivalent desktop PCs and/or servers.

OEM Verbatim Responses:

- Guess - from a supply chain standpoint it is because of increased use across all OEMs, more available on more products
- Not sure, certain amount of awareness of competitive advantage. Power supply manufacturers like working with us because we essentially fund R&D of efficient power supplies, leveraging best practices across all lines - longer life better reliability quieter
- Volume production always drops cost.

SI Verbatim Responses:

- More models and manufacturers to choose from

15. Can you give an approximate incremental manufacturing cost in $US for each of these levels?

	OEMs		SIs	
Base	#	%	#	%
$7	1	25%	0	0%
Don't Know/Confidential	3	75%	4	100%
Total*	4	100%	4	100%

*Includes any respondent that sells 80 PLUS certified or equivalent desktop PCs and/or servers.

	OEMs		SIs	
Bronze	#	%	#	%
$4-6	1	25%	0	0%
$10	0	0%	1	25%
Don't Know/Confidential	3	75%	3	75%
Total*	4	100%	4	100%

*Includes any respondent that sells 80 PLUS certified or equivalent desktop PCs and/or servers.

	OEMs		SIs	
Silver	#	%	#	%
$8-10	1	25%	0	0%
Don't Know/Confidential	3	75%	4	100%
Total*	4	100%	4	100%

*Includes any respondent that sells 80 PLUS certified or equivalent desktop PCs and/or servers.

	OEMs		SIs	
Gold	#	%	#	%
$22	1	25%	0	0%
Don't Know/Confidential	3	75%	4	100%
Total*	4	100%	4	100%

*Includes any respondent that sells 80 PLUS certified or equivalent desktop PCs and/or servers.

	OEMs		SIs	
Platinum	#	%	#	%
Don't Know/Confidential	4	100%	4	100%
Total*	4	100%	4	100%

*Includes any respondent that sells 80 PLUS certified or equivalent desktop PCs and/or servers.

OEM Verbatim Responses:

- Confidential
- Going to bronze was $4-6 range - going from 80 to 85% in a 12

SI Verbatim Responses:

- Apples and oranges question to him- hard to compare to a high end non-80 PLUS power supply, compared to a

month window. We've had longer time to go from 85% to 88% and there was no specific push other than customers wanting it.
- No - too many other factors
- The cost of a base 80 PLUS unit over a 67% efficient model is $7 (base) an 80 PLUS gold unit would be an additional $15. Do not know other levels off the top of head.

$30 junk power supply as it is much more costly, not aware of extra cost exist due to purchase for other reasons
- No, $10 about

16. What do you think energy efficiency advocates, regulators, or others can do to increase the use of energy-efficient power supplies? [Open ended question – response categories assigned by interviewer based on verbatim responses]

	OEMs		SIs	
Actions*	**#**	**%**	**#**	**%**
Consumer education	2	40%	2	40%
Government mandate/efficiency standard	1	20%	2	40%
Create simplified, internationally standardized certifications/requirements	2	40%	0	0%
Consumer rebates	1	20%	0	0%
Promote energy savings benefits of virtualization	1	20%	0	0%
Don't know	0	0%	1	20%
Total	5	100%	5	100%

*Respondents can provide more than one response, so percentages may not sum to 100%.

OEM Verbatim Responses:
- Biggest thing beside a mandate is proof of return on investment (ROI), education of ROI, no point if costs don't come down
- Making rebate programs available to customers. Top tier ENERGY STAR ratings will have pressure on energy efficiency - we like this. Having resources available to customers, consumer reports, etc. to promote highly efficient PCs, good better, best. If no incentive in the United States then there could be a US only version of a power supply that is base level. Disincentive to this is bar too high from ENERGY STAR then they could cause overall pickup of energy efficient power supplies to drop
- PCs are VERY configurable systems not like a fridge or stove. 1000's of SKUs for a single product. A label for PCs does not work for PCs or servers. We are burdening systems with costs to verify numbers we already know. Use internet to show energy consumption as the system is configured. Regulators want a sticker which does not make it a better box. Labeling adds cost and doesn't deliver superior performance or energy savings. Mexico requires energy consumption to be marked on PCs but this is impossible for PCs. 300 eco labels worldwide - our PC would look like a NASCAR if we labeled everything.
- Switch to our technology! - tongue in cheek - promote virtualization technology, promote ROI of virtualization
- What we're seeing now is that there are probably 8-10 emerging EE regulations that are currently ongoing on a global basis. EU has an ERP going. Upcoming changes in China and Japan.

SI Verbatim Responses:
- Education, promote ENERGY STAR part of it get customers to request ENERGY STAR power supplies
- Enact legislation to require a level of energy efficiency for specific types of computer equipment. This would be similar to the auto industry with various EPA regulations and NLEV type programs. In addition, from our understanding, power supply manufacturers cannot take advantage of incentives as most power supplies are produced outside of the United States.
- Mandate
- Solar is buttressed by state subsidy's but doesn't think power supply industry needs that - biggest obstacle they have is marketing, ENERGY STAR is recognizable, underwriters lab are more recognizable - awareness campaign. Bad power supply is the quickest way to break other components in

Everyone has their own flavor on their EE requirements. That poses an intriguing challenge to meet all those requirements. We are trying to convince the powers that be globally to harmonize on one specific standard.

your computer. Market the value of a good cool high efficiency power supply to consumers

16a. What is a realistic goal in the next three years for the share of power supplies that are 80 PLUS certified?

	OEMs		SIs	
	#	%	#	%
35%	0	0%	1	20%
50%	0	0%	1	20%
80%	0	0%	1	20%
100%	2	40%	1	20%
Don't know	3	60%	1	20%
Total	5	100%	5	100%

OEM Verbatim Responses:

- Base level & bronze - 100% European and Australian governments are setting up regulations to force this.
- Don't know depends on cost and deltas. ENERGY STAR 6.0 could change a lot as well, doesn't think it will go down - same or up
- Goal is 100% for us.

SI Verbatim Responses:

- Don't know current share - just needs to increase. Trend will go more 80 PLUS, push back will be the cheap PC seller

17. What are the barriers to full adoption of 80 PLUS certified power supplies in the future? [Open ended question – response categories assigned by interviewer based on verbatim responses]

	OEMs		SIs	
	#	%	#	%
No barriers	1	20%	0	0%
Cost (general)	2	40%	4	80%
Cost (only for low-end machines)	1	20%	1	20%
Don't know	1	20%	0	0%
Total	5	100%	5	100%

OEM Verbatim Responses:

- Barriers - none. If 80 PLUS (Ecos) could become an External Power Supply (EPS) verification point they would then be a one stop shop and it would be easier for us to get all PC's certified.
- Cost - cheaper units are always a factor
- Cost. But again, given that the market has continually moved in that direction, I don't really see that as an obstacle, and we've seen great strides from our suppliers in terms of being able to provide what we need.
- Don't know
- Most other companies we are competing with are in low end

SI Verbatim Responses:

- Cost
- Costs
- No, other than typical business cycles. If the cost of 80 PLUS power supplies could be equal to non-80 PLUS power supplies it would be helpful. Non energy efficient power supply is $20
- Only on low end - purely expense driven - maybe cheapo power

market - low cost machines don't promote energy efficient power supplies	supplies need to be 80 PLUS certified as well, price point needs to drop

18. Do you have any other comments on the market for energy-efficient power supplies that you would like to share?

OEM Verbatim Responses:	*SI Verbatim Responses:*
• I consider the 80 PLUS program an example of excellence, and I am delighted to encourage the program. • In general the organizations focused on energy efficiency should go out of their way to find companies doing this and promote this, agencies should highlight highly efficient products, consumer rebates, nation, not regional campaigns • Word on market is 90% gold is about the top efficiency because cost of platinum has a negative effect on ROI, pay lots more for 90+% for the savings	• Not at this time

Appendix C-2: Power Supply Manufacturer Survey Results

1. How has the recent US economic downturn influenced your company's sales of power supplies over the last 1 to 2 years?

Desktop PCs	Frequency	Percent
No Influence	2	25.0%
Decreased Sales	5	62.5%
Don't Know	1	12.5%
Total	8	100.0%

Servers	Frequency	Percent
Increased Sales	1	12.5%
No Influence	1	12.5%
Decreased Sales	3	37.%
Don't Know	3	37.5%
Total	8	100.0%

Optional Comments:

- Sales decreased 2 years ago, and increased 1 year ago.
- We don't enter US retail market.

2. In the next 1 to 2 years, does your company expect the number of power supplies manufactured for the following to increase, decrease, or remain the same?

Desktop PCs	Frequency	Percent
Increase	5	62.5%
Decrease	3	37.5%
Total	8	100.0%

Servers	Frequency	Percent
Increase	5	62.5%
Decrease	1	12.5%
Don't Know	2	25%
Total	8	100.0%

3. Over the past 3 years, what is the trend in your company's sales of power supplies? (all types)

	Frequency	Percent
Increased	5	62.5%
Decreased	3	37.5%
Total	8	100.0%

4. Over the past 3 years, what is the trend in your company's sales of power supplies specifically for the following?

Desktop PCs	Frequency	Percent
Increased	5	62.5%
Decreased	2	37.5%
Don't Know	1	12.5%
Total	8	100.0%

Servers	Frequency	Percent
Increased	4	50.0%
Decreased	1	12.5%
Don't Know	3	37.%
Total	8	100.0%

5. If sales have increased or decreased, approximately what percentage does this change represent?

Desktop PCs	Frequency	Percent
-10%	1	12.5%
+5%	1	12.5%
+20%	1	12.5%
Don't Know	5	37.5%
Total	8	100.0%

Servers	Frequency	Percent
5%	1	12.5%
Don't Know	7	87.5%
Total	8	100.0%

6. Does your company expect these trends to continue for the next 1 to 2 years?

Desktop PCs	Frequency	Percent
Yes	6	75.0%
Don't Know	2	25.0%
Total	8	100.0%

Servers	Frequency	Percent
Yes	4	50.0%
Don't Know	4	50.0%
Total	8	100.0%

7. What are the key factors that make you believe that the trends will continue?

Open-Ended Responses:

Desktop PCs

- Customer demand and economy improvement
- Notebook sales increases
- Right product, right strategy
- Windows OS upgrade

Servers

- Cloud computing
- Customer demand and economy improvement

8. Does your company manufacture 80 PLUS certified power supplies for desktop PCs and servers?

	Frequency	Percent
Yes – both desktop PCs and servers	7	87.5%
Yes – desktops, but not servers	1	12.5%
Total	8	100.0%

9. What has been the trend over the last 2 to 3 years for your company's sales of 80 PLUS certified power supplies for the following:

Desktop PCs	Frequency	Percent
Increased	6	75.0%
Decreased	1	12.5%
Don't Know	1	12.5%
Total	8	100.0%

Servers	Frequency	Percent
Increased	4	57.1%
Decreased	1	14.3%
Don't Know	2	28.6%
Total*	7	100.0%

* Includes all respondents who manufacture 80 PLUS certified power supplies for servers.

10. If increasing or decreasing, approximately what percentage does this change represent?

Desktop PCs	Frequency	Percent
+5%	2	25.0%
+20%	1	12.5%
Don't Know	5	62.5%
Total	8	100.0%

Servers	Frequency	Percent
+5%	1	14.3%
Don't Know	6	85.7%
Total*	7	100.0%

* Includes all respondents who manufacture 80 PLUS certified power supplies for servers.

11. Do you expect these trends to continue for the next 1 to 2 years?

Desktop PCs	Frequency	Percent
Yes	6	75.0%
No	1	12.5%
Don't Know	1	12.5%
Total	8	100.0%

Servers	Frequency	Percent
Yes	5	71.4%
Don't Know	2	28.6%
Total*	7	100.0%

* Includes all respondents who manufacture 80 PLUS certified power supplies for servers.

12. What are the key factors that make you believe that the trends will continue for the next 1 to 2 years?

Open-Ended Responses:

Desktop PCs

- Customer demand for green energy.
- Green products required from people.
- People are well educated with EPA power.

Servers

- Customer demand for green energy.
- Green products required from people.

13a. Approximately what percent of your company's power supply sales for desktop PCs in 2009 were: Non-80 PLUS (%)

	Frequency	Percent
35%	1	12.5%
Don't Know	7	87.5%
Total	8	100.0%

13b. Approximately what percent of your company's power supply sales for desktop PCs in 2009 were: 80 PLUS Base (%)

	Frequency	Percent
5%	1	12.5%
20%	1	12.5%
Don't Know	6	75.0%
Total	8	100.0%

13c. Approximately what percent of your company's power supply sales for desktop PCs in 2009 were: 80 PLUS Bronze (%)

	Frequency	Percent
54%	1	12.5%
80%	1	12.5%
Don't Know	6	75.0%
Total	8	100.0%

13d. Approximately what percent of your company's power supply sales for desktop PCs in 2009 were: 80 PLUS Silver (%)

	Frequency	Percent
2%	1	12.5%
Don't Know	7	87.5%
Total	8	100.0%

13e. Approximately what percent of your company's power supply sales for desktop PCs in 2009 were: 80 PLUS Gold (%)

	Frequency	Percent
5%	1	12.5%
Don't Know	7	87.5%
Total	8	100.0%

13f. Approximately what percent of your company's power supply sales for desktop PCs in 2009 were: 80 PLUS Platinum (%)

	Frequency	Percent
Don't Know	8	100.0%
Total	8	100.0%

13g. Approximately what percent of your company's power supply sales for desktop PCs in 2009 were: Unknown (%)

	Frequency	Percent
Don't Know	8	100.0%
Total	8	100.0%

14a. Approximately what percent of your company's power supply sales for servers in 2009 were: Non-80 PLUS(%)

	Frequency	Percent
Don't Know	7	100.0%
Total*	7	100.0%

* Includes all respondents who manufacture 80 PLUS certified power supplies for servers.

14b. Approximately what percent of your company's power supply sales for servers in 2009 were: 80 PLUS Base (%)

	Frequency	Percent
Don't Know	7	100.0%
Total*	7	100.0%

* Includes all respondents who manufacture 80 PLUS certified power supplies for servers.

14c. Approximately what percent of your company's power supply sales for servers in 2009 were: 80 PLUS Bronze (%)

	Frequency	Percent
Don't Know	7	100.0%
Total*	7	100.0%

* Includes all respondents who manufacture 80 PLUS certified power supplies for servers.

14d. Approximately what percent of your company's power supply sales for servers in 2009 were: 80 PLUS Silver (%)

	Frequency	Percent
Don't Know	7	100.0%
Total*	7	100.0%

* Includes all respondents who manufacture 80 PLUS certified power supplies for servers.

14e. Approximately what percent of your company's power supply sales for servers in 2009 were: 80 PLUS Gold (%)

	Frequency	Percent
Don't Know	7	100.0%
Total*	7	100.0%

* Includes all respondents who manufacture 80 PLUS certified power supplies for servers.

14f. Approximately what percent of your company's power supply sales for servers in 2009 were: 80 PLUS Platinum (%)

	Frequency	Percent
Don't Know	7	100.0%
Total*	7	100.0%

* Includes all respondents who manufacture 80 PLUS certified power supplies for servers.

14g. Approximately what percent of your company's power supply sales for servers in 2009 were: Unknown (%)

	Frequency	Percent*
Don't Know	7	100.0%
Total*	7	100.0%

* Includes all respondents who manufacture 80 PLUS certified power supplies for servers.

15a. Over the past 3 years, what is the trend in your company's sales of the following power supplies: Non-80 PLUS

	Frequency	Percent
Remained the Same	1	12.5%
Decreased	5	62.5%
Don't Know	2	25.0%
Total	8	100%

15b. Over the past 3 years, what is the trend in your company's sales of the following power supplies: 80 PLUS Base

	Frequency	Percent
Increased	1	12.5%
Decreased	5	62.5%
Don't Know	2	25.0%
Total	8	100%

15c. Over the past 3 years, what is the trend in your company's sales of the following power supplies: 80 PLUS Bronze

	Frequency	Percent
Increased	5	62.5%
Decreased	1	12.5%
Don't Know	2	25.0%
Total	8	100%

15d. Over the past 3 years, what is the trend in your company's sales of the following power supplies: 80 PLUS Silver

	Frequency	Percent
Increased	2	25.0%
Decreased	4	50.0%
Don't Know	2	25.0%
Total	8	100%

15e. Over the past 3 years, what is the trend in your company's sales of the following power supplies: 80PLUS Gold

	Frequency	Percent
Increased	5	62.5%
Decreased	1	12.5%
Don't Know	2	25.0%
Total	8	100%

15f. Over the past 3 years, what is the trend in your company's sales of the following power supplies: 80 PLUS Platinum

	Frequency	Percent
Increased	3	37.5%
Decreased	1	12.5%
Don't Know	4	50.0%
Total	8	100%

15g. Over the past 3 years, what is the trend in your company's sales of the following power supplies: Unknown

	Frequency	Percent
Increased	1	12.5%
Don't Know	7	87.5%
Total	8	100%

16. What are the key factors driving changes in your 80 PLUS qualified power supply sales?

Open-Ended Responses:

- Customer requirement
- EPA power can save user's money, protect the globe
- Market trend

17. How has the incremental cost of an 80 PLUS certified power supply changed over the last two years?

	Frequency	Percent
Increased	4	50.0%
Remained the Same	1	12.5%
Decreased	1	12.5%
Don't Know	2	25.0%
Total	8	100%

Optional Comment:

- Decreased a little.

18a. What is the additional cost over a non-80 PLUS power supply (in rough $US) to manufacture an: 80 PLUS Base ($)

	Frequency	Percent
$17	1	12.5%
Don't Know	7	87.5%
Total	8	100%

18b. What is the additional cost over a non-80 PLUS power supply (in rough $US) to manufacture an: 80 PLUS Bronze ($)

	Frequency	Percent
$57	1	12.5%
Don't Know	7	87.5%
Total	8	100%

18c. What is the additional cost over a non-80 PLUS power supply (in rough $US) to manufacture an: 80 PLUS Silver ($)

	Frequency	Percent
$115	1	12.5%
Don't Know	7	87.5%
Total	8	100%

18d. What is the additional cost over a non-80 PLUS power supply (in rough $US) to manufacture an: 80 PLUS Gold ($)

	Frequency	Percent
$15	1	12.5%
$273	1	12.5%
Don't Know	6	75.0%
Total	8	100%

18e. What is the additional cost over a non-80 PLUS power supply (in rough $US) to manufacture an: 80 PLUS Platinum ($)

	Frequency	Percent
Don't Know	8	100.0%
Total	8	100%

19. Do you have any other comments on the market for energy-efficient power supplies that you'd like to share?

Open-Ended Responses:

- Only have one ECOS qualification company is not enough, more competition is necessary.

Appendix C-3: End-User Interview Results

1. What are the factors influencing your company's purchase decisions for desktop PCs? Do these factors vary between desktop PCs and laptops? What about servers?

Verbatim Responses:

- Aging hardware - cycle things out and increase horsepower. More of a trend to move to laptops, increase in laptops over last several years. Move to more destops to virtual desktops and get rid of desktops all together. Driver again is growth in applications and demand of computing power - virtualized 80% of servers they have, still have a lot of servers.
- Functionality in the sense of what that piece of equipment supposed to do, also form factor - space is a premium, laptops for execs because of mobility. Ghosts in the organization i.e. type of software loaded on pc then create a footprint with all apps, load all security, anti virus, network access. Everything applies to laptops unless work is performed outside hosp. Servers are a little different - dictated by vendor overlaid by software. Virtualizing servers across hospital. Can now get three to four application on one server rather than multiples - reduces hardware cost, power, A/C, all types of things.
- Look for the ENERGY STAR rating on desktop computers, fall into 2 categories day to day and workstations (CAD) tend to aim for middle of road on standard, good processor for word, email, memory for efficient running. Has initiative with big fix so machines sitting for more that 20 minutes go to sleep. Just started this initiative this summer. Plan to expand it to turn off at night. On the laptops they make sure power supplies are efficient HPs with smart adapters, so power adapter automatically turns its self down. Looks for ENERGY STAR machines for laptops and monitors.

1a. How important, if at all, is energy efficiency in your company's computer purchasing decisions?

[Open ended question – response categories assigned by interviewer based on verbatim responses]

	#
Somewhat important	3
Total	3

Verbatim Responses:

- Everything we buy is ENERGY STAR rated and has been that way for several years - mandated or not, it makes sense.
- It is important, but functionality is most important, 2nd after that - in a green movement at hospital = lower cost of usage. They look at efficiency of laptops - overheating is a big problem - energy consumption = heat, heat is bad, look to keep things cool.
- Wouldn't say it is top priority but does factor in - top is correct chip set and memory.

1b. How would you know if a desktop PC is energy efficient? What about a laptop? What about a server?

Verbatim Responses:

- Trusting what everyone tells them but have done some internal testing, found out newer models are better desktops kept for 4 years and laptops for 3 years. Have a sustainability group but don't know how much measurement goes on.
- We compare it to other desktop PCs. Have some large form factor PCs but they are rare. Small PCs can now do the same thing. Logical to move from large to small. Same for laptops and servers. Paper is inefficient to the hospital - people are not enthralled because of green movement but because of cost. Constantly looking at heating and cooling, planning out years into the future, have a 5 yr plan. Energy efficiency comes up all the time - even talk with software app vendors to find out why apps are so heavy on CPU use and thus energy hogs. Standard QA process is energy efficiency.
- We do not have the tools, not monitoring. Assumption is old equals less efficient, with laptops that is not the case. They have extensive instrumentation of data servers and monitor power loss in their servers and optimize servers, not with desktops and laptops.

2. Are you aware of the 80 PLUS performance specification for power supplies in desktop PCs? What about servers?

	#
No	3
Total	3

2a. If yes, how did you become aware of this performance specification?

	#
Not applicable	3
Total	3

3. Are you aware of the ENERGY STAR qualification for desktop PCs? What about servers?

	#
Yes	3
Total	3

Verbatim Responses:

- Yes - that it is there, not aware of details, none for servers.

3a. If yes, how did you become aware of this performance specification?

Verbatim Responses:

- Can't recall - has been there so long I forget.
- HP and Lenovo are our vendors and meet with us several times a year and they told us about ENERGY STAR
- That's an interesting story - advising a bunch of folks putting together programs for seniors, energy costs also going up, heating oil is due to go way up average home square footage going way up so keeping house hot or cold is going to get really expensive - as part of this I researched ENERGY STAR programs. Talk to aarp - about cutting energy use.

4. Does your company request or require 80 PLUS qualified desktop PCs from its vendors in the normal course of computer purchases? What about servers?

	#
No – not aware of 80 PLUS	3
Total	3

4a. What about ENERGY STAR qualified desktop PCs? What about servers?

Desktop PCs	#
Yes	2
No	1
Total	3

Servers	#
Yes	1
No	1
Don't know	1
Total	3

Verbatim Responses:

- I think we say it is a preferred option - if looking at two vendors, ENERGY STAR is a good thing. But apps drive final purchase. Same for servers.
- Yes we do - I am sure they do for servers as well.

5. What has been the sales trend over the last 2 to 3 years for your company's purchase of desktop PCs? What about the trend for laptop purchases? What about the trend for servers your company purchases?

Desktop PCs	#
Decreased	3
Total	3

Laptops	#
Increased	3
Total	3

Servers	#
Decreased	2
Don't know	1
Total	3

Verbatim Responses:

- In the sense that going away from paper it is the same or increased now going mobile recently like laptops and tablets and finally Androids and iPods. Look at person and spec solution for individual person - looking for wearable pc. Constantly in the mode of smart technology in healthcare. Looking to wireless. Looking at new tablets for mobility, a couple of physicians are using iPod technology, constantly looking at new ways. Virtualization in servers looking at power usage, lots of servers and lots of heat. Cooler datacenter = less money on AC. Have a mandate to run leaner every year without decrease in performance
- The number is going down. In 2000 we were 60% desktop and now 70% notebooks, more "on the move types" of people in the company.
- Trending down, moving towards laptops, can't give numbers. Laptops up 10%, went through a virtualization so servers are larger but fewer, don't know number off top of head for server reduction.

5a. By what percentage would you say that the purchase of desktop PCs has changed (decreased/increased) over the last 2 to 3 years? What about laptops? What about servers?

Desktop PCs	#
Don't know	3
Total	3

Laptops	#
+10%	1
Don't know	2
Total	3

Servers	#
Don't know	3
Total	3

5b. What are the main causes of the changes (decrease/increase) in the purchase of desktop PCs? What about laptops? What about servers?

Verbatim Responses:

- Mobility, virtualization of servers, driver is cost in datacenters easier to maintain and operate 100 servers vs. 600. Space, financial for servers.
- Mobility, laptops now run more and more apps.
- With a mobile workforce it is expected that you are "on" more often - global company.

5c. Does your company expect these trends to continue for the next 1 to 2 years?

	#
Yes	3
Total	3

Verbatim Responses:

- Yes definitely - probably more mobile and on all the time - looking at iPad and iPhones always connected.

5d. Does your company foresee any erosion of its desktop PC purchases by laptops or vice-versa, or will there be no erosion of one over the other?

	#
Yes – fewer desktops	3
Total	3

Verbatim Responses:

- Yes - end computing, thin client use for warehouses, temp offices, training, dummy terminals going back to a server somewhere else.
- Yes - going to laptops and tablets
- Yes desktops going down

6. Has the recent US economic downturn influenced your company's purchase of desktop PCs over the last 1 to 2 years? If so, how? How about the purchase of laptops? How about servers?

Desktops	#
Yes	1
No	2
Total	3

Laptops	#
Yes	2
No	1
Total	3

Servers	#
No	1
Don't know	2
Total	3

Verbatim Responses:

- Huge, everybody looking at hospitals as a major source of power usage. Users request more stuff on same environment. Feds come in and tell hospitals to be paperless, online. Laptops in the sense it focuses the interest on laptops, sharper pencil in process of specing hardware - must operate more efficiently in the future.
- Not a bit - Tight to begin with. Might have kept more folks from going to laptops. No effect on servers.

7. Does your company have locations outside of the Pacific Northwest region of the United States?

	#
Yes	3
Total	3

7a. Can you describe any difference in your company's national desktop PC buying trends versus in the Northwest region specifically?

Verbatim Responses:

- Actually no - we buy global consumption models only. Have different models of tablets and CAD stations.
- Can't speak for them, reflective of other sites - all comes back to heat.
- Not aware of any differences.

8. Approximately what share of the desktop PCs your company buys are 80 PLUS qualified?

80 PLUS	#
Don't Know	3
Total	3

8a. What about ENERGY STAR?

ENERGY STAR	#
100%	2
Don't Know	1
Total	3

Verbatim Responses:

- Called two weeks too soon, doing an inventory now.
- 100% as far as I am aware

8b. Does your company anticipate any changes to this share in the next 1 to 2 years?

	#
Yes	1
No	2
Total	3

Verbatim Responses:

- Trying to do changes reasonably, not dictatorily, moving toward ENERGY STAR but budget driven process. would like to swap out everything but can't.
- No - we plan to stay with ENERGY STAR as long as we can.

9. Are you aware of any incremental costs associated with the purchase of 80 PLUS qualified desktop computers?

	#
Not applicable – not aware of 80 PLUS	3
Total	3

9a. What about servers?

	#
Not applicable – not aware of 80 PLUS	3
Total	3

10. Are you aware of any incremental costs associated with the purchase of ENERGY STAR certified desktop computers?

	#
Yes	1
Don't know	2
Total	3

Verbatim Responses:

- Goes thru to total cost of ownership, upfront cost is offset by energy savings, yes there are costs but we look at ROI, not 1st cost. ROI is 6 mo right now.
- I'm not aware of anything directly attributable.
- No, not aware but have never looked.

10a. What about servers?

	#
Yes	1
Don't know	2
Total	3

11. Is your company willing to pay more for an 80 PLULS qualified desktop computer?

	#
Not applicable – not aware of 80 PLUS	3
Total	3

11a. Roughly how much more in $US per unit is your company willing to pay?

	#
Not applicable – not aware of 80 PLUS	3
Total	3

12. Is your company willing to pay more for an ENERGY STAR qualified desktop computer?

	#
Yes	3
Total	3

Verbatim Responses:

- I would say yes, but how much is more is always a question.
- Obviously yes - we do it. Still has to be a fit for the application.
- Probably some - no sense of $.

12a. Roughly how much more in $US per unit is your company willing to pay?

	#
Don't know	3
Total	3

Verbatim Responses:

- 5% is no problem, above 15% requires lots of justifying.

13. What do you think would encourage your company to increase the use of energy-efficient power supplies?

Verbatim Responses:

- Already at 100%.
- Cost and knowledge - vendor could sell us on it. Choose models globally, would have a hard time if it did not work globally.
- Something to offset costs. What? Meaningful use program from feds gets us a rebate.

14. What do you think energy efficiency advocates, regulators, or others can do to increase the use of energy-efficient power supplies?

Verbatim Responses:

- Don't think so - knowledge is best, price next and then globally.
- Move rebates downstream.
- Work with vendors and manufacturers to only offer those guidelines - let consumers know what is good and what is not, marketing and education.

15. Do you have any other comments on the market for energy-efficient power supplies that you would like to share?

Verbatim Responses:

- The one thing I am finding interesting is lack of water in western US. Climate change is making this worse - is someone looking at water propagation more energy efficient?

Appendix D: Secondary Research Memo

To: **Rita Siong (NEEA)**
From: **Greg Ekrem and Stuart Schare**
Date: **August 19, 2010 (revised September 02, 2010)**
Re: **Task 2 Key Findings and Recommendations of Secondary Research**

This memorandum describes key findings and recommendations resulting from Navigant Consulting's secondary research into NEEA's 80 PLUS initiative.

Navigant Consulting reviewed the following documents in the course of its secondary research:

- The 2006 Market Progress Evaluation Report (MPER) prepared by Quantec;
- The 2008 Market Progress Evaluation Report (MPER) prepared by Quantec;
- The program's logic model included in both MPERs;[27]
- NEEA's Alliance Cost Effectiveness (ACE) model;[28]
- The interview completed in the Spring of 2010 with NEEA's 80 PLUS program manager Andy Ekman;
- The interview completed in the Spring of 2010 with the 80 PLUS program administrator Ryan Rasmussen of Ecos Consulting; and
- The Southern California Edison 2004-2005 80 PLUS program evaluation.[29]

Overview

Navigant's secondary research into the commercial PC market concluded the following:

- The PC market is rebounding off of historically low shipments in 2008; however, the growth trend through 2014 is primarily in the portable PC market. IDC Worldwide Quarterly PC Tracker forecasts that shipments of desktop PCs will decline from 27.1 million units in 2010 to 25.5 million units in 2014. During the same time period, IDC Worldwide Quarterly forecasts that portable PC sales will increase from 52.8 million units in 2010 to 95.8 million units in 2014.[30]
- The domestic PC market is still dominated by HP, Dell, Acer, Apple, and Toshiba, which make up roughly 80 percent of the market share.[31]
- Secondary research suggests that the adoption of the 80 PLUS power supply has been slower than anticipated, but has gained acceptance rapidly recently.
- The program has seen the number of unique certified power supply units in production swell in numbers from just 403 in December 2007 to 2,567 today. This growth is aided by the inclusion of 80 PLUS in the ENERGY STAR 4.0 requirements and the

[27] Review of the logic model will be documented in a separate memo to NEEA.

[28] Review of NEEA's ACE model will be documented in a separate memo to NEEA.

[29] The 80 Plus evaluation was part of the IDEEA Constituent Program Evaluations, led by Quantec, LLC and completed in 2008.

[30] IDC Worldwide Quarterly PC Tracker, June 2010.

[31] IDC Worldwide Quarterly PC Tracker, July 14, 2010.

differentiation of Bronze, Silver, Gold, and Platinum 80 PLUS standards to distinguish higher levels of efficiency.[32]

MPER review

The remaining barriers and challenges identified in the second MPER relate to five key concerns:

- The incremental cost of 80 PLUS power supplies continues to be higher than anticipated despite more power supply models available to the market.
- The rebate amounts are relatively small as compared with the actual incremental cost of an 80 PLUS power supply.
- Demand from end users still needs to be more pronounced.
- Disclosure of proprietary sales information may still pose a barrier to entry to new program participants.
- The market for desktops is decreasing while the market for laptops is increasing. This threatens to undermine the potential market for 80 PLUS power supplies.

80 PLUS project manager and program administrator interviews

In addition to the mechanics and background of the 80 PLUS program, interviews with both the 80 PLUS project manager and program administrator highlighted several interesting facets of the program.

- Although the 80 PLUS program is defined as a commercial program, there is a high likelihood that 80 PLUS power supplies have entered the residential market as well.
- NEEA believes that at least 90 percent of participating vendors are reporting sales to Ecos.
- Regional tracking of 80 PLUS units can be difficult, however. Ecos believes that it tracks nearly 100 percent of units shipped, but unknowns include institutional buyers who buy into one zip code but distribute their PCs across multiple zip codes, non-participating System Integrators, and nonparticipating computer original equipment manufacturers (OEMs) such as Apple.
- The 80 PLUS program saw a boost as a result of 80 PLUS certified power supplies being a requirement for ENERGY STAR 4.0 certification in 2007.
- The 80 PLUS certification further expanded with the partnership with Climate Smart. Current certified power supplies include Bronze, Silver, Gold, and Platinum, each with higher efficiencies.
- NEEA is viewed as a critical sponsor and is generally credited with creating the stability required to recruit partners into the program.

[32] 80 PLUS website (www.80plus.org).

Review of Southern California Edison's 80 PLUS program

Navigant's review of the Southern California Edison 2004-2005 Innovative Designs for

Energy Efficiency Activities (IDEEA) Constituent Program Evaluations document prepared in 2008 concluded that while adoption of 80 PLUS power supplies has been slower than projected, efforts to increase power supply manufacturer and computer OEM participation in the program have been successful. Continued impediments to market transformation include:

- The incremental cost of 80 PLUS power supplies;
- Limited efforts to educate and increase product demand by average commercial consumers; and
- Inconsistent promotion of the 80 PLUS program.

Recommendations

Navigant's next step in the market research plan is to complete the review of the logic and ACE model, draft survey instruments and conduct interviews with market actors. Based on the secondary research outlined above, Navigant will focus questioning on four main areas (in addition to addressing specific items contained in the Statement of Work):

- Sales and market trends, specifically sales in the Northwest when possible, including questioning on the current incentive structure as well as purchases by the business sector;
- Incremental costs of the 80 PLUS power supply;
- End-user performance and demand, including product awareness; and
- The process of specifying and buying PCs from both a manufacturing and consumer point of view.

Appendix E: ACE and Logic Models Review Memo

To: **Rita Siong (NEEA)**
From: **Jane Hummer, Greg Ekrem, and Stuart Schare**
Date: **September 29, 2010 (revised October 4, 2010)**
Re: **Task 3 Key Findings and Recommendations of ACE and Logic Models Review**

This memorandum describes key findings and recommendations resulting from Navigant's review of the ACE and logic models for NEEA's 80 PLUS initiative. Navigant reviewed the 80 PLUS initiative's ACE and logic models with the specific objectives of:

- Identifying any discrepancies between the logic model and current program implementation (as understood by Navigant based on the results of the secondary research and program staff interviews conducted in Task 2).
- Assessing the validity of the program logic, i.e., the logical linkages between program inputs, outputs, and short- and long-term outcomes.
- Understanding the energy savings and cost-effectiveness calculations used in the ACE model.
- Identifying program performance indicators and ACE model inputs that may need updating through primary or secondary research.

1. Program Logic Model

Navigant's review of the program logic model included in MPERs #2 concluded the following:

- The program inputs include Ecos Consulting staff time and budget for marketing, incentives, incentive administration, and evaluation.

- The program activities/outputs include developing and implementing a marketing plan, recruitment of power supply and computer manufacturers, developing a test protocol, testing and certifying power supplies, paying invoices from participating manufacturers, recruiting additional sponsors, maintaining the website, and sharing data with EPA.

- The expected short term outcomes (1-3 years) are: inquiries from power supply manufacturers, OEMs and SIs, electric utilities, and large consumers; increasing website traffic; accessible and up-to-date testing protocols available on website; $5 incentives for qualifying PCs and $10 incentives for servers, payable to the OEMs or SIs; sales of at least 70,000 qualifying units before end of 2005; participation from at least one major desktop PC OEM; buy-down spurs OEM and SI sales of qualifying PCs; recruitment of at least one other major utility or energy efficiency organization to sponsor the program; EPA includes power supply specifications in its revised ENERGY STAR standard for computers.

    - The program has clearly achieved the targeted short-term outcomes in terms of developing testing protocols, recruiting major OEMs, PSMs, and additional

sponsors for the program, and the goal of including power supply specifications in the ENERGY STAR designation.

- Expected longer-term outcomes include: 75% or higher market share of 80 PLUS-equipped PCs by 2010; industry continuing to embrace ENERGY STAR as a competitive marketing advantage.
    - It does not appear that the program is on track to achieve a 75% market share by the end of 2010; based on the latest ACE model, the market share in 2007 and 2008 appears to be roughly 7-8%.
- Navigant suggests that the program staff move incentives from outcomes to outputs within the logic model, as they are something that the program has direct control over.
- Navigant notes that the program logic model does not offer many specifics in terms of marketing activities or other methods to drive consumer demand for 80 PLUS. Providing more specific descriptions of program marketing activities and outputs would provide more clarity to the program logic and help identify program performance metrics to be tracked.
- The logic model does not clearly identify the target market as larger commercial customers.
- Given that some programs milestones or targets have been exceeded or passed without being met, the program staff should update the logic model to reflect new program goals.

2. ACE Model

Navigant's review of the Alliance Cost Effectiveness (ACE) model (last updated in November 2009) concluded the following:

Energy Savings

- The ACE model currently divides all 80 PLUS units into two tiers: Tier 1 is "80 PLUS units" (82.1 kWh/unit annual savings) and Tier 2 is "ENERGY STAR 5.0" (117.9 kWh/unit). However, the 80 PLUS program now includes five levels of efficiency under the 80 PLUS umbrella (base, bronze, silver, gold, and platinum). If Navigant's primary research indicates that many of the non-ENERGY STAR 5.0 (but still 80 PLUS) units being sold are higher than the base 80 PLUS level, it may be useful to update the ACE model's energy savings assumptions or add in additional tiers to reflect the different levels of energy savings.
- The ACE model's energy savings assumptions appear to blend the energy savings expected from residential and commercial PCs; however, Navigant's discussions with NEEA staff indicated that the primary target market for 80 PLUS is business customers. Given the variations in computer operating parameters between business users and residential users (e.g., annual hours of usage), perhaps using the energy savings estimates

from commercial/business users only would be appropriate. However, if it appears that there is significant spillover of 80 PLUS technology into the residential/consumer market, then the blended savings estimate is likely appropriate.

Market Share

- The forecasted 80 PLUS market share for 2010 is 10.4% (Tier 1) and 5.4% (Tier 2 – ENERGY STAR 5.0).

- The ACE model assumes that the Northwest share of total U.S. computer sales is proportional to the Northwest's share of the total U.S. population; based on 2009 U.S. Census data, that share is now 4.24% as opposed to the 4.1% used in the ACE model (based on 2006 estimates).[33] While it is a minor change, it does impact the estimate of the target market size and thus the market share.

- The forecasts for total U.S. computer sales from 2009-2013 are based on an IDC report dated March 5, 2009; newer data sources are available to update those assumptions. The ACE model currently forecasts 61.5M computers sold in the U.S. in 2010; the latest IDC reports estimate 78.4M computers will sell in the U.S. this year[34], a significant difference from the ACE model assumptions.

- The ACE model assumes that the share of computers that go to the business market remains steady at 62% through 2025; this is an assumption that warrants further review, as recent news reports indicate that the consumer PC market is struggling while the business PC market is expected to make up a larger share of total sales in 2010 than initially forecasted.

- Program staff should update the share of total computer sales that are laptops; the ACE model assumes 58% for 2010, but recent IDC reports forecast that the laptop share will be 63% in 2010 and 74% by 2014. [35] The ACE model also assumes that the share of business PCs that are laptops is equivalent to the share of total computer sales in the U.S. that are laptops; however, it may be that laptops are favored by the consumer market while the business market favors desktop PCs.

Incremental Costs

- The ACE model estimates the incremental cost of 80 PLUS (to the consumer) to be $20 for Tier 2 and $4 for Tier 1 power supplies. Navigant will devote a significant portion of the OEM and SI interview efforts to better understanding the actual incremental costs of different levels of 80 PLUS and ENERGY STAR computers, given the significant impact that these costs have on the cost-effectiveness of the program as a whole.

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[33] http://factfinder.census.gov/.

[34] http://www.itnewsonline.com/news/IDC:-Business-PC-Buying-to-Ensure-Double-Digit-Growth-in-H2-2010/20784/3/3.

[35] http://www.itnewsonline.com/news/IDC:-Business-PC-Buying-to-Ensure-Double-Digit-Growth-in-H2-2010/20784/3/3.

3. Recommendations

Navigant noted several opportunities for improvement to the logic and ACE models in the bullets above; in particular, program staff should update the logic model to reflect current program implementation and to set new goals for the program going forward, as most of the milestones identified in the current logic model have been met. Specific recommendations for the **logic model** include:

- Move incentives from "outcomes" to "outputs".
- Identify the target market as commercial customers.
- Provide more specifics on marketing and how the program intends to drive demand for 80 PLUS within the target market.
- Define program milestones and goals for the program going forward.

The assumptions to be updated in the **ACE model** will be explored in Navigant's remaining primary and secondary research to be completed. At the completion of this evaluation, Navigant will recommend specific changes to the ACE model assumptions if warranted.

Navigant's next step in the market research plan is to conduct interviews with market actors, pending NEEA approval of the survey instruments submitted within the past two weeks. Navigant has developed the survey instruments with the findings of the ACE and logic models review in mind, along with the results of the secondary research and program staff interviews.

research/into/action inc

Final Report

2010 BetterBricks Market Progress Evaluation Report

Funded By:

neea

Prepared By:

research/into/action inc

Marjorie McRae, Ph.D.
Mersiha Spahic
Jun Suzuki
Michelle Levy
Robert Scholl

Research Into Action, Inc.

WASHINGTON STATE UNIVERSITY
EXTENSION ENERGY PROGRAM

Rick Kunkle, P.E

PWP, Inc.

Phillipus Willems, Ph.D.

December 31, 2010

ACKNOWLEDGEMENTS

As always, there are many in addition to the evaluation team who contribute to the production of a market progress evaluation and report. They include: the owners, executives, facility managers, and other staff of the various target market organizations who responded to our surveys; the contacts at the professional organizations partnering with BetterBricks; and the Market Specialists for the various segments. Each of these people was a willing and friendly respondent to our requests for information.

We would like to acknowledge the assistance of Aaron James of the Northwest Energy Efficiency Alliance, who served as our evaluation project manager. We also thank: Rob Russell, Senior Manager for Market Research and Evaluation; Peter Wilcox, Senior Manager Commercial Sector; Kim Hughes, Operations Manager Commercial Sector; the BetterBricks Market Managers – John Jennings, Janice Peterson, and Jack Davis; and Elaine Miller, BetterBricks Marketing Manager.

Collin Elliot, of Itron, Inc., conducted the analysis of the 2008 Kilowatt Crackdown savings. Steven Scott of MetaResources validated the 2010 savings for H&H. We report impacts validated in 2009 (in work led by Research Into Action, Inc. prior to the current contract) by Mike Kennedy and a team of analysts at ECONorthwest, Inc. As part of that same 2009 effort, Tami Rassmussen of ECONorthwest led staff in a review of the BetterBricks ACE model assumptions, which we include in this report.

TABLE OF CONTENTS

EXECUTIVE SUMMARY I

1. INTRODUCTION 1

INITIATIVE DESCRIPTION 2

PROGRAM THEORY AND GOALS 3

MPER ACTIVITIES AND PAST RECOMMENDATIONS 4

REPORT OBJECTIVES 5

2. EVALUATION ACTIVITIES 7

MARKET MANAGER INTERVIEWS 7

DOCUMENT REVIEW 7

MARKET SURVEYS 8

PROFESSIONAL ASSOCIATION INTERVIEWS 8

DATA SOURCES 9

3. MARKET CHARACTERIZATION 11

DESIGN AND CONSTRUCTION MARKET 11

OFFICE REAL ESTATE 12

HOSPITALS AND HEALTHCARE 13

BUILDING OPERATIONS 14

4. MARKET PROGRESS FINDINGS 15

DESIGN AND CONSTRUCTION (D&C) 16

Professional Association Interviews 16

Market Survey of Architects 17

OFFICE REAL ESTATE (ORE)

Professional Association Interviews 22

Market Survey of Office Real Estate Firms 23

HOSPITAL AND HEALTHCARE (H&H) 26

Professional Associations Interviewed 27

BUILDING OPERATIONS (BOPS) 31

Professional Association Interviews 31

Market Survey of Mechanical Contractor Firms 32

BETTERBRICKS ADOPTION BY URBAN AND RURAL AREAS 34

5. IMPACT FINDINGS AND ACE MODEL REVIEW 37

IMPACT FINDINGS 37

ACE MODEL REVIEW 38

6. SUMMARY AND RECOMMENDATIONS 39

SUMMARY OF FINDINGS 39

CAVEATS AND DISCUSSION OF FINDINGS 42

RECOMMENDATIONS 45

Appendices

APPENDIX A: METHODOLOGICAL DETAIL A-1

Prior BetterBricks MPER Research A-1

Survey and Interview Populations A-2

Participants A-2

Hospital Population A-2

Office Real Estate Population A-3

Design & Construction and Building Operations Populations A-3

Professional Associations Population A-3

Survey and Interview Samples and Dispositions A-4

Survey Samples and Dispositions A-4

Interview Sample A-6

Sample Weighting A-6

Estimating Market Size A-7

Corroboration of Total New Construction Square Footage A-7

Survey Design A-7

Analysis Algorithms for Market Survey Data A-8

APPENDIX B: ADDITIONAL RESEARCH FINDINGS B-1

Program Activities b-1

D&C Market Activities B-1

H&H Market Activities B-4

BOPS Market Activities B-5

Additional findings from Professional association Interviews B-8

D&C Professional Associations B-8

ORE Professional Associations B-9

H&H Professional Associations B-9

BOPS Professional Associations B-10

Participant Suggestions for NEEA's Commercial Sector Activities B-10

APPENDIX C: LOGIC MODELS C-1

APPENDIX D: ACE MODEL ASSUMPTION VALIDATIONS D-1

Healthcare D-1
Office Real Estate D-14
ACE Validation Methodology Market Adoption Estimate D-26
Data Sources D-26
Approach D-26
ACE Validation Estimates of Market Size D-28
Office D-28
Health / Hospitals D-29

APPENDIX E: SURVEYS AND INTERVIEW GUIDES E-1
Design and Construction (D&C) Market Survey – 9/28/10 ..... E-1
Offices and Real Estate (ORE) Market Survey – 9/29/10 ..... E-19
Hospitals and Healthcare Market Survey – 10/04/10 ..... E-34
Building Operators (BOPS) Market Survey – 10/28/10 ..... E-50

EXECUTIVE SUMMARY

This document constitutes the final market progress evaluation report (MPER) of the Northwest Energy Efficiency Alliance's (NEEA) 2005-2009 BetterBricks Initiative. In December 2009, as part of NEEA's continuous improvement commitment, NEEA launched a redesign of its commercial sector initiative. NEEA plans to launch the redesigned initiative in 2011. This MPER evaluates the BetterBricks Initiative prior to the redesign. The MPER research sought to: 1) assess the adoption of BetterBricks best practices, per market progress indicators; 2) describe the 2010 baseline condition of these markets in terms of business practices; and 3) validate, to the extent possible, energy savings achieved by BetterBricks participants.

For this MPER, we conducted market surveys in each of the four markets targeted by BetterBricks initiatives: architects for the Design and Construction (D&C) effort; real estate managers for the Office Real Estate (ORE) effort; hospital facility directors for the Hospital and Healthcare (H&H) effort; and mechanical contractors for the Building Operations (BOPS) effort. The respondents to each market survey include: firms with extensive direct involvement with BetterBricks (we term them *participants*); firms with exposure to BetterBricks through its training, website, and other outreach (we term them *Light Touch;* they comprise both firms directly involved – but to a much lesser degree than participants – and directly influenced by BetterBricks); and firms that reported no direct involvement with BetterBricks and little or no direct influence (*nonparticipants*).

BetterBricks promulgates five primary principles subsuming a number of best practices. We captured these concepts in five metrics of market progress and an overall, summary metric. Based on these metrics, we estimate:

- Overall adoption among *participants* in the Design & Construction (D&C), Office Real Estate (ORE), and Building Operations (BOPs) markets is 85% or more; overall adoption among Hospitals & Healthcare (H&H) *participants* is 50%
- Overall adoption among *nonparticipants* in the four markets ranges from 0% to 45%
- Adoption of the BetterBricks best practice metrics among the *total market* ranges from 40% to 70%

We conclude that 2005-2009 BetterBricks met its 2010 objectives for adoption of best practices and market change in the specific markets as follows:

- **D&C:** submarkets that adjusted business practices to ensure high performance buildings
- **ORE:** targeted ORE floor space that adopted energy management plans; professionals capable of managing energy-related business practices change; and professionals

downloading the High Performance Portfolio Framework and associated tools, and beginning implementation

- **H&H**: regional hospital beds whose decision-makers: 1) are committed to and practicing SEMP – strategic energy management plan – elements; 2) request/ require trade allies to support SEMP practices, including enhanced O&M; and 3) consider BetterBricks an excellent source of information and practical tools on energy-related business and technical practices

- **BOPS:** building operations market whose service providers adopt business approaches that promote building operating performance

BetterBricks appears to have partially met the following 2010 objective:

- **D&C:** significant percentage of new project designs incorporate partial and fully integrated design (ID) strategies that result in savings greater than 25% over baseline. While we found ID features used by 55% of the market, we do not know the savings.

BetterBricks has also met its 2010 objectives common to all four markets (Table ES.1).

Table ES.1: BetterBricks Met 2010 Objectives Common to All Four Markets

Objective	D&C	ORE	H&H	BOPS
Adoption of best practices through BetterBricks involvement and influence	✓	✓	✓	✓
High market awareness (greater than 50%) of *betterbricks.com*	✓	✓	✓	✓
Market awareness of the benefits of high performance buildings	✓	✓	✓	✓
Collaboration with professional associations	✓	✓	✓	✓

To date (2008-2010), we and other researchers have validated 3.84 aMW of electricity savings and 714,657 therms of natural gas savings at BetterBricks' participant facilities. This number may change, as there is an effort underway to validate additional 2010 savings for D&C and BOPS. Given our project findings, we believe it likely that BetterBricks has generated energy savings far in excess of those that research has validated, yet a lack of program tracking data continues to prevent a full accounting of program savings.

While BetterBricks accomplished the bulk of its behavior change goals, there was still very little data to tie these changes to energy savings. While we believe that there are energy savings which resulted from this change, the data do not exist to validate this. Prior to the redesign effort, market progress indicators (MPIs) were not sufficiently defined to enable energy savings calculations. It is key to the success of the re-designed commercial initiative to build in the measurement and data collection necessary to tie desired behavior change to energy savings.

1 INTRODUCTION

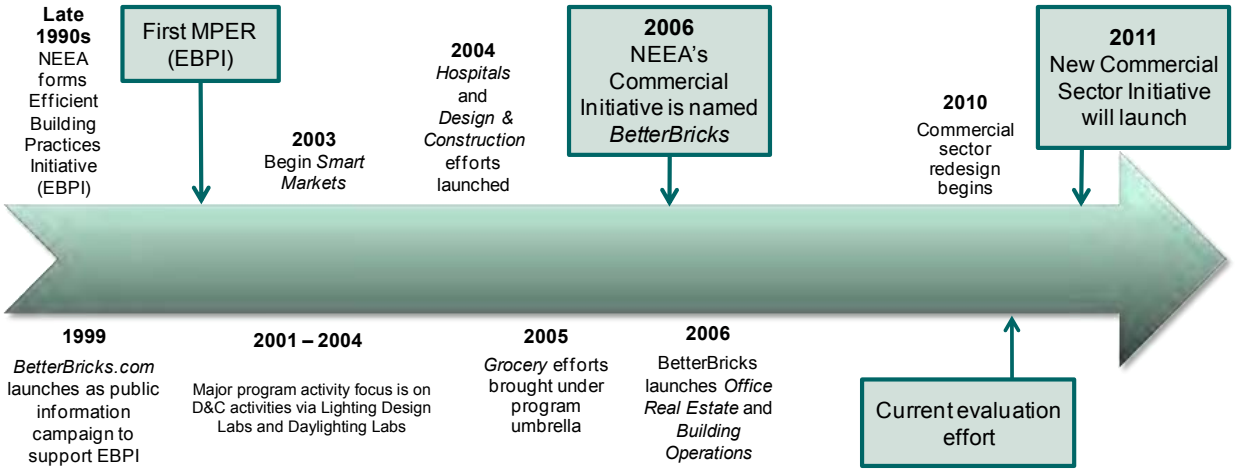
This document constitutes the final market progress evaluation report (MPER) of the 2005-2009 BetterBricks Initiative, the most recent approach of the Northwest Energy Efficiency Alliance's (NEEA) commercial sector initiative. In December 2009, as part of NEEA's continuous improvement commitment, NEEA launched a redesign of the commercial sector initiative to focus on efforts that accelerate market transformation, while filling the energy efficiency pipeline with opportunities to achieve significant regional savings. The redesigned initiative attempts to better tie behavior change to energy savings. NEEA plans to launch the redesigned initiative in 2011. This MPER evaluates the BetterBricks Initiative prior to the redesign.

A team led by Research Into Action, Inc., in association with PWP, Inc. and Washington State University Extension Energy Program, conducted the evaluation. NEEA is a non-profit corporation with stakeholders that include: the Bonneville Power Administration, electric utilities, public benefits administrators, state governments, public interest groups, and energy efficiency industry representatives. These entities work together to make affordable, energy-efficient products and services available in the marketplace.

BetterBricks is NEEA's commercial sector energy efficiency initiative. According to the *BetterBricks Reference Guide*, its mission is to "help drive the demand for, and supply of, energy efficient products and services in commercial markets." The strategy for achieving this is two-pronged: 1) Work directly with commercial building owners and managers to change energy-related business practices; and 2) work with trade allies in both new construction and existing building management to help develop their service offerings and enhance their capabilities to deliver energy-efficient high performance buildings. By influencing both the demand and supply sides of the energy efficiency market, BetterBricks hopes to create natural market demand for energy-related best practices while bolstering the market's capability to supply the services that organizations need to achieve those best practices.

NEEA has implemented some form of commercial sector energy efficiency initiative since the late 1990s, adapting and changing the approach in response to changing market conditions and evaluation feedback on what did and did not work well (see Figure 1.1). BetterBricks was born out of this evolution, and NEEA's commercial sector initiative continues to evolve today.

Figure 1.1: Evolution of Commercial Sector Initiative and BetterBricks



INITIATIVE DESCRIPTION

In 2005-2009 BetterBricks parlance, the organizations with a *demand* for energy-related services fall into two *Target Market* initiatives, **Hospitals & Healthcare** and **Office Real Estate**. The firms that *supply* energy-related services are part of two *Cross-Cutting Market* initiatives – **Design & Construction** and **Building Operations**:

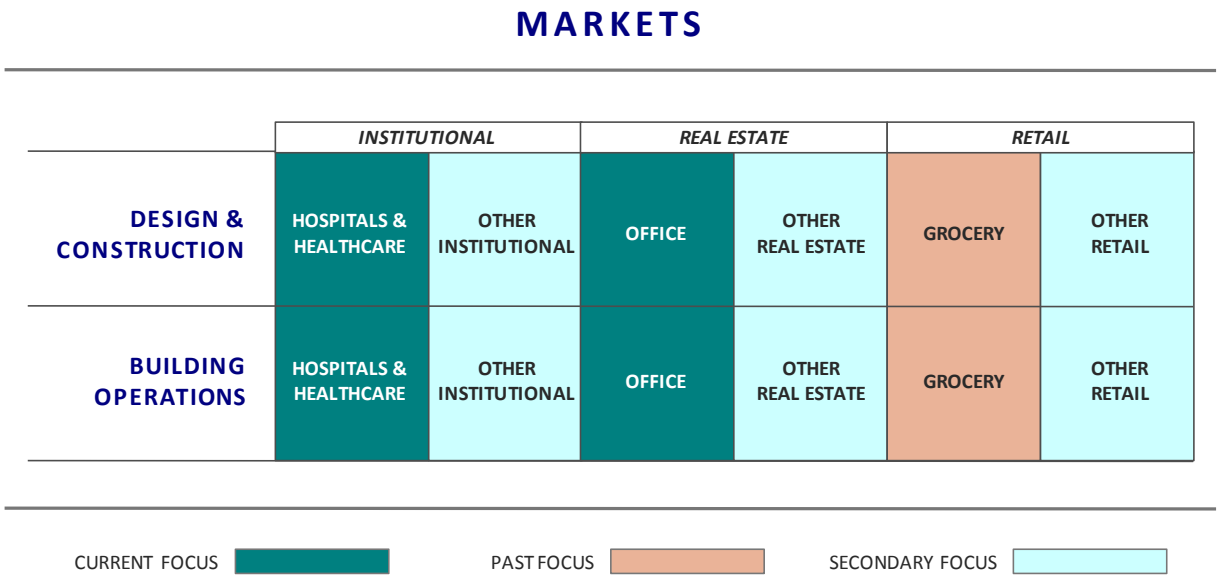
- **Hospitals & Healthcare (H&H)**[1] targets to hospitals and hospital systems that have their headquarters in the region served by NEEA.
- **Office Real Estate (ORE)** targets managed commercial real estate, excluding owner-occupied buildings.
- **Design & Construction (D&C)** focuses on those serving the commercial new construction market, principally architects and design engineers, especially in the office real estate and healthcare sectors.
- **Building Operations (BOPS)** targets those supplying building operations services in existing buildings, principally mechanical contractors.

Figure 1.2 illustrates the way in which the target and cross-cutting markets intersect. What makes BetterBricks unique is the *way* in which it addresses the two sides of the market: separately but with a coordinated, overlapping effort that is augmented by robust marketing and education and training efforts dedicated to supporting BetterBricks. These elements taken together yield a

[1] Formerly the High Performance Hospitals Program.

comprehensive commercial sector initiative aimed at changing behavior and transforming the building market to produce long-term sustained energy efficiency gains.

Figure 1.2: Illustration of 2005-2009 BetterBricks Target and Cross-cutting Markets Approach



BetterBricks managers believe that changes in particular behaviors within the target and cross-cutting markets will reduce facilities' energy-related capital and operating costs. Such changes also have the potential to create non-energy benefits, such as occupant comfort and productivity, and to bring design and construction projects into alignment with industry best practices.

PROGRAM THEORY AND GOALS

BetterBricks works to achieve market transformation through a set of market interventions in each of the target and cross-cutting markets. The ultimate long-term goal of all program efforts is electricity savings. Short-term goals vary for each of the markets and include such outcomes as increased awareness of the benefits of energy efficiency, use of BetterBricks tools, and adoption of energy efficiency behaviors. Chapter 4 provides, as an introduction to the research findings, the 2010 market outcomes sought by BetterBricks. For comprehensive, long versions of each logic model, see *2008 BetterBricks Overall Market Progress Evaluation Report*.[2] For a complete list of intended short-term and long-term program goals, see graphic representations of logic models in Appendix C.

[2] Report #E09-208, July 17, 2009. Prepared for NEEA by Research Into Action, Inc., Tecmarket Works, PWP, Inc., Dethman & Associates, and Washington State University. *http://neea.org/research/reports/EO9-208_v3.pdf.*

BetterBricks' overall goal has been to transform targeted commercial markets such that energy efficiency best practices become standard business practice, and that providers of energy-efficient products and services are capable of meeting this increased demand.

BetterBricks' strategy for achieving targeted changes is to "work with a few to influence the many." BetterBricks works intensively with selected organizations in the target markets with the intent to illustrate the value of adopting recommended business practices specific to their individual needs. BetterBricks also works intensively with selected organizations in the cross-cutting markets to increase market capacity to meet demand for best practices by supplying related products and services.

BetterBricks provided a range of services to help participating organizations adopt the targeted behavior changes. The aim was to help move the selected organizations to the point where they could maintain the recommended practices – and associated energy savings – without continued initiative assistance. Those organizations achieving sustained business practice changes would serve as models and – the program theory posits – would stimulate targeted behavior changes in other similar organizations through natural market competition and imitation. Chapter 4 provides additional description of the BetterBricks approach, as does Appendix B.

MPER ACTIVITIES AND PAST RECOMMENDATIONS

Table A.1 in Appendix A illustrates the evaluation tasks that have been performed for each BetterBricks MPER, starting in 2005 and culminating with the current MPER. Prior MPER recommendations and current status included the following:

- BetterBricks should elevate the importance of energy tracking; BetterBricks management should consider modifying the initial approach used with participants to focus on the benefits of knowing about their own energy expenditures and opportunities (target markets) or those of their clients (cross-cutting markets). In addition, BetterBricks should seek ways to address and minimize the burden of energy tracking by developing and facilitating the use of existing tools that are appropriate to the sector participants' capacity and capability. *Status: BetterBricks demonstrated progress by motivating firms to invest in energy tracking and analysis software.*

- BetterBricks needs to develop a robust system of tracking and additional savings analysis in order to tie the validated energy savings to specific business-practice changes and ultimately to estimate market savings. *Status: Tracking improvements showed some progress, but not sufficient to validate energy savings.*

- Program staff need to clearly define the criteria for determining which of the energy efficiency business practices being promoted by BetterBricks can be considered sufficient to qualify a firm as meeting the energy management and business plan objectives. Ensure that future plan objectives are measurable for the cross-cutting markets; there are currently insufficient data available to estimate market share. *Status: Development of the*

BetterBricks Guide (November 15, 2009) demonstrated some progress, however more work is needed. The current research needed to define much of the criteria.

- Program staff should revise the *adoption continuum* model of progress for each market to explicitly include an exit strategy, with criteria and tools for facilitating the process. Program staff should use the designation s*ustaining* only with those participants who meet the criteria established in the exit strategy. *Status: The BetterBricks Guide and the management and reporting tools developed by the market managers demonstrated progress.*

- BetterBricks' management should continue to work with the target market and cross-cutting market managers to identify areas where interactions between them would be most useful and to develop strategies to achieve them. *Status: Market managers showed progress by demonstrating teamwork in the projects considered during the current validation research.*

- Program staff should continue looking for ways to make the website as user-friendly as possible and to develop strategies and tactics that will drive target market actors to the website, helping to make it the first thing that members of the target population think of when they want information on energy management. For each of the target markets, specific research should be conducted to understand whether and how the BetterBricks website is being used. *Status: This evaluation shows high market awareness of betterbricks.com, indicating it is top of mind when looking for information on energy management, though the recommended research did not occur.*

- BetterBricks management should continue to increase the level of direct (face-to-face) communication with utilities to gain more complete awareness of utility needs and differences, and to clarify questions about the BetterBricks approach and how BetterBricks can support utilities to meet their goals. *Status: not investigated.*

REPORT OBJECTIVES

This report provides the final MPER for the 2005-2009 BetterBricks Initiative. This report constitutes a combined MPER for the four market components active at the time of the evaluation. It represents the fifth MPER for Hospitals & Healthcare, the fourth for Design & Construction & Building Operations, and the third for Office Real Estate.

This report has three main purposes: To assess the degree to which actors in the four target markets have adopted BetterBricks best practices, per market progress indicators; to describe the 2010 baseline condition of these markets in terms of business practices; and to validate, to the extent possible, energy savings achieved by BetterBricks.

2 EVALUATION ACTIVITIES

Four key data collection activities informed the evaluation: interviews with market managers, review of BetterBricks documents, surveys of the four targeted markets, and interviews with professional associations. Figure 2.1 presents the schedule of these activities.

Figure 2.1: Schedule of Data Collection Activities

2009-2010	• Document Review
Summer 2010	• Market Manager Interviews
Fall 2010	• Market Surveys
Fall 2010	• Professional Association Interviews

MARKET MANAGER INTERVIEWS

In the summer of 2010, we launched our research for this MPER by conducting a series of three interviews with each BetterBricks market manager to obtain input for the market surveys, as follows:

- Interview 1: Explain the research approach and learn more about each program's targeted behavior change.
- Interview 2: Seek comments on proposed topics to include in the surveys.
- Interview 3: Obtain feedback on survey phrasing.

DOCUMENT REVIEW

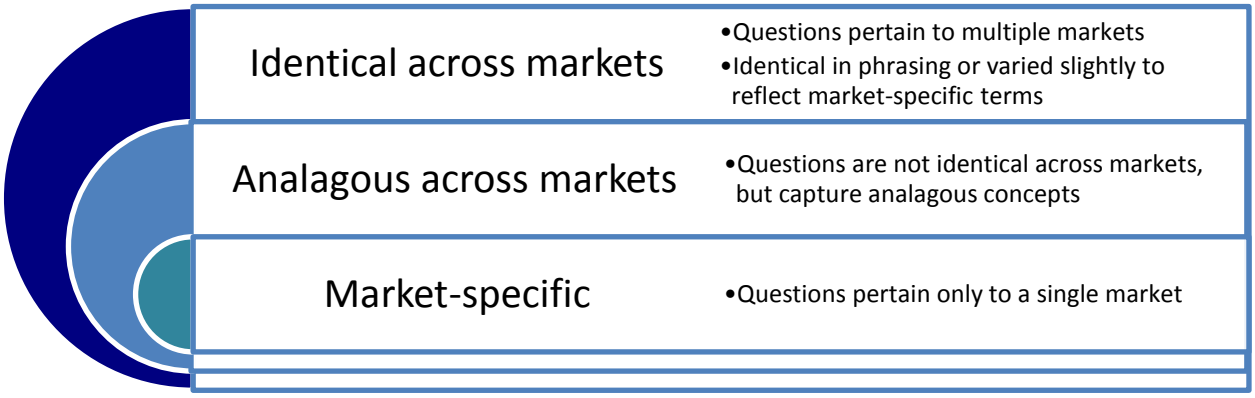
In the fall of 2009, the BetterBricks team wrote the *NEEA BetterBricks Reference Guide* to describe the specific changes BetterBricks has sought in the four markets. In late 2009, under a separate contract to the current MPER, we conducted interviews with BetterBricks market managers, business advisors, and technical advisors to better understand the concepts in the *Reference Guide.* We also have reviewed the previous MPER, *2008 BetterBricks Overall Market Progress Evaluation Report,* and have based our general descriptions of the four BetterBricks market activities on that source.

MARKET SURVEYS

Although each of the evaluation activities contributed important information to the project, the market surveys lie at the heart of the analysis for this MPER. As implied by the program theory of diffusion of best practices from "the few to the many," BetterBricks expects that when leading companies advance their practices, they influence others within the markets to adopt best practices. BetterBricks therefore targets its direct-touch market activities to medium and large firms, with the assumption that larger firms are more influential and more likely imitated in the market. Given this, we conducted surveys with medium and large firms in the four markets of H&H, ORE, D&C, and BOPS. The population surveyed includes all firms in the target markets, spanning the gamut from those with extensive BetterBricks involvement to those unaware of it.

We designed the market surveys to be as similar across the four markets as possible. With that in mind, we created three main question types: Questions that *identically* pertain to all the markets, questions that *analogously* pertain to multiple markets, and questions that pertain only to *one specific* market. Figure 2.2 summarizes the three main types of survey questions:

Figure 2.2: Market Survey Question Types



Appendix E provides further explaination and the survey instruments.

PROFESSIONAL ASSOCIATION INTERVIEWS

In addition to the market surveys, we conducted interviews with 12 professional organizations serving the targeted markets, with which BetterBricks partnered. These professional associations are a key aspect of the program's theory of change, in large part because they enable BetterBricks to reach an audience beyond their targeted firms, thus facilitating market diffusion of best practices. Examples of BetterBricks market partners include the local chapters of both the American Institute of Architects (AIA) and the Building Owners and Managers Association (BOMA). See Appendix A for details.

We designed the professional association interviews to explore such concepts as perceptions of BetterBricks, compatibility of BetterBricks' message with a member organization's message, influence of BetterBricks on the market, and future market trends. Appendix E provides the interview guides.

DATA SOURCES

Table 2.1 provides our data sources and sample sizes for the MPER. We called non-responding contacts in the population ten times in an attempt to secure a survey. Appendix A provides more information on our methods, including survey sample goals and dispositions.

Table 2.1: Data Sources for MPER

Data Collected	Source	Participant Sample Size	Nonparticipant Sample Size
Program Information	Market Manager Interviews	4	N/A
Market Practices	Market Surveys	45	81
Design &Construction	Architectural Firms	9	**35**
Large (25 or more employees)		9	16
Medium (10-25 employees)		0	19
Office Real Estate	Commercial Real Estate Firms	6	**25**
Large (25 or more employees)		4	11
Medium (10-25 employees)		2	14
Hospitals & Healthcare	Hospital Facility Directors	22	**14**
Large (300 or more beds)		15	7
Medium (WA/OR 150-299 beds; ID/MT 100-299 beds)		7	10
Building Operations	Mechanical Contractors	8	**7**
Large (25 or more employees)		7	6
Medium (10-25 employees)		1	1
Perceptions of BetterBricks and Market Trends	Professional Association Interviews	12	N/A

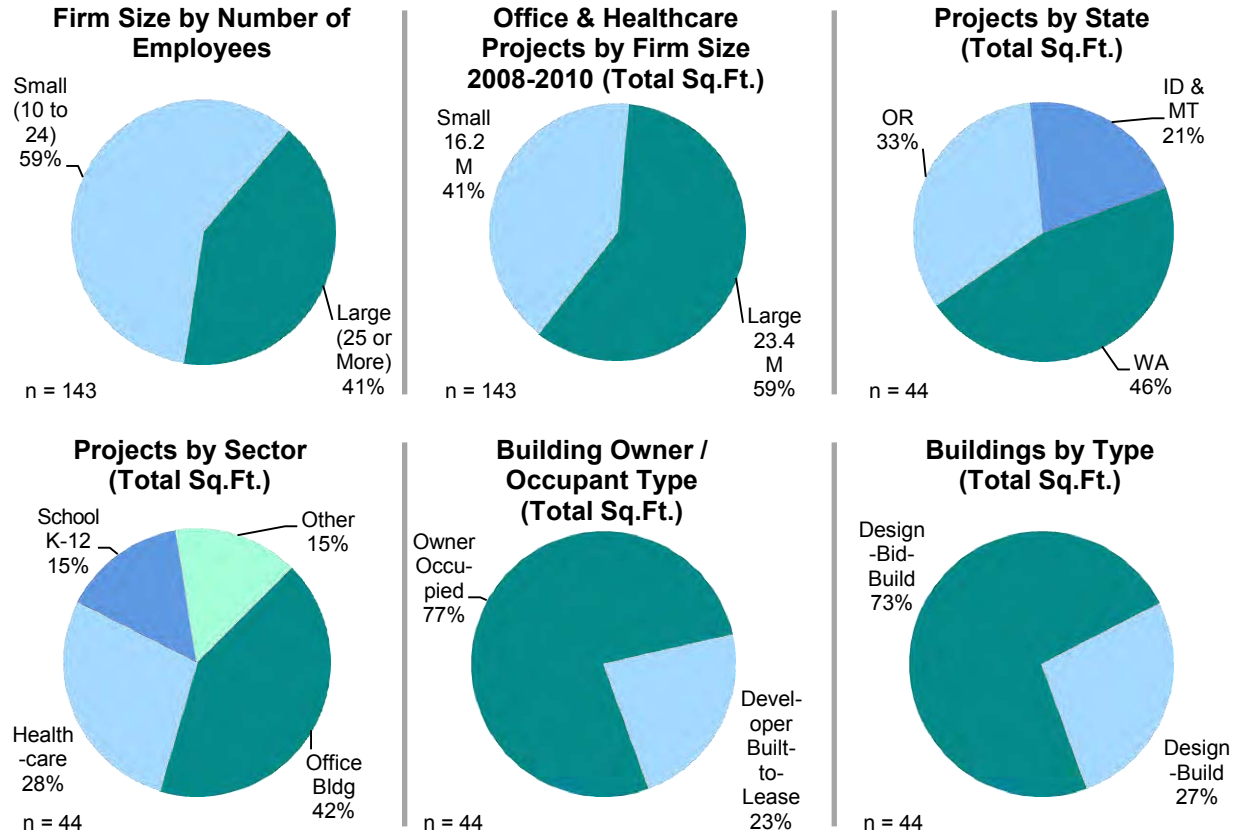
3 MARKET CHARACTERIZATION

This chapter characterizes the D&C, ORE, H&H, and BOPs markets targeted by BetterBricks. We derive our market descriptions from our survey data; Chapter 2 provides our survey sample sizes; Appendix A provides a detailed explanation of our methods for estimating market sizes.

DESIGN AND CONSTRUCTION MARKET

Based on current Dun & Bradstreet (D&B) data, we estimate that 143 architectural firms in the Pacific Northwest have ten or more employees and design for the office and healthcare sectors. Their design projects in these sectors during the last three years total approximately 40 million square feet. We corroborated square footage estimates with data from the U.S. Census (see Appendix A for details). Figure 3.1 provides additional market characteristics.

Figure 3.1: Estimated Architectural Firm Characterizations

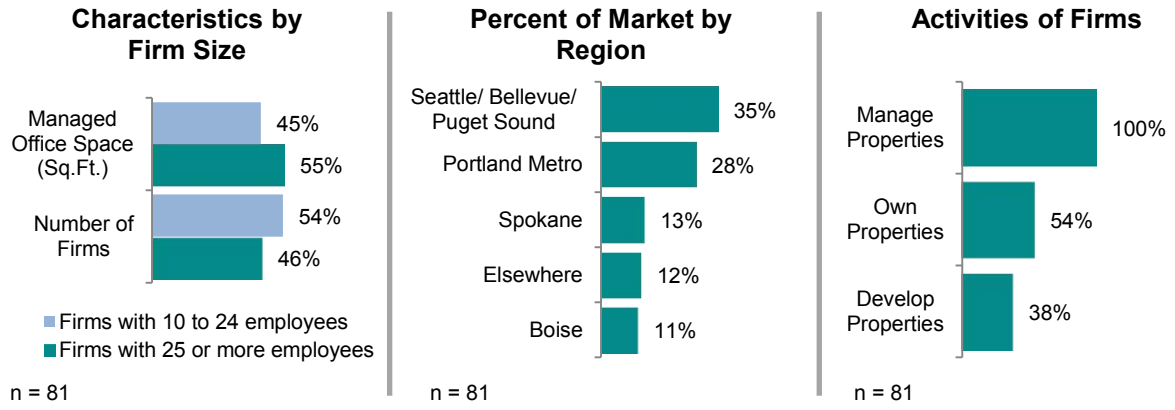


The D&C market contracted severely in late 2008 and 2009 with the economic recession and remained contracted through 2010. According to the US Census (*www.census.gov/const/www/c30index.html*), the value of private nonresidential construction put in place (seasonally adjusted annual rate) fell month-to-month from a peak of $412,197 million in October 2008 to a low of $252,323 million in July 2010 (a 39% reduction). The national market had contracted 28% as of the end of 2009. Disaggregated data are available through 2009 and show nonresidential construction in the western U.S. declined 28% through 2009; office construction in the West through 2009 declined 34%, and healthcare construction declined 7%. Since 1995, the American Institute of Architects produces the Architecture Billings Index. A value of 50 indicates no change in billings from the previous month, and values below 50 indicate a decrease. The December 2010 value for the West was 40.0 and its national value for the commercial/industrial sector was 42.7. According a December 27, 2010 special report of the *Architectural Record (http://archrecrod.construction.com/news/daily/ archives/210/12/ 101227recession_update.asp)*, "Joblessness persists in the field. Some AIA leaders put the unemployment rate at 20 percent or higher. And more gloom is spelled out by the Architecture Billings Index, compiled by the AIA. Since January 2008, the index has cleared 50 only twice, in September and November of 2010 (anything less than 50 suggests an industry in contraction)."

OFFICE REAL ESTATE

We estimate, based on information from the ORE market manager, business journals, and contest participants, that 81 firms in the Pacific Northwest have ten or more employees and manage roughly 51 million square feet of commercial office space. Figure 3.2 provides additional descriptors.

Figure 3.2: Estimated Office Real Estate Firm Characterizations



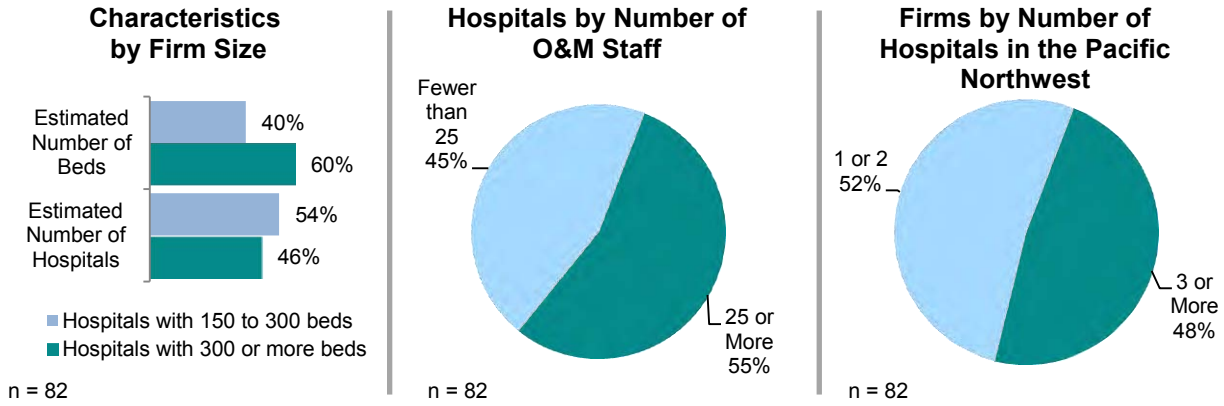
The recession has also affected the office real estate market, as suggested by the decline in the value of new construction put in place, reported above for the D&C market. The *Wall Street Journal*, in the July 6, 2010 article *Office Vacancy Rate Keeps Climbing*, reports a national office vacancy rate of 17.4%, described as the highest level since 1993

(*http://online.wsj.com/article/SB10001424052748703778504575347190869129432.html*). According to the ORE professional associations interviewed for this BPER, building values are down, vacancies up, rents down, and new construction has virtually ceased. It is hard to find capital and owners cannot raise rents to invest in energy efficiency. Building ownership is changing. People who have taken big losses will be less eager to do anything. Owners are in survival mode – looking for ways to survive in the short term. It is a challenge in this environment to look beyond the low hanging fruit and address energy use holistically to achieve deeper energy savings.

HOSPITALS AND HEALTHCARE

Based on data provided by the H&H market manager, we estimate that 82 hospitals with 150 beds or more in Washington and Oregon and 100 beds or more in Idaho and Montana are operating in the Pacific Northwest. These hospitals operate approximately 22 thousand beds. Figure 3.3 provides additional descriptors, as do the previous BetterBricks MPERs.

Figure 3.3: Estimated Hospital Firm Characterizations



The H&H market is the least affected by the recession, although BetterBricks hospital professionals interviewed indicated hospitals have curtailed most new construction and capital investment in facilities. The 2009 value of new construction put in place for acute care facilities (hospitals) did not differ appreciably from that of 2008, according to the disaggregated U.S. Census data source reported previously for the D&C market. These projects were initiated before the recession; 2010 figures by sector are not yet available.

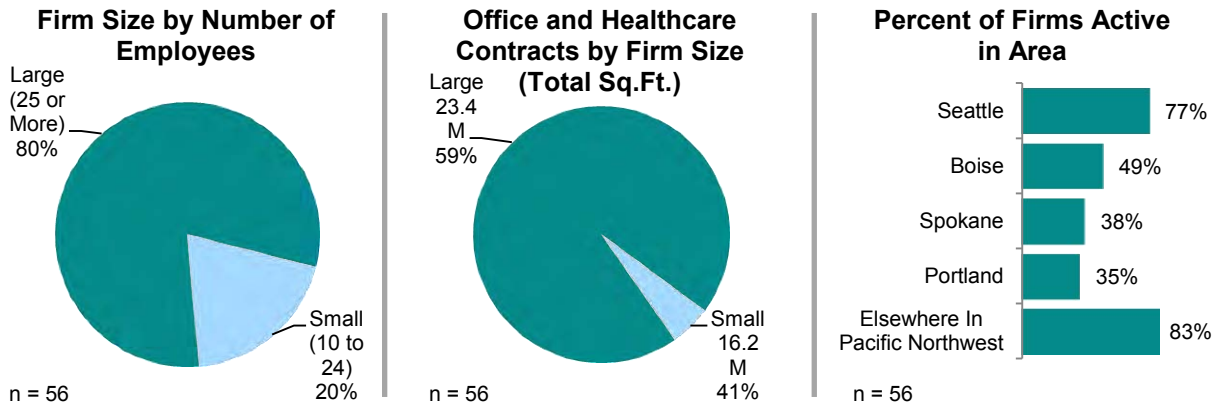
Hospitals face new regulations and reform due to the *Health Care and Education Reconciliation Act of 2010*. Studies conducted independent of the current research offer mixed reviews on the state of energy efficiency in the healthcare sector. The report *2010 Energy Efficiency Indicator: Healthcare Sector* concludes that "investment in building energy efficiency remains strong in the

North American healthcare industry" and calls the sector "a leader among other sectors" in energy efficiency.[3] In contrast, a survey conducted by the Corporate Realty, Design & Management Institute and reported on by Matthew Wheeland of Greener World Media on December 2, 1010, concluded that healthcare professionals undervalue investments in energy efficiency despite a broad recognition of the importance and benefits of sustainability projects.

BUILDING OPERATIONS

Based on current D&B data, we estimate that 56 mechanical contractor firms in the Pacific Northwest have ten or more employees. These firms provide services to approximately 50 million square feet of commercial office and healthcare space. Virtually all firms offer the services of equipment servicing, equipment installation, and equipment system design. Figure 3.4 provides additional descriptors.

Figure 3.4: Estimated Mechanical Contractor Firm Characterizations



The BOPS market supplies the ORE market and other markets in contraction due to the recession. BOPS revenues are down as floor space sits empty and clients seek to curtail expenditures. As cited in the ORE section above, the *Wall Street Journal* reported an estimated office vacancy rate of over 17% in mid-2010.

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3 Derek Supple. *2010 Energy Efficiency Indicator – Healthcare Sector,* Issue Brief, October 2010. Institute for Building Efficiency, an initiative of Johnson Controls. Johnson Controls partnered with the International Facility Management Association (IFMA) and the American Society for Healthcare Engineering (ASHE) to commission a survey of more than 1,400 decision-makers across North America responsible for managing commercial buildings and their energy use. *http://www.instituteBE.com/Energy-Efficiency-Indicator/energy-efficiency-in-healthcare.aspx*.

4 MARKET PROGRESS FINDINGS

This chapter presents our findings from our survey research and interviews with professional associations. The chapter also draws on information from BetterBricks documents and market managers and the *2008 BetterBricks Overall Market Progress Evaluation Report.*[4]

BetterBricks has a market transformation theory: help a few leaders/early adopters be successful and then publicize that success to motivate the near majority to begin to copy the practices, while supporting the entire market by making tools available on the website *betterbricks.com* and by offering free and reduced-cost training. BetterBricks resources provided to the targeted firms comprise both technical advice and business assistance, provided by program contractors referred to as Technical Advisors and Business Advisors or Market Specialists. This focus on a limited number of targeted firms, called *Firm Focus* in some markets, aims to help these firms advance their practices so they become market leaders in energy efficiency and their progress influences others within the market to adopt best practices.

These market dynamics, combined with key elements of the diffusion strategy, help spread best practices. Diffusion-oriented efforts supported by BetterBricks comprise: education and training; marketing and advertising, including the promotion of case studies and other success stories; product development, which includes creation of tools that embody the lessons learned through BetterBricks-supported projects; and the *betterbricks.com* website, which both supports marketing and outreach, and serves as the repository of BetterBricks-developed tools and links to other resources. Marketing includes the annual *BetterBricks Awards* to recognize regional and market-segment achievements, press releases to announce the winners, and case studies, profile articles, and brochures.

To leverage these diffusion efforts, BetterBricks has established long-term relationships with a number of professional organizations that serve the targeted markets to support them in delivering training, seminars, conferences, and lectures from distinguished speakers, and annual awards recognizing energy-efficient design and facility operations.

The survey results we present refer to the targeted or Firm Focus firms as *participants*, although this is not a term used by the BetterBricks staff; these firms had extensive direct involvement with BetterBricks. We use the term *Light Touch* to describe firms that report that BetterBricks has enhanced their energy efficiency practices. These *Light Touch* firms include both firms with direct involvement – although considerably less involvement than *participant* firms – and firms with direct influence from BetterBricks. We use the term *nonparticipant* to describe the

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[4] Report #E09-208, July 17, 2009. Prepared by Research Into Action, Inc., Tecmarket Works, PWP, Inc., Dethman & Associates, and Washington State University. *http://neea.org/research/reports/EO9-208_v3.pdf*.

remaining firms in the regional markets that do not report BetterBricks influence or involvement; these firms may or may not be aware of BetterBricks.

BetterBricks intends to directly affect a significant amount of square footage in the healthcare and office real estate markets through its intervention among both demand-side and supply-side firms. BetterBricks staff selected the Firm Focus firms in the Design and Construction and Building Operations components of BetterBricks, in part, on their share of the healthcare and office real estate markets.

Appendix B provides a more detailed description of program activities.

DESIGN AND CONSTRUCTION (D&C)

The text box presents the outcomes NEEA anticipated by 2010 for D&C.

- Market partners, including utilities, trade associations and select firms help support and promote integrated design
- Sixty percent of Northwest A&E firm decision-makers are aware of the business opportunity and client benefits of high performance buildings
- A&E firms representing a significant percentage of the design and construction market adjust their business practices to deliver high performance buildings
- A significant percentage of the floor area of new project designs are incorporating partial and fully integrated energy design strategies that rely on passive or low-energy solutions for lighting, ventilation, comfort and critical process loads resulting in savings greater than 25% over baseline.

Professional Association Interviews

To explore D&C progress toward its first 2010 goal, we spoke with representatives of partnering professional associations: the Seattle and Portland chapters of American Institute of Architects, the Idaho chapter of American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE), and the Cascadia chapter of the U.S. Green Building Council.

Across the professional associations interviewed, it is clear that BetterBricks support reaches a wide and somewhat diverse audience comprising not only design professionals, but also representatives of owners, students, and government officials. The number of participants in BetterBricks-sponsored events ranged from 70 to 80 a year for a regional chapter of ASHRAE, to several thousand for Cascadia.

Events supported included an annual conference, lectures, seminars, and the development of a complete course intended to help design professionals attain the benchmarks associated with the *2030 Challenge*. In addition, BetterBricks worked with these professional associations to help: fund a position to support training activities; a study to determine the feasibility of higher-level

training; and several ad hoc activities pertinent to BetterBricks goals that could not proceed without additional funding.

Representatives of the professional associations believe their members and event participants regard BetterBricks as a credible source of information. Contacts spoke highly of NEEA staff and contractors that they worked with, noting that they provided not just funding, but extensive knowledge and insight that helped make their efforts more effective. One respondent emphasized that: "NEEA has a wealth of knowledge they are willing to share."

All the professional associations interviewed spoke highly of the overall level of support provided and noted that BetterBricks is a critical part of their success. Respondents describe BetterBricks as an unseen or behind-the-scenes force helping the associations to advance its own agenda, as well as that of BetterBricks. The association contacts themselves adequately articulated BetterBricks' basic goals and priorities, as well as the key messages.

All of the contacts looked forward to continuing to work with BetterBricks in the future. One contact expressed concern that NEEA's commercial initiative redesign has shifted focus away from new construction.

In sum, BetterBricks' interaction with professional associations appears to be effective in promoting the goals of transforming design and construction practice to achieve more energy-efficient high performance buildings. The selected associations play a significant role in informing their members and view BetterBricks as a valuable resource in helping them to fulfill that mission (Table 4.1).

Table 4.1: D&C Professional Association Support (n=4)

Question	Yes	No
Desire to work with BetterBricks in the future	100%	0%
Does BetterBricks help promote a shared agenda?	100%	0%
Is BetterBricks a credible source of Information?	100%	0%

➡ **As evidenced by interviewed professional associations desiring to work with BetterBricks in the future, viewing it as helping to promote the shared goal of high performance buildings and providing a credible source of information, and other overwhelmingly positive comments, we infer D&C attained its 2010 goal that "market partners help support and promote integrated design."**

Market Survey of Architects

Table 4.2 characterizes the BetterBricks targeted architectural market (ten or more employees) serving office real estate and hospitals, based on findings from our survey sample (weighted).

Table 4.2: BetterBricks Targeted Architectural Market

Submarkets of BetterBricks	Firm Size	Estimated Population Characteristics			
		Number of Firms	Percent of Firms	Total Sq Ft of Designs	Percent of Sq Ft
BB Participants	**Large**	**9**	**6%**	**8,724,000**	**22%**
BB Light Touch	Large	37	26%	10,862,000	27%
	Medium	37	26%	7,115,000	18%
	Total	**74**	**52%**	**17,977,000**	**45%**
BB Nonparticipant	Large	13	9%	3,816,000	10%
	Medium	47	33%	9,055,000	23%
	Total	**60**	**42%**	**12,872,000**	**33%**
Total		**143**	**100%**	**39,5723,000**	**100%**

➡ **It appears that D&C has met is 2010 goal that "60% of Northwest architectural firm decision-makers are aware of the business opportunity and client benefits of high performance buildings."** Decision-makers involved with about two-thirds (22% participants + 45% Light Touch) of the regional square footage of newly constructed office and healthcare facilities report BetterBricks has enhanced areas of their practice involving energy efficiency, which we construe as indicating they appreciate the benefits.

The data presents the percentage of the total market and submarket square footage that has adopted the BetterBricks best practice, as described by our market progress indicators (MPIs). We developed the MPIs directly from the D&C best practices, with the exception of certification (that is, buildings receiving LEED [Leadership in Energy and Environmental Design] certifications or other designations), which we include as an indicator of D&C best practices, rather than itself constituting a D&C best practice. We gauge adoption of best practices from the questions we posed in the D&C market survey.

The following comments provide some methodological background appropriate to the interpretation of the data, as well as to the analogous tables in the subsequent sections for the other three markets.

We consider that a contact's responses satisfy the BetterBricks criteria if they meet about two-thirds of the conditions defining the MPI statistics. (Appendix A identifies how we defined and quantified the MPI statistics. Reviewing the frequency distribution of all MPIs across all four markets, we defined *about two-thirds* as greater than or equal to 0.63.) We round the percentages shown in the table to the nearest 5% to facilitate comparisons across the differing-sized samples.

Table 4.3: Estimated BetterBricks D&C Market Progress Indicators

MPI	Proportion of Market Evidencing MPI				
	Total Market (n=43)	Participants (n=8)	Light Touch (n=19)		Nonparticipants (n=16)
		Large	Large	Medium	Large & Medium
Design Practices	35%	75%	50%	30%	0%
…Benchmarking	10%	25%	15%	15%	0%
…Tracking and Reporting	15%	25%	0%	45%	0%
…Energy Performance Targets	35%	50%	65%	30%	10%
…Certification	15%	50%	20%	0%	0%
…ID Awareness	60%	100%	85%	45%	20%
…ID Team	70%	60%	80%	55%	75%
…Energy Modeling	55%	85%	65%	55%	25%
…ID Process	50%	75%	65%	55%	15%
…ID Features	55%	75%	85%	70%	10%
Strategic Leadership	60%	100%	80%	45%	25%
…Executive Commitment	50%	100%	70%	45%	10%
…Vision	65%	100%	95%	70%	15%
…Intention	45%	100%	50%	30%	15%
Mobilize the Organization	55%	85%	70%	70%	10%
…Communicating Expectations	45%	85%	55%	45%	15%
…Training	65%	85%	80%	85%	25%
Contracts with Clients	45%	60%	55%	30%	30%
Overall Adoption	45%	100%	65%	30%	0%

We weighted the respondents to represent their market share (percent of floor space or, in the case of hospitals in Table 4.10, beds) according to the joint characteristics of participant status (participant, Light Touch, and nonparticipant) and size (large, medium). Every respondent within a group has the same weight, both for simplicity and because the self-reported data on the organization's market share lack precision.

We designated firms as Light Touch according to their self-report that BetterBricks enhanced their energy efficiency practices. According to the BetterBricks theory, we anticipate that adoption of BetterBricks best practices will increase with degree of involvement with BetterBricks (from nonparticipant to Light Touch, to participant) and with size of organization (from medium to large firms). The data, Table 4.7, Table 4.11, and Table 4.14 differ in their presentation of MPI statistics by size of firm, as small samples for some groups precluded showing medium and large firms separately.

Because we achieved nonparticipant sample sizes smaller than our goals, which were derived based on 90/10 confidence precision (see Appendix A), we do not conduct statistical tests of significance for the differences we report between groups. The reader should interpret the findings as suggestive, not precise.

The data suggest a number of tentative implications, as follows:

➡ **Participants and Light Touch firms have adopted D&C BetterBricks practices in greater proportions than nonparticipants. This is the first among the series of BetterBricks MPERs to demonstrate this finding**.

- However, given the absence of baseline research for D&C on these MPIs, we cannot rule out the possibility that these positive findings reflect some self-selection bias. It is possible that D&C targeted the firms already engaged to some extent in the best practices it promotes. It is also possible that Light Touch firms similarly had embraced more energy efficiency practices than had nonparticipants prior to exposure to D&C.
- On the other hand, all the participants and Light Touch firms themselves credit D&C activities with enhancing their energy efficiency practices.

➡ **D&C appears to have met its 2010 goal that "Architecture firms representing a significant percentage [defined as 20% to 40%, depending on the submarket] of the design and construction market adjust their business practices to deliver high performance buildings**. We found that firms designing about 45% of the square footage evidence BetterBricks best business practices.

➡ **D&C appears from these behavior indicators to be on the way to meeting its 2010 goal that "A significant percentage of the floor area [defined as 10-40%, depending on the submarket] of new project designs are incorporating partial and full integrated energy design strategies that rely on passive or low-energy solutions for lighting, ventilation, comfort and critical process loads resulting in savings greater than 25% over baseline."** We found ID features (the strategies listed in the goal) used by 55% of the market. However, we do not know the savings compared to baseline.

➡ **We lack a measure of the extent to which D&C has met its 2010 goals for engineering firms (its target market is "A&E" firms).** D&C targeted architectural firms and architectural firms comprise our D&C market survey population. We also lack a measure of D&C's goal for working with utilities as market partners.

About three-quarters of the architectural market has heard of the website *betterbricks.com* and one-third have heard of the *BetterBricks Awards* (see Table 4.4).

Table 4.4: Familiarity with BetterBricks Among Architectural Market

Program Element	Participants (n=8)	Light Touch (n=19)	Nonparticipants (n=16)
Heard of NEEA	100%	95%	60%
Heard of *betterbricks.com*	100%	100%	75%
Visited *betterbricks.com*'s D&C section	90%	95%	70%
Used content from *betterbricks.com*	90%	95%	15%
Heard of BetterBricks Awards	100%	75%	35%
Attended BetterBricks Awards	90%	35%	10%
Saw BetterBricks media	100%	90%	30%
BetterBricks directly influenced your energy efficiency practices	100%	80%	0%
BetterBricks enhanced your energy efficiency practices	100%	100%	0%

➡ **Participants and Light Touch firms are familiar with BetterBricks program elements in greater proportions than nonparticipants. The architectural market appears to have high awareness of BetterBricks (at least 75% of non-participants, and 100% of participants and Light Touch firms have heard of betterbricks.com or some other element of BetterBricks).**

OFFICE REAL ESTATE (ORE)

The text box presents the outcomes NEEA anticipated by 2010 for ORE.

- Market partners, including utilities, trade associations, and select firms begin support and promotion of high performance portfolios
- Real estate professionals receive and download the High Performance Portfolio Framework and associated tools, and begin implementation
- Fifty percent of targeted real estate decision-makers are aware of the specific benefits available from new and existing high performance buildings
- Real estate companies representing 20% of targeted real estate floor space adopt energy management plans that change energy-related business practices, including:
  - Two or more nationally-based companies with significant Northwest assets
  - One or more regional companies in each major Northwest commercial market
- Twenty percent of relevant real estate professionals are capable of managing change in energy-related business practices for design and construction and facility operations

Professional Association Interviews

To explore ORE progress toward its first 2010 goal, the evaluation team interviewed contacts at the Seattle and Portland chapters of the Building Owners and Managers Association (BOMA), the Urban Land Institute, and Seattle's 2030 District – professional associations that worked with ORE.

ORE partners with the organizations to deliver education, seminars, events, and contests. Resources and ideas are leveraged and shared. The organizations market to their members and ORE underwrites the events and activities. They share ideas on how to strategically move the market forward and identify opportunities they can take advantage of. BetterBricks participates as a member and investor in some of the organizations.

The professional associations estimated that in the last two years approximately 1,000 people[5] participated in the *BetterBricks Awards*, BOMA Energy Efficiency Program (BEEP) and the Best of BEEP, the *Kilowatt Crackdown*, *Office Showdown*, training on benchmarking, and seminars on green leasing, sustainability, and green financing. Contacts said their members were very aware of ORE's involvement in these events.

The professional associations said ORE aids them in meeting their goals by helping to provide services to their members. Sustainability can also be part of the organizations' goals, as reflected in BOMA's seven-point challenge. Members benefit from having access to expertise through ORE that otherwise would not be available. The associations believe that the overall knowledge of their members has improved and that the real estate workforce is better trained about energy efficiency. Associations believe members have a deeper understanding that achieving energy efficiency is more than just taking advantage of the low hanging fruit. Energy management business practice change is becoming more of a first concern, as reflected in an increase in building benchmarking and in real energy reductions.

When asked about how their members perceive ORE, the professional associations said it has a lot of credibility and has a great reputation (Table 4.5). They see ORE as a solid partner that has done good things in the market, been strategic, and has established a lot of trust. Contacts view ORE as having no conflict of interest or motives, in contrast to other firms or organizations in the market. One association said ORE is the first place they would go to learn anything about energy efficiency.

[5] These are not unique individuals. A person may be counted more than once if they participated in multiple events.

Table 4.5: BetterBricks Professional Association Support (n=4)

Question	Yes	No
Desire to work with BetterBricks in the future	100%	0%
Does BetterBricks help promote shared agenda?	100%	0%
Is BetterBricks a credible source of Information?	100%	0%

➡ **As evidenced by the number of co-sponsored events and member participation, and by interviewed professional associations desiring to work with BetterBricks in the future, viewing it as helping to promote the shared goal of high performance buildings and providing a credible source of information, and other overwhelmingly positive comments, we infer ORE attained its 2010 goal that "market partners begin support and promotion of high performance portfolios."**

Market Survey of Office Real Estate Firms

Table 4.6 characterizes the BetterBricks-targeted office real estate market based on findings from our survey sample (weighted). Refer to the paragraphs introducing The data for additional methodological detail useful in interpreting the tables in this section.

Table 4.6: BetterBricks Targeted Office Real Estate Market

Submarkets of BetterBricks	Firm Size	Estimated Population Characteristics			
		Number of Firms	Percent of Firms	Total Sq Ft	Percent of Sq Ft
BetterBricks Participants	Large	4	5%	4,000,000	8%
	Medium	2	2%	1,500,000	3%
	Total	**6**	**7%**	**5,500,000**	**11%**
BetterBricks Light Touch	Large	15	19%	11,000,000	21%
	Medium	18	22%	13,200,000	26%
	Total	**33**	**41%**	**24,200,000**	**47%**
BetterBricks Nonparticipant	Large	18	22%	9,300,000	18%
	Medium	24	30%	12,400,000	24%
	Total	**42**	**52%**	**21,700,000**	**42%**
Total		**81**	**100%**	**51,400,000**	**100%**

➡ **It appears that ORE has met is 2010 goal that "50% of targeted real estate decision-makers are aware of the specific benefits available from new and existing high performance buildings."** Decision-makers involved with about 60% (11% participants + 47% Light Touch) of the regional square footage of office real estate report BetterBricks

has enhanced areas of their practice involving energy efficiency, which we construe as indicating they appreciate the benefits.

Table 4.7 presents the percentage of the total market and submarket square footage that has adopted the BetterBricks best practice, as described by our market progress indicators (MPIs).

Table 4.7: Estimated BetterBricks ORE Market Progress Indicators

MPI	Proportion of Market Evidencing MPI			
	Total Market (n=31)	Participants (n=6)	Light Touch (n=11)	Nonparticipants (n=14)
		Large & Medium	Large & Medium	Large & Medium
Building Operations	55%	85%	65%	35%
…Benchmarking	45%	75%	55%	30%
…Tracking and Reporting	50%	85%	55%	30%
…Energy Performance Targets	60%	85%	75%	35%
…Energy Efficiency Plan	55%	100%	65%	25%
…Energy Efficiency Study	75%	100%	90%	45%
…Energy Efficiency Tune-Up	75%	100%	90%	45%
Strategic Leadership	70%	85%	80%	55%
…Executive Commitment	80%	100%	90%	65%
…Vision	65%	65%	80%	50%
…Intention	85%	100%	100%	70%
Mobilize the Organization	55%	85%	65%	30%
…Communicating Expectations	55%	85%	55%	50%
…Training	65%	85%	80%	45%
Contracts with Clients and Suppliers	60%	85%	45%	70%
Overall Adoption	70%	85%	90%	45%

The data in Table 4.6 and Table 4.7 suggest a number of implications, as follows:

➡ **Participants and Light Touch firms have adopted ORE BetterBricks practices in greater proportions than nonparticipants. This is the first among the series of BetterBricks MPERs to demonstrate this finding.**

- As with the D&C findings, we cannot rule out the possibility that these positive findings reflect some self-selection bias; yet all the participants and Light Touch firms themselves credit ORE activities with enhancing their energy efficiency practices.

➡ **ORE appears to have met its 2010 goal that "Real estate companies representing 20% of targeted real estate floor space adopt energy management plans that change energy-related business practices."** We found that about 40% more participating and Light Touch square footage has such plans than nonparticipating square footage.

- The total market adoption of such plans as suggested by our data is 55%. However, we recognize the limits of self-reported data; respondents may provide answers that we code as meeting best practices that a site-visit or ethnographic study would code as not meeting best practices. We recognize that all the data – participants/Light Touch included – may reflect self-report bias.

➡ **ORE appears to have met its goal that "Twenty percent of relevant real estate professionals are capable of managing change in energy-related business practices for facility operations."** We found that more than half of the market has been affected by targeted or Light Touch activities (Table 4.6), and that these firms report 20% greater adoption of BetterBricks facility operational practices than do nonparticipants.

➡ **We lack a measure of the extent to which ORE has met its 2010 goals for design and construction.** With the downturn in the economy, few if any office real estate firms engaged in new design and construction in the last three years and thus we did not pursue the issue in our survey. Utilities were not sureveyed so we also lack a measure of ORE's goal for working with utilities as market partners.

About half of the office real estate market has heard of the website *betterbricks.com* and one-third have heard of the BetterBricks Awards (see Table 4.8).

Table 4.8: Familiarity with BetterBricks Among Office Real Estate Market

Program Element	Participants (n=6)	Light Touch (n=11)	Nonparticipants (n=14)
Heard of NEEA	100%	75%	35%
Heard of *betterbricks.com*	100%	100%	50%
Visited *betterbricks.com*'s ORE section	85%	55%	30%
Used Content from *betterbricks.com*	85%	55%	15%
Heard of *BetterBricks Awards*	65%	100%	35%
Attended *BetterBricks Awards*	65%	45%	10%
Saw High Performance Portfolio Framework	65%	20%	0%
Saw BetterBricks media	85%	80%	5%

Continued

Program Element	Participants (n=6)	Light Touch (n=11)	Nonparticipants (n=14)
BetterBricks directly influenced your energy efficiency practices	100%	80%	5%
BetterBricks enhanced your energy efficiency practices	100%	100%	0%
Participated in BEEP classes	50%	55%	15%
Participated in Seattle *Kilowatt Crackdown*	65%	25%	30%
Participated in Portland *Office Showdown*	15%	35%	0%

➡ **The office real estate market overall appears to have moderate awareness of BetterBricks as less than 50% of non-participants are aware of most BetterBricks program elements. Awareness increases the more direct the BetterBricks involvement with participants showing a high level of awareness.**

HOSPITAL AND HEALTHCARE (H&H)

The text box presents the outcomes NEEA anticipated by 2010 for BetterBricks Hospital & Healthcare (H&H). SEMP signifies "strategic energy management plan."

- BetterBricks can document market awareness of SEMP benefits among hospital decision-makers representing 75% of beds
- Hospitals representing 25% or more of regional beds will be committed to and practicing SEMP elements:
  - Financial decision-making clear and uses total-cost-of-ownership
  - Integrated design in new facilities and major renovations
  - Enhanced facility O&M practices
  - Consistent purchase of energy-efficient equipment
  - Cost-effective capital upgrades
  - Tracking and accountability
- Hospital decision makers (DMs) representing 25% of beds request and/or require (e.g., through RFPs and contracts) trade allies to support SEMP practices as follows:
  - Financial Decision-Making: DMs request/ require that engineers and equipment vendors provide well-documented energy & O&M cost data for financial analysis of energy investments
  - Integrated Design: DMs request/require that A&E teams are experienced in or willing to learn ID
  - Purchasing and Upgrades: See financial decision-making above
- Hospital decision-makers and their associations consider BetterBricks an excellent source of information & practical tools on energy-related business & technical practices
- Enhanced O&M: DMs request/ require that service providers are experienced in, or willing to learn, enhanced O&M

Professional Associations Interviewed

Partnerships with professional organizations serving hospitals provide a key marketing venue. Partnering organizations include the state societies for healthcare engineering (serving facility directors) and the state hospital associations (serving executives). In particular, BetterBricks presentations have occurred at each state chapter of healthcare engineers in Washington, Oregon, Idaho, and Montana.

We interviewed representatives of the Washington, Idaho, and Montana chapters of the State Societies of Healthcare Engineers. We did not interview a representative from the Oregon State Society of Healthcare Engineers in order to maintain a regional balance of interviews (see Appendix A). Overall, these contacts correctly understood the role of BetterBricks as an entity to help their members to benchmark their facilities and to create and implement energy management plans.

The contacts reported involvement during the past two years in from two to eight events in which BetterBricks participated. Attendance at these events ranged from 30 to 50, with some individuals attending multiple events. The professional associations' members have a positive view of BetterBricks, see it as a credible source of information, and believe its message is the right one for this market (Table 4.9).

Table 4.9: H&H Professional Association Support

Question	Yes (n=3)	No
Desire to work with BetterBricks in the future	100%	0%
Is BetterBricks a credible source of Information?	100%	0%
Do you think this is the right message for this market?	100%	0%
Do you think the Initiative is getting this message to the market?	100%	0%

➡ **As evidenced by interviewed professional associations desiring to work with BetterBricks in the future, viewing it as providing the right message for the market and a credible source of information, we infer H&H attained its 2010 goal that partnering associations view BetterBricks as an "excellent source of information and practical tools on energy-related business and technical practices."**

Market Survey of Hospital Facility Directors

Table 4.10 characterizes the BetterBricks target hospital market of medium and large hospitals based on findings from our survey sample (weighted).[6] Refer to the paragraphs introducing The data for additional methodological detail useful in interpreting the tables in this section.

Table 4.10: BetterBricks Targeted Hospital Market

Submarkets of BetterBricks	Firm Size	Estimated Population Characteristics			
		Number of Firms	Percent of Firms	Total Beds	Percent of Beds
BetterBricks Participants (n=22)	Large	15	18%	5,200	24%
	Medium	7	9%	1,400	6%
	Total	**22**	**27%**	**6,600**	**30%**
BetterBricks Light Touch (n=5)	Large	22	27%	7,800	36%
	Medium	3	4%	700	3%
	Total	**25**	**31%**	**8,500**	**39%**
BetterBricks Nonparticipant (n=8)	Large	1	1%	200	1%
	Medium	34	41%	6,700	30%
	Total	**35**	**42%**	**6,900**	**31%**
Total (n=35)		**82**	**100%**	**22,000**	**100%**

➡ **It appears that H&H has roughly met its 2010 goal that "BetterBricks can document market awareness of SEMP benefits among hospital decision-makers representing 75% of beds."** Decision-makers involved with about 70% (30% participants + 39% Light Touch) of the regional hospital beds report BetterBricks has enhanced areas of their practice involving energy efficiency, which we construe as indicating they appreciate the benefits.

Table 4.11 presents the percentage of the total market and submarket square footage that has adopted the BetterBricks best practice, as described by our market progress indicators (MPIs). All of the large organizations among the sampled nonparticipants indicated BetterBricks had influenced their efficiency practices, making them what we term Light Touch organizations. The Light Touch organizations shown in the table also include one medium-size hospital. No large organizations remained in the nonparticipant sample.

[6] For Washington and Oregon, hospitals with more than 150 beds. For Idaho and Montana, hospitals more than 100 beds.

Table 4.11: BetterBricks Hospital & Healthcare Market Progress Indicators

MPI	Proportion of Market Evidencing MPI			
	Total Market (n=35)	Participants (n=22)	Light Touch (n=5)	Nonparticipants (n=8)
		Large & Medium	Large	Medium
Building Operations	70%	95%	75%	33%
…Benchmarking	45%	80%	50%	10%
…Tracking and Reporting	60%	95%	50%	45%
…Energy Performance Targets	70%	85%	90%	35%
…EE Plan	75%	70%	90%	55%
…EE Study	65%	80%	75%	45%
…EE Tune-Up	85%	100%	100%	45%
Life Cycle Cost Analysis Financial Analysis	70%	80%	85%	45%
Capital Improvements	80%	85%	85%	65%
Design Practices*	60%	65%	85%	20%
…ID Awareness	60%	70%	75%	35%
…ID Modeling	50%	80%	60%	10%
…ID Activities	75%	70%	90%	55%
…ID Features	75%	95%	85%	35%
Strategic Leadership	50%	35%	75%	35%
…Executive Commitment	70%	60%	100%	35%
…Vision	50%	35%	75%	35%
Mobilize the Organization	15%	15%	25%	0%
…Communicating Expectations	15%	25%	25%	0%
…Training	20%	15%	35%	10%
Contracts with Suppliers	40%	35%	60%	20%
Overall Adoption	40%	50%	50%	20%

* We asked all contacts if they were aware of "the architectural design process called integrated design;" we asked only contacts whose organizations had engaged in new construction or major renovation in the last three years the remaining ID questions.

These findings suggest a number of implications that can be tentatively drawn, as follows:

➡ **Participants and Light Touch firms have adopted H&H BetterBricks practices in greater proportions than nonparticipants. This is the first among the series of BetterBricks MPERs to demonstrate this finding.**

- As with the D&C and ORE findings, we cannot rule out the possibility that these positive findings reflect some self-selection bias; yet all the participants and Light

Touch firms themselves credit H&H activities with enhancing their energy efficiency practices.

➡ **H&H appears to have met its 2010 goal that "Hospitals representing 25% or more of regional beds will be committed to and practicing SEMP elements."** We found adoption of the SEMP elements among participant and Light Touch hospitals exceeded that among nonparticipants by more than 25% for every element except capital upgrades, where the difference was 20%.

- The total market adoption of the SEMP elements is around 40%. As discussed for ORE, the difference in reported behaviors between participants/Light Touch and nonparticipants provides a more conservative estimate of market adoption.

➡ **H&H appears to have met its 2010 goals that "Hospital decision-makers representing 25% of beds request and/or require (e.g., through RFPs and contracts) trade allies support SEMP practices," and that "decision-makers require that service providers are experienced in, or willing to learn, enhanced O&M."** We find the overall adoption of contracts with energy efficiency provisions at 40% of beds.

About three-quarters of the hospital market has heard of the website *betterbricks.com* and one-half have heard of the *BetterBricks Awards* (see Table 4.12).

Table 4.12: Familiarity with BetterBricks Among Hospital Market

Program Element	Participants	Light Touch	Nonparticipants
Heard of NEEA	100%	85%	65%
Heard of *betterbricks.com*	100%	100%	80%
Visited *betterbricks.com's* H&H section	100%	100%	55%
Used Content from *betterbricks.com*	70%	60%	22%
Heard of *BetterBricks Awards*	95%	75%	55%
Attended *BetterBricks Awards*	65%	10%	10%
Saw BetterBricks media	55%	65%	65%
BetterBricks directly influenced your energy efficiency practices	70%	50%	10%
BetterBricks enhanced your energy efficiency practices	80%	65%*	0%

* For the other three markets, we defined Light Touch as those firms in the nonparticipant sample who reported their practices had been enhanced by BetterBricks. For H&H, we augmented this definition by including hospitals reported by market specialists to have had some limited but direct involvement with BetterBricks.

➡ **The hospital market appears to have high awareness of BetterBricks as even nonparticipants have more than 50% awareness of most program elements**. However, our low response rate for the H&H survey may have resulted in an

oversampling of firms familiar with NEEA. We also lack a measure of H&H's goal for working with utilities as market partners.

➡ **H&H appears to have met its 2010 goals that "Hospital decision-makers consider BetterBricks an excellent source of information and practical tools on energy-related business and technical practices," as decision-makers for 70% of beds reported using content from betterbricks.com and those for 80% of beds report BetterBricks enhanced their energy efficiency practices.**

BUILDING OPERATIONS (BOPS)

The text box presents the outcomes NEEA anticipated by 2010 for BetterBricks Building Operations (BOPS).

- Northwest service provider decision-makers representing 50% of market share are aware of the business opportunity and customer benefits from improving building operating performance
- Service providers representing a significant percentage of the building operations market adopt business approaches that promote building operating performance
  - 25% of healthcare market share
  - 10% of targeted real estate market share

Professional Association Interviews

BOPS seeks partnership opportunities for its education and training and outreach activities. These opportunities include the BOMA Energy Efficiency Program (BEEP) series and events with Local 290, the Plumbers and Steamfitters Union, and other trade unions to address issues of common interest.

We interviewed a representative of the Washington chapter of the International Facility Management Association, a BOPS partnering association with more than 300 members who work with buildings of diverse types and uses, and who reflect a range of training and experience levels. This professional association has co-sponsored five trainings with BetterBricks, and with utility and other corporate sponsors during the past two years, with attendance ranging from 20 to 40. The associations' members are aware of BetterBricks' participation in those events, and see BetterBricks as a credible, easily accessible asset in giving guidance in best practices and benchmarking.

The contact considers the BetterBricks' messaging appropriate for this market, and believes BetterBricks is influencing the market by transforming best practices into standard practices. This contact views such transformation as consistent with trends in this market to: 1) communicate to organizations the value facility managers bring to them; and 2) increase the competencies expected of facility managers, including the addition of sustainability in 2011.

➡ **Given that the professional association has cosponsored five trainings with BetterBricks and believes that BetterBricks is a credible source of energy efficiency information and is transforming best practices into standard practice, we conclude BOPS is successfully engaging professional associations. BOPS did not set a 2010 goal relating to market partners**.

Market Survey of Mechanical Contractor Firms

Table 4.13 characterizes the BetterBricks targeted mechanical contractor market (firms with ten or more employees) serving office real estate and hospitals, based on findings from our survey sample (weighted). Refer to the paragraphs introducing The data for additional methodological detail useful in interpreting the tables in this section.

Table 4.13: BetterBricks Targeted Mechanical Contractor Market

Submarkets of BetterBricks	Firm Size	Estimated Population Characteristics			
		Number of Firms	Percent of Firms	Total Sq Ft	Percent of Sq Ft
BetterBricks Participants	Large	7	13%	10,900,000	22%
	Medium	3	5%	400,000	1%
	Total	**10**	**18%**	**11,300,000**	**23%**
BetterBricks Light Touch	Large	6	11%	5,900,000	12%
	Medium	0	0%	0	0%
	Total	**6**	**11%**	**5,900,000**	**12%**
BetterBricks Nonparticipant	Large	32	57%	31,000,000	61%
	Medium	8	14%	2,200,000	4%
	Total	**40**	**71%**	**33,200,000**	**65%**
Total		**56**	100%	**50,400,000**	100%

Table 4.14 presents the percentage of the total market and submarket square footage that has adopted the BetterBricks best practice, as described by our market progress indicators (MPIs).

The nonparticipant sample included only one contact reporting BetterBricks influenced its energy efficiency practices, that is, a Light Touch firm. We do not include the responses of this single firm in the table.

Table 4.14: Estimated BetterBricks BOPS Market Progress Indicators

MPI	Proportion of Market Evidencing MPI		
	Total Market (n=15)	Participants (n=8)	Nonparticipants (n=7)
		Large & Medium	Large & Medium
Building Operations	30%	75%	15%
…Benchmarking	20%	85%	0%
…Tracking and Reporting	60%	85%	50%
…Energy Performance Targets	15%	50%	0%
…EE Plan	25%	50%	15%
…EE Study	25%	60%	15%
…EE Tune-Up	75%	100%	65%
Capital Improvements	85%	100%	80%
Strategic Leadership	60%	90%	50%
…Executive Commitment	25%	60%	15%
…Vision	85%	90%	80%
Mobilize the Organization	40%	75%	30%
…Communicating Expectations	35%	85%	15%
…Training	40%	60%	30%
Contracts with Clients	60%	85%	50%
Overall Adoption	45%	85%	30%

These findings suggest a number of implications that can be tentatively drawn, as follows:

➡ **Participants and Light Touch firms have adopted BOPS BetterBricks practices in greater proportions than nonparticipants. This is the first among the series of BetterBricks MPERs to demonstrate this finding.**

- As with the other market findings, we cannot rule out the possibility that these positive findings reflect some self-selection bias; yet all the participants and Light Touch firms themselves credit BOPS activities with enhancing their energy efficiency practices.

➡ **BOPS appears to have met its 2010 goals: 1) "Northwest service provider decision-makers representing 50% of market share are aware of the business opportunity and customer benefits from improving building operating performance"; and 2) "Service providers representing a significant percentage (10% to 25% by submarket) of the building operations market adopt business approaches that promote building operating performance."** We found the adoption among participants of BetterBricks overall best practices exceeds the adoption among nonparticipants by over 50%.

- The total market adoption of the BetterBricks elements is around 45%. As noted for the other markets, the difference in reported behaviors between participants and nonparticipants provides a more conservative estimate of market adoption.

➡ **We lack a measure of BOPS' goal for working with utilities as market partners.**

About half of the mechanical contractor market has heard of *betterbricks.com* (see Table 4.15).

Table 4.15: Familiarity with BetterBricks Among Mechanical Contractor Market

Program Element	Participants (n=8)	Nonparticipants (n=7)
Heard of NEEA	100%	50%
Heard of *betterbricks.com*	100%	50%
Visited *betterbricks.com*'s BOPS section	100%	30%
Used Content from *betterbricks.com*	85%	15%
Heard of *BetterBricks Awards*	85%	0%
Attended *BetterBricks Awards*	60%	0%
Saw Fat Building Brochure	100%	0%
Saw BetterBricks media	85%	85%
BetterBricks directly influenced your energy efficiency practices	100%	0%
BetterBricks enhanced your energy efficiency practices	75%	0%
Participated in Seattle *Kilowatt Crackdown*	50%	0%
Participated in Portland *Office Showdown*	40%	0%

➡ **The mechanical contractor market appears to have moderate awareness of BetterBricks, based on a relatively high awareness of program elements by participants (60% or more for most elements) and a mixed awareness among nonparticipants (0% to 85%).** However, our low response rate for the BOPS survey may have resulted in an oversampling of firms familiar with NEEA.

BETTERBRICKS ADOPTION BY URBAN AND RURAL AREAS

NEEA currently uses the 2003 Rural-Urban Continuum Codes (RUCC) published by the U.S. Department of Agriculture, Economic Research Service, to define urban and rural areas. The RUCC uses a nine-point scale to categorize counties on a urban/rural continuum. NEEA designates codes 1-5 (county population of more than 20,000 in, or adjacent to, an urban area) as urban counties and codes 6-9 as rural counties. Using this classification, approximately 89% of households in the Northwest live in urban counties.

All participating, light touch, and nonparticipating (which we limited to firms of 10 or more employees) firms identified in this MPER research are located in urban areas. The research was unable to determine the extent to which the D&C, ORE, and BOPs firms conduct activity in rural areas, or the extent to which the hospital organizations have facilities in rural areas. However, because of the RUCC county designations, a great deal of the BetterBricks activity will likely occur outside rural counties.

BetterBricks also conducted education and training (E&T) activities throughout the region. Where attendee information was gathered, the mailing address zip code was used to determine whether the attendee was in a rural or urban county. Using a USDA table cross referencing zip codes and counties, we were able to provide a breakdown of attendee location by county. Approximately 4% of the attendees were from rural counties with an additional 14% from unknown locations. See Table 14.16

It appears that the attendees from rural counties are at least close to the proportion of total employees (our proxy for commercial floorspace[7]) in rural counties.

Table 4.16: E&T Attendees by State and Urban/Rural County (n=601)

State	Rural	Urban	U/K	**Total**
ID	0.0%	8.5%	0.0%	**8.5%**
MT	0.0%	0.0%	0.2%	**0.2%**
WA	2.0%	52.2%	0.0%	**54.2%**
OR	1.7%	21.8%	0.0%	**23.5%**
U/K	0.0%	0.0%	13.6%	**13.6%**
Total attendee distribution	**3.7%**	**82.5%**	**13.8%**	**100.0%**
Four-state urban/rural employee[7] distribution	*4.8%*	*95.2%*	**0.0%**	**100.0%**

[7] The commercial floor area per county is not currently available. As a proxy, we used employee by county from Sector 00: CB0800A1: 2008 County Business Patterns: Geography Area Series: County Business Patterns: 2008, US Economic Census under the assumption that commercial square footage will be roughly proportionate to the distribution of employees per county.

5 ENERGY SAVINGS VALIDATION AND ACE MODEL REVIEW

NEEA's standard practice is to estimate energy savings by measuring the market adoption of products or practices with defined levels of energy savings per unit. For BetterBricks, however, validation of energy savings is limited to individual projects because the program's prescribed practices were not sufficiently defined and tracking data was largely unavailable. Without such definition or tracking data, it was not possible to estimate energy savings for overall market change. As a result, NEEA's Alliance Cost Effectiveness (ACE) models show only the aggregated energy savings of individually validated projects and are not a calculation of whole market savings.

ENERGY SAVINGS VALIDATION

Table 5.1 provides a tabular summary of the electricity and natural gas savings validated by the various research activities to date.

Table 5.1. Validated Electricity and Natural Gas Savings

Activity	Validated Savings Estimates		
	Savings Prior to 2010		2010 Savings to date
	Research Conducted 2008	Research Conducted 2009	
Design and Construction	1.59 aMW 529,882 therms	0.06 aMW 35,373 therms	Projects pending
Office Real Estate	—	1.49 aMW 4,056 therms	Projects pending
Building Operations: Healthcare Facilities	0.34 aMW 47,130 therms	0.09 aMW 96,300 therms	0.06 aMW 0 therms Projects Pending
Building Operations: Other Facilities	—	0.10 aMW 1,916 therms	Projects pending
Rooftop HVAC	—	0.02 aMW 0 therms	N/A
Grocery Stores	—	0.09 aMW 0 therms	N/A
Validated BetterBricks Total	**1.93 aMW 577,012 therms**	**1.85 aMW 137,645 therms**	**0.06 aMW 0 therms**

The findings in this section cover research conducted by the team of Research Into Action, Inc., Mike D. Kennedy, Inc., Itron, Inc., ECONorthwest, and MetaResources during 2009 – 2010, and research conducted by The Cadmus Group – built on previous research conducted by Heschong Mahone Group, Inc. – in 2008-2009 to evaluate energy savings for BetterBricks. NEEA will

conduct research to validate additional 2010 savings in 2011. The research attempts to validate program-reported savings estimates, rather than conduct the rigorous measurement and verification activities employed, for example, with pay-for-performance contracts.

NEEA can provide on request documents describing the research and findings summarized in Table 5.1. None of the work summarized addresses the attribution of savings to BetterBricks or other influences, nor does it validate savings from random samples. Thus, it would be inappropriate for NEEA to assume causality, extrapolate validated savings to other sites, or make assumptions about the persistence of validated savings.

We were able to validate savings from relatively few BetterBricks projects, which inevitably resulted in a small quantity of validated energy savings. We attribute the small number of validated projects to the facts that BetterBricks implementation did not lay a foundation for evaluation and, perhaps as a consequence, the program data-tracking system (Commercial Tracking System – CTS) has incomplete data. Based on our market survey findings, professional association interviews, understanding of BetterBricks activities, and understanding through other commercial sector research we have conducted, we suspect that BetterBricks' impacts to date far exceed the savings the impact evaluators have validated.

ACE MODEL REVIEW

NEEA estimates the cost-effectiveness of its initiatives through its Alliance Cost Effectiveness (ACE) models. The ACE models include all of the assumptions necessary to forecast aMW savings through an initiative's market transformation period or the time estimated to transform a market. 2005-2009 BetterBricks has two ACE models: Hospitals (H&H) and Offices (ORE).

The H&H ACE Model has two cross-cutting focuses – *Building Operations and Design & Construction* – within two vertical markets: *Hospitals and Other Healthcare Facilities*. Design and Construction', encompasses savings measures corresponding to the BetterBricks design and construction activities of new buildings; Building Operations, comprises BetterBricks' savings measures corresponding to existing building stock. Like the H&H ACE model, The ORE ACE Model has two cross-cutting focuses – *Building Operations and Design & Construction* – but within four vertical markets: *large and medium/small office real estate that are either owner occupied or non-owner occupied*.

In 2009, Research Into Action and ECONorthwest reviewed the BetterBricks ACE models' key assumptions. We suggested revisions to assumptions relating to market size and growth, energy utilization index, adoption, codes and standards, and plug loads, and recommended some additional research. We lacked sufficient data to comment on the key assumptions of BetterBricks energy savings, ramp up period, persistence, and consumer costs. Both models were subsequently revised to reflect these recommendations. Appendix D provides the ACE model reviews.

6 SUMMARY AND RECOMMENDATIONS

SUMMARY OF FINDINGS

BetterBricks seeks to collaborate with professional organizations serving its target markets as a means of market diffusion. Interviewed professional associations confirm that BetterBricks has had an active presence in their organizations, has sponsored or co-sponsored numerous trainings and educational events, and provides their membership with valuable information.

Figure 6.1 illustrates the degree of familiarity of *betterbricks.com* and other BetterBricks program elements among nonparticipants (those with neither BetterBricks direct involvement or direct influence; neither participant nor Light Touch) in the four target markets. Half or more of the surveyed nonparticipants in each market have heard of *bettterbricks.com* and about one-in-six nonparticipants have used content from the website. More than one-third of nonparticipant contacts in D&C, ORE, and H&H have heard of the *BetterBricks Awards*.

Figure 6.1: Familiarity with BetterBricks Among Nonparticipants

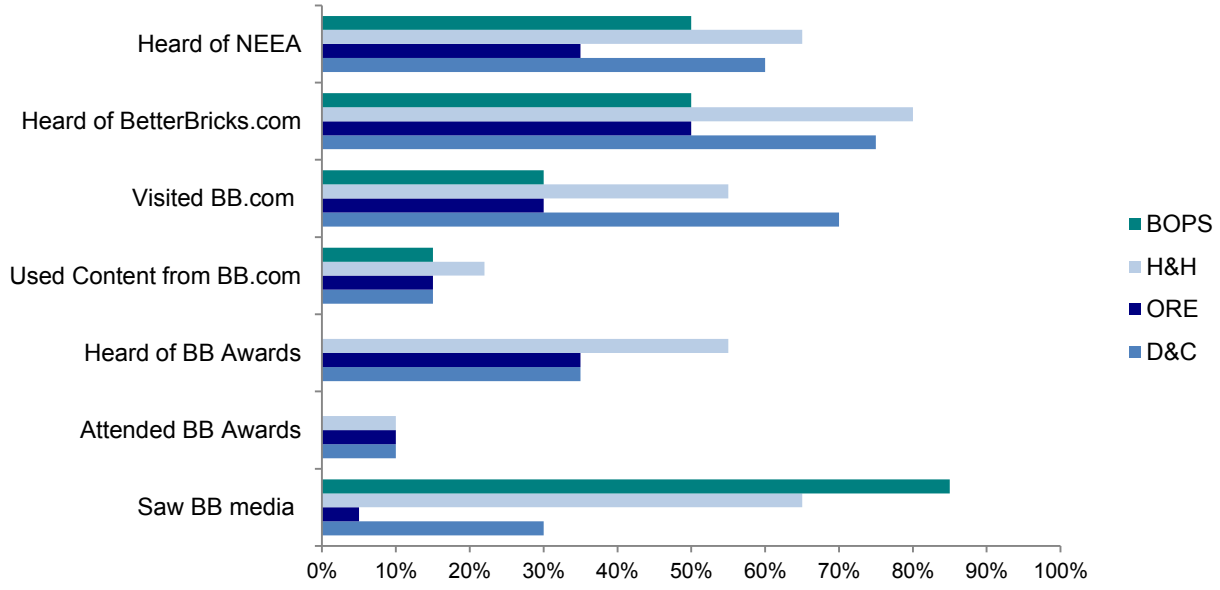
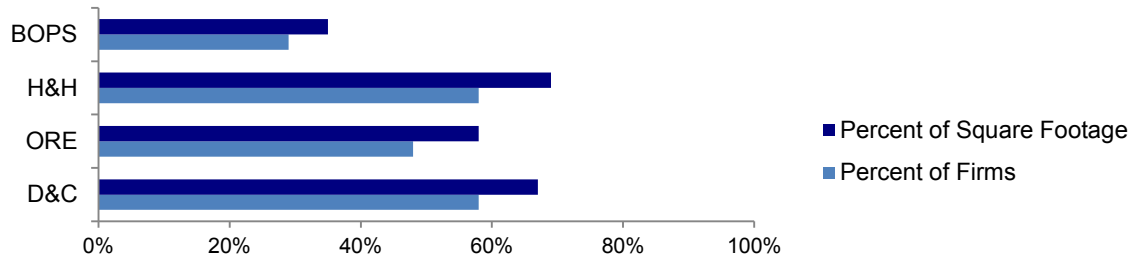


Figure 6.2 illustrates the estimated market adoption of BetterBricks influence, by proportion of firms in the target market and proportion of target market square footage (or, for hospitals, beds). We estimate this adoption as the market share comprised by participant and Light Touch firms. Estimated adoptions range for three markets from about half to about two-thirds; we estimate the adoption of the BOPS market at about one-third.

Figure 6.2: Estimated BetterBricks Market Influence



Note: Percent of square footage goals were met for all four target markets.

BetterBricks promulgates five primary principles subsuming a number of best practices. We captured these concepts in five metrics and an overall, summary metric. Figure 6.3 illustrates the estimated adoption (in terms of square footage and, for hospitals, beds) of these best practice metrics among participants. We estimate overall adoption among participants in three markets at 85% or more; we estimate the overall adoption among H&H participants at 50%. Details given in Chapter 4 show high adoptions within H&H of the BetterBricks best practices most directly related to energy savings – building operations, design and construction, use of Life Cycle Cost Analysis (LCCA), and capital improvements – yet low adoptions related to strategic leadership, mobilization, and contracts with suppliers.

Figure 6.3: Estimated Adoption of BetterBricks Best Practices Among Participants

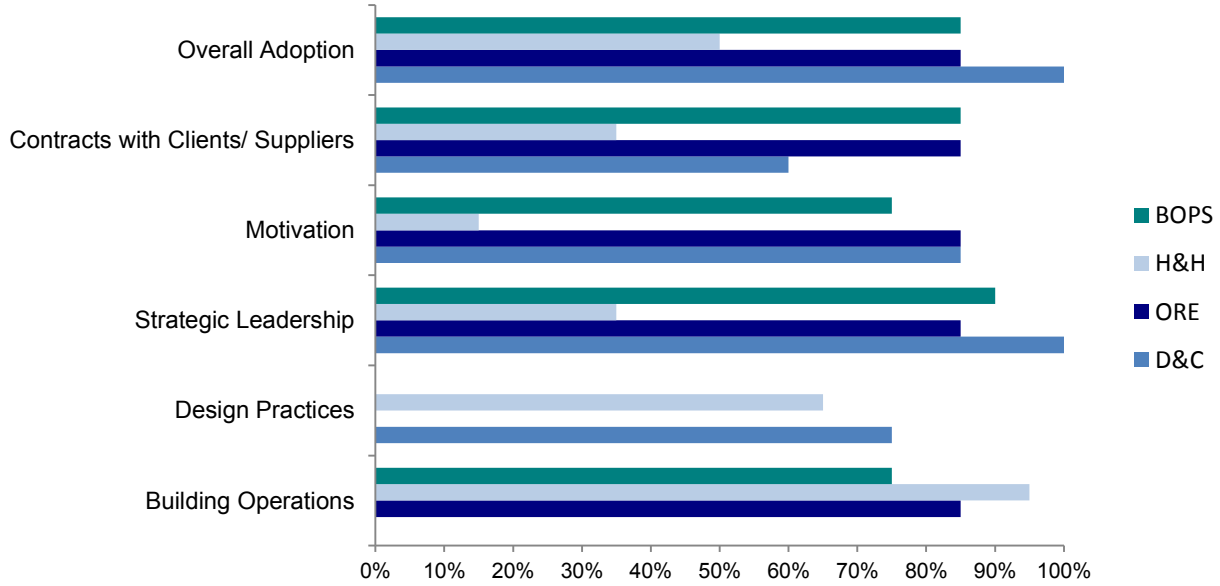


Figure 6.4 illustrates the estimated adoption of the BetterBricks best practice metrics among nonparticipants, which exclude Light Touch firms. We estimate overall adoption among nonparticipants in the four markets ranging from 0% to 45%.

Figure 6.4: Estimated Adoption of BetterBricks Best Practices Among Nonparticipants

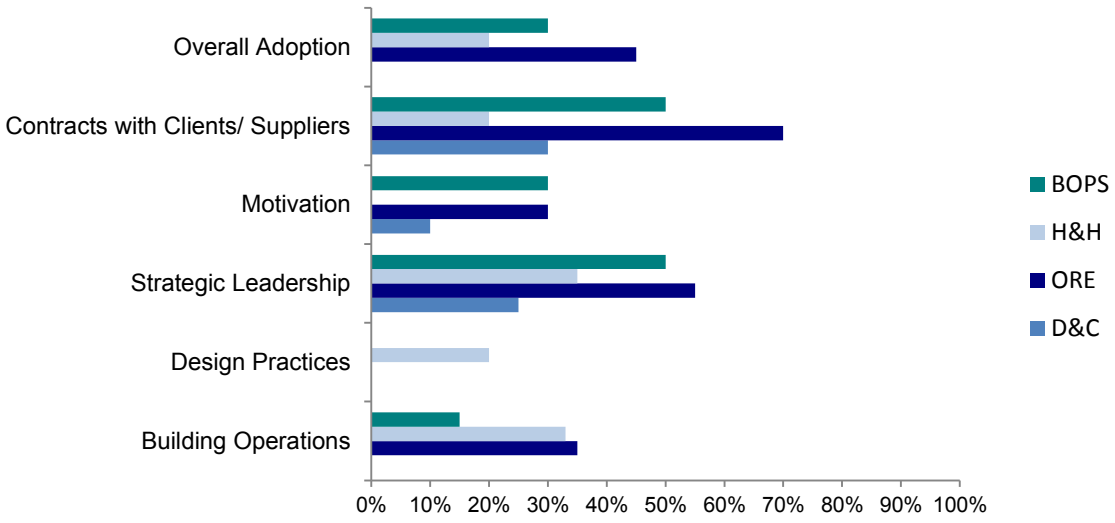
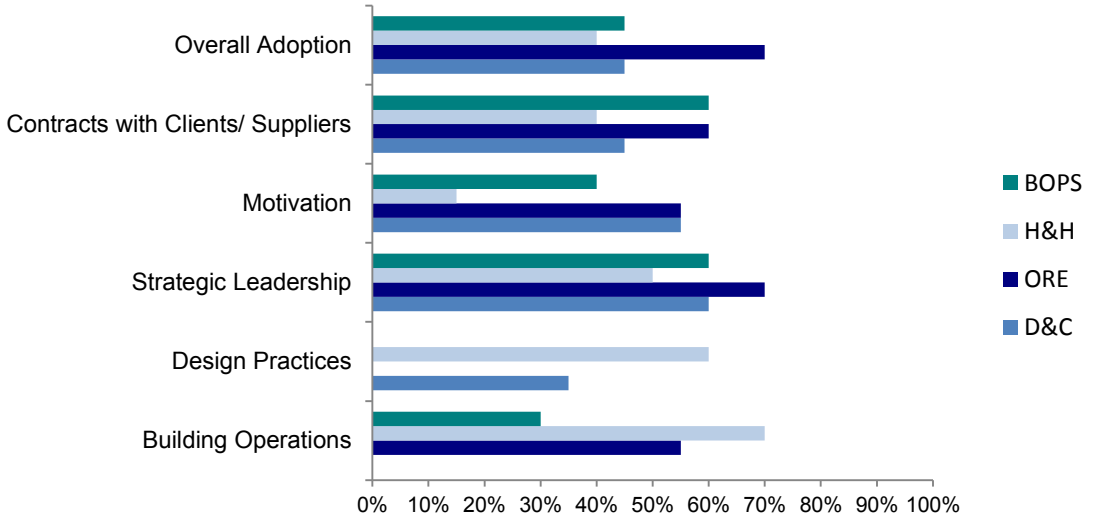


Figure 6.5 builds on Figures 6.3 and 6.4 and illustrates the estimated adoption of the BetterBricks best practice metrics among the total market (participants, Light Touch, and nonparticipants). ORE shows the highest overall adoption at 70%; the other three markets show an overall adoption of about 40 to 45%.

Figure 6.5: Estimated Adoption of BetterBricks Best Practices Among the Total Market



The custom nature of BetterBricks work makes savings validation problematic. Additionally, there is a lack of tracking data. The combined result is that there are no savings to extrapolate onto the broader market. Additionally, this study was able to validate only a small quantity of

energy savings for BetterBricks participants; NEEA will undertake additional validation analysis of 2010 program savings in 2011.

CAVEATS AND DISCUSSION OF FINDINGS

The nonparticipant samples may over-represent those firms familiar with NEEA. To the extent that this occurs, the estimated market awareness of BetterBricks (Figure 6.1) and market adoption of BetterBricks influence (Figure 6.2) are biased upward. Further, the nonparticipant samples are smaller than our goal sample sizes, which corresponded to 90/10 confidence/ precision. Thus, we have less confidence in the nonparticipant estimates than we would like.

We derived the estimated adoption of BetterBricks best practices metrics from about 100 detailed questions. Some of the questions sought categorical responses on the proportion of contact's activity that met the condition posed in the question, and we gave more points toward the metric the higher the proportion. Other questions asked whether an activity had ever occurred. Thus, high scores on the metric indicate the contact's firm has engaged in the best practice. High scores do not preclude the possibility that the firm could conduct the best practice more thoroughly, on a larger proportion of its activities. Thus, the reader should not interpret high metric adoptions as indicative that no further progress can be made in the market. Firms could embrace the best practice more thoroughly, and subsequent studies might want to "raise the bar" for measuring market transformation through more stringent metric definition.

The research relies on self-reported behaviors. Any of the contacts might have overstated their firm's uptake of the behaviors, particularly if they perceive the behaviors represent "socially desirable" actions. It also seems reasonable to surmise that nonparticipants, in particular, may have overstated their firms' uptake of the behaviors. This supposition makes sense because of both practical and theoretical considerations. On the practical side, the nonparticipant responses suggest a higher baseline adoption of the best practices than one might expect based on familiarity with the degree to which commercial facilities have attained energy efficiency. On the theoretical side, nonparticipants are less likely than participants to have recently discussed many of the concepts posed in the questions. While we crafted the questions from simple language, nonetheless, nonparticipants may have a less stringent interpretation of the practices than participants, who have been steeped in BetterBricks thinking.

Because of these caveats, we believe it would be a mistake to interpret the various percentages as precise quantifications of BetterBricks' best practices adoptions. Rather, they are rough indicators. Nonetheless, we believe the data support a comparison between participants and nonparticipants. Participants report engaging in the BetterBricks best practices to a much greater extent than do nonparticipants, with the metrics typically differing by 30 percentage points or more.

Because previous baseline studies did not address these specific metrics, we cannot rule out the possibility that participants were already conducting these best practices at greater rates than nonparticipants prior to their BetterBricks involvement. While this may be true, participant adoptions exceed nonparticipant adoptions by over 50 percentage points for more than one-third

of the metrics. The participants would have to have had substantial uptake of the best practices prior to their BetterBricks involvement to evidence no program effect in comparison with the nonparticipants. Again, familiarity with the commercial sector suggests this was not the case. Finally, all of the participants stated that BetterBricks enhanced their energy efficiency practices.

SUMMARY CONCLUSIONS FOR BETTERBRICKS

We conclude that 2005-2009 BetterBricks met its 2010 objectives common to all four markets as shown in Table 6.1.

Table 6.1: BetterBricks Met 2010 Objectives Common to All Four Markets

Objective	D&C	ORE	H&H	BOPS
Adoption of best practices through BetterBricks involvement and influence	✓	✓	✓	✓
High market awareness (greater than 50%) of betterbricks.com	✓	✓	✓	✓
Market awareness of the benefits of high performance buildings	✓	✓	✓	✓
Collaboration with professional associations	✓	✓	✓	✓

We also conclude that 2005-2009 BetterBricks met its 2010 objectives for adoption of best practices and market change in the specific markets as follows:

- **D&C:** submarkets that adjusted business practices to ensure high performance buildings
- **ORE:** targeted ORE floor space that adopted energy management plans; professionals capable of managing energy-related business practices change; and professionals downloading the High Performance Portfolio Framework and associated tools, and beginning implementation
- **H&H**: regional hospital beds whose decision-makers: 1) are committed to and practicing SEMP elements; 2) request/ require trade allies to support SEMP practices, including enhanced O&M; and 3) consider BetterBricks an excellent source of information and practical tools on energy-related business and technical practices
- **BOPS:** building operations market whose service providers adopt business approaches that promote building operating performance

BetterBricks appears to have partially met the following 2010 objective:

- **D&C:** significant percentage of new project designs incorporate partial and fully integrated design strategies that result in savings greater than 25% over baseline. While we found ID features used by 55% of the market, we do not know the savings compared to baseline.

Due to unavailability of data or insufficient definition, we lack measures of the extent that BetterBricks met the following 2010 objectives:

- **D&C:** all objectives for engineers working outside of architectural firms
- **ORE:** objectives for design and construction activity (little new ORE construction occurred in 2008-2010)
- **All Markets:** objectives for working with utilities as market partners

To date (2008-2010), we and other researchers have validated 3.84 aMW of electricity savings and 714,657 therms of natural gas savings at BetterBricks participant facilities. Given the BetterBricks activities, the feedback we obtained from partnering professional associations, and the findings from market surveys, we believe it likely that BetterBricks has generated energy savings far in excess of those that research has validated. The research relied on incomplete data on program participants and their activities, and incomplete detail for the targeted changes sought from the market sufficient to identify actions taken and determine approaches for estimating change in energy usage.

We also conclude that most of the BetterBricks managers had not defined their markets nor identified market participants in a manner that would enable them to know their progress toward market share goals. Only the H&H market manager had created a list of organizations in the target market and market share (number of beds). Other market managers claimed participants constituted a certain market share, but did not provide evaluators with information in support of these claims. For instance, the D&C goals are defined in terms of A&E (architectural and engineering) firms and their market share, yet all program participants were architectural firms. Had the initiative explicitly addressed and defined its target market at the outset, it could have followed an adaptive management approach and either revised its goals or revised its Firm Focus activities as it became apparent the two were not consistent.

Finally, we note that BetterBricks staff did not provide sufficiently discreet and defined definitions of the changes they sought to stimulate in the market until late in the initiative (fall 2009). They specified goals using language that lacked direct, observable correlates. The goals use terms such as “high performance buildings,” “enhanced O&M,” and “fully integrated design.” While these terms may be appropriate for goals, the program team did not define those into discrete, observable, and measureable components so that all can agree on progress toward goals. With each round of BetterBricks MPERs, the evaluators sought to deconstruct the goal concepts into multiple, specific actions that trained observers could recognize or market actors – upon hearing the actions – would interpret with relative consistency. Yet each successive evaluation found program staff countering that the measured actions did not accurately reflect the behavior changes they were promulgating. Again, an adaptive management approach would make these concepts specific at the outset and subsequently revise, as necessary, either the goals or the program activities.

It should be noted that while BetterBricks accomplished the bulk of its behavior change goals, there was still very little to tie these changes to energy savings. While we believe that there are energy savings which resulted from this change, the data do not exist to validate this. Prior to the redesign effort, MPI's were not sufficiently defined to enable energy savings calculations. It is key to the success of the re-designed commercial initiative to build in the measurement and data collection necessary to tie desired behavior change to energy savings.

RECOMMENDATIONS

We offer NEEA's commercial sector staff the following recommendations as it embarks on a redesigned commercial sector initiative.

1. **Define the target markets in such a way that the number of firms in the market and the market shares of the firms or groupings of firms can be determined**. Early in an initiative, determine the number of firms and measures of market share.
2. **Identify the discrete, observable, and measurable changes the program seeks to promulgate – those actions that informed observers could agree have or have not been taken and that program staff agree constitute evidence of a desired behavior change**. The program staff or evaluators assisting them can then assemble these discrete elements into a handful of metrics whose measurements summarize program progress toward goals.
3. **For complex efficiency behaviors, such as fully integrated design, define the combination of elements that constitute the behavior**. Ensure the use of consistent definitions of the complex behaviors in all impact validations, in validating ACE model assumptions, and in program management.
4. **Develop behavior change measures that are more clearly tied to energy savings.**
5. **Conduct baseline research on the defined target markets to obtain information on the current adoption of desired behaviors, as evidenced by the metric scores.**
6. **Incorporate into the commercial sector initiative's work with market actors, the tracking and reporting necessary to determine energy use pre- and post-intervention and to understand the measure or change**. Ensure market actors' willingness to share this information with program staff. Although tracking activities can appear to staff and participants to divert attention from implementation, tracking provides both the implementing organization and the program staff with the information necessary to assess the value of the actions taken.
7. **Record data pertinent to savings validation research in the program database. This includes such information as baseline data, design and construction models, project characteristics, and project initiation and completion dates**. For projects implemented in phases over time, add suffixes to project IDs to enable tracking the characteristics and progress of individual interventions.

APPENDICES

APPENDIX A: METHODOLOGICAL DETAIL

APPENDIX B: ADDITIONAL RESEARCH FINDINGS

APPENDIX C: LOGIC MODELS

APPENDIX D: ACE MODEL ASSUMPTION VALIDATIONS

APPENDIX E: SURVEY INSTRUMENTS

A METHODOLOGICAL DETAIL

PRIOR BETTERBRICKS MPER RESEARCH

Table A.1 shows the evaluation tasks conducted for each BetterBricks MPER. NEEA discontinued the BetterBricks Grocery component in 2008.

Table A.1: Evaluation Tasks for BetterBricks' Target Markets

Component	Market	MPER				
		2005	2006	2007	2008	2010
Conduct Baseline/Market Survey	D&C		●	●		
	ORE			●		●
	Hospitals	●		●		●
	BOPS		●	●		
	Grocery	●		●		
Market Characterization	D&C		●	●	●	●
	ORE			●	●	●
	Hospitals		●	●	●	●
	BOPS		●	●	●	●
	Grocery		●	●	●	
Assess Logic Model	D&C		●	●	●	●
	ORE			●	●	●
	Hospitals	●	●	●	●	●
	BOPS		●	●	●	●
	Grocery	●	●	●	●	
Assess Market Progress	D&C			●	●	●
	ORE				●	●
	Hospitals	●	●	●	●	●
	BOPS			●	●	●
	Grocery	●	●	●	●	

Continued

Component	Market	MPER				
		2005	2006	2007	2008	2010
Assess Progress Toward Goals	**D&C**		●	●	●	●
	ORE				●	●
	Hospitals	●	●	●	●	●
	BOPS	●	●	●	●	●
	Grocery	●	●	●	●	●
Estimate/Validate Savings Impact	**D&C**					●
	ORE					●
	Hospitals				●	●
	BOPS					●
	Grocery				●	●
ACE Model Review	**D&C**	NA	NA	NA	NA	NA
	ORE				●	●
	Hospitals				●	●
	BOPS	NA	NA	NA	NA	NA
	Grocery				●	●

SURVEY AND INTERVIEW POPULATIONS

Participants

NEEA BetterBricks Reference Guide identifies BetterBricks participants (that is, targeted firms; see page 2). The market managers updated this list and provided contact information for the participants.

Hospital Population

The manager of the Hospital Initiative in 2007 developed a detailed list of all hospital acute care facilities in the Pacific Northwest. This list includes number of beds and indicates hospitals belonging to a system, such as Providence Health and Services. We defined *large* hospitals as those with 300 beds or more and *medium* hospitals in Washington and Oregon as those with 150 to 299 beds. In order that our sample distribution by state might resemble the distribution of the total population of hospitals by state, we defined *medium* hospitals in Idaho and Montana as those with 100 to 299 beds. When applying these criteria to the detailed list, we estimate that there are 82 hospitals with 150 or more beds in Oregon and Washington, and 100 beds or more in Idaho or Montana. These hospitals operate approximately 22 thousand beds across the Pacific Northwest.

Office Real Estate Population

We developed an Office Real Estate market list from several sources. First, the ORE market manager had developed a partial list of the largest and most influential commercial real estate firms in the Northwest. Second, we added the largest firms we found listed in the *Business Journals* for Portland, Puget Sound, Spokane, and Idaho for 2010. Finally, we added real estate management firms that had buildings participating in BetterBricks' *Kilowatt Crackdown* (in Seattle) and *Office Energy Showdown* (in Portland). We defined *large* firms as those with 25 or more employees and *medium* firms as those with 10 to 24 employees, according to respondents' self-report. From these multiple sources and criteria, we estimate that there are 81 office real estate firms who have 10 or more employees and who manage approximately 51-million square feet of commercial office space.

Design & Construction and Building Operations Populations

The managers of the other initiatives did not have comparable lists of their target markets. For D&C and BOPs, we used Dunn & Bradstreet (D&B) to indentify market actors. We identified the target market for D&C from a D&B listing of architects (NAICS code 541310 *Architectural Services)* in NEEA's region. This was the only NAICS code that was obviously architects and included known targeted firms. We pulled a stratified sample of *large* (25 or more employees, per the D&B data) and *medium* firms (10 to 24 employees). Based on this sample and given that there is no evidence to suggest that there is a significant number of architectural firms not listed under this NAICS code, we estimate that there are 143 architectural firms in the Northwest with ten or more employees.

We similarly identified the target market for BOPS from D&B's listing of mechanical contractors in the region (NAICS code 238220 *Contractors, Mechanical)* and pulled an analogous stratified sample. This NAICS code was suggested by NEEA's market specialist and contained firm focus firms. We also had to filter out some firms that were primarily residential firms or whose primary business was not commercial HVAC. Again, based on this sample and given that there is no evidence to suggest that there is a significant number of mechanical contractor firms not listed under this NAICS code, we estimate that there are 56 mechanical contractor firms in the Northwest with ten or more employees. In analyzing the survey data, we learned there was little correlation between the number of employees reported by D&B and those reported by the survey respondent. Consequently, we stratified the samples for the analytical findings we report in Chapter 4 according to self-reported organization size, which was well correlated with other measures of size the contact reported (such as square footage of market activities).

Professional Associations Population

The market managers identified a list of 12 professional organizations with contacts at 25 chapters (Table A.2).

Table A.2: Professional Associations Identified by BetterBricks Staff

Organization	Chapters				
	WA	OR	ID	MT	Region
2030 District	●				
American Institute of Architects (AIA)	●	●	●	●	
American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)	●	●	●		●
Building Owners and Managers Association (BOMA)	●	●	●		●
International Facility Management Association (IFMA)	●				
Montana Joint Engineers				●	
National Sustainable Building Advisor Program	●				
Northwest Energy Education Institute		●			
Northwest Trade Ally Network					●
State Society of Healthcare Engineers (SSHE)	●		●	●	
U.S. Green Building Council (USGBC)	●		●	●	
Urban Land Institute (ULI)	●				
TOTAL	9	4	5	4	3

SURVEY AND INTERVIEW SAMPLES AND DISPOSITIONS

Survey Samples and Dispositions

Table A.3 gives our goal and completed sample sizes for the nonparticipant surveys in each market and Table A.4 provides comparable information for the participant surveys. We were unable to attain our goals for the *large* strata in all but the Design & Construction markets. However, we also found little correlation between the size of firm (in number of employees) given by Dunn & Bradstreet and the size of firm as reported by respondents, perhaps owing to the downsizing of firms that has occurred in the recession that started in fall 2008. We consequently do not report results by the strata in which we had grouped the firms in advance of surveying them. Also note that the table includes *Light Touch* with the nonparticipants, as we identified Light Touch firms based on their responses to the survey, with the exception of three *Light Touch* hospitals that we knew in advance and include in our goals for participants.

Table A.3: Nonparticipant Survey Goals, Completes, Dispositions

	D&C	ORE	H&H	BOPS
Initial Population List (Qualifying Population Unknown)	218	84	56	71
Goal	51	38	31	35
Complete	**35**	**25**	**13**	**7**
Response Rate	**20%**	**33%**	**24%**	**13%**
Numbers Dialed	218	84	56	71
Firm Disqualified (not in target market) / Out of Business	30	4	1	9
Bad Number	11	4	0	5
Callbacks (placed 10 calls; not completed)	123	34	31	32
No answer	4	0	1	1
Refusals	15	17	10	17

Table A.4: Participant Survey Goals, Completes, Dispositions

	D&C	ORE	H&H	BOPS
Population (Known)	9	6	22	8
Goal	9	6	22	8
Complete	**8**	**6**	**22**	**8**
Response Rate	**89%**	**100%**	**100%**	**100%**
Refused or Not Available	1	0	0	2

We were disappointed with the nonparticipant response rates. We called each non-responding firm ten times over several weeks, at different times of day, and yet did not succeed in reaching our quotas. Unfortunately, we did not have individual contacts for the nonparticipants and tried to reach the correct person by describing the position and responsibilities of the desired contact. When the response rate to the hospital survey was low, we contacted the BetterBricks market manager and asked for assistance. The hospital market specialists provided us with contact names for about one-third of the sample. In the cases where the names they provided were new to us, we called these new contacts ten times, so the hospital organizations were called on average more than ten times.

We think it likely that contacts aware of NEEA more readily agreed to answer our questions than contacts unaware of NEEA. Thus, our nonparticipant sample is likely biased toward respondents aware of NEEA and influenced by NEEA. Consequently, our estimates of Light Touch market share likely overstates BetterBrick's reach into the market. On the other hand, because we mentioned the Northwest Energy Efficiency Alliance as the survey sponsor in our introductory remarks, it is possible our nonparticipant sample is biased toward firms more engaged in energy efficiency, irrespective of their awareness of NEEA. To the extent that is the case, the percentage

differences in the MPIs between nonparticipants and BetterBricks participants/ Light Touch understate BetterBricks' influence.

Interview Sample

Per the statement of work, we interviewed 12 professional association contacts. We interviewed one contact at each of the chapters listed in Table A.5. Note that for H&H, we sought to interview either the Oregon or Washington chapter of SSHE, but not both, according to the decision to allocate the total sample of 12 contacts across the four states. We completed the interview with the Washington contact first and therefore did not pursue the Oregon contact.

Table A.5: Professional Association Interview Sample

Market	Organization	Chapters
D&C	AIA	WA, OR
	ASHRAE	ID
	USGBC	WA
Office Real Estate	BOMA	WA, OR
	ULI	WA
	2030 District	WA
Hospitals and Healthcare	SSHE	WA, ID, MT
Building Operations	IFMA	WA

SAMPLE WEIGHTING

We analyzed the survey responses to determine the proportion of respondents that were *medium* (10 to 24 employees) and *large* (25 or more employees), and we made the simplifying assumption that our survey respondents are representative of the population for this characteristic. We also made the simplifying assumption that our original population lists contain all the medium and large firms in the market; we adjusted this population downward based on the proportion of firms that failed the survey screening. From these statistics, we developed estimates of the numbers of medium and large firms in each population. We grouped the observations into *medium* and *large* based on the respondents' statements of firm size (in terms of number of employees), and we weighted the observations based on the total market square footage (self-reported by the respondents) comprised by the medium and by the large firms. Thus, the square footage of weighted medium firms totals our estimate of population square footage comprised by medium firms, and the same for large firms.

ESTIMATING MARKET SIZE

We estimated the number of firms in each market in a three-step process. We started with lists provided by the H&H manager, drawn from Dunn & Bradstreet for D&C and BOPS, and developed from multiple sources for ORE. We augmented these lists as necessary to include participant firms and cleaned the lists to develop the best possible initial estimate of the number of firms in the population. In step 2, we conducted the market surveys and in doing so learned that some firms did not meet the target criteria or were no longer in business. From these we developed an estimate of the proportion of the initial list that does not belong in the market estimate. In step 3, we applied this estimated proportion of non-qualifying firms to our initial market size to develop a revised estimate of number of firms in the target market.

We estimated the square footage in each market (or, for H&H, number of beds) from the survey responses.

CORROBORATION OF TOTAL NEW CONSTRUCTION SQUARE FOOTAGE

From the U.S. Census sources *Annual Value of Private Construction Put In Place 2002-2009*, and *Value of Private Construction Put In Place – Seasonally Adjusted Annual Rate* (for 2010), we obtained the total dollar value for offices and healthcare nationally. The share for the Pacific Northwest we assumed to equal the region's share of the national population. We used $150 per square foot construction costs for offices (per a general contractor for office construction) and $405 for hospitals, per Joel Loveland, University of Washington. We estimated a 2008-2010 market size of 43.8 million square feet.

SURVEY DESIGN

BetterBricks promulgates five primary principles subsuming a number of best practices. In 2009, under a separate contract, we interviewed the BetterBricks market managers and business and technical advisors to learn more about the best practices and what these program staff considered to be evidence of targeted behavior change. Under this contract in 2010, we interviewed and held discussions with the market managers on three more occasions, to further increase our understanding of the targeted behavior changes, to seek comments on draft survey questions, and to obtain feedback on final, specific question phrasing. Through this process we developed market surveys for D&C, ORE, H&H, and BOPS that we used to identify the adoption of best practices among participants, Light Touch firms, and nonparticipants.

We strove to craft each question using plain English, terms we expected the audiences would have a common understanding of. We intentionally did not use terms of art common to BetterBricks and the energy efficiency community, such as enhanced O&M and high performance buildings.

ANALYSIS ALGORITHMS FOR MARKET SURVEY DATA

We derived the estimated adoption of BetterBricks best practices metrics from about 100 detailed questions. Some of the questions sought categorical responses on the proportion of contact's activity that met the condition posed in the question, and we gave more points toward the metric the higher the proportion. Other questions asked whether an activity had ever occurred. Thus, high scores on the metric indicate the contact's firm has engaged in the best practice. High scores do not preclude the possibility that the firm could conduct the best practice more thoroughly, on a larger proportion of its activities. Thus, the reader should not interpret high metric adoptions as indicative that no further progress can be made in the market. Firms could embrace the best practice more thoroughly, and subsequent studies might want to "raise the bar" for measuring market transformation through more stringent metric definition.

The research relies on self-reported behaviors. Any of the contacts might have overstated their firm's uptake of the behaviors, particularly if they perceive the behaviors represent "socially desirable" actions. It also seems reasonable to surmise that nonparticipants, in particular, may have overstated their firms' uptake of the behaviors. This supposition makes sense because of both practical and theoretical considerations. On the practical side, the nonparticipant responses suggest a higher baseline adoption of the best practices than one might expect based on familiarity with the degree to which commercial facilities have attained energy efficiency. On the theoretical side, nonparticipants are less likely than participants to have recently discussed many of the concepts posed in the questions. While we crafted the questions from simple language, nonetheless, nonparticipants may have a less stringent interpretation of the practices than participants, who have been steeped in BetterBricks thinking.

We coded the response to each yes/no question using a binary 0,1 code (yes = 1, no/don't know/refused = 0). We coded the response to each categorical, ordinal variable with a scalar that ranged between 0 and 1; we coded responses that they were not at all engaged in the action as 0, responses that they were fully engaged in the action as 1, and responses in between these two extremes according to the number of response categories. For example, questions asking frequency that had the response categories of "seldom or never, less than half, about half, more than half, and virtually all the time" we coded as 0, 0.25, 0.5, 0.75, and 1, respectively.

Table A.6 shows the how we created the D&C market metrics used, based on the five primary BetterBricks principles and their corresponding best practices, per *BetterBricks Reference Guide.* Tables A.7, A.8, and A.9 provide the derivation of the market metrics for ORE, H&H, and BOPS.

Table A.6: Design & Construction Market Metrics

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Design Practices				
57	Calculated the energy use per square foot of completed buildings	0.33	Benchmarking	0.11	Design Practices 0.5
58	Compared the energy use of completed buildings to the energy use as modeled during design	0.33			
59	Used energy use per square foot results to establish key performance indicators across projects?	0.33			
60	Completed a formal Post Occupancy evaluation or assessment	0.4	Tracking and Reporting	0.11	
61	Reported the results of a post-occupancy assessment or energy use calculation to the building owners	0.4			
62	Do you have any post-occupancy evaluations planned for any projects currently in design?	0.2			
34	Do any of your projects have written energy efficiency goals?	0.1	Energy Performance Targets	0.11	
35	About what percentage of your projects have specific energy efficiency goals or targets other than meeting code?	0.2			
37	About what percentage of your buildings over the past three years were designed to be ……at least 10% more efficient than code?	0.3			
38	...at least 25% more efficient than code?	0.4			
39	Have any of the design projects you completed in the past three years obtained a certification rating such as LEED, Living Building, Green Globe, Earth Advantage?	0.0	Certification	0.11	
40	Which certifications? LEED, Living Building, Green Globe, Earth Advantage	0.2			
41	How many of your projects completed in the past three years received LEED certification?	0.2			

Continued

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Design Practices, cont.				
42	How many of those were LEED Platinum?…	0.30	Certification, cont.	0.11	Design Practices 0.5
43	...LEED Gold?	0.20			
45	Please rate your agreement with the following statement: The current LEED criteria guarantee energy efficient buildings.	0.10			
126	How familiar are you with the architectural design process called Integrated Design?	0.33	ID Awareness	0.11	
127	Has your firm used integrated design for any of its new construction, addition or renovation design projects in the last three years?	0.33			
128	What proportion of your projects over the last three years has used integrated design elements?	0.33			
136	Thinking of these groups as possible members of the integrated team, about what proportion of projects used some sort of integrated team?	0.17	ID Team	0.11	
137	And considering just those projects that used some sort of integrated team, about how often did the integrated teams meet, on average, before the end of schematic design?	0.17			
138	And how often, on average, did they meet after the end of schematic design?	0.17			
130	How often were the following people included in the design team...The engineering consultant	0.083			
131	...The general contractor	0.083			
132	...Owner's representatives	0.083			
133	...Representatives of the operations and maintenance staff	0.083			
134	...The commissioning agent	0.083			
135	...Representatives of the building users or occupants	0.083			

Continued

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Design Practices, cont.				
139	Other than for code compliance, on how many of your last five projects did you use energy modeling to determine the design?	0.50	Energy Modeling	0.11	Design Practices 0.5
140	For those projects where you used energy modeling, on average, how many times during the design process was the whole building energy use modeled?	0.50			
144	...A design charette was held where the designer meets with the owner, building operator, and consulting engineers?	0.33	ID Process	0.11	
153	...Commissioning began during the design process	0.33			
154	...A plan was made for operator or occupant training	0.33			
145	...Daylighting with controls was used reduce electric lighting	0.14	ID Features	0.11	
146	...Building orientation was selected to minimize heating, cooling, or lighting loads	0.14			
147	...Thermal mass of the building served to reduce heating and cooling loads	0.14			
148	...A major system--such as the chiller, boiler, ventilation, or lighting system--was designed to use less significantly less energy than in comparable facilities or required by code.	0.14			
150	...Occupancy sensors were used to control ventilation	0.14			
151	...Energy efficient equipment was specified	0.14			
152	...Occupancy sensors were used to control lighting	0.14			

Continued

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Strategic Leadership				
161	Does the senior management of your firm believe a priority on energy efficient design will provide the firm with a strategic advantage?	0.20	Executive Commitment	0.33	Strategic Leadership 0.2
163	Has your firm formally adopted, through policies and procedure statements, energy efficiency and sustainability goals for your design projects?	0.20			
182	Has your firm retained outside energy efficiency or sustainability specialists or groups?	0.20			
183	Do you have a mechanical engineer on staff that specifically supports energy efficient design?	0.20			
184	In selecting engineering consultants, has your firm included in its criteria demonstrated Integrated Design or energy efficiency capability?	0.20			
166	Does your firm consider energy efficiency to be part of its market identity?	0.2	Vision	0.33	
167	Do your firm's marketing materials describe integrated design specialties?	0.2			
168	Do your firm's marketing materials describe the advantages of energy efficient or high performance buildings?	0.2			
169	Do your firm's marketing materials highlight its capabilities or successes with energy efficiency or sustainability?	0.2			
170	Does your organization's website contain a section specifically featuring your sustainability or energy efficiency credentials, successes or related awards you have received?	0.2			
176	About what proportion of your clients come to you specifically looking for designs that are more energy efficient than code?	0.5	Intention	0.33	
164	Has your firm accepted the AIA 2030 Challenge targets?	0.5			

Continued

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Mobilizing the Organization				
196	Does your firm consider demonstrated competence in energy efficiency as a factor in promotion decisions?	0.5	Communicating Expectations	0.34	Mobilizing the Organization 0.2
198	Does your firm recognize its energy efficiency or sustainability achievements in staff meetings and credit key individuals and teams?	0.5			
188	Have you or other staff participated in any seminars or training related to any aspect of energy efficiency and building design?	0.1	Training	0.66	
190	What organizations sponsored the presentation or training? AIA, Cascadia Green Building Council, Other (specify)	0.2			
191	About what proportion of your design staff are LEED accredited?	0.3			
193	Does your firm allocate staff time to improving capability in energy efficiency?	0.2			
194	Is energy efficiency included in your professional development planning for any staff?	0.2			
	Metrics Related to Contracts with Clients				
157	Do any of your design contracts with clients include specific energy efficiency requirements?	1.0	Contracts with Clients	1.0	Contracts with Clients 0.1

Table A.7: Office Real Estate Market Metrics

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Building Operations				
64	…Obtained an ENERGY STAR® score (ES=1)	0.33	Benchmarking	0.167	Building Operations 0.25
89	[If ES=1] Have you trained any of your staff in using ENERGY STAR Portfolio Manager?	0.33			
85	[If ES=1] AND [If Goal=1] Have you used the ENERGY STAR results to help in establishing an energy use or savings target? [If needed, the results on ENERGY STAR score]	0.33			
88	[If ES=1] Have you reported ENERGY STAR results to building owners decision makers?	0.33	Tracking and Reporting	0.167	
87	Have you used ENERGY STAR results to attract a new client?	0.33			
65	…[If ES=1] Kept the ENERGY STAR score current by regularly updating the information	0.33			
66	…Set a goal or target for energy use or energy use reduction [Note: target can be for multiple buildings considered collectively and does not need to be for an individual building] [Goal=1]	1.0	Energy Performance Targets	0.167	
108	…Goal is written (If necessary, "not jut generally understood"	NA (Eliminated due to data issues)			
109	…Goal specifies numeric targets for energy savings or use				
110	…Goal includes a completion date				
112	…Goal includes a budget				
113	…Goal is authorized by senior management				
114	…Senior management receives updates on progress toward goal				

Continued

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Building Operations, cont.				
98	…Plan is written (If necessary, "not jut generally understood"	0.167	Energy Efficiency Plan	0.167	Building Operations 0.25
99	…Plan includes numeric goals for energy savings or use	0.167			
101	…Plan includes a timeline	0.167			
103	…Plan includes a budget	0.167			
104	…Plan is authorized by senior management	0.167			
105	…Senior management receives updates on plan achievements	0.167			
67	…Conducted a study to identify ways to reduce building energy use [Study=1] AND, if response "less than half" or "about half", then [Study_Potential=1] [Study_Potential=0 for responses "none," "more than half", "and virtually all"]	0.4	Energy Efficiency Study	0.167	
92	[If Study_Potential=1] You mentioned you have conducted a study to identify ways to reduce building energy use, but have not done so for all of your buildings. Do you currently have plans to study most of the remaining buildings over the next two years?	0.25			
93	[If Study=0] Do you have plan within the next two years to conduct a study to identify opportunities to reduce building energy use?	0.25			
94	[If Study=1] Who conducted the study, was it: the utility, staff working for your firm, or contractors (or someone else (specify)) [multiple responses allowed; if multiple responses ask "So more than one building has been studied?" If a single study, probe to get single response to the question]	0.2			
95	[If Study=1] Did the study look for operations and maintenance changes that might lower energy costs?	0.4			

Continued

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Building Operations, cont.				
69	…Taken steps to reduce building energy use [Actions=1]	0.5	Energy Efficiency Tune-Up	0.167	Building Operations 0.25
71	[If Actions=1] Have you seen an improvement in the energy performance of any of your buildings?	0.5			
117	For any of your buildings, have you made any no or low cost changes in operations or maintenance to reduce energy costs in the last two years?	NA (Eliminated due to data issues)			
	Metrics Related to Strategic Leadership				
161	Does the senior management of your organization believe a commitment to sustainability or energy efficient facilities will provide the organization with a strategic advantage?	0.25	Executive Commitment	0.33	Strategic Leadership 0.25
162	Please rate the extent to which you agree with the following statement, where "1" signifies strongly disagree and "5" signifies strongly agree: Decreasing a building's typical energy use increases its asset value.	0.25			
163	Have energy efficiency and sustainability goals been formally adopted through a mission statement or policy and procedures statements?	0.25			
179	Has your firm established a specific individual, team or committee responsible for energy use reduction and/ or sustainability?	0.25			
166	Does your firm consider energy efficiency to be part of its brand identity?	0.33	Vision	0.33	
169	Do your firm's marketing materials highlight its capabilities or successes with energy efficiency or sustainability?	0.33			
170	Does your organization's website contain a section specifically featuring your sustainability or energy efficiency credentials, successes or related awards you have received?	0.33			

Continued

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Strategic Leadership, cont.				
172	Does your firm communicate with any of the following groups about energy efficiency and sustainability for the property? …Tenants?	0.25	Intention	0.33	Strategic Leadership 0.25
173	…Property management teams?	0.25			
174	…Owners?	0.25			
175	…Service providers?	0.25			
	Metrics Related to Mobilizing the Organization				
196	Does your firm consider demonstrated competence in energy efficiency as a factor in promotion decisions?	0.33	Communicating Expectations	0.34	Mobilizing the Organization 0.25
197	Is energy efficiency included in job descriptions of managerial staff positions?	0.33			
198	Does your firm recognize its energy efficiency or sustainability achievements in staff meetings and credit key individuals and teams?	0.33			
186	Have you trained any of your building engineers and operators in how to conduct studies to identify energy savings opportunities? [NA response category for don't employ staff appropriate for this]	0.167	Training	0.66	
188	Have you or other staff participated in any seminars or training related to any aspect of energy efficiency in office real estate?	0.167			
190	[If Y] What organizations sponsored the presentation or training? (open-ended with pre-codes, check all that apply, continue to probe with "Anything else?":) BOMA, ULI (Urban Land Institute), IFMA, AIA, Cascadia Green Building Council, CEM, Other (specify)	0.167			
193	Does your firm allocate staff time for improving capability in energy efficiency?	0.167			
194	Is energy efficiency included in your professional development planning for any staff?	0.167			
195	Would you say that over the last year staff have received more training in energy efficiency than in previous years?	0.167			

Continued

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Contracts with Clients and Suppliers				
187	Have you identified contractors with demonstrated capability to conduct studies to identify energy savings opportunities?	0.33	Contracts with Clients and Suppliers	1.0	Contracts with Clients and Suppliers 0.25
157	Do any of your contracts with equipment service providers include energy efficiency requirements?	0.33			
158	Has your firm adopted language specific to energy efficiency in your leasing and property management contracts? [EE_CONTRACT=1]	0.33			

Table A.8: Hospitals and Healthcare Market Metrics

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Building Operations				
57	…Calculated the energy use per square foot (EUI=1) (if necessary: also known as energy intensity, energy utilization index, or EUI)	0.125	Benchmarking	0.167	Building Operations 0.18
64	…Obtained an ENERGY STAR score (ES=1)	0.125			
76	[If ES=0 AND EUI=1] You indicated you've calculated the energy use per square foot. What tool did you use, if any? (open-ended. Pre-codes: ENERGY STAR Portfolio Manager, Energy Expert, Utility Manager Pro, Avista IQ, Microsoft Excel, Other (specify)	NA (Eliminated due to data issues)			
80	…Comparing across buildings you are responsible for?	0.125			
81	…Comparing across buildings in the region?	0.125			
82	…Comparing performance of the same building over time?	0.125			
83	…[If Goal=1] Comparing building performance to energy use goals?	0.125			
89	[If ES=1] Have you trained any of your staff in using ENERGY STAR Portfolio Manager?	0.125			
85	…[If Goal=1] Used results to help in establishing an energy use or savings target?	0.125			
88	…Reported results to building owners decision makers	0.5	Tracking and Reporting	0.167	
63	…[If EUI=1] Kept the estimate of energy use per square foot current by regularly updating the information	0.25			
65	…[If ES=1] Kept the ENERGY STAR score current by regularly updating the information	0.25			

Continued

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Building Operations, cont.				
66	…Set a goal or target for energy use or energy use reduction [Note: target can be for multiple buildings considered collectively and does not need to be for an individual building] [Goal=1]	1.0	Energy Performance Targets	0.167	Building Operations 0.18
108	…Goal is written (If necessary, "not jut generally understood"	NA (Eliminated due to data issues)			
109	…Goal specifies numeric targets for energy savings or use				
110	…Goal includes a completion date				
111	…Goal identifies the responsible parties				
112	…Goal includes a budget				
113	…Goal is authorized by senior management				
114	…Senior management receives updates on progress toward goal				
98	…Plan is written (If necessary, "not jut generally understood"	0.125	Energy Efficiency Plan	0.167	
99	…Plan includes numeric goals for energy savings or use	0.125			
100	…Plan includes specific action items	0.125			
101	…Plan includes a timeline	0.125			
102	…Plan identifies the responsible parties	0.125			
103	…Plan includes a budget	0.125			
104	…Plan is authorized by senior management	0.125			
105	…Senior management receives updates on plan achievements	0.125			
67	…Conducted a study to identify ways to reduce building energy use [Study=1] AND, if response "less than half" or "about half", then [Study_Potential=1] [Study_Potential=0 for responses "none," "more than half", "and virtually all"]	0.4	Energy Efficiency Study	0.167	

Continued

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Building Operations, cont.				
92	[If Study_Potential=1] You mentioned you have conducted a study to identify ways to reduce building energy use, but have not done so for all of your buildings. Do you currently have plans to study most of the remaining buildings over the next two years?	0.25	Energy Efficiency Study, cont.	0.167	Building Operations 0.18
93	[If Study=0] Do you have plan within the next two years to conduct a study to identify opportunities to reduce building energy use?	0.25			
94	[If Study=1] Who conducted the study, was it: the utility, staff working for your firm, or contractors (or someone else (specify)) [multiple responses allowed; if multiple responses ask "So more than one building has been studied?" If a single study, probe to get single response to the question]	0.2			
95	[If Study=1] Did the study look for operations and maintenance changes that might lower energy costs?	0.4			
69	…Taken steps to reduce building energy use [Actions=1]	0.1425	Energy Efficiency Tune Up	0.167	
71	[If Actions=1] Have you seen an improvement in the energy performance of any of your buildings?	0.1425			
117	For any of your buildings, have you made any no or low cost changes in operations or maintenance to reduce energy costs in the last three years?	0.1425			
119	…Improved the scheduling of equipment, such as lighting and HVAC?	0.1425			
120	…Corrected situations of simultaneous heating and cooling?	0.1425			
121	...Adjusted the outside air usage or economizer functioning?	0.1425			
122	...Recalibrated sensors in the last two years?	0.1425			

Continued

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Life Cycle Cost Analysis Financial Analysis				
73	Are you familiar with life-cycle cost analysis, also called total cost of ownership analysis? [LCCA=1]	0.5	Life Cycle Cost Analysis Financial Analysis	1.0	Life Cycle Cost Analysis Financial Analysis .005
74	[IF LCCA=1] Which statement best describes your organization's investment decision-making with respect to life-cycle cost analysis. Would you say you: __Have not used nor plan to use life-cycle cost analysis, __Have plans to use life-cycle cost analysis for some investments, __Have made investments based on lowest life-cycle cost	0.5			
	Capital Improvements				
116	For any of your buildings, have you replaced existing equipment with high-efficiency equipment in the last three years?	1.0	Capital Improvements	1.0	Capital Improvements .005
	Metrics Related to Design Practices				
126	[Ask All] How familiar are you with the architectural design process called Integrated Design? Would you say… __Not at all, __Somewhat, or __Very	0.33	ID Awareness	0.25	Design Practices 0.18
127	[If ID=somewhat or very] Has your organization used integrated design for any of its new construction, addition or renovation design projects in the last three years?	0.66			
139	[IF NC_INV=1] Other than for code compliance, did you use energy modeling to determine the design?	1.0	ID Modeling	0.25	
144	[IF NC_INV=1] Was a design charette held where the architect meets with the owner, building operator, and consulting engineers?	1.0	ID Activities	0.25	
148	[IF NC_INV=1] Was any major system--such as the chiller, boiler, ventilation, or lighting system--designed to use less significantly less energy than in comparable facilities or required by code?	1.0	ID Features	0.25	

Continued

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Strategic Leadership				
161	Does the senior management of your organization believe a commitment to sustainability or energy efficient facilities will provide the organization with a strategic advantage?	0.33	Executive Commitment	0.5	Strategic Leadership 0.18
163	Have energy efficiency and sustainability goals been formally adopted through a mission statement or policy and procedures statements?	0.33			
179	Has your firm established a specific individual, team or committee responsible for energy use reduction and/ or sustainability?	0.33			
166	Does your organization consider sustainability or energy efficiency to be part of its market identity?	1.0	Vision	0.5	
	Metrics Related to Mobilizing the Organization				
196	Does your organization consider demonstrated competence in energy efficiency as a factor in promotion decisions?	0.33	Communicating Expectations	0.34	Mobilizing the Organization 0.18
197	Is energy efficiency included in job descriptions of operational staff positions?	0.33			
198	Does your organization recognize its energy efficiency or sustainability achievements in staff meetings and credit key individuals and teams?	0.33			
186	Have you trained any of your building engineers and operators in how to conduct studies to identify energy savings opportunities? [NA response category for don't employ staff appropriate for this]	0.125	Training	0.66	
188	Have you or any of the O&M staff participated in any seminars or training related to energy efficiency?	0.125			
189	[If Y training] About what proportion of the O&M staff have received training related to energy efficiency? Would you say Less than Half, More than Half, Virtually All	0.125			

Continued

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Mobilizing the Organization, cont.				
190	[If Y] What organizations sponsored the presentation or training? (open-ended with pre-codes, check all that apply, continue to probe with "Anything else?":) BOC, CEM, IFMA, AIA, Cascadia Green Building Council, OSHE, WASHE, society of healthcare engineers, conferences, PGE, utility, Seattle IDL (Integrated Design Lab), Practice Greenhouse, University of Washington, community colleges, other (specify)	0.125	Training, cont.	0.66	Mobilizing the Organization 0.18
191	[If Y training] Have you or any of your staff received certifications relating to energy efficiency?	0.125			
193	Does your organization allocate time for your operations staff to improve capability in energy efficiency?	0.125			
194	Is energy efficiency included in your professional development planning for any staff?	0.125			
195	Would you say that over the last two years operations staff have received more training in energy efficiency than in previous years?	0.125			
	Metrics Related to Contracts with Suppliers				
187	Have you identified contractors with demonstrated capability to conduct studies to identify energy savings opportunities?	0.25	Contracts with Suppliers	1.0	Contracts with Suppliers 0.18
157	Do any of your contracts with equipment service providers include energy efficiency requirements?	0.25			
158	Has your organization included energy efficiency requirements in any of its specs for equipment purchases? [EE_SPECS=1]	0.25			
155	[If ID=somewhat or very] Does your organization plan to request for future new construction projects that your A&E team be experienced in or willing to learn Integrated design?	0.25			

Table A.9: Building Operations Market Metrics

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Building Operations				
57	…Calculated the energy use per square foot (EUI=1) (if necessary: also known as energy intensity, energy utilization index, or EUI)	0.14	Benchmarking	0.167	Building Operations 0.5
64	…Obtained an ENERGY STAR score (ES=1)	0.14			
80	…Comparing across buildings you are responsible for?	0.14			
81	…Comparing across buildings in the region?	0.14			
82	…Comparing performance of the same building over time?	0.14			
83	…[If Goal=1] Comparing building performance to energy use goals?	0.14			
85	…[If Goal=1] Used results to help in establishing an energy use or savings target?	0.14			
88	…Reported results to building owners decision makers	0.25	Tracking and Reporting	0.167	
87	…Used results to attract a new client	0.25			
63	…[If EUI=1] Kept the estimate of energy use per square foot current by regularly updating the information	0.25			
65	…[If ES=1] Kept the ENERGY STAR score current by regularly updating the information	0.25			
66	…Set a goal or target for energy use or energy use reduction [Note: target can be for multiple buildings considered collectively and does not need to be for an individual building] [Goal=1]	1.0	Energy Performance Targets	0.167	
68	…Created a proposal for services to address energy savings opportunities [Plan=1]	1.0	Energy Efficiency Plan	0.167	
67	…Conducted a study focused on energy saving opportunities [Study=1]	1.0	Energy Efficiency Study	0.167	

Continued

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Building Operations, cont.				
69	…Taken steps to reduce building energy use [Actions=1]	0.1425	Energy Efficiency Tune-up	0.167	Building Operations 0.5
71	[If Actions=1] Have you seen an improvement in the energy performance of any of your customers?	0.1425			
117	For any of your customers, have you made any no or low cost changes in operations or maintenance to reduce energy costs in the last two years?	0.1425			
119	…Improved the scheduling of equipment, such as lighting and HVAC?	0.1425			
120	…Corrected situations of simultaneous heating and cooling?	0.1425			
121	...Adjusted the outside air usage or economizer functioning?	0.1425			
122	...Recalibrated sensors in the last two years?	0.1425			
	Metrics Related to Capital Improvements				
116	For any of your customers, have you replaced existing equipment with high-efficiency equipment in the last two years?	1.0	Capital Improvements	1.0	Capital Improvements 0.05
	Metrics Related to Strategic Leadership				
161	Does the senior management of your firm believe that energy efficiency services are a viable product?	0.5	Executive Commitment	0.5	Strategic Leadership 0.15
179	Does your firm have an energy efficiency or sustainability services group?	0.5			
168	Do your firm's marketing materials describe the advantages of energy efficient or high performance buildings?	0.33	Vision	0.5	
169	Do your firm's marketing materials highlight its capabilities or successes with energy efficiency or sustainability?	0.33			
170	Does your organization's website contain a section specifically featuring your sustainability or energy efficiency credentials, successes or related awards you have received?	0.33			

Continued

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
	Metrics Related to Mobilizing the Organization				
196	Does your organization consider demonstrated competence in energy efficiency as a factor in promotion decisions?	0.33	Communicating Expectations	0.34	Mobilizing the Organization 0.15
197	Is energy efficiency included in job descriptions of operational staff positions?	0.33			
198	Does your organization recognize its energy efficiency or sustainability achievements in staff meetings and credit key individuals and teams?	0.33			
186	Have you trained any of your technicians or engineers in how to conduct studies to identify energy savings opportunities? [NA response category for don't employ staff appropriate for this]	0.11	Training	0.66	
188	Have you or any of the sales and operations staff participated in any seminars or training related to energy efficiency?	0.11			
189	[If Y training] About what proportion of the sales and operations staff have received training related to energy efficiency? Would you say Less than Half, More than Half, Virtually All	0.11			
190	[If Y] What organizations sponsored the presentation or training? (open-ended with pre-codes, check all that apply, continue to probe with "Anything else?":) BOC, CEM, IFMA, AIA, Cascadia Green Building Council, OSHE, WASHE, society of healthcare engineers, conferences, PGE, utility, Seattle IDL (Integrated Design Lab), Practice Greenhouse, University of Washington, community colleges, other (specify)	0.11			
191	[If Y training] Have you or any of the staff received certifications relating to energy efficiency?	0.11			
192	[If Y] What certifications? Pre-codes: BOC, CEM, Other (specify)	0.11			

Continued

Question Number	Question	Question Weight	Sub-Metric	Sub-Metric Weight	Final Metric & Weight
Metrics Related to Mobilizing the Organization, cont.					
193	Does you firm allocate time for your sales and operations staff for training in energy efficiency?	0.11	Training, cont.	0.66	Mobilizing the Organization 0.15
194	Is energy efficiency included in your professional development planning for any staff?	0.11			
195	Would you say that over the last year staff have received more training in energy efficiency than in previous years?	0.11			
Metrics Related to Contracts with Clients					
158	Has your firm adopted any contract language specific to energy efficiency? [EE_CONTRACT=1]	0.167	Contracts with Clients	1.0	Contracts with Clients 0.15
46	Do you have written service protocols for energy efficiency service offerings to include in contracts?	0.167			
48	...tracking building energy costs?	0.167			
49	...calculating the energy use per square foot or ENERGY STAR score?	0.167			
50	…conducting a study focused on energy savings opportunities?	0.167			
54	[IF EE_PKG=1] Do you have sales targets for these products?	0.167			

B ADDITIONAL RESEARCH FINDINGS

This appendix provides additional research findings. The following sections describe program activities, present additional findings from the professional association interviews, and provide program recommendations offered by BetterBricks participants.

PROGRAM ACTIVITIES

D&C Market Activities

D&C seeks to achieve significant and persistent energy efficiency in new commercial buildings – especially offices and healthcare – through influencing design practice among architectural firms. This effort involves business planning assistance, in-depth project-based education (also known as technical assistance), research and development on design strategies and tools, and professional staff development with a few targeted early adopter firms. The effort advocates using a core set of best practices as a means of delivering high performance buildings that meet the *2030 Challenge* targets for energy and carbon reduction.

The best practices include:

- Use of integrated design (ID) – defined as the synthesis across climate, use, loads, and systems resulting in buildings that are far more energy-efficient than current best practices – and a team approach to address energy use
- Setting project energy performance targets significantly better than code
- Use of enabling design tools and approaches to achieve synergies between climate, use, loads, and systems
- Commissioning the building, systems, and equipment
- Help structure a hand-off to operators, educate occupants, and monitor start-up
- Enable and support post-occupancy evaluations

A regional network of Integrated Design Labs (IDLs or labs) operated by Schools of Architecture at five universities in the four states provide the technical assistance. The labs help designers learn how to deliver building projects that perform at the highest levels of energy efficiency and interior quality, with little or no additional capital cost through integrated design team problem-solving.

For business assistance, D&C deploys a national consulting firm specializing in architecture and engineering business and strategic planning as a Business Advisor to work with senior members

of each Firm Focus firm to make ID and energy efficiency an integral part of their business strategy.

The D&C professional organizations enjoy wide recognition and credibility among design professionals. Examples include the local and regional chapters of the American Institute of Architects; Cascadia – a regional organization that both serves as the local chapter of the United States Green Building Council (USGBC) and pursues other endeavors; state chapters of the American Society for Heating, Refrigeration and Air Conditioning (ASHRAE), the New Buildings Institute, and several others.

ORE Market Activities

ORE, launched in March 2006, "advocates for changes to energy-related business practices" among real estate firms that own and manage office buildings in the Pacific Northwest. The target market consists of managed commercial real estate and does not include owner-occupied buildings. ORE began working with three real estate firms in June 2008.

An important early accomplishment of ORE, reported in the first Market Progress Evaluation Report,[8] was establishing a strategic alliance with the Building Owners and Managers Association (BOMA). Through shared sponsorship of BOMA education and training and other events, ORE established recognition and credibility and raised awareness in its target audience. ORE has continued to build on its relationship with BOMA while also developing relationships with other organizations, such as the Urban Land Institute (ULI) and the Cascadia Chapter of the U.S. Green Building Council.

In 2007, BOMA and ORE partnered to deliver the *BOMA Energy Efficiency Program* (BEEP) in Seattle, Portland, and Boise. Over 600 people attended these BEEP events. BOMA offered BEEP in Spokane in 2008. BOMA continues to offer the *Best of BEEP* – a condensed version of the six-session BEEP series, with attention on smaller markets like Tacoma, the Tri-Cities, and Eugene.

ORE served as the primary catalyst, as well as a sponsor, of the BOMA Portland *Energy Office Showdown* and the BOMA Seattle/King County *Kilowatt Crackdown*. These friendly competitions use ENERGY STAR® Portfolio Manager to benchmark participating office buildings. They also provide free assistance to obtain ENERGY STAR® certification, scoping to identify energy efficiency opportunities, and workshops and assistance on energy benchmarking. Through the competitions, building managers benchmarked sizeable portions of the office real estate in Portland and Seattle/King County, spreading benchmarking capability in the office real estate market. In the third annual Portland *Energy Office Showdown* in 2009, 32 properties representing over 11 million square feet participated. In the first *Kilowatt Crackdown*, 53

[8] *Office Real Estate Initiative Market Progress Evaluation Report #1*, Northwest Energy Efficiency Alliance, January 25, 2008.

buildings – representing over 18 million square feet (approximately 20% of the Puget Sound office inventory) – completed the contest and over 100 buildings are signed up for the 2nd *Kilowatt Crackdown*. BOMA chapters in other parts of the country have copied these events.

In 2007, ORE worked with its contractors to develop the *High Performance Portfolio Framework* (HPPF), a "how-to guide for real estate professionals . . . to create – and maintain – energy excellence" in their office portfolios. The HPPF outlines the process to achieve a high performance office building portfolio by following five steps: *Assess*, *Commit*, *Plan*, *Implement*, *and Capitalize.* A series of 27 supporting briefs and templates complement the HPPF. These tools and resources, available on the BetterBricks website, support education, outreach, and direct work with real estate firms.

In recent years, ORE has been focusing on leveraging the transactional nature of the real estate business. Some of the topics addressed include:

- **Green Leases:** ORE has offered education events in partnership with BOMA and *Lunch and Learn* sessions at real estate firms attended by more than 250 real estate professionals. ORE has assisted several real estate firms to modify their leases to support enhanced energy management. NEEA has used its recent experience finding new office space to develop case study articles on their selection process and green lease agreement.

- **Property Management Agreements**: ORE has worked with some real estate firms to incorporate energy management requirements into property management agreements.

- **Tenant Improvements**: ORE recently released the *Sustainable Tenant Improvement Manual*, developed in partnership with a leading real estate asset management company. Research is underway to understand better the tenant improvement process. This research will support the future development of tools and resources.

- **Building Valuation and Financing**: ORE is a founding member of the Green Building Finance Consortium. The Executive Director of the Consortium, Scott Muldavin, recently published *Value Based Cost Savings, How to Underwrite Sustainable Properties* with support from ORE. This is part of ORE's efforts to link the role energy efficiency plays in the value of commercial buildings. In partnership with Cushman Wakefield, ORE recently released the *Green Building Opportunity Index*. The Index highlights the ingredients necessary for a healthy green building market. ORE has also offered seminars on green financing.

ORE also tries to be opportunistic by taking advantage of and supporting market activities that are consistent with its goals. An example is the 2030 District in Seattle. The district includes six major downtown property managers and owners, and, with involvement from utilities, the city, and other organizations, is developing energy and greenhouse reduction goals and strategies to meet those goals. ORE plays a supportive role by being a catalyst for new ideas, helping to make connections between people and organizations, and potentially assisting with carrying out the strategies to meet the 2030 District goals.

ORE is currently working with eight real estate firms in the Seattle-area, Portland, and Boise. Six of these firms are receiving a comprehensive level of service, while two others are receiving more limited and focused services (this evaluation categorizes these firms as *Light Touch*). ORE staff design services tailored to the needs and interests of each firm. This is not a one-size-fits-all approach. Work to assist one of the original real estate firms is currently on hold, partly because of "transitions" at the firm, but two other firms have made enough progress that they will be ending their relationship with ORE soon.

The ORE manager developed a report card to gauge the progress of a real estate firm in achieving a high performance portfolio. There are four stages: *engaged*, *committed*, *advancing*, and *sustaining*. ORE staff has completed report cards for six of the real estate firms (through the 2nd quarter 2010). According to staff, one of the firms has reached sustaining status, while most of the others are advancing (Table B.1).

Table B.1: Real Estate Firm Report Card Beginning and Current Stage Progression

Firm	Starting Date	Starting Stage	Current Stage
Firm 1	6-08	Engaged	Sustaining
Firm 2	6-08	Committed	Advancing
Firm 3	10-08	Engaged	Committed
Firm 4	6-09	Committed	Advancing
Firm 5	6-09	Engaged	Advancing
Firm 6	1-10	Committed/ Advancing	Advancing/ Sustaining

H&H Market Activities

H&H targets hospital and hospital systems that have their headquarters in the four-state region served by NEEA. H&H seeks to transform the regional healthcare market so healthcare organizations design and operate their hospitals and associated facilities according to best energy efficiency practices. H&H starts this transformation at an individual hospital or hospital system by encouraging these organizations to adopt Strategic Energy Management Plans (SEMPs). SEMPs provide the blueprints for the organizations to create lasting changes in business practices and lead to reduced energy consumption in all buildings.

Market Specialists work with targeted hospitals to develop and implement SEMPs. The main categories of business practice changes contained in a SEMP are: 1) design and construction, operations and maintenance; 2) financial practices and purchasing; 3) capital upgrades; and 4) monitoring and tracking. Typical early steps include the identification of efficiency opportunities for facility operations and upgrades, estimation of the resources required and of the return on investment, and creation of an action plan to address the opportunities over several years. Once a

hospital has developed a SEMP and an executive has signed it, the Market Specialists assist in plan implementation.

H&H has developed and assembled tools and materials to support the Market Specialists and the hospitals engaged in developing and implementing SEMPs. The BetterBricks website provides links to these tools and resources, which are organized under: *Assessment*; *Planning; Financial; Purchasing; Operations & Maintenance; Design & Construction; Staff and Public Awareness; Tracking & Recognition.* In addition, the website provides links to relevant regional and national case studies, and links to additional references and hospital resources. Two notable hospital guides produced by BetterBricks are the *Guide to the Design & Construction of High Performance Hospitals,* and the *Guide to Optimizing Hospital Facility Investments*.

Training and education workshop titles included, among others: *Financial Decision-Making Tools for Hospitals*, *High Performance Hospitals and Medical Research Facilities, Lighting for Healthcare Facilities,* and *Understanding the Value of Commissioning*. BetterBricks co-sponsored a national conference held in Colorado entitled *Successful Strategies for Achieving Green Hospitals* and promoted hospital-sector-specific conferences and education conducted by the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) and by the Washington and Oregon chapters of the American Institute of Architects (AIA).

H&H promotes the use of *total-cost-of-ownership* or, equivalently, lifecycle cost analysis (LCCA) by hospitals considering capital investments, including new equipment, equipment replacements, and new construction. Such an analysis gives value to the long-term savings of energy efficiency and makes it possible to use a single financial criterion to assess diverse investment decisions.

BOPS Market Activities

BOPS focuses on improving regional building performance by facilitating market adoption of improved operations and maintenance (O&M) strategies by market actors on both the demand and supply sides of the market.

On the supply side, BOPS helps to build local teams to provide O&M services. BOPS provides technical training and business development support to select mechanical and controls service providers. This effort, known as *Firm Focus*, builds skills to deliver new building tune-up and retro-commissioning services, and helps firms enhance their basic service agreements to include energy-efficiency benchmarking, monitoring, and on-going service. Technical Advisors provide how-to training, and Business Advisors teach firms how to market, sell, and write effective proposals for their energy efficiency services.

On the demand side, BOPS stimulates demand for building operations and maintenance services in the Pacific Northwest, primarily by identifying energy savings opportunities among targeted ORE and H&H organizations. BOPS has also assisted end-users by developing O&M RFPs.

NEEA's market research showed a need to define and differentiate building-performance services in order to enhance market value for those services. To that end, NEEA articulated customer screening (customer qualification) and scoping (project identification) services that in turn can lead to further energy efficiency services. These additional services include:

- Enhanced O&M practices
- Energy tune-up
- Commissioning / retro-commissioning
- Equipment replacement

Through Firm Focus, NEEA collaborates with building service providers in the Northwest, providing business-planning and technical assistance, to help those service providers offer building performance services in a way that will provide greater value to their customers, increase their revenues and profits, and give them a competitive advantage in the marketplace. BOPS works with eight Firm Focus contractors in Washington, Oregon, and Idaho. Some are large, full-service mechanical and controls contractors whose customers include large high-rises with complex systems; some are smaller firms that tend to service smaller buildings with unitary equipment.

BOPS has also assembled a set of tools to enhance O&M diagnostic, assessment, benchmarking, and monitoring services. BetterBricks introduces, provides training about, and supports the purchase of these tools. The *betterbricks.com* website offers the tools developed by BetterBricks and links to proprietary tools, as well as technical information and additional resources, including video training.

The BOPS tool box includes building and system best practices and performance indicators for tracking utility bills, for benchmarking, and for trend logging. The tool box also includes the Field Diagnostic Services Inc. (FDSI) *HVAC Service Assistant* tool, a hand-held diagnostic tool for rooftop AC units. Another tool, *Air Advice*, provides system efficiency information as part of an air quality assessment. Technical Advisors work with targeted office real estate firms and hospitals using a BOPS-developed assessment tool that includes in-depth interviews with building managers. The initial building performance services, screening and scoping reports, walkthroughs, and resulting proposals, are also important tools, particularly for Hospital projects. For ongoing monitoring, BOPS encourages facility managers to acquire tools to support a dashboard of system performance, such as *Energy Expert*, a proprietary tool developed by NorthWrite.

As of 2008, BOPS and its partnering professional associations had over 70 trained technicians who can use the FDSI tool, and who have pursued approximately 24 retro-commissioning and building tune-up projects with Technical Advisors. Technical Advisors have also supported about 30 projects in the Hospitals and Office Real Estate markets. Due to BetterBricks' support for the purchase of a FDSI tool and training local trainers, the BOPS market manager estimates

that hundreds of union members in the Portland area have been exposed to energy-efficiency field-diagnostic equipment.

The following list identifies BetterBricks-sponsored events appropriate to the BOPS target market.

- Annual IFMA Seattle Education Symposium, Lynnwood
- Idaho ASHRAE Conference
- Northwest Facilities Expo, Portland
- MSHE/ASHRAE 2009 Spring Conference, May, Butte, MT
- 2009 Joint Engineering Conference, at OSU Corvallis
- National Conference on Building Commissioning, Seattle
- Powerful Business Conference, Bellevue, WA
- International Building Operators Association Annual Conference and Trade Show, Idaho Falls
- Monitoring Load Shape for Energy Savings, PGE
- Chilled Water Systems, PGE
- Oregon Society for Healthcare Engineering Fall 2009 Conference, Salishan
- CSI Mt. Rainier Chapter Continuing Education Conference, Lynnwood
- Best of BOMA's Energy Efficiency Program (BEEP), Washington
- FDSI HVAC Service Assistant Tool training
- Benchmarking trainings
- AEE Westcoast Energy Management Conference

The BetterBricks business advisor conducted workshops with:

- Oppenheimer Boise
- Wright-Runstad Bellevue
- McKinstry Energy Services Group Seattle
- MckInstry Service Maintenance Group Seattle
- MacDonald-Miller Sales Portland
- Merit Mechanical Sales – Redmond

The BetterBricks business advisor also conducted the following webinars and trainings:

- Idaho Office of Energy Renewables – Schools Tune-up Program

- 10-12 Engineering Companies September 15th & 17th 2009 total of 45+ engineers
- 26 Mechanical Service Contracting companies April 13th & 15th 2010 total of 107 people. Also included detailed training on Service Assistant tool from FDSI.

- BOC Webinars
  - Common Opportunities
  - Finding Outside Air and Equipment Scheduling Opportunities

ADDITIONAL FINDINGS FROM PROFESSIONAL ASSOCIATION INTERVIEWS

D&C Professional Associations

While all the professional association contacts said their organizations take pains to emphasize BetterBricks sponsorship through, for example, use of the BetterBricks logo and verbal acknowledgement in presentations and written materials, they believe most participants do not fully understand the role played by BetterBricks.

Even individuals at the professional organizations may not be fully aware of the extent of BetterBricks assistance. One respondent cited a course that was developed and delivered with BetterBricks support; the organizers received such an enthusiastic response to the course that they plan a roll-out for other parts of the region and even the rest of the country. But it was only when planning the roll-out in other regions that the organization realized how much "hidden" support BetterBricks had provided – for example, in curriculum development and helping to pay for presenters.

Respondents describe BetterBricks as an unseen or behind-the-scenes force helping the professional association to advance its own agenda, as well as that of BetterBricks. In part because of this low-key approach, one respondent said that the organization is not always sure whether it is meeting BetterBricks' expectations.

The professional association contacts themselves adequately articulated BetterBricks' basic goals and priorities, as well as the key messages. Again, however, respondents did not think many of their members were fully aware of BetterBricks' mission. Several contacts said they do not believe their membership has a clear understanding of BetterBricks' fundamental goals . One respondent noted, "market transformation is a difficult concept to explain to design professionals." One suggested that NEEA develop a brief one-to-two minute video message summarizing the goals and role of BetterBricks in supporting its partnering associations, which the partners could present at the start of a training session or seminar.

Changes offered by professional association contacts for NEEA to consider include:

➡ Improve communication about the full range of monetary and other support provided both directly and indirectly by Better Bricks to further individual education and training.

- More clearly set out NEEA's expectations from the partnering associations regarding, for example, training content or numbers of workshop participants.
- Provide professional associations with the tools to succinctly explain to their members the role of BetterBricks and why it is supporting a specific initiative (that is, how the goals of BetterBricks align with those of the partner organization).

ORE Professional Associations

Some of the contacts we interviewed for this evaluation we also interviewed for prior MPERs, so we can track the development of these professional association relationships. The input from associations about ORE has been quite positive and their enthusiasm has increased in the series of interviews we have conducted. ORE's relationships with long-time partnering associations like BOMA have matured and a level of comfort and trust has developed.

While the professional associations believe ORE has effectively reached large building owners and managers of class A office buildings in the urban markets, they believe there are significant opportunities to reach other groups. This includes owners and managers with smaller portfolios of class B and C office buildings in the suburbs and in smaller markets. This less sophisticated group of owners is harder to reach, is less motivated, has resource constraints, and is less likely to belong to or participate in BOMA chapters.

H&H Professional Associations

The contacts described challenges to transforming the healthcare market with energy efficiency efforts. For example, their members' primary concerns are patient care and satisfaction, followed by regulatory compliance, which easily trumps energy efficiency. The contacts also mentioned reduced capital budgets and the low cost of electricity as additional barriers to energy-efficiency for this market. Contacts attributed to these barriers what they view as the slow and modest adoption of BetterBricks.

At the same time, the frequent and ongoing changes in legislation and technology give the healthcare market a dynamism that creates opportunities for intervention. Examples include facility upgrades required by American Disabilities Act compliance, asbestos mitigation, and earthquake structural compliance. One contact noted it is often easier to build new facilities than to bring existing facilities into compliance, suggesting a focus on new construction would be fruitful.

The professional associations' members have a positive view of BetterBricks, see it as a credible source of information, and believe its message is the right one for this market. However, contacts believe their members are becoming sated with energy efficiency messages that are of limited value to them because of their employers' healthcare and regulatory-compliance priorities. Contacts' suggestions for addressing this challenge included linking energy efficiency messages to other primary concerns such as staff and patient well-being, and the "environment of care."

The contacts conveyed a sense of vagueness about their understanding of BetterBricks' role in the region, especially due to the commercial sector initiative redesign occurring this year (2010).

BOPS Professional Associations

(We have no additional detail for BOPS professional association findings.)

PARTICIPANT SUGGESTIONS FOR NEEA'S COMMERCIAL SECTOR ACTIVITIES

Table B.2 provides the open-ended responses of BetterBricks participants asked "What, if anything, would you like NEEA to consider as it evolves how it works with [D&C: the design community; ORE: the office real estate community; H&H: the hospital and healthcare community; BOPS: the mechanical contractor community] to increase energy efficiency?"

Table B.2: Participant Suggestions for Future NEEA Activities

Participant Suggestion
D&C Survey
Big thing my firm is doing now is developing metrics to capture project performance. BetterBricks funded the preliminary effort and it needs to do more things like that.
What's missing are the examples. We're lacking data about what's happening around the country; need upfront payback analyses for clients.
Educate and communicate ways for us all to do better in our practices w/ regard to energy efficiency. The integrated design labs are excellent as ways for us to access information and assistance (through daylighting studies, energy modeling, seminars and presentations) so they are important "gateways" to maintain. Just keep informing us of what is available.
Communicate successes. Publishing case studies and actual examples of projects that achieve outstanding results is great incentive for all of us in the design community to keep improving and incorporating energy efficiency into our buildings. Knowing that someone else has actually achieved some great results in their project is very important to keep us all striving to do better.
More case studies on lessons learned.
Continue and do more of the following: 1) education to design professionals, 2) partnerships with design professionals, 3) grassroots like the labs (IDLs), 4) utility partnerships.
More funding for the research labs (IDLs); working with them has been very beneficial allowing the firm to make informed decisions.
More education on modeling.
Support for firms to do more/better benchmarking.
Architects need more resources as there is more demand than can be met.
Many architectural clients do not want to pay for energy modeling and it would be good to have a source of funds for this purpose.

Continued

Participant Suggestion
ORE Survey
Key is getting the third party property management firms on board and trained.
Recently there has been much greater awareness in the real estate business of the importance of energy efficiency; BetterBricks/NEEA needs to capitalize on that.
More mandatory policies and codes for buildings for energy efficiency.
They are doing a lot of the right things and the pace is just right.
They are already doing a fantastic job, can't think of much more they can do.
H&H Survey
Provide more direct support for implementation of measurement and verification systems.
Further promotion of recommissioning of buildings, especially in this tough economy.
Only parts of hospitals are truly 24/7 operations and the portion that is not is the true opportunity to save energy.
Efforts to conserve energy need not be grandiose, don't discount small projects.
Continue to educate senior facilities management staff on both the value of and opportunities associated with energy management.
More BetterBricks communications with CEO level types regarding value of energy efficiency for their hospitals.
More operational on-site training at the hospitals.
Help, support, cooperation with utilities in regard to their incentive plans to devise a custom plan for hospital/health care market.
Continued support: from tech advisors; continued funding for system energy manager position; keep dialogue/communications ongoing.
Was working closely w/ BB doing big study, but ran out of funds would like to continue the study.
Provide more grants.
Need to be more practical in what they are delivering, need to be able to provide more solutions to their customers. [From a Light Touch respondent]
Would like them to become a funding source, like ETO and provide low interest loans up front. [From a Light Touch respondent]
Hard to sell to her organization's senior management the projections made by BetterBricks as to what the savings are versus the cost of employing an energy manger. [From a Light Touch respondent]
BOPS Survey
Incentivizing the monitoring is really big with building owners.
Raising awareness to recognize potential opportunities, that would be helpful. There should be more influence in the service industry: service offerings, and maintenance and operations. There is a lot of potential here since contractors or staff are not trained in what they should be looking for when they repair or replace equipment.
I would say continue the Better Bricks program as it is. It helps to have the funding sources or incentives to get buildings off the decision block or to nudge buildings' owners to make these decisions. Also, support from the [BOPS Technical Advisor and Market Specialist] should continue. We made some progress over the last year, and without them we would not be one tenth of the way we are right now. it sounds like BetterBricks funding is going away . We have a long way to go to implement and develop these services.

Continued

Participant Suggestion
BOPS Survey, Cont.
It always surprised me that NEEA is comprised of utility companies and, yet NEEA does not cooperate well with utilities and vice-versa. I'll give you an example: we want interval data on electrical usage for one of our clients. We are doing tune-up with a client through NEEA, and we cannot get hands on interval data from [the utility]. You can use interval data in Energy Expert, a software for energy use forecasting, and [the utility] has interval data. NEEA is trying to get it for us and has been trying for six weeks. I feel, there is a lack of cooperation. They need to work on that and beyond that. Over the last three years there have been turf wars. [The utility] has programs that parallel NEEA programs, and they compete. [The utility] and NEEA want to save energy or maximize energy savings so they can attribute them to their accomplishments. What comes out is the problem like interval data issue in the example I gave. They need to get their act together.
I think it is important for NEEA to continue to invest in Firm Focused contractors and continue to emphasize commercial office sector with Better Bricks Program and Kilowatt Crackdown. I think the healthcare market is a viable market. NEEA is an advocate for increased incentives and behavior change that focus on ownership teams in both commercial and healthcare sectors. Those initiatives have been valuable. It is still very early in the education process and the adoption rate is still low, and there should be continued investment . I would encourage NEEA to assist with that – continue to invest in [a Firm Focus firm] and the customers.
Do not cancel the program. We heard something to that effect. Two people that worked with us from NEEA were told that they will not have a job this upcoming January. I want to convey my disgust to who ever made that decision. We just got on board and hope program will continue.
NEEA does not understand what mechanical contractors are all about. They do not know even what type of a proposal we give to a customer. We are for profit. They do not understand the process of making a sale. They view us as an engineering firm. There is a disconnect; e.g. early on with NEEA Better Bricks program, we did a client interview that owns large office and production facility. Senior VP and controller and director were there. We had this initial interview about operations and maintenance practices. Consultant from NEEA was asking a long list of questions. She would ask questions and enter it into a laptop as if those were cut and dry responses. They were dealing with cut and dry engineering facts and not looking into sales or how one is to sell an energy package. It was frankly a bit embarrassing. We made some changes after that and we did the rest of the interviews ourselves.
Any sort of rebates or incentives for upgrades and repairs (e.g. economizer) is what I see as the most powerful tool to get people to invest in energy-efficient services.
We need more of enhancing incentives in the state of Oregon on the government level. For example, there is a provision in Oregon constitution that does not allow for agencies to use utility/energy savings to be redirected toward paying for other costs/loans. That would help motivate agencies to make these savings more readily.

C LOGIC MODELS

Figure C.1, Figure C.2, Figure C.3, and Figure C.4 present the Design & Construction (D&C), Office Real Estate (ORE), Hospitals and Healthcare (H&H), and Building Operations (BOPS) logic models, respectively.

Figure C.1: Simplified Logic Model for BetterBricks Design & Construction (D&C) Cross-Cutting Market

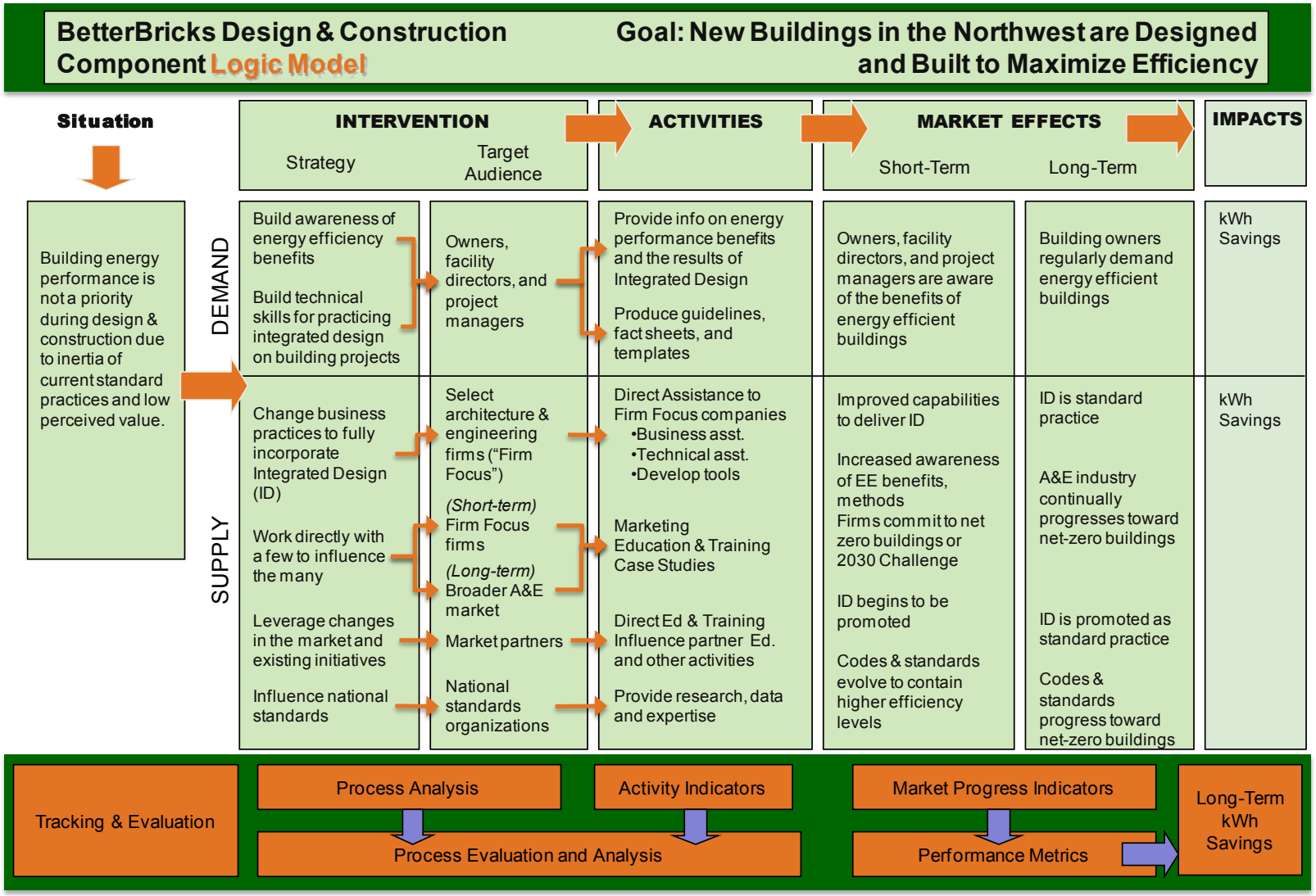


Figure C.2: Simplified Logic Model for BetterBricks Office Real Estate (ORE) Target Market

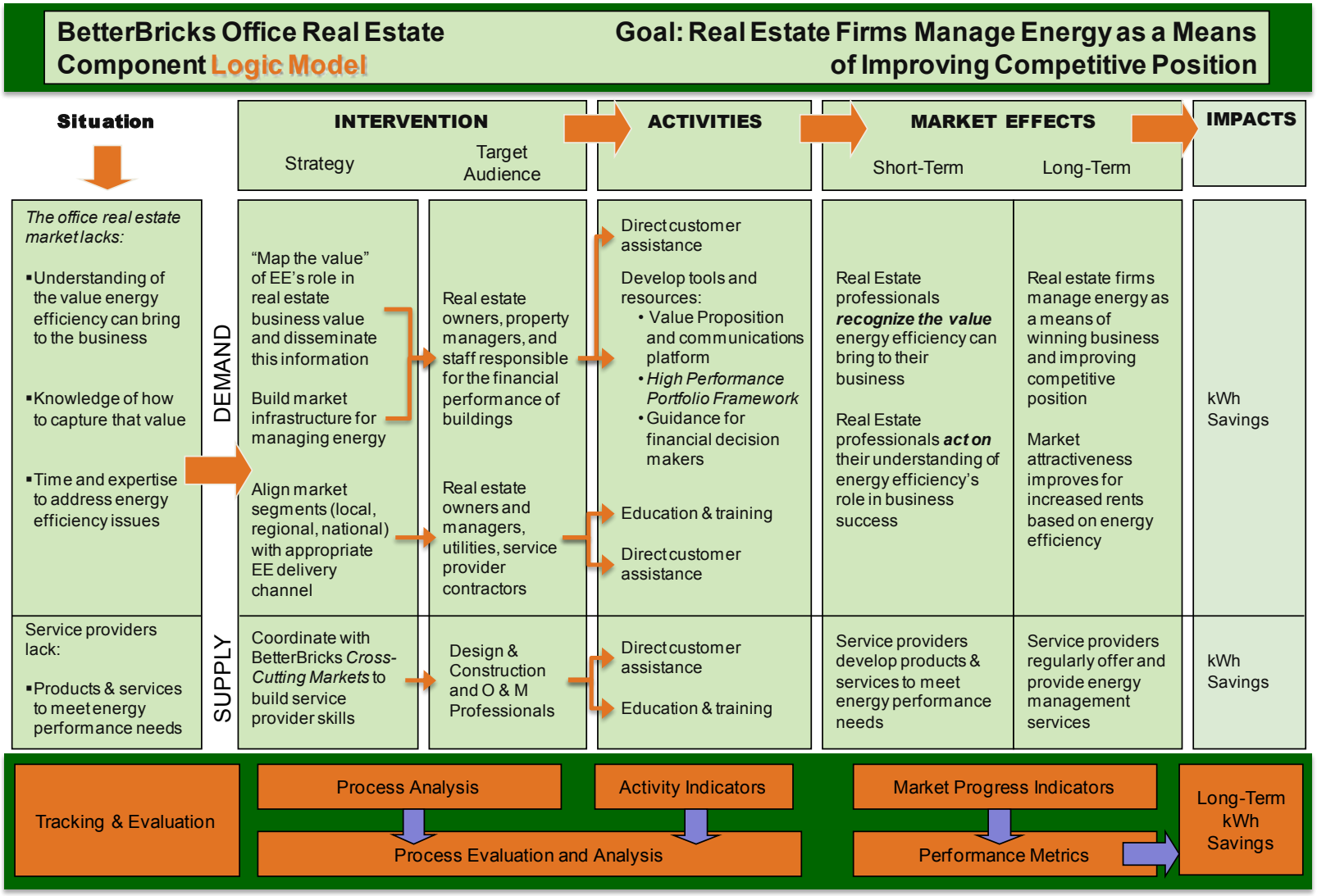


Figure C.3: Simplified Logic Model for BetterBricks Hospitals & Healthcare (H&H) Target Market

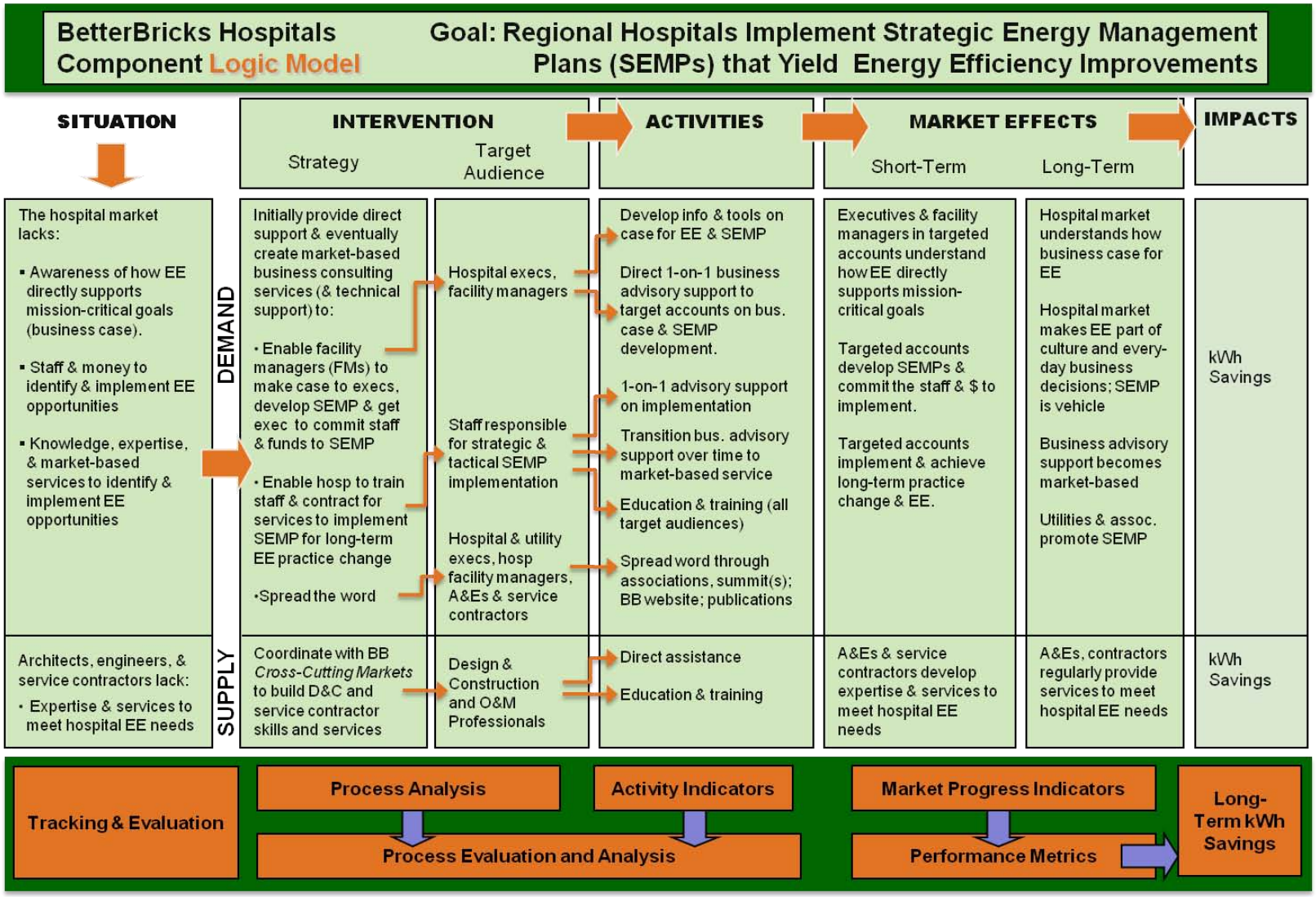
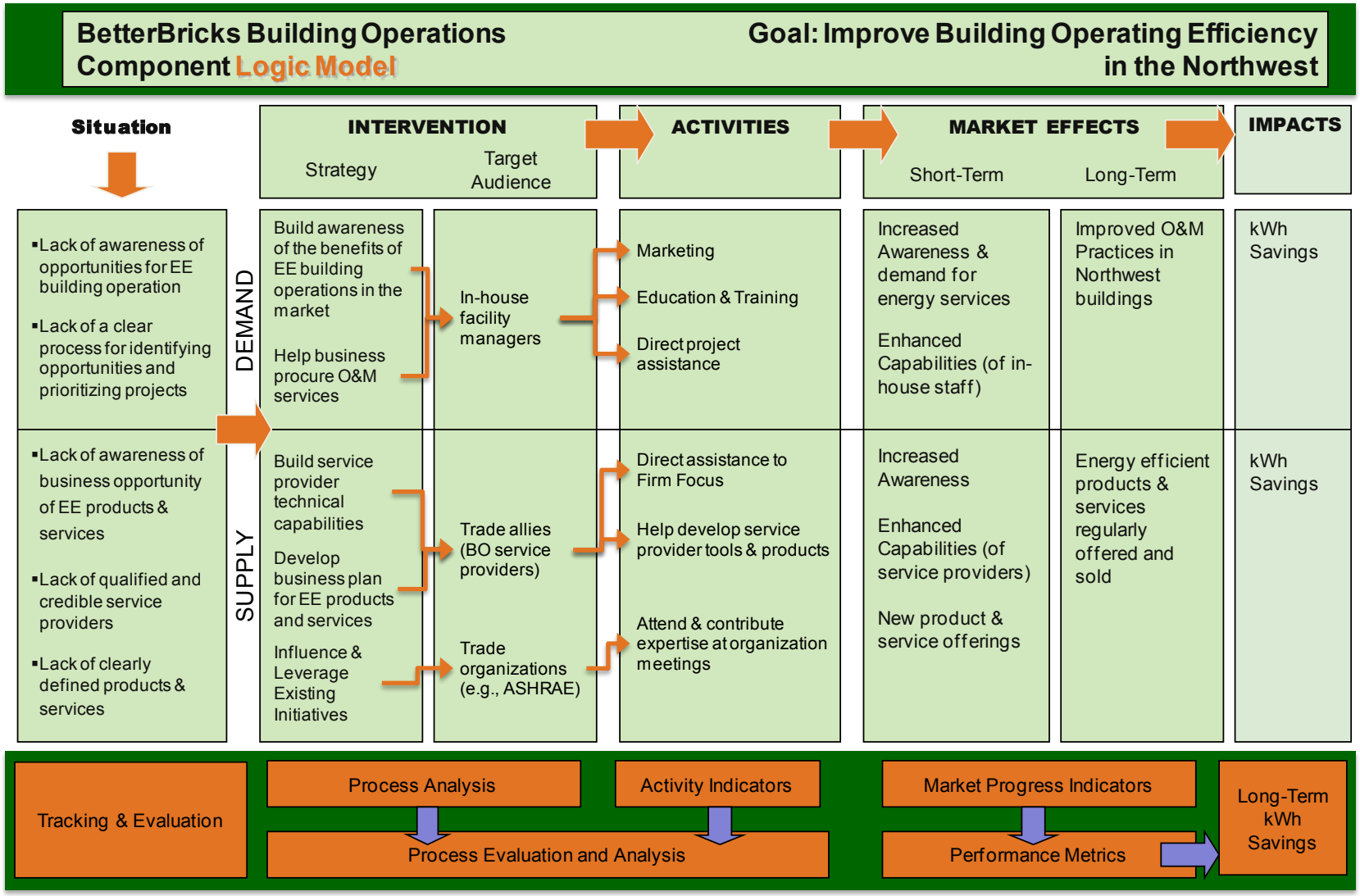


Figure C.4: Simplified Logic Model for BetterBricks Building Operations (BOPS) Cross-Cutting Market



D ACE MODEL ASSUMPTION VALIDATIONS

HEALTHCARE

This section presents the results of our efforts to validate assumptions used in the Alliance Cost Effectiveness (ACE) model for BetterBricks activity in the Hospitals and Healthcare market. Our efforts constitute only first steps in a complete validation of the ACE model assumptions, as lack of BetterBricks and regional data, coupled with a short project duration, limited our ability to validate many of the assumptions.

We use the following abbreviations in Table D.1:

- **D&C** = Design & Construction
- **ID** = Integrated Design
- **PID** = Partial Integrated Design
- **EEM** = Energy Efficiency Measures
- **OH** = Other Healthcare
- **BOps** = Building Operations
- **C.U.** = Capital Upgrades

Table D.1 identifies two documents included below in this section: *Market Adoption Estimation Approach* (Used in the ACE Review) and *Market Size Estimates* (Used in the ACE Review below). The table also identifies source documents provided to the NEEA evaluation manager under separate cover.

Table D.1: Hospitals (H) and Other Healthcare (OH)

	Input Assumption	Finding	Recommendation	Sources
1	Market size (bldg. square footage) and annual growth • H – 68.0 MMsf in 2004 to 87.4 MM sf in 2020 • OH – 84.7 MMsf in 2004 to 132.3 MMsf in 2020	Our finding is that the latest Northwest Power and Conservation Council (NPCC) estimates/forecasts of hospital/healthcare floor space are: • Hospitals – 64.3 MMsf in 2005 and 80.6 MM sf in 2020 • Other Healthcare – 62.2 MMsf in 2005 and 84.3 MMsf in 2020 *Other Healthcare* definition is based on NAICS code definition in model documentation, excluding residential facilities.	We recommend that NEEA update the Hospitals estimates to match the current Power Council estimates, which reflect a slow-down from prior estimates of new construction, likely attributable to the recession.	NPCC updated forecast commercial floor space data, provided by Massoud Jourabchi in November 2009. *See below: Market Size Estimates* (Used in ACE Review) Analysis calculations: *NWCouncilForecastNov09-1.xls*
2	Average energy utilization index (EUI) Electric – Post 2004 • H: 25.3 kWh/sf • OH: 14.3 kWh/sf Electric – Pre 2005 • H: 31.4 kWh/sf-yr • OH: 14.3 kWh/sf-yr Gas – (assumptions not currently used, but may be used in the future) • H: 154.1 kBtu/sf • OH: 154.1 kBtu/sf	Our finding is that the most current applicable values are the 2009 CBSA (Core Based Statistical Area) median estimates: Electric - • H: 17.9 kWh/sf • OH: 30.2 kWh/sf In the near-term, we believe the median estimates are more appropriate than mean because the program likely does not treat the highest use buildings. If vintage data were available in the Commercial Tracking System (CTS), we would suggest using median EUIs by vintage.	In the near-term, we recommend updating the EUI estimates to the current 2009 CBSA median estimates. We recommend that the CTS record vintage, the model apply 2009 CBSA median estimates by vintage, and then apply vintage weights from the CTS. We recommend using a combined fuel EUI in the future to account for changes in end-use fuel saturations over time, as a result of the change in building efficiency and fuel-type choices.	2009 CBSA Update Analysis explanation and tables: *Hospitals EUI.doc*

Continued

	Input Assumption	Finding	Recommendation	Sources
3	Linking Gas Savings Estimates to Electric Savings Percent Application and percent Gas to Electricity Savings (when converted to kWh, for applicable measures) by Program Building Operations • BOps 20% 21% • Procurement 0% 21% • C.U. 100% 21% Design and Construction • ID 100% 100% • PID 100% 100% • EEM 50% 100%	See Input 13 To date insufficient data are available from impact validation efforts regarding proportion of gas to electricity savings in hospital building operations. Interviews with BetterBricks contractors suggest the proportion of savings should equal, at a first approximation, the proportion of fuel use (expressing both gas and electricity in Btus). The current D&C research—for a sample of 9 projects, including 1 medical building—suggests deeper savings for gas than electricity. When both electricity and gas savings are denoted in Btus, electricity counts for 34% of this total and gas savings account for 66%.	Change assumptions according to findings from current research.	*See below: Design and Construction*

Continued

	Input Assumption	Finding	Recommendation	Sources
4	Background adoption (naturally occurring conservation) rate Logistic curve used to forecast baseline • 2008: 7.5% of Total Regional Savings • 2023: 50% of Total Regional Savings • 2030: 100% of Total Regional Savings	We find that: 491,393 square feet of newly constructed hospital/healthcare space is projected by the U.S. Green Building Council (USGBC) to be LEED Silver or better in 2009. USGBC defines *Health* as healthcare buildings that do not list residential. This estimate equals 29% of the projected new construction market for H/OH in 2009 (see Input 1). Reviewing the small sample of impact evaluation D&C sites (includes one OH facility), we found about half of the sites that received BetterBricks D&C measures also were LEED Silver or better. Thus, there is overlap between LEED and BetterBricks (see Appendix G). There are no currently available data to validate BOps background adoption estimates.	We recommend that NEEA confirm that LEED's sector definitions are consistent with the model definitions. NEEA should assess the extent of overlap between D&C and LEED for a larger sample that includes more H/OH observations. NEEA should assess the extent to which BetterBricks D&C efforts were critical to meeting LEED. In the absence of evidence of criticality, increase the background adoption D&C adoption rate to 15% (50% x 29%) for hospitals/healthcare in 2009. Assessing the background rate of BOps adoption awaits efforts underway to clarify key performance indicators for BOps and to survey the market concerning these indicators. In the long-term, we recommend that NEEA conduct regular market surveys to assess total regional market adoption and attribution (that is, for buildings that have adopted efficiency, determine whether their actions were influenced by NEEA, local utilities, other influences, or occurred on their own) and update the background adoption estimates using the survey results.	USGBC – LEED projected Silver, Gold and Platinum certifications by year for Montana, Idaho, Oregon and Washington Analysis calculations: *sum LEED.xls*" *See below: Design and Construction*

Continued

	Input Assumption	Finding	Recommendation	Sources
5	Building Operations: Annual adoption rate: • H: 3% to 10% • OH: 1% to 3%	We note that the Hospitals ACE model and Offices ACE model differ in the structuring of assumptions for Input 5. For 2009, BetterBricks market adoption is estimated at: • H: 950,000 square feet • OH: 700,000 square feet When combined with the latest 2009 sector population estimates (see Input 1), the fraction of existing square footage penetrated is estimated at: • H: 0.9% • OH: 0.7%	In the near-term, we recommend that NEEA update its market adoption estimates with the CTS adoption estimates reported here, combined with NEEA's estimates of local program adoption. In the long-term, we recommend that NEEA improve the CTS to accurately record BOps efficiency activities at sites, year activity initiated (and, for C.U., completed), and attrition (drop out). Project completion and attrition rates will improve the BetterBricks market adoption estimates going forward. See long-term recommendation for Input 4. NEEA should update total regional market adoption using survey results.	CTS See Input 1 *See below:"Market Adoption Estimation Approach* (Used in ACE Reviews) Analysis calculations: • Market Adoption Estimation.xls • Attrition Rate Estimation 2009.xls

Continued

	Input Assumption	Finding	Recommendation	Sources
6	Building Operations: Maximum achievable adoption rate by 2020 H: • BOps: 67% • Procurement: 67% • C.U.: 55% OH: • BOps: 22% • Procurement: 22% • C.U.: 18%	We note that the Hospitals ACE model and Offices ACE model differ in the structuring of assumptions for Input 6. The recommendation for Input 5 gives the 2009 market adoption (the lower bound of the current range). • In order to reach 67% adoption by 2020, starting from a base of 3% (H), the annual adoption rate must increase by 11% each year (that is, from 3% in 2009, to 3.3% in 2010, to 3.8% in 2011, up to 9.5% in 2018). • To reach 55% adoption by 2020, starting from a base of 3% (H), the annual adoption rate must increase by 7% each year. • To reach 22% by 2020, starting from a base of 1% (OH), the annual adoption rate must increase by 10% each year. • To reach 18% by 2020, starting from a base of 1% (OH), the annual adoption rate must increase by 7% each year. *Cont.*	We recommend NEEA reduce its 2020 maximum achievable adoption rate, although we do not have sufficient data to suggest alternative percentages.	*Additional Opportunities for Energy Efficiency in New Hampshire,* prepared for the New Hampshire Public Utilities Commission by GDS Associates, Inc.

Continued

Input Assumption	Finding	Recommendation	Sources
6	Some of these assumptions seem overly optimistic. And note that while the above analyses assume adoptions in 2009 of 3% (H) and 1% (OH), these are the recommendations for Input 5. According to CTS, the 2009 values are less than 1% (0.9% H and 0.7% OH). While no data are available with direct bearing on BOps adoption rates, some inferences might be drawn from a 2009 technical potential study by GDS Associates for the New Hampshire Public Utilities Commission. This study estimates, for the nonresidential sector, market potential for C.U. savings equal to 31% of the technical potential.		

Continued

	Input Assumption	Finding	Recommendation	Sources
7	Design & Construction: Annual adoption rate • 10% to 33% for hospitals • 3% to 20% for other healthcare facilities The Design and Construction adoption rates correspond to an annual change in total floor space and, therefore, are not cumulative.	For 2009, BetterBricks market adoption estimates are: FID: • H: 0 • OH: 388,001 square feet PID: • H: 0 • OH: 0 EE Measures: • H: 1,103,052 square feet • OH: 0 When combined with the latest 2009 sector new construction estimates (see Input 1), the fraction of new square footage penetrated is estimated at: FID: • H: 0% • OH: 25% PID: • H: 0% • OH: 0% EE Measures: • H: 130% • OH: 0%	In the near-term, we recommend that NEEA update its market adoption estimates in consideration of the CTS adoption estimates reported here, NEEA's estimates of local program adoption, and the estimates of LEED adoption contained in this table. In the long-term, we recommend that NEEA improve the CTS to accurately record D&C projects, including strategies, year initiated, and year completed or attrition (drop out). Project completion and attrition rates will improve the BetterBricks market adoption estimates going forward. See long-term recommendation for Input 4.	CTS See Input 1 *See below: Market Adoption Estimation Approach* (Used in ACE Review) Analysis calculations: • Market Adoption Estimation.xls • Attrition Rate Estimation.xls

Continued

	Input Assumption	Finding	Recommendation	Sources
8	Adoption rate of new codes/standards Every 5 years, the adoption rate starts over at year-1 levels, with increments of 25% each succeeding year 85% compliance factor	Our finding is that current Northwest code savings studies do not have sufficient detail to address the adoption rates and compliance factor assumptions in the model.	We recommend that NEEA consider incorporating adoption rates and compliance factors into future Northwest code savings studies to assess these inputs.	
9	Reduction in EUI because of new codes/standards: 25% in 2011, by 10% every subsequent 5 years	We estimate that hospital whole-building savings associated with code between 2005 and 2011 are 8%. This estimate excludes some measures that code will address, so the savings should be higher than 8%, though lower than savings for other buildings (offices are 14%).	We recommend that NEEA assume that code savings are 11% (8% + (14% - 8%) / 2) of the total hospital electric EUI. We recommend that NEEA update these assumptions as the region finalizes its 2010 codes and as new code savings studies are conducted.	*Non-Residential Energy Savings From Northwest Energy Code Changes 2005-2008* (NEEA) December 4, 2009 • Montana IECC2003-IECC2006 increment: Adoption is assumed (savings from simulations for document referenced above before MT failed to adopt in 2008). • Idaho/Montana IECC2006-2009 adoption: Adoption assumed. Savings estimated arbitrarily, assumed to be 4%. • WA 2010: Savings from public testimony and NEEA-funded code savings estimates. • OR 2010: Savings assumed to be the same rate as WA code. Analysis calculations: *Code savings.xls*

Continued

	Input Assumption	Finding	Recommendation	Sources
10	Plug Loads ramp up: • 2011: 30% of EUI not affected by codes • 2016: 40% of EUI not affected by codes • 2021: 50% of EUI not affected by codes • 2026: 60% of EUI not affected by codes • 2031: 70% of EUI not affected by codes	Our finding for healthcare: 18% of EUI is not affected by codes.	Our recommendation is to lower the current assumption of 50% to 18% for hospitals/ healthcare of EUI not affected by codes. For 2011 onward, revisit this assumption as new data are available.	CEUS Itron March 2006 (plug + misc eq. + process/ total from Table E3)
11	Ramp-up period for Building Ops. Measures: • 4 years, 7 years for Capital Upgrades • 1 year measure savings lag	We do not have any data with which to assess these assumptions.	We recommend that NEEA improve the CTS to capture ramp-up rate and that future impact evaluations be designed, where possible, to address savings as a dynamic stream over several years.	
12	Ramp-up period for D&C measures: • Concurrent (no ramp-up period) • 1 year measure savings lag	See Input 11.		
13	Savings rates (baseline is the 2005 EUI): • BOps: 10% • Procurement : 4% • C.U.: 15% • Integrated Design: 30% • Partial Integrated Design: 20% • Energy Efficiency Measures: 15% *Lag implementation by one year*	To date, insufficient data are available from impact validation efforts to estimate either building operations or D&C savings for hospitals. The *Draft Sixth Northwest Power Plan* produced by the NPCC provides savings estimates for retrocommissioning of 6% of electricity consumption and 5.3% of gas consumption.	For the NPCC, in support of its *Sixth Power Plan*, Research Into Action reviewed impact studies obtained from contacts across the country. That review found a handful of studies that might be relevant to ACE savings assumptions regarding C.U. and D&C energy efficiency measures. NEEA might want to pursue this resource.	*Draft Sixth Northwest Power Plan*, Northwest Power and Conservation Council Research Into Action deliverable to the NPCC

Continued

	Input Assumption	Finding	Recommendation	Sources
14	Consumer Bldg Ops. Management costs Resource Conservation Manager: • 1/4 FTE for years 1-3 • 1/12 FTE for years 4-15 RCM • 1 FTE = $80k Strategic Energy Manager: • 1/20 FTE all years • exclude Capital Upgrades • 1 FTE = $120k	We do not have any data with which to assess these assumptions.		
15	Consumer D&C Management costs Resource Conservation Manager: • 1/4 FTE for years 1-3 • 1/12 FTE for years 4-15 RCM • 1 FTE = $80k Strategic Energy Manager: • 1/20 FTE all years • exclude EE measures for OH • 1 FTE = $120k	We do not have any data with which to assess these assumptions.		
16	Consumer D&C first costs (Net) • ID: $0.99 • PID: $1.96 • EEM: $0.51 – H and $0.32 OH	We do not have any data with which to assess these assumptions.	For the NPCC, in support of its Sixth Power Plan, Research Into Action reviewed impact studies obtained from contacts across the country. That review found a handful of studies that might be relevant to ACE cost assumptions regarding C.U. and D&C energy efficiency measures. NEEA might want to pursue this resource.	Research Into Action deliverable to NPCC

Continued

	Input Assumption	Finding	Recommendation	Sources
17	Consumer Bldg. Ops. first costs (Net) • BOps: $0.27 • C.U.: $0.35 – H and $0.11 OH • Procurement: $0	We do not have any data with which to assess these assumptions.	For the NPCC, in support of its Sixth Power Plan, Research Into Action reviewed impact studies obtained from contacts across the country. That review found a handful of studies that might be relevant to ACE cost assumptions regarding C.U. and D&C energy efficiency measures. NEEA might want to pursue this resource.	Research Into Action deliverable to NPCC
18	Time to market transformation: 15 years	We do not have any data with which to assess this assumption.		
19	Price of electricity and load shape	We did not assess this assumption.		
20	Line losses	We did not assess this assumption.		
21	Local incentives – 65% of regional savings	We do not have any data with which to assess this assumption.	We recommend that NEEA collect information from NPCC and from the Bonneville Power Administration (BPA), Energy Trust of Oregon, and other major Northwest energy efficiency program administrators to determine local program adoption. Also, attempt to determine the extent of overlap with LEED for D&C measures.	Review of major Northwest programs such as Energy Trust and BPA through websites and interviews
22	Building Operations Target Market Size aMWs available, except for the market energy penetrated by ID within five years	We are unable to use CTS to assess this assumption, based on incomplete data (vintage is not recorded).	We recommend that NEEA improve the CTS by collecting vintage of all buildings in order to assess this model assumption.	

Continued

	Input Assumption	Finding	Recommendation	Sources
23	Measure life 30 years for Design and Construction and 8 years for Building Operations measures. Building Operations should be 5 years; procurement should be 5 years (lamps 4, chiller 10-12 years, computers 4, rooftop equipment 15 years). Capital Upgrades is 15 to 20 years. Using an average of the measures, the measure life for Building Operations is 8 years.	We did not assess these assumptions.	A literature review might yield information relevant to assessing these assumptions.	

OFFICE REAL ESTATE

This section presents the results of our efforts to validate assumptions used in the Alliance Cost Effectiveness (ACE) model for BetterBricks activity in the Office Real Estate market. Our efforts constitute only first steps in a complete validation of the ACE model assumptions, as lack of BetterBricks and regional data, coupled with a short project duration, limited our ability to validate many of the assumptions.

We use the following abbreviations in Table D.2:

- **D&C** = Design & Construction
- **ID** = Integrated Design
- **PID** = Partial Integrated Design
- **EEM** = Energy Efficiency Measures
- **M/S** = Medium/Small Offices
- **BOps** = Building Operations
- **C.U.** = Capital Upgrades

Table D.2 identifies two documents included in this report: *Market Adoption Estimation Approach Used in ACE Review* and *Market Size Estimates Used in ACE Review*. The table also identifies source documents provided to the NEEA evaluation manager under separate cover.

Table D.2: Offices Large and Medium/Small (M/S)

	Input Assumption	Finding	Recommendation	Source
1	Market size (bldg. square footage) and annual growth • Large – 191.7 MMsf in 2005 to 297.3 MMsf in 2020 • M/S – 191.7 MMsf in 2005 to 297.3 MMsf in 2020 • Assuming owner-occupied is 30% of large and M/S • Large>=100,000 square feet	Our finding is that the latest Northwest Power and Conservation Council (NPCC) estimates/forecasts of office floor space are: • Large – 193.5 MMsf in 2005 and 247.3 MMsf in 2020 • M/S – 189.4 MMsf in 2005 and 242.1 MMsf in 2020	We recommend that NEEA update the Office estimates to match the current Power Council estimates, which reflect a slow-down from prior estimates of new construction, likely attributable to the recession.	NPCC updated forecast commercial floor space data, provided by Massoud Jourabchi in November 2009. *See below: Market Size Estimates* (Used in ACE Review) Analysis calculations: *NWCouncilForecastNov09-1.xls*
2	Initial (2005) average energy utilization index (EUI) Electric – • 17.7 kWh/sf for Large • 15.2 kWh/sf for M/S Gas – (assumptions not currently used, but may be used in the future) • 84.68 kBtu/sf for large offices • 78.54 kBtu/sf for M/S offices No difference in EUI by ownership type	Our finding is that the most current applicable values are the 2009 CBSA (Core Based Statistical Area) median estimates: Electric - • L: 16.7 kWh/sf • M/S: 15.1 kWh/sf In the near-term, we believe the median estimates are more appropriate than mean because the program likely does not treat the highest use buildings. If vintage data were available in the Commercial Tracking System (CTS), we would suggest using median EUIs by vintage.	In the near-term, we recommend updating the EUI estimates to the current 2009 CBSA median estimates. We recommend that the CTS record vintage, the model apply 2009 CBSA median estimates by vintage, and then apply vintage weights from the CTS. We recommend using a combined fuel EUI in the future to account for changes in end-use fuel saturations over time, as a result of the change in building efficiency and fuel-type choices.	2009 CBSA Update Analysis explanation and tables: *Offices EUI.doc*

Continued

	Input Assumption	Finding	Recommendation	Source
3	Linking Gas Savings Estimates to Electric Savings Percent Application and percent Gas to Electricity Savings (when converted to kWh, for applicable measures) by Program Building Operations • BOps 20% 21% • Procurement 0% 21% • C.U. 100% 21% Design and Construction • ID 100% 100% • PID 100% 100% • EEM 50% 100%	See Input 13 To date insufficient data are available from impact validation efforts regarding proportion of gas to electricity savings in office building operations. Interviews with BetterBricks contractors suggest the proportion of savings should equal, at a first approximation, the proportion of fuel use (expressing both gas and electricity in Btus). The current D&C research suggests deeper savings for gas than electricity. When both electricity and gas savings are denoted in Btus, electricity counts for 34% of this total and gas savings account for 66%.	Change assumptions according to findings from current research.	*See below: Design and Construction*

Continued

	Input Assumption	Finding	Recommendation	Source
4	Background adoption (naturally occurring conservation) rate Logistic curve used to forecast baseline • 2008: 7.5% of Total Regional Savings • 2023: 50% of Total Regional Savings • 2030: 100% of Total Regional Savings	We find that: 9,863,927 square feet of newly constructed office space is projected to be LEED Silver or better in 2009 USGBC defines Offices = non-governmental offices (primary category) This estimate equals 136% of the projected new construction for offices in 2009 (see Input 1). Reviewing the small sample of impact evaluation D&C sites (includes four office facilities), we found about half of the sites that received BetterBricks D&C measures also were LEED Silver or better. Thus, there is overlap between LEED and BetterBricks (see Appendix G) There are no currently available data to validate BOps background adoption estimates.	We recommend that NEEA confirm that LEED's sector definitions are consistent with the model definitions. NEEA should assess the extent of overlap between D&C and LEED for a larger sample that includes more office observations. NEEA should assess the extent to which BetterBricks D&C efforts were critical to meeting LEED. In the absence of evidence of criticality, increase the background adoption D&C adoption rate to 50% (100% x 50%) for offices. Assessing the background rate of BOps adoption awaits efforts underway to clarify key performance indicators for BOps and to survey the market concerning these indicators. In the long-term, we recommend that NEEA conduct regular market surveys to assess total regional market adoption and attribution (that is, for buildings that have adopted efficiency, determine whether their actions were influenced by NEEA, local utilities, other influences, or occurred on their own) and update the background adoption estimates using the survey results.	USGBC – LEED projected Silver, Gold and Platinum certifications by year for Montana, Idaho, Oregon and Washington Analysis calculations: *sum LEED.xls*" *See below: Design and Construction*

Continued

	Input Assumption	Finding	Recommendation	Source
5	Building Operations: Annual adoption rate: Large / M/S • BOps 1-10% / 1-10% • Procurement 1-10% / 1-10% • C.U. 3-7% / 3-7% Same rates by ownership type	We note that the Offices ACE model and Hospitals ACE model differ in the structuring of assumptions for Input 5. For 2009, BetterBricks market adoption estimates for offices are 0 square feet/0%, as there are no projects completed in 2009 or estimated as completed in 2009 per the CTS database. 2009 BetterBricks market adoption for other building types (that is, all commercial space net offices and hospitals/ health care) are: • 40,010 square feet When combined with the latest 2009 sector new construction estimates (see Input 1), the fraction of new square footage penetrated for other buildings is estimated at: • 0.001% (See *market adoption estimation approach.doc* for a description of the approach.)	In the near-term, we recommend that NEEA update its market adoption estimates to be the lower bound of its current assumed range, unless estimates of local program adoption suggest otherwise. In the long-term, we recommend that NEEA improve the CTS to accurately record BOps efficiency activities at sites, year activity initiated (and, for C.U., completed), and attrition (drop out). Project completion and attrition rates will improve the BetterBricks market adoption estimates going forward. See long-term recommendation for Input 4. NEEA should update total regional market adoption using survey results.	CTS See Input 1 *See below:"Market Adoption Estimation Approach* (Used in ACE Reviews) Analysis calculations: • Market Adoption Estimation.xls • Attrition Rate Estimation 2009.xls

Continued

	Input Assumption	Finding	Recommendation	Source
6	Building Operations: Maximum achievable adoption rate by 2018 Large / M/S • BOps 68% 68% • Procurement 68% 68% • C.U. 55% 55% Same rates by ownership type	We note that the Offices ACE model and Hospitals ACE model differ in the structuring of assumptions for Input 6. The recommendation for Input 5 gives 2009 market adoption (the lower bound of the current range). In order to reach 68% adoption by 2018, starting from a base of 1%, the annual adoption rate must increase by 39% each year (that is, from 1% in 2009 to 1.39% in 2010 to 1.9% in 2011, up to 19.4% in 2018). These assumptions seem overly optimistic. For C.U., to reach 55% adoption starting from a base of 3%, the annual adoption rate must increase by 13% each year. This seems more realistic, yet note that, while 3% is the value recommended for Input 5, the adoption to date as tracked in CTS is miniscule. While no data are available with direct bearing on BOps adoption rates, some inferences might be drawn from a 2009 technical potential study by GDS Associates for the New Hampshire Public Utilities Commission. This study estimates, for the nonresidential sector, market potential for C.U. savings equal to 31% of the technical potential.	We recommend NEEA reduce its 2020 maximum achievable adoption rate, although we do not have sufficient data to suggest alternative percentages.	*Additional Opportunities for Energy Efficiency in New Hampshire,* prepared for the New Hampshire Public Utilities Commission by GDS Associates, Inc.

Continued

	Input Assumption	Finding	Recommendation	Source
7	Design & Construction: Annual adoption rate Large / M/S • I.D. 5-12% / 2-4% • P.I.D. 5-14% / 6-7% • E.E.M 18-20% / 18-20% Same rates by ownership type The Design and Construction adoption rates correspond to an annual change in total floor space and, therefore, are not cumulative.	For 2009, BetterBricks market adoption estimates are: FID: • L: 0 • M/S: 199,677 square feet PID: • L: 599,999 square feet • M/S: 37,323 square feet EE Measures: 0 When combined with the latest 2009 sector new construction estimates (see Input 1), the fraction of new square footage penetrated is estimated at: FID: • L: 0% • M/S: 6% PID: • L: 17% • M/S: 1% EE Measures: 0% 2009 BetterBricks market adoption for other building types (i.e., all commercial space net offices and hospitals/healthcare): • FID: 1,332,683 square feet • PID: 1,390,303 square feet • EE Measures: 267,274 *Cont.*	In the near-term, we recommend that NEEA update its market adoption estimates in consideration of the CTS adoption estimates reported here, NEEA's estimates of local program adoption, and the estimates of LEED adoption contained in this table. In the long-term, we recommend that NEEA improve the CTS to accurately record D&C projects, including strategies, year initiated, and year completed or attrition (drop out). Project completion and attrition rates will improve the BetterBricks market adoption estimates going forward. See long-term recommendation for Input 4.	CTS See Input 1 *See below: Market Adoption Estimation Approach* (Used in ACE Review) Analysis calculations: • Market Adoption Estimation.xls • Attrition Rate Estimation.xls

Continued

	Input Assumption	Finding	Recommendation	Source
7		When combined with the latest 2009 sector new construction estimates (see input 1), the fraction of new square footage penetrated is estimated at: • FID: 4% • PID: 4% • EE Measures: 0.7%		
8	Adoption rate of new codes/standards Increments of 25% each succeeding year 85% compliance factor	Our finding is that current Northwest code savings studies do not have sufficient detail to address the adoption rates and compliance factor assumptions in the model.	We recommend that NEEA consider incorporating adoption rates and compliance factors into future Northwest code savings studies to assess these inputs.	

Continued

	Input Assumption	Finding	Recommendation	Source
9	Reduction in EUI because of new codes/standards: 25% in 2011, by 10% every subsequent 5 years	We estimate that office whole-building savings associated with code between 2005 and 2011 for offices are 14%.	We recommend that NEEA assume that code savings are 14% of the total office electric EUI. We recommend that NEEA update these assumptions as the region finalizes its 2010 codes and as new code savings studies are conducted.	*Non-Residential Energy Savings From Northwest Energy Code Changes 2005-2008* (NEEA) December 4, 2009 • Montana IECC2003-IECC2006 increment: Adoption is assumed (savings from simulations for document referenced above before MT failed to adopt in 2008). • Idaho/Montana IECC2006-2009 adoption: Adoption assumed. Savings estimated arbitrarily, assumed to be 4%. • WA 2010: Savings from public testimony and NEEA-funded code savings estimates. • OR 2010: Savings assumed to be the same rate as WA code. Analysis calculations: *Code savings.xls*
10	Plug Loads ramp up: • 2011: 30% of EUI not affected by codes • 2016: 40% of EUI not affected by codes • 2021: 50% of EUI not affected by codes • 2026: 60% of EUI not affected by codes • 2031: 70% of EUI not affected by codes	Our finding for offices: 24% of EUI is not affected by codes.	Our recommendation is to lower the current assumption of 50% to 24% for offices of EUI not affected by codes. For 2011 onward, revisit this assumption as new data are available.	CEUS Itron March 2006 (plug + misc eq. + process/ total from Table E3)

Continued

	Input Assumption	Finding	Recommendation	Source
11	Ramp-up period for Building Ops. Measures: • 4 years, 7 years for Capital Upgrades • 1 year measure savings lag	We do not have any data with which to assess these assumptions.	We recommend that NEEA improve the CTS to capture ramp-up rate and that future impact evaluations be designed, where possible, to address savings as a dynamic stream over several years.	
12	Ramp-up period for D&C measures: • Concurrent (no ramp-up period) • 1 year measure savings lag	See Input 11.		
13	Savings rates (baseline is the 2005 EUI): Building Operations: • BOps: 10% • Procurement: 4% • C.U.: 15% Design and Construction: • ID: 50% (2006) 80% (2020) • PID: 30% (2006) 50% (2020) • EEM: 15% *Lag implementation by one year*	The current report finds building operations savings for offices of 6.7% or less, depending on the specific BOPs activity (tune-up, Service Assistant, POES). The *Draft Sixth Northwest Power Plan* produced by the NPCC provides savings estimates for retrocommissioning of 6% of electricity consumption and 5.3% of gas consumption. *Appendix G: Design and Construction* supports an assumption of 22% for buildings receiving LEED Silver, Gold, or Platinum certification. This estimate was derived using a realization rate calculated from a sample of four buildings. No other data are available to estimate D&C savings.	Use a savings rate for BOps of 7%. Use a savings rate of 25% for Integrated Design. Savings for Partial Integrated Design are likely considerably less than those for Integrated Design. Future evaluations should estimate LEED (or integrated design) savings rates and realization rates from random samples of sufficient numbers of buildings to provide the desired accuracy. For the NPCC, in support of its *Sixth Power Plan*, Research Into Action reviewed impact studies obtained from contacts across the country. That review found a handful of studies that might be relevant to ACE savings assumptions regarding C.U. and D&C energy efficiency measures. NEEA might want to pursue this resource.	The current evaluation report. *Draft Sixth Northwest Power Plan*, Northwest Power and Conservation Council Research Into Action deliverable to the NPCC

Continued

	Input Assumption	Finding	Recommendation	Source
14	Consumer Bldg Ops. Management costs • Large: 1/20 FTE SM = $3,750 • M/S: 1/50 FTE SM = $1,500 • Nothing for Capital Upgrades	We do not have any data with which to assess these assumptions.		
15	Consumer D&C Management costs • Large: 1/10 FTE SM = $7,500 (years 1-3, then $6,250) • M/S: 1/25 FTE SM = $3,000 • Nothing for E.E.M.	We do not have any data with which to assess these assumptions.		
16	Consumer Bldg. Ops. first costs • BOps: $0.27/sf • Procurement: net to zero • C.U.: $0.11/sf – Large • C.U.: $0.16/sf – S/M	We do not have any data with which to assess these assumptions.	For the NPCC, in support of its Sixth Power Plan, Research Into Action reviewed impact studies obtained from contacts across the country. That review found a handful of studies that might be relevant to ACE cost assumptions regarding C.U. and D&C energy efficiency measures. NEEA might want to pursue this resource.	Research Into Action deliverable to NPCC
17	Consumer D&C first costs ID: • Hard Cost: $0.00/sf • Soft Cost: $0.97 (begins ramping down by 20% each year starting in 2008) PID: • Hard Cost: $1.19/sf • Soft Cost: $0.54 (begins ramping down by 20% each year starting in 2008) EEM • Large: $0.44/sf • M/S: $0.28/sf	We do not have any data with which to assess these assumptions.		

Continued

	Input Assumption	Finding	Recommendation	Source
18	Time to market transformation: 15 years	We do not have any data with which to assess this assumption.		
19	Price of electricity and load shape	We did not assess this assumption.		
20	Line losses	We did not assess this assumption.		
21	Local incentives – 65% of regional savings	We do not have any data with which to assess this assumption.	We recommend that NEEA collect information from NPCC and from the Bonneville Power Administration (BPA), Energy Trust of Oregon, and other major Northwest energy efficiency program administrators to determine local program adoption. Also, attempt to determine the extent of overlap with LEED for D&C measures.	Review of major Northwest programs such as Energy Trust and BPA through websites and interviews
22	Building Operations Target Market Size aMWs available except for the market energy penetrated by ID within five years	We are unable to use CTS to assess this assumption, based on incomplete data (vintage is not recorded).	We recommend that NEEA improve the CTS by collecting vintage of all buildings in order to assess this model assumption.	
23	Measure life 30 years for Design and Construction and 8 years for Building Operations measures. Building Operations should be 5 years; procurement should be 5 years (lamps 4, chiller 10-12 years, computers 4, rooftop equipment 15 years). Capital Upgrades is 15 to 20 years. Using an average of the measures, the measure life for Building Operations is 8 years.	We did not assess these assumptions.	A literature review might yield information relevant to assessing these assumptions.	

ACE VALIDATION METHODOLOGY MARKET ADOPTION ESTIMATE

The following is the market adoption estimation approach used in the ACE review.

Data Sources

- BetterBricks Commercial Tracking System (CTS) extract
- *Northwest Council Forecast Population and New Construction by Sector* (*NWCouncilForecastNov09..xls*, generated by Mike Kennedy with input data provided by Massoud Jourabch, Northwest Power and Conservation Council)

Approach

1. Set completion date for projects that are missing the completion date (82% of projects) by assuming that projects are completed three years after initiation.
2. Map recommended measures to program measure categories (i.e., Design & Construction [D&C]: fully integrated, partially integrated, energy efficiency measures only; Building Operations [BOps]: BOps, capital upgrades, procurement) using the following definitions:
    a. **Fully Integrated Design** (FID): six or more qualified integrated measures[9] in three or more systems[10]
    b. **Partially Integrated Design** (PID): two or more integrated measures, but not enough to meet FID criteria
    c. **Energy Efficiency Measures Only**: any and/or all non-integrated measures, plus up to one integrated measure
    d. **Building Operations** (BOps): CTS does not provide enough information to categorize BOps projects into *BOps* or *capital upgrades*. Therefore, all the BOps projects are reported as *BOps*.
    e. **Procurement**: There are no procurement measures in the database

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[9] In CTS database, a total of 22 unique strategy ideas were recorded in the fields *strat1* through *strat21* (three different daylighting measures were combined into one daylight measure). Of those, all but the following seven measures were considered as integrated measures: efficient electric lighting, lighting controls, occupancy sensors for lighting, efficient HVAC equipment, scheduling/optimization, high efficiency glazing, and insulation beyond code.

[10] The 22 unique measures were categorized into six different categories – *lighting*, *HVAC*, *ventilation*, *glazing*, *insulation*, and *other*. Each of these categories are referred as a system.

3. Estimate the number of projects completed in 2009 (where completion date is 2009), by market sector (i.e., large office buildings, small office buildings, healthcare, hospitals, and other) and measure category (i.e., FID, PID, energy efficiency measures, BOps).
4. Adjust the 2009 completed projects estimates (step 3) for attrition by estimating and applying an attrition rate to account for the fact that not all initiated projects are completed within three years (and there is no way of knowing which projects are incomplete in the database).
    a. Compute the fraction of projects in the CTS that do not have any recommended measures within three years of project initiation for projects initiated between 2003 and 2006, by Hospitals, Offices, Other, and BOps vs. D&C projects.
    b. Arbitrarily divide that fraction in two (since some projects will not have recorded measures that were completed, but it is unknown what fraction) for the estimated attrition rate.
5. Estimate the square footage penetrated in 2009 by multiplying the number of projects (step 4), by the average 2009 project square footage (used since square footage is missing 32% of the time), by market sector (i.e., large office buildings, small office buildings, healthcare, hospitals, and other) and measure category (i.e., FID, PID, energy efficiency measures, and BOps)
6. Calculate the 2009 adoption rate by dividing the 2009 square footage (step 5) penetrated by the total market size, based on the recent Power Council estimates (see input 1).
    a. **BOps Market Size**: 2009 population estimates do not account for prior program adoption.
    b. **D&C Market Size**: 2009 new construction estimate is used, which does not reflect cumulative new construction available for adoption in 2009 (some fraction of which was likely to have been penetrated by the program).

ACE VALIDATION ESTIMATES OF MARKET SIZE

The following are the market size estimates used in the ACE review.

Office

Market Segments Growth in Total Floor Space (MM square feet)

Year	Owner Occupied (Non-governmental)		Non-Owner Occupied (Governmental)		Total	
	Large	Medium/Small	Large	Medium/Small	Large	Medium/Small
2005	193.5	189.4	61.6	60.4	255.1	249.8
2006	198.1	194.0	63.1	61.8	261.3	255.8
2007	201.6	197.4	64.2	62.9	265.9	260.3
2008	205.3	201.0	65.4	64.1	270.7	265.1
2009	208.7	204.3	66.5	65.1	275.2	269.4
2010	214.5	210.0	64.3	63.0	278.8	273.0
2011	218.1	213.5	65.4	64.0	283.5	277.6
2012	221.6	217.0	66.5	65.1	288.1	282.1
2013	225.1	220.4	67.5	66.1	292.6	286.5
2014	228.2	223.5	68.4	67.0	296.7	290.5
2015	231.3	226.5	69.4	67.9	300.7	294.4
2016	234.2	229.3	70.2	68.8	304.5	298.1
2017	237.1	232.2	71.1	69.6	308.2	301.8
2018	240.2	235.2	72.0	70.5	312.2	305.7
2019	243.4	238.3	73.0	71.5	316.4	309.8
2020	247.3	242.1	74.1	72.6	321.4	314.7

Health / Hospitals

Market Segments Growth in Total Floor Space (MM square feet)

Year	Hospitals	Other Health	Total
2004	60.6	133.1	193.6
2005	64.3	137.2	201.5
2006	65.3	140.8	206.2
2007	66.9	143.8	210.7
2008	68.5	146.9	215.4
2009	70.2	150.2	220.3
2010	70.8	152.5	223.3
2011	71.4	155.0	226.5
2012	72.4	158.1	230.5
2013	73.5	161.6	235.1
2014	74.5	165.0	239.5
2015	75.6	168.6	244.2
2016	76.6	171.8	248.4
2017	77.6	175.4	253.0
2018	78.6	179.2	257.8
2019	79.6	182.5	262.1
2020	80.6	185.9	266.4

E SURVEYS AND INTERVIEW GUIDES

We intended the surveys to be no more than 20 minutes in length; in fact, the average time ranged across the markets between 14 and 19 minutes for nonparticipants. Average administration times for participants ranged from approximately 20 to 30 minutes, depending on the detail the respondent chose to provide.

DESIGN AND CONSTRUCTION (D&C) MARKET SURVEY – 9/28/10

Hi, my name is _____ from Research Into Action and I'm calling on behalf of the Northwest Energy Efficiency Alliance BetterBricks program. I am not selling anything. We are talking to architects from a select sample of firms who design commercial office buildings and healthcare facilities in the Pacific Northwest.

IF CONTACT NAME KNOWN: I would like to speak with [Name]

IF CONTACT NAME NOT KNOWN: I would like to speak with the person at this office of your firm who is most familiar with your business in the office and healthcare markets, such as an owner, principal or senior designer. Who would that be?

NAME:

TITLE:

PHONE:

WHEN GET CORRECT PERSON: Hi, my name is __ calling from Research Into Action on behalf of BetterBricks, a program of the Northwest Energy Efficiency Alliance. I am not selling anything. We are doing a survey on design practices, and I am talking to architects to better understand the way in which office and healthcare buildings in the Pacific Northwest are designed.

Your participation in this study is very important, and the results of this research will guide many professional development activities targeted to architects in the Northwest over the next five years. Your responses are completely confidential.

If needed: Appointment date and time:_____

[IF ASKED] We would be happy to send you an executive summary for the results from this study, and the full study will be published on NEEA's website in early 2011.

SC1. Before we begin, I'd like to confirm that your organization is involved in the architectural or design aspect of commercial office buildings or healthcare facilities in the Pacific Northwest?

1. Yes, involved
2. No, not involved IF NOT, THANK AND TERMINATE

SC2. We would like information about your firm's design practices for commercial office buildings and/or healthcare facilities in the Pacific Northwest. Would you be able to provide us information on your work in these areas?

1. Yes
2. No ==> Is there another senior person at your firm responsible for commercial office or healthcare projects with whom we might speak? IF NOT, THANK AND TERMINATE

About the Contact

Q1. Would you please tell me your title?

Q6. About how many new or renovated office and healthcare buildings in the Pacific Northwest have you been personally involved in designing since the beginning of 2008 (including those you are working on now)? _____ (Range 0-97)

Q7. And how many square feet did those new or renovated buildings represent? _____ (Range 1-1,000,000)

Q7a (If Q7=D/K) Would you say those new or renovated buildings were more than or less than 50,000 square feet?

1. More
2. Less

SC2. (IF Q6 is less than 3 AND Q7 is less than 50,000 square feet or Q7a =2) We are talking to architects who have designed at least 3 new commercial or institutional projects or a total of 50,000 square feet in the Pacific Northwest since 2008. Is there another senior person at your firm who might have such experience? IF NOT, THANK AND TERMINATE.

About The Firm

Q17. How many offices does your firm have in the four states of the Pacific Northwest? [If necessary: Washington, Oregon, Idaho, and Montana] (Range 1-97)

Q18. How many employees work at your location? Would you say…

1. Less than 10,
2. 10-24,
3. 25 or more,

(If Q18=1) Thank you for your time, but we are looking to speak with organizations with 10 or more employees. Have a good day. (TERMINATE)

Q19. And how many of those are architects? (Range 1-997)

Thinking about all the projects in the Pacific Northwest that your office was involved in since the beginning of 2008--not just offices and healthcare--I'm going to ask you to give me your best estimate of the percentage breakdown of that square footage for several criteria: [IF SF NOT KNOWN, JUST IDENTIFY THE MARKETS IN WHICH THE FIRM HAS DESIGNED BUILDINGS BY ENTERING "101"]

What percent of the overall square footage was for buildings located in:

Q21. Washington (Range 0-100, 101=DK, but have buildings in this market, 102=DK)

Q22. Oregon (Range 0-100, 101=DK, but have buildings in this market, 102=DK)

Q24. Idaho (Range 0-100, 101=DK, but have buildings in this market, 102=DK)

Q25. Montana (Range 0-100, 101=DK, but have buildings in this market, 102=DK)

What percent of the overall square footage was for buildings in the following sectors?:

Q27. Hospital/medical/medical offices (Range 0-100, 101=DK, but have buildings in this sector, 102=DK)

Q28. Office Buildings (government and private) (Range 0-100, 101=DK, but have buildings in this sector, 102=DK)

Q29. K-12 schools (Range 0-100, 101=DK, but have buildings in this sector, 102=DK)

What percentage of the overall square footage was for buildings by the following project type?: NOTE; IF THESE DO NOT ADD TO 100 PERCENT, ASK THE RESPONDENT TO RE-ESTIMATE

Q30. Owner occupied _____%

Q31. Developer-built-to-lease _____%

What percentage of the overall square footage was for buildings by the following project type?: NOTE; IF THESE DO NOT ADD TO 100 PERCENT, ASK THE RESPONDENT TO RE-ESTIMATE

Q32. Design-build _____%

Q33. Design-bid-build _____%

EUI, ES, Goals, Studies, Plans

Thank you for that background information. Now I have questions on your business practices. These questions explore your practices with all of your projects since 2008. [If needed, "not just your office and healthcare projects."]

Q34. Do any of your projects have written energy efficiency goals?

1. Yes
2. No

Q35. (if Q34=1) About what percentage of your projects have specific energy efficiency goals or targets other than meeting code? Would you say…

1. Zero
2. Less than Half,
3. About Half,
4. More than Half,
5. Virtually All

(if Q34=1) Using those same categories, about what percentage of your buildings over the past three years were designed to be …

Q37. ....at least 10% more efficient than code?

1. Zero
2. Less than Half,
3. About Half,
4. More than Half,
5. Virtually All

Q38. ...at least 25% more efficient than code?

1. Zero
2. Less than Half,
3. About Half,
4. More than Half,
5. Virtually All

Q39. Have any of the design projects you completed in the past three years obtained a certification rating such as LEED, Living Building, Green Globe, Earth Advantage?

1. Yes
2. No

Q40. (if Q39=1) What certifications? (Do not read, responses are pre-codes. Multiple responses allowed)

1. LEED
2. Living Building,
3. Green Globe,
4. Earth Advantage,
5. Other (specify)

Q41. (if Q40=1) How many of your projects completed in the past three years received LEED certification? (Range 1-997)

Q42. How many of those were LEED Platinum? (Range 0-997. NOTE: Response cannot be greater than Q41)

Q43. How many of those were.LEED Gold? (Range 0-997. NOTE: Response cannot be greater than Q41)

Q44. How many of those were LEED Silver? (Range 0-997. NOTE: Response cannot be greater than Q41)

Q45. Please rate your agreement with the following statement, where "1" indicates strongly disagree and "5" indicates strongly agree: The current LEED criteria guarantee energy efficient buildings.

1 2 3 4 5

Please let me know for about what proportion of your design projects you have done the following in the last three years:

Q57. Calculated the energy use per square foot of completed buildings (if necessary: also known as energy intensity, energy utilization index, or EUI)

1. Zero
2. Less than Half,
3. About Half,
4. More than Half,
5. Virtually All

Q58. (if Q57=1 through 5) Compared the energy use of completed buildings to the energy use as modeled during design

1. Zero
2. Less than Half,
3. About Half,
4. More than Half,
5. Virtually All

Q59. (if Q57=1 through 5) Used energy use per square foot results to establish key performance indicators across projects?

1. Zero
2. Less than Half,
3. About Half,
4. More than Half,
5. Virtually All

Q60. Completed a formal Post Occupancy evaluation or assessment?

1. Zero
2. Less than Half,
3. About Half,
4. More than Half,
5. Virtually All

Q61. Reported the results of a post-occupancy assessment or energy use calculation to the building owners?

1. Zero
2. Less than Half,
3. About Half,
4. More than Half,
5. Virtually All

Q62. Do you have any post-occupancy evaluations planned for any projects currently in design?

1. Yes
2. No

Integrated Design

Q126. How familiar are you with the architectural design process called Integrated Design? Would you say…

1. Not at all,
2. Somewhat, or
3. Very

Q127. (if Q126=2 or 3) Has your firm used Integrated Design for any of its new construction, addition or renovation design projects in the last three years?

1. Yes
2. No

Q128. (if Q127=1) What proportion of your projects over the last three years has used integrated design elements?

1. Zero
2. Less than Half,
3. About Half,
4. More than Half,
5. Virtually All

For your projects over the last three years--thinking about the different people who were included on the design team from the beginning of the project, please tell me the extent of involvement each of the following groups had. Please indicate if the group was never or rarely included, sometimes included, or almost always included from the beginning of the design process:

Q130. The engineering consultant

1. Never or rarely included
2. Sometimes included, or
3. Almost always included

Q131. The general contractor

1. Never or rarely included
2. Sometimes included, or
3. Almost always included

Q132. Owner's representatives

1. Never or rarely included
2. Sometimes included, or
3. Almost always included

Q133. Representatives of the operations and maintenance staff

1. Never or rarely included
2. Sometimes included, or
3. Almost always included

Q134. The commissioning agent
1. Never or rarely included
2. Sometimes included, or
3. Almost always included

Q135. Representatives of the building users or occupants
1. Never or rarely included
2. Sometimes included, or
3. Almost always included

Q136. Thinking of these groups as possible members of the integrated team, about what proportion of projects used some sort of integrated team?
1. Zero
2. Less than Half,
3. About Half,
4. More than Half,
5. Virtually All

Q137. And considering just those projects that used some sort of integrated team, about how often did the integrated teams meet, on average, before the end of schematic design?
1. Daily
2. Several times a week
3. Several times a month
4. Once per month
5. Every other month
6. Less frequently than every other month

Q138. And how often, on average, did they meet after the end of schematic design?
1. Daily
2. Several times a week
3. Several times a month
4. Once per month
5. Every other month
6. Less frequently than every other month

Q139. Other than for code compliance, on how many of your last five projects did you use energy modeling to determine the design?

1. 1
2. 2
3. 3
4. 4
5. 5
6. 0

Q140. (if Q139=1-5) For those projects where you used energy modeling, on average, how many times during the design process was the whole building energy use modeled? (Range 1-97)

Q141. Were energy use models done for any of the individual buildings systems, such as cooling or lighting, by themselves?

1. Yes
2. No

Q142. (if Q141=1) Which systems were modeled? (Record)

In how many of your last five projects – if any – were the following features present:

Q144. A design charette was held where the designer meets with the owner, building operator, and consulting engineers?

1. 1
2. 2
3. 3
4. 4
5. 5
6. 0

Q145. Daylighting with controls, used to reduce electric lighting

1. 1
2. 2
3. 3
4. 4
5. 5
6. 0

Q146. Building orientation was selected to minimize heating, cooling, or lighting loads

1. 1
2. 2
3. 3
4. 4
5. 5
6. 0

Q147. Thermal mass of the building served to reduce heating and cooling loads

1. 1
2. 2
3. 3
4. 4
5. 5
6. 0

Q148. A major system--such as the chiller, boiler, ventilation, or lighting system-- was designed to use less significantly less energy than in comparable facilities or required by code.

1. 1
2. 2
3. 3
4. 4
5. 5
6. 0

Q150. Occupancy sensors were used to control ventilation

1. 1
2. 2
3. 3
4. 4
5. 5
6. 0

Q151. Energy efficient equipment was specified

1. 1
2. 2
3. 3
4. 4
5. 5
6. 0

Q152. Occupancy sensors were used to control lighting

1. 1
2. 2
3. 3
4. 4
5. 5
6. 0

Q153. Commissioning began during the design process

1. 1
2. 2
3. 3
4. 4
5. 5
6. 0

Q154. A plan was made for operator or occupant training

1. 1
2. 2
3. 3
4. 4
5. 5
6. 0

Contracts

Q157. Do any of your design contracts with clients include specific energy efficiency requirements?

1. Yes
2. No

Q159. (if Q157=1) Can you briefly describe some of the energy efficiency provisions? (Probe for other than LEED) (Record)

Commitment

Q161. Does the senior management of your firm believe a priority on energy efficient design will provide the firm with a strategic advantage?

1. Yes
2. No

Q163. Has your firm formally adopted, through policies and procedure statements, energy efficiency and sustainability goals for your design projects?

1. Yes
2. No

Q164. Has your firm accepted the AIA 2030 Challenge targets?

1. Yes
2. No

Q165. Have you formally adopted the AIA 2030 Commitment?

1. Yes
2. No

Q166. Does your firm consider energy efficiency to be part of its market identity?

1. Yes
2. No

Q167. Do your firm's marketing materials describe Integrated Design specialties?

1. Yes
2. No

Q168. Do your firm's marketing materials describe the advantages of energy efficient or high performance buildings?

1. Yes
2. No

Q169. Do your firm's marketing materials highlight its capabilities or successes with energy efficiency or sustainability?

1. Yes
2. No

Q170. Does your organization's website contain a section specifically featuring your sustainability or energy efficiency credentials, successes or related awards you have received?

1. Yes
2. No

Q176. About what proportion of your clients come to you specifically looking for designs that are more energy efficient than code? Would you say…

1. Zero
2. Less than Half,
3. About Half,
4. More than Half,
5. Virtually All

Organization

Q178. Which best describes how your firm incorporates energy efficiency expertise into its design teams?

1. Sustainability specialists or advisors work with design teams,
2. A specific team does most of the sustainable and energy efficient designs,
3. Most teams have considerable expertise in sustainability and energy efficiency,
4. Most teams have some expertise in sustainability and energy efficiency, 5. Or something else (specify)

Q179. Does your firm have an in-house energy efficiency or sustainability specialist or group?

1. Yes
2. No

Q182. Has your firm retained outside energy efficiency or sustainability specialists or groups?

1. Yes
2. No

Q183. Do you have a mechanical engineer on staff that specifically supports energy efficient design?

1. Yes
2. No

Q184. In selecting engineering consultants, has your firm included in its criteria demonstrated Integrated Design or energy efficiency capability?

1. Yes
2. No

Staff Training and Recognition

Q188. Have you or other staff participated in any seminars or training related to any aspect of energy efficiency and building design?

1. Yes
2. No

Q190. (if Q188=1) What organizations sponsored the presentation or training? (Do not read, responses are pre-codes. Multiple responses allowed, probe for additional responses)

1. AIA,
2. Cascadia Green Building Council,
3. Other (specify)

Q191. About what proportion of your design staff are LEED accredited? Would you say…

1. Zero
2. Less than Half,
3. About Half,
4. More than Half,
5. Virtually All

Q193. Does you firm allocate staff time to improving capability in energy efficiency?

1. Yes
2. No

Q194. Is energy efficiency included in your professional development planning for any staff?

1. Yes
2. No

Q196. Does your firm consider demonstrated competence in energy efficiency as a factor in promotion decisions?

1. Yes
2. No

Q198. Does your firm recognize its energy efficiency or sustainability achievements in staff meetings and credit key individuals and teams?

1. Yes
2. No

Better Bricks Touch

Q200. Have you received project assistance or information from the Integrated Design Labs at state universities in Washington, Idaho, or Montana or from the Energy Studies in Buildings Lab at the University of Oregon?

1. Yes
2. No

Q201. Before today, have you heard of an organization called the Northwest Energy Efficiency Alliance or NEEA?

1. Yes
2. No

Q202. Before today, have you heard of BetterBricks or BetterBricks.com?

1. Yes
2. No

Q203. (if Q202=1) Have you or any of your staff visited the website BetterBricks.com and its Design and Construction section?

1. Yes
2. No

Q204. (if Q203=1) Have you or any of your staff used any ideas, materials or tools from the Better Bricks website?

1. Yes
2. No

Q206. (if Q202=1) Have you heard of the annual BetterBricks Awards for excellence in energy-efficient buildings?

1. Yes
2. No

Q207. (if Q206=1) Have you or any of your staff attended the BetterBricks Awards?

1. Yes
2. No

Q210. (if Q201=1 OR Q202=1) Have you seen any print advertisements or feature stories on Better Bricks or NEEA, or about a firm or facility involved with Better Bricks or NEEA?

1. Yes
2. No

Q211. (if Q201=1 OR Q202=1) Did BetterBricks or NEEA information, training, or assistance directly influence any your firm's practices regarding energy efficiency?

1. Yes
2. No

Q212. (if Q211=1) In what way? (Record)

Q213. (if Q201=1 OR Q202=1) Are there areas of your practice involving energy efficiency that have been enhanced by BetterBricks or NEEA activity?

1. Yes
2. No

Q217. Can you name three firms whose energy efficiency practices have influenced those of your firm?

1. Gave response
2. cannot name any firms

That's all of my questions. Thank you very much for your time.

OFFICES AND REAL ESTATE (ORE) MARKET SURVEY – 9/29/10

Hi, my name is _____ from Research Into Action and I'm calling on behalf of the Northwest Energy Efficiency Alliance BetterBricks program. I am not selling anything. We are talking with experts from a select sample of real estate firms about key trends in energy efficiency and sustainability in the Northwest office market.

IF CONTACT NAME KNOWN: I would like to speak with [Name]

IF CONTACT NAME NOT KNOWN: a person who is responsible for asset management, property management, or portfolio operations for commercial office real estate. This position likely is responsible for budgets and planning across multiple buildings. Who would that be?

Name:

Title:

Phone:

[LIKELY TITLES: VP of Property Management, Senior Property Manager, Property Manager, General Manager, Asset Manager, Facility Director, Facility Manager, Manager of Facility Operations, Chief Engineer]

WHEN GET CORRECT PERSON Hi, my name is __ calling from Research Into Action on behalf of BetterBricks, a program of the Northwest Energy Efficiency Alliance. I am not selling anything. We are doing a survey on key trends in energy efficiency and sustainability in the Northwest office market.

Your participation in this study is very important, and the results of this research will guide many professional development activities for commercial real estate professionals in the Northwest over the next five years. Your responses are completely confidential. Is this a good time to talk or can we schedule another time? Our interviews take about 20 minutes.

If needed: Appointment date and time:_____

[IF ASKED] We would be happy to send you an executive summary for the results from this study, and the full study will be published on NEEA's website in early 2011.

SC1. Do your responsibilities include the management of operations and profitability for office buildings in the Pacific Northwest?

1. Yes
2. No ➔ Is another senior person at your firm responsible for asset or property management or portfolio operations with whom we might speak? IF NOT, THANK AND TERMINATE

About The Contact

Q1. Please tell me your title?

Which of the following do your responsibilities cover?

Q2. Asset management
1. Yes
2. No

Q3. Property management
1. Yes
2. No

Q4. Portfolio management
1. Yes
2. No

IF NONE APPLY, THANK AND TERMINATE

Q6. For how many office buildings in the Pacific Northwest are you responsible? _____ (Range 0-97)

Q7. About how much square footage do these office buildings comprise? _____ (Range 1-1,000,000)

Q7a. (If Q7=D/K) Would you say those buildings you are responsible for were more than or less than 50,000 square feet?
1. More
2. Less

SC2. (If Q6 less than 3 and Q7 is less than 50,000 square feet or Q7a=2): We are talking to commercial real estate managers with responsibility for at least 3 office buildings or a total of 50,000 square feet of offices in the Pacific Northwest. Is there another senior person at your firm responsible for asset management, property management or portfolio operations who might have such experience? IF NOT, THANK AND TERMINATE

About The Firm

Which of these roles does your firm play in the office real estate market in the four sates of the Pacific Northwest (If necessary: Washington Oregon, Idaho, and Montana)?

Q13. Owner
1. Yes
2. No

Q14. Developer
1. Yes
2. No

Q15. Manager
1. Yes
2. No

Q16. Any other roles (please specify) _____

IF Q15 NE 1, THANK AND TERMINATE

Q17. How many offices does your firm have in the fours states of the Pacific Northwest? [If necessary: Washington, Oregon, Idaho, and Montana] (open-ended)

Q18. How many employees work at your location? Would you say…
1. Less than 10
2. 10-24
3. 25 or more

(IF Q18=1) Thank you for your time, but we are looking to speak with organizations with 10 or more employees. Have a good day. (TERMINATE).

Q20. What category best describes the total square footage of commercial real estate managed by your office? Would you say…
1. Less than 2 million
2. 2 million to less than 4 million, or
3. 4 million or more

And about what percentage of this square footage is in each of the following geographic areas: [NOTE: If respondent replies D/K, PROBE: You may be uncertain of the percentage of overall square footage, but do you have buildings in this market?]

Q21. Seattle/ Bellevue/Puget Sound (Range 0-100, 101=DK, but have buildings in this market, 102=D/K)

Q22. Portland Metro (Range 0-100, 101=DK, but have buildings in this market, 102=D/K)

Q23. Spokane (Range 0-100, 101=DK, but have buildings in this market, 102=D/K)

Q24. Boise (Range 0-100, 101=DK, but have buildings in this market, 102=D/K)

Q25. Elsewhere in the Pacific Northwest (Range 0-100, 101=DK, but have buildings in this market, 102=D/K)

EUI, ES, Goals, Studies, Plans

Thank you for that background information. Now I have questions on your business practices.

You indicated that about [READ IN Q6] buildings are currently under your responsibility or oversight.

Please let me know for about what proportion of these buildings you have done the following in the last two years: Please use the categories of None, Less than Half, About Half, More than Half, Virtually All

Q64. Obtained an ENERGY STAR score

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q65 (if Q64=2-5) Kept the ENERGY STAR score current by regularly updating the information

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q66. (if Q64=2-5) Set a goal or target for energy use or energy use reduction [Note: target can be for multiple buildings considered collectively and does not need to be for an individual building]

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q67. (if Q64=2-5) Conducted a study to identify ways to reduce building energy use

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q68. (if Q64=2-5) Created a plan to reduce building energy use

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q69. (if Q64=2-5) Taken steps to reduce building energy use

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q71. (if Q69=2-5)Have you seen an improvement in the energy performance of any of your buildings?

1. Yes
2. No

Q72. (if Q71=1) What changes did you make that likely led to the improved energy performance? (open-ended)

EUI and ES Details

Q85. (if Q64=2-5) AND (if Q66=2-5) Have you used the ENERGY STAR results to help in establishing an energy use or savings target? [If needed, the results on ENERGY STAR score]

1. Yes
2. No

Q87. Have you used ENERGY STAR results to attract a new client?

1. Yes
2. No

Q88. (if Q64=2-5) Have you reported ENERGY STAR results to building owners decision makers?

1. Yes
2. No

Q89 (if Q64=2-5) Have you trained any of your staff in using ENERGY STAR Portfolio Manager?

1. Yes
2. No

Study Details

Q92. (if Q67=2 or 3) You mentioned you have conducted a study to identify ways to reduce building energy use, but have not done so for all of your buildings. Do you currently have plans to study most of the remaining buildings over the next two years?

1. Yes
2. No

Q93. (if Q67=1, 4 or 5) Do you have plan within the next two years to conduct a study to identify opportunities to reduce building energy use?

1. Yes
2. No

Q94a. (if Q67=2-5) Was more than one building studied?

1. Yes
2. No

Q94. (if Q67=2-5) Who conducted the study, was it: (PROGRAMMERS NOTE: If Q94a=1, allow multiple responses for Q94. If Q94a=2, Q94 is single response only)

1. The utility
2. Staff working for your firm
3. Contractors, or
4. Someone else (specify)

Q95. (if Q67=2-5) Did the study look for operations and maintenance changes that might lower energy costs?

Plan Details

You indicated you have created a plan to reduce building energy use. Which of the following describe the plan? [If respondent having indicates several plans with different characteristics, ask if any of the plans include any of the following]

Q98. (if Q68=2-5) Plan is written (If necessary, "not jut generally understood")

1. Yes
2. No

Q99. (if Q68=2-5) Plan includes numeric goals for energy savings or use
1. Yes
2. No

Q101. (if Q68=2-5) Plan includes a timeline
1. Yes
2. No

Q103. (if Q68=2-5) Plan includes a budget
1. Yes
2. No

Q104. (if Q68=2-5) Plan is authorized by senior management
1. Yes
2. No

Q105. (if Q68=2-5) Senior management receives updates on plan achievements
1. Yes
2. No

Goal Details in Absence of Plan

You indicated you have created a goal to reduce building energy use. Which of the following describe the goal? [If respondent indicates having several goals with different characteristics, ask if any of the goals include any of the following]

Q108. (if Q66=2-5 AND Q68=1, D/K or Ref) Goal is written (If necessary, "not jut generally understood"
1. Yes
2. No

Q109. (if Q66=2-5 AND Q68=1, D/K or Ref) Goal specifies numeric targets for energy savings or use
1. Yes
2. No

Q110. (if Q66=2-5 AND Q68=1, D/K or Ref) Goal includes a completion date

1. Yes
2. No

Q112. (if Q66=2-5 AND Q68=1, D/K or Ref) Goal includes a budget

1. Yes
2. No

Q113. (if Q66=2-5 AND Q68=1, D/K or Ref) Goal is authorized by senior management

1. Yes
2. No

Q114. (if Q66=2-5 AND Q68=1, D/K or Ref) Senior management receives updates on progress toward goal

1. Yes
2. No

Action Details

Q116. (if Q69=2-5) For any of your buildings, have you replaced existing equipment with high-efficiency equipment in the last two years?

1. Yes
2. No

Q117. (if Q69=2-5) For any of your buildings, have you made any no or low cost changes in operations or maintenance to reduce energy costs in the last two years?

1. Yes
2. No

Contracts

Q157. Do any of your contracts with equipment service providers include energy efficiency requirements?

1. Yes
2. No

Q158. Has your firm adopted language specific to energy efficiency in your leasing and property management contracts?

1. Yes
2. No

Q159. (if Q158=1) Can you briefly describe some of the energy efficiency provisions? (open-end)

Commitment

Q161. Does the senior management of your organization believe a commitment to sustainability or energy efficient facilities will provide the organization with a strategic advantage?

1. Yes
2. No

Q162. Please rate the extent to which you agree with the following statement, where "1" signifies strongly disagree and "5" signifies strongly agree: Decreasing a building's typical energy use increases its asset value.

1 2 3 4 5

Q163. Have energy efficiency and sustainability goals been formally adopted through a mission statement or policy and procedures statements?

1. Yes
2. No

Q166. Does your firm consider energy efficiency to be part of its brand identity?

1. Yes
2. No

Q169. Do your firm's marketing materials highlight its capabilities or successes with energy efficiency or sustainability?

1. Yes
2. No

Q170. Does your organization's website contain a section specifically featuring your sustainability or energy efficiency credentials, successes or related awards you have received?

1. Yes
2. No

Does your firm communicate with any of the following groups about energy efficiency and sustainability for the property?

Q172. Tenants?

1. Yes
2. No

Q173. Property management teams?

1. Yes
2. No

Q174. Owners?

1. Yes
2. No

Q175. Service providers?

1. Yes
2. No

Organization

Q179. Has your firm established a specific individual, team or committee responsible for energy use reduction and/ or sustainability?

1. Yes
2. No

Staff Training and Recognition

Q186. Have you trained any of your building engineers and operators in how to conduct studies to identify energy savings opportunities?

1. Yes
2. No
3. Not-applicable: Do not employ staff appropriate for this

Q187. Have you identified contractors with demonstrated capability to conduct studies to identify energy savings opportunities?

1. Yes
2. No

Q188. Have you or other staff participated in any seminars or training related to any aspect of energy efficiency in office real estate?

1. Yes
2. No

Q190. (if Q188=1) What organizations sponsored the presentation or training? (open-ended with pre-codes, check all that apply, continue to probe with "Anything else?":)

1. BOMA
2. ULI (Urban Land Institute)
3. IFMA
4. AIA
5. Cascadia Green Building Council
6. CEM
7. Other (specify)

Q193. Does you firm allocate staff time for improving capability in energy efficiency?

1. Yes
2. No

Q194. Is energy efficiency included in your professional development planning for any staff?

1. Yes
2. No

Q195. Would you say that over the last year staff have received more training in energy efficiency than in previous years?

1. Yes
2. No

Q196. Does your firm consider demonstrated competence in energy efficiency as a factor in promotion decisions?

1. Yes
2. No

Q197. Is energy efficiency included in job descriptions of managerial staff positions?

1. Yes
2. No

Q198. Does your firm recognize its energy efficiency or sustainability achievements in staff meetings and credit key individuals and teams?

1. Yes
2. No

Better Bricks Touch

Q201. Before today, have you heard of an organization called the Northwest Energy Efficiency Alliance or NEEA?

1. Yes
2. No

Q202. Before today, have you heard of BetterBricks or BetterBricks.com?

1. Yes
2. No

Q203. (if Q202=1) Have you or any of your staff visited the website BetterBricks.com and its Office Real Estate section?

1. Yes
2. No

Q204. (if Q203=1) Have you or any of your staff used any ideas, materials or tools from the Better Bricks website?

1. Yes
2. No

Q205. (if Q204=1)What was the topic? (open-ended w/ pre-codes, check all that apply)

1. Leasing
2. Property Management Agreements
3. Other (specify)

Q206. (if Q202=1) Have you heard of the annual BetterBricks Awards?

1. Yes
2. No

Q207. (if Q206=1) Have you or any of your staff attended the BetterBricks Awards?

1. Yes
2. No

Q209. Have you seen the High Performance Portfolio Framework?

1. Yes
2. No

Q210. (if Q201=1 or Q202=1) Have you seen any print advertisements or feature stories on Better Bricks or NEEA, or about a firm or facility involved with Better Bricks or NEEA?

1. Yes
2. No

Q211. (if Q201=1 or Q202=1) Did BetterBricks or NEEA information, training, or assistance directly influence any your firm's practices regarding energy efficiency?

1. Yes
2. No

Q212. (if Q211=1) In what way? (open-ended)

Q213. (if Q201=1 or Q202=1) Are there areas of your practice involving energy efficiency that have been enhanced by BetterBricks or NEEA activity?

1. Yes
2. No

Q214. (if Q21=1-101) Have any of your buildings participated in the Kilowatt Crackdown competitions?

Q215 (if Q22=1-101) Have any of your buildings participated in the Office Energy Showdown competitions?

Q217. Can you name three firms whose energy efficiency practices have influenced those of your firm? (open-ended)

1. Gave response
2. Cannot name any firms

That's all of my questions. Thank you very much for your time.

HOSPITALS AND HEALTHCARE MARKET SURVEY – 10/04/10

Hi, my name is _____ calling on behalf of the Northwest Energy Efficiency Alliance BetterBricks program.

[If FF=0] I am not selling anything. We are talking with facility directors from a select sample of hospitals about key trends in hospital facility operations in the Northwest.

IF CONTACT NAME KNOWN: I would like to speak with [Name]

[If FF=0] IF CONTACT NAME NOT KNOWN: the Director of Facilities or manager responsible for facility operations. Who would that be?

Name:

Title:

Phone:

[If FF=0; WHEN GET CORRECT PERSON] Hi, my name is __ calling on behalf of BetterBricks, a program of the Northwest Energy Efficiency Alliance. I am not selling anything. We are surveying hospital facility directors on current practices in facility operations in the Northwest. Your participation in this study is very important, and the results of this research will guide many professional development activities for hospital facilities staff in the Northwest over the next five years. Your responses are completely confidential. Is this a good time to talk or can we schedule another time? Our interviews take about 20 minutes.

If needed: Appointment date and time:_____

[IF ASKED] We would be happy to send you an executive summary for the results from this study, and the full study will be published on NEEA's website in early 2011.

SC1. Are you responsible for decisions about facility operations and management for hospital facilities in the Pacific Northwest?

1. Yes
2. No ➔Is there another senior person responsible for decisions about facility operations and management with whom we might speak? IF NOT, THANK AND TERMINATE

About the Contact

Q1. Please tell me your title?

Q5. Do your responsibilities include directing new construction, major renovation or additions for your organization?

1. Yes
2. No

Q6. How many beds are in the facilities you are responsible for? Would you say

1. 1-149
2. 150-249
3. 250-349, or
4. 350 or more

[IF LESS THAN 150 BEDS] We are talking with Facility Directors at larger facilities, those with at least 150 beds. So that is all my questions for you. Thank you very much. TERMINATE

About the Firm

Q17. How many acute-care locations does your organization have in the four states of the Pacific Northwest? [If necessary: Washington, Oregon, Idaho, and Montana] (Range 1-97)

Q18. About how many staff work in operations and maintenance at this location? Would you say…

1. 1-4
2. 5-9
3. 10-24, or
4. 25 or more

EUI, ES, Goals, Studies, Plans

Thank you for that background information. Now I have questions on your business practices.

You indicated that about [Read in Q17] buildings are currently under your responsibility or oversight.

Please let me know for about what proportion of these buildings you have done the following in the last three years: Please use the categories of None, Less than Half, About Half, More than Half, Virtually All

Q57. Calculated the energy use per square foot (EUI=1) (if necessary: also known as energy intensity, energy utilization index, or EUI)

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q63 (if Q57=2-5) Kept the estimate of energy use per square foot current by regularly updating the information

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q64. Obtained an ENERGY STAR score

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q65 (if Q64=2-5) Kept the ENERGY STAR score current by regularly updating the information

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q66. Set a goal or target for energy use or energy use reduction [Note: target can be for multiple buildings considered collectively and does not need to be for an individual building]

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q67. Conducted a study to identify ways to reduce building energy use

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q68. Created a plan to reduce building energy use

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q69. Taken steps to reduce building energy use

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q71. (if Q69=2-5) Have you seen an improvement in the energy performance of any of your buildings?

1. Yes
2. No

Q72. (if Q71=1) What changes did you make that likely led to the improved energy performance? (open-ended)

Q73. Are you familiar with life-cycle cost analysis, also called total cost of ownership analysis?

1. Yes
2. No

Q74. (if Q73=1) Which statement best describes your organization's investment decision-making with respect to life-cycle cost analysis. Would you say you:

1. Have not used nor plan to use life-cycle cost analysis
2. Have plans to use life-cycle cost analysis for some investments
3. Have made investments based on lowest life-cycle cost

EUI and ES Details

Q76. (if Q64=1, D/K or Ref AND Q57=2-5) You indicated you've calculated the energy use per square foot. What tool did you use, if any? (multiple response) (do not read)

1. ENERGY STAR Portfolio Manager
2. Energy Expert
3. Utility Manager Pro
4. Avista IQ
5. Microsoft Excel
6. Other (specify)

(if Q64=1, D/K or Ref AND Q57=2-5) READ: What are you comparing the results to? Are you…

(if Q64=2-5) READ: You indicated you've obtained an ENERGY STAR score. What are you comparing the results to? Are you…

Q80. (if Q57=2-5 or Q64=2-5) Comparing across buildings you are responsible for?

1. Yes
2. No

Q81. (if Q57=2-5 or Q64=2-5) Comparing across buildings in the region?

1. Yes
2. No

Q82. (if Q57=2-5 or Q64=2-5) Comparing performance of the same building over time?

1. Yes
2. No

Q83. (if Q66=2-5) Comparing building performance to energy use goals?

(if Q57=2-5 or Q64=2-5) Have you done any of the following with the results? Have you… [If needed, the results on energy use per square foot or ENERGY STAR score]

Q85. (if Q66=2-5) Used results to help in establishing an energy use or savings target?

1. Yes
2. No

Q88. Reported results to building owners decision makers

1. Yes
2. No

Q89. (if Q64=2-5) Have you trained any of your staff in using ENERGY STAR Portfolio Manager?

1. Yes
2. No

Study Details

Q92. (if Q67=2-3) You mentioned you have conducted a study to identify ways to reduce building energy use, but have not done so for all of your buildings. Do you currently have plans to study most of the remaining buildings over the next two years?

1. Yes
2. No

Q93. (if Q67=1) Do you have plan within the next two years to conduct a study to identify opportunities to reduce building energy use?

1. Yes
2. No

Q94a. (if Q67=2-5) Was more than one building studied?

1. Yes
2. No.

Q94. (if Q67=2-5) Who conducted the study, was it: (PROGRAMMERS NOTE: If Q94a=1, allow multiple responses for Q94. If Q94a=2, Q94 is single response only)

1. The utility
2. Staff working for your firm
3. Contractors, or
4. Someone else (specify)

Q95 (if Q67=2-5) Did the study look for operations and maintenance changes that might lower energy costs?

1. Yes
2. No

Plan Details

You indicated you have created a plan to reduce building energy use. Which of the following describe the plan? [If respondent having indicates several plans with different characteristics, ask if any of the plans include any of the following]

Q98. (if Q68=2-5) Plan is written (If necessary, "not jut generally understood")

1. Yes
2. No

Q99. (if Q68=2-5) Plan includes numeric goals for energy savings or use

1. Yes
2. No

Q100. (if Q68=2-5) Plan includes specific action items

1. Yes
2. No

Q101. (if Q68=2-5) Plan includes a timeline

1. Yes
2. No

Q102. (if Q68=2-5) Plan identifies the responsible parties
1. Yes
2. No

Q103. (if Q68=2-5) Plan includes a budget
1. Yes
2. No

Q104. (if Q68=2-5) Plan is authorized by senior management
1. Yes
2. No

Q105. (if Q68=2-5) Senior management receives updates on plan achievements
1. Yes
2. No

Goal Details in absence of plan

You indicated you have created a goal to reduce building energy use. Which of the following describe the goal? [If respondent indicates having several goals with different characteristics, ask if any of the goals include any of the following]

Q108. (if Q66=2-5 AND Q68=1) Goal is written (If necessary, "not just generally understood")
1. Yes
2. No

Q109. (if Q66=2-5 AND Q68=1) Goal specifies numeric targets for energy savings or use
1. Yes
2. No

Q110. (if Q66=2-5 AND Q68=1) Goal includes a completion date
1. Yes
2. No

Q111. (if Q66=2-5 AND Q68=1) Goal identifies the responsible parties
1. Yes
2. No

Q112. (if Q66=2-5 AND Q68=1) Goal includes a budget
1. Yes
2. No

Q113. (if Q66=2-5 AND Q68=1) Goal is authorized by senior management
1. Yes
2. No

Q114. (if Q66=2-5 AND Q68=1) Senior management receives updates on progress toward goal
1. Yes
2. No

Action Details

Q116. (if Q69=2-5) For any of your buildings, have you replaced existing equipment with high-efficiency equipment in the last three years?
1. Yes
2. No

Q117. (if Q69=2-5) For any of your buildings, have you made any no or low cost changes in operations or maintenance to reduce energy costs in the last three years?
1. Yes
2. No

Please indicate whether in the last two years you have done any of the following or identified the need to do so….

Q119. (if Q69=2-5) Improved the scheduling of equipment, such as lighting and HVAC?
1. Yes
2. No

Q120. (if Q69=2-5) Corrected situations of simultaneous heating and cooling?
1. Yes
2. No

Q121. (if Q69=2-5) Adjusted the outside air usage or economizer functioning?
1. Yes
2. No

Q122. (if Q69=2-5) Recalibrated sensors in the last two years?
1. Yes
2. No

Integrated Design

Q124. In the last three years, has your organization initiated any new construction, renovation, or addition project?
1. Yes
2. No

Q125. (if Q124=1) Did you have any involvement in the design of that project?
1. Yes
2. No

Q126. How familiar are you with the architectural design process called Integrated Design? Would you say…
1. Not at all
2. Somewhat, or
3. Very

Q127. (if Q126=2 or 3) Has your organization used integrated design for any of its new construction, addition or renovation design projects in the last three years?
1. Yes
2. No

Q139. (if Q125=1) Other than for code compliance, did you use energy modeling to determine the design?
1. Yes
2. No

Q144. (if Q125=1) Was a design charette held where the architect meets with the owner, building operator, and consulting engineers?

1. Yes
2. No

Q148. (if Q125=1) Was any major system--such as the chiller, boiler, ventilation, or lighting system--designed to use less significantly less energy than in comparable facilities or required by code?

1. Yes
2. No

Q149. (if Q148=1) What system? (open-ended w pre-codes. Do Not Read)

1. chiller
2. boiler
3. ventilation
4. lighting
5. Other (specify)

Q155. (if Q126=2 or 3) Does your organization plan to request for future new construction projects that your A&E team be experienced in or willing to learn Integrated design?

1. Yes
2. No

Contracts

Q157. Do any of your contracts with equipment service providers include energy efficiency requirements?

1. Yes
2. No

Q158. Has your organization included energy efficiency requirements in any of its specs for equipment purchases?

1. Yes
2. No

Q159. (if Q158=1) Which equipment specs have included energy efficiency requirements? (open-end)

Commitment

Q161. Does the senior management of your organization believe a commitment to sustainability or energy efficient facilities will provide the organization with a strategic advantage?

1. Yes
2. No

Q163. Have energy efficiency and sustainability goals been formally adopted through a mission statement or policy and procedures statements?

1. Yes
2. No

Q166. Does your organization consider sustainability or energy efficiency to be part of its market identity?

1. Yes
2. No

Organization

Q179. Has your firm established a specific individual, team or committee responsible for energy use reduction and/ or sustainability?

1. Yes
2. No

Staff Training and Recognition

Q186. Have you trained any of your building engineers and operators in how to conduct studies to identify energy savings opportunities?

1. Yes
2. No
3. (vol) Not Applicable - don't employ staff appropriate for this

Q187. Have you identified contractors with demonstrated capability to conduct studies to identify energy savings opportunities?

1. Yes
2. No

Q188. Have you or any of the O&M staff participated in any seminars or training related to energy efficiency?

1. Yes
2. No

Q189. (if Q188=1) About what proportion of the O&M staff have received training related to energy efficiency? Would you say…

1. Less than Half
2. More than Half, or
3. Virtually All

Q190. (if Q188=1) What organizations sponsored the presentation or training? (open-ended with pre-codes, Do not read, multiple response, continue to probe with "Anything else?":)

1. BOC
2. CEM
3. IFMA
4. AIA
5. Cascadia Green Building Council
6. OSHE
7. WASHE
8. Society of Healthcare Engineers
9. Conferences
10. PGE
11. Utility
12. Seattle IDL (Integrated Design Lab)
13. Practice Greenhouse
14. University of Washington
15. Community colleges
16. Other (specify)

Q191. (if Q188=1) Have you or any of your staff received certifications relating to energy efficiency?

1. Yes
2. No

Q192. (if Q191=1) What certifications? (Pre-codes, do not Read):

1. BOC
2. CEM
3. Other (specify)

Q193. Does your organization allocate time for your operations staff to improve capability in energy efficiency?

1. Yes
2. No

Q194. Is energy efficiency included in your professional development planning for any staff?

1. Yes
2. No

Q195. Would you say that over the last two years operations staff have received more training in energy efficiency than in previous years?

1. Yes
2. No

Q196. Does your organization consider demonstrated competence in energy efficiency as a factor in promotion decisions?

1. Yes
2. No

Q197. Is energy efficiency included in job descriptions of operational staff positions?

1. Yes
2. No

Q198. Does your organization recognize its energy efficiency or sustainability achievements in staff meetings and credit key individuals and teams?

1. Yes
2. No

Better Bricks Touch

Q200. Have you received project assistance or information from the Integrated Design Labs at state universities in Washington, Idaho, or Montana or from the Energy Studies in Buildings Lab at the University of Oregon?

1. Yes
2. No

Q201. Before today, have you heard of an organization called the Northwest Energy Efficiency Alliance or NEEA?

1. Yes
2. No

Q202. Before today, have you heard of BetterBricks or BetterBricks.com?

1. Yes
2. No

Q203. (if Q202=1) Have you or any of your staff visited the website BetterBricks.com and its Healthcare section?

1. Yes
2. No

Q204. (if Q203=1) Have you or any of your staff used any ideas, materials or tools from the Better Bricks website?

1. Yes
2. No

Q206. (if Q202=1) Have you heard of the annual BetterBricks Awards for excellence in energy-efficient buildings?

1. Yes
2. No

Q207. (if Q206=1) Have you or any of your staff attended the BetterBricks Awards?

1. Yes
2. No

Q208. (if Q207=1) Has anyone in your organization received a BetterBricks Award?

1. Yes
2. No

Q210. (if Q201=1 or Q202=1) Have you seen any print advertisements or feature stories on Better Bricks or NEEA, or about a firm or facility involved with Better Bricks or NEEA?

1. Yes
2. No

Q211. (if Q201=1 or Q202=1) Did BetterBricks or NEEA information, training, or assistance directly influence any your firm's practices regarding energy efficiency?

1. Yes
2. No

Q212. (if Q211=1) In what way? (open-ended)

Q213. (if Q201=1 or Q202=1) Are there areas of your practice involving energy efficiency that have been enhanced by BetterBricks or NEEA activity?

1. Yes
2. No

Q217. Can you name three firms whose energy efficiency practices have influenced those of your firm? (open-ended)

1. Gave response
2. Cannot name any firms

That's all of my questions. Thank you very much for your time.

BUILDING OPERATORS (BOPS) MARKET SURVEY – 10/28/10

Intro A: Hi, my name is _____ calling on behalf of the Northwest Energy Efficiency Alliance BetterBricks program.

I am not selling anything. We are talking with experts from a select sample of mechanical contractors about key trends in building systems operations and servicing in the Northwest.

IF CONTACT NAME KNOWN: I would like to speak with [Name]

IF CONTACT NAME NOT KNOWN: a sales manager who is responsible for mechanical operations and service contracts with commercial offices or healthcare facilities. Who would that be?

Name:

Title:

Phone:

[WHEN GET CORRECT PERSON] Hi, my name is __ calling on behalf of BetterBricks, a program of the Northwest Energy Efficiency Alliance. I am not selling anything. We are surveying mechanical contractors on current practices in mechanical systems servicing and maintenance in Northwest office and healthcare facilities. Your participation in this study is very important, and the results of this research will guide many professional development activities for mechanical contractors in the Northwest over the next five years.

If needed: Appointment date and time:_____

[IF ASKED] We would be happy to send you an executive summary for the results from this study, and the full study will be published on NEEA's website in early 2011.

SC1. Do your responsibilities cover marketing, sales, and contracts for mechanical systems operations and servicing to commercial office buildings and/or healthcare clients in the Pacific Northwest?

1. Yes
2. No -> Is there another senior person at your firm responsible for marketing, sales, and contracts in the office building or healthcare sectors with whom we might speak? IF NOT, THANK AND TERMINATE. If another respondent comes to the phone, return to Intro A

About the Contact

Q1. Please tell me your title?

Q6. For how many commercial office buildings are you responsible? _____ (Range 0-97)

Q7. About how much square footage do these commercial office buildings comprise? (Range 1-1,000,000)

Q8. For how many healthcare buildings are you responsible? ____ (Range 0-97)

Q9. About how much square footage do these healthcare buildings comprise? (Range 1-1,000,000)

SC2. [IF Q6 + Q8 LESS THAN 3 AND Q7 + Q9 LESS THAN 250,000 SQUARE FEET] We are talking to sales managers with responsibility for at least 3 buildings or a total of 250,000 square feet in the Pacific Northwest. Is there another sales manager at your firm who might have such experience? IF NOT, THANK AND TERMINATE. If another respondent comes to phone, return to Intro A.

About the Firm

About what proportion of your firm's revenue comes from the following market sectors?...

Q10. Residential (Range 0-100)

Q11. Commercial (Range 0-100)

Q12. Industrial (Range 0-100)

SC3. [IF Q11 LESS THAN 50%, THANK AND TERMINATE]

Which of the following activities does your firm engage in for building mechanical systems?

Q13. Design
1. Yes
2. No

Q14. Installation
1. Yes
2. No

Q15. Servicing
1. Yes
2. No

SC4. [IF Q15=2 THANK AND TERMINATE]

Q17. How many offices does your firm have in the four states of the Pacific Northwest? [If necessary: Washington, Oregon, Idaho, and Montana] (open-ended)

Q18. About how many employees work at your location? Would you say…
1. 1-4
2. 5-9
3. 10-24
4. 25 or more

SC5. [IF Q18=1 or 2 THANK AND TERMINATE]

Q19. About how many of these are engaged in the equipment servicing arena—both sales and operations? _____ (Range 0-97)

In which of the following regions does your firm have a market presence?

Q21. Seattle/ Bellevue/Puget Sound
1. Yes
2. No

Q22. Portland Metro
1. Yes
2. No

Q23. Spokane
1. Yes
2. No

Q24. Boise
1. Yes
2. No

Q26. Elsewhere in the Pacific Northwest
1. Yes
2. No

EUI, ES, Goals, Studies, Plans

Thank you for that background information. Now I have questions on your business practices. These questions explore your practices with your entire customer base. [If needed, "not just your office and healthcare customers."]

Q46. Do you have written service protocols for energy efficiency service offerings to include in contracts?
1. Yes
2. No

Which of the following, if any, are included in any of your service packages?...

Q48. Tracking building energy costs?
1. Yes
2. No

Q49. Calculating the energy use per square foot or ENERGY STAR score?
1. Yes
2. No

Q50. Conducting a study focused on energy savings opportunities?
1. Yes
2. No

Q52. (if Q48, Q49, or Q50=1) What do you call your service package that includes these features? (open-ended)

Q53. (if Q48, Q49, or Q50=1) Are these service packages sold by your entire sales force, or are there energy efficiency specialists that sell these services?
1. All
2. Specialists

Q54. (if Q48, Q49, or Q50=1) Do you have sales targets for these products?

1. Yes
2. No

Q55a. Earlier you mentioned you mentioned you are responsible for the operation of [READ IN Q6 response] buildings. For about how many of these buildings are you providing any energy efficiency services? (Range 1-97) [PROGRAMMERS NOTE: Q55a cannot be GT Q6]

Please let me know for about what proportion of these buildings you have done the following in the last two years: Please use the categories of None, Less than Half, About Half, More than Half, Virtually All

Q57. Calculated the energy use per square foot (if necessary: also known as energy intensity, energy utilization index, or EUI)

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q63. (if Q57=2-5) Kept the estimate of energy use per square foot current by regularly updating the information

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q64. Obtained an ENERGY STAR score

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q65. (if Q64=2-5) Kept the ENERGY STAR score current by regularly updating the information

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q66. Set a goal or target for energy use or energy use reduction [Note: target can be for multiple buildings considered collectively and does not need to be for an individual building]

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q67. Conducted a study focused on energy saving opportunities

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q68. Created a proposal for services to address energy savings opportunities

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q69. Taken steps to reduce building energy use

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q70. About what proportion of your contracts, if any, specifically include pursuing energy efficiency by such things as making needed adjustments to equipment schedules, sensors, and controls? Please use the same categories (None, Less than Half, About Half, More than Half, Virtually All)

Q71. (if Q69=2-5) Have you seen an improvement in the energy performance of any of your customers?

1. None
2. Less than Half
3. About Half
4. More than Half
5. Virtually All

Q72. (if Q71=1) What changes did you make that likely led to the improved energy performance? (open-ended)

EUI and ES Details

Q76. (if Q64=1 and Q57=2-5) You indicated you've calculated the energy use per square foot. What tool did you use, if any? (open-ended w/ Pre-codes, do not read:)

1. ENERGY STAR Portfolio Manager
2. Energy Expert
3. Utility Manager Pro
4. Avista IQ
5. Microsoft Excel
6. Other (specify)

[If Q64=1 and Q57-2-5] READ: What are you comparing the results to? Are you comparing…

[if Q64=2-5] READ: You indicated you've obtained an ENERGY STAR score. What are you comparing the results to? Are you…

[If Q57=2-5 or Q64=2-5 ask the following]

Q80. Comparing across buildings you are responsible for?
1. Yes
2. No

Q81. Comparing across buildings in the region?
1. Yes
2. No

Q82. Comparing performance of the same building over time?
1. Yes
2. No

Q83. (if Q66=2-5) Comparing building performance to energy use goals?
1. Yes
2. No

[if Q57=2-5 or Q64=2-5] Have you done any of the following with the results? Have you… [If needed, the results on energy use per square foot or ENERGY STAR score]

Q85. (if Q66=2-5) Used results to help in establishing an energy use or savings target?
1. Yes
2. No

Q87. Used results to attract a new client
1. Yes
2. No

Q88. Reported results to building owners decision makers
1. Yes
2. No

Q89. (if Q64=2-5) Have you trained any of your staff in using ENERGY STAR Portfolio Manager?
1. Yes
2. No

Q90. (if Q89=1) And are these staff in clerical, sales, or operations positions? (multiple record)
1. Clerical
2. Sales
3. Operational

Action Details [If Action=1]

Q116. (if Q69=2-5) For any of your customers, have you replaced existing equipment with high-efficiency equipment in the last two years?
1. Yes
2. No

Q117. (if Q69=2-5) For any of your customers, have you made any no or low cost changes in operations or maintenance to reduce energy costs in the last two years?
1. Yes
2. No

Please indicate whether in the last three years for any of your buildings you have done any of the following or identified the need to do so….

Q119. (if Q69=2-5) Improved the scheduling of equipment, such as lighting and HVAC?
1. Yes
2. No

Q120. (if Q69=2-5) Corrected situations of simultaneous heating and cooling?
1. Yes
2. No

Q121. (if Q69=2-5) Adjusted the outside air usage or economizer functioning?
1. Yes
2. No

Q122. (if Q69=2-5) Recalibrated sensors in the last two years?
1. Yes
2. No

Contracts

Q158. Has your firm adopted any contract language specific to energy efficiency?

1. Yes
2. No

Q159. (if Q158=1) Can you briefly describe some of the energy efficiency provisions? _____

Commitment

Q161. Does the senior management of your firm believe that energy efficiency services are a viable product?

1. Yes
2. No

Q168. Do your firm's marketing materials describe the advantages of energy efficient or high performance buildings?

1. Yes
2. No

Q169. Do your firm's marketing materials highlight its capabilities or successes with energy efficiency or sustainability?

1. Yes
2. No

Q170. Does your organization's website contain a section specifically featuring your sustainability or energy efficiency credentials, successes or related awards you have received?

1. Yes
2. No

Organization

Q179. Does your firm have an energy efficiency or sustainability services group?

1. Yes
2. No

Q180. (if Q179=1) Does this group work independently or work with other teams?

1. Independently
2. With other teams

Q181. (if Q179=2) Would you characterize most of your services group as having a little energy efficiency expertise, a moderate amount, or considerable expertise?

1. A little efficiency expertise
2. A moderate amount
3. Considerable expertise

Staff Training and Recognition

Q186. Have you trained any of your technicians or engineers in how to conduct studies to identify energy savings opportunities?

1. Yes
2. No
3. Not-applicable; Do not employ staff appropriate for this

Q188. Have you or any of the sales and operations staff participated in any seminars or training related to energy efficiency?

1. Yes
2. No

Q189. (if Q188=1) About what proportion of the sales and operations staff have received training related to energy efficiency? Would you say Less than Half, More than Half, Virtually All

1. Less than Half
2. More than Half
3. Virtually All

Q190. (if Q188=1) What organizations sponsored the presentation or training? (open-ended with pre-codes, check all that apply, continue to probe with "Anything else?":)

1. BOC
2. CEM
3. IFMA
4. AIA
5. Cascadia Green Building Council
6. OSHE
7. WASHE
8. society of healthcare engineers
9. conferences
10. PGE
11. utility
12. Seattle IDL (Integrated Design Lab)
13. Practice Greenhealth
14. University of Washington
15. community colleges
16. other (specify)

Q191. (if Q188=1) Have you or any of the staff received certifications relating to energy efficiency?

1. Yes
2. No

Q192. (if Q191=1)What certifications? Pre-codes, do not read:

1. BOC
2. CEM
3. Other (specify)

Q193. Does you firm allocate time for your sales and operations staff for training in energy efficiency?

1. Yes
2. No

Q194. Is energy efficiency included in your professional development planning for any staff?

1. Yes
2. No

Q195. Would you say that over the last year staff have received more training in energy efficiency than in previous years?

1. Yes
2. No

Q196. Does your organization consider demonstrated competence in energy efficiency as a factor in promotion decisions?

1. Yes
2. No

Q197. Is energy efficiency included in job descriptions of operational staff positions?

1. Yes
2. No

Q198. Does your organization recognize its energy efficiency or sustainability achievements in staff meetings and credit key individuals and teams?

1. Yes
2. No

Better Bricks Touch

Q201. Before today, have you heard of an organization called the Northwest Energy Efficiency Alliance or NEEA?

1. Yes
2. No

Q202. Before today, have you heard of BetterBricks or BetterBricks.com?

1. Yes
2. No

Q203. (if Q202=1) Have you or any of your staff visited the website BetterBricks.com and its Building Operations section? [WEB=1]

1. Yes
2. No

Q204. (if Q203=1) Have you or any of your staff used any ideas, materials or tools from the Better Bricks website?

1. Yes
2. No

Q206. (if Q202=1) Have you heard of the annual BetterBricks Awards for excellence in energy-efficient buildings?

1. Yes
2. No

Q207. (if Q206=1) Have you or any of your staff attended the BetterBricks Awards?

1. Yes
2. No

Q209. Have you seen the Fat Building brochure?

1. Yes
2. No

Q210. (if Q201=1 or Q202=1) Have you seen any print advertisements or feature stories on Better Bricks or NEEA, or about a facility involved with Better Bricks or NEEA?

1. Yes
2. No

Q211. (if Q201=1 or Q202=1) Did BetterBricks or NEEA information, training, or assistance directly influence any your firm's practices regarding energy efficiency?

1. Yes
2. No

Q212. In what way? (open-ended)

Q213. (if Q201=1 or Q202=1) Are there areas of your practice involving energy efficiency that have been enhanced by BetterBricks or NEEA activity?

1. Yes
2. No

Q214. (if Q21=1) Have any of your clients had buildings that participated in the Kilowatt Crackdown competitions?

1. Yes
2. No

Q215. (if Q22=1)Have any of your clients had buildings participated in the Office Energy Showdown competitions?

1. Yes
2. No

Q216. (if Q214 or Q215=1) Have these clients requested energy efficiency services from you?

1. Yes
2. No

Q217. Can you name three firms whose energy efficiency practices have influenced those of your firm? (open-ended)

1. Gave response
2. Cannot name any firms

That's all of my questions. Thank you very much for your time.

October 27, 2011
REPORT #E11-229

Northwest Ductless Heat Pump Initiative 2010

Market Progress Evaluation Report #1

Prepared by:
Research Into Action, Inc.
PO Box 12312
Portland, OR 97212

Northwest Energy Efficiency Alliance
PHONE
503-688-5400
FAX
503-688-5447
EMAIL
info@neea.org

research/into/action inc

Final Report

Northwest Ductless Heat Pump Initiative 2010 Market Progress Evaluation Report #1

Funded By:

neea

Prepared By:

research/into/action inc

Jane S. Peters, Ph.D.
Marjorie McRae, Ph.D.
April Armstrong
Research Into Action, Inc.

October 3, 2011

ACKNOWLEDGEMENTS

The Research Into Action team would like to thank Anu Teja, Northwest Energy Efficiency Alliance (NEEA) evaluation manager, for providing direction and support to this research effort. We would also like to thank Alexis Allan at NEEA for her contributions to the research and willingness to be interviewed. This research was dependent on contributions from regional utilities, contractors, and consumers. We also wish to thank national DHP manufacturers for their willingness to be interviewed.

TABLE OF CONTENTS

EXECUTIVE SUMMARY ..... **I**

MARKET PROGRESS INDICATORS ..... **ERROR! BOOKMARK NOT DEFINED.**

RECOMMENDATIONS I

1. INTRODUCTION **1**

DHP 2010 INITATIVE THEORY AND LOGIC 3

2. METHODOLOGY **4**

3. FINDINGS FROM INTERVIEWS **6**

MANUFACTURERS AND DISTRIBUTORS 6

Initiative Influence 6

Marketing 7

Sales and Supply Chain 8

Issues 10

Future Projections 11

UTILITY PROGRAM ADMINISTRATOR INTERVIEWS 11

Program Structure 11

Installations and Goals 12

Utility Program Successes 13

Challenges 14

Other Markets 14

Future Projections 15

INITIATIVE IMPLEMENTATION STAFF INTERVIEWS 15

Initiative Evolution 15

Successes 16

4. FINDINGS FROM SURVEYS **19**

CONTRACTOR SURVEY 19

Methodology 19

Total HVAC Contractor Market 19

HVAC Contractors Aware of DHPs 20

Initiative Participation and Awareness among Contractors Aware of DHPs 20

DHP Marketing by Contractors Installing DHPs 22

Customers' Purchasing Motivations per DHP-Installing Contractors 24

Incented and Unincented DHP Installations by DHP-Installing Contractors 25

Perspectives of Non-Installing Contractors 28

PARTICIPANT SURVEY 29
Source of DHP Awareness 29
Initial Interest 30
Participant Satisfaction 31

5. FINDINGS FROM ACE MODEL REVIEW 32

6. CONCLUSIONS AND RECOMMENDATIONS 33

SUMMARY OF FINDINGS 33
MARKET PROGRESS INDICATORS 34
CONCLUSIONS 35
RECOMMENDATIONS 36

APPENDICES 1

APPENDIX A: PARTICIPANT FINDINGS 1
APPENDIX B: CONTRACTOR FINDINGS 1
APPENDIX C: FOCUS GROUP FINDINGS 1
APPENDIX D: DHP ACE MODEL VALIDATION MEMO 1
APPENDIX E: ADDITIONAL UNINCENTED INSTALLATION RESEARCH 1
APPENDIX F: LOGIC MODEL 1
APPENDIX G: INTERVIEW GUIDES 1

APPENDIX A: PARTICIPANT FINDINGS A-1

APPENDIX B: CONTRACTOR SAMPLE DETAILS B-1

APPENDIX C: FOCUS GROUP FINDINGS C-1

APPENDIX D: DHP ACE MODEL VALIDATION MEMO D-1

APPENDIX E: ADDITIONAL UNINCENTED INSTALLATIONS RESEARCH E-1

APPENDIX F: LOGIC MODEL F-1

APPENDIX G: INTERVIEW GUIDES G-1

DHP MANUFACTURER / DISTRIBUTOR SURVEY, 2010 EVALUATION G-1
UTILITY INTERVIEW GUIDE G-6
DHP 2010 IMPLEMENTATION TEAM SURVEY G-12
HVAC CONTRACTOR SURVEY INSTRUMENT – CSRS #91907NEEA 2010 DHP EVALUATION, APRIL 2011 ..... G-15
DHP PARTICIPANT INTERVIEW GUIDE, 2010 EVALUATION G-34

LIST OF FIGURES

Figure 1: Initiative Participation among Initiative-Aware Contractors (n=152) 20
Figure 2: Awareness of NEEA's Initiative among DHP-Aware Contractors 21
Figure 3: Awareness and Understanding of Initiative's "Displacement versus Replacement" Approach among Initiative-Aware Contractors 22
Figure 4: Informational Resources and Marketing Media Used by DHP-Installing Contractors (n=188) 23
Figure 5: Customer Source of DHP Awareness as Reported by DHP-Installing Contractors (n=188) 23
Figure 6: Customers Specifically Requesting DHPs as Reported by DHP-Installing Contractors (n=188) 24
Figure 7: Customers' DHP Purchasing Motivations as Reported by DHP-Installing Contractors (n=188) 25
Figure 8: Prevalence and Average Number of Unincented Installations among DHP-Installing Contractors (n=152) 27
Figure 9: Reasons for Unincented Installations among DHP-Installing Contractors (n=149) 27
Figure 10: Comparison of Brands Installed by DHP-Installing Contractors with Brands of Incented DHPs) 28
Figure 11: Participant Sample and Residential Population 29
Figure 12: Source of Initial DHP Awareness among Participants (Left; n=___) and Most Influential Source of Awareness (Right; n=67) 30
Figure 13: Sampled Contractor State Versus Population 1
Figure 14: Brands of DHP Installed by DHP-Aware Contractors Compared to Overall Contractor Population 2
Figure 15: Sources of DHP Information Used by Participants (n=67) 3
Figure 16: What Initially Interested Participants in DHPs (n=67) 3
Figure 17: Concerns Before Purchasing a DHP (n=67) 4
Figure 18: Prior and Current Space Conditioning 5
Figure 19: Respondent Cooling Before DHP 6
Figure 20: Respondent Cooling Before DHP 7
Figure 21: Respondent Cooling Before DHP 8
Figure 22: Participant Consumer Satisfaction 8
Figure 23: Participants Reasons for and Willingness to Recommend DHPs 9
Figure 24: DHP-Aware Surveyed Contractor Firm Sizes 2

LIST OF TABLES

Table 1: 2010 DHP Initiative Market Progress Indicators ..... **Error! Bookmark not defined.**
Table 2: DHP Initiative Evaluation Primary Data Collection 4
Table 3: Correspondence of Research Objectives and Data Collection 5
Table 4: Interview Groups and Sample Sizes 6
Table 5: Total HVAC Contractor Market Awareness of, and Experience Installing, DHPs 20
Table 6: DHP Installations as of May 2011 (DHP-Installing Contractors) 26
Table 7: Reasons Participants Considered DHPs 30
Table 8: 2010 DHP Initiative Market Progress Indicators 34
Table 9: Wood Usage 5
Table 10: Respondent Cooling Before DHP 6
Table 11: Surveyed Contractor Respondent States 1
Table 12: Contractor Groups, Counts, and Weights 2
Table 13: Ductless Heat Pump (DHP) Program - 2010 3
Table 14: Unincented DHP Sample Groups and Dispositions 1
Table 15: Unincented DHP Sample and Total Installs by State 2
Table 16: Unincented DHP Installations 2

E EXECUTIVE SUMMARY

This market progress evaluation report (MPER) describes the progress, accomplishments, and challenges of the Northwest Energy Efficiency Alliance's (NEEA) 2010 Northwest Ductless Heat Pump (DHP) Initiative. The initiative began in 2010, following a pilot phase that launched in October of 2008. Both the pilot and the initiative share the goal of promoting the displacement of electric zonal heat in residential applications with ductless heat pumps. NEEA and implementation contractor, Fluid Market Strategies, worked through 2010 to promote DHP installations through marketing and supporting utility incentive programs, track installations, work with DHP manufacturers and suppliers, train installers, and assure installation quality.

This report is one component of on-going comprehensive research underway on DHP technical performance and market acceptance. Previous MPERS evaluated the DHP pilot progress and market acceptance of DHPs through surveys and interviews with market actors.

Key findings of this report, by market actor, include:

Manufacturers: In 2010, manufacturer contacts reported that they better understood the Initiative theory and goals, and were more engaged in it. In particular, they had incorporated Initiative fundamentals into their training and marketing materials. Manufacturers also reported that, due to the Initiative, the Northwest is a viable market for DHPs and that the Initiative provides an effective model for similar DHP programs in other regions. Both manufacturers and Initiative implementation staff said they planned to branch into new, innovative marketing approaches intended generate interest from more diverse populations of potential DHP consumers.

Installers: About eighty percent of HVAC installers in the region had installed at least one DHP. Participating contractors, which made up about twenty percent of the total regional contractors, had installed about eighty percent of the target market installations. Utility program administrators reported that installation quality remained consistent or improved in 2010. Initiative implementation staff and utility program administrators credited the Master Installer Program with encouraging quality installations and rewarding those installers who have an advanced understanding of Initiative theory and practices.

Utilities: Ninety-one utilities participated in the Initiative in 2010, an increase of five from 2009. Utility contacts reported a sustained consumer demand for DHP technology which results in valuable energy savings for their programs. Utility contacts reported plans to continue running their DHP programs for as long funding allows.

Installations: As of May 2011, the NW Ductless Initiative had installed 10,500 DHP systems. Participating contractors, which make up about twenty percent of the total regional contractors, have installed about eighty percent of the target market installations. Additional surveys conducted with contractors installing un-incented units, indicate that at minimum, 2,603

installations replaced baseboards/zonal heat in single-family homes and 1,842 were installed in supplemental or add-on space in single family homes.

RECOMMENDATIONS

NEEA should continue to offer the initiative and continue building on its successes.

Residential target market: The initiative staff should expand outreach activities to the market of homeowners younger than 60, pursuing activities begun in 2010 such as involving social media, television advertising, and publicizing the very positive consumer response to DHPs. The staff should ensure the target market definition and market size estimate it uses in its operations are consistent with that of the DHP ACE (Alliance Cost-Effectiveness) model and the Northwest Power and Conservation Council's *Sixth Power Plan.* Alternatively, the program and ACE model might use the number of northwest single family electrically heated homes estimated by the U.S. Census.

Expanded northwest markets: Initiative staff should consider ways to support residential DHP installations in markets beyond the target market, regardless of whether incentives are offered for these applications. The initiative might promote short-run ducting with DHPs for new construction applications to address aesthetic barriers. It might initiate conversations or collaborations between manufactured housing manufacturers and DHP manufacturers. It might develop case studies or testimonials showcasing residential-size DHPs in small commercial applications.

Utility support: Initiative staff should strategize with Energy Trust of Oregon staff about possible responses to the research findings that the Portland area has among the lowest saturations of HVAC contractors installing incentivized DHPs and among the lowest rates of customers specifically requesting DHPs (per contractor reports). Initiative staff should continue to collaborate with utilities and support them with best practices.

Contractor support: Initiative staff should continue to grow the Master Installer Network and conduct installer training, especially in areas with lower initiative participation: rural areas, Portland, Spokane, and the other locations in the Spokane grouping. Contractors would welcome additional marketing materials and support, and might benefit from sales training that highlights customer-reported benefits of the DHPs and promotes DHPs to displace existing zonal electric heating systems. Initiative staff should continue the current approach of showcasing successful contractors.

Manufacturer support: Initiative staff should work with manufacturers to expand the locations – such as utility offices – where consumers can observe DHPs and experience their space conditioning, noise levels, and appearance. Initiative staff should continue its successful work with manufacturers to increase manufacturers' marketing supportive of the initiative and technical support of contractors.

Retail support: Initiative staff should continue collaborations to increase the number of big box retailers and retail store locations that sell and install DHPs.

1 INTRODUCTION

The Northwest Energy Efficiency Alliance (NEEA) is a non-profit corporation supported by electric utilities, public benefits administrators, state governments, public interest groups, and energy efficiency industry representatives that operate in the states of Idaho, Montana, Oregon, and Washington.[1] These organizations combine efforts to promote energy efficiency in the Northwest.

NEEA hired Research Into Action, Inc. to evaluate its 2010 Northwest Ductless Heat Pump Initiative. This market progress evaluation report (MPER) describes the 2010 initiative progress, accomplishments, and challenges.

The initiative began in 2010, following a pilot phase that began in October of 2008. Research Into Action completed two MPERs on the pilot activities and market progress. Both the pilot and the initiative share the goal of promoting the displacement of electric zonal heat in residential applications with ductless heat pumps. NEEA and implementation contractor, Fluid Market Strategies (Fluid), worked through 2010 to promote DHP installations through marketing and supporting utility incentive programs, track installations, work with DHP manufacturers and suppliers, train installers, and assure installation quality. This research seeks to evaluate the initiative's progress towards market transformation, contractor education, and DHP installations. NEEA's research on the technical performance of ductless heat pumps (DHPs) is ongoing through 2012. Ecotope, Inc. is performing the regional technical evaluation efforts for NEEA, including lab testing, metering, and energy savings calculations.

Historically, the DHP supply chain and likely target market were unaware of DHPs' viability for displacement of existing space conditioning or did not see potential for DHPs in the Northwest. Due to the perception of limited market potential, DHP manufacturers and distributors did little to encourage sales of DHPs in the Northwest. The pilot ran from October 2008 to December 2009 and helped generate a strong consumer demand for DHPs, as well as a supply chain of interested manufacturers, distributors, and contractors. The pilot demonstrated the capability of DHPs to residential consumers and the market potential to HVAC contractors. The pilot also involved regional utilities in incentivizing and promoting DHPs to their customers. By the end of 2009, the pilot had made documented progress toward creating a market for DHPs in the Northwest and a network of trained contractors to support that market. During the pilot, the Bonneville Power Administration (BPA) sponsored the installation of 1,500 installations. Utilities sponsored an additional thousand units. By November of 2009, the pilot had installed its installation goals and as of December 31, 2009 had installed 3,899 DHP units in the region.

[1] See the website at *www.neea.org*.

The 2010 DHP initiative built on the successes of the pilot with more DHP installations and stronger networks between the supply chain and initiative stakeholders. The primary goals of the 2010 initiative are to:

- **Continue to demonstrate the effectiveness of inverter-driven ductless heat pumps in displacing electric heat in the Northwest;**
- **Partner with Northwest utilities and energy efficiency organizations to achieve a 15% market share of DHP by 2014 in single family electrically heated homes**
- **Increase consumer awareness of DHP technology**
- **Maintain and enhance a robust trade ally network**
- **Increase affordability and variety of DHPs available throughout the region**

The *Project Implementation Document* specifies several objectives related to these goals, including to:

- **Accelerate market adoption of ductless heat pumps by building on the progress and infrastructure of the 2009 pilot.**
- **Promote quality installations throughout the region and communicate findings to market actors and Project partners**
- **Maintain and enhance the upstream market by partnering with manufacturers to implement effective regional marketing platforms**
- **Ensure that ductless systems are well supported by the distribution channel in the Northwest and support technology advancements in the region**
- **Create and maintain a sales data tracking mechanism to monitor ductless heat pump sales and gauge progress regionally**
- **Increase contractor awareness and adoption of ductless heat pump technology and applications in single family homes with electric resistance heat;**
- **Create and maintain robust trade ally network and increase active contractor participation by 20 percent and ensure contractors are trained in the technical nuances of installing DHPs**
- **Verify appropriate ductless heat pump applications and installations according to the expectations and requirements of the Project and manufacturer specifications.**
- **Begin to shift the responsibility of quality installations to the marketplace by providing contractors with near-term feedback on best practices and areas of concern**
- **Coordinate and review quality assurance protocols with utilities**

DHP 2010 INITATIVE THEORY AND LOGIC

Prior to the DHP pilot, the Northwest was viewed by DHP manufacturers as a minor market. The Initiative theory posits that through direct intervention with market actors that initiative will increase DHP sales, transform the market, and build a sustainable market for DHPs.

Historically, DHP manufacturers' perception that the U.S. represents a limited market for sales of residential DHPs resulted in a lack of manufacturer marketing activities for DHPs and limited availability of DHPs through distributors. Consumer barriers to the uptake of DHPs included lack of familiarity with DHP technology, aesthetic concerns, and cost. Related to these factors, installers had minimal experience with DHP installation and limited access to training.

The pilot project theory assumes that by directly intervening with market actors, DHP marketing, training, and distribution networks would strengthen and consumer awareness of DHPs would increase. The theory further assumed that by offering an economic stimulus on DHP installations, utilities across the region would overcome participants' first-cost hurdle for DHP installation, persuading them to participate in the project (see Appendix ___ for logic model.

2 METHODOLOGY

This report addresses the primary objective of the 2010 DHP Initiative evaluation: to assess market response and progress by collecting data from market actors and participants. Research Into Action reviewed the DHP Alliance Cost-Effectiveness (ACE) model and key initiative assumptions to evaluate the validity of the ACE Model assumptions and initiative logic.

Building on the concepts from the ACE Model and initiative logic, Research Into Action collected data from participants, initiative implementation staff, contractors, and manufacturer/distributors. We called a sample of participants and installation contractors up to six times to reduce the likelihood of convenience sampling bias. Table 1 shows the populations and samples for each group.

Table 1: DHP Initiative Evaluation Primary Data Collection

Group	Estimated Population	Sample Size	Confidence/ Precision
Interviews			
Initiative Implementation Staff (NEEA and Fluid)	3	3	Census
Participating DHP Program Administrators (administrators with one or more installations)	76	19	85/15
Manufacturer Contacts (brands with 35+ units installed – 0.5% or more of installations)	5 brands	5 brands, 15 contacts	NA
Manufacturer Contacts (brands with < 0.5% share)	4 brands	4 brands, 4 contacts	NA
Focus Groups (to Support Survey Development)			
Participating Installation Contractors	NA	3 groups	NA
Participating Consumers	NA	3 groups	NA
Surveys			
HVAC Contractors	2,000+	Strata 1:47	Strata 1:85/10
		Strata 2:47	Strata 2:85/10
		Strata 3:18	Strata 3:80/15
		Strata 4:50	Strata 4:85/10
		Strata 5:6	Strata 5:80/20
		Strata 6:46	Strata 6:85/10
		Total: 214	**Overall: 95/10**
2010 Participating DHP Customers	3,000+	67	Greater than 90/10

Table 2 summarizes the data collection undertaken for the MPER. We tailored the questions for each group to address the research questions and evaluation goals. Table 2 shows the correspondence between the data collection efforts and the research objectives.

Table 2: Correspondence of Research Objectives and Data Collection

Research Objectives	Data Collection Techniques				
	Quantitative Market Surveys	Interviews	Focus Groups	Initiative Documents, etc.	Secondary Sources
Sample	268 Contractors 100 Consumers	3 Initiative Implementation Staff 19 Program Administrators 19 Manufacturers	3 Contractor Groups 3 Consumer Groups	NA	NA
Progress toward Market Share Goal …Market Penetration of Incented Units …Market Penetration of Unincented Units	✓	*		✓	*
Progress toward Utility/ Energy Agency Partnering Goal		✓		*	
Progress toward Consumer Awareness Goal	✓	*	*	*	
Progress toward Trade Ally Network Goal	✓	*	*	*	
Progress toward Goals for DHP Variety, Availability and Affordability	✓			✓	
Progress toward Market Transformation	✓	*			
Validation of Initiative Logic	✓	✓	✓	✓	
Validation of ACE Model	✓			✓	✓
Informing Adaptive Management	✓	✓		✓	

* Data source contributed to understanding the research objective, but did not constitute the key source.

Research Into Action completed two additional data collection components: a series of focus groups to inform the data collection instruments and follow-up research with DHP contractors regarding DHPs they had installed without initiative incentives. Please see appendices for more details on findings, findings from additional research tasks, and all data collection instruments

3 FINDINGS FROM INTERVIEWS

This chapter presents findings from interviews conducted by Research Into Action with the manufacturers, utility program administrators, and initiative implementation staff. Table 3 shows the sample sizes for each group.

Table 3: Interview Groups and Sample Sizes

Manufacturers and Distributors	Utility Program Administrators	Initiative Implementation Staff
19	19	3

MANUFACTURERS AND DISTRIBUTORS

Research Into Action interviewed 19 manufacturer or distributor contacts. Contacts included a diverse representation of manufacturer contacts, manufacturer's representatives, and distributors. We spoke with 15 contacts representing brands with 0.5% or more of installations through the initiative: Mitsubishi, Fujitsu, Daikin, LG, and Sanyo. We also spoke with four contacts representing brands with just a few program installations. Some contacts represented distributors working with more than one brand of DHP.

On average, manufacturer contacts reported that two-thirds of the outdoor DHP units they manufacture or stock qualified for initiative incentives. Contacts manufactured or stocked an average of 13 qualifying outdoor DHP units and seven DHPs that did not qualify for incentives.[2] Nonqualifying units either were not inverter driven or did not meet the SEER requirements. Contacts reported that their most popular units were high efficiency, qualified for the initiative, easy to install, quiet, and were capable of operating in cold weather conditions.

Initiative Influence

Respondents indicated that the NW Ductless Heat Pump Initiative has influenced their marketing, changed their perception of the regional and national market, and provided lessons that they will apply to the rest of the United States. Only one contact – a distributor – reported that the initiative did not change either the DHP models they carry or the number of individual DHP units that they stock. Contacts reported that initiative outreach, including the initiative

[2] Initially, we sought to understand the number and proportion of DHP systems (consisting of configurations of both indoor and outdoor DHP units) that manufacture contacts manufacture or stock that qualify for initiative incentives. This approach was problematic because of the large number of possible configurations of indoor and outdoor DHP units. Therefore, we asked manufacturer contacts solely about the proportion of *outdoor* DHP units they manufacture or stock that qualified for initiative incentives, in an effort to infer the value of the variable of interest.

website and email blasts from Fluid, generated a high level of contractor and consumer awareness about DHPs and the initiative incentives.

Marketing

Manufacturer contacts reported that DHP marketing is primarily conducted through their contractor networks. Direct marketing approaches varied across respondents; most of the representatives reported they did not conduct direct marketing of DHPs, while two of the brands maintained national awareness campaigns. These two contacts described their national DHP marketing as emphasizing comfort, efficiency, and zonal control. Manufacturers reported that marketing through contractors or distributors is the established method of marketing, while direct to consumer marketing for DHPs is a more recent development. In some cases, manufacturers provide co-op marketing dollars to contractors or distributors based on the sales these contractors or distributors generate.

Initiative Influence on Marketing

In general, respondents indicated that the initiative had expanded their perspective and awareness of potential DHP applications and value, including displacement applications for DHPs. Contacts further reported that this increased awareness has influenced the messages they seek to convey to contractors about the current DHP market, proper DHP installation techniques, and effective marketing approaches, In addition, respondents indicated that their increased awareness had prompted them to increase their marketing focus on the Pacific Northwest. Representative comments included:

> *The initiative has helped us focus our attention on the Northwest, where we have not traditionally had very good results.*
>
> *Everything the initiative is doing is tremendous in terms of raising awareness. It has definitely made us more attuned to the displacement concept as a market. Even five years ago, if you talked to a contractor they saw DHP only as a spot cooling application. Now you cannot go to a contractor that does now know about DHPs and all their applications. It has come a long way in a short period of time.*
>
> *I'd say the project has influenced our viewpoint on the DHP market. It has showed us what the Northwest market can do and what works out there, things which could work in other parts of the country.*

In addition to the traditional marketing approaches and target demographic, the initiative encouraged manufacturers to expand their message to promote DHP energy efficiency and zonal displacement to a more diverse population. Contacts indicated that this broader focus has been successful in appealing to more diverse groups of customers.

A few manufacturers indicated that they had participated in or been approached about co-branding with the initiative, yet they were not enthusiastic about co-branding. Co-branding would allow the initiative and the manufacturers to share marketing dollars to promote the technology and the initiative simultaneously. Even those manufacturers who had already

participated in co-branding reported being cautious about participating again because the approach has ―no capacity to target," meaning that the manufacturer did not see a direct return in sales for their brand from their investment. One co-branding approach that manufacturers did consider effective was radio advertising, specifically pairing an initiative advertisement with a manufacturer advertisement on National Public Radio. Manufacturer and distributor contacts indicated plans to keep their marketing approaches the same as current beyond 2010 which includes the increased collaboration with utility programs and distribution networks caused by the initiative.

Sales and Supply Chain

Market Share

While none of the manufacturers or distributors knew the approximate market share of each manufacturer, but about half were willing to speculate. Contacts reported their perception of the existing market shares; they placed Mitsubishi at around one-third of the total market followed by (in rank order) Fujitsu, Daikin, LG and Sanyo. According to the initiative installation database, Mitsubishi accounts for almost half of initiative installations (47%), followed by Fujitsu (27%), Daikin (10%), and Sanyo (7%).

Sales and Availability

Manufacturer and distributor respondents universally agreed that the initiative positively impacted sales. However, none of the manufacturer contacts reported that the increased sales resulted in a larger number of DHPs being manufactured. None of the manufacturers or distributors indicated any serious concerns about DHP availability, although several discussed possible supply limitations subsequent to the March 11, 2011 tsunami in Japan, which disrupted production of critical DHP components.

Retail

Manufacturers are hesitant about working with retailers to sell DHPs in big box stores, although they are aware of retailers' interest in doing so. Working with retail stores would reduce the need for the distributors. Both distributors and manufacturers value their established relationships; however, manufacturers indicated that unless distributors can add significant value to the product customers will almost certainly demand the added convenience of retail. Retail stores can offer financing through store credit cards and the purchase can be coordinated prior to installation, which necessitates a trained installer. DHPs are already sold in retail environments internationally, but contacts explained that the domestic contractor base is new to the technology and without the support from manufacturers and distributors the quality of installations might decrease. Manufacturers expressed concern that lower quality installations would result in less satisfied customers, more warranty claims, and bad publicity. Previous research also revealed concerns among manufacturers and distributors about potential misapplication (installation in

inappropriate applications or incorrect sizing) of DHPs if installed without the existing level of regulation.[3]

Submarkets

We asked manufacturers and distributors which markets, beyond residential retrofits, are potentially suitable for DHPs.

Contacts indicated that new construction is a promising market for DHPs. For example, contacts expressed that DHPs are ideally suited for new construction of small spaces such as condos. Most respondents agreed that the new construction market for DHPs will grow in the coming years. Contacts reported large design and construction firms to be the biggest barrier to new construction applications as these large firms are inflexible and slow to see the benefits of DHP compared to traditional heating systems since DHPs require additional upfront costs. Respondents also considered the physical appearance of the indoor DHP units to be a barrier to their application in new construction. To address this barrier, respondents suggested loosening initiative requirements that disqualify DHP systems with a small amount of ducting. Contacts suggested that these energy-efficient "hybrid" systems with minimal ducting are an effective approach to addressing the aesthetic barrier in new construction and other DHP markets. The contacts noted that while the current slow economy has significantly reduced the size of the new construction market, it has as a positive outcome led to increased demand for smaller houses, which are well suited to DHPs.

Contacts reported no current focus on manufactured housing as a market for DHPs. Although manufactured housing is the ideal size and configuration for DHPs, contacts indicated that there are several barriers – in addition to first costs – to DHP installation in manufactured homes. Existing codes and manufacturing procedures are barriers to this application, as well as the ducting present in nearly all manufactured homes.

Manufacturer and distributor contacts considered multi-family housing to be a promising market although there have been few installations and the potential is relatively unknown. Additional markets that the contacts considered promising were hotel rooms, assisted living communities, and low income housing. However, the contacts noted that such applications for DHPs are not yet widespread.

Training and Education

Manufacturer contacts reported offering an increased number of DHP trainings since the inception of the initiative. Respondents indicated that initiative requirements are now included in their northwest trainings- such as line height or line set covering requirements. One contact indicated that these concepts, which were previously less important, are presented "universally as a quasi-requirement," and added, "the initiative has influenced installation training." In addition,

[3] Northwest Ductless Heat Pump Pilot Project, Market Progress Evaluation Report #2.

some manufacturers reported increasing the technical assistance they provide to support the expanding contractor network.

Manufacturer and distributor contacts indicated that contractor education is the largest barrier to expanding application of DHPs into additional submarkets. According to one contact, ―The technology can move forward only as quickly as the contractor understanding." Despite increased training activities, some manufacturer and distributor contacts remained skeptical about their capacity to convince contractors about the technical and market potential of DHPs.

Issues

We asked manufacturers and distributors about some potential program challenges, including meeting demand, the discontinuation of the tax credit, and cold climate performance concerns.

- All contacts except three indicated that they have experienced or anticipate difficulty meeting demand. Barriers to meeting demand include the unreliable oversea supply chain, the tsunami in Japan, and inventory restrictions[4].
- Contacts universally agreed that the federal tax credit had a substantial positive influence on their business. Respondents reported an uptake of tax-credit qualified units that vastly outpaced the uptake of non-qualified units. Manufacturer and distributor contacts indicated mixed experiences since the tax credit ended. Some have seen a decrease in sales while others have not. Contacts indicated that without the tax credit they foresee a potential decrease in sales.
- Universally, contacts reported that DHPs are functional down to zero or negative five degrees; however, cold weather efficiency varies by brand. Some units remain efficient at low temperatures while other units require more energy to function at colder temperatures. With an additional wind baffle, manufacturers report that the units remain highly efficient. The technology is continually improving and not a single contact indicated that cold climate conditions are a serious barrier to DHP sales.

- Contacts reported ongoing consumer education issues around the operation and functionality of DHPs. Manufacturers report continued misunderstanding of the DHP remote control, which has a separate temperature sensor than the DHP unit itself and features buttons that can be confusing to some consumers. Additionally, manufacturer and distributor contacts indicated that consumers are not being sufficiently educated about what to expect when operating the DHP. Instead of operating similar to a traditional heating system, the DHP runs more often and for longer periods of time.

[4] Inventory restrictions apply only to Sanyo, which is allowed to hold a limited amount of inventory while transitioning to new management under Panasonic.

Contacts indicated that increasing contractor training may be helpful in overcoming these shortcomings in consumer education.

Future Projections

Contacts universally expect growth in DHP sales in the near future. All contacts also expressed a belief that DHPs are a viable market in the Northwest now and in the long-term future. Beyond the current applications, contacts expect an expansion of whole house DHP solutions and multi-headed systems. While multi-zonal systems are expected to increase, contacts estimated that the majority of the market (at least 60%) will continue to be one-to-one applications.

UTILITY PROGRAM ADMINISTRATOR INTERVIEWS

Research Into Action interviewed 19 utility program administrators from around the Northwest. We sampled utility program administrators with diverse numbers of DHP installations across urban and rural territories. Contacts represent both small and large utilities.

Program Structure

Utility contacts reported only very minor program changes in initiative structure in 2010. One program had added an in-house financing component, another added minimum insulation requirements, and another has reduced their incentive amount by $250. The majority of program administrators are waiting for the Bonneville Power Administration (BPA) to announce major program changes, anticipated in October of 2011, and plan to keep their programs consistent until that time. Aside from changes dictated by BPA, program administrators reported no plans to change their existing programs.

Quality Assurance Inspections

Overall, the program administrators report doing less quality assurance than they did at the onset of the initiative. None of the program administrators had any concerns about the quality of installations in their territory. Program administrators credit the quality assurance performed by Fluid and the utilities with increasing and maintaining installation quality. Respondents reported high levels of satisfaction with the quality assurance services performed by Fluid. Several program administrators indicated that conducting as many inspections as possible is a ―best practice" for maintaining a successful DHP program, as it encourages both quality installations and strong relationships between contractors and utility staff.

Program Interactions

All contacts reported maintaining at least email interaction with NEEA and/or Fluid staff about their program. Installation status updates or approvals were the most common reasons for communication. Aside from daily administration, respondents reported that interactions with NEEA were less common than interactions with Fluid. Interactions with Fluid have reportedly improved in 2010 from pilot experiences. Utility contacts indicated that interactions with Fluid

are faster than in previous years and more comprehensive. The level of interaction varied by program structure; utilities with pre-approval processes or for whose programs Fluid provides application form processing have the most interactions with Fluid.

Manufacturer and Distributor Interactions

Few (3) utility program administrators indicated that they have interacted with DHP manufacturers or distributors. Aside from a two who had offered trainings featuring presentations by the manufacturers or distributors, most had only contacted the manufacturers or distributors for clarification on technical issues or not at all. One utility had extensive interactions with one manufacturer because the manufacturer provided materials which conflicted with utility practices. Overall, contacts did not communicate with manufacturers or distributors often but reported that they could if they wanted to do so.

Incentives

All but two of the program administrators indicated their satisfaction with the current incentive level. The amount was considered both appropriate and sufficient to motivate people to consider a DHP. The remaining two administrators thought the incentive could be smaller and still motivate potential customers, as long as the incentive remains in place for a sufficient period of time. Several of the utility administrators served by expressed a concern that BPA might reduce the incentive amount, which they thought would reduce installation rates. All of the interviewed utilities plan to continue offering the current incentive or the maximum incentive that BPA authorizes. All of the interviewed program administrators indicated that DHPs constitute a viable market in their territory, but none were confident that the market was ready for the incentives to be eliminated. Program administrators see the incentives as a very important sales motivator.

Installations and Goals

None of the interviewed program administrators had numerical goals for DHP installations. Instead, energy savings targets directed the DHP program efforts. All but two of the program administrators reported meeting their energy savings goals in 2010. The DHP is identified as a useful tool for achieving energy savings goals and several utilities indicated that they are relying on the savings to meet their future energy savings goals. All utility program administrators reported that their programs met all established objectives.

Installation Costs

Program administrators reported an average installation cost of four thousand dollars. Within individual territories the lowest average cost was $3,600 and the highest average cost was $5,800. The lowest cost was achieved via a partnership between a local installer and electrician, which reduced the overall installation costs. The highest cost was attributed to the urban local economy, which has higher costs for all goods and services in that area. Utility program administrators indicated that the installation costs have been fairly consistent.

Marketing

Few of the utility program administrators reported having major marketing campaigns. Instead, most administrators relied on their contractor network to market the DHP initiative and technology. In addition to the contractor network, administrators indicated a preference for marketing through traditional channels such as bill stuffers and print media. The most commonly mentioned form of print media was the *Ruralite* magazine, which reaches over 300,000 homes monthly across Alaska, Washington, Oregon, Idaho, Nevada, California, and Montana. The *Ruralite* has been identified by both utility program administrators and DHP consumers as a popular source of DHP awareness and information since the DHP pilot.

Beyond print, some utilities have begun expanding their marketing into website marketing and radio campaigns. Radio campaigns have provided co-branding opportunities for the utilities and manufacturers to pool funds and purchase radio airtime. Utility program administrators had more favorable impressions regarding the co-branding than the interviewed manufacturers, who reported that the approach was not sufficiently targeted towards their individual brands. Utility contacts reported positive customer response to the co-op advertising.

Utilities identified display units installed in their own lobby or offices as a marketing best practice. Display units were also identified as a powerful sales tool when taken to state fairs and home shows. A display unit overcomes the initial lack of familiarity many potential customers have. Being able to see an operational unit also alleviates sound level and appearance concerns. Some utilities reported receiving funds from NEEA or the manufacturers to aid in the purchase of their display units. Manufacturers may also benefit from providing display units as the utilities reported promoting the brand of their demo display unit to their customers.

Utility program administrators indicated they planned to continue their current marketing strategies in the future. Only one utility indicated they had any plans to extend their marketing; expansion plans included potential television spots and more radio advertising to target younger consumers.

Utility Program Successes

Utility contacts reported various forms and levels of program success, from a few installations to a significant refocus of contractor attention towards DHPs. Universally, utility program administrators reported nearly universal positive feedback from their customers. All utilities had also installed a sufficient amount of DHPs to meet their energy savings goals.

Inspections and Contractor Education

In addition to positive customer feedback, utility contacts reported successes with contractor education and inspections. Those utility administrators with active inspection programs reported that the inspections provided an opportunity to enforce quality installations and educate their contractor networks. Fluid inspections were also credited with improved installations and contractor education. Utility contacts indicated that their inspection processes have resulted in high quality installations and well-educated contractor networks, which are a major asset in

promoting the DHP initiative. The inspection process has also given the utilities an opportunity to strengthen their relationships with their contractor networks.

Challenges

Contractor Education

Although most utilities consider the contractor education efforts successful, in some of the smaller areas, which utility contacts described as more rural, contractor awareness and education are still lacking. Contractors without sufficient understanding of the DHP technology or faith in DHP performance do not drive DHP sales. New installers, or those who do few installations, have lower levels of understanding of the DHP initiative. The DHP is also less profitable to some contractors than the traditional ducted systems, which reduces the interest level from some contractors. Utility contacts indicated that education could overcome these barriers.

Cost

Even with the incentive, four thousand dollars is a considerable financial commitment to many potential customers. This is especially true in some of the areas hit hardest by the current economic recession and in rural areas. In these areas it is more difficult for contractors to make an appealing case to their potential customers, especially because the typical DHP customer is elderly or owns a small home and may have a modest budget for home improvements.

Other Markets

We asked the utility program administrators about other potential markets for DHPs in their territory. Some had already expanded into other markets, beyond the residential single-family homes included in the program.

Commercial

Some utilities have already encouraged DHP installations in small commercial facilities, such as in fast food restaurants, in their territories. One utility reported that every Subway restaurant in their town has a DHP. Program administrators believe small commercial installations constitute a potentially large market for DHPs. In addition to fast food chains, administrators see small retail establishments, labs, server facilities, and space additions in office buildings as promising applications for DHPs.

Multi-Family

Only two utilities had installed DHPs in multi-family housing. The other utilities offered conflicting opinions about the viability of DHPs for multi-family housing. Some utilities view DHPs as a perfect fit for small multi-family housing with shared walls. Other contacts do not believe the units can be correctly situated to serve multi-family housing sufficiently. The two contacts that had already installed DHPs in multi-family housing reported that the installations

are functional and well received. Some of the smaller utilities indicated that they do not have much multi-family housing potential. Program administrators see some opportunity for DHPs in multi-family homes and, at the time of our interviews, were waiting to see if multi-family incentives will continue.

Manufactured Homes

Program administrators do not regard manufactured homes as a promising DHP opportunity. Manufactured homes are built with ducts. To convert them to be conditioned with DHPs, the ducts would have to be closed off. Two utility contacts indicated that manufactured homes are better candidates for Performance Tested Comfort Systems (PTCS) than for DHP conversion.

Future Projections

Utility program administrators plan to continue their programs for as long as funding continues, from BPA or, for investor-owned utilities, from their management. Contacts indicated that they will continue quality assurance inspections and contractor education efforts into the coming year. Program administrators intend to continue building contractor knowledge and training. Additionally, they intend to continue current marketing practices and are considering expanding their marketing into more technologically advanced approaches.

INITIATIVE IMPLEMENTATION STAFF INTERVIEWS

Research Into Action completed three interviews with initiative implementation staff from Fluid (2) and NEEA (1). All contacts reported that their role in the 2010 initiative had remained consistent since the previous year. Contacts reported, however, that the 2010 initiative brought about new developments, successes, and challenges.

Initiative Evolution

During the 2010 initiative, interactions between contractors and the Fluid staff transitioned from primarily application paperwork processing to a more ―hands-off" relationship, which consisted of inspections and recruiting additional contractors. In 2010, BPA took a more active role in processing paperwork, freeing more Fluid staff time for inspections and targeted training. Fluid also directed their attention to providing more technical support to the utilities. The program focus also extended beyond the original single-family electric resistance homes into some multi-family and manufactured homes. NEEA maintained the same role from 2009 through 2010, although the specific focus of some parts of its involvement shifted.

Working with Installers

Implementation contacts reported that relationships with installers have progressed since 2009. The initiative now has a more advanced marketing structure and can provide well-tested templates to installers instead of customizing marketing to each individual firm. While training and orientation for installers have remained primarily the same, the initiative developed a new

Master Installer program in 2010, which includes a best practices web training, preferential ranking on the DHP website, and a recognition of well performing installers who have demonstrated advanced knowledge of initiative theory and implementation.

Implementation contacts also indicated that firms are sending more contractors per firm to training then for the pilot. Initiative trainings are increasingly coordinated with manufacturers, especially Mitsubishi. The initiative is also conducting more trainings in regions that previously had lower uptake. The implementers planned for more events in 2011 to capitalize on the momentum generated in 2010.

Working with Retail

Implementation contacts envision DHP sales through big box retailers as a step towards market transformation as the technology branches out into new sales channels. Fluid contacts reported that DHPs are, and will continue to be, sold in retail outlets. Mitsubishi has already started working with Home Deport in some areas. Fluid is attempting to make this practice more common and extend it to other manufacturers. Currently, Home Depot only sells Mitsubishi units and contractors who work through Home Depot are limited to that one brand. Fluid contacts indicated that retail stores have the ability to show unfamiliar customers a display DHP unit. Retail stores also provide the customer with the option of using a store credit card to finance the purchase of the DHP unit and installation. These stores, however, do not have the capability to provide estimates, scope a household, size an appropriate unit, or install the units.

Successes

Implementation contacts described 2010 as a very successful program year. Contacts identified marketing achievements, contractor recruitment and training, and increased regional support among the key initiative successes in 2010. The 2010 initiative also achieved 5,300 new installations. Contacts indicated that over 80 percent of total DHP installs are in single-family zonal homes, the intended target of the initiative.

Marketing

In 2010 the initiative's marketing efforts explored some new avenues, such as television and radio. The initiative was able to capitalize in radio Public Service Announcement rates to get a great deal of radio play at a low cost. Manufacturers had the opportunity to contribute funds to the radio advertising to promote their brand of DHP. The radio ads had an estimated 32,000 plays in some of the largest potential DHP markets. NEEA focused specifically on markets with low DHP uptake or affordable radio advertising slots. The radio outreach was very cost effective and contacts estimated the value of the advertising was over $500,000. The initiative created about 150,000 contractor sales sheets to help contractors market the DHP to their customers.

In previous years, the majority of customers installing DHPs were over age 60. To address this, the initiative employed online marketing to attract a younger market. Contacts judged this successful, as they saw an increase in installations among younger groups. The initiative also tested online banner ads which received about ten million postings and brought an estimated

2,700 visitors to the website. The implementers placed banner ads on weather websites on particularly hot or cold days.

Initiative implementation contacts indicated that 2010 was a key year in advancing their relationship with manufacturers and distributors in terms of marketing. Mitsubishi and Fujitsu committed to adopting some initiative messaging in their marketing materials. The existing marketing materials used by these manufacturers will be adapted to include some displacement and single unit benefits. This will create a marketing tool that can appeal to customers interested in various DHP applications and options. By joining together with the initiative in this marketing effort, manufacturers and distributors are displaying an acceptance of the initiative goals unparalleled in previous years.

Moving forward, contacts indicated that marketing will move into social media, billboards, and television PSA advertising. Along with new modes of advertising, the initiative will continue to work with manufacturers and distributors to create a unified message around DHPs. Contacts indicated that a future goal is to expand the displacement message beyond the Northwest.

Challenges

Implementation contacts reported no new challenges in 2010, yet some of the issues present in the prior years carried forward. Most notable, the challenge of increasing consumer and contractor awareness remains.

For consumers, implementation contacts reported that awareness and first cost are still substantial barriers. The initiative has made substantial progress informing a previously unaware consumer market about the potential of DHPs. Implementation contacts indicated that the initiative goals seek to make the DHP as ubiquitous as the dishwasher or refrigerator in the home. In addition to awareness, the first cost of a DHP is still considered high by many potential customers, with costs averaging around four thousand dollars.

Implementation contacts believe contractor education has made great strides and the Master Installer Program has been especially successful. Despite these successes, contacts indicated that contractor education in rural areas or areas with few installations is still lacking. Implementation contractors indicated that some contractors are still learning how to sell this relatively new technology. The implementation team has made steps towards overcoming this education gap with contractor sales sheets, increased webinar training, and increased coordination of the entire supply chain. Contacts also credited inspections conducted by Fluid with educating contractors and increasing the quality of installations.

Future Plans

Implementation contacts indicated that several accomplishments in 2010 could be expanded in future efforts- specifically relationships with manufacturers and distribution networks. In 2010 these relationships evolved as the manufacturers and initiative implementers developed agreement around advertising messages. In 2011 the initiative will continue to work with manufacturers to create cohesive messaging and a unified front for DHP sales in displacement applications.

The initiative also began working with Energy Star in 2010 to shape the messaging the brand will use around DHPs. Initiative staff helped define the Energy Star marketing and installation guidelines. This relationship allows the initiative to apply the knowledge gained over the past years towards a larger audience through Energy Star. In 2011 the initiative will continue to build on this established relationship.

4 FINDINGS FROM SURVEYS

CONTRACTOR SURVEY

Methodology

We completed surveys with 214 northwest residential HVAC contractors. Working from Dunn and Bradstreet[5], augmented with data from program records, we divided the population into six groups (strata) to capture a representative distribution of urban and rural, large and small, and participating or non-participating contractors. Our survey instrument screened HVAC contractors to exclude those not working in the residential sector, to confirm or revise the strata classification of each, and to establish awareness of DHPs; we completed surveys only with contractors aware of DHPs. Our survey disposition enabled us to estimate the market size of each strata and the proportion of the market strata aware of DHPs.

We weighted the data to represent the population of contractors aware of DHPs; Appendix B provides additional information on the surveyed firms and the weighting. The contractor statistics in this report describe weighted findings; the respondent sample sizes (the ~~"n~~'s" given in tables and figures) describe the actual, unweighted number of survey respondents.

We report any statistically significant differences among the strata; we found no statistically significant differences between the oriented participating contractors and oriented non-participating contractors.

Total HVAC Contractor Market

Table 4 provides our estimates of the proportions of the total northwest residential HVAC contractor market aware of DHPs and the initiative and experience installing incentivized and unincentivized DHPs, by submarket. Note that the column ~~"i~~nstalled DHPs" includes contractors – only 3% of the total – who have installed DHPs only in commercial applications. For details on the total amount of DHP installations in the region, with an emphasis on unincented installations, see *DHP Installations* later in this chapter.

Please note, a contractor may have installed DHPs and be unaware of the initiative, or may be aware of the initiative yet not have installed any DHPs; however, all contractors who installed incentivized DHPs are also members of the set of contractors that have installed DHPs and the set that is aware of the initiative. Finally, the reader should understand that contractors installing initiative DHPs may also have installed nonincented DHPs, a topic discussed further in the section *Incented and Unincented DHPs by DHP-Installing Contractors.*

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5 Dunn and Bradstreet provides information about over 150 million businesses and corporations worldwide for use in business to business marketing and supply chain manage.

Table 4: Total HVAC Contractor Market Awareness of, and Experience Installing, DHPs

HVAC Contractor Market	Percent of Regional HVAC Contractors			
	Aware of DHPs	Installed DHPs	Aware of Initiative	Installed Incentivized DHPs
Total HVAC Contractor Market	92%	79%	61%	20%
Oriented, Participating Contractors	100%	100%	100%	100%
Oriented, Non-participating Contractors	100%	94%	100%	0%
Large Urban Contractors (non-oriented, non-participating)	90%	78%	49%	0%
Small Urban Contractors (non-oriented, non-participating)	88%	68%	37%	0%
Large Rural Contractors (non-oriented, non-participating)	100%	83%	50%	0%
Small Rural Contractors (non-oriented, non-participating)	86%	57%	43%	0%

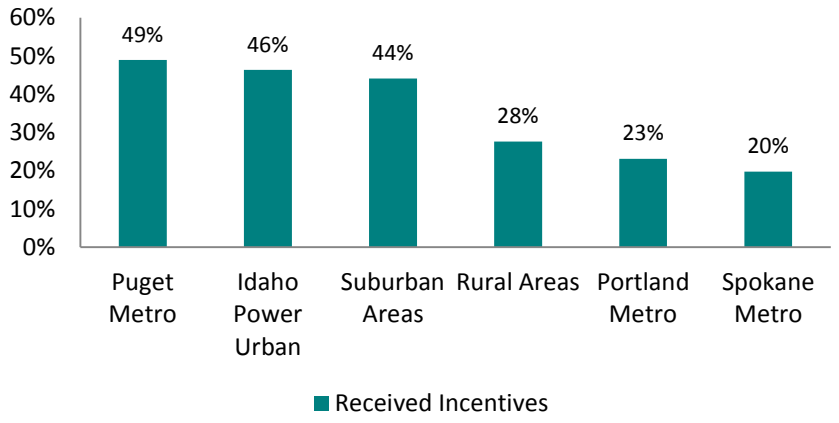
HVAC Contractors Aware of DHPs

The remainder of analysis in this chapter presents findings from the survey of contractors aware of DHPs. The text clearly states whether the frame of reference is all contractors aware of DHPs, all contractors that installed DHPs, all contractors aware of the initiative, or all contractors installing incentivized DHPs through the initiative.

Initiative Participation and Awareness among Contractors Aware of DHPs

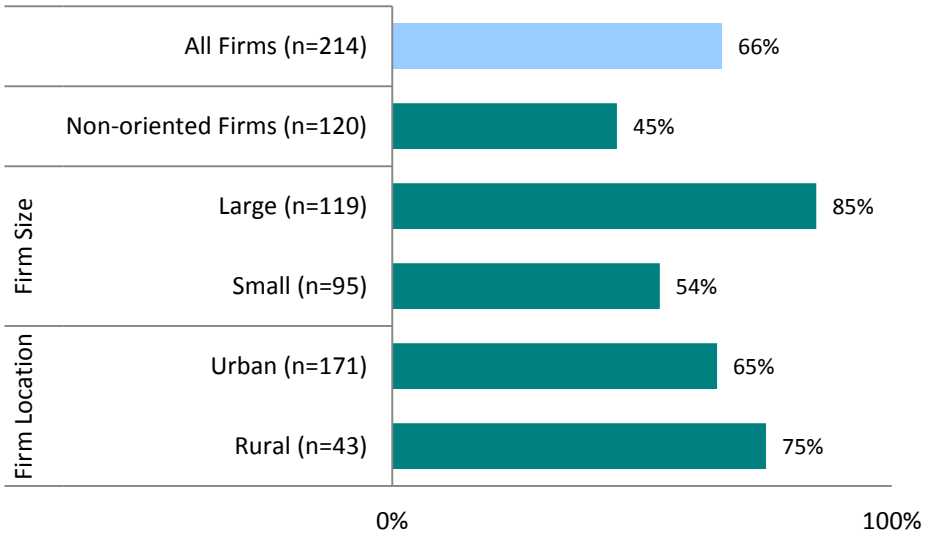
Of DHP-aware contractors, slightly less than a quarter (21%) (20% of the total HVAC contractor market) reported having received an incentive through the initiative. A large proportion (67%) of large rural firms did not know if their company had received an incentive through the initiative. Among those aware of the initiative, only 20 percent of firms in the Spokane grouping (see Appendix B for definition) reported receiving incentives, compared to almost half of the firms in the Puget metro, Idaho area, and rural areas.

Figure 1: Initiative Participation among Initiative-Aware Contractors (n=152)



Overall, two-thirds (66%) of DHP-aware contractors (61% if total HVAC contractor market) reported awareness of the initiative (Figure 2). About half of all non-participating contactors reported initiative awareness. Non-oriented small rural and small urban firms reported the lowest levels of initiative awareness (between 39% and 50% unaware). Smaller firms reported less awareness when compared to large firms. Half of surveyed small firms reported no awareness, compared to 30 percent of large firms. Contractors in the Spokane area reported the lowest levels of awareness (52%). This difference is statistically significant when compared against the Clark/Eugene area, Idaho, and rural areas. Both the Spokane area (64%) and the Seattle area (58%) had more contractors who had not attended an orientation than the overall average (44%).

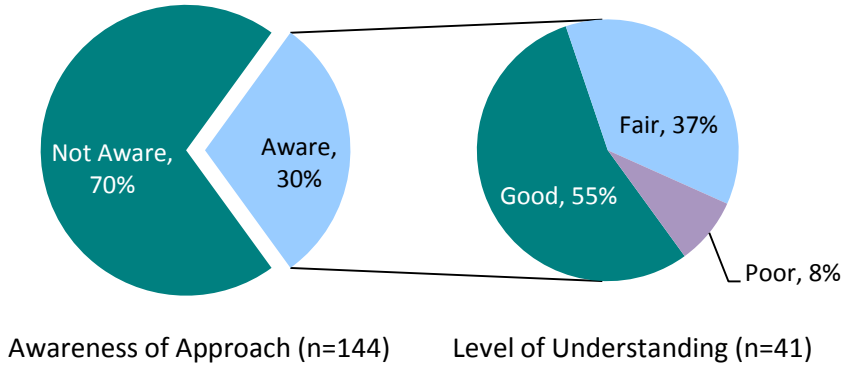
Figure 2: Awareness of NEEA's Initiative among DHP-Aware Contractors



The NW Ductless Heat Pump Initiative is based on a theory of displacement instead of replacement, meaning the DHPs are intended to displace the existing primary electric heating system in the home to reduce energy use. Seventy percent of contractors who reported being aware of the initiative said that they had not heard of the displacement versus replacement approach (Figure 3).[6] Of those who had heard of it, slightly more than half (55%) indicated that they had a ―good understanding" of the approach. An additional third (37%) indicated they had a ―fair understanding".

[6] Contractors indicating familiarity with the program responded to the question: "Have you heard of the NW Ductless Heat Pump Program's „displacement not replacement' approach to DHP installations?"

Figure 3: Awareness and Understanding of Initiative's "Displacement versus Replacement" Approach among Initiative-Aware Contractors



Among those initiative-aware contractors, 62 percent of contractors reported visiting the initiative website, including a large majority (89%) of all oriented contractors. Most contractors who had visited the website (70%) rated it in the top two boxes on a five-point satisfaction scale. Significantly more of the participating contractors found it useful than did the oriented but not participating contractors.

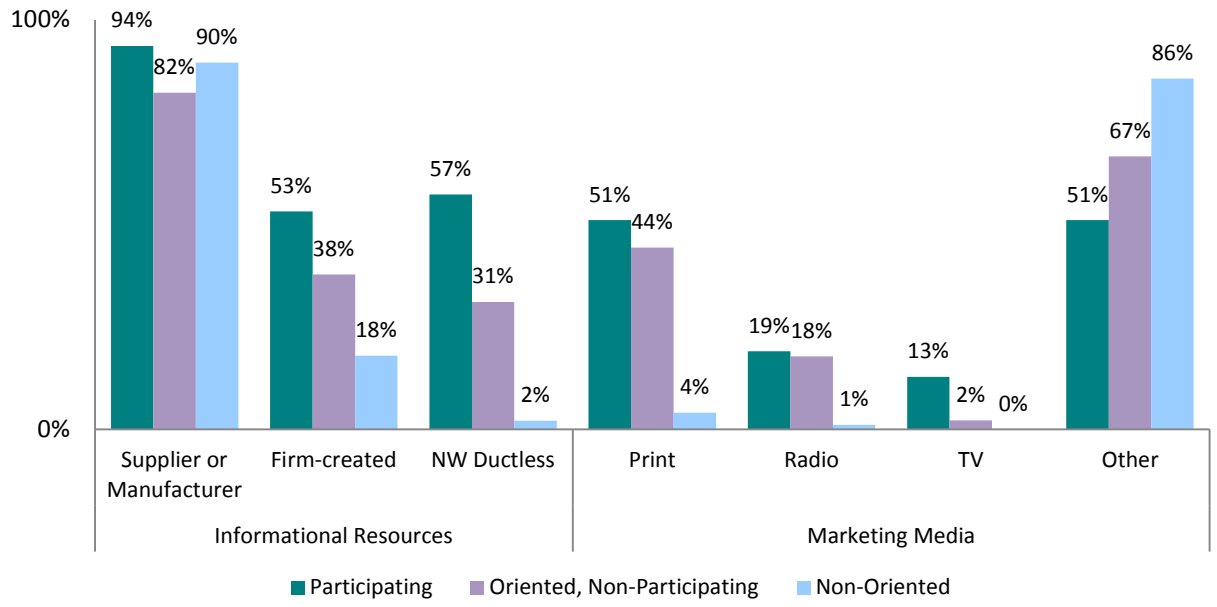
Less than half (45%) of the initiative-aware respondents had contacted an initiative representative. Participating contractors reported the most contact with initiative staff. Large urban contractors were the only group aside from the oriented and/or participating contractors to report any contact with initiative staff. Respondents in Portland, Spokane, and rural areas reported the lowest levels of contact with initiative staff. Surveyed contractors universally rated the initiative staff as responsive with a majority (92%) rated them a ~~"4~~" or ~~"5~~" on a five point scale.

Half of contractors familiar with the initiative (51%) expressed a preference for keeping the current incentive amount for whatever duration the utilities can support rather a larger incentive for a shorter time or smaller incentive for a longer period of time. A majority (57%) of non-oriented small rural contractors expressed a preference for a smaller incentive over a longer period of time.

DHP Marketing by Contractors Installing DHPs

Contractors who had installed DHPs reported using a variety of materials to introduce customers to the technology (Figure 4). Nearly all (89%) reported distributing materials from the manufacturer or distributor. Participating and oriented non-participating contractors reported distributing NW Ductless or personally created materials more often than all other groups. A majority of participating contractors reported distributing both initiative materials and materials created by their firm. Oriented non-participating and participating contractors reported the highest rates of print and radio marketing.

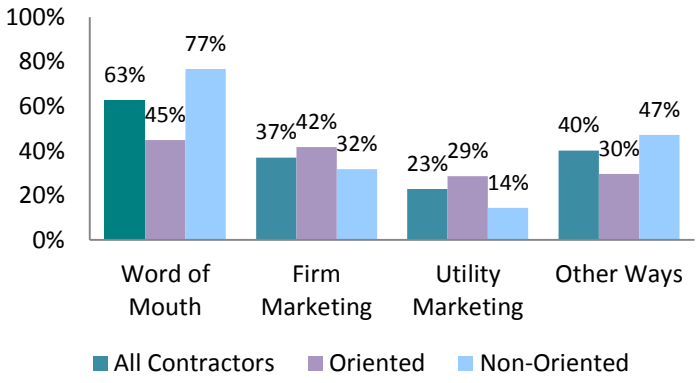
Figure 4: Informational Resources and Marketing Media Used by DHP-Installing Contractors (n=188)



A large majority of non-oriented contractors reported ―other marketing" which consisted primarily of online/website advertising (32%), various types of print ad (19%) and word of mouth (11%). Overall, radio marketing was more common in rural areas, while print marketing was most commonly used in the Puget Metro and Idaho Power areas.

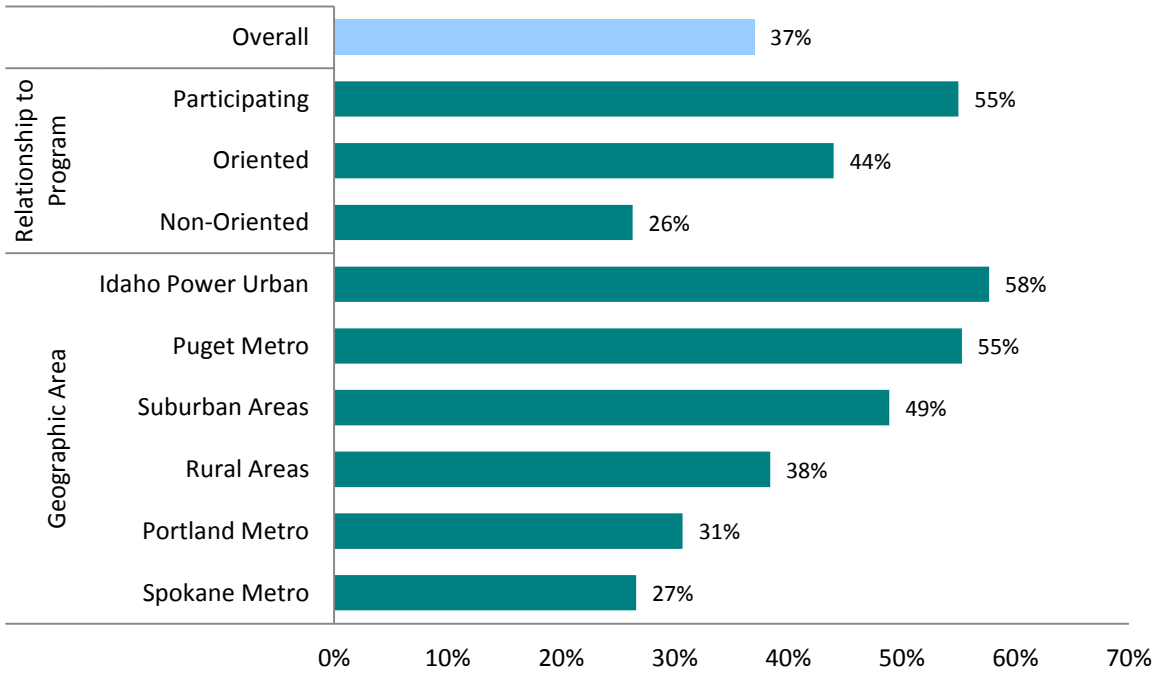
Participating and non-participating oriented contractors reported the highest percentage of sales to customers who contacted them in response to utility marketing. These contractors reported lower than average rates of customers contacting them due to word of mouth (less than 50% compared to 63% on average).

Figure 5: Customer Source of DHP Awareness as Reported by DHP-Installing Contractors (n=188)



Participating and non-participating oriented contractors reported the highest rates of customers asking specifically for DHPs (55% and 44% respectively, compared to 37% overall). The Portland Metro and Spokane areas reported the lowest rates of customers asking specifically for DHPs.

Figure 6: Customers Specifically Requesting DHPs as Reported by DHP-Installing Contractors (n=188)



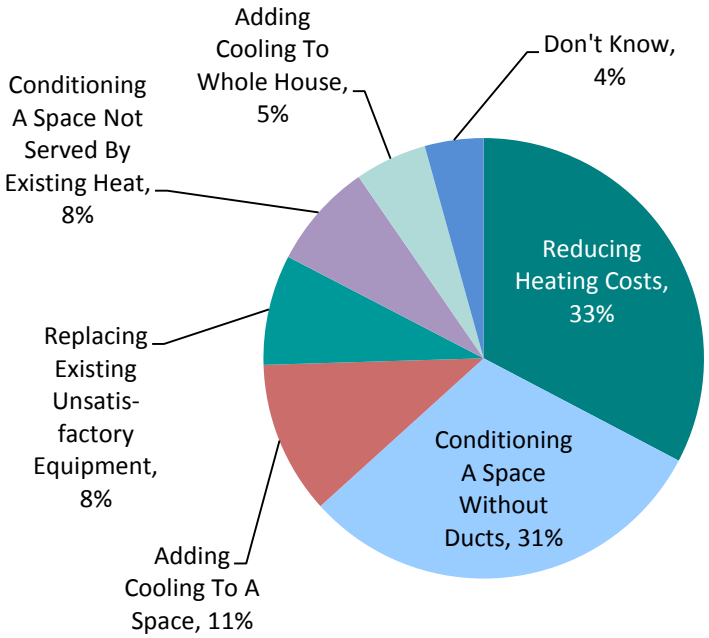
Just under half of all DHP-installing contractors (46%) reported having strategies to encourage customer referrals. Participating and oriented non-participating contractors reported having referral strategies more often than any other groups. These strategies included providing incentives, suggesting their customers refer others, and following up with prior customers. Among non-oriented firms, large urban contractor firms reported using incentives to encourage referrals more often than small rural or urban contractors. About half of initiative-aware contractors indicated that additional resources could help them increase the number of DHPs they sell. None of the large rural contractors indicated a need for additional resources. Additional resources contractors suggested might be useful included additional technical support from distributors, additional marketing materials, and additional support from manufacturers.

Customers' Purchasing Motivations per DHP-Installing Contractors

Contractors who have installed residential DHPs identified what they believe to be the reasons customers consider DHPs. These contractors most frequently identified the motivators of reducing heating costs (33%) and conditioning and space with ducts (31%). Less common

reasons included adding cooling to a space (11%), replacing existing unsatisfactory equipment (8%) and conditioning a space not conditioned by existing equipment (8%).

Figure 7: Customers' DHP Purchasing Motivations as Reported by DHP-Installing Contractors (n=188)



Incented and Unincented DHP Installations by DHP-Installing Contractors

Installations Prior to the Initiative

Prior to the program (both its pilot and initiative phases), DHP-aware contractors had installed an average of 12 DHPs in homes. Participating and oriented non-participating contractors reported installing significantly more DHPs prior to the program than the other non-participating contractors.

Relatively few DHP-aware contractors reported installing short run or concealed duct DHP systems in the past two years, and these systems comprised a small portion (under 6%) of DHP system installations. No rural contractors, small or large, reported installing these types of systems. Contractors in the Spokane area were even less likely to report having performed these types of installations than the contractors in other areas.

Initiative Installations

As of May 2011, the NW Ductless Initiative installed 10,500 DHP systems.[7] The 20% of regional contractors that participated in the initiative installed about 80% of the estimated target market installations, which include unincented installations. Through contractor reports, we estimated the total number of residential-size DHPs installed in the region since the initiative began (through summer 2011) to be around 22,950 (Table 5).

Table 5: DHP Installations as of May 2011 (DHP-Installing Contractors)

Installation Category	Amount
Total Number of Residential-Size DHPs Installed in Region Since Pilot Began (the subsequent categories constitute various subsets of this group)	22,950
Total Installed through NW Ductless Heat Pump Initiative (per program database)	10,500
Total Installed without Incentives (sum of residential and commercial)	12,450
Total Installed in Commercial Applications	4,265
Total Unincented units Installed in Residences	8,185
Total Unincented Installed in Existing Homes	7,544
Total Installed One-to-One Systems in Homes (irrespective of construction status as existing or new)	4,754
Total Units NOT in Existing Homes OR NOT One-to-One Systems	5,169
Total Units IN Existing Homes AND One-to-One Systems	3,016

Unincented Installations

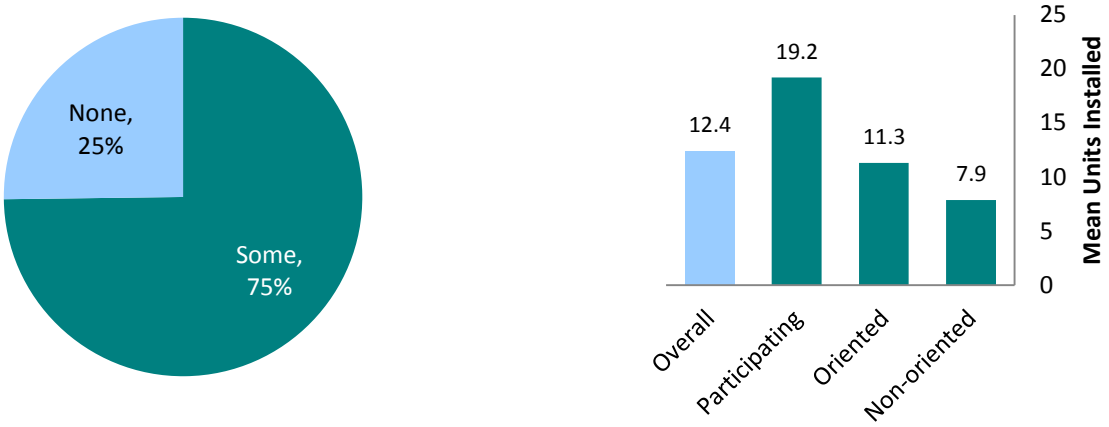
All DHP-installing contractors reported their unincented DHPs comprised mostly (67%) single head systems. Large and small rural contractors reported higher proportions of single head systems than any other group. On average, ten percent of unincented units went into newly constructed homes. Slightly more than a quarter (27%) of unincented installations conditioned space that was previously unconditioned.

Three quarters of initiative-aware contractors reported having installed at least one DHP without a program incentive (Figure 8). While this population average generally held in each of the subgroups we examined, in contrast only 35% of contractors in heating zone three that were aware of the program had installed at least one unincented unit.

Participating contractors reported installing more unincented units than non-participating contractors, with a mean of 19.2 compared to the overall mean of 12.4. Contractors in urban areas reported significantly more unincented installations (13.4) compared to rural contractors (7.6).

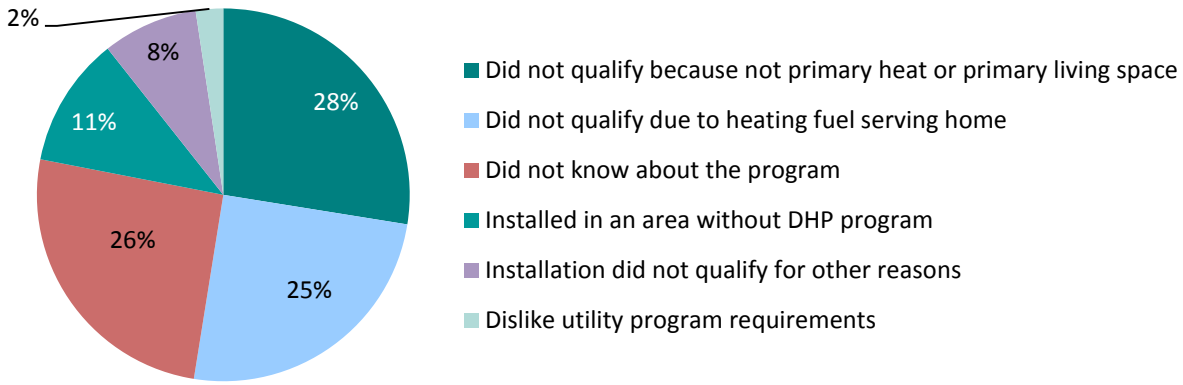
[7] As of September 13, 2011, the initiative database included 12,047 incentivized installations.

Figure 8: Prevalence and Average Number of Unincented Installations among DHP-Installing Contractors (n=152)



DHP-installing contractors provided a variety of explanations for why units are installed without incentives. Participating contractors most frequently (47%) reported that applications did not qualify (not primary living space or primary heat). Contractors in the Idaho area also cited disqualification as the most common reason (79%) for unincented installations. Overall, participating and oriented non-participating contractors reported secondary heating fuel as a reason for unincented installations more than the other non-participating contractors. Non-participating contractors cited not being aware of the initiative as the largest reason for unincented installs (26%) followed by secondary heating disqualification (25%) (Figure 9).

Figure 9: Reasons for Unincented Installations among DHP-Installing Contractors (n=149)

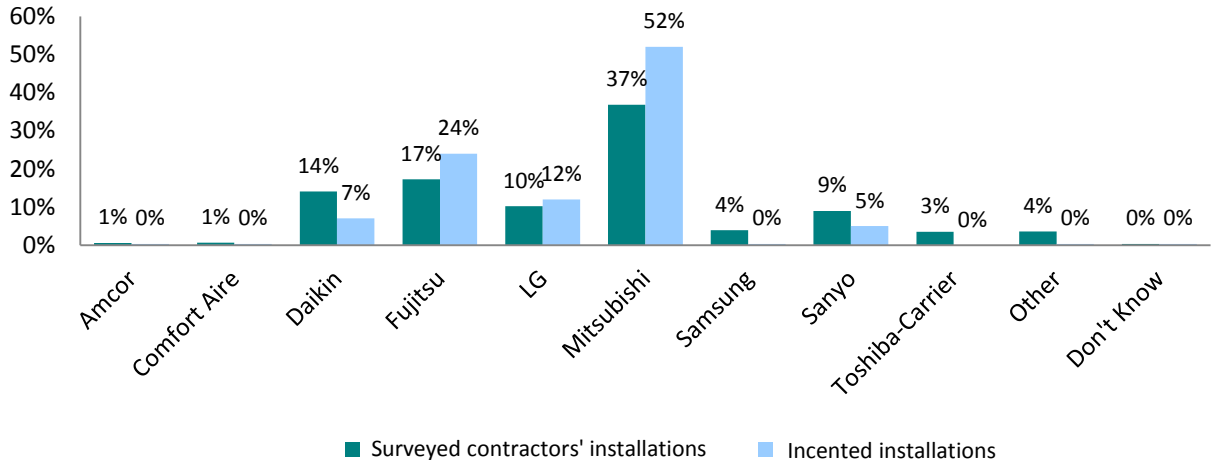


Brands Installed

Forty percent of DHP-installing contractors offered more than one brand to their customers. Installers reported stocking Mitsubishi (37%) and Fujitsu (17%) units most often. These

proportions reflected the incentivized installations for the same January to May 2010 timeframe (Figure 10).

Figure 10: Comparison of Brands Installed by DHP-Installing Contractors with Brands of Incented DHPs)



*Other brands: Amana, Bryant, EMI, Geo Comfort, Goodman, Gree, Gustave Larson, Knight, York, and Turbo Air.

The most popular brands have remained consistent since the beginning of the NW Ductless Initiative in 2008[8]. The brands of unincented installations varied by region.

Perspectives of Non-Installing Contractors

Advantages and Disadvantages of DHPs

We asked contractors who had not sold any DHPs to residential customers about what advantages DHPs offer and if the technology has any disadvantages. Contractors most frequently selected lower installation costs (28%) and lack of ducts (12%) as the strongest strengths from a list. Non-installing contractors also offered some other advantages such as the zonal controls, quiet operation, and suitability to small houses.

The most common identified disadvantages included costs, cold weather performance, availability, and appearance.

Plans

Of contractors who reported no DHP installations, more than half (16 of 26) indicated planning to recommend DHPs to their residential customers in the future. Of those who commented on

[8] NW Ductless Heat Pump Pilot Project Market Progress Report. Research Into Action.

their future sales projections, about two-thirds of contractors anticipated selling more DHPs than in 2010.

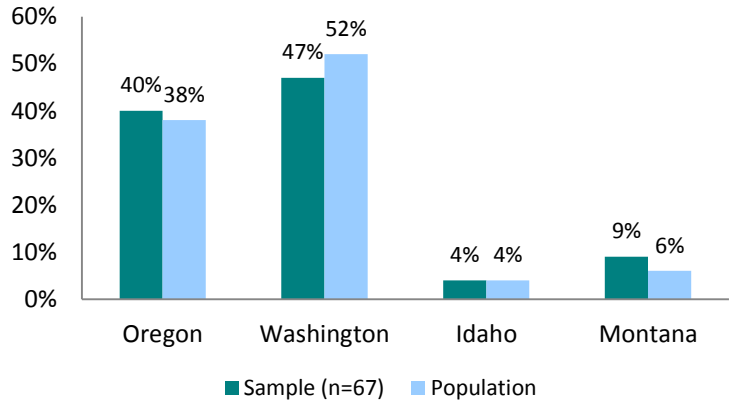
PARTICIPANT SURVEY

The evaluation team completed surveys with 67 participants who had installed DHPs through the initiative. We completed the surveys between May 25 and June 5, 2011. The surveys lasted between 15 and 20 minutes. The team placed up to five calls to each potential respondent and called potential respondents in evenings and on weekends to prevent convenience bias.

The research team selected potential respondents randomly from a list of residential customers who had installed a DHP between January and May of 2010. This selection ensured that participants represented the 2010 initiative year and had experienced both a heating and cooling season. The sample also represented participants in all three cooling and heating zones[9]. We sampled for a 90/10 confidence and precision. We used the Pearson χ^2 test to identify statistically significant differences across the cooling and heating zones. We found only no significant differences among groups.

The sample included participants in all four states (Figure 11) in proportions roughly equal to the population.

Figure 11: Participant Sample and Residential Population

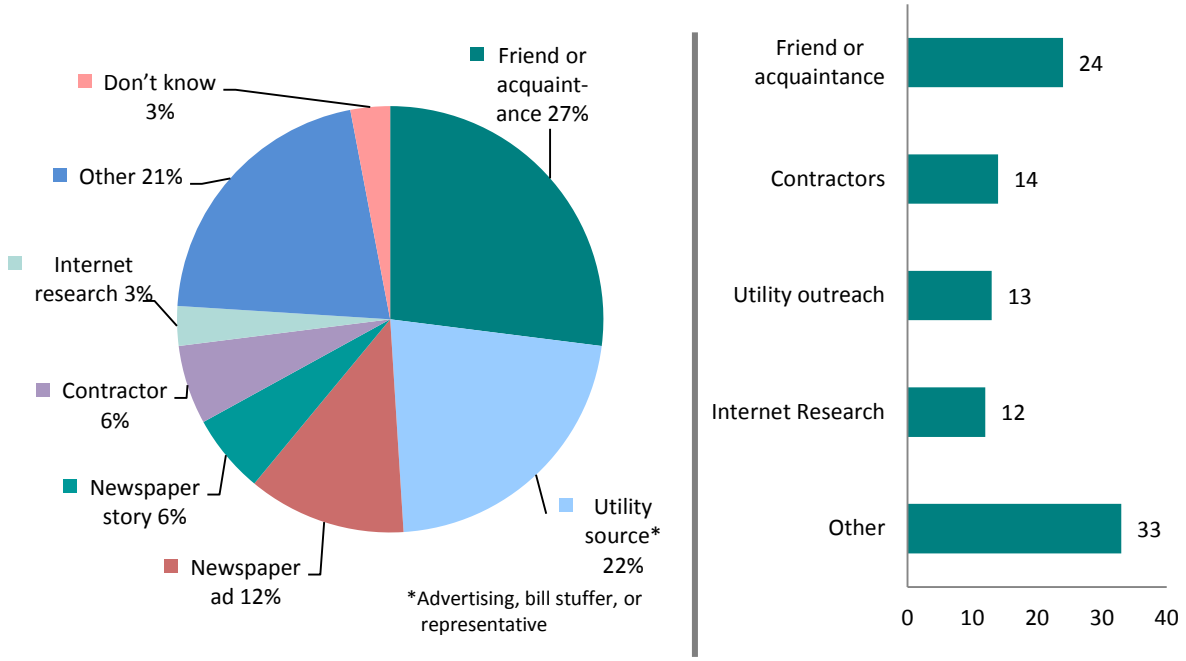


Source of DHP Awareness

Participants reported their initial source of awareness about ductless heat pumps. The majority of respondents indicated that they heard about DHPs from someone they knew or via utility outreach, consistent with contractor perceptions (Figure 12).

[9] See Appendix A for explanation of heating and cooling zones.

Figure 12: Source of Initial DHP Awareness among Participants (Left; n=___) and Most Influential Source of Awareness (Right; n=67)



The ―other" responses included other publications (3), travel (2), and seeing a DHP in person at stores (2). Twenty-eight respondents also indicated additional sources of awareness about the DHP. When asked to prioritize the most influential source of information the majority indicated that their friends or acquaintances were the most influential (24), followed by contractors (14), with utility outreach ranked third (13).

Initial Interest

We asked participants what initially interested them in a DHP. Respondents indicated that reducing their heating bills (29) and needing to supplement or replace their existing heating (18) prompted them to investigate DHPs. Respondents were allowed to give multiple answers.

Table 6: Reasons Participants Considered DHPs

Initial Reason For Interest	Frequency
Wanted to reduce heating bill	29 (43%)
Needed additional or supplemental heating	18 (27%)
Needed space conditioning but did not have/want ducts	16 (24%)
Wanted to add cooling where none was installed before	14 (21%)
Needed additional or supplemental cooling	12 (18%)
Rebates or incentives	5 (1%)
Alternative to wood	4 (<1%)

Initial Reason For Interest	Frequency
Existing heat was broken	4 (<1%)
Converting a space or adding new space to home	2 (<1%)
DHP capability to heat AND cool	2 (<1%)
Quiet	2 (<1%)
Don't know	3 (<1%)
Total	**NA**

All of the participants reported looking for information about DHPs to support their purchase decision. The most common sources of information were speaking to contractors (34), the internet (20), and printed materials from contractors (17). Additionally, 16 respondents sought information from another individual who already had a DHP installed. Fourteen respondents reported that their utility was a source of information, either through their websites, speaking to a representative, or publications.

Although several (34) participants reported that their contractor was a source of information before purchase, 86 percent (60) of all participants reported that they sought out a contractor who could install the DHP rather than being approached by a contractor who suggested a DHP.

Participant Satisfaction

In 2010 participants reported high levels of satisfaction with the DHP technology and purchasing process. All except one respondent also reported that they had (61%) or would (37%) recommend the DHP to a friend or colleague. The most popular reasons participants would recommend the DHP were financial benefits (29), increased comfort (12), efficiency (12), and the combination of heating and air conditioning (7).

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5 FINDINGS FROM ACE MODEL REVIEW

As part of the MPER research, we conducted a validation of the DHP ACE model, assisted by the firm of Proctor Engineering Group. Appendix D provides the memorandum deliverable of the research findings.

Here, we summarize the key findings.

Target Market Definition, Size, and Energy Savings: The ACE model defines the DHP Initiative target market as *existing single family (SF) homes with electric zonal heat,* yet the initiative manager defines the target market as *all* existing electrically heated SF homes. This difference between the two target market definitions has implications for the ACE Model, as follows.

The model assumes a high total market share for DHPs at the end of the forecasting period. If the market size of all existing electrically heated SF homes is considerably larger than that of existing zonal electrically heated SF homes, it may not be reasonable to assume that DHPs will attain the same ultimate penetration of the larger market as it might attain of the smaller market. In addition, if the market size of all electric heat homes is considerable greater than that of zonal electric heat homes, then the size of the complementary non-target market (non-incented residential-size units) is smaller than it is with a target market of zonal heat.

The ACE model assumes an energy savings value consistent with findings to date on savings for homes with electric zonal heat. Engineering principles suggest there may be less energy saved at homes with electric heat controlled through a central thermostat, such as forced air furnaces. Thus, it would not be appropriate for the model to apply the zonal heat savings estimate to other applications.

Net Energy Savings: NEEA defines net energy savings as non-incented *residential (3 tons or less)*[10] DHP units, regardless of their application within or outside of the target market. For example, commercial applications of residential units count toward estimates of net energy savings. The ACE model currently accommodates a single parameter for net energy savings, yet the energy savings will differ according to market application.

As suggested in Table 6 and detailed in Appendix E, *Additional Unincented Installations Research,* the initiative net market effects are potentially large if the savings of all unincented installations of residential-size DHP units are included.

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10 Fluid, NEEA's DHP implementation contractor, suggested that residential-sized units are as large as 5 tons, while commercial units are as small as 3 tons. Yet Ecotope, NEEA's DHP impact evaluation contractor, strongly recommends that residential units be defined as 3 tons or less, as larger units use a different technology (VRF) that NEEA has not investigated.

6 CONCLUSIONS AND RECOMMENDATIONS

This chapter summarizes the findings and presents the conclusions and recommendations we draw from the 2010 evaluation of the Northwest Ductless Heat Pump Initiative.

SUMMARY OF FINDINGS

Our findings relating to the initiative's goals and objectives follow:

***Goal:* Partner with Northwest utilities and energy efficiency organizations to achieve a 15% market share of DHP by 2014 in single family electrically heated homes**

Findings: In 2010, the DHP Initiative continued to expand awareness and uptake of ductless heat pumps. The initiative strengthened partnerships with utilities and energy efficiency organizations to maintain initiative installations and advance marketing to expand into new demographics. Initiative outreach is increasingly targeting younger potential customers and those reached by alternative marketing such as social media.

***Goal:* To continue to demonstrate the use of inverter-driven DHPs to displace electric resistance space heat in existing Northwest homes**

Findings: More than half of the contractors in the region are aware of the initiative, and more than 70 percent of those contractors are aware of the initiative's objective to displace existing electric zonal heating equipment. Manufacturers reported increased cooperation with and appreciation for the initiative and displacement applications. DHP-installing contractors are satisfied with the technology. Cold weather efficiency performance varies by brand, yet even lower-efficiency brands still provide sufficient space conditioning. Manufacturers suggest an additional wind baffle can help increase the cold-weather efficiency of some units.

***Goal:* Increase contractor awareness and adoption of ductless heat pump technology and applications in single family homes with electric resistance heat**

Findings: Over 90% of northwest residential HVAC contractors are aware of ductless heat pumps, nearly 80% have installed them (one quarter of these have installed DHPs through the initiative, installing about half of the regional residential DHPs installations since 2009 and 80% of all target market applications). Surveyed contractors (contractors aware of DHPs) reported actively pursuing the initiative target market of single family homes with electric resistance heat. Contractors plan to continue promotion of DHPs. Utility, manufacturer, and contractor contacts described less understanding of the technology and the goal of electric-heat displacement among contractors in rural areas and contractors who do few installations.

***Goal:* Maintain and enhance a robust trade ally network**

Findings: In 2010 the initiative formed a Master Installer Network. This network created a system of recognition for installers with an advanced knowledge of the initiative structure and

generated additional market leads for these installers. As a result, the trade ally network has become stronger and more effective at providing installations that meet all initiative requirements. Contractors indicate a desire for additional manufacturer support and initiative marketing materials.

***Goal:* Increase affordability and variety of DHPs available throughout the region**

Findings: According to respondents and program data, the price of DHPs has decreased slightly in the 2010 initiative year. Some regions have developed sales partnerships between contractors and electricians which result in lower overall costs. Affordability remains an issue in regions where depressed local economies limit homeowners' investments in their homes, but very few contractors described DHP price as limiting sales. Contractors reported installing at least nine brands of DHPs.

***Goal:* Begin to shift the responsibility of quality installations to the marketplace by providing contractors with near-term feedback on best practices and areas of concern**

Findings: The 2010 Initiative has provided best practices for installations and inspections to utility program administrators, delivered through initiative-created webinars and trainings. Manufacturers' contacts reported including the installation best-practices content in their DHP contractor training; in the words of one contact, —The initiative has influenced installation training." Some manufacturers have increased the technical assistance they provide to support the expanding contractor network. Both contractors and utility contacts reported that installation quality has increased or remained high in 2010.

MARKET PROGRESS INDICATORS

Table 7 assesses and describes the initiative's market progress with respect to stated goals and logic model outcomes.

Table 7: 2010 DHP Initiative Market Progress Indicators

Program Goal or Logic Model Outcome	2010 Status	Findings
Utilities signed up; utilities embrace DHPs; utilities are actively promoting DHPs	Goal met	Five utilities joined initiative post pilot (total is 91). All surveyed utilities promote DHPs as part of their residential portfolio; some aggressively promote DHPs; all describe ongoing commitment to DHP program
Manufacturers and distributors provide cooperative marketing, including unified messaging	Progress	Manufacturers and distributors demonstrated new commitment to initiative marketing strategy and messaging by creating new materials featuring the displacement concept and promoting one-to one (singe head) applications

Program Goal or Logic Model Outcome	2010 Status	Findings
15% market share	Progress	3% market share. Initiative installations (~10,000) plus contractor-estimated installations in single-family electrically heated homes (2,600), divided by NWPCC estimate of population (402,000)
Over 250,000 systems installed	Progress	10% of goal. ~23,000 residential DHP systems installed (all applications) in region from start of pilot to May 2011
DHPs constitute largest share of residential energy efficiency portfolio savings	Progress	DHP installations continue to increase; utilities satisfied with their contribution to portfolio savings; contacts unable to comment on DHP's share of portfolio savings
Market actors report diminished importance of market barriers: Price point; cold-weather performance; aesthetics	Progress	Among noninstalling contractors, 30% reported price as a barrier and just a few respondents reported cold-weather performance or aesthetics as barriers. Among installing contractors, price perceived as a barrier in communities with depressed economies and little home remodeling.
HVAC contractors see DHPs as viable solution for their customers; contractors consider DHPs a viable solution for customers; have experience installing	Progress	About 80% of contractors have installed DHPs. About 30% of non-installing contractors have recommended DHPs to customers. Installations have occurred in single-family homes for primary living space and for secondary space, newly constructed homes, and multifamily and manufactured homes. Installing contractors report DHP buyers ask specifically for DHPs about one-third of time and two-thirds of time the contractor suggests; participants report opposite proportions
25% of AC installations are DHPs	Progress	DHPs comprise about 10% of cooling equipment installations, based on contractor estimates of both DHP and AC (CAC and RAC) sales
DHPs in big box retailers	Progress	DHPs sold by some Home Depot stores; initiative program and implementation staff and manufacturer contacts anticipate more retailers will offer DHPs.
Builders view DHPs as a viable alternatives in new homes; remodel contractors offer DHPs on appropriate projects (e.g., bonus rooms)	Progress	Manufacturers and distributors report new home applications, especially in some "higher end" new homes; installers estimate new-home installations comprise about 10% and secondary and add-on-space applications comprise about 20% of total residential installations
Some contractors specialize in DHPs	Progress	Some contractors reported DHPs are their primary business; some created custom sales approaches to promote DHPs, such as partnerships with electricians

CONCLUSIONS

The Northwest Ductless Heat Pump Initiative is making good progress in the attainment of its goals, objectives, and desired outcomes. Through efforts with the DHP supply chain and advertising interventions, NEEA increasing the market acceptance and adoption of residential ductless heat pumps within the initiative-targeted market, in the broader northwest market for residential-sized units, and outside of the region. Manufacturers serving the national market and organizations such as Energy Star are taking notice of the initiative structure and goals.

The initiative has been very successful in stimulating consumer demand for DHPs and accounts for almost half of estimated regional installations and 80% of installations in its target market. Traditional marketing has been very successful at reaching a certain

demographic of potential DHP customers, but uptake among younger and more diverse potential customers remains slow. NEEA and the regional utilities are advancing and diversifying DHP advertizing, including accessing social media and television and developing testimonials, which capitalize on enthusiasm for word of mouth advertising (reported as the primary source of DHP awareness by over one quarter of participants). Consumer satisfaction with DHPs – their performance, effectiveness, and operating costs – is very high, consistent with findings from the pilot evaluations.

The initiative has made substantial progress towards increasing contractor knowledge around the initiative theory of displacement not replacement; however, certain areas and contractor types still evidence a lack of understanding. More than half of contractors in the region are aware of the initiative and more than 70 percent of those are aware of the initiative's objective to displace existing electric zonal heating equipment. In 2010, the initiative started the Master Installers Network, which rewards those contractors who display advanced understanding of the initiative theory. While many contractors are aware of the initiative, and the Master Installers Network is gaining popularity, interview respondents indicate that contractors in rural areas or those areas with slow DHP sales still do not fully understand the initiative theory or how to translate the initiative goals into sales.

While DHP manufacturers' and distributors' objectives are not fully in line with those of the initiative, the initiative has made substantial progress building cooperative relationships with manufacturers and distributors. Manufacturers and distributors are happy to have new and expanded markets for DHPs, yet they are driven by the profit motive and have no particular interest in displacing electrical load in the target market. Manufacturers and distributors have, however, begun to embrace the initiative displacement theory and have agreed to more cooperative marketing outreach, because the initiative sales have generated an understanding of new market potential. The cooperative marketing activities provide evidence that manufacturers and distributors are displaying an acceptance of the initiative goals unparalleled in prior years.

RECOMMENDATIONS

NEEA should continue to offer the initiative and continue building on its successes.

Residential target market: The initiative staff should expand outreach activities to the market of homeowners under the age of 60, pursuing activities begun in 2010 such as involving social media, television advertising, and publicizing the very positive consumer response to DHPs. The staff should ensure the target market definition and market size estimate it uses in its operations are consistent with that of the DHP ACE model and the Northwest Power and Conservation Council's *Sixth Power Plan.* Alternatively, the program and ACE model might use the number of northwest single family electrically heated homes estimated by the U.S. Census.

Expanded northwest markets: Initiative staff should consider ways to support residential DHP installations in markets beyond the target market, regardless of whether incentives are offered for these applications. The initiative might promote short-run ducting with DHPs for new construction applications to address aesthetic barriers. It might initiate conversations or

collaborations between manufactured housing manufacturers and DHP manufacturers. It might develop case studies or testimonials showcasing residential-size DHPs in small commercial applications.

Utility support: Initiative staff should strategize with Energy Trust of Oregon staff about possible responses to the research findings that the Portland area has among the lowest saturations of HVAC contractors installing incentivized DHPs and among the lowest rates of customers specifically requesting DHPs (per contractor reports). Initiative staff should continue to collaborate with utilities and support them with best practices.

Contractor support: Initiative staff should continue to grow the Master Installer Network and conduct installer training, especially in areas with lower initiative participation: rural areas, Portland, Spokane, and the other locations in the Spokane grouping. Contractors would welcome additional marketing materials and support, and might benefit from sales training that highlights customer-reported benefits of the DHPs and promotes DHPs to displace existing zonal electric heating systems. Initiative staff should continue the current approach of showcasing successful contractors.

Manufacturer support: Initiative staff should work with manufacturers to expand the locations – such as utility offices – where consumers can observe DHPs and experience their space conditioning, noise levels, and appearance. Initiative staff should continue its successful work with manufacturers to increase manufacturers' marketing supportive of the initiative and technical support of contractors.

Retail support: Initiative staff should continue collaborations to increase the number of big box retailers and retail store locations that sell and install DHPs.

APPENDICES

APPENDIX A: PARTICIPANT FINDINGS

APPENDIX B: CONTRACTOR FINDINGS

APPENDIX C: FOCUS GROUP FINDINGS

APPENDIX D: DHP ACE MODEL VALIDATION MEMO

APPENDIX E: ADDITIONAL UNINCENTED INSTALLATION RESEARCH

APPENDIX F: LOGIC MODEL

APPENDIX G: INTERVIEW GUIDES

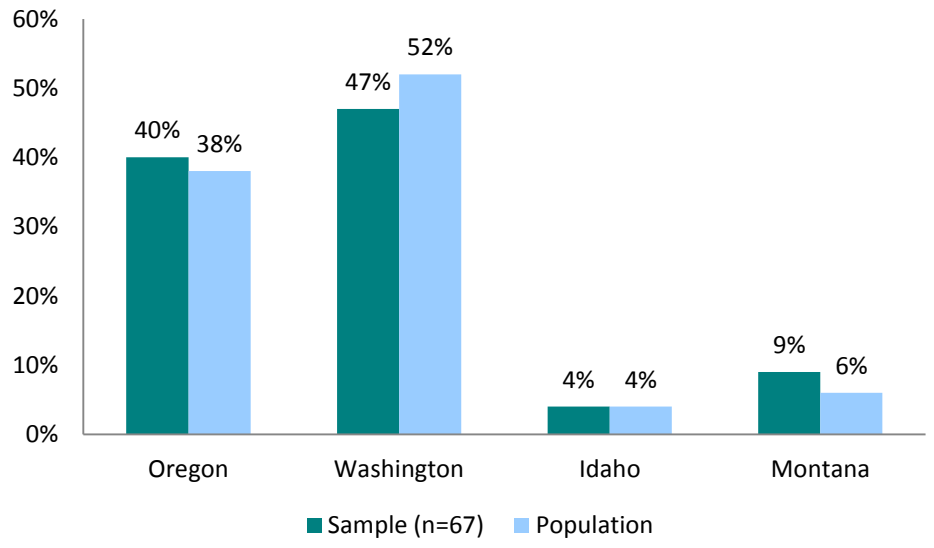
A APPENDIX A: PARTICIPANT FINDINGS

The evaluation team completed surveys with 67 participants who had installed DHPs through the initiative. We completed the surveys between May 25 and June 5, 2011. The surveys lasted between 15 and 20 minutes. The team placed up to five calls to each potential respondent and called potential respondents in evenings and on weekends to prevent convenience bias.

The research team selected potential respondents randomly from a list of residential customers who had installed a DHP between January and May of 2010. This selection ensured that participants represented the 2010 initiative year and had experienced both a heating and cooling season. The sample also represented participants in all three cooling and heating zones. We sampled for a 90/10 confidence and precision. We used the Pearson χ^2 test to identify statistically significant differences across the cooling and heating zones. We found only no significant differences among groups.

The sample included participants in all four states (Figure 13) in proportions roughly equal to the population.

Figure 13: Sampled Contractor State Versus Population



Cooling and Heating Zones

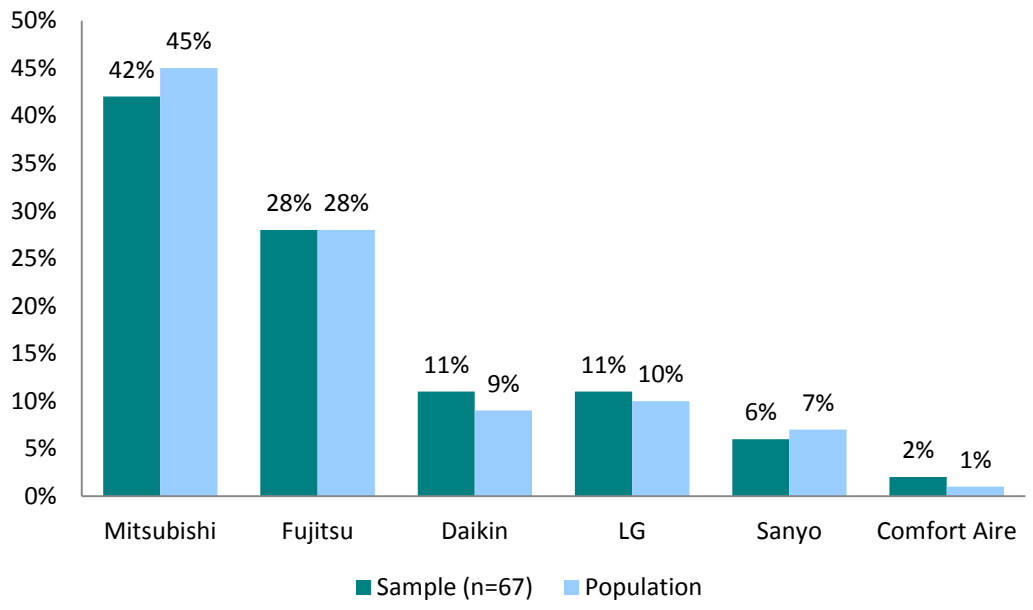
We consider the heating and cooling zones of the Northwest in relevant analysis. These zones are defined as:

- Heating Zone 1: less than 6,000 heating degree days
- Heating Zone 2: 6,001 to 7,499 heating degree days
- Heating Zone 3: Greater than 7,500 heating degree days
- Cooling Zone 1: Less than 300 cooling degree days
- Cooling Zone 2: 300 to 600 cooling degree days
- Cooling Zone 3: Greater than 600 cooling degree days

BRAND

Respondents had installed a DHP from one of six manufacturers. The most popular manufacturers were Mitsubishi and Fujitsu, which reflects the overall install trends.

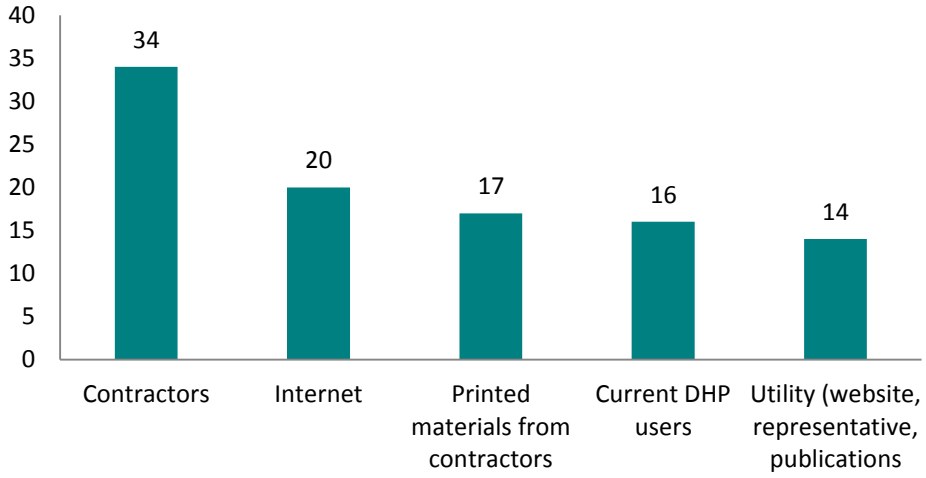
Figure 14: Brands of DHP Installed by DHP-Aware Contractors Compared to Overall Contractor Population



Sources of DHP Information

Participants reported varied sources for information about DHPs. The most commonly reported source was contact with contractors.

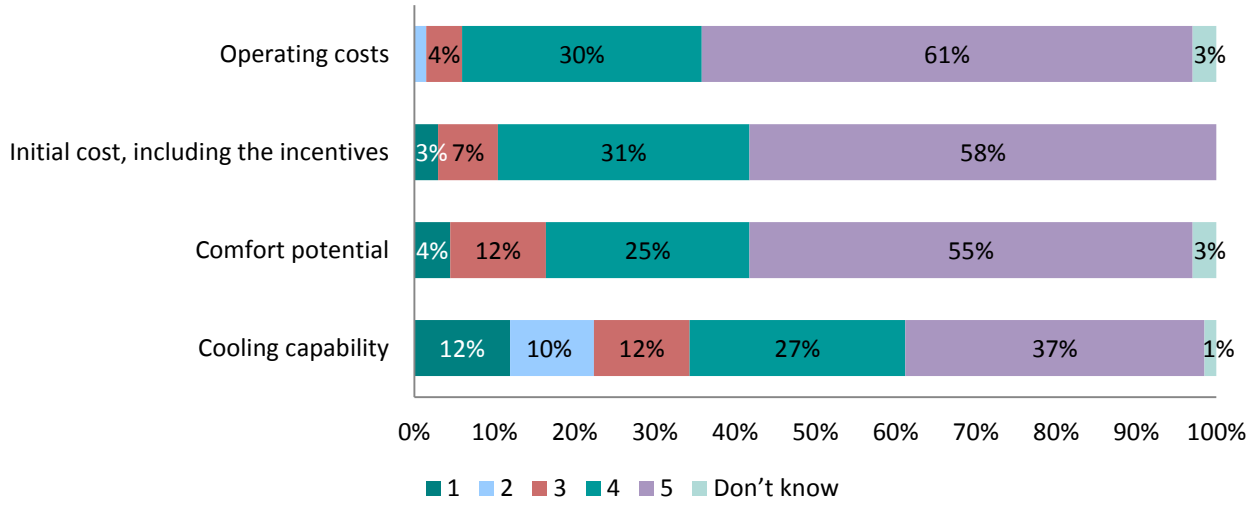
Figure 15: Sources of DHP Information Used by Participants (n=67)



PURCHASING PRIORITIES

The survey team asked respondents how important a few key factors were in their decision to purchase a DHP. Participants rated each factor on a one-to-five scale with one being ―not at all important" and five being ―very important".

Figure 16: What Initially Interested Participants in DHPs (n=67)



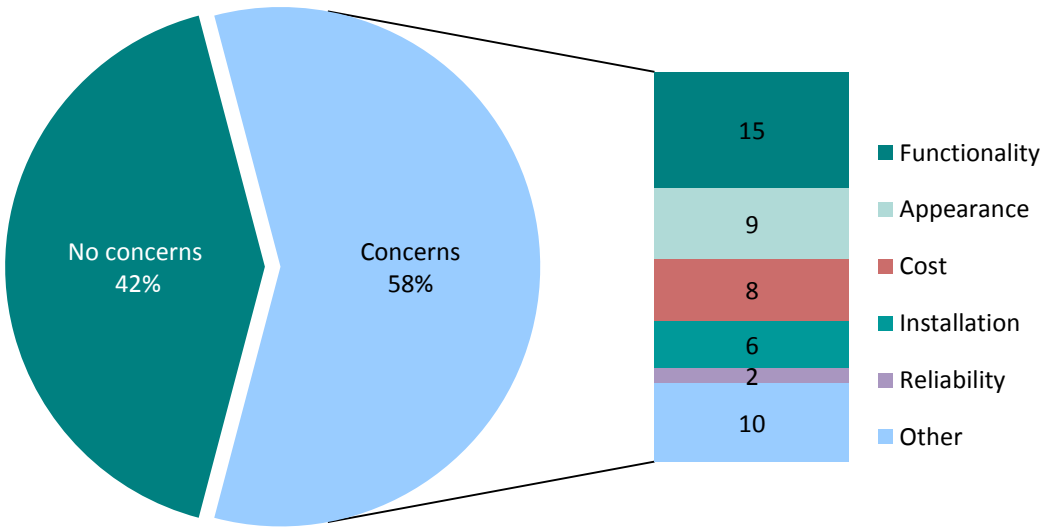
Participants gave the highest importance to potentially cheaper operating costs and the overall cost of the DHP purchase. Respondents offered some spontaneous comments about other

important motivations. The most common among these was the quiet operation (12 mentions), lack of ducts (11 mentions), and ease of install (4 mentions).

PRE-PURCHASE CONCERNS

We asked respondents about any concerns they had before purchasing their DHP. Slightly less than half (42%) of respondents said they had no concerns before purchasing the DHP. Of those who did have concerns, the capability and functionality of the DHP was the most common concern (15) followed by appearance (9) and cost (8). In additional comments six respondents indicated that they were concerned about the installation processes either being damaging to their home or resulting in an unsightly installation. When asked how they overcame any initial concerns respondents indicated that they spoke to their contractor (17 mentions) or did additional research online or by speaking to others who owned DHPs (7).

Figure 17: Concerns Before Purchasing a DHP (n=67)



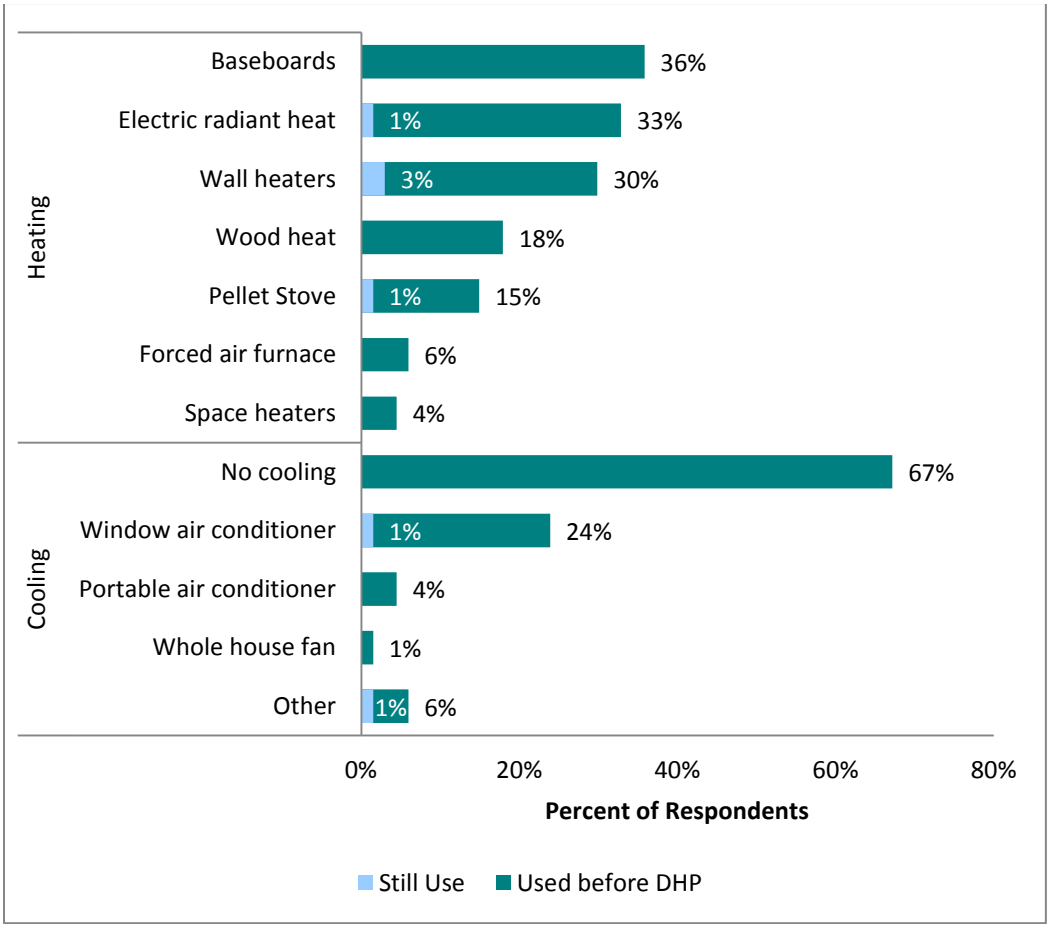
INSTALLATION EXPERIENCE

More than half (57%) of respondents indicated that the contractors did not leave any materials for them beyond the DHP manual. Respondents who did receive additional information (31%) reported receiving items such as brochures, information on cleaning the filters, rebate information, tax credit information, and contractor contact information. The initiative has created a one-page quick reference guide intended to accompany the DHP. No respondents reported having received this guide.

HEATING BEFORE AND AFTER DHP

Participants commonly had space conditioning systems without ducts before they installed their DHP. As noted above, respondents primarily purchased DHPs to reduce the heating bills from their existing equipment or to supplement unsatisfactory existing equipment. Baseboards and electric radiant heat were the most common pre-DHP heating systems among respondents.

Figure 18: Prior and Current Space Conditioning



Participants who used wood before installing the DHP used between a half chord of wood and five chords.

Table 8: Wood Usage

Amount of Wood	Frequency
Less than a chord	2 (17%)
One to two chords	5 (41%)
Three to four chords	3 (25%)

Amount of Wood	Frequency
Five to six chords	2 (17%)
Total	**12 (100%)**

Ten of 12 wood using respondents indicated that they use less wood since installing the DHP, two used the same amount of wood.

COOLING BEFORE AND AFTER DHP

Less than half of the respondents had cooling installed before installing their DHP. Of these, most had window air conditioning units.

Table 9: Respondent Cooling Before DHP

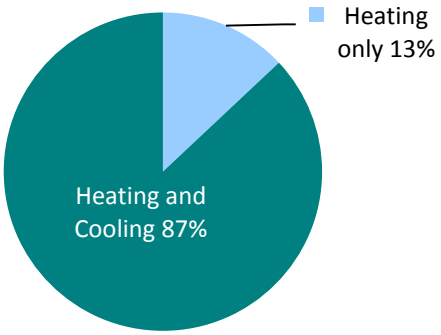
Type of Cooling	Frequency
Window air conditioner	16 (24%)
Portable air conditioner	3 (5%)
Whole house fan	1 (1%)

Only two respondents indicated continuing to use their prior cooling after installing the DHP. Forty-seven respondents did not have any cooling before they installed the DHP. Nearly a quarter (21%) of respondents listed adding new cooling to their homes as a motivation for purchasing the DHP.

DHP USAGE

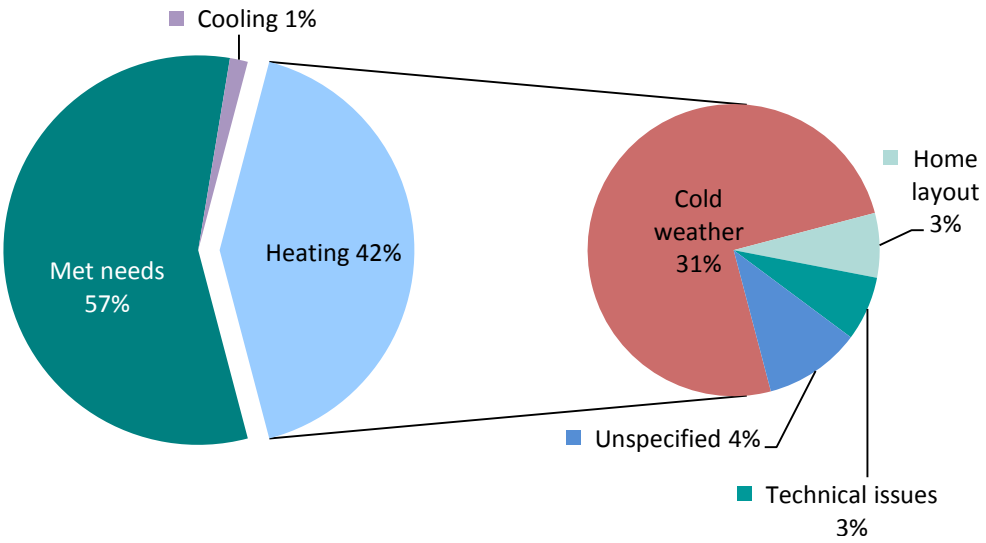
Since installing the DHP, all of respondents had used it for heating and 87% had used it for both heating and cooling.

Figure 19: Respondent Cooling Before DHP



Slightly more than a quarter (28%) of the respondents indicated that the DHP had been unable to meet their heating expectations at least once. Only one percent of respondents indicated that the DHP had ever been unable to meet their cooling expectations. Of the 28 respondents who indicated that the heating did not meet their expectations, 19 reported that the DHP did not function optimally in extremely cold weather. The remaining respondents explained that their house layout prevented the DHP from covering all areas optimally (2) or they had experienced technical difficulties, which they had since resolved (2)[11].

Figure 20: Respondent Cooling Before DHP

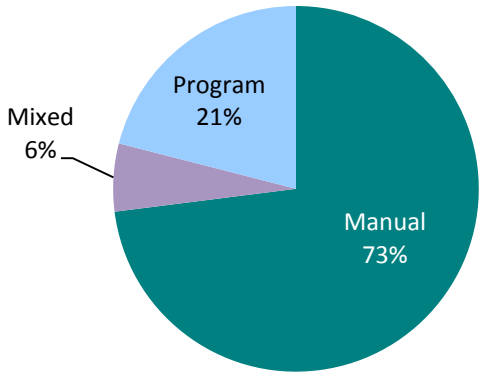


The majority (85%) of respondents reported that they had cleaned their DHP filter since installing the unit.

Nearly three quarters (73%) of the respondents indicated that they control the DHP manually, instead of running it on a program.

[11] The remaining six respondents who were not completely satisfied with the heat did not specify why or gave reasons unrelated to the DHP, such as power outages.

Figure 21: Respondent Cooling Before DHP



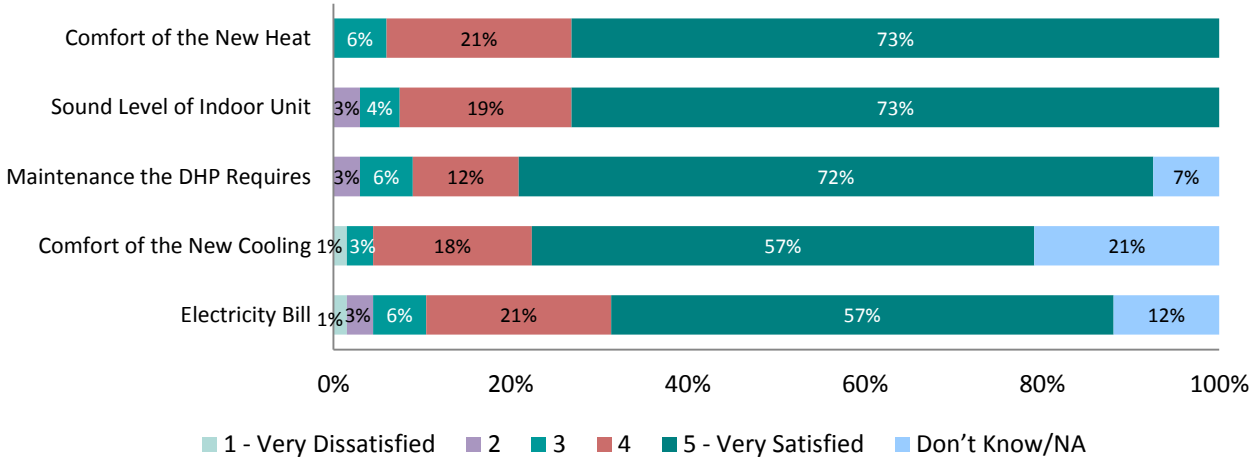
OTHER HEATING EQUIPMENT

Ninety percent of respondents had not purchased any other heating or cooling equipment since installing the DHP. The seven who had purchased equipment purchased another heat pump (1), a fireplace insert (1), a ceiling fan (1), wall heaters and a wood stove (1), and unrelated equipment (3).

PARTICIPANT SATISFACTION WITH DHP

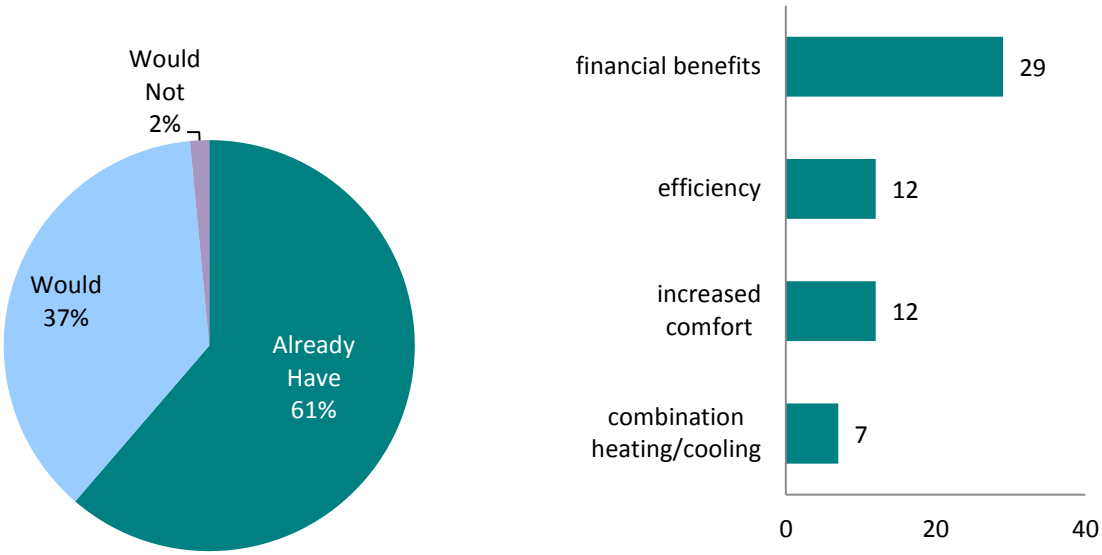
We asked participants to rate their satisfaction with their DHP. Overall, respondents reported high levels of satisfaction with the DHP. Participants reported the highest satisfaction with the comfort of the DHP heat and the sound of the indoor unit.

Figure 22: Participant Consumer Satisfaction



All except one respondent indicated that their overall experience with the DHP has met their expectations. The one respondent whose expectations were not met reported that their DHP was having mechanical issues. All except one respondent also reported that they had (61%) or would (37%) recommend the DHP to a friend or colleague. The most popular reasons participants would recommend the DHP were financial benefits (29), increased comfort (12), efficiency (12), and the combination of heating and air conditioning (7).

Figure 23: Participants Reasons for and Willingness to Recommend DHPs



B APPENDIX B: CONTRACTOR SAMPLE DETAILS

SURVEYED CONTRACTORS' FIRM CHARACTERISTICS

We completed interviews with DHP-aware contractors within each of the six strata designed to ensure fair representation of rural and urban, large and small, and participating or nonparticipating contractors. We placed up to six calls to each contractor, striving for, but not always attaining, sample sizes providing 90/10 confidence/precision for the stratum. Twenty percent of the surveyed contractors represented rural firms, according to the U.S. Census classification[12].

Our analysis also identifies any statistically significant differences among areas with especially high or low initiative uptake, specifically: the Puget Sound metropolitan area, the Portland metro area, Spokane and similar urban areas, the urban areas within Idaho Power's territory, rural areas (per NEEA's designation), and all other areas (which for distinction we term ―suburban," yet includes smaller urban areas in the region). While not contiguous geographically, each grouping reflects a similar DHP market in terms of utility program characteristics and rate of DHP uptake.

Surveyed contractors (the sample of contractors aware of DHPs) represented all four Northwest states.

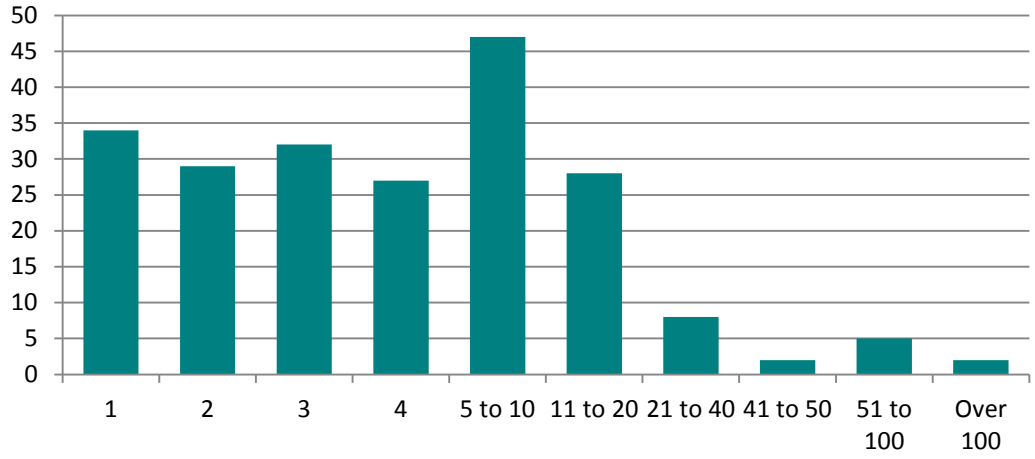
Table 10: Surveyed Contractor Respondent States

Group	Count	Percent
Oregon	56	26%
Washington	51	24%
Idaho	23	11%
Montana	29	14%
Washington and Oregon	35	16%
Oregon and Idaho	10	5%
Washington and Idaho	5	2%
Oregon and Montana	1	<1%
Oregon, Washington, Idaho and Montana	1	<1%
Washington, Idaho, and Montana	1	<1%
Total	**214**	**100%**

[12] The Census Bureau classifies as "urban" all territory, population, and housing units located within an urbanized area (UA) or an urban cluster (UC). It delineates UA and UC boundaries to encompass densely settled territory. It classifies all other areas as "rural" http://www.census.gov/geo/www/ua/ua_2k.html

Firm sizes varied from one installer to 150 (Figure 24). The majority of surveyed firms (79 percent) consisted of one to ten employees. Sixteen percent of surveyed firms had only one employee.

Figure 24: DHP-Aware Surveyed Contractor Firm Sizes



Nearly all (95%) of the firms had been in business longer than two years. Urban areas have more new contractor firms than rural areas. Over half (55%) of contacting firms has sent at least one employee to the DHP initiative orientation. The majority of companies (86%) had sent at least one employee to manufacturer training for the DHP. Additionally, almost half of installers (48%) reported planning to send at least one staff person to manufacturer training in the next year.

All surveyed contractors (firms aware of DHPs) sold residential HVAC equipment. Firms also reported selling commercial HVAC equipment (85%) and performing home remodels (85%). Significantly more rural firms reported selling commercial HVAC equipment. Small rural contractors and contractors in heating zone three were the most likely to engage in home remodels.

CONTRACTOR SURVEY WEIGHTING

We weighted the contractor survey sample to reflect the overall population of contractors in the Northwest. The weights ranged from 4.9 to 16.2. The largest weight was applied to the small, urban contractors group, which had the lowest response rate compared to the population.

We weighted the contractor survey sample to reflect the overall population of contractors in the Northwest (Table 11).

Table 11: Contractor Groups, Counts, and Weights

Group	Count	Percent	Weight	Weighted Count	Weighted Percent
Group 1: Participating Contractors	47	22%	8.8	414	21%

Group	Count	Percent	Weight	Weighted Count	Weighted Percent
Group 2: Oriented Non-participating Contractors	47	22%	7.2	338	17%
Group 3: Small, Rural Non-participating Contractors	18	8%	6.7	121	6%
Group 4: Small, Urban Non-participating Contractors	50	23%	16.2	810	42%
Group 5: Large, Rural Non-participating Contractors	6	3%	4.9	29	2%
Group 6: Large, Urban Non-participating Contractors	46	22%	5.1	235	12%
Total	**214**	**100%**	**--**	**1947**	**100%**

GROUPINGS BY MARKET AREA

Our analysis identifies statistically significant differences among contractors by location of interest to the DHP initiative manager, specifically: the Puget Sound metropolitan area, the Portland metro area, Spokane and similar urban areas, the urban areas within Idaho Power's territory, rural areas (per NEEA's designation), and all other areas (which for distinction we term ―suburban," yet includes smaller urban areas in the region). While not contiguous geographically, each grouping reflects a similar DHP market in terms of utility program characteristics and rate of DHP uptake. Included in the ―Spokane and similar urban areas" category are installers in Spokane, Yakima, Benton, Columbia, Grant, Lewis, and Whitman counties.

C APPENDIX C: FOCUS GROUP FINDINGS

Research Into Action conducted six focus groups in three locations: Eugene (March 8), Bellevue (March 10), and Idaho Falls (March 15). In each location, we held one focus group with customers who had installed DHPs (participants) and another with DHP installers. The Eugene groups drew ten participants and six contractors. In Bellevue, the groups consisted of six participants and six contractors. The Idaho Falls groups had nine participants and two contractors.

Research Into Action conducted the focus groups to inform the data collection instruments for future quantitative data collection efforts. The participant groups gathered information about how participants became aware of DHPs and what factors motivated them to buy a unit. Contractor groups explored how they find customers and promote the DHP to those customers, and sales of DHPs without incentives. The focus groups exposed many issues which we will investigate in the upcoming during data collection to gather more quantifiable findings in support of sound conclusions and recommendations.

The following is a summary of findings and implications for future research from the participant and contractor focus groups.

PARTICIPANTS

Awareness

Participants had varied sources of awareness about DHPs. In Eugene, participants reported being exposed to DHP promotional media from their utility and local contractors, along with news stories featuring the DHP. Participants also said they learned about DHPs in person at home shows, fairs, and in the homes of friends and acquaintances. Eugene has unparalleled utility support for the DHP. Participants in Eugene may represent a uniquely informed population. Participants in Bellevue also indicated the importance of utility promotion. In Idaho Falls, participants corroborated the value of utility advertising and endorsement.

In all three locations, respondents valued word-of-mouth referrals from friends and acquaintances especially highly. Respondents reported that no one source brought them from a state of unfamiliarity with the DHP directly to the purchase decision. This level of detail was not present in previous research.

These findings will help frame questions for the larger data collection phase. Questions should obtain all of the sources of awareness customers were exposed to and ask for which were the most compelling. For instance, based on the focus group members' comments, participants may *become aware* of the technology through a bill stuffer, but will not be *compelled to buy one* until they have a face-to-face interaction with someone who has a DHP in their home or business, or a convincing contractor. Instead of asking *how* they become aware of the DHP, the questions will

focus on *who* gave them the confidence to make a purchase. In most cases, the contractors are acting as the "face" of the DHP, which makes their ability to educate the consumer and present a compelling argument for installation especially important.

Motivation

The focus group guide asked participants what motivated them to consider a DHP. Participants in all groups identified the same factors as the most important. These factors are: cost, comfort, and the desire to replace a problematic existing heating system. Participants saw the DHP as a cost-effective ―answer" to a wide range of problems. Questions in the upcoming interview instruments will be open-ended with a list of pre-codes informed by the focus group findings. This will allow the distillation of a wide range of motivations into easy-to-understand frequencies.

Cost

The cost of the DHP is the one element that participants could be relatively sure of before purchasing the unit itself. While the comfort, noise level, and operating cost of the DHP often required leaps of faith on the part of the participants, bids from contractors established the upfront costs. Due to the tax credits and incentives, the DHP represented an appealing alternative to installing expensive duct work. Participants also indicated that they had considered other options, but the DHP was the only one that appeared to be a sufficiently appealing financial investment. Most participants said the heating system they had before they installed the DHP was ineffective and expensive, which made the DHP's cost-benefit equation even more favorable. We will confer with the NEEA evaluation manager to determine what, if any, further exploration of cost factors we should include in the survey.

Replacement

Focus group participants revealed that replacing or supplementing existing equipment was an important motivator in their purchase decision. We found that participants had a surprisingly sophisticated awareness that the DHP was a supplemental, rather than a primary or sole, source of heating and cooling. In the next wave of research, we will ask additional questions about how much participants continue to use their existing heating system and they had expected do so when they bought the DHP. We also will ask participants they are using the DHP, how they anticipated using it, and they made an unanticipated adaptations due to the DHP.

Cooling

Previous research gave limited attention to cooling. However, participants in the focus groups, especially in Idaho Falls, placed a greater importance on cooling than expected. Contractors in Bellevue reported a growing niche market of using DHPs to provide cooling in bedrooms or other isolated spaces. Contractors also indicated that cooling is a major selling point in all three locations. The upcoming survey will gather more information about cooling, specifically if

cooling was important in the purchase decision or if it became an unexpected benefit. We also will ask if participants have recommended the DHP to other family members and friends, based on the cooling capability.

Concerns

Participants expressed few concerns about the DHP. Concerns included the appearance of the indoor unit, noise, and coverage. Overall, participants had a clear understanding of what the DHP was promised to do and how it would benefit them. Since their expectations were reasonable, they reviewed the DHP favorably. Future research will determine if participants had any concerns before buying the DHP that had not been resolved after they used it. Additionally, we will ask if participants had any issues with the DHP they wish they had known about they bought one. This information will help inform future consumer education efforts and marketing. We also will ask participants how they informed their expectations for the DHP, and if they felt their expectations were reasonable.

CONTRACTORS

Initial Contact

All contractors in the three locations reported that DHP customers were coming to them, so most of them did not actively promote the DHP through advertising and outreach. Some of the larger contractors reported doing advertising outreach, but many did not see this as necessary. Most customers who bought a DHP called the contractors already knowing that the DHP might be solution to their problems. Contractors indicated that by the time a customer contacted them, the customer already had heard something appealing about the DHP. The rate of customers who were unaware of the DHP but who became interested after the contractor explained the benefits has not changed since the pilot started. Additionally, the small market for DHPs in heating converted or added spaces has not been influenced by the program. This niche existed before the program and continues at the same pace as before. Outreach and Marketing

Contractors reported that utility outreach has been the single most vital source of their DHP business. Home shows and smaller marketing efforts also bring in customers, but the utility voice lends credibility to an unfamiliar technology. Contractors are demonstrating increasingly sophisticated techniques to sell the DHP. Some reported overcoming the DHP's appearance obstacle by showing potential customers marketing materials developed by the manufacturer or utility that show DHPs installed in homes; some contractors also show potential customers pictures of units they have installed. All of the contractors knew at least one contractor who uses a mobile demonstration unit. Data collection instruments will ask contractors about the most effective new strategies and tools to sell the DHP. Questions will focus on progress, innovation, and lessons learned. We also will ask contractors how they encourage referrals from their existing customers and what follow-up they do after an installation.

Incentives

Contractors reported that the incentives are driving the market, and without them, the sales would slow significantly. However, they do think the amount of the incentive in some locations could be reduced and instead spread over a longer period of time to sustain demand. In the coming interviews we will ask contractors about their perceptions of the appropriateness of the existing incentives and the ideal incentive structure to achieve the maximum amount of sustained DHP sales.

Unincented Units

Contractors agreed that in all cases where a home qualifies for a DHP, they take full advantage of the incentives and tax credits. They installed unincented units in non-qualifying applications, such as houses with gas service, add-ons, and homeowners who want more than one unit or only want to for cool a particular space. In Idaho Falls, contractors also reported spillover of installations into areas without an incentive program. Contractors explained that this was due to word-of-mouth advertising and customers' conviction that the product would best meet their needs, even without the benefit of incentives. Contractors also said that the unincented units, other than those in non-qualifying territories, were not saving electricity because they were being used to replace existing non-electrical equipment or to condition spaces that previously had not been conditioned. However, one contractor explained that people are ―not going to be uncomfortable" and the DHP may be replacing undocumented inefficient conditioning such as a space heaters or window ACs.

In Eugene, contractors reported 5-10 percent of their installations were unincented and 5-15% of their customers were transitioning away from wood heat.

In Bellevue, contractors reported 20 percent of their installations were unincented and almost none of their customers were transitioning away from wood heat.

In Idaho Falls, contractors reported that more than 50 percent of their installations were unincented and they had many customers who use wood as at least a supplemental heat source.

We also asked contractors who could not attend the focus groups how many unincented units they had installed. The consensus gathered from those contractors was around 5-15 percent across all three locations.

Contrary to information in the program database, contractors reported that many brands of DHP are being installed. The brands that do not qualify for the program incentives are lesser known and usually not of optimal quality and efficiency. These undocumented installations represent a challenge to the installers because they lead to customer dissatisfaction and negative word-of-mouth. In the next research phase, we will inquire about this overflow of DHP sales into non-incented areas, such as neighboring utility territories.

Market Expansion

We will ask contractors how they are expanding their markets for DHP and any new applications they have discovered for the DHP. We will ask them to quantify the percent of the units they have installed that are used in the common applications identified in the focus groups: supplemental heating/cooling of a primary living space, primary heating/cooling of a specific space, and converting a space into conditioned space.

Advice to Other Contractors

Since most of the contractors in the focus groups are successful installers, we asked them what advice they could offer to contractors in areas with less established DHP resources. Contractors suggested that any contractor looking to install DHPs take the time to thoroughly understand the units themselves by studying the manuals and manufacturer materials, and by attending manufacturer training. Additionally, contractors suggested that the best way to learn about installing DHPs is to watch someone who knows how and get hands-on experience. Contractors also suggested choosing equipment only from the major manufacturers (Mitsubishi and Fujitsu specifically) to avoid issues with equipment quality and support.

D APPENDIX D: DHP ACE MODEL VALIDATION MEMO

DUCTLESS HEAT PUMP (DHP) PROGRAM

This memo presents the results of efforts undertaken in early 2011 by Research Into Action, Inc. and Proctor Engineering Group to validate assumptions used in the Alliance Cost Effectiveness (ACE) model for the Ductless Heat Pump (DHP) Program.

While we have not had direct feedback from NEEA on this memorandum, we continue to have interactions with the NEEA evaluation and DHP program staff that have bearing on this work. At the time this review was undertaken – February 2011 – we understood the target market to be *existing single family (SF) homes with electric zonal heat*. Subsequent to the first draft, we have learned that the target market is *all* existing electrically heated SF homes. This was not the understanding we had formed from our work on the DHP Pilot Project evaluation, nor is this definition consistent with the first ACE model assumption. Fortunately, our findings given in the table below address the size of the existing electrically heated SH home market.

Also subsequent to this February review, we learned that NEEA defines net energy savings as non-incented *residential (3 tons or less)* DHP units, regardless of their application within or outside of the target market. For example, commercial applications of residential units count toward estimates of net energy savings.

We submit this revised memo to bring to NEEA's attention several implications for the ACE model and for the program's cost-effectiveness of a program target market of all electrically heated homes rather than those with zonal heat. We do not discuss these implications in our table of findings, as we conducted our review prior to learning this additional information.

1) The model assumes an energy savings value (assumption #4) that is consistent with findings to date on savings for homes with electric zonal heat. Engineering principles suggest there may be less energy saved at homes with electric heat controlled through a central thermostat, such as forced air furnaces. Thus, it would not be appropriate for the model to apply the zonal heat savings estimate to other applications.

2) The model assumes a high total market share for DHPs at the end of the forecasting period (assumption #7). If the market size of all existing electrically heated SF homes is considerably larger than that of existing zonal electrically heated SF homes, it may not be reasonable to assume that DHPs will attain the same ultimate penetration of the larger market as it might attain of the smaller market. In addition, if the market size of all electric heat homes is considerable greater than that of zonal electric heat homes, then the size of the complementary non-target market (non-incented residential-size units) is smaller than it is with a target market of zonal heat.

Table 12: Ductless Heat Pump (DHP) Program - 2010

	Input Assumption	Finding	Recommendation	Sources
1	Total market: Defined as "existing single family w electric baseboard heat" (a.k.a. zonal heat) Size = 401,718 units	401,718 units is an NWPCC calculation. Census data gives the NW population of single-family dwellings with electric heat as 1,533,656. We did not find a data source for proportion of electrically heated homes using baseboard heat	Current program description and definition of net impacts as non-incented units (including non-qualifying units) suggests total electric heat population is the relevant market. If program to address only baseboard heat, then NEEA might research proportion of electric heat population with baseboard heat and measure non-incented units within this segment	US Census Bureau, American Community Survey 2005-2009 Summary Tables, generated using American Fact Finder: *http://factfinder.census.gov*; (February 25, 2011)
2	Tracked Units (incented installations): Cumulative (Q4 2008- approx. Q3 2010): 8,804 2010 Annual: 5,000	NEEA updates quarterly with number of incented installations from the DHP program tracking system	No action needed	Interview with NEEA planning analyst
3	Tracked Units (non-incented installations): TBD	MPER research underway in 2011 will generate an estimate	Revise when estimate available. Value will need to be re-estimated every few years	NA

	Input Assumption	Finding	Recommendation	Sources
4	Savings Rate (incented): 3,500 kWh	Consistent with NEEA's DHP Pilot Project research (monitoring and bench testing) conducted by Ecotope, with BPA's monitoring study conducted by Ecotope, and with an independent derivation of expected savings based on key parameters included in the Ecotope work. The latter research estimates 3,838 kWh for regions with 4,000-5,499 heating degree days (HDD); 4,540 kWh for 5,500-7,000 HDD; and 4,796 kWh for >7,000 HDD	No action needed	Ecotope, Inc. 2010. *Ductless Heat Pumps – Evaluation & Keys to Successful Installations.* The Energy & Environmental Building Alliance, Excellence in building Conference & Expo, October 14, 2010 Ecotope, Inc. 2010. *Residential Ductless Mini-Split Heat Pump Retrofit Monitoring: 2008-2010 Analysis.* Bonneville Power Administration, September 27, 2010. Proctor Engineering Group, 2010, unpublished. This research used: *2005 Residential Energy Consumption Survey: Energy Consumption and Expenditures Tables, Table SH8. Average Consumption for Space Heating by Main Space Heating Fuel Used, 2005*
5	Savings Rate (non-incented): TBD	MPER research underway in 2011 will provide qualitative information on the types of homes in which non-incented DHPs are installed	Once data on types of homes with non-incented DHPs are available, develop research plan to estimate savings or assumptions to support the derivation of a multiplier to be applied to the incented savings rate as a proxy for the non-incented savings rate	NA
6	Naturally Occurring Baseline (pre-intervention, 2007): 1% of total installations	Accurate representation of best available market research	No action needed	Source cited in ACE documentation

	Input Assumption	Finding	Recommendation	Sources
7	Market Share Forecast (with program intervention) 2010: 2%; 2014: 15%; 2020: 62%	Insufficient data currently available to validate	No action needed. However, if total market (assumption #1) definition changes to be all single family with electric heat, these assumptions should be revised	NA
8	Naturally Occurring Baseline Market Share Forecast: 2014: 6%	Insufficient data currently available to validate	No action needed	NA
9	Total Benefits ($/installation): $6,567	This is the sum of assumptions #10, #11, and #12. Given our recommendation to revise assumption #11, the corresponding total benefits would be: $6,468	Revise assumption to $6,468	Calculation from revised assumptions #10, #11, and #12
10	Energy Benefits: $5,426	Consistent with an independent derivation of energy benefits from 3,500 kWh annual savings. Research found $5,583 lifetime energy savings based on 2008 retail prices per kWh, weighted by state	No action needed	Proctor Engineering Group, 2010, unpublished. This research used: *Electric Power Monthly Table 5.6.B. Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, State*
11	Line Loss: $931	Independent research estimates value of avoided losses at $454. Approach: applied utility-reported kWh losses as a percent of retail sales to expected DHP savings. Model uses average kW reduction during heating and a $23/kW loss value assigned by NWPCC	Revise assumption to $454	Proctor Engineering Group, 2010, unpublished. This research used: *EIA State Electricity Profiles Table 10. Supply and Disposition of Electricity, 1990 Through 2008*
12	Act Credit: $636	This value is 10% of the sum of assumptions #10 and # 11. Given our recommendation to revise assumption #11, the corresponding Act credit would be: $588	Revise assumption to $588	Calculation from revised assumption #11

	Input Assumption	Finding	Recommendation	Sources
13	Non-Electric Benefits: $426	Accurate representation of best available market research	No action needed	Source cited in ACE documentation
14	Net Total Resource Cost (2006 $s): $3,953	We verified calculations embodied in the ACE model Excel sheet. Accurate representation of best available data. Calculations make us of observed average cost of the 1-to-1 DHP units in the program tracking system, updated quarterly	No action needed	Interview with NEEA planning analyst
15	First Cost (2006 $s): $3,967/installation	We verified calculations embodied in the ACE model Excel sheet. Accurate representation of best available data. Calculations make us of observed average cost of the 1-to-1 DHP units in the program tracking system, updated quarterly	No action needed. However, we recommend the input assumption name be changed, as "first cost" is standard term to describe the cost to the consumer, and term is used here to describe total cost (end user's plus programmatic costs) in first period of the program	Interview with NEEA planning analyst
16	Declining Cost Assumption: Declines by $100 in yr. 2; by $200 in yr. 3; by 3% or more in yr. 4	NEEA updates annually, comparing with annual average costs of the 1-to-1 units in the DHP program tracking system. This is the best possible dataset and approach. Forecast is reasonable based on historic evidence	No action needed	Interview with NEEA planning analyst
17	NEEA Costs (2010): $1.5 million	This value is the sum of assumptions #18, #19, and #20. Given our recommendation to revise those assumptions, the corresponding NEEA costs are $1,671,734	Revise assumption to $1,672,000	Calculation from revised assumptions #18, #19, and #20
18	Contracts & Implementation: 2010: $1,000,000	$1,141,763 reported by program manager for 2010	Revise assumption to $1,142,000	NEEA DHP program manager

	Input Assumption	Finding	Recommendation	Sources
19	Evaluation: 2010: $395,000	Budget: $394,450 Billed: $377,995	Revise assumption to $378,000	Ecotope (evaluation contractor for 2010)
20	NEEA Overhead Costs: 2010: $139,500	This value is 10% of the sum of assumptions #18 and # 19. Given our recommendation to revise those assumptions, the corresponding overhead costs are $152,000	Revise assumption to $152,000	Calculation from revised assumptions #18 and #19
21	Government Costs: 2010: $82 per installation	Reviewed method; judged appropriate; we did not independently derive this assumption	No action needed	Interview with NEEA planning analyst
22	Incentives: $1,505	NEEA updates quarterly with average incentives for the 1-to-1 installations in the DHP program tracking system. This is the best possible dataset and approach	No action needed	Interview with NEEA planning analyst
23	Utility Local Program Administrative Costs: $3.0 million	Model assumes utility admin costs are 20% of incentives. Utilities paid $14.9 million in incentives (implication: admin costs are 17% of their total program costs). NEEA vetted this assumption with its Cost Effectiveness Advisory Committee in a 2010 webinar. Research on national program administrative budgets found administrative costs are 48% of total portfolio costs. Adding assumptions #23 and #17 (NEEA's costs) gives region's administrative costs at 24% of total program costs. We judge assumption #23 to be reasonable, yet NEEA might investigate this assumption through survey research	Consider surveying utilities to obtain an estimate of their administrative costs as a proportion of their incentive costs	Goldman, C. et al. 2010. *Energy Efficiency Services Sector: Workforce Size and Expectations for Growth*. Ernest Orlando Lawrence Berkeley National Laboratory

	Input Assumption	Finding	Recommendation	Sources
24	Non Energy Benefit: $1,131	Conservative value – one-half of the value estimated by market research conducted by ECONorthwest for NEEA, which is the best available information	No action needed	Source cited in ACE documentation
25	Cost Effectiveness (Societal perspective): Benefit/Cost=2.1 Levelized Cost= 3.4 cents	Accurate representation of NWPCC methodology and NEEA assumptions	No action needed	Interview with NEEA planning analyst

E APPENDIX E: ADDITIONAL UNINCENTED INSTALLATIONS RESEARCH

This memo reports on findings from research into unincented DHPs that NEEA requested Research Into Action undertake. Research into Action completed the following activities:

- Review and summary of the existing ACE Model assumptions regarding unincented DHPs
- Collection of additional data to better describe unincented DHP installations
- Generation of multipliers for the NEEA DHP ACE Model

SUMMARY OF EXISTING ACE MODEL AND ASSUMPTIONS

The existing ACE Model has a placeholder for a count of unincented units, but does not provide an estimated number for such installations. In the absence of an estimated number of unincented units, the model outputs are limited to those associated with DHPs that are tracked by the program. We have learned through interviews with program stakeholders, NEEA staff, regional utilities, and DHP contractors that DHPs are being installed in the region without incentives, and are therefore not tracked in the program database. We discussed the DHP ACE Model with NEEA staff and agreed that the model does not accurately summarize the unincented DHP landscape.

Research Into Action initially conducted a survey of Northwest HVAC contractors to estimate the number of DHPs installed (both with and without incentives) since the NW Ductless Initiative began (2009 – 2010). The survey team completed 214 surveys, using a stratified sample providing 90/10 confidence/precision and estimated to constitute 10% of total (incented and unincented) regional DHP installations. Contractors reported a total of 12,450 DHPs installed without incentives (both residential and commercial). Of those, 4,265 are commercial applications and 8,185 are residential. After collaboration with NEEA staff, Research Into Action re-surveyed 99 of the contractors who previously reported installing DHPs *without* incentives, using a stratified sample providing 90/10 confidence/precision relative to the sample of 214 and estimated to constitute 5% of *unincented* regional DHP installations.

Table 13: Unincented DHP Sample Groups and Dispositions

Group	Description	Goal Sample	Actual Completes
1	Participating contractors	28	26
2	Oriented contractors	28	28
3	Small rural contractors	14	2
4	Small urban contractors	29	18
5	Large rural contractors	6	2
6	Large urban contractors	27	23

Table 14: Unincented DHP Sample and Total Installs by State

State	Percent of Sample	Percent of Total Installs
WA	53%	54%
OR	33%	37%
MT	10%	4%
ID	4%	5%

High Level Findings

- Two-thirds (66%) of unincented installations are residential applications. Of these, between two-thirds (67%) and 88% are in existing single-family homes.
- Nearly three quarters (74%) of unincented single-family (existing) residential DHPs are installed in primary living spaces.
- About half (48%) of those installations replace electric, zonal heat.
- For one-quarter (24%) of units installed in residences, contractors were unable to describe the application (e.g., existing home, new construction, multifamily, or manufactured). By assuming that the units of unknown application are distributed across the housing types in the same proportions as the units of known application, we derived the estimate of 88% as the upper bound of units installed in existing single-family homes (as summarized in the first bullet). We believe this assumption that the applications of known units is a good proxy for the applications of unknown units, and thus we recommend NEEA use the estimate of 88% of residential units installed in existing single-family homes.

Data Details

Table 15 presents the percentages and numbers of the unincented installations as reported by the surveyed contractors and the recalculated totals with the "unknown/don't know" answer reallocated. We weighted the counts to represent the overall population of unincented DHP installations.

Table 15: Unincented DHP Installations

	Without Reallocated "Unknowns"		With Reallocated "Unknowns"	
Application	Percent	Count	Percent	Count
Total Unincented Installations		**12,450**[13]		**12,450**

[13] Total count of unincented units taken from original research collected by Research Into Action in May of 2011. This number includes all unincented installations since the beginning of the NW Ductless Pilot.

Application	Without Reallocated "Unknowns" Percent	Without Reallocated "Unknowns" Count	With Reallocated "Unknowns" Percent	With Reallocated "Unknowns" Count
Commercial Installations	**34%**	**4,265**	**34%**	**4,265**
Residential Installations	**66%**	**8,185**	**66%**	**8,185**
Single-family homes (existing)	67%	5,468	88%	7,168
In a supplementary or add-on space	*26%*	*1,405*	*26%*	*1,842*
In a primary living space	*74%*	*4,063*	*74%*	*5,326*
Replaced baseboards/zonal heating	*48%*	*1,944*	*49%*	*2,603*
Replaced gas heat	*11%*	*463*	*12%*	*620*
Replaced wood heat	*8%*	*344*	*9%*	*461*
Replaced oil heat	*2%*	*82*	*2%*	*110*
Replaced other heat	*28%*	*1,144*	*29%*	*1,532*
Don't know	*2%*	*86*	*-*	*-*
New Construction (single-family homes)	**7%**	**586**	**9%**	**768**
Multifamily Homes	**1%**	**100**	**2%**	**132**
Replaced electric heat	*39%*	*40*	*46%*	*60*
Replaced another form of heat	*26%*	*26*	*30%*	*40*
Installed in new construction	*21%*	*21*	*24%*	*32*
Don't know	*14%*	*14*	*-*	*-*
Manufactured Homes	**1%**	**89**	**1%**	**117**
Replaced electric heat	*65%*	*58*	*65%*	*76*
Replaced another form of heat	*35%*	*31*	*35%*	*41*
Installed in new construction	*0%*	*0*	*0%*	*0*
Don't know	*0%*	*-*	*-*	*-*
Unknown or Other	**24%**	**1,941**	**-**	**-**

Summary

- 2,603 unincented DHPs installed in the program's target market; NEEA can either apply to these units the per-unit savings estimate currently assumed in the ACE model for incented units or can await the conclusion of Ecotope's current impact research to provide a per-unit savings estimate.

For the remaining units categorized here, regional DHP experts contacted by Research Into Action as part of this study indicated that per-unit savings estimates are unavailable.

- 768 unincented DHPs installed in residential new construction; 50% (384 units) substitutes a potential new electric heat application (based on distribution of electric and nonelectric heat sources for existing SFD)
- 1,842 unincented DHPs in supplementary or add-on space; electricity savings less than SFD estimate (technical research is needed to determine electricity savings).
- 60 unincented DHPs installed in existing multi-family dwellings displacing electric heat and 20 units in newly constructed multi-family dwellings, substituting a potential new electric heat application (based on distribution of electric and nonelectric heat sources for existing multi-family dwellings); electricity savings less than single family dwelling estimate (technical research is needed to determine electricity savings).
- 76 unincented DHPs installed in manufactured homes displacing electric heat; electricity savings less than single-family dwelling estimate (technical research is needed to determine electricity savings).
- 4,265 unincented DHPs installed in commercial applications *potentially* displacing electric heat; electricity savings unknown (technical research is needed to determine electricity savings).
- 3,200 unincented DHPs displacing or substituting nonelectric heat sources; greenhouse gas emission savings only, no electricity savings.
- These items sum to 12,450 total unincented DHPs

Discussion

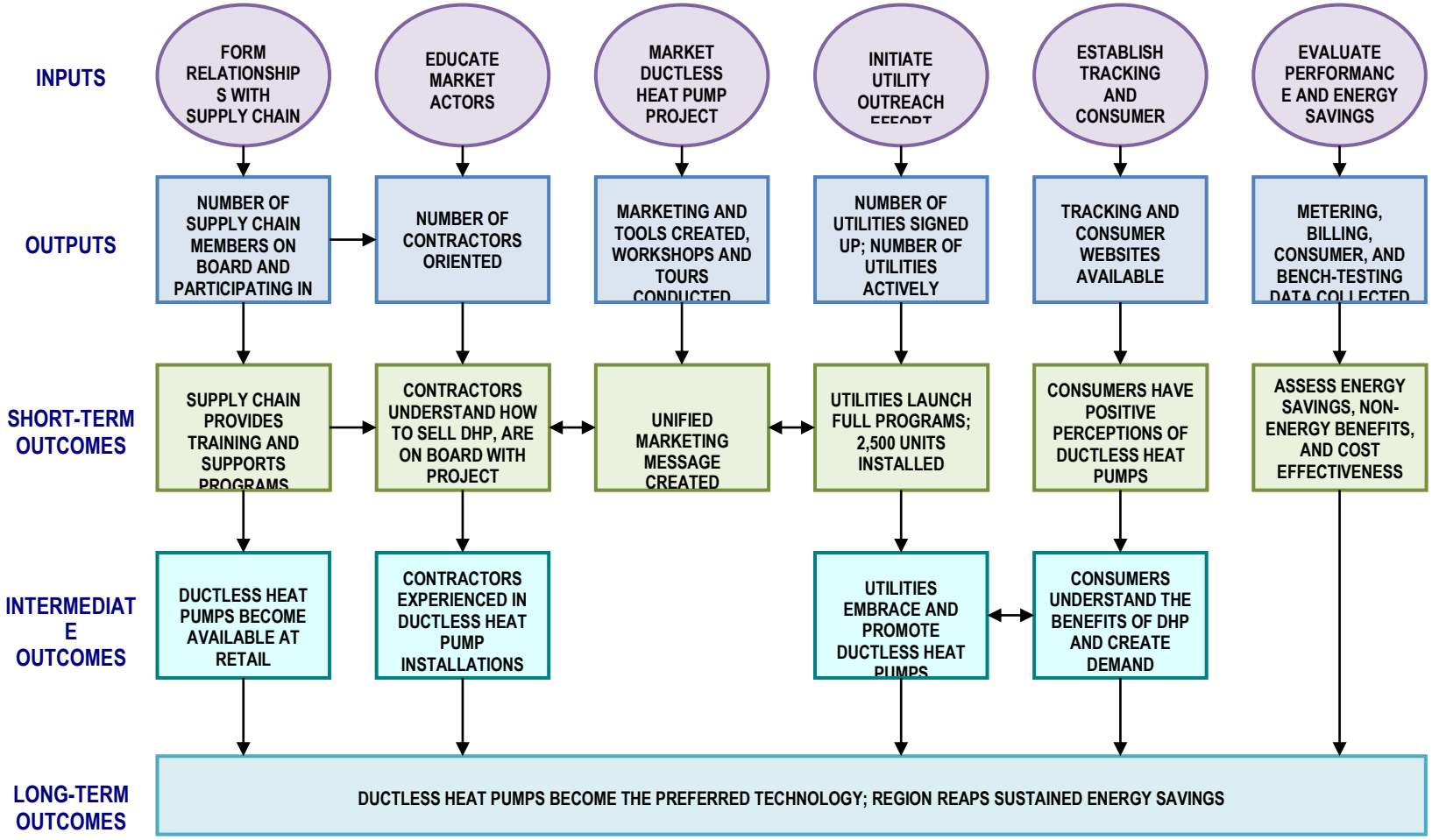
Currently, there are no complete data sources available on the total amount of installed DHPs in the Northwest. This analysis triangulated multiple data sources to create the most accurate picture possible of the total DHP installations in the Northwest.

The initial data collection resulted in a summary of the existing DHP installations in the Northwest, both incented and unincented (survey n = 214). The research team weighted the data to reflect the known population of Northwest HVAC contractors and DHP installations. Our sample consisted of six strata representing six types of contractors. Four of these strata were weighted based on geography (urban/rural) and firm size (small/large) characteristics. Other two groups were weighted based on participation in the program, indicated by participation in a program orientation and completed applications. To further refine the data, we referenced the known program installation data about the surveyed firms. We looked at the actual amount of incentivized installations attributed to each contractor who completed the survey. The research team determined that contacts over reported their own program incented installations by 200 to 250 percent. Based on this determination, we reduced the self-reported incented *and* unincented installation counts by the average over-reporting ratio to bring them in line with actual data.

Research Into Action has access to a various sets amount of sales data from manufacturers. These data provide an incomplete representation of the DHP installation landscape because the nature of the data reported and the level of aggregation varies by manufacturer, model, distributor, region, and type of DHP. The sales data and raw self-reports indicate that the total number of DHPs installed in the region might be as much as two and half times as the figures

listed above. Research Into Action has provided in the above table the numbers with the most substantiated data behind them, and acknowledges that these are conservative estimates.

F APPENDIX F: LOGIC MODEL



G APPENDIX G: INTERVIEW GUIDES

DHP MANUFACTURER / DISTRIBUTOR SURVEY, 2010 EVALUATION

Interviewee Name:

Date:

Interviewer:

Hi my name is _____ calling from Research Into Action on behalf of the NW Ductless Heat Pump Project. May I please speak to _____?

Hi my name is _____ calling from Research Into Action on behalf of The Northwest Energy Efficiency Alliance (NEEA). The Northwest Energy Efficiency Alliance (NEEA) is conducting an evaluation of the NW Ductless Heat Pump Project. We are speaking to manufacturers/distributors to learn about the DHP market.

This will take about ____ minutes. Is this a good time?

I will be referring to the ductless heat pump as a DHP to save time.

Role

1. Please describe your role at [company].

DHP Marketing

2. How do you currently market residential DHPs [PROBE: internet, TV, radio, newspaper, magazines?]

3. In the past year, have you altered your marketing? [IF YES] In what ways? [PROBE FOR TYPES AND AMOUNT]

   - ☐ Yes, please specify how:
   - ☐ No
   - ☐ Don't know

4. Do you also rely on contractors to market residential DHPs?

   - ☐ Yes, please specify how:
   - ☐ No
   - ☐ Don't know

5. Have there been any instances in which the messaging or marketing efforts of the NW Ductless Program and/or the utilities has conflicted with the marketing or messaging efforts of your company?{Probe: If yes, what have you done to resolve the issue}

6. How has the project influenced on your marketing efforts? What types of support (not just monitory have you received? [We're trying to understand if the Program has got them thinking of tailoring their marketing to more zonal heat homes and or other types of homes say with forced air etc]

7. For the Pacific Northwest, does your company's DHP marketing message focus on promoting multi-headed DHP units for whole house solutions (that is, one or more outdoor units with multiple indoor heads) or one-to-one or one-to-two configurations to displace zonal electric heat)? Why?

DHP Sales

8. How many DHP models do you currently have in stock? That qualify for 2010 NW Ductless Heat Pump Program incentives?

9. How many models do you have that don't qualify? What is different about these models?

10. What are the characteristics of your most popular DHP models [PROBE: one-to-one? Qualifies for (reduced) federal tax credit?]

11. Has the market share of any of the DHP brands changed in 2010? How so? [PROBE TO GET NUMERICAL ESTIMATES]

    a. What impact has the Program had on sales of residential DHPs? Since its inception, has the Program impacted the number of DHP units that you…

        i. [MANUFACTURERS ONLY] Manufacturer/distribute? [PROBE TO GET NUMERICAL ESTIMATES]

        ii. [MANUFACTURER REPS ONLY] Distribute? [PROBE TO GET NUMERICAL ESTIMATES]

        iii. [DISTRIBUTORS ONLY] The variety of DHP brands/models you carry?

        iv. [DISTRIBUTORS ONLY] How many DHP units you keep in stock? [PROBE TO GET NUMERICAL ESTIMATES]

    b. [ALL] What challenges, if any, have you experienced in meeting demand?

12. Has the impact of the Program on residential DHP sales increased, decreased, or stayed the same, in the past year?

    a) [IF INCREASED OR DECREASED] Why is that?

Installers

13. [IF MANUFACTURER] Have you made any changes to your post-pilot DHP installation training activities for contractors? [INTERVIEWER LISTEN FOR: *who conducts training and how, also probe for numbers of trainings]*

14. [IF MANUFACTURER] What any changes, if any, have you made to your post-pilot sales training, technical support, and/or service support?

Big Box

15. [MANUFACTURERS AND MANUFACTURER REPS ONLY]: What is [COMPANY NAME] thinking about working with retailers to sell DHPs?

    a) [IF CONSIDERING RETAIL] What are the potential advantages/disadvantages of working with retailers to sell DHPs? [PROBE: Do you think that potential for misapplication and improper installation of DHPs could be addressed by implementing a sales model similar to that which is currently applied to retail sales of water heaters, in which retail water heater sales include the cost of installation through a network of professional installers? Why/Why not?]

    b) [IF CURRENTLY WORKING WITH RETAIL] What about this approach has been successful/unsuccessful so far? [PROBE: Why/Why not?]

    c) Not considering working with retail

Manufactured Homes

16. Do you sell DHPs that are used in manufactured homes?

    - ☐ Yes, how common is this?
    - ☐ No
    - ☐ Don't know

17. Do you sell DHPs that are used in new homes?

- ☐ Yes, How common is this?:
- ☐ No
- ☐ Don't know

18. Are there any barriers preventing DHPs from being used in manufactured or new homes?

- ☐ Yes, please specify:
- ☐ No
- ☐ Don't know

Interactions

19. What involvement have you had with the NW Ductless Heat Pump Program in the past year? [If none, skip to Q23]

20. How has the Program influenced your view the DHP market in the NW? How about the overall US market?

21. Have you had any post-pilot challenges during 2010? [PROBES: With the rebate mechanism? With NEEA/Fluid management? With the activities of installers? With DHP equipment? Anything else?]

Pricing

22. Do you see any evidence that incentives result in higher prices charged to consumers for DHPs?

- ☐ Yes, please specify:
- ☐ No
- ☐ Don't know

23. Have the tax credits influenced your business? [Probe: is this any different now that 2 ton units are included? Have the tax credits had any impact on which models are being sold?]

- ☐ Yes, please specify how:
- ☐ No
- ☐ Don't know

Technology

24. Are there any new developments with DHPs in cold climate applications?

Future Projections

25. What are your expectations for the future regarding your company's DHP sales volume and/or market share?

    a) Do you anticipate that your company will be able to keep up with market-demand for DHPs?

26. Do DHPs constitute a viable market for you? How do they compare with other products that you manufacture (for distributors only: carry?)

27. [IF NOT ANSWERED ALREADY] In the Pacific Northwest, going forward, what proportion of your DHP sales do you expect will be multi-headed DHP units for whole house solutions – (one or more outdoor units with multiple indoor heads) vs. –one-to-one" or –one to two" configurations (to displace zonal electric heat)?

28. [DISTRIBUTORS ONLY] Do you currently stock heat pump water heaters? What is your opinion of the market- viability for heat pump water heaters?

Moving Forward

I would like to ask a little about the current state and future of the DHP market.

29. Are there any new or growing market segments for DHPs? [New construction, remodels, mobile housing, etc]

30. Are there any specific applications for DHPs that seem to be becoming more popular? [Ex: cooling, converting spaces]

General

31. What have you learned from the Program?

32. Do you have any other thoughts or comments about DHPs in general, the market, or the project?

UTILITY INTERVIEW GUIDE

Interviewee Name:

Date:

Interviewer:

Hi my name is _____. I'm calling on behalf of NEEA. I would like to talk to you about your 2010 DHP program.

NW Ductless Heat Pump Project Impressions

1. How has your role as manager of your utility's DHP program changed in the past year? [Probe for detail]

2. Have any changes been made to your utility's DHP program in the past year? What? Why (rationale)? By way of summary, let me briefly run through a list of possible changes; just let me know which ones occurred:

   Changes to incentive amount?

   Changes to customer application process?

   Pre-approval process changes?

   Changes to customer eligibility requirements?

   Changes to customer application?

   Changes to or new marketing initiatives?]

3. What do you see as being the major successes or achievements to date in promoting DHPs to the region?

   a. What factors do you think contributed to these successes?

Interaction

4. Have you had any interactions in the past year with NEEA and/or Fluid staff related to your utility's DHP program? [CLARIFY IF INTERACTION WAS WITH FLUID OR NEEA STAFF].

   ☐ Yes
   ☐ No

a. [IF YES] How if applicable have your interactions with Project staff changed during the course of 2010?

5. Have you had any interactions in the past year with DHP installers?

   - ☐ Yes
   - ☐ No

   a. [IF YES] How have your interactions with DHP installers changed since the Pilot ended ? [Probe for detail]

6. Do you have any concerns about the quality of DHP installations in your territory ?

   - ☐ Yes
   - ☐ No

7. Do you think the typical installation quality has improved, stayed the same, or declined over the past year?

   - ☐ Improved
   - ☐ Stayed the same
   - ☐ Declined

8. Have you had any interactions in the past year with DHP manufacturers or their reps and distributors?

   - ☐ Yes
   - ☐ No. Why not?

   a. [IF YES] Have your interactions with DHP manufacturers (and reps and distributors) changed since the Pilot ended? [Probe for detail]

9. Have there been any changes to your utility's use of the Program implementation team for assistance and support in the past year?

10. Do you interact with other utilities concerning their DHP programs?

    a. What about?

    b. How frequently?

    c. Have you engaged in any activities to help other utilities with their DHP programs?

d. Have your interactions with other utilities changed in the past year?

Marketing

11. What additional marketing activities have you done for the heat pump program in 2010?

    a. Considering your marketing activities in 2010, which have been most successful?

    b. Which activities in 2010 have been least successful?

    c. Have these activities led to any ―lessons learned" regarding marketing DHPs?

    d. Have there been any efforts to market DHPs to specific demographics?

        a. [IF YES] Why? What have you learned about the targeted demographic(s)?

        b. [ASK ALL] Do you maintain demographic information for your DHP customers?

DHP Installations

12. What were your program goals for 2010(numerically, or simply ―higher/lower" than Pilot, perhaps with percentage)?

    a. Did you meet your 2010 goals?

        __met goal

        __exceeded and met the demand

        __potentially exceeded, but limited incentives to budgeted amount

        __fell short of goal

            a. [IF YES] What factors contributed to meeting the goals?

            b. [IF NO] What factors do you attribute your utility having not met the goals

13. How closely are the resources provided through the NW Ductless Heat Pump Project aligned with consumer demand for DHP technology in your service territory?

14. Do you think that the climatic conditions within your service territory are a barrier or an asset to DHP sales?

15. Does your utility receive what you would describe as a large volume of inquiries regarding DHPs and the utility DHP program?

    a. What was the typical cost of a DHP installation in your territory last year? Was there any difference from 2009? What factors if any have lead to differing costs, such as brand, installer, location?

    b. Has the typical cost changed over the past year?

        i. [IF YES] What factors have contributed to this change? [PROBE: DHP brand? Inflation? Contractor cost?]

    c. Is the typical cost of a DHP installation in your service territory different from other service territories or regions?

        ii. [IF YES] Do you have any insights or concerns as to why your costs may differ from that of other service territories or regions?

        iii. Are DHPs being sold in big box retail stores in your territory?

16. Realizing that program resources are finite, which of the following scenarios would you prefer: READ AND PICK ONE.

    1 Larger incentive than currently available, but for a shorter period of time
    2 Smaller incentive for a longer period of time
    3 Current incentive level and program duration
    8 DON'T KNOW
    9 REFUSED

17. Will you continue to offer incentives this year?

18. What feedback have you received from consumers?

    a. Which of this feedback, if any, occurred since we last spoke in fall 2009?

Future Projections

19. Do DHPs constitute a viable market in your utility's service territory?

20. Do you think the market interest in your utility's service territory will grow or fade over time?

21. What do you consider to be ―good" and ―cost-effective" applications for DHPs?

a. [IF NOT ANSWERED] What do you think are good subsectors within the residential sector—by housing type, heating equipment type, etc?

b. Do you have any concerns about the cost-effectiveness of DHPs, or their cost-effectiveness in specific markets?

22. The Program primarily targets existing single-family, site-built homes using electric heat and secondarily targets existing manufactured homes using electric heat. Does your utility intend to target additional types of homes ?

a. Is your utility targeting commercial customers for DHP installations?

b. Multi-family residences?

c. Manufactured homes?

23. [IF NOT ANSWERED] Which additional market segments have potential for uptake of DHPs? What conditions are necessary or market barriers need to be addressed, to increase market adoption of DHPs in the Pacific Northwest and in your service territory in particular?

a. [PROBES: Market research into the technical potential, market constraints, and market needs of DHP submarkets (including new and existing manufactured housing, residential new construction, home remodels and conversions, and small commercial property owners)?]

i. [IF NOT ADDRESSED] With regards to addressing each of the market barriers, what roles and activities do you see for the various actors in the Project—that is NEEA, Fluid, the utilities, the manufacturers (and manufacturer reps and distributors), the installers?

b. [IF NOT ADDRESSED] What types of marketing activities would be most helpful for NEEA to engage in?

General

24. What are the main challenges you are facing in the future?

a. How have you addressed these challenges?

b. Have any new challenges developed in the past year? How have you addressed these challenges?

25. Aside from the issues we have already talked about, what lessons have you learned from your involvement with the Project so far? [PROBE: Project staff, utility involvement, the manufacturers (and reps and distributors), installers, residential customers]

26. Do you have any final comments – either positive or negative, that you'd like to share about your utility's involvement with NW Ductless Program?

Thank you for your time.

DHP 2010 IMPLEMENTATION TEAM SURVEY

Interviewee Name:

Date:

Interviewer:

Hi my name is _____ calling from Research Into Action on behalf of the NW Ductless Heat Pump program. May I please speak to _____?

Background

1. NEEA: How has your role with the Northwest Ductless Heat Pump Project changed in this second phase of the Project?
   FLUID: How has Fluid's role in the Northwest Ductless Heat Pump Project changed in 2010? [Probe for detail]

   a. FLUID: Related to these changes, how has *your* role changed, specifically?[Probe for detail]

2. What do you see as being the Project's major successes or achievements in 2010 ? What have you done differently since the beginning of 2011?

   a. What do you think contributed to these successes?

3. What are the main challenges you have faced?

   a. How have you addressed these challenges?

   b. [If not addressed] Do you anticipate any future challenges associated with market adoption of DHPs in the Pacific Northwest?

4. Have there been any changes to the market sector(s) targeted in 2010? What changes?

   a. [IF YES] What prompted these changes?

5. What conditions are necessary or market barriers need to be addressed, to increase market adoption of DHPs in the Pacific Northwest moving forward?

   a. [PROBES: Continued (or modified) consumer incentive program? Continued upstream market support targeting installers and manufacturers (and reps and distributors)? Marketing activities (targeting consumers and/or installers)?]

6. [IF NOT ADDRESSED] With regards to addressing each of the market barriers, what roles and activities do you see for the various actors in the Pilot—that is NEEA, Fluid, the utilities, the manufacturers (and reps and distributors), and installers?

7. What is NEEA's/FLUID's thinking about working with retailers to sell DHPs?

Marketing

8. What marketing activities were conducted in 2010?

    a. Which were the most successful?

    b. What new marketing approaches have you used in 2011?

    c. Have the activities led to any "lessons learned" regarding marketing DHPs? [If yes] What are these?

9. What do you consider to be the ideal incentive amount for DHPs marketed through the Program?

    a. PROBE: Does the ideal incentive amount vary by geographic area, etc?

10. Overall, have you noticed the prices of DHPs going down?

Interactions

11. Have your interactions with FLUID/NEEA changed in 2010? Any issues?

    a. FLUID: Have management directives been clear and reasonable?

    b. FLUID: Have expectations been clear and reasonable?

    c. BOTH: Have any issues come up?

        i. [If yes] How have the issues been resolved?

12. Have your interactions with installers changed in 2010? Any issues?

13. FLUID: Have your interactions with installers changed in 2010? Any issues?

    a. [IF NOT ADDRESSED] What sorts of feedback you have received from installers in 2010?

i. [PROBES: regarding the DHP market, regarding DHP orientation sessions, regarding DHP manufacturer training, regarding current market conditions, regarding their interaction with utilities, regarding consumer satisfaction, etc.]

14. Have your interactions with utilities changed in 2010? Any issues?

    a. How have the utility DHP programs changed in the 2010 phase of the Program?

15. Have your interactions with DHP manufacturers (also: manufacturer representatives or distributors) changed in 2010? Any issues?

16. Have you received any feedback from consumers during the 2010 phase of the Program? [IF SO, please describe what they said].

General Comments

In this final set of questions, think about what the market needs in order to increase market adoption of DHPs in the Pacific Northwest.

17. How effective do you think the Project was in 2010?

18. Aside from the issues we have already talked about, what lessons have you learned from your involvement with the Project so far?

19. Aside from the obstacles we have already talked about, have you noticed any additional obstacles with the program so far?

20. Do you have any final comments – either positive or negative, that you'd like to share about the Project?

HVAC CONTRACTOR SURVEY INSTRUMENT – CSRS #91907NEEA 2010 DHP EVALUATION, APRIL 2011

Completes Desired

Strata	Sample Definition	Quota Definition	Population	Desired Completes (85/10 C/P)
Group 1 Participating Contractors	(E=1 & F=0) or (E=1 & F=1) SAMPLE 1	Q.1c=Yes	457	47 is 85/10 Quota 1=47
Group 2 Oriented (Nonparticipating) Contractors	E=0 & F=1 SAMPLE 2	Q1c=No/DK/RF/Blank and Q1d=Yes	354	45 is 85/10 Quota 2=45
Group 3 Small Rural Contractors	E=0 & F=0 & G=0 & H=0 SAMPLE 3	1c=No/DK/RF/Blank and Q1d=No/DK/RF/Blank and Q3 is less than or equal to 3 and Q0=Rural	274	44 is 85/10 Quota 3=44
Group 4 Small Urban Contractors	E=0 & F=0 & G=1 & H=0 SAMPLE 4	1c=No/DK/RF/Blank and Q1d=No/DK/RF/Blank and Q3 is less than or equal to 3 and Q0=Urban	1652	50 is 85/10 Quota 4=50
Group 5 Large Rural Contractors	E=0 & F=0 & G=0 & H=1 SAMPLE 5	1c=No/DK/RF/Blank and Q1d=No/DK/RF/Blank and Q3 is 4 or more and Q0=Rural	71	30 (or max possible) Quota 5=30
Group 6 Large Urban Contractors	E=0 & F=0 & G=1 & H=1 SAMPLE 6	1c=No/DK/RF/Blank and Q1d=No/DK/RF/Blank and Q3 is 4 or more and Q0=Urban	681	48 is 85/10 Quota 6=48
Total				Overall Quota=264

INTRO1 - Hi, my name is _____ calling from CSRS on behalf of the Northwest Energy Efficiency Alliance, also known as NEEA (KNEE-A) – and the Northwest Ductless Heat Pump Program. Does your firm sell residential HVAC equipment?

1 YES → CONTINUE
2 NO → THANK AND TERMINATE, RECORD AS NQ.INTRO1
8 DON'T KNOW →THANK AND TERMINATE, RECORD AS DK.INTRO1
9 REFUSED → THANK AND TERMINATE, RECORD AS RF.INTRO1

I would like to talk with a sales manager or the person who is most knowledgeable about your firms' sales of residential HVAC equipment, especially ductless heat pumps. Who would I need to speak with? *GET REFERRAL TO CORRECT PERSON.*

_____

1 CORRECT PERSON IS AVAILABLE → CONTINUE
2 CORRECT PERSON **IS NOT** AVAILABLE → SCHEDULE CALL BACK

INTRO2 - Hi, my name is _____ calling from CSRS on behalf of the NEEA (KNEE-A). NEEA (KNEE-A) is conducting an evaluation of the Northwest Ductless Heat Pump Program. I would like to ask about your firm's familiarity and experiences with ductless heat pumps. Is this a good time? [IF ASK: TELL RESPONDENT IT WILL TAKE ABOUT 15 MINUTES DEPENDING ON THEIR ANSWERS]

1 YES → CONTINUE
2 NO → SCHEDULE CALL BACK
9 REFUSED → THANK AND TERMINATE, RECORD AS RF.INTRO2

Installer Background

[IF LOCCOUNTY IS BLANK ASK Q.0 OTHERWISE SKIP TO Q.1a] Thinking only about the location I've called to, what state and county is your company located in?

1 Washington
2 Oregon
3 Idaho
4 Montana

WASHINGTON COUNTY:

53001 ADAMS COUNTY	53029 ISLAND COUNTY	53057 SKAGIT COUNTY
53003 ASOTIN COUNTY	53031 JEFFERSON COUNTY	53059 SKAMANIA COUNTY
53005 BENTON COUNTY	53033 KING COUNTY	53061 SNOHOMISH COUNTY
53007 CHELAN COUNTY	53035 KITSAP COUNTY	53063 SPOKANE COUNTY
53009 CLALLAM COUNTY	53037 KITTITAS COUNTY	53065 STEVENS COUNTY
53011 CLARK COUNTY	53039 KLICKITAT COUNTY	53067 THURSTON COUNTY
53013 COLUMBIA COUNTY	53041 LEWIS COUNTY	53069 WAHKIAKUM COUNTY
53015 COWLITZ COUNTY	53043 LINCOLN COUNTY	53071 WALLA WALLA COUNTY
53017 DOUGLAS COUNTY	53045 MASON COUNTY	53073 WHATCOM COUNTY
53019 FERRY COUNTY	53047 OKANOGAN COUNTY	53075 WHITMAN COUNTY
53021 FRANKLIN COUNTY	53049 PACIFIC COUNTY	53077 YAKIMA COUNTY
53023 GARFIELD COUNTY	53051 PEND OREILLE COUNTY	88888 DON'T KNOW
53025 GRANT COUNTY	53053 PIERCE COUNTY	99999 REFUSED
53027 GRAYS HARBOR COUNTY	53055 SAN JUAN COUNTY	

OREGON COUNTY:

41001 BAKER COUNTY	41027 HOOD RIVER COUNTY	41053 POLK COUNTY
41003 BENTON COUNTY	41029 JACKSON COUNTY	41055 SHERMAN COUNTY
41005 CLACKAMAS COUNTY	41031 JEFFERSON COUNTY	41057 TILLAMOOK COUNTY
41007 CLATSOP COUNTY	41033 JOSEPHINE COUNTY	41059 UMATILLA COUNTY
41009 COLUMBIA COUNTY	41035 KLAMATH COUNTY	41061 UNION COUNTY
41011 COOS COUNTY	41037 LAKE COUNTY	41063 WALLOWA COUNTY
41013 CROOK COUNTY	41039 LANE COUNTY	41065 WASCO COUNTY
41015 CURRY COUNTY	41041 LINCOLN COUNTY	41067 WASHINGTON COUNTY
41017 DESCHUTES COUNTY	41043 LINN COUNTY	41069 WHEELER COUNTY
41019 DOUGLAS COUNTY	41045 MALHEUR COUNTY	41071 YAMHILL COUNTY
41021 GILLIAM COUNTY	41047 MARION COUNTY	88888 DON'T KNOW
41023 GRANT COUNTY	41049 MORROW COUNTY	99999 REFUSED
41025 HARNEY COUNTY	41051 MULTNOMAH COUNTY	

IDAHO COUNTY:

16001 ADA COUNTY
16003 ADAMS COUNTY
16005 BANNOCK COUNTY
16007 BEAR LAKE COUNTY
16009 BENEWAH COUNTY
16011 BINGHAM COUNTY
16013 BLAINE COUNTY
16015 BOISE COUNTY
16017 BONNER COUNTY
16019 BONNEVILLE COUNTY
16021 BOUNDARY COUNTY
16023 BUTTE COUNTY
16025 CAMAS COUNTY
16027 CANYON COUNTY
16029 CARIBOU COUNTY
16031 CASSIA COUNTY
16033 CLARK COUNTY
16035 CLEARWATER COUNTY
16037 CUSTER COUNTY
16039 ELMORE COUNTY
16041 FRANKLIN COUNTY
16043 FREMONT COUNTY
16045 GEM COUNTY
16047 GOODING COUNTY
16049 IDAHO COUNTY
16051 JEFFERSON COUNTY
16053 JEROME COUNTY
16055 KOOTENAI COUNTY
16057 LATAH COUNTY
16059 LEMHI COUNTY
16061 LEWIS COUNTY
16063 LINCOLN COUNTY
16065 MADISON COUNTY
16067 MINIDOKA COUNTY
16069 NEZ PERCE COUNTY
16071 ONEIDA COUNTY
16073 OWYHEE COUNTY
16075 PAYETTE COUNTY
16077 POWER COUNTY
16079 SHOSHONE COUNTY
16081 TETON COUNTY
16083 TWIN FALLS COUNTY
16085 VALLEY COUNTY
16087 WASHINGTON COUNTY
88888 DON'T KNOW
99999 REFUSED

MONTANA COUNTY:

30001 BEAVERHEAD COUNTY
30003 BIG HORN COUNTY
30005 BLAINE COUNTY
30007 BROADWATER COUNTY
30009 CARBON COUNTY
30011 CARTER COUNTY
30013 CASCADE COUNTY
30015 CHOUTEAU COUNTY
30017 CUSTER COUNTY
30019 DANIELS COUNTY
30021 DAWSON COUNTY
30023 DEER LODGE COUNTY
30025 FALLON COUNTY
30027 FERGUS COUNTY
30029 FLATHEAD COUNTY
30031 GALLATIN COUNTY
30033 GARFIELD COUNTY
30035 GLACIER COUNTY
30037 GOLDEN VALLEY COUNTY
30039 GRANITE COUNTY
30041 HILL COUNTY
30043 JEFFERSON COUNTY
30045 JUDITH BASIN COUNTY
30047 LAKE COUNTY
30049 LEWIS AND CLARK COUNTY
30051 LIBERTY COUNTY
30053 LINCOLN COUNTY
30055 MCCONE COUNTY
30057 MADISON COUNTY
30059 MEAGHER COUNTY
30061 MINERAL COUNTY
30063 MISSOULA COUNTY
30065 MUSSELSHELL COUNTY
30067 PARK COUNTY
30069 PETROLEUM COUNTY
30071 PHILLIPS COUNTY
30073 PONDERA COUNTY
30075 POWDER RIVER COUNTY
30077 POWELL COUNTY
30079 PRAIRIE COUNTY
30081 RAVALLI COUNTY
30083 RICHLAND COUNTY
30085 ROOSEVELT COUNTY
30087 ROSEBUD COUNTY
30089 SANDERS COUNTY
30091 SHERIDAN COUNTY
30093 SILVER BOW COUNTY
30095 STILLWATER COUNTY
30097 SWEET GRASS COUNTY
30099 TETON COUNTY
30101 TOOLE COUNTY
30103 TREASURE COUNTY
30105 VALLEY COUNTY
30107 WHEATLAND COUNTY
30109 WIBAUX COUNTY
30111 YELLOWSTONE COUNTY
88888 DON'T KNOW
99999 REFUSED

1a Are you familiar with ductless heat pumps, also known as DHPs or mini-splits?

1 YES → CONTINUE
2 NO → THANK AND TERMINATE, RECORD AS NQ.Q1A
8 DON'T KNOW → THANK AND TERMINATE, RECORD AS DK.Q1A
9 REFUSED → THANK AND TERMINATE, RECORD AS RF.Q1A

1b Most of the electric utilities in this region offer incentives for qualifying residential ductless heat pumps through the Northwest Ductless Heat Pump Program. Are you familiar with this program?

1 Yes
2 No --> skip to Q 2
8 Don't know → SKIP TO Q.2
9 REFUSED → SKIP TO Q.2

1c Has your firm received incentives through the Northwest Ductless Heat Pump Program?

1 YES
2 NO
8 DON'T KNOW
9 REFUSED

1d. Has anyone at your company attended a contractor orientation session for the Northwest Ductless Heat Pump Program? [IF NECESSARY: This could be in person or via a webinar]

1 YES
2 NO
8 DON'T KNOW
9 REFUSED

2. Which DHP brands is your firm able to offer? (DO NOT READ LIST) ACCEPT MULTIPLE ANSWERS

01 AMCOR
02 COMFORT AIRE
03 DAIKIN
04 FUJITSU
05 LG
06 MITSUBISHI
07 SAMSUNG
08 SANYO
09 TOSHIBA-CARRIER
10 OTHER (SPECIFY): _____
88 DON'T KNOW
99 REFUSED

3. How many people are employed by your firm at this location? [only if needed: Please count part time staff as .5. BEFORE ACCEPTING A DON'T KNOW/REFUSED ASK FOR THE RESPONDENT'S BEST ESTIMATE. ROUND UP TO WHOLE NUMBER]

_____ 9999=REFUSED → THANK AND TERMINATE, RECORD AS NQ.Q3

4. About how many of your company's staff have received manufacturer training on ductless heat pumps? [BEFORE ACCEPTING A DON'T KNOW/REFUSED ASK FOR THE RESPONDENT'S BEST ESTIMATE]

_____ 8888=DON'T KNOW 9999=REFUSED

5. Do you have any plans to send staff to DHP manufacturer training in the next year?
   1 YES
   2 NO
   8 DON'T KNOW
   9 REFUSED

6. Which of the following activities does your firm engage in? [Read all]:

		Yes	No	Don't Know	Refused
a.	Sales of Residential HVAC equipment	1	2	8	9
b.	Sales of Commercial HVAC equipment	1	2	8	9
c.	Home remodels	1	2	8	9

7. Has your firm been in business for more than two years?
   1 YES
   2 NO
   8 DON'T KNOW
   9 REFUSED

8. In what states does your firm install residential HVAC equipment? [MARK all that apply]
   1 Washington
   2 Oregon
   3 Idaho
   4 Montana
   8 DON'T KNOW → SKIP TO Q.10
   9 REFUSED → SKIP TO Q.10

9a. [IF Q8=1 ASK Q.9a] What counties in Washington do you install residential HVAC equipment?

53001 ADAMS COUNTY	53029 ISLAND COUNTY	53057 SKAGIT COUNTY
53003 ASOTIN COUNTY	53031 JEFFERSON COUNTY	53059 SKAMANIA COUNTY
53005 BENTON COUNTY	53033 KING COUNTY	53061 SNOHOMISH COUNTY
53007 CHELAN COUNTY	53035 KITSAP COUNTY	53063 SPOKANE COUNTY
53009 CLALLAM COUNTY	53037 KITTITAS COUNTY	53065 STEVENS COUNTY
53011 CLARK COUNTY	53039 KLICKITAT COUNTY	53067 THURSTON COUNTY
53013 COLUMBIA COUNTY	53041 LEWIS COUNTY	53069 WAHKIAKUM COUNTY
53015 COWLITZ COUNTY	53043 LINCOLN COUNTY	53071 WALLA WALLA COUNTY
53017 DOUGLAS COUNTY	53045 MASON COUNTY	53073 WHATCOM COUNTY
53019 FERRY COUNTY	53047 OKANOGAN COUNTY	53075 WHITMAN COUNTY
53021 FRANKLIN COUNTY	53049 PACIFIC COUNTY	53077 YAKIMA COUNTY
53023 GARFIELD COUNTY	53051 PEND OREILLE COUNTY	88888 DON'T KNOW
53025 GRANT COUNTY	53053 PIERCE COUNTY	99999 REFUSED
53027 GRAYS HARBOR COUNTY	53055 SAN JUAN COUNTY	

9b. [IF Q8=2 ASK Q.9b] What counties in Oregon do you install residential HVAC equipment?

41001 BAKER COUNTY	41027 HOOD RIVER COUNTY	41053 POLK COUNTY
41003 BENTON COUNTY	41029 JACKSON COUNTY	41055 SHERMAN COUNTY
41005 CLACKAMAS COUNTY	41031 JEFFERSON COUNTY	41057 TILLAMOOK COUNTY
41007 CLATSOP COUNTY	41033 JOSEPHINE COUNTY	41059 UMATILLA COUNTY
41009 COLUMBIA COUNTY	41035 KLAMATH COUNTY	41061 UNION COUNTY
41011 COOS COUNTY	41037 LAKE COUNTY	41063 WALLOWA COUNTY
41013 CROOK COUNTY	41039 LANE COUNTY	41065 WASCO COUNTY
41015 CURRY COUNTY	41041 LINCOLN COUNTY	41067 WASHINGTON COUNTY
41017 DESCHUTES COUNTY	41043 LINN COUNTY	41069 WHEELER COUNTY
41019 DOUGLAS COUNTY	41045 MALHEUR COUNTY	41071 YAMHILL COUNTY
41021 GILLIAM COUNTY	41047 MARION COUNTY	88888 DON'T KNOW
41023 GRANT COUNTY	41049 MORROW COUNTY	99999 REFUSED
41025 HARNEY COUNTY	41051 MULTNOMAH COUNTY	

9c. [IF Q8=3 ASK Q.9c] What counties in Idaho do you install residential HVAC equipment?

16001 ADA COUNTY	16033 CLARK COUNTY	16065 MADISON COUNTY
16003 ADAMS COUNTY	16035 CLEARWATER COUNTY	16067 MINIDOKA COUNTY
16005 BANNOCK COUNTY	16037 CUSTER COUNTY	16069 NEZ PERCE COUNTY
16007 BEAR LAKE COUNTY	16039 ELMORE COUNTY	16071 ONEIDA COUNTY
16009 BENEWAH COUNTY	16041 FRANKLIN COUNTY	16073 OWYHEE COUNTY
16011 BINGHAM COUNTY	16043 FREMONT COUNTY	16075 PAYETTE COUNTY
16013 BLAINE COUNTY	16045 GEM COUNTY	16077 POWER COUNTY
16015 BOISE COUNTY	16047 GOODING COUNTY	16079 SHOSHONE COUNTY
16017 BONNER COUNTY	16049 IDAHO COUNTY	16081 TETON COUNTY
16019 BONNEVILLE COUNTY	16051 JEFFERSON COUNTY	16083 TWIN FALLS COUNTY
16021 BOUNDARY COUNTY	16053 JEROME COUNTY	16085 VALLEY COUNTY
16023 BUTTE COUNTY	16055 KOOTENAI COUNTY	16087 WASHINGTON COUNTY
16025 CAMAS COUNTY	16057 LATAH COUNTY	88888 DON'T KNOW
16027 CANYON COUNTY	16059 LEMHI COUNTY	99999 REFUSED
16029 CARIBOU COUNTY	16061 LEWIS COUNTY	
16031 CASSIA COUNTY	16063 LINCOLN COUNTY	

9d. [IF Q8=4 ASK Q.9d] What counties in Montana do you install residential HVAC equipment?

30001 BEAVERHEAD COUNTY	30041 HILL COUNTY	30081 RAVALLI COUNTY
30003 BIG HORN COUNTY	30043 JEFFERSON COUNTY	30083 RICHLAND COUNTY
30005 BLAINE COUNTY	30045 JUDITH BASIN COUNTY	30085 ROOSEVELT COUNTY
30007 BROADWATER COUNTY	30047 LAKE COUNTY	30087 ROSEBUD COUNTY
30009 CARBON COUNTY	30049 LEWIS AND CLARK COUNTY	30089 SANDERS COUNTY
30011 CARTER COUNTY	30051 LIBERTY COUNTY	30091 SHERIDAN COUNTY
30013 CASCADE COUNTY	30053 LINCOLN COUNTY	30093 SILVER BOW COUNTY
30015 CHOUTEAU COUNTY	30055 MCCONE COUNTY	30095 STILLWATER COUNTY
30017 CUSTER COUNTY	30057 MADISON COUNTY	30097 SWEET GRASS COUNTY
30019 DANIELS COUNTY	30059 MEAGHER COUNTY	30099 TETON COUNTY
30021 DAWSON COUNTY	30061 MINERAL COUNTY	30101 TOOLE COUNTY
30023 DEER LODGE COUNTY	30063 MISSOULA COUNTY	30103 TREASURE COUNTY
30025 FALLON COUNTY	30065 MUSSELSHELL COUNTY	30105 VALLEY COUNTY
30027 FERGUS COUNTY	30067 PARK COUNTY	30107 WHEATLAND COUNTY
30029 FLATHEAD COUNTY	30069 PETROLEUM COUNTY	30109 WIBAUX COUNTY
30031 GALLATIN COUNTY	30071 PHILLIPS COUNTY	30111 YELLOWSTONE COUNTY
30033 GARFIELD COUNTY	30073 PONDERA COUNTY	88888 DON'T KNOW
30035 GLACIER COUNTY	30075 POWDER RIVER COUNTY	99999 REFUSED
30037 GOLDEN VALLEY COUNTY	30077 POWELL COUNTY	
30039 GRANITE COUNTY	30079 PRAIRIE COUNTY	

10. Based on your experience with customers with electric heat in your service territory, about what proportion do you estimate have systems with a central thermostat, such as forced air furnaces?

_____% 888=DON'T KNOW 999=REFUSED Prior Experience

Next, I'd like to ask about your firm's experiences with DHPs.
IF Q.1b=YES CONTINUE OTHERWISE SKIP TO Q.12a

11a. About how many DHPs has your firm installed **that received incentives** through the Northwest Ductless Heat Pump Program? [FIRST try to get them to be as specific as possible OTHERWISE ASKS FOR RANGE AND ENTER RESPONSE UNDER RANGE. BEFORE ACCEPTING A DON'T KNOW/REFUSED ASK FOR THE RESPONDENT'S BEST ESTIMATE.]

Exact or estimated number: _____ 8888=DON'T KNOW 9999=REFUSED

11b. [ASK IF Q11a=8888 OR 9999] Range:

00 NONE
01 1 TO 4
02 5 TO 10
03 11 TO 25
04 26 TO 50
05 51 TO 75
06 76 TO 100
07 101 TO 150
08 151 TO 200
09 OVER 200
88 DON'T KNOW
99 REFUSED

12a. About how many DHPs has your firm installed in homes in the last two years (2009 and 2010) that did not receive utility incentives through the Northwest Ductless program? [FIRST try to get them to be as specific as possible OTHERWISE ASKS FOR RANGE AND ENTER RESPONSE UNDER RANGE. BEFORE ACCEPTING A DON'T KNOW/REFUSED ASK FOR THE RESPONDENT'S BEST ESTIMATE.]

Exact or estimated number: _____ 8888=DON'T KNOW 9999=REFUSED

12b. [ASK IF Q12a=8888 OR 9999] Range:

00 NONE
01 1 TO 4
02 5 TO 10
03 11 TO 25
04 26 TO 50
05 51 TO 75
06 76 TO 100
07 101 TO 150

08 151 TO 200
09 OVER 200
88 DON'T KNOW
99 REFUSED

12c.[If Q12a or q12b =1 OR MORE ASK Q.12c (unincented/ non-program units)] Why did these installations not go through the program? [IF NEEDED CAN read LIST; probe to code; MARK all that apply]

1 DID NOT QUALIFY DUE TO HEATING FUEL SERVING HOME
2 DID NOT QUALIFY BECAUSE OF APPLICATION [NOT PRIMARY HEAT OR PRIMARY LIVING SPACE]
3 INSTALLED IN AN AREA WHERE THERE IS NO DHP PROGRAM
4 DISLIKE UTILITY PROGRAM REQUIREMENTS
5 OTHER 1 (PLEASE SPECIFY) _____
6 OTHER 2 (PLEASE SPECIFY) _____
8 DON'T KNOW
9 REFUSED

12d.[If Q12a or q12b =1 OR MORE ask q.12d (unincented/ non-program units)] About what percent of the non-program residential units you installed in the past year are from each of the manufacturers you supply? [Percentages must total 100%.]

Amcor _____%
Comfort Aire_____%
Daikin_____%
Fujitsu_____%
LG_____%
Mitsubishi ____%
Samsung____%
Sanyo _____%
Toshiba- Carrier____%
OTHER 1_____%
OTHER 2 _____%
DON'T KNOW 888
REFUSED 999

If % provided for other, then please specify brand

12e.[If Q12a or q12b =1 OR MORE ask q.12e (unincented/ non-program units)] Please estimate the proportion of non-program residential units your company installs that are one-to-one systems, as distinguished from a multi-headed system. What percent are one-to-one applications? [IF NEEDED: ONE TO ONE SYSTEMS - one outdoor unit (compressor) and one indoor unit (air handler). MULTIPLE HEADED SYSTEM – MULTIPLE INDOOR UNITS.] [BEFORE ACCEPTING A DON'T KNOW/REFUSED ASK FOR THE RESPONDENT'S BEST ESTIMATE]

_____% 888=DON'T KNOW 999=REFUSED

12f.[If Q12a or q12b =1 IS MORE ASK Q.12f (unincented/ non-program units)] About what proportion of your sales in 2010 of non-program residential units were in newly constructed homes? [BEFORE ACCEPTING A DON'T KNOW/REFUSED ASK FOR THE RESPONDENT'S BEST ESTIMATE]

_____% 888=DON'T KNOW 999=REFUSED

12g.[If Q12a or q12b = 1 IS MORE ASK Q.12g (unincented/ non-program units)] About what proportion of your sales in 2010 were in newly heated areas of the home, including new additions to existing homes, such as garages, bonus rooms or in-law units? [BEFORE ACCEPTING A DON'T KNOW/REFUSED ASK FOR THE RESPONDENT'S BEST ESTIMATE]

____% 888=DON'T KNOW 999=REFUSED

[NOTE: Q12f AND Q12g DOES NOT NEED TO ADD TO 100%]

13a.About how many DHPs did your firm install in homes before October of 2008 when the incentive program started? [FIRST try to get them to be as specific as possible OTHERWISE ASKS FOR RANGE AND ENTER RESPONSE UNDER RANGE. BEFORE ACCEPTING A DON'T KNOW/REFUSED ASK FOR THE RESPONDENT'S BEST ESTIMATE.]

Exact or estimated number: _____ 8888=DON'T KNOW 9999=REFUSED

13b.[ASK IF Q13a=8888 OR 9999] Range:

00 none
01 1 to 4
02 5 to 10
03 11 to 25
04 26 to 50
05 51 to 75
06 76 to 100
07 101 TO 150
08 151 TO 200
09 Over 200
88 DON'T KNOW
REFUSED

13c.[IF Q11a or Q11b IS 1 OR MORE] In the future, do you anticipate selling more DHPs, the same amount as you sold in 2010, or fewer DHPs?

1 More DHPs
2 The same amount as you sold in 2010
3 Fewer DHPs
8 DON'T KNOW
9 REFUSED

[Ask the following questions (if Q11a or Q11b = 1 or more) or (Q12a OR q12b = 1 or more) or (Q13a OR q13b = 1 or more) {AT LEAST 1 residential DHP sales of any type} skip to Q.20 otherwise continue]

14a.Have you recommended DHPs to any of your residential customers?

1 Yes → CONTINUE
2 No → SKIP TO Q.14d
8 Don't know → skip to q.14e
9 REFUSED → skip to q.14e

14b. Which of the following applications have you recommended them for? Read all.

		Yes	No	Don't Know	Refused
a.	Manufactured homes	1	2	8	9
b.	Multifamily homes	1	2	8	9
c.	Newly constructed homes	1	2	8	9
d.	Spaces like basements, in-laws units, garages – spaces that were previously unheated or are new additions to existing homes	1	2	8	9
e.	Homes with zonal electric heat	1	2	8	9
f.	Homes with wood heat	1	2	8	9
g.	Homes with gas heat	1	2	8	9
h.	Anything else? [IF YES, PLEASE SPECIFY _____]	1	2	8	9

14c.What are some common reasons why your customers have decided not to install a DHP? [Do not read. Probe to code. Check all that apply]

1 COST
2 APPEARANCE
3 LACK OF INTEREST
4 UNFAMILIAR WITH THE TECHNOLOGY; LACK OF CONFIDENCE WITH THE TECHNOLOGY
5 ANOTHER TECHNOLOGY IS BETTER SUITED TO THEIR NEEDS
6 OTHER (PLEASE SPECIFY): _____
8 DON'T KNOW
9 REFUSED

SKIP TO Q.14e

14d.Why have you not recommended DHPs to any of your residential customers? [DO NOT READ. PROBE TO CODE. CHECK ALL THAT APPLY]

1 COST

2 APPEARANCE
3 LACK OF INTEREST
4 UNFAMILIAR WITH THE TECHNOLOGY; LACK OF CONFIDENCE WITH THE TECHNOLOGY
5 ANOTHER TECHNOLOGY IS BETTER SUITED TO THEIR NEEDS
6 OTHER (PLEASE SPECIFY): _____
8 DON'T KNOW
9 REFUSED

14e. Do you plan to recommend DHPs to your residential customers going forward?
1 YES
2 NO
8 DON'T KNOW
9 REFUSED

14f.Briefly, what advantages do you think DHPs offer? [DO NOT READ, CHECK ALL THAT APPLY]
1 LOWER OPERATING COSTS
2 LOWER INSTALLATION COSTS
3 ABILITY TO HEAT **AND** COOL
4 SIMPLE TO OPERATE
5 NO DUCTS
6 SAVING ENERGY
7 OTHER (SPECIFY): _____
8 DON'T KNOW
9 REFUSED

14g.Briefly, what do you see are the disadvantages of DHPs? [DO NOT READ, CHECK ALL THAT APPLY]
1 COST
2 APPEARANCE
3 UNFAMILIAR TECHNOLOGY
4 DON'T WORK WELL IN VERY COLD WEATHER
5 OTHER (SPECIFY): _____
8 DON'T KNOW
9 REFUSED

If asked the Q14A TO Q14g (company has not installed any DHPs), then SKIP TO vERIFY1 RECORD as cm.q14

20. Did you install any ~~–s~~hort run ducted" or ~~–c~~oncealed duct" DHP systems homes in the last two years? [IF NEEDED: Some manufacturers offer DHP units that allow a short run of ductwork to be connected to a concealed indoor unit. They offer similar features to a true

–ductless" heat pump, but incorporate the use of small ducts to distribute hot and cold air. These units are typically called –short run ducted" or –concealed duct" systems.]

1 YES → CONTINUE
2 NO → SKIP TO Q.22A
8 DON'T KNOW → SKIP TO Q.22A
9 REFUSED → SKIP TO Q.22A

21. What percent of all installations are of the –short run" or –concealed duct" type? [BEFORE ACCEPTING A DON'T KNOW/REFUSED ASK FOR THE RESPONDENT'S BEST ESTIMATE]

_____% 888=DON'T KNOW 999=REFUSED

22a. About how many residential-size DHPs – units of 3 tons or less – has your firm installed in commercial establishments in the last two years? [FIRST try to get them to be as specific as possible OTHERWISE ASK FOR RANGE AND ENTER RESPONSE UNDER RANGE. BEFORE ACCEPTING A DON'T KNOW/REFUSED ASK FOR THE RESPONDENT'S BEST ESTIMATE.] [If necessary: Examples of a residential DHP installation in a commercial establishment would be server rooms in small offices, and small businesses such as restaurants or cafes]

Exact or estimated number: _____ 8888=DON'T KNOW 9999=REFUSED

22b. [ASK IF Q22a=8888 OR 9999] Range:

00 NONE
01 1 TO 4
02 5 TO 10
03 11 TO 25
04 26 TO 50
05 51 TO 75
06 76 TO 100
07 101 TO 150
08 151 TO 200
09 OVER 200
88 DON'T KNOW
99 REFUSED

23a. About how many of your residential customers have purchased central or room air conditioning equipment in the last two years, excluding any DHP sales? [FIRST try to get them to be as specific as possible OTHERWISE ASK FOR RANGE AND ENTER RESPONSE UNDER RANGE. BEFORE ACCEPTING A DON'T KNOW/REFUSED ASK FOR THE RESPONDENT'S BEST ESTIMATE.]

Exact or estimated number: _____ 8888=DON'T KNOW 9999=REFUSED

23b. [ASK IF Q23a=8888 OR 9999] Range:

00 NONE
01 1 TO 4
02 5 TO 10
03 11 TO 25
04 26 TO 50
05 51 TO 75
06 76 TO 100
07 101 TO 150
08 151 TO 200
09 OVER 200
88 DON'T KNOW
99 REFUSED

Marketing and Outreach

24. About what percentage of customers contacted you … [CAN TOTAL MORE THAN 100%]
    In response to marketing by your firm ____%
    In response to utility marketing they saw ____%
    Due to word of mouth_____%
    Any other ways? Please specify, ____%
    DON'T KNOW 888
    REFUSED 999

25. And thinking of your **DHP** customers, about what proportion came to you seeking a DHP, and what proportion came to you seeking to improve their heating or cooling, but didn't specifically request a bid for a DHP? [PERCENTAGES MUST ADD UP TO 100%]
    Asked for DHP ____%
    Didn't specifically request DHP ____%
    DON'T KNOW 888
    REFUSED 999

26. When you want to introduce customers who are not familiar with the technology to DHPs, would you say you…[MARK all that apply]
    1 Use marketing materials distributed by the Northwest Ductless Program
    2 Use marketing materials your firm created
    3 Use materials your supplier or manufacturer created
    4 Or something else (please specify) _____
    8 DON'T KNOW
    9 REFUSED

27. What types of DHP marketing, if any, has your company done? [DO NOT READ]
    1 PRINT- FLIERS, NEWSPAPER ADS
    2 RADIO
    3 TV

4 OTHER, PLEASE SPECIFY: _____
8 DON'T KNOW
9 REFUSED

28. What do you do, if anything, to encourage referrals from your DHP customers?
1 NOTHING
2 PROVIDE INCENTIVES FOR REFERRALS
3 SUGGEST THAT YOUR CUSTOMERS REFER OTHERS
4 OTHER: PLEASE SPECIFY _____
8 DON'T KNOW
9 REFUSED

29. What other types of support, if any, would be beneficial to you? [CHECK ALL THAT APPLY, READ LIST IF NECESSARY]

1 ADDITIONAL SUPPORT FROM DISTRIBUTORS (TECHNICAL SERVICE SUPPORT)
2 ADDITIONAL MARKETING MATERIALS/RESOURCES
3 ADDITIONAL SUPPORT FROM MANUFACTURERS
4 OTHER, PLEASE SPECIFY:_____
5 NONE
8 DON'T KNOW
9 REFUSED

30. What are the key reasons your customers consider DHPs? [IF NEEDED read LIST; probe to code; MARK all that apply]
01 REPLACING EXISTING UNSATISFACTORY EQUIPMENT
02 CONDITIONING A SPACE WITHOUT DUCTS
03 CONDITIONING A SPACE NOT SERVED BY THEIR EXISTING HEAT
04 ADDING COOLING TO A SPACE
05 ADDING COOLING TO THE WHOLE HOUSE
06 REDUCING HEATING COSTS
07 OTHER 1, PLEASE SPECIFY:_____
08 OTHER 2, PLEASE SPECIFY:_____
88 DON'T KNOW
99 REFUSED

31. What features of the DHP are most appealing to your customers? [IF NEEDED read LIST; probe to code; MARK all that apply]
01 HEATING WITHOUT DUCTS
02 COOLING CAPABILITY
03 MORE COMFORTABLE HEATING THAN EXISTING EQUIPMENT
04 MORE CONTROLLABLE HEATING THAN EXISTING EQUIPMENT
05 COST

06 INCENTIVES
07 OTHER 1, PLEASE SPECIFY: _____
08 OTHER 2, PLEASE SPECIFY: _____
88 DON'T KNOW
99 REFUSED

32. Initially what concerns, if any, do customers typically have about DHPs? [IF NEEDED READ LIST; probe to code; mark all that apply]
    0 NONE
    1 APPEARANCE
    2 COST
    3 EFFECTIVENESS
    4 NEEDING MORE THAN ONE UNIT
    5 OTHER 1, PLEASE SPECIFY:_____
    6 OTHER 2, PLEASE SPECIFY:_____
    8 DON'T KNOW
    9 REFUSED

ASK REMAINING QS IF Q1b=YES, FAMILIAR WITH PROGRAM. ELSE, SKIP TO VERIFY1 RECORD AS CM.Q32

Program Services

33. Have you or your staff visited the Northwest Ductless Heat Pump Program website? [Note: the address is nwductless.com]
    1 YES → CONTINUE
    2 NO → SKIP TO Q.35
    8 DON'T KNOW → SKIP TO Q.35
    9 REFUSED → SKIP TO Q.35

34. Please rate how useful you found the website information to be, using a five-point scale with 1 meaning "not at all useful" and 5 meaning "extremely useful"?
    1 1 – Not At All Useful
    2 2
    3 3
    3 4
    5 5 – Extremely Useful
    8 DON'T KNOW
    9 REFUSED

35. Have you contacted Northwest Ductless Program staff?
    1 YES → CONTINUE
    2 NO → SKIP TO Q.37
    8 DON'T KNOW → SKIP TO Q.37
    9 REFUSED → SKIP TO Q.37

36. How responsive was the Program staff on a five-point scale with 1 meaning ―not at all responsive" and 5 meaning ―extremely responsive"?
    1 1 – Not At All Responsive
    2 2
    3 3
    4 4
    5 5 – Extremely Responsive
    8 DON'T KNOW
    9 REFUSED

37. Are there any **resources or support** that might help you to increase the number of ductless heat pumps you sell? [Probe: Specifically, are there any resources that the Project could provide?]
    1 YES
    2 NO
    8 DON'T KNOW
    9 REFUSED

37a. Record comments [IF RESPONDENT MADE ANY COMMENTS WHEN ANSWERING Q37 RECORD COMMENT HERE]

_____
_____
_____
_____

38. Realizing that program resources are finite, which of the following scenarios would you prefer: READ AND PICK ONE.
    1 Larger incentive than currently available, but for a shorter period of time
    2 Smaller incentive for a longer period of time
    3 Current incentive level and program duration
    8 DON'T KNOW
    9 REFUSED

38a. Record comments [IF RESPONDENT MADE ANY COMMENTS WHEN ANSWERING Q38 RECORD COMMENT HERE]

_____
_____
_____
_____

39. Have you heard of the Northwest Ductless Heat Pump Program's ―displacement not replacement" approach to DHP installations?
    1 YES → CONTINUE
    2 NO → SKIP TO Q.40
    8 DON'T KNOW → SKIP TO Q.40
    9 REFUSED → SKIP TO Q.40

39a. Would you say that your staff has a good understanding of what the program intends by "displacement not replacement", a fair understanding, or a poor understanding?

1 Good understanding
2 Fair understanding
3 Poor understanding
8 DON'T KNOW
9 REFUSED

40. Would you like to offer any comments, either positive or negative, about the Northwest Ductless Heat Pump Program or the ductless heat pump technology?

_____
_____
_____
_____

CONTINUE AND RECORD AS CM.Q40

Verify1. (IF WE ALREADY HAVE A NAME) Those are all the questions I have. I would also like to verify that your name is _____ and that I reached you at _____.

VERIFY2. (IF THERE IS NO NAME) Those are all the questions I have. In case my supervisor needs to verify my work, may I please have your name?

_____

Thank you very much for helping us with this important study! Have a good day/evening.

DHP PARTICIPANT INTERVIEW GUIDE, 2010 EVALUATION

Interviewee Name:

Date:

Interviewer:

Hi my name is _____ calling from Research Into Action on behalf of [utility]. The Northwest Energy Efficiency Alliance (NEEA) is conducting an evaluation of the NW Ductless Heat Pump Program. We are speaking to people who installed ductless heat pumps in their homes to learn about your experiences with the heat pump.

This will take about ____ minutes. Is this a good time?

I will refer to the ductless heat pump as a DHP to save time.

Awareness

1. How did you first hear about DHPs? [DO NOT READ; CHOOSE ONE, THE FIRST PLACE THEY HEARD OF IT]

   - ☐ Friend or acquaintance had one
   - ☐ Utility advertising, bill stuffer
   - ☐ Newspaper ad
   - ☐ Newspaper story
   - ☐ Television ad
   - ☐ Contractor
   - ☐ Internet research
   - ☐ Other:

2. Did you hear about it anywhere else? Or learn more about it from another source?

   - ☐ Friend or acquaintance had one
   - ☐ Utility advertising, bill stuffer
   - ☐ Newspaper ad
   - ☐ Newspaper story
   - ☐ Television ad
   - ☐ Contractor
   - ☐ Internet research
   - ☐ Other:

3. Could you also please tell me what sources of information, including the one(s) you just mentioned, were especially important in your decision to install the DHP- top two?

- ☐ Friend or acquaintance who had one
- ☐ Utility advertising, bill stuffer
- ☐ Newspaper ad
- ☐ Newspaper story
- ☐ Television ad
- ☐ Contractor
- ☐ Internet research
- ☐ Other:

4. Since you purchased the DHP, have you purchased any other heating or cooling equipment (If needed: space heaters, window ACs)?

   - ☐ Yes
   - ☐ No
   - ☐ Don't Know

5. [If yes:] What did you purchase? [check all that apply]

   - ☐ Heating, specify type:_____
   - ☐ Cooling, specify type:_____

Motivation

6. What initially interested you in the DHP? [DO NOT READ, PROBE TO CODE, CHECK ALL THAT APPLY]

   - ☐ Needed space conditioning, had no ducts
   - ☐ Needed additional or supplemental space conditioning
   - ☐ Existing heating was not working well enough
   - ☐ Existing heating was broken
   - ☐ Wanted to add cooling
   - ☐ Other, please specify:_____

7. Did you seek out a contractor who could install a DHP or was the DHP a suggestion from a contractor you were already working with?

   a. Was customers idea
   b. Was contractor suggestion
   c. Other:

8. What heat source(s) did you have before you installed the DHP? [DO NOT READ LIST UNLESS NECESSARY; CHECK ALL THAT APPLY—PROBE –ANYTHING ELSE?"; DO ASK Q10-13)

	9. Type of heat	10. Fuel	11. Do you still use it?	12. Before the DHP, what was your primary heat?	13. What is your primary heat now?
Forced Air Furnace					
Baseboards					
Wall Heaters					
Electric radiant heat					
Wood heat					
DHP					
Space Heaters					
Other					

14. [If they used wood] About how much wood did you typically use in a season?
__cords OR __pounds of pellets

15. Did you have any cooling equipment before you purchased the DHP? What kind?

a. None
b. Window AC
c. Full house AC
d. Portable AC
e. Swamp cooler
f. Other:_____

[If had cooling] Do you still use this other cooling equipment?

Please rate how important each of the following factors was in your decision to purchase a DHP:

How important was…	1	2	3	4	5
16. The comfort potential offered by the DHP					
17. The cost of the DHP, including the incentives					
18. The potentially cheaper operating costs of the DHP compared to your previous heating/cooling system					
19. The cooling capability of the DHP					

20. Were there any other aspects of the DHP that were appealing to you?

- ☐ Yes, please specify: _____
- ☐ No

21. How did you gather information about the DHP before you made your purchase? [Check all that apply]

- ☐ Online
- ☐ Contractor provided materials
- ☐ Speaking to the contractor
- ☐ Speaking to someone who already had a DHP installed
- ☐ Did not look for any information
- ☐ Other, please specify: _____

22. Was there anything you were concerned about when you were considering a DHP? [DO NOT READ; Check all that apply]

- ☐ Appearance
- ☐ Capability/functionality
- ☐ Cost
- ☐ Reliability
- ☐ Maintenance

- ☐ Other, please specify:_____

23. [IF YES] How did you overcome those concerns?

24. Now I'd

    a. Yes, one page quick reference guide
    b. Yes, other information
    c. No information
    d. Other:_____
    e. Don't remember

DHP Experience

Next, I'd like to ask about your experiences using your DHP.

25. Since it was installed, have you used the DHP for:

    - ☐ Heating
    - ☐ Cooling
    - ☐ Both

26. Has the DHP ever been unable to meet your heating or cooling needs?

    - ☐ Yes, heating
    - ☐ Yes, cooling
    - ☐ No

    Elaboration:_____

27. Have you cleaned the filter in your DHP?

    - ☐ Yes, how often:
    - ☐ No
    - ☐ Don't know

28. Have you programmed your DHP to automatically adjust the temperature it is set to during different periods of the day or week, or do you typically adjust the temperature on the unit manually?

    - ☐ Manual
    - ☐ Automatic

- ☐ Mixed
- ☐ Don't know

Satisfaction

Please rate your satisfaction with the following aspects on a 5-point scale where 1 means "very dissatisfied" and 5 means "very satisfied":

How satisfied are you with the….	1	2	3	4	5
29. Sound level of the indoor unit					
30. Electricity bill since installing the DHP					
31. Comfort of the new heat					
32. Comfort for the new cooling					
33. Maintenance the DHP requires					

34. Overall, has the DHP met your expectations?

- ☐ Yes
- ☐ No, how so?_____

35. Have you, or would you, recommend the DHP to a friend or colleague?

a. Yes, have
b. Yes, would
c. No
d. Don't know

36. [IF RESPONDENT SAYS THEY WOULD RECOMMEND THE DHP OR ALREADY HAVE] What are some of the reasons you (would) recommend(ed) the DHP?

37. Thinking back over your whole experience with the DHP and the buying process - is there anything you would change?

Thank you for your time.

July 14, 2011
Report No. E11-225

Ductless Heat Pump Impact & Process Evaluation: Lab-Testing Report

Prepared by:
Ecotope Inc.
4056 9th Avenue NE
Seattle, WA 98105

Northwest Energy Efficiency Alliance
PHONE
503-688-5400
FAX
503-688-5447
EMAIL
info@neea.org

Table of Contents

EXECUTIVE SUMMARY ..... **III**

1. INTRODUCTION **1**

1.1. GOALS AND OBJECTIVES 2

2. METHODOLOGY **3**

2.1. EQUIPMENT SELECTION 3
2.2. TESTING FACILITY 4
2.3. INSTRUMENTATION AND MEASUREMENTS 6
2.4. INDOOR UNIT AIRFLOW AND OUTPUT CAPACITY MEASUREMENTS 6
2.5. HEATING MODE TESTS 7
2.6. COOLING MODE TESTS 9

3. AIRFLOW AND CAPACITY MEASUREMENT COMPARISON RESULTS **10**

3.1. INDOOR UNIT AIRFLOW MEASUREMENTS 10
3.2. AIR AND REFRIGERANT CAPACITY MEASUREMENT COMPARISON 10

4. HEATING PERFORMANCE MAP TEST RESULTS **12**

4.1. STEADY STATE HEATING CAPACITY AND INPUT POWER 12
4.1.1. Steady State Heating Efficiency and Field Agreement *15*
4.2. DEFROST CYCLE 18
4.3. HEATING MODE CYCLING 21
4.4. COMPARATIVE HEATING MODE PERFORMANCE 21

5. COOLING RESULTS **23**

5.1. STEADY-STATE COOLING CAPACITY AND INPUT POWER 23
5.1.1. Steady State Cooling Efficiency *24*
5.2. COOLING MODE CYCLING 26

6. SEER AND HSPF RATINGS EVALUATION **28**

7. PERFORMANCE MODEL DEVELOPMENT **31**

7.1. OVERVIEW 31
7.2. MODEL 32
7.3. CURVE FIT AND MODEL EXAMPLE 35
7.4. COOLING MODEL 36

8. CONCLUSIONS **37**

APPENDIX A. WORKS CITED **39**

APPENDIX B. EXPERIMENTAL SETUP FROM HERRICK LABS **40**

APPENDIX C. TEST MATRIX **45**

APPENDIX D. ADDITIONAL HEATING MODE GRAPHS **51**

APPENDIX E. HEATING AND COOLING MODEL FROM HERRICK LABS **52**

List of Tables

Table 1. Equipment Specifications per Manufacturer's Literature....4
Table 2. 12RLS Indoor Unit Airflow Measurements....10
Table 3. FE12NA Indoor Unit Airflow Measurements....10
Table 4. Defrost Test Results....20
Table 5. HSPF and SEER Calculation Results....29
Table 6. Maximum Output Capacity Curve Fit Coefficients....33
Table 7. Maximum Power Input Curve Fit Coefficients....33
Table 8. Curve Fit Coefficients to Predict DHP Input Power....33
Table 9. Additional Modeling Parameters....34

List of Figures

Figure 1. Herrick Labs Control and Data Logging Station for Psychrometric Chambers....5
Figure 2. Equipment Installed in Psychrometric Chambers....6
Figure 3. Capacity Measurement Comparison for 12RLS Data....11
Figure 4. Capacity Measurement Comparison for FE12NA Heating Data....11
Figure 5. 12RLS Steady-State Heating Capacity for Indoor Temperature of 70°F....13
Figure 6. FE12NA Steady-State Heating Capacity for Indoor Temperature of 70°F....14
Figure 7. 12RLS COP Plot....16
Figure 8. FE12NA COP Plot....17
Figure 9. 12RLS Defrost Cycles at 35°F....19
Figure 10. Frost Accumulation on Outdoor Coil of FE12NA at -3°F....20
Figure 11. Comparative Input and Output at Maximum Capacity....22
Figure 12. Comparative Efficiency and Maximum Capacity....22
Figure 13. 12RLS Steady-State Cooling Capacity for 80°F (67°F wb) Indoor Temperature....23
Figure 14. FE12NA Steady-State Cooling Capacity for 80°F (67°F wb) Indoor Temperature....24
Figure 15. 12RLS COP Plot....25
Figure 16. FE12NA COP Plot....26
Figure 17. Example of DHP Performance Curve and Resistance Heat Interaction in a Sample House....36

Executive Summary

NEEA hired the team of Ecotope, Inc., supported by Research Into Action, Inc., Stellar Processes, and Herrick Labs, to evaluate the Northwest Ductless Heat Pump Pilot Project. The pilot project ran from October 2008 to December 2009. The DHP Pilot Project sought to displace energy used by zonal electric heating equipment, with DHPs. The DHP Program, which succeeded the pilot project in 2010, continues to address this goal.

As an integral part of the Ductless Heat Pump Evaluation Project, Ecotope carried out an extensive laboratory analysis of DHP performance. The lab evaluation developed a detailed understanding of DHP performance to support the field monitoring and subsequent data analysis of DHPs installed in houses. The evaluation also collected data for creating detailed and accurate equipment performance models for use in simulation tools.

In conjunction with NEEA, Ecotope established the following goals for the lab evaluation:

- Develop a performance map of the equipment at all temperature bins and operating modes while providing special focus to low temperature heating performance.
- Review standard ratings (AHRI 210/240) published by the manufactures and establish the relationship between the ratings at controlled test conditions and other tests at conditions more likely in the Pacific Northwest applications.
- Assess performance variation with various control strategies and operating modes.
- Conduct measurements to review and verify the data collected in the field metering, especially in situ coefficient of performance (COP) measurements. Ecotope installed a detailed metering package in over 30 houses to directly measure equipment output capacity and input power to observe COP (the details of which will be presented in another report).
- Establish empirical performance curves to predict the efficiency and output of the equipment in energy simulations and other engineering calculations. The modeling capability will directly support regional energy planning efforts and conservation program design.

Working with NEEA, Ecotope selected two DHP models to evaluate which are representative of those found in the field installations: the Fujitsu 12RLS and Mitsubishi FE12NA. Ecotope developed a testing strategy and contracted with Herrick Labs of Purdue University to conduct the measurements. The lab measured performance impacts on the two equipment models over a wide range of operating conditions that would be encountered in Pacific Northwest installations, including outside temperature ranges from -5°F to +105°F. Additionally, because the efficiency and flexibility of the DHP systems stem from their ability to vary compressor thermal outputs and indoor fan flow in response to changing ambient conditions or occupant intervention, the testing plan also called for measuring high, medium, and low capacity outputs and also included high, medium, and low indoor fan speeds.

Herrick Labs installed all necessary instrumentation to accurately and precisely measure the DHP operating parameters for all the data points in the testing plan. In particular, the lab

measured both an air-side and refrigerant-side equipment output capacity. These measurements are two independent measurements of the same quantities. The agreement achieved between the two measurements was 6% or less for both equipment models in both heating and cooling modes. The agreement demonstrates the veracity of the data.

Using the data on the equipment performance map collected in the lab tests, both Ecotope and Herrick Labs developed predictive energy use models of the equipment. Ecotope's model will be used inside the SEEM (Simple Energy and Enthalpy Model) residential energy use simulation to predict annual energy consumption and savings from DHP installations. The field data collected from installations across the region will be integrated with the laboratory test data and results to refine, calibrate, and validate the model.

The detailed performance mapping and subsequent analysis produced significant findings including:

- **The lab data demonstrates the high performance of both models.** The highly efficient operation will enable significant energy savings opportunities in both retrofit and new applications. Both equipment models have the potential to deliver on the promise of generous energy savings. Had the lab data revealed poor efficiency results, the ultimate energy savings estimates would be compromised. In the end, the savings achieved in a particular house will depend on a number of factors including the installation location within the building or the interaction with the existing heating system. Compressor and distribution efficiency of the DHP, however, will provide a strong foundation on which to build energy savings.

- **Lab and field COP measurements show good agreement.** The early analysis of the field data compares well to the lab measurements. Both measurements provide a useful cross reference for each other. The lab data is collected in a stable, repeatable, and highly controllable situation which provides a "reference set" for the field measurements of similar DHPs. Likewise, the field metering of COP shows which equipment operating modes are most common and therefore the most important parameters to measure in the lab. At the outset of the project, Ecotope did not anticipate the amount of synergy between the two data sets. It yields more confidence in both, while simultaneously demonstrating the benefits of an integrated evaluation approach to ductless heat pumps.

- **Both equipment models perform well at low outdoor temperatures.** Both models continue to operate well in cold temperatures with the 12RLS showing slightly higher capacity and efficiency. Installers and home-owners should be made aware that the equipment will continue to run and provide benefits at cold temperatures so that energy savings can be maximized.

- **The current HSPF and SEER ratings are not well suited to DHPs.** The testing standard and calculation procedure do not always produce ratings which characterize the performance of the equipment well or allow one to determine how the equipment might operate in a controlled lab environment, let alone a field installation. In lieu of the ratings, more data is needed to assess both the relative performance between models and the likely energy use of a single model. Performance curves (including capacity and input power over a range of compressor loadings) and descriptions of operational

strategies will be useful in this regard. An updated testing procedure should include changes to the testing conditions, compressor speeds in particular, that make them more applicable to the way the DHPs perform in actual operation.

- **The equipment can be modeled in SEEM.** The performance model developed with the data collected in the lab will be implemented within SEEM. The models will be carefully calibrated with field data to provide accurate predictive capacity. The simulation will be appropriate to determine energy savings in both retrofit applications and new construction scenarios. This will allow the results of the lab testing and field data to be generalized to future evaluation of DHPs as a regional energy efficiency resource.

Lastly, the project demonstrates the value of an integrated approach to program evaluation. The simultaneous lab and field measurements reinforce one another. For example, the carefully measured indoor airflows in the lab were useful for calibrating the field measurements of output capacity and the subsequent equipment efficiency. Further, the field data showed which operating conditions were important to investigate in the lab. Finally, both will be combined to produce energy modeling tools.

1. Introduction

The Northwest Energy Efficiency Alliance (NEEA) is a non-profit corporation supported by electric utilities, public benefits administrators, state governments, public interest groups, and energy efficiency industry representatives that operate in the states of Idaho, Montana, Oregon, and Washington. These entities work together to make affordable, energy-efficient products and services available in the marketplace.[1]

NEEA hired the team of Ecotope, Inc., supported by Research Into Action, Inc., Stellar Processes, and Herrick Labs, to evaluate the Northwest Ductless Heat Pump Pilot Project. The pilot project ran from October 2008 to December 2009. The DHP Pilot Project sought to displace zonal, electric resistance heating equipment, such as baseboards, with DHPs. The DHP Program, which succeeded the pilot project in 2010, continues to address this goal.

As an integral part of the Ductless Heat Pump Evaluation Project, Ecotope carried out an extensive laboratory analysis of DHP performance. The lab evaluation was designed to develop a detailed understanding of DHP performance for use in simulation tools and to support the field monitoring and subsequent data analysis of DHPs installed in homes. This report describes the equipment selected for detailed lab investigation, the methods used in the evaluation, the performance mapping results, and the performance model developed from the data for use in energy prediction tools. The work reported here will also be used to inform metering results from the field installations. That subsequent portion of the analysis will be included in a broader report after the field data has been collected and analyzed.

Like all heat pumps, single point ratings of performance are published following guidelines specified by the Department of Energy (DOE) and Air-Conditioning Heating and Refrigeration Institute (AHRI). The rating points, such as the heating seasonal performance factor (HSPF) and seasonal energy efficiency ratio (SEER), depend on a single curve describing the performance of the equipment over a temperature range which is essentially continuous and predictable. For conventional split system heat pumps the single rating point is marginal, at best, for determining energy use (Francisco 2004). Likewise, although the AHRI standard (AHRI 210/240-2008) has specific tests for variable speed equipment, early observations indicated that the ratings do not measure well the equipment response to changing control signals (Davis 2009). Moreover, existing field tests indicate DHP technologies often perform better than the ratings suggest by optimizing the outputs and inputs to the current environmental conditions (Geraghty, 2009). The efficiency and flexibility of the DHP systems stem from their ability to change thermal outputs and indoor fan flow in response to control signals from changing ambient conditions or the occupant. Therefore, a single rating point for variable speed DHPs can only represent a small fraction of the capable operational range. The lab testing and performance modeling of

[1] See the NEEA website at www.neea.org.

this project seeks to better understand DHP operation and energy use with an eye towards characterizing its savings energy saving potential.

1.1. Goals and Objectives

To support the project evaluation at large, the lab evaluation established the following goals:

- Develop a performance map of the equipment at all temperature bins and operating modes while providing special focus to low temperature heating performance.
- Assess performance variation with various control strategies and operating modes.
- Conduct measurements to review and verify the data collected in the field metering, especially *in situ* COP measurements.
- Establish empirical performance curves to predict the efficiency and output of the equipment in simulations (SEEM) or other engineering calculations. The modeling capability to be developed as part of this goal, in particular, will lead to directly supporting regional energy planning efforts and conservation program design.

To expand on the published rating values and to gather enough information for energy modeling, the lab evaluation was designed to measure the performance impacts on the equipment over the range of operating conditions that would be encountered in real installations. In practice, as the equipment is installed in climates that encounter both -5°F and +105°F temperatures, this creates the need for a performance map over a wide temperature range. The lab setting provides a stable, controlled situation to accurately and precisely measure equipment output as a function of environmental conditions.

Due to the continuously variable compressor design, the equipment capacity and efficiency is also variable. Generally, higher capacity output results in a lower system efficiency while the converse is true for lower capacity output. With this in mind, the lab performance mapping was designed to explore high, medium, and low capacities and also included high, medium, and low indoor fan speeds.

2. Methodology

Broadly, the test design called for steady-state measurements of efficiency with variations in outdoor temperature (and relative humidity), indoor temperature (and relative humidity), indoor fan speed, and compressor power. Additional tests with wet and dry indoor coils, outdoor frosting conditions, and equipment on/off cycling were also conducted. The methods and procedures used in the lab adhered to industry standards including ASHRAE Standard 116 and AHRI Standard 210/240. Appendix C includes a full definition of the test matrix applied to these two pieces of equipment.

2.1. Equipment Selection

The equipment to test was selected in conjunction with NEEA and other regional stakeholders. The priorities in selecting the equipment models included: frequency of occurrence of the specific model in the field, number of similar models installed in the field, range of HSPF/SEER ratings, age of model, and the number of field sites installed with the detailed instrumentation (in situ COP rig) package[2]. By selecting equipment that is frequently used in the field (or similar models) we will gain a better, direct understanding over that segment of houses. By covering a range of HSPF/SEER scenarios we can simulate a wider range of equipment. Next, by selecting newer, rather than older models, the lab data will be relevant farther into the future. The DHP equipment models are evolving and changing rapidly so selecting an older model might only represent many units installed in the early part of the pilot program while a newer model might represent 10,000s of units into the future.

Based on these criteria, we selected a Fujitsu 12RLS and Mitsubishi FE12NA. For the time period of the pilot project evaluation where the total number of units installed was 3,899, 7% of all units were the 12RLS. A total of 32% were Fujitsu units that behave in a very similar way[3] to the 12RLS. For the same period, 6% of installs used the FE12NA while we determined roughly 25% of all installations had comparable Mitsubishi units. Both units are recent models from the manufacturers representing the most mature equipment designs. The rated HSPF values were 12.0 for the 12RLS and 10.6 for the FE12NA. This range of performance is reasonably representative, if slightly skewed towards the high end, across most of the DHP installation in the pilot program. The trade-off for selecting equipment that will be relevant longer into the

[2] The field installed COP measurement package consists of supply and return air temperature sensors, airflow anemometers, and power meters. Using these measurements, the output capacity and input power are directly calculated.

[3] The definition of similarity between models was first constrained to units from a single manufacturer and then determined by observing behavioral trends from field monitored data. For example, some models exhibited a tendency to change compressor speed multiple times in an hour and "hunt" for an optimal setting regardless of the load, while others remained at stable speeds throughout that hour. Additionally, equipment from the same model line, differing only in rated capacity, was assumed to be similar.

future, was to evaluate models that perform above average in the current market. Table 1 shows the equipment specifications obtained from the manufacturers' literature. Throughout the report, the references to "manufacturer's literature," "spec sheet," and "published" data all refer to service manuals, design, and installation forms prepared by the manufacturers and obtain from their websites (Fujitsu 2009, Mitsubishi 2009).

Table 1. Equipment Specifications per Manufacturer's Literature

Model:		12RLS		FE12NA	
	Units	Rated*	Range†	Rated*	Range†
Cooling Capacity	Btu/hr	12,000	3,800-14,500	12,000	2,800-12,000
Heating Capacity	Btu/hr	16,000	3,100-24,000	13,600	3,000-21,000
Cooling Input Power	kW	0.83	0.20-1.53	0.93	0.16-0.96
Heating Input Power	kW	1.2	0.20-2.23	0.95	0.15-2.25
EER Cooling	Btu/hrW	14.46	--	12.9	--
COP Heating	kW/kW	3.9	--	4.2	--
SEER	Btu/hrW	25	--	23	--
HSPF (IV)	Btu/hrW	12	--	10.6	--
Power Factor Cooling	%	93	--		--
Power Factor Heating	%	95	--		--
Defrost		Reverse Cycle		Reverse Cycle	
Compressor Type		DC Inverter-driven Rotary		DC Inverter-driven Rotary	

* Rating conditions: 47°F outside temperature for heating. 95°F for cooling. Compressor operation at manufacturer determined intermediate speed. Indoor fan on high flow rate.

† Capacity and power range covers all outdoor temperatures and operating conditions – not just the range at the rating conditions.

The purpose of the report was not to select two heat pump models to directly compare, although some comparisons are inevitable. Instead, the intention was to pick equipment representative of DHPs installed in the field during the DHP Pilot Project and models offering a variety of control possibilities to better increase our understanding of DHP operation. The selected equipment is among the highest performing in the manufacturers' product lines, so the results can be more readily applied to future equipment even as this technology evolves.

2.2. Testing Facility

The performance mapping was conducted under contract to Herrick Labs within the Mechanical Engineering Department at Purdue University. Herrick Labs has tested and modeled the performance of vapor compression refrigeration cycle equipment for several decades. Ecotope has contracted with Herrick Labs since 2004 on a number of heat pump performance investigations. For the past projects and the current one, Ecotope acts to manage the lab work, which includes devising a test strategy, creating a matrix of testing conditions, providing guidance and quality control to the testing process, validating the data, and producing performance curves with the results. Herrick Labs carries out the test strategy by installing the necessary instrumentation, conducting the measurements, and reporting the results.

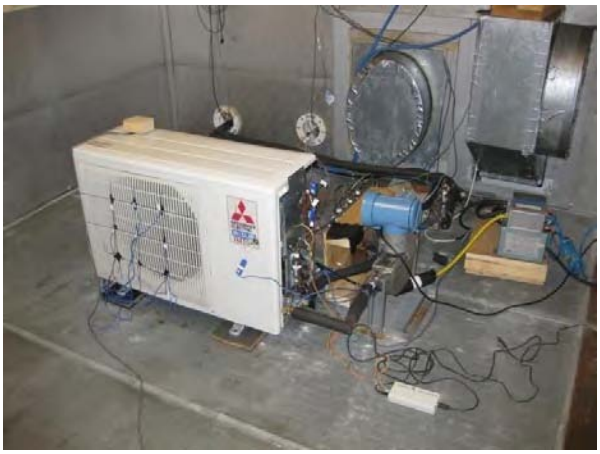
Figure 1. Herrick Labs Control and Data Logging Station for Psychrometric Chambers.

(The psychrometric rooms are entered through the doors to the left (simulating outdoor conditions) and right (simulating indoor conditions) of the computer terminals.)

The main equipment used in the testing are two, side-by-side ASHRAE standard psychrometric chambers (see Figure 1). Each chamber is an insulated room with independently controllable temperature and humidity using a computerized control system. The controllable temperature range of the rooms is from about -15°F to 125°F. For the testing, the outdoor unit of the DHP was installed in one chamber while the indoor unit was installed in the other (see Figure 2). Refrigerant and control lines are connected through ports between the chambers. The indoor unit is attached to a discharge plenum which is ducted to an ASHRAE standard air measurement box to observe air temperature and flow to determine the air-side capacity. The outdoor coil air flow rate is not measured directly but can be identified using an energy balance. A set of instrumentation is also installed on the refrigerant lines to measure mass flow, temperature, and pressure in order to calculate a refrigerant-side capacity. Throughout the performance mapping process, these capacities are compared. The good agreement between the two verifies the validity of the measurements.

Figure 2. Equipment Installed in Psychrometric Chambers.

(Outdoor unit instrumented at left: note grid of nine thermocouples monitoring outdoor air inlet temperature. Indoor unit at right: note window in green, insulated discharge plenum to allow remote controller to signal instructions to the equipment.)



2.3. Instrumentation and Measurements

Each ductless heat pump under evaluation was instrumented to make the following measurements. The specific instruments used are described in Appendix B.

- Compressor input power
- Fan power for both the indoor and outdoor units
- Total heat pump power (including controls, fans, and compressor)
- Refrigerant flows, pressures, and temperatures: refrigerant flow is measured in the liquid line whereas pressures and temperatures are measured for the compressor suction line, compressor discharge line, liquid line, and inlet to the evaporator
- Indoor coil supply air temperature, humidity, and flow
- Indoor coil return air temperature, humidity, and flow
- Outdoor coil inlet and outlet air temperatures (humidity not recorded)

2.4. Indoor Unit Airflow and Output Capacity Measurements

A crucial measurement to all of the lab tests and, indeed, the field measurement sites with the COP rig, is the accurate determination of airflow across the indoor coil. Knowing the airflow is necessary to calculate the "air-side" output capacity of the equipment. The capacity is determined by using the measured temperature difference between the supply and return air of the indoor unit and the airflow rate. The lab computes both this "air-side" capacity as well as a "refrigerant-side" capacity which comes from measurements of refrigerant temperatures, pressures, and flows. The field measurements compute capacity based only on the air-side method so the lab data is used as a reference for field air measurements.

The lab measures the airflow by monitoring the pressure drop across a known orifice. The orifice is one of several nozzles inside a box set up in accordance with ASHRAE Std 41.2, Standard Methods for Laboratory Airflow Measurement. Measuring the flow requires ducting the ductless air discharge from the indoor unit to the nozzle box. Since adding a discharge plenum and duct system to the ductless unit creates additional static pressure for the indoor fan whereby reducing the airflow, the lab added a booster fan inline with the duct to match conditions that would exist for the indoor fan discharging into free air. To do so, the lab measured the fan power as well as the pressure drop across the indoor unit heat exchanger both before and after the discharge plenum was attached. The booster fan is then set to a flow level to match the indoor unit fan power to the values observed during the free air discharge case.

A central component of the lab testing approach was the simultaneous measurement of air-side and refrigerant side capacity. The measurements taken to determine each come from independent sensors. As stated previously, there is a set of temperature, pressure, and flow meters for the refrigerant and another for the air. Collecting data in this way is tantamount to performing two independent measurements to determine one quantity. If one measurement disagrees wildly from the other it could indicate a spurious data point. Further, if the one method consistently yields higher or lower values than the other, it could expose a bias in the measurements. Finally, when both consistently agree, it demonstrates a check on the experiment and verifies the results. Throughout the testing, both air and refrigerant side calculations are monitored for agreement to confirm the results.

2.5. Heating Mode Tests

In the Pacific Northwest climate, the cost-effectiveness of residential applications of DHP technology depends on the performance of the equipment during the heating season. As a result, the testing matrix and the analysis of these lab results have focused heavily on the efficiency of the DHPs in heating mode. Heating mode tests include steady-state, cycling, and defrost tests. The steady-state points are collected over the entire operating range of the equipment to form the basis of the equipment performance map. Cycling and defrost tests are special cases that impact the warm temperature and cold, humid temperature operation.

Steady-state testing conditions cover heating at outdoor temperatures from -5ºF to 65ºF at approximately 10ºF increments. For each set of ambient conditions, different combinations of fan speed and compressor speed ranging from minimum to maximum were used. For the list of specific data collection points (the test “suite” or test “matrix”), see Appendix C. In addition to the full performance map, all of the AHRI 210/240 tests specified to calculate the HSPF and SEER values were carried out.

The matrix was designed to optimize test time by testing a combination of compressor and fan speeds at the high and low temperature extremes and then filling in between with a smaller set of likely fan and compressor speeds. One goal was to include extreme points for both temperature and compressor speed in an attempt to cover the vast majority of operating conditions. The valid range of any performance model will be limited by the extreme test points beyond which any values must be extrapolated with less certainty. For operating conditions within the testing range, the performance values can be interpolated between measured data points thus increasing certainty.

The majority of tests were conducted at a single indoor ambient air temperature of 70°F. A subset was conducted at varied indoor temperatures (60°F, 65°F, and 75°F) to observe the effect on indoor coil performance. The results show a predictable dependence on indoor temperature that also agrees with the available manufacturer's data. Broadly, cooler indoor temperatures improve efficiency because they provide a colder temperature sink into which heat is rejected. The converse is true for higher temperatures. The indoor temperature dependence is important to measure because field work at DHP sites has shown rooms to be stratified. For the wall mounted units, the return air temperature will therefore be higher than the set point and general living space temperature which slightly decreases performance.

To collect the steady-state data, the operating parameters are set and the equipment is run until it reaches a stable state. The stable state is defined as being reached when no monotonic changes in refrigerant discharge temperature are observed over a 10 minute period. Data is then logged over the next 10 minute interval and averaged to a single value for each measurement point. The refrigerant discharge temperature is a good indicator of system state because it is influenced by both compressor speed and the electronic expansion valve (EEV) position. The equipment typically adjusts its compressor speed very quickly (approximately 30-120 seconds) to respond to load changes and then optimizes operation by slowly[4] adjusting the EEV to meter refrigerant flow.

Different strategies were employed to get the compressor to operate at the desired output. For the FE12NA, Mitsubishi provided a controller which uploads a program to the unit's logic board and forces it into a certain compressor and fan speed combination. This covered some, but not all of the desired mapping points. For the 12RLS, there was no controller available for the testing. In those cases, a combination of fixing the psychrometric chamber's temperature and the DHP's set point was used to drive the compressor operation. For example, by setting the DHP set point 6 ºF above the room temperature, the DHP runs at high output. Conversely, by setting the DHP to a set point close to the room temperature, the DHP runs at minimum output. Intermediate compressor loadings were more challenging to obtain since the lab had to experiment with what temperature set point combinations would produce a mid range compressor power draw and stable operation. Fan speed is easily set and fixed via the standard remote control.

Neither the unit itself nor the equipment controller displays the compressor operating speed (frequency). Both Ecotope and the lab considered different approaches to directly measuring the rotational frequency including the use of an accelerometer mounted to the compressor in the outdoor unit but ultimately opted against this measurement due to time constraints. Instead, throughout the project and this report, we assert that the compressor power measurement is a

[4] The speed of EEV adjustment varies by equipment model. The major adjustments happen in conjunction with the large changes in compressor speed while minor adjustments can continue for many 10s of minutes longer. For example, in many instances, the FE12NA was observed to take 2 hours to reach a stable state. In contrast, the 12RLS often stabilized in a quarter to half the time or sooner. Note: these are rough approximations.

surrogate for speed. From an energy performance modeling perspective, knowing the speed is not necessary but input power and output capacity are. Therefore, the performance mapping goals of the project were not compromised by not having this measurement. The standard equipment ratings are based on compressor frequency (see Section 6) but with no direct way to set the frequency, not being able to measure it did not prove to be a disadvantage. Measuring and documenting the relationship between frequency and input power may provide further insight into how the equipment operates. Therefore, future projects may want to consider a direct measure of speed but the successful completion of the performance maps and subsequent modeling (see Section 7) for this project show it was not necessary.

2.6. Cooling Mode Tests

The procedures for the steady-state cooling tests are similar to those outlined for heating: for each operating condition, different combinations of fan speed and compressor speed are used ranging from minimum to maximum speed. As in heating mode, different combinations of indoor air conditions were explored. Unlike heating, cooling performance depends on the indoor air moisture content, not just the temperature. The moisture content of the indoor air, and the indoor coil state, either wet or dry, affects the sensible, latent, and total cooling capacities. Therefore the performance map included variations in indoor relative humidity and the lab also monitored the split between sensible (temperature change) and latent (dehumidification) cooling capacity.

The main indoor air conditions were 80°F dry bulb, 67°F wet bulb which are the most common conditions for the EER and SEER tests. Additional tests included 80°F db with variations of 58°F, 62°F, 65°F, and 72°F wb as well as dry coil tests with 70°F, 80°F, and 85°F db. For the complete cooling mode test matrix see Appendix C. The cooling mode matrix shows that different numbers of tests were conducted on the FE12NA and the 12RLS. The larger number of the FE12NA was done when the lab realized more tests were needed to characterize the performance variation.

3. Airflow and Capacity Measurement Comparison Results

3.1. Indoor Unit Airflow Measurements

The airflow measurement results for both equipment models are given in Table 2 and Table 3. For comparison, the literature values from the technical and service manuals for the units are also shown. Both tables show the high efficiency levels of the indoor fan. The 12RLS ranges from 0.05 W/CFM to 0.8 W/CFM. The FE12NA ranges from 0.04 W/CFM to 0.07 W/CFM. One reason the fan power remains so low is that both models are pulling return air from and discharging supply air to free space with little resistance to flow. Regardless, both draw little power across the range of flows.

Table 2. 12RLS Indoor Unit Airflow Measurements

Fan Setting	Measured Values				Literature Values *
	Heating		Cooling		Heating and Cooling
	Flow (CFM)	Power (W)	Flow (CFM)	Power (W)	Flow (CFM)
Low	251	12	286	14	274
Med	348	21	378	25	374
High	425	29	487	39	453

* from Fujitsu Design and Technical Data for 12RLS

Table 3. FE12NA Indoor Unit Airflow Measurements

Fan Setting	Measured Values				Literature Values *	
	Heating		Cooling (wet)		Heating	Cool (wet)
	Flow (CFM)	Power (W)	Flow (CFM)	Power (W)	Flow (CFM)	Flow (CFM)
Low	149	6	144	5	166	144
Med	217	10	204	8	240	202
High	337	24	338	23	399	350

* From Mitsubishi Service Manual for MSZ-FE12NA

3.2. Air and Refrigerant Capacity Measurement Comparison

The comparison results of the air-side and refrigerant-side capacity measurements for the steady state tests are depicted in Figure 3, Figure 4, and Figure 5. In the figures, the closer the ratio of the air-side to refrigerant-side capacity is to one, the closer it appears to the 45° line showing concurrence. For some of the cooling tests, the refrigerant entering the flow meter or exiting the evaporator was in both the liquid and gas phase so its mass flow rate could not be metered. Therefore, no refrigerant-side capacity was calculated. All of the FE12NA cooling tests exhibited two-phase flow so no comparison data is available. Approximately half of the steady state cooling tests for the 12RLS showed two-phase flow. The ones that did not are compared in the plots. Overall, for the heating and cooling calculations available, the air-side and refrigerant-side measurements showed agreement to within ±6% of one another in the steady state tests. Because of the close agreement, the air-side calculations can be relied upon to determine

capacity for the cases where the refrigerant measurements could not be made. Finally, the agreement between the two measurement methods demonstrates the veracity of the determination of output capacity.

Figure 3. Capacity Measurement Comparison for 12RLS Data.

(Data points in blue. Red dashed line is the 45° line showing agreement.)

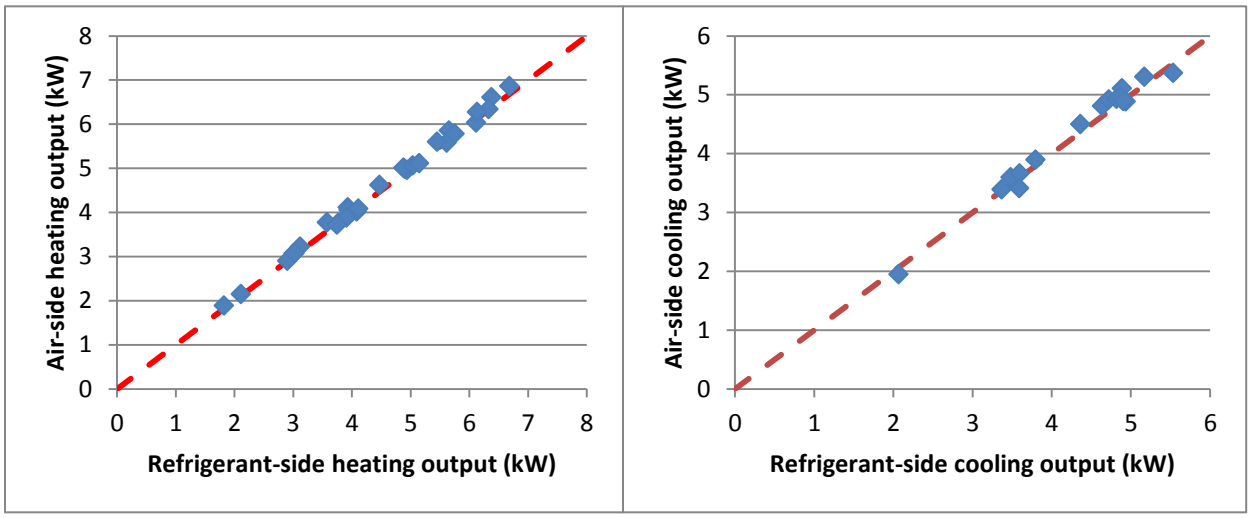
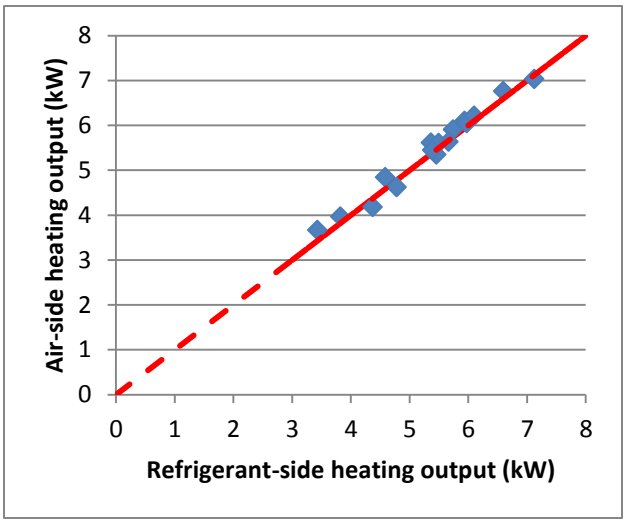


Figure 4. Capacity Measurement Comparison for FE12NA Heating Data.

(Data points in blue. Red dashed line is the 45° line showing agreement.
Cooling data comparison not available.)



4. Heating Performance Map Test Results

When looking at the full results from the steady-state tests, the fully variable speed nature of the equipment becomes apparent. The variety of compressor and fan speeds combine to offer a huge range of input powers and output capacities to meet the space conditioning load. A clear trend from the data shows that the higher the output capacity, the lower the efficiency. Equipment performance is maximized when the loads are small. This is true for both heating and cooling. Additionally, the ability of the equipment to run at a very low speed will greatly reduce the amount of time the equipment must cycle on and off in low load situations. This on-off cycling is a performance penalty for single speed heat pump systems but, in comparison, is largely avoided with the DHP variable speed equipment.

The main variables determining the system capacity are outdoor temperature and humidity, indoor temperature and humidity, indoor fan airflow, and total input power. In single speed systems, indoor airflow and compressor frequency are fixed but the inverter-driven DHPs can change these according to demand adding two more variable aspects to the capacity. When plotted together, the large set of variables creates a complex space of data points. To simplify the plots and isolate certain effects, the plots in this report show only variation among a select few of the inputs on a given graph.

4.1. Steady State Heating Capacity and Input Power

Figure 5 and Figure 6 show the heating capacity of the 12RLS and FE12NA for 70°F indoor temperature[5]. High compressor speed tests are plotted in blue, medium in red, and low in green. Figures D1 and D2 in Appendix D are similar plots but show steady state input power as a function of capacity. In practice, the later set of figures is more closely aligned with how the equipment controllers work but is a less traditional way of graphing heat pump data. Given a desired set point, as set by a remote control thermostat, the DHP will change its input power to attempt to meet the load. This is discussed further in the performance model section. The available literature data on capacity and input power are plotted in the Figure 5 and Figure 6 for comparison to the lab measurements. The manufacturer selected data lies in the middle of the operating range and generally includes the nominal rating point[6].

The heating capacity and input power of the two models should not be directly compared because they are rated at slightly different sizes. The 12RLS has a nominal output rating of 16,000 Btu/hr at 47°F while the FE12NA has a nominal output rating of 13,600 Btu/hr. As

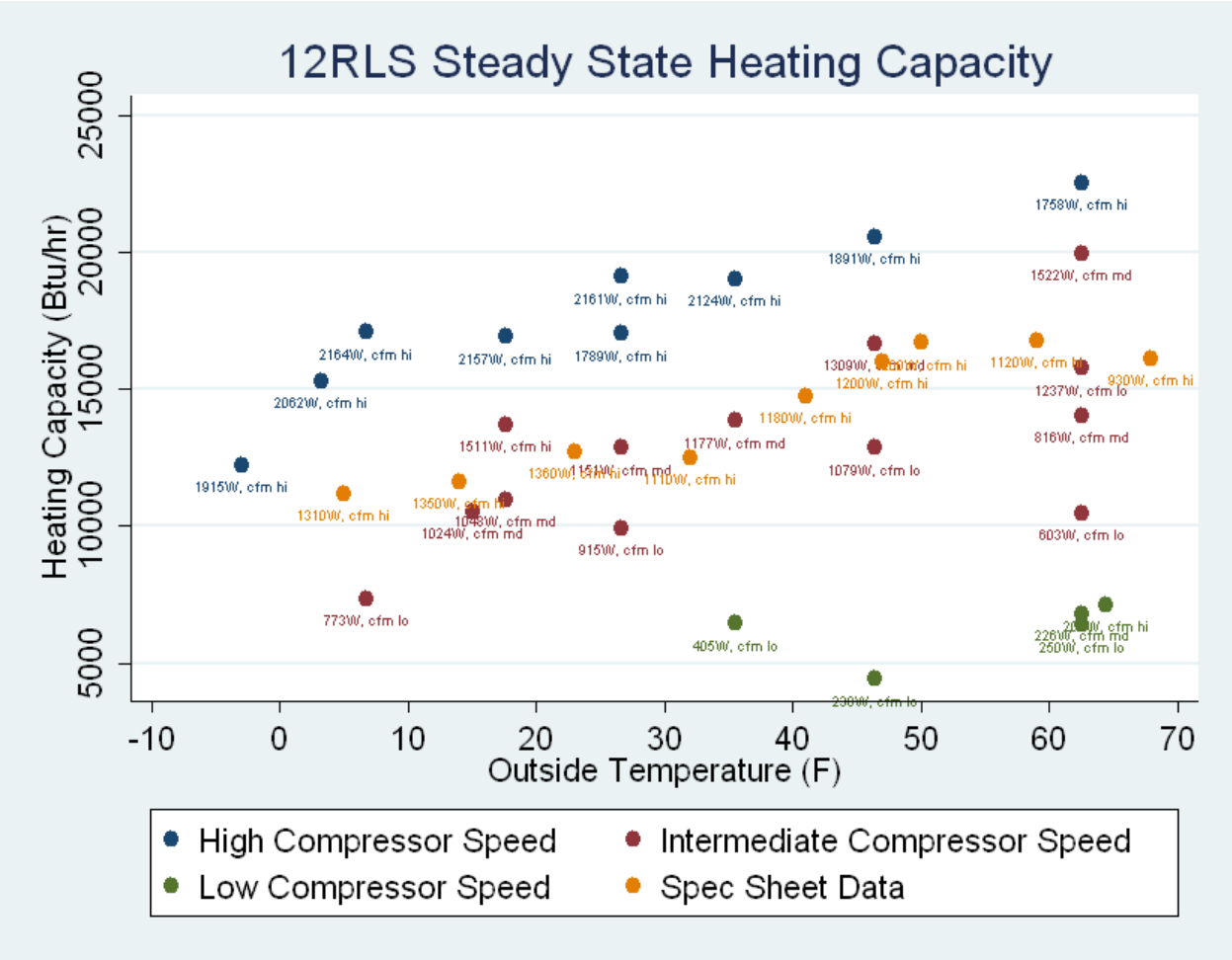
[5] Additional data were collected at indoor temperatures different from 70°F temperature but are not shown here. When the indoor temperature is higher, system capacity and efficiency decreases slightly. The converse is true for lower indoor temperatures. The data were used in developing the performance model.

[6] The nominal rating point refers to the conditions under which the rated capacity is measured. For heating, this is output at 47°F outdoor, 70°F indoor, and intermediate compressor speed. For cooling, it is 95°F outdoor, 80°F at 50% RH indoor, and intermediate compressor speed.

Figure 5 and Figure 6 indicate, this nominal rating is squarely in the middle of the output range. This is typical of all DHP equipment labeling. One reason is the equipment often operates in the middle of the load range. In fact, the equipment controls appear to differentially choose to operate at this set of speeds suggesting that such a choice might be the most accurate estimate of overall performance.[7] Another potential motivation is that, by listing a nominal output in the middle of the compressor range, the performance rating will be higher than that of a maximum output capacity.

Figure 5. 12RLS Steady-State Heating Capacity for Indoor Temperature of 70°F.

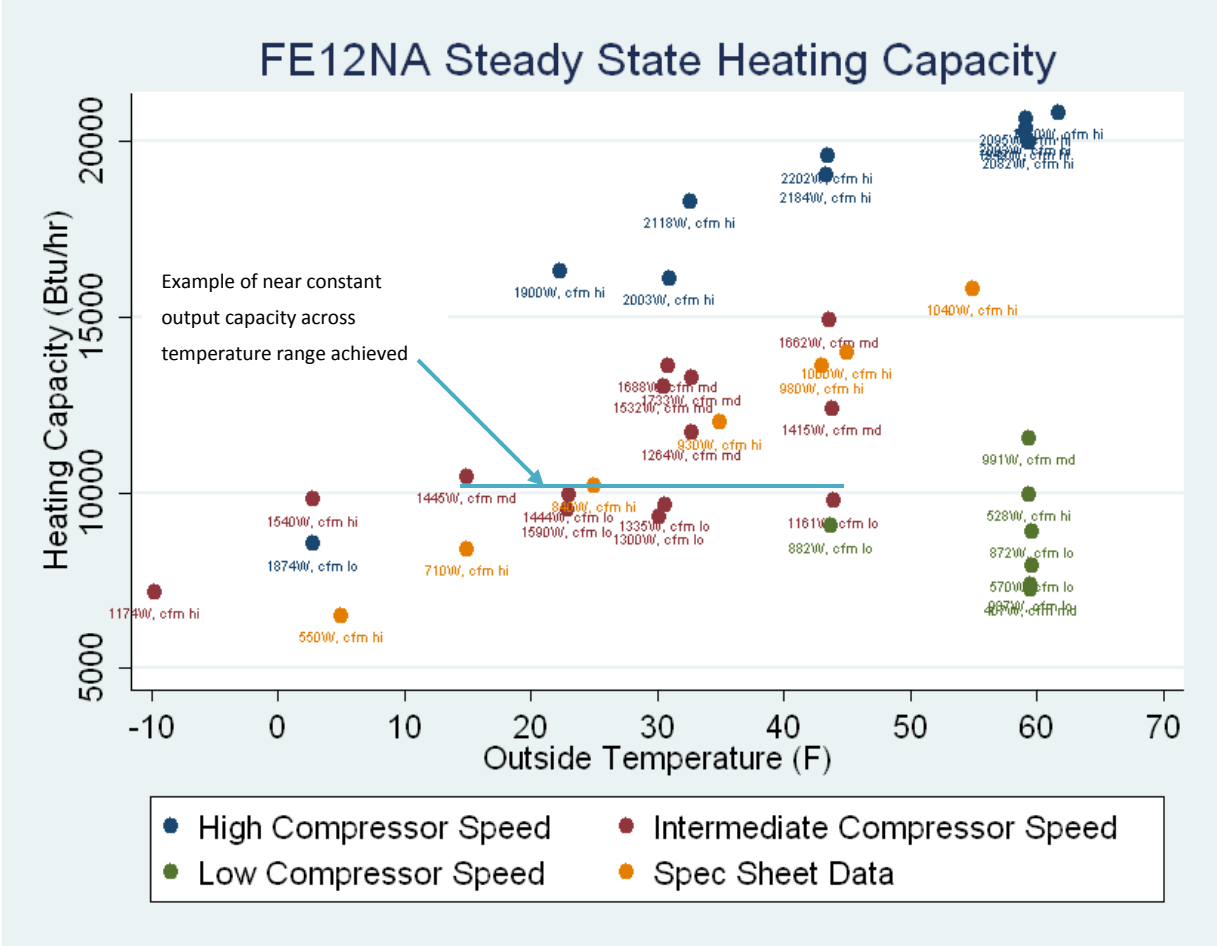
(Equipment input power and indoor unit fan speed are shown below each point. The measured outdoor coil inlet temperatures were unavailable so the temperature for the outdoor psychrometric chamber is used in the plot.)



[7] Field data in particular, shows again and again, the preponderance of equipment operation in mid-capacity ranges.

Figure 6. FE12NA Steady-State Heating Capacity for Indoor Temperature of 70°F.

(Equipment input power and indoor unit fan speed are shown below each point. The measured outdoor coil inlet temperatures are used in the plot, which differ slightly from the targeted set point of the psychrometric chamber.)



Both Figure 5and Figure 6 show the expected trend of decreasing output capacity with decreasing outdoor temperature. The trend is somewhat obscured by the fact that the equipment has variable input power but it is clear for the maximum compressor speed (blue points with highest capacity) which, to a first approximation, has a fixed input power. The blue plots always reference tests that targeted the maximum compressor speed. Some of these tests stabilized at less than maximum capacity. In those cases, the data was recorded, classified in the high capacity range, and the test restarted. Other max speed tests were paired with lower indoor fan flow rates which results in lower capacities. Next, the figures also demonstrate the effect of hypothetically fixing the output capacity. For instance, Figure 6 shows that the FE12NA outputs about 10,000 Btu/hr at 15°F using 1400W whereas a similar output is achieved at 45°F using 1100W.

Figure 5, in particular, shows low equipment input powers at low load conditions. There is a cluster of data points from 50-60°F with power draws of 225-300W which indicates light loadings and low compressor speeds. That the DHP could operate at such a low partial load was an unexpected finding. Conditions for heat transfer are obviously favorable at such warm

outdoor temperatures but the DHP also exhibits the ability to operate at a low part load at even lower temperatures (~40°F).

4.1.1. Steady State Heating Efficiency and Field Agreement

The steady state heating coefficient of performance (COP) is shown in

Figure 7 and Figure 8. COP is defined as output capacity divided by input power. Both plots demonstrate the high efficiencies possible from DHPs. They also show the range of COP due to variations in compressor load: a lower load always leads to a higher efficiency. In the plots, as with Figure 5and Figure 6, low load points are green, medium load are red, and high load are blue. As with earlier plots, the literature data is also shown in yellow. In addition to the lab results, the figures plot data obtained from field-monitored COP sites (light gray box plots)[8]. The results suggest a consistent relationship between outdoor temperature and COP. While the result is expected, there is also clear agreement between both the field measurements and the controlled setting laboratory measurements. The ability of the observed data to follow the curves derived from the lab (in spite of variations in compressor speeds as the equipment meets the loads of the house, defrost behavior and occupant intervention) provides confidence in using the lab data to develop performance prediction models.

Both

Figure 7 and Figure 8 show strikingly high levels of performance at low temperatures. For temperatures from -10°F to 10°F, the steady state COPs are still shown to be 1.5 to almost 2.5. Actual performance is less because the equipment undergoes defrost cycles which are, by definition, not in steady state. The box plots from the field data are more representative of actual performance because they include both defrost events at low temperatures and cycling effects at warmer temperatures.

The range of efficiencies for a given temperature can be seen in

Figure 7. For example, tests of varying compressor and fan speed at 47°F show a COP of 3.2 at maximum load to a COP of greater than 5.5 at a low load.

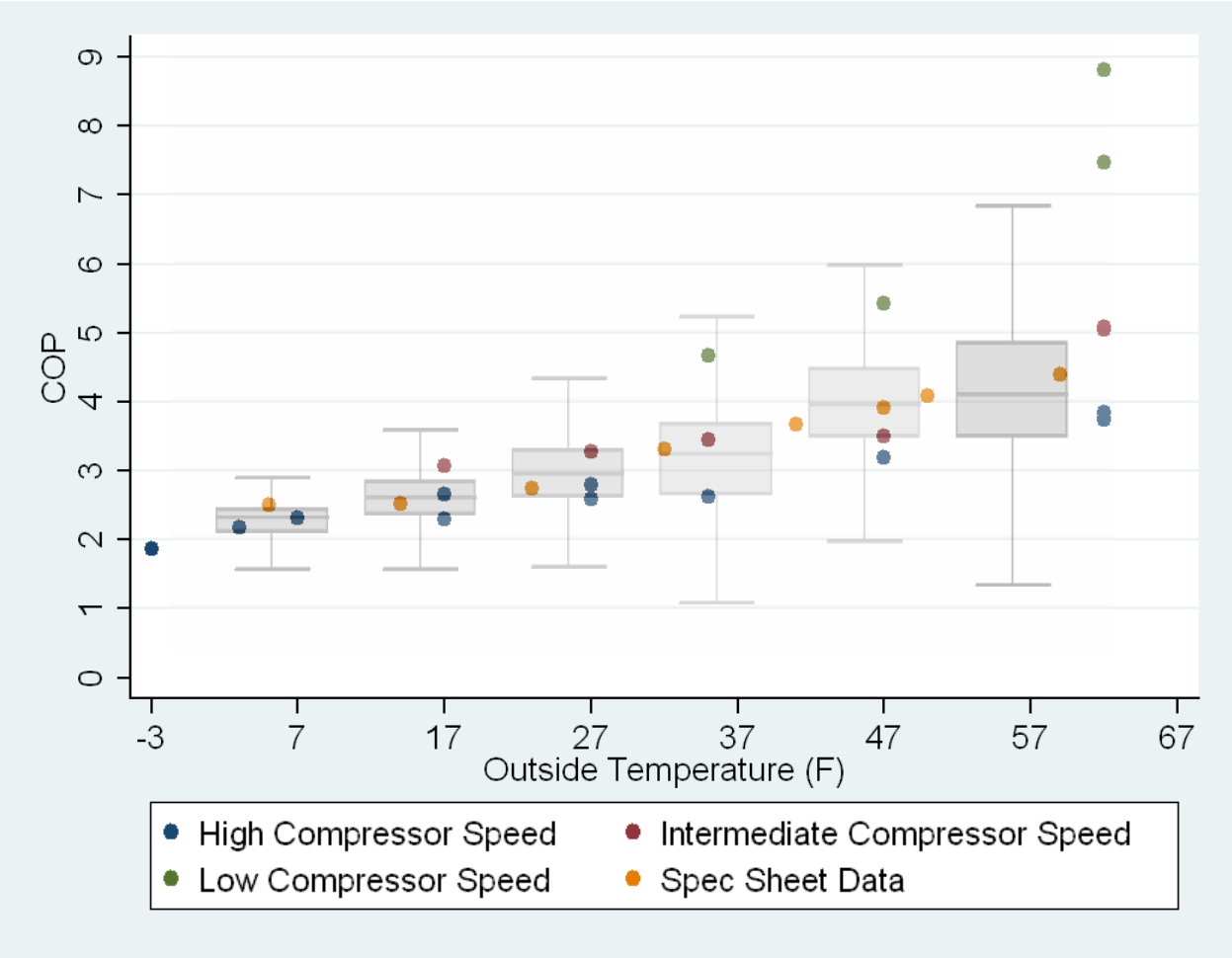
Figure 8 demonstrates agreement between the lab results and the field measurements. The published performance curve, however, differs especially at low ambient temperatures from the other two measurement sources. This could be partly explained by defrost behavior. Additionally, some of the variation is clearly due to the selected published data being at low load for the low temperature range. For instance, the 15°F and 25°F data points are only at 58% and 75% of nominal input power respectively. In contrast, operation in an actual house at these

[8] The field data includes six sites for each equipment type and spans a full range of winter temperatures. The box plots represent the upper and lower quartiles, the median value is given as the band in the middle, the upper and lower whiskers are the maximum and minimum observations.

temperatures is likely to require far greater input and output to meet the heating load[9]. These higher loads will reduce the COP. Lastly, the variation could be due to other factors in the test procedure which are discussed in subsequent sections.

Figure 7. 12RLS COP Plot.

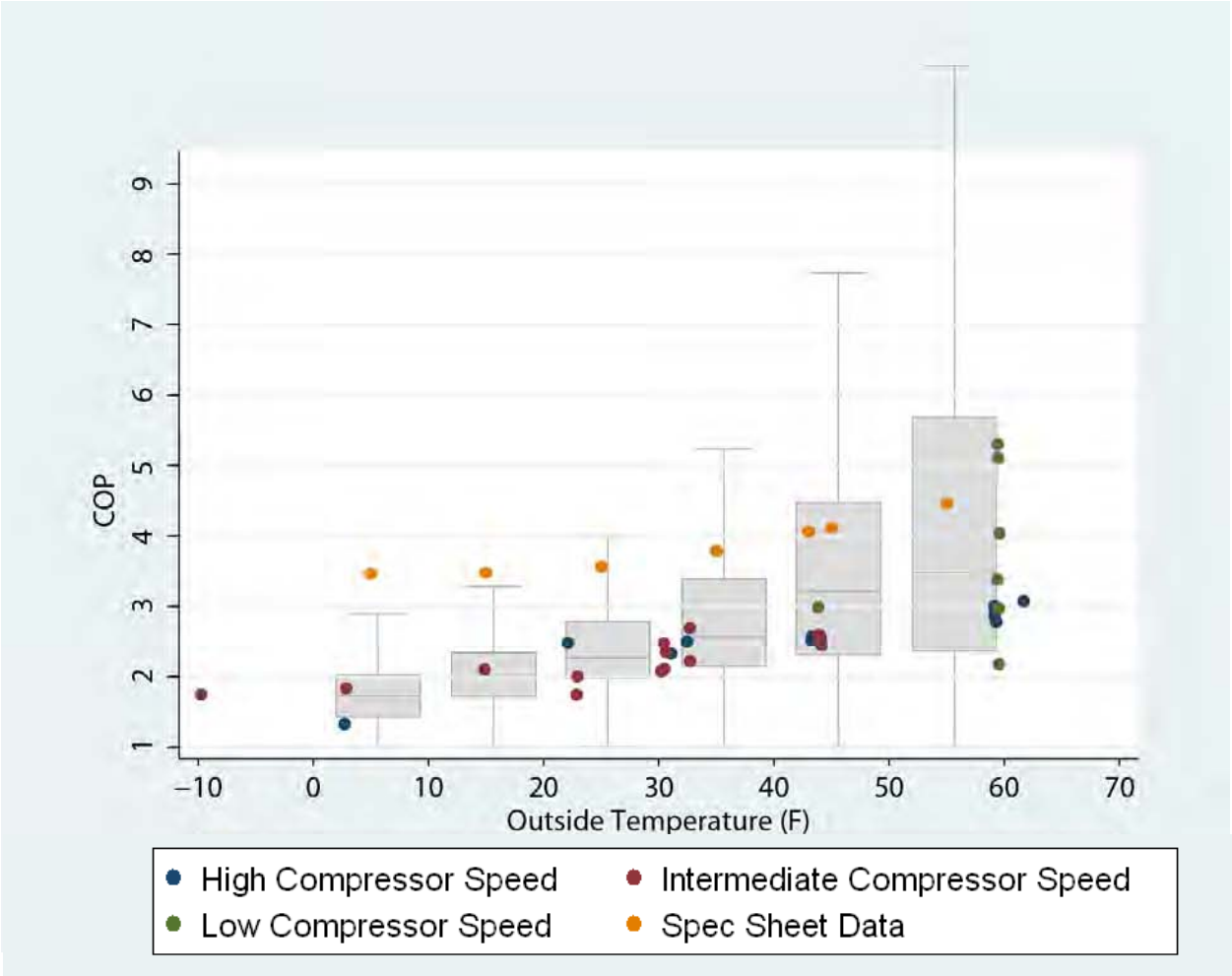
(Field data given as box plots. Steady state lab data plotted as points.)



[9] Field data confirm this.

Figure 8. FE12NA COP Plot.

(Field data given as box plots. Steady state lab data plotted as points.)



4.2. Defrost Cycle

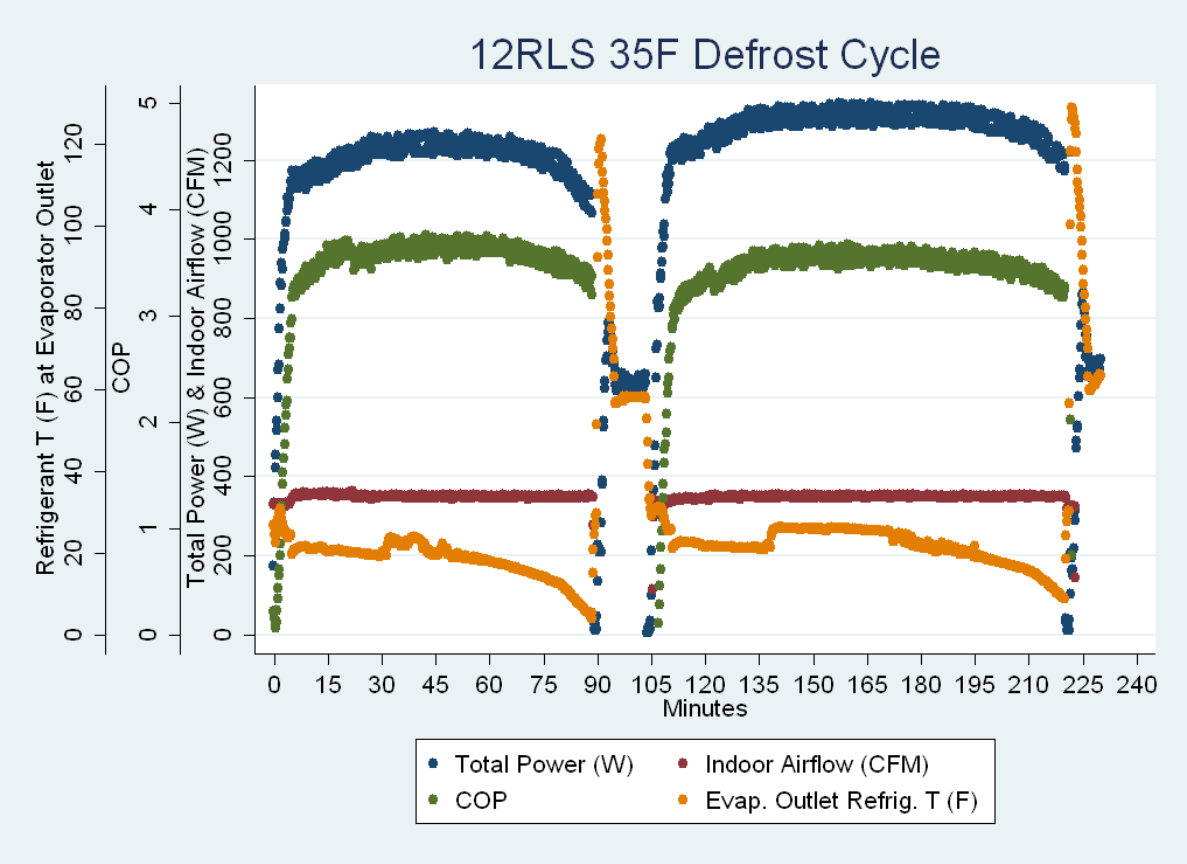
In heating mode, the DHP outdoor unit acts as an evaporator which extracts heat from the outdoor air. In the process, the outdoor coil cools down considerably creating a condensation and nucleation site for ambient water vapor. The subsequent build-up of frost leads to increasingly poor heat transfer from the air to the refrigerant. To address this problem, the DHP will periodically initiate a defrost cycle which reverses the hot refrigerant vapor flow to melt the ice. The two equipment models considered here (and, indeed, all of the observed models in the pilot program field study) use a reverse cycle defrost method.

The DHP monitors outdoor temperature, run time, and refrigerant pressures to identify trends associated with frost formation. The precise strategy to determine the time to initiate a defrost cycle varies with equipment model. When the cycle initiates, the controller turns the compressor and the indoor fan off. Typically, the DHP also illuminates a light on the indoor unit indicating defrost operation to the occupant. Next, the controller switches the direction of the 4-way valve to reverse refrigerant flow. The compressor is subsequently turned on again so now the outdoor coil is acting as a condenser. Then, the compressor runs (with the indoor fan off), adding heat to the refrigerant, which melts ice off the coil. After the ice melts, the controller returns the DHP to normal heating operation. Alternatively, the defrost time may exceed a default limit set by the controller and the equipment returns to heating mode before satisfying all of its defrost criteria and potentially not melting all the ice. Since the DHP, without integrated auxiliary resistance heat, provides no heat to the space during defrost, the maximum defrost time is designed to limit the amount of time without heating regardless of coil conditions.

Figure 9 plots the data from the 12RLS 35°F defrost test. Per the AHRI 210/240 procedure, the equipment is observed through two defrost cycles. Data used to calculate the defrost penalty is taken from the second cycle. The defrost penalty is the amount of energy used in the cycle that does not go towards heating the space. Figure 9 shows two full cycles with quasi-steady state operation before each defrost event (which start at minutes 90 and 220). Before defrost occurs, the green COP plot shows a noticeable decline in equipment performance. The yellow plot of refrigerant temperature at the evaporator outlet serves as a proxy for frost accumulation on the coil. Starting about halfway through each heating cycle, the evaporator outlet temperature begins to decline more rapidly indicating frost buildup. COP also drops off. For the defrost event, the compressor runs at about 650W. After defrosting, the COP increases as the equipment ramps up to meet the load and optimizes its EEV position and compressor speed.

Figure 9. 12RLS Defrost Cycles at 35°F.

(Data sampled at 10 second intervals.)



Our testing plan expanded slightly on the standard AHRI 210/240 defrost testing conditions to explore frosting at 47°F and 75% RH as well as at 35°F and 17°F. There are a significant number of morning hours with temperatures in the 40-50°F range and high relative humidity in the Northwest marine climate which can present frosting challenges to heat pumps. Neither the 12RLS nor the FE12NA showed frost buildup at the 47°F test point. Accordingly, no data were collected.

In testing the FE12NA, some unexpected opportunities arose to collect defrost data when the unit began frosting during the steady-state testing sequence. These data were added to the results and provide a more complete picture of defrost with the FE12NA. Table 4 shows the defrost test results in terms of equipment COP over the entire cycle. The table shows that defrost cycles occur more frequently and last a longer portion of the cycle at colder temperatures. Although the humidity ratio in colder air is less than warmer air suggesting the need for less frequent defrost, lab photos (see Figure 10) showed frost accumulated on the coil at even the -3°F (n3) test condition. Further, the whole cycle extends longer because the colder temperatures require a longer defrost time to warm up the coil.

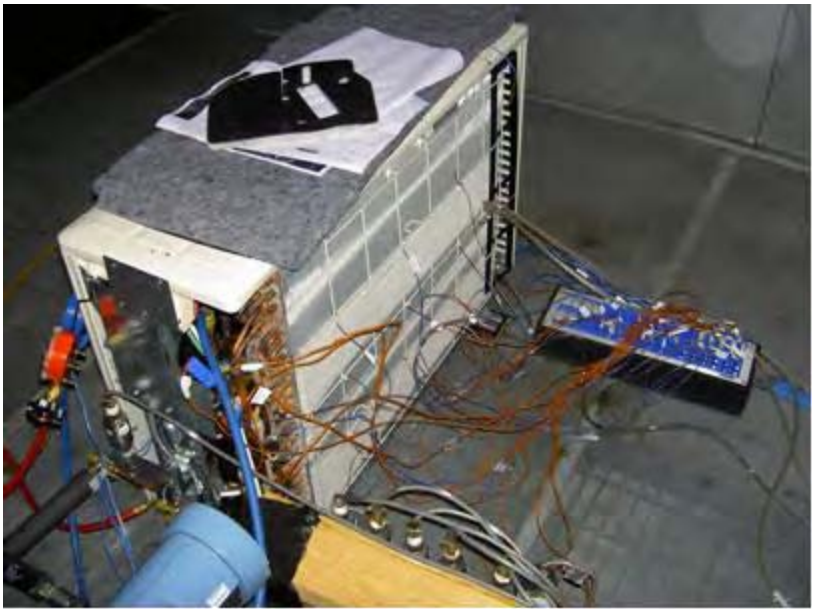
Table 4. Defrost Test Results.

	Test code	Cycle Time (hrs)	Heating Time in Cycle (hrs)	Defrost Time in Cycle (hrs)	Fraction of Cycle Time in Defrost	Full Cycle COP	Heating-Only Segment of Cycle COP	Relative COP Penalty
FE12NA	H-SS-n3-H-MX	0.79	0.62	0.17	22%	1.35	1.52	11%
	H-SS-7-H-MX	0.52	0.48	0.04	7%	1.54	1.60	4%
	H-SS-7-L-MX	0.39	0.35	0.04	11%	1.08	1.13	5%
	H-SS-17-H-MX	1.51	1.45	0.06	4%	2.24	2.28	2%
	H-SS-17-M-MX	1.50	1.45	0.06	4%	0.88	0.89	1%
	H-SS-27-H-MX	1.31	1.28	0.03	3%	1.72	1.74	1%
	H-DF-35-M-MX	1.50	1.45	0.06	4%	1.76	1.78	1%
12RLS	H-DF-17-M-MX	2.35	2.10	0.25	11%	2.91	3.06	5%
	H-DF-35-M-MX	2.12	1.94	0.18	8%	3.29	3.39	3%

Test Code: H is heating, SS/DF for intended steady-state or defrost test,
-3/7/17/27/35 Outdoor T (F), H/M/L is High/Medium/Low fan, MX is Max compressor speed

Figure 10. Frost Accumulation on Outdoor Coil of FE12NA at -3°F.

(Moments before the defrost cycle is initiated)



4.3. Heating Mode Cycling

Single speed heat pumps cycle on and off in order not to exceed the heating set point temperature. Only at peak load times do single speed systems run continuously. In contrast, variable speed DHPs turn down their input power in the response to a decreasing load and run continuously. Even so, there comes a point when the load required is so low, that the unit begins to cycle. In heating, this corresponds with warm outside temperatures. Therefore the standard heating cyclic mode tests are conducted at a 62°F outdoor temperature. Cycling comes at an energy cost associated with starting and stopping the system. The low load cycling tests capture this impact.

The heat mode cyclic degradation coefficient, Cd, as determined by the AHRI 210/240 standard was found to be:

- 12RLS C_d (heating): 0.28
- FE12NA C_d (heating): 0.45

In the context of single-speed heat pumps, both of these values for Cd are surprisingly high where we might see a Cd range from 0.05-0.15. For variable speed systems, Cd has a far less importance, however, since compressor can run at small load fractions instead of cycling. If the testing outcome results in a value greater than 0.25, the 210/240 standard calls for a replacement of the high value with 0.25 for HSPF calculation purposes.

When both the 12RLS and the FE12NA cycle on, their compressors initially overshoot the desired minimum load. After this initial spike, the compressors ramp down into the low load state. The higher power draw at the beginning of a cycle results in a performance penalty explained by Cd. The lab data shows the FE12NA ramps its compressor up higher than the 12RLS at the initial startup stages, which is why it has a larger Cd.

In order to use the cycling coefficient, it is necessary to know under what conditions the unit cycles. First, while it is the low load that causes the cycling, the practical limitation for the DHP is the minimum input power level needed for operation. The lab data shows the 12RLS will turn down to 220W and the FE12NA to 450W. This corresponds to roughly 20% of the rated and 10% of the maximum power for the 12RLS; and 45% of the rated and 20% of the maximum power for the FE12NA. This turn down fraction agrees with the specified data from Table 1 for the 12RLS but is about double for the FE12NA. Logged power measurements from field data support this finding.

4.4. Comparative Heating Mode Performance

It is somewhat challenging to directly compare the heating mode performance of the two variable speed DHPs because they have different responses across their load range. One can compare the performance at maximum capacity which will be especially relevant at low temperatures but could be misleading at higher temperatures where the control algorithms might use different strategies and speeds to meet the heating load. Figure 11 and Figure 12 show curve fits for the maximum heating capacity and COP at that capacity for steady-state data. The characteristics are similar between the equipment models at middle temperature ranges but diverge at both low and high temperatures. On an annual basis, high temperature maximum output is not critically important to energy use, but low temperature maximum and middle temperature intermediate

output are. The differences in maximum-capacity, low-temperature efficiency explain some of the performance variation in the two models. Since Figure 11 and Figure 12 show little variation in performance at maximum output over the mid-range temperatures, we can assert that most of the variation in performance occurs under the part-load conditions.

Figure 11. Comparative Input and Output at Maximum Capacity

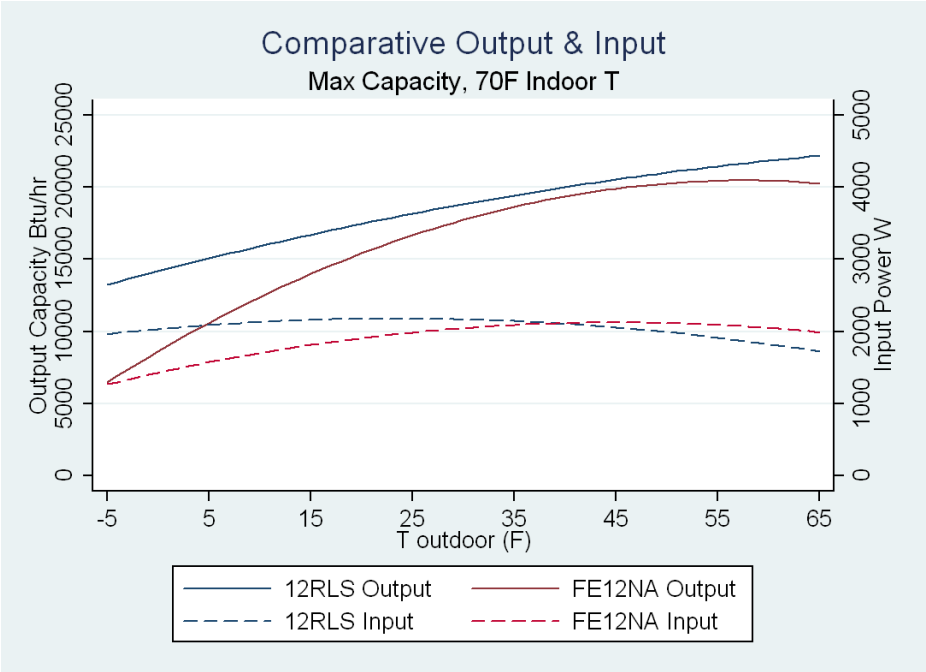
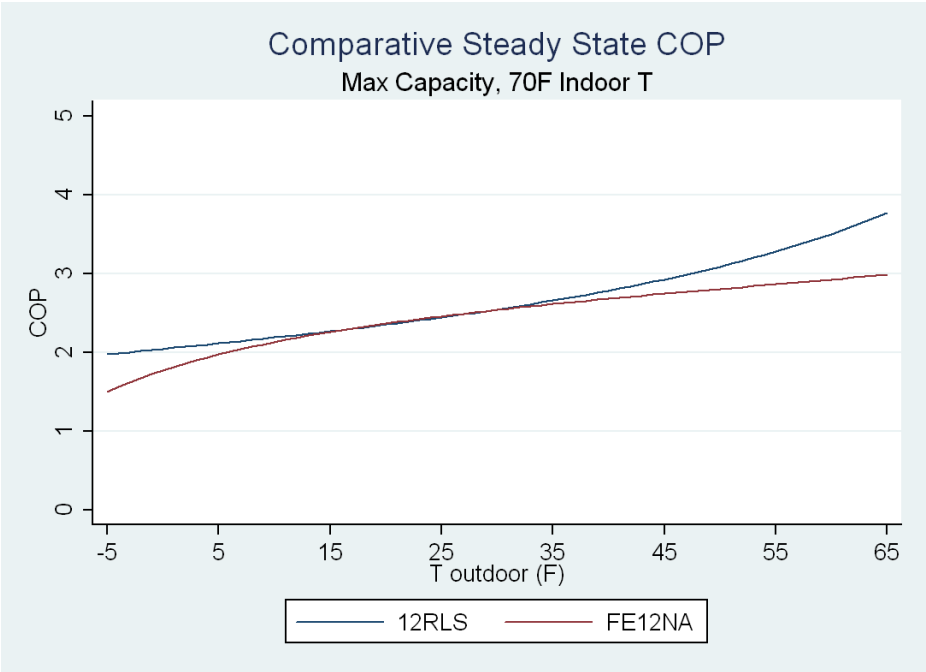


Figure 12. Comparative Efficiency and Maximum Capacity



5. Cooling Results

The cooling mode tests were carried out in the same way as the heating mode. One difference in the results is the added dependence of performance on both indoor temperature and RH and the impact on sensible and latent cooling capacity. Further, outdoor coil frosting is not an issue in cooling so there are no defrost tests. In this section the illustrations are made at indoor conditions of 80°F and 50% RH. These are standard conditions used in calculating SEER. As of this writing, the cooling data from the field test is not available for comparison to the laboratory COP data.

5.1. Steady-State Cooling Capacity and Input Power

Figure 13 and Figure 14 show the cooling capacity of the 12RLS and FE12NA for 80°F (67°F wb) indoor temperature. For comparison, in addition to the lab measurements, the available literature data on capacity and input power are plotted in the figures. The manufacturer selected data lies in the middle of the operating range for the 12RLS but covers the higher end for the FE12NA. Both models are nominally rated at 95°F to deliver 12,000 Btu/hr of cooling. The corresponding input power requirements are 0.83kW for the 12RLS and 0.93kW for the FE12NA. In contrast to the nominal heating capacity of the FE12NA, which was in the center of the output range, the cooling nominal capacity is at the high end of the output range. The nominal output of the 12RLS in cooling is, like heating, in the center of the range.

Figure 13. 12RLS Steady-State Cooling Capacity for 80°F (67°F wb) Indoor Temperature.

(Equipment input power and indoor unit fan speed are shown below each point.)

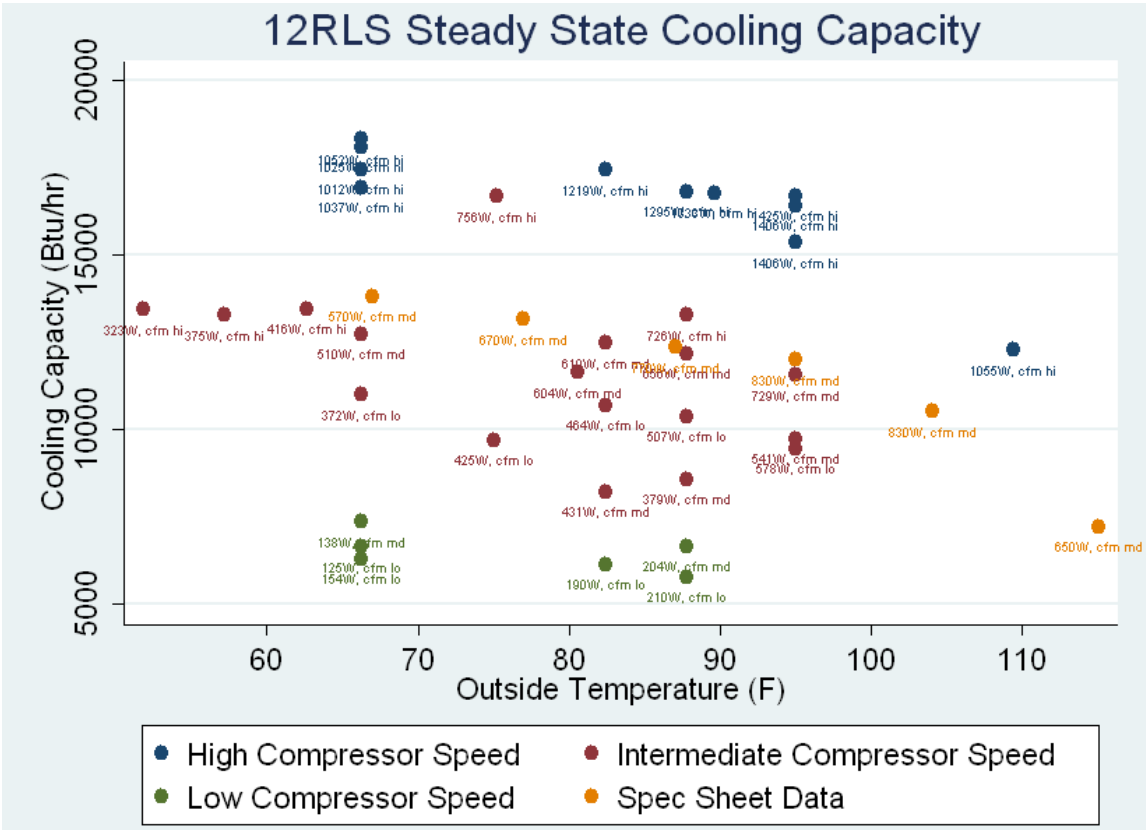
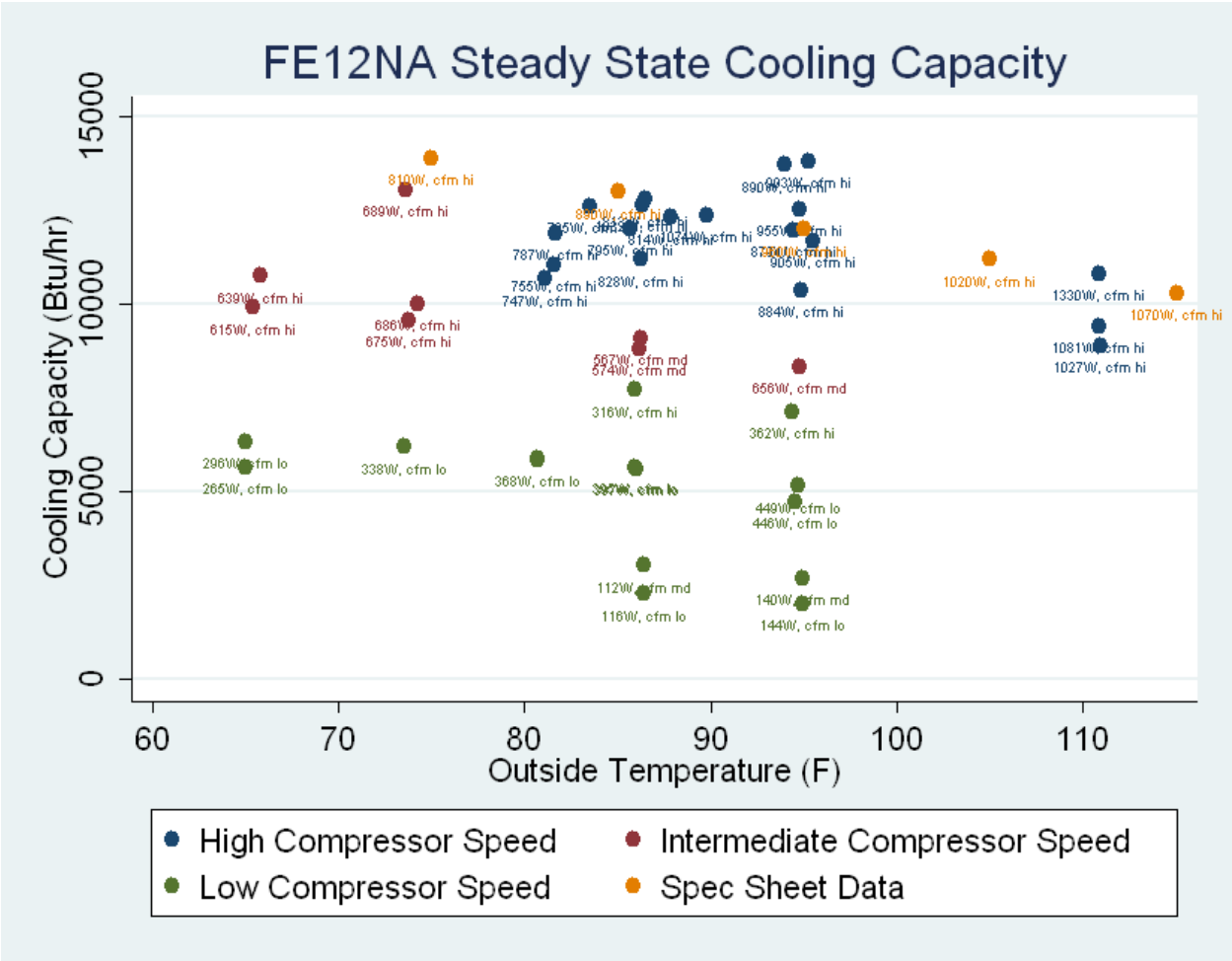


Figure 14. FE12NA Steady-State Cooling Capacity for 80°F (67°F wb) Indoor Temperature.

(Equipment input power and indoor unit fan speed are shown below each point.)



5.1.1. Steady State Cooling Efficiency

The cooling efficiency in steady state is plotted in Figure 15and Figure 16. The graphs are given in terms of COP, instead of the more familiar cooling, mixed-unit, EER. To convert between the two, multiply COP by 3.412. Similar to heating, both models show high efficiencies across the temperature range. In general, the manufacturer's cooling ratings are in good agreement with our lab test results.

Figure 15. 12RLS COP Plot.

(Steady state lab data plotted as blue, red, and green points.)

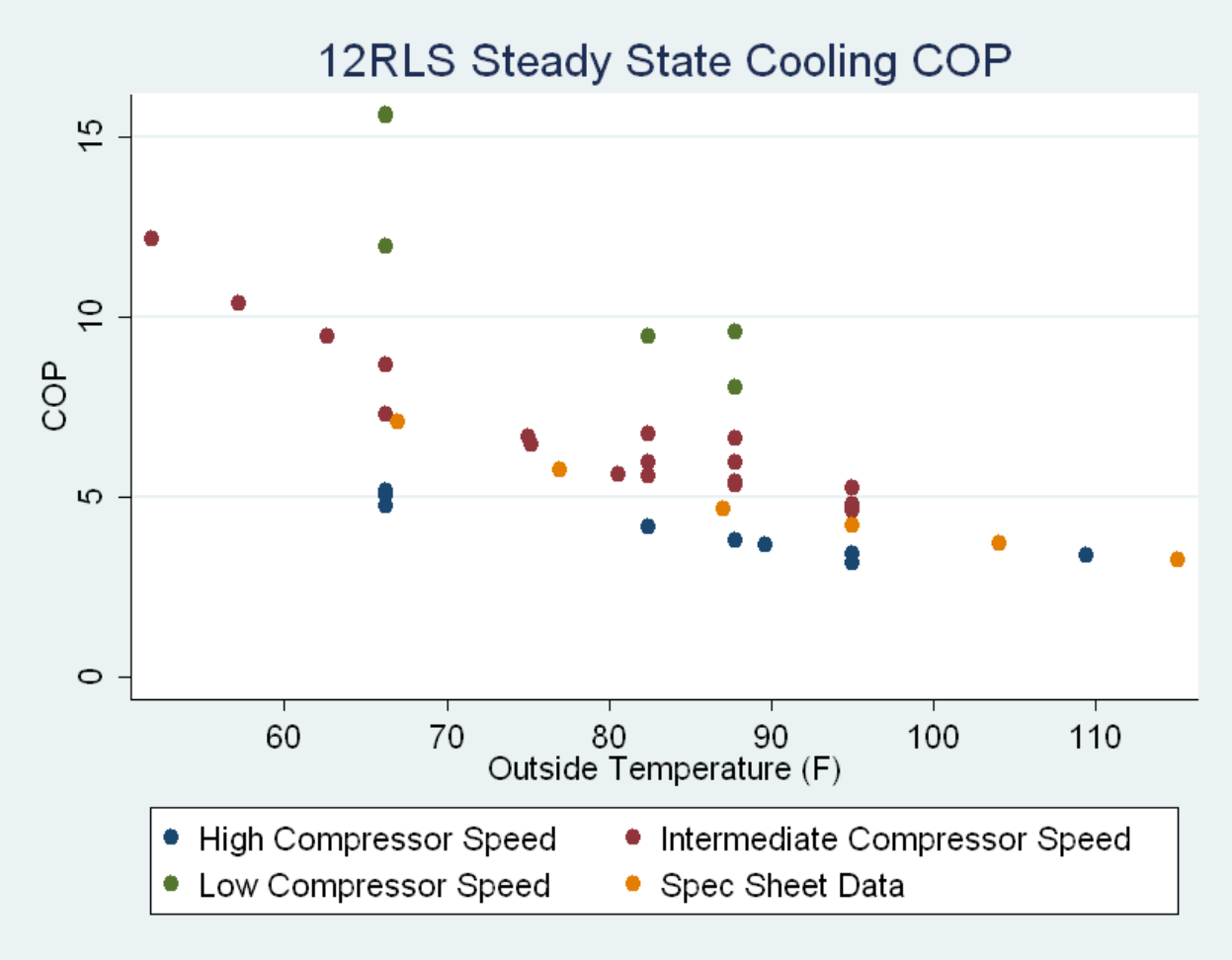
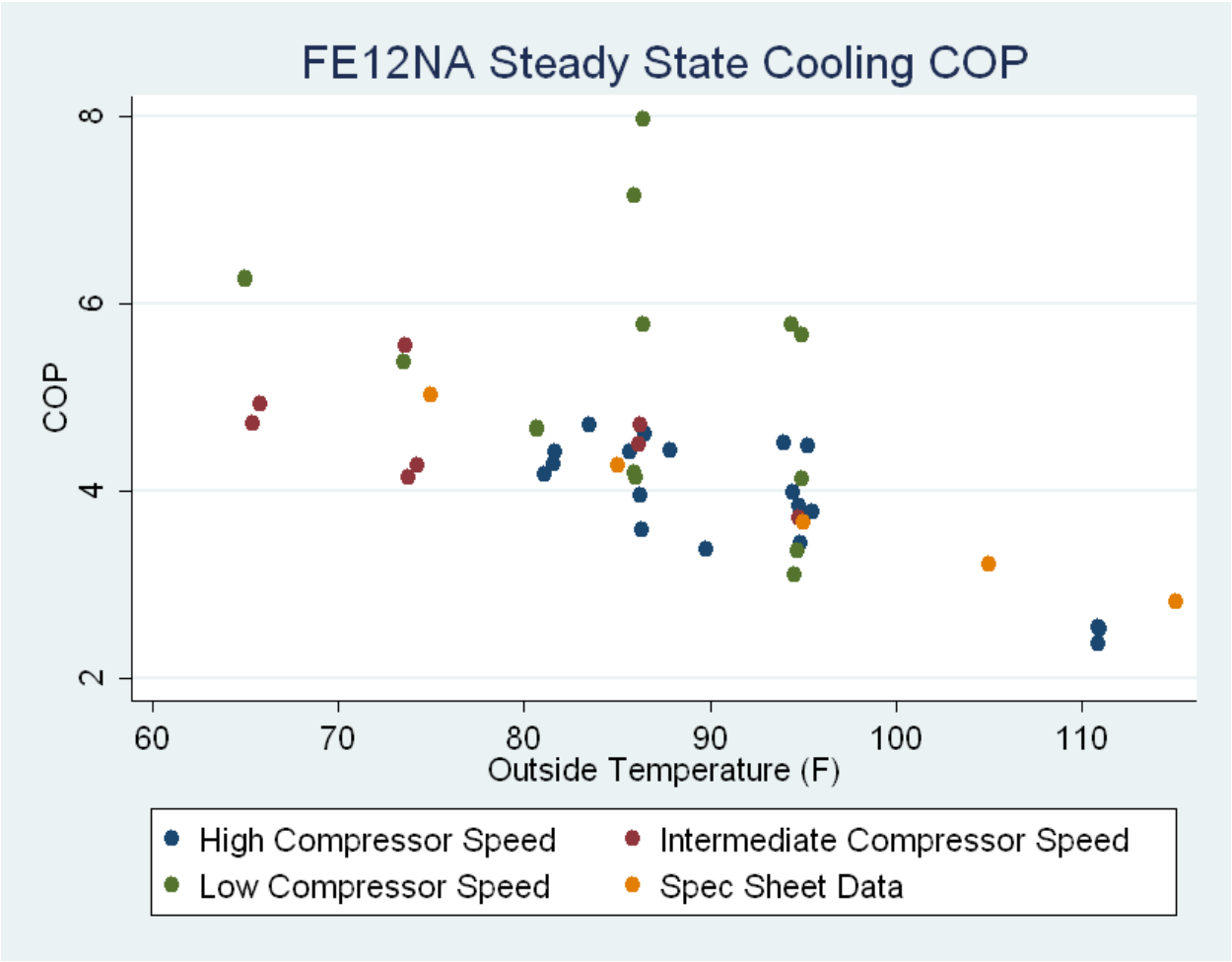


Figure 16. FE12NA COP Plot.

(Steady state lab data plotted as blue, red, and green points.)



5.2. Cooling Mode Cycling

Two cycling tests were conducted for each DHP. The first was the AHRI 210/240 specified one which cycles the equipment from low power to off at 67°F outdoor temperature. A second test was added which cycles the equipment from high power to off at the same temperature to better understand the effects of cycling. The max load to off cycling demonstrated there is very little energy penalty to this type of cycling. Essentially, the equipment is well set up to switch on to a high fan and high power state. This was the same findings as in heating. For the low load cycling, there is still a noticeable energy penalty when compared to the equipment operating at steady state at that low load. When cycling on, the DHP targets an initially higher output than required and overshoots the optimal performance range.

The cooling cyclic degradation coefficient, Cd, was determined to be 0.43 for the 12RLS. The Cd for the FE12NA could not be determined due to testing challenges. Even with the manufacturer supplied controller, the lab could not replicate the required, paired steady-state and

cycling tests to determine Cd. For the cycling test, the FE12NA would cycle on but at a load lower than any observed in the steady-state test regime. Operating at this lower load will give a comparatively higher COP and thus results in a negative Cd. The lab made several attempts at the tests to confirm the challenges and then moved on to the over items in the test suite. In all SEER calculations, the default value of 0.25 is used for both equipment models instead of the measured value.

6. SEER and HSPF Ratings Evaluation

The lab testing plan called for conducting the full set of tests necessary in calculating SEER and HSPF ratings. The purpose of conducting the rating point tests was not to verify the manufacturer's rating but to understand the relationship between the ratings mandated by the federal standards and the performance of this equipment in a variety of load conditions. The other tests in the test suite create a detailed performance map that far surpasses any single rating. Therefore, these can be used as a baseline comparison for equipment performance to the rating tests.

The AHRI 210/240 testing and rating procedures call for several tests at different rating conditions which are then weighted together to derive a single rating. This procedure was designed in the 1980s to rate single speed compressors in split systems. With the advent of widely available variable speed equipment, the test standard was expanded to include specific tests and a specific section on the calculation procedure for those systems. While the weighting scheme may have limitations for single speed technology, its use in the variable speed compressors and fan systems of the DHP requires that the tests be restricted to operating conditions and control points that are arbitrary. In effect, the equipment could have a wide variety of ratings depending on the testing and control decisions made during the testing process.

One important finding is learning how challenging it is to replicate the ratings for variable speed equipment. There are a total of eight heating tests and seven cooling tests which must be exactly replicated if one expects to match literature data. Further, the critical values in the rating calculation come from "intermediate" speed compressor operation. The intermediate speed is generally the basis for nominal input, output, and COP at a particular testing temperature. All of the mid-range points plotted in Figure 5, Figure 6, Figure 13, and Figure 14 demonstrate the DHPs have multiple of what can be considered intermediate operating conditions in the compressor and several in the fan. Deviations from the exact intermediate values will lead to differences in output calculations, which is what we encountered. Much of the difference may be traced to decisions of what would be considered representative control points.

To consistently create an intermediate operating speed for purposes of lab testing, manufacturers generally have a special controller which sets and maintains a specific operation. The device is external to the DHP and designed to be used in the rating process. At the start of testing, both manufacturers were queried about obtaining and using the controller in the project. The controller for the FE12NA was obtained and used while the one for the 12RLS was not.

Surprisingly, it was easier to replicate the 12RLS results without a controller. Even with the manufacturer's controller for the FE12NA, the equipment could not be coaxed into a critical, intermediate test point for use in the HSPF calculation. Several attempts were made before testing priorities, such as completing the full performance map, and time constraints necessitated the need to move on.

The calculation of the HSPF for the 12RLS showed agreement with the catalog value, while the HSPF for the FE12NA did not agree. The first approach at the FE12NA HSPF calculation was made using the measured, $H1_1$ and $H2_V$ test points[10], which gave an unreasonably low result due to difficulties in observing the DHP at the proper compressor speed. Therefore, the second, and final approach, used simulated data points for these two tests from the performance model to calculate the HSPF value which proved to be a much higher result. The results are given in Table 5. The data should not be taken as an official result in part because of the simulated data point used.

Neither of the measured SEER values agreed with the catalog data and both were lower. This is somewhat expected as previous Ecotope work on three single speed heat pump showed lower measured SEER values (Kruse 2006, Kruse 2008, Palmiter 2011). The earlier work showed values roughly one point lower while all but one of these are substantially lower. It should be pointed out that the EER, rather than SEER, which is influenced by humid test conditions, is more indicative of energy performance in the Pacific Northwest with its dry, almost completely sensible cooling climate.

Table 5. HSPF and SEER Calculation Results.

(HSPF Zones are defined in the 210/240 Std. Zone 1 is the warmest; 5 is the coldest. Zone 6 is for marine climates. Only Zone 4 HSPF is required to be published and printed on the equipment label.[11])

		12RLS	FE12NA*
Heating HSPF by Zone	1	15.2	10.4
	2	14.6	10.3
	3	13.8	10.1
	4	11.8 [12]	9.3 [10.6]
	5	8	7.1
	6	15.8	10.6
Cooling SEER		20.3 [25]	15.5 [23]
Cooling EER		11.4 [14.46]	10.9 [12.9]

[bracketed] number indicates catalog value.

*All HSPF values calculated using simulated $H1_1$ $H2_V$ tests.

Because of the challenges encountered in testing, these results do not definitively demonstrate higher or lower performance than the catalog data. As discussed above, one major reason for the disagreement of the values is due to the intermediate speed operating points which were difficult to replicate. It is likely that the compressor speeds used in the lab for generating these data

[10] See AHRI 210/240 for definition of $H1_1$ and $H2_V$ test conditions.

[11] See Francisco, Palmiter and Baylon 2004 for a discussion of HSPF zones

points were higher than those used by the manufacturer. The use of a higher speed would lead to lower efficiencies and hence a lower HSPF and SEER rating. Another possibility for the difference is the tolerance allowed in the testing conditions which is a ±2°F variation in both the indoor and outdoor dry bulb temperatures. A tightly controlled thermal chamber could be set to operate at the optimal ends of the tolerance range and produce better rating results.

Another source of the discrepancy could be due to ambiguities in the calculation procedure itself. For example, the HSPF calculation requires the input of a temperature where the heat pump stops operating and where resistance heat would take over. Guidance is not given in the standard on what to use in this case since there is no electric element in the DHPs tested. We elected to use field data collected at several sites which encountered very low outside temperatures. This resulted in a direct observation of the controller's response to the cold temperatures and to the increased load that the house experienced during these temperatures.[12]

For the SEER calculation, there is an undefined temperature input value,[13] used to determine the efficiency across a range of compressor speeds and temperatures. Its meaning can be inferred from other parts of the calculation procedure but a clear definition would remove the ambiguity. As with the HSPF testing we referred to the operating characteristics we could observe in the field for guidance which allowed a better sense of compressor speeds during high temperature cooling events. Unfortunately, it does not appear that either manufacturer's SEER rating is well represented by our testing.

[12] For further clarification, the lowest value for the design heating requirement, DHR, in the HSPF calculation was used per Energy Conservation Program for Consumer Products: Test Procedure for Residential Central Air Conditioners and Heat Pumps. 10 CFR Part 430. (2005).

[13] The temperature variable in question is T_2. AHRI Std 210/240-2008, page 97, Section 4.1.4.1. Inferred to mean temperature at which the compressor, operating at maximum speed, matches the building load.

7. Performance Model Development

7.1. Overview

One of the main goals of the lab evaluation was to collect enough data to develop a set of equipment performance models. The performance models are intended to be used in simulation programs as predictive tools to determine how much energy a DHP would use on an annual basis.

The foundation of the model is based on the performance map of the steady-state data. The steady state data describes how the equipment would operate in an idealized, constant load situation. From there, the steady state performance is modified with additional factors and curve fits to account for on/off cycling, defrost cycles, and responses to load/set point changes. Additionally, in simulation software, for applications where the DHP shares the heating load with another system (as is the case in this pilot study), the program needs to account for the interaction of the two systems. This report mainly deals with the performance curve fits and models of the DHP only. Field data, which are being collected in other parts of the pilot project, are needed to determine how to couple the two heating systems together.

For this project, the performance model is being developed for use with SEEM (Simple Energy and Entropy Model)[14] although any simulation software could use the curve fits. In the simulation, SEEM will "request" the needed output capacity from the performance model. This approach differs from single-speed equipment which has a fixed capacity as a function of temperature. Instead, SEEM checks if the needed capacity is within the realm of possible for the equipment and then determines the required power input to generate that output. In a situation where the DHP is sharing the house load, some a priori assumption is likely needed to determine which fraction of the house heating load the DHP could satisfy. SEEM would then request this fractional capacity from the performance model.

The performance curves for the DHPs are formulated as functions of equipment load, outdoor temperature and RH, indoor temperature and RH, and indoor unit airflow. The equipment load is used in the curve as a proxy for compressor speed. The heating model is the simplest case because it does not depend on indoor RH. Cooling will depend on indoor humidity and whether the indoor coil is wet or dry. The cooling model will also account for the split between sensible and latent capacities.

[14] SEEM was developed by Larry Palmiter at Ecotope to model heating and cooling energy use in small scale residential structures. The program consists of an hourly thermal and moisture (humidity) simulation that interacts with duct specifications, equipment, and weather parameters to calculate the annual energy requirements of the building. It employs algorithms consistent with current ASHRAE, AHRI, and ISO calculation standards. SEEM is used extensively in the Northwest to estimate conservation measure savings for regional energy utility policy planners.

Herrick Labs developed full equipment performance models as well as useful parameterization techniques to deal with the variable speed nature of the compressor and fan. Ecotope employed some of the parameterization concepts and then independently developed a heating model. The cooling model used is the one developed by Herrick Labs. In all cases, regression techniques were used on the entire performance map of the measured data to create simplified functional fits.

7.2. Model

The model concepts are first explained briefly and then developed in more detail below. The model is intended to be used in the following way:

- Calculate maximum output capacity, Q_{max} (Eqn 1), and maximum input power, W_{max} (Eqn 2) at the given indoor and outdoor conditions using a fitted curve from equations 1 and 2.
- Using the load requested from the simulation, Q, determine at what fraction of capacity the compressor is operating: Q/ Q_{max} and $(Q/ Q_{max})^2$
- Using the airflow value supplied by the simulation, CFM,[15] and the capacity, Q, calculate Q/CFM. The model then checks the capacity to flow ratio against a maximum allowed value to insure the simulation is not trying to ask for an unrealistically high capacity with a low flow. The parameterization and values for Q/CFM are derived from the lab tests themselves.
- Calculate the predicted power input, $W_{predicted}$, that is needed to generate the requested capacity at the selected airflow under the specific ambient air conditions (Eqn 3).
- If the load is low and the equipment is cycling, applying a cycling factor correction.
- If the ambient conditions are in a frosting regime, applying a defrost factor correction.

The first step in developing the model is to determine the maximum input power and output capacity across all temperatures. These curve fits are plotted in Figure 11 for heating. The fits are given in the equations below and the coefficients in Table 6 and Table 7. All temperatures are input in °F; Qmax, the output capacity, is output in Btu/hr; and Wmax, the input power is output, in W. Equations 1 and 2 capture both the indoor and outdoor temperature dependence.

$$Q_{max} = q_{rate}*[qb0 + qb1*T_{out} + qb2*T_{out}^2 + qb8*(T_{in}-70)/(70-T_{out})] \quad \text{(Equation 1)}$$

$$W_{max} = w_{rate}*[wb0 + wb1*T_{out} + wb2*T_{out}^2 + wb8*(T_{in}-70)/(70-T_{out})] \quad \text{(Equation 2)}$$

[15] The airflow value is either a user input, fixed value, or function designed to operate the equipment at optimum efficiency.

Table 6. Maximum Output Capacity Curve Fit Coefficients.

(The r^2, goodness of fit, value is also given in the table.)

	12RLS	FE12NA
r^2	0.91	0.99
q_{rate}	20587	19580
qb0	0.6890756	0.4413528
qb1	0.0088316	0.0209345
qb2	-0.0000440	-0.0001815
qb8	-0.0526629	-0.1584849

Table 7. Maximum Power Input Curve Fit Coefficients.

(The r^2, goodness of fit, value is also given in the table.)

	12RLS	FE12NA
r^2	0.91	0.79
w_{rate}	1925	2226
wb0	1.05754	0.6432956
wb1	0.0064188	0.013828
wb2	-0.000137	-0.0001534
wb8	0	-0.0870158

Using these max value curves from equations 1 and 2, both the input power and output capacity are parameterized as fractions of the maximum value. The max value curves are also used in the simulation to bound the upper limit of output provided by the DHP.

To capture the airflow performance dependence, we introduce another term which is the ratio of the capacity to the airflow, Q/cfm. With the ratio of desired capacity to maximum capacity, and the capacity to airflow, the power input required can be predicted using Equation 3 and Table 8.

$$W_{predicted} = W_{max} * [d0 + d1*(Q/Q_{max}) + d2*(Q/Q_{max})^2 + d11*(Q/cfm)] \qquad \text{(Equation 3)}$$

Table 8. Curve Fit Coefficients to Predict DHP Input Power.

(Use with Equation 3.

The r^2 values are also given which demonstrate overall model fit to measured data.)

	12RLS	FE12NA
r^2	0.97	0.89
d0	-0.1228436	-0.2208177
d1	0.6949213	1.051991
d2	0.3444927	0
d11	0.0016292	0.0037269

The lab results showed that changing the indoor fan speed setting, from low, medium, or high, changed the performance. The higher the airflow, the better the heat transfer across the indoor coil, so both capacity and efficiency increase. As the airflow increases, so does the power needed to run the fan (typically 20W from low to high), but the efficiency gains in heat transfer make up for the added power. Conversely, for a given output capacity, as the airflow decreases, the compressor has to work harder in order to raise the supply air temperature. This comes as a performance penalty. Instead of separating fan power in the model, we rolled it into the total power.

To complete the heating model, several more parameters are needed, including a maximum allowable capacity per unit airflow, the cycling degradation coefficients, and a minimum low load limit. These are given in Table 9.

Empirically, each piece of equipment was determined to have a maximum capacity per unit airflow, $Q/CFM|_{max}$. This is because in practice, maximum capacity is achieved with maximum airflow not with minimum. A larger value of $Q/CFM|_{max}$ means the equipment can deliver more heating or cooling with less flow. The capacity to airflow ratio limit is necessary in the model to prevent nonphysical conditions from being specified. It explicitly prevents a DHP airflow from being set low and then requesting a large capacity. Inside a simulation, when this occurs, the control strategy could be to either increase the airflow level or limit the output capacity. The $Q/CFM|_{max}$ limit is distinct from the maximum equipment output capacity which is governed mostly by the outdoor temperature. For a given set of ambient and indoor conditions, $Q/CFM|_{max}$ limits the capacity for a fixed indoor fan speed.

Equipment cycling modeling turns out to be especially important in DHP retrofit applications where the DHP can share the space heating load with an existing system such as a resistance heater. If this heater is configured to provide heat concurrently with the DHP, the apparent load on the DHP will diminish causing it to cycle. This would conceivably happen at lower outside temperatures than if the DHP were simply heating the space on its own. Therefore, it is useful to think of heating cycling occurring at the load fraction (which changes as a function of temperature) corresponding to the minimum input power. The minimum continuously observed operating power is given as the Min Power Input in Table 9. For loads (and powers) below this, the unit will cycle on and off. A standard treatment of cycling similar to what is used in the AHRI 210/240 standard for calculating the HSPF is used in the model.

Table 9. Additional Modeling Parameters.

	Units	12RLS	FE12NA
$Q/CFM\|_{max}$	Btu/hr/CFM	55	65
Min Power Input	W	220	450
Cd	--	0.28	0.45

The impact of defrost on the performance still needs to be implemented. The defrost tests suggest a 5-10% decrease but long-term observations of the field data show the impact could be larger. The field data measurements show it is possible to observe the frequency, duration, and power use during a defrost cycle. Therefore, Ecotope plans to mine the field data for defrost impacts and incorporate those findings into the final performance curves.

7.3. Curve Fit and Model Example

The curve fits and performance model can be better understood through an example using a house with the following characteristics:

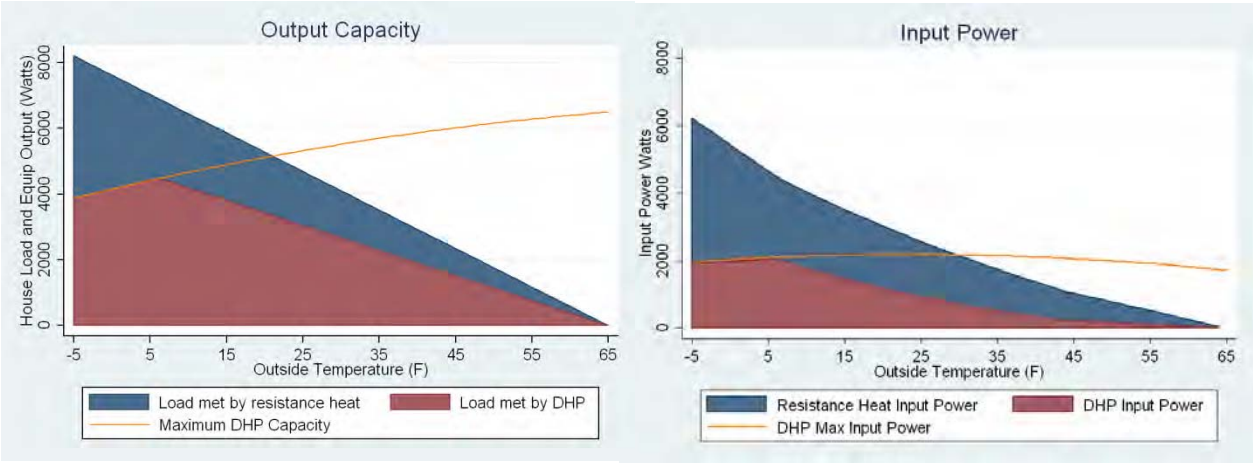
- House UA = 400 Btu/hr°F. 65°F balance point. House set point is 70°F.
- DHP assumed to heat 65% of house. Remaining 35% heated with resistance baseboards.
- Use 12RLS DHP
- Defrost not yet in model
- Low load cycling in model is included

Figure 17 shows the output capacity and input power for the example house from -5°F to 65°F outside temperature. The area in red represents the DHP while the area in blue represents the baseboard resistance heaters. The load on the house increases as the temperature drops. In response, the DHP (and the baseboard heaters) increase their output capacity.[16] Because the DHP is carrying only 65% of the load, some resistance heat is used at all temperatures. Physically, this could happen if the occupant desires heat in a bedroom while the DHP is located in the living room. The DHP can't always heat the far zone effectively so supplemental heat is needed.

As the capacity of the DHP increases, so does the required input power. Notice the curved shape to the input power graph which comes directly from Equation 3. The graphs also plot the maximum capacity and input power from equations 1 and 2 as orange lines. When the load required by the house meets the maximum possible DHP capacity, the capacity then remains at maximum (which happens near 5°F and below in this example). When the DHP output is maximized, but the house load is greater, the simulation fills in the missing capacity with more resistance heat. Near 45°F, there is another inflection point in the input power. Above this temperature, for this house configuration, the load on the DHP is low enough that the equipment begins to cycle. The input power increases but the capacity, which is driven by the house heating requirements, stays the same. At the low temperature end, when the defrost model is implemented, it will effectively decrease the maximum available capacity when frosting occurs and increase the relative input power requirement.

[16] In practice, the baseboard heaters do not increase their capacity. They have a fixed output. Instead, the heaters will cycle on and off for different periods of time. Alternatively, more heaters, in different parts of the house could turn or off as well.

Figure 17. Example of DHP Performance Curve and Resistance Heat Interaction in a Sample House.



7.4. Cooling Model

The cooling performance model we elected to use was developed by Howard Cheung and Simbarashe Niyaka at Herrick Labs. Ecotope verified the workings of the model and was satisfied with its explanatory and predictive capability. It is attached in Appendix E where it is explained in detail.

8. Conclusions

The detailed performance mapping and subsequent analysis conducted in the lab testing of the 12RLS and FE12NA DHPs leads to several significant findings. They are described below.

- **The lab data demonstrates the high performance of both models.** The highly efficient operation will enable significant energy savings opportunities in both retrofit and new applications. Both equipment models have the potential to deliver on the promise of generous energy savings. Had the lab data revealed poor efficiency results, the ultimate energy savings estimates would be compromised. In the end, the savings achieved in a particular house will depend on a number of factors including the installation location within the building or the interaction with the existing heating system. Compressor and distribution efficiency of the DHP, however, will provide a strong foundation on which to build energy savings.

- **Lab and field COP measurements show good agreement.** The early analysis of the field data compares well to the lab measurements. Both measurements provide a useful cross reference for each other. The lab data is collected in a stable, repeatable, and highly controllable situation which provides a "reference set" for the field measurements of similar DHPs. Likewise, the field metering of COP shows which equipment operating modes are most common and therefore the most important parameters to measure in the lab. At the outset of the project, Ecotope did not anticipate the amount of synergy between the two data sets. It yields more confidence in both, while simultaneously demonstrating the benefits of an integrated evaluation approach to ductless heat pumps.

- **Both equipment models perform well at low outdoor temperatures.** Both models continue to operate well in cold temperatures with the 12RLS showing slightly higher capacity and efficiency. Installers and home-owners should be made aware that the equipment will continue to run and provide benefits at cold temperatures so that energy savings can be maximized.

- **The current HSPF and SEER ratings are not well suited to DHPs.** The testing standard and calculation procedure do not always produce ratings which characterize the performance of the equipment well or allow one to determine how the equipment might operate in a controlled environment like the lab, let alone a field installation. In lieu of the ratings, more data is needed to assess both the relative performance between models and the likely energy use of a single model. This data should include the typical operating speeds and compressor outputs that the equipment's controller uses to respond to heating conditions. Performance curves (including capacity and input power over a range of compressor loadings such as those developed in this project) and description of operational strategies will be useful in this regard. An updated testing procedure should include changes to the testing conditions, compressor speeds in particular, that make them more applicable to the way they perform in actual operation.

- **The equipment can be modeled in SEEM.** The performance model developed with the data collected in the lab will be implemented within SEEM. Importantly, the field data from the project will be integrated with the simulation to refine, calibrate, and validate

the model. The simulation will be appropriate to determine energy savings in both retrofit applications and new construction scenarios. This will allow the results of the lab testing and field data to be generalized to future evaluation of DHPs as a regional energy efficiency resource.

Lastly, the project demonstrates the value of an integrated approach to program evaluation. The simultaneous lab and field measurements reinforce one another. For example, the carefully measured indoor airflows in the lab were useful for calibrating the field measurements of output capacity and the subsequent equipment efficiency. Further, the field data showed which operating conditions were important to investigate in the lab. Finally, both will be combined to produce energy modeling tools.

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Appendix B. Experimental Setup from Herrick Labs

Experimental setup: 12RLS

The Fujitsu 12RLS unit has an indoor unit and an outdoor unit that are installed in the corresponding rooms in the psychrometric chamber as shown in Figure 1 and Figure 2. A refrigerant circuit schematic diagram is shown in Figure 3.

Figure 1 Photo of the indoor unit with insulated discharge plenum

Figure 2 Photo of the outdoor unit

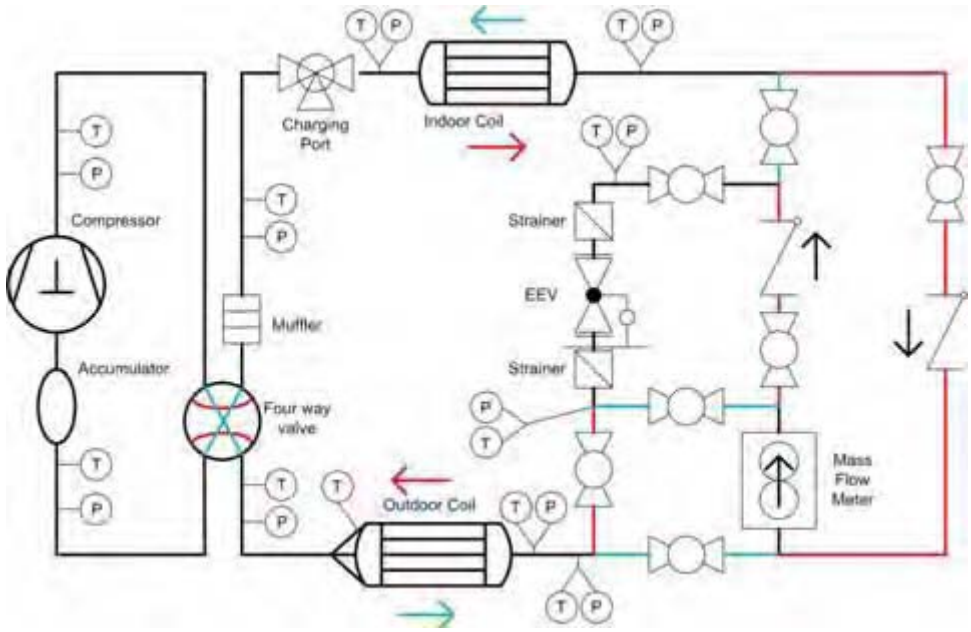


Figure 3 Refrigerant circuit schematic diagram

To characterize the refrigerant states, 11 OMEGA T-type thermocouples and 10 OMEGA PX32B1-2.5KAV millivolt pressure transducers are installed along the circuit ("T" and "P", respectively, in Figure 3). A system of valves allows the unidirectional Coriolis-type mass flowmeter to be used in both heating and cooling mode.

The system was initially charged with 1.25kg of R410a refrigerant for the heating mode tests. The recommended charge of 1.25kg gave zero subcooling for cooling mode operation which was unexpected. After consulting with Fujitsu on the expected subcooling values, the charge was increased to 1.52kg for all of the cooling tests. Three heating tests were conducted at both charge levels to ascertain if the higher charge value would alter the performance. Two of the tests showed a slightly higher heating capacity while one showed a lower heating capacity showing that the higher charge was on average 2.9% higher. The average difference is within the error bound of the measurement between refrigerant-side and air-side capacity so it was determined the added charge would not have had a measureable impact on the rest heating mode tests.

The air-side capacity of the indoor unit is computed using dry-bulb temperature, humidity, and airflow measurements on the indoor unit. Airflow is measured with a standard nozzle. An array of 9 T-type thermocouples on the inlet and 8 T-type thermocouples on the outlet are used to measure the average inlet and discharge air temperatures. The discharge plenum attached to the unit is insulated. Air flow is corrected for density, which is calculated from the humidity and temperature measurements made by a dew point sampling pump and 3 RTD sensors. Humidity at the inlet and outlet of the indoor unit was measured by a General Eastern Model SSM-1 humidity sampling pump. In each test, 10 minutes of stead-state dewpoint measurements were taken from one location. A toggle switch was then used to switch to the second location. Atmospheric pressure is measured by a mercury barometer, and power meters measure the total power to the indoor and outdoor units.

Data are collected at 10 second intervals and processed using an Agilent 34980A Multifunction Switch/Measure Unit and a Labview program generated specifically for this setup.

Experimental Setup FE12NA

Figure 4 and Figure 5 show the installation of the unit in the rooms of the psychrometric chamber. Refrigerant circuit schematics with refrigerant-side measurement points are shown in Figure 6, Figure 7 and Figure 8.

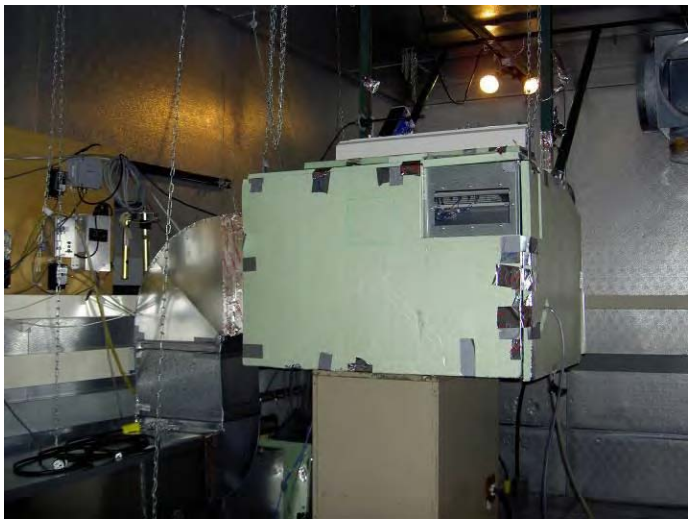


Figure 4 Photo of the indoor unit in the indoor room with insulated discharge plenum

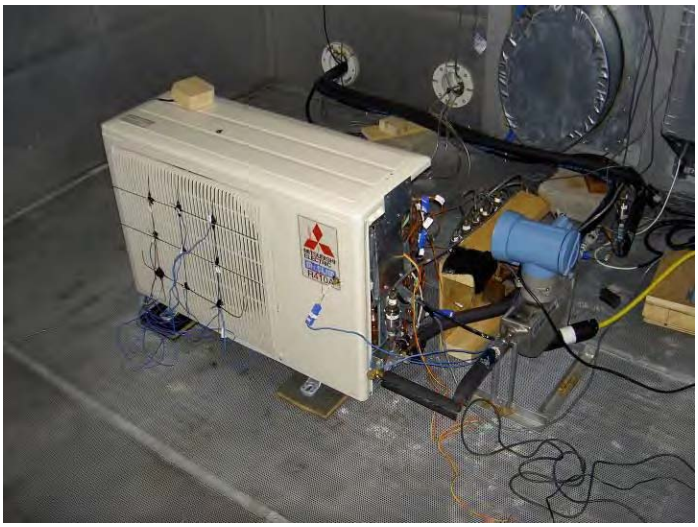


Figure 5 Photo of the outdoor unit in the outdoor room

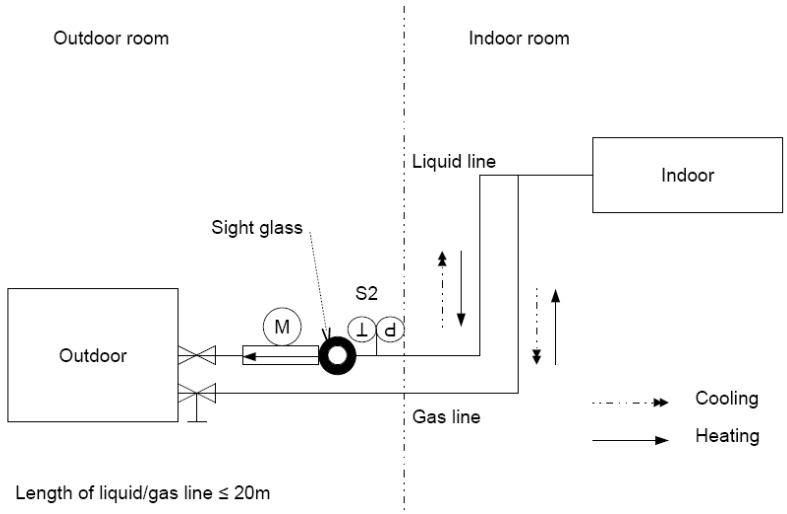


Figure 6 Overall refrigerant circuit schematic diagram

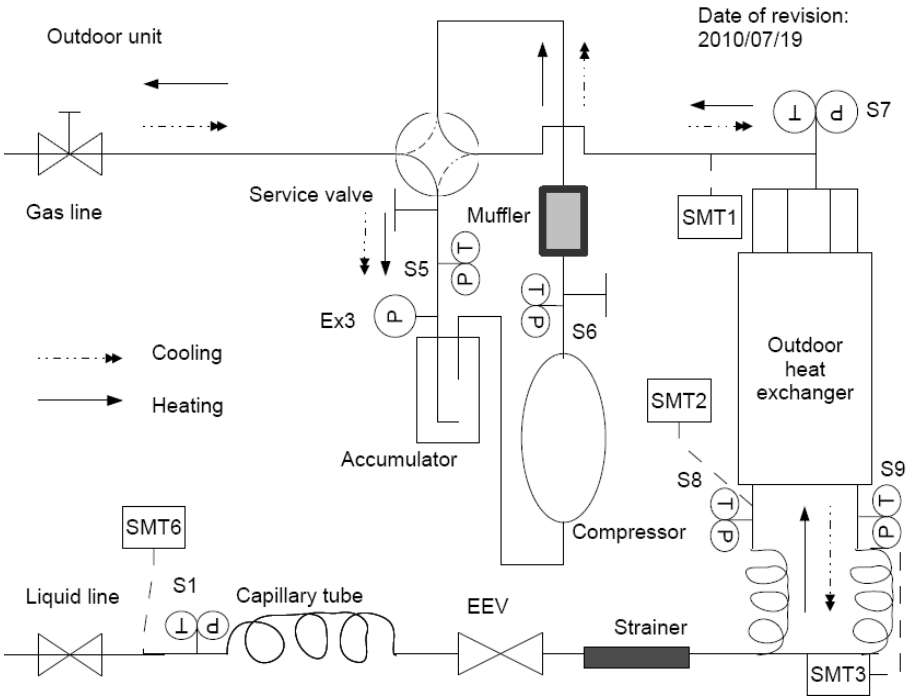


Figure 7 Refrigerant circuit schematic diagram of outdoor unit

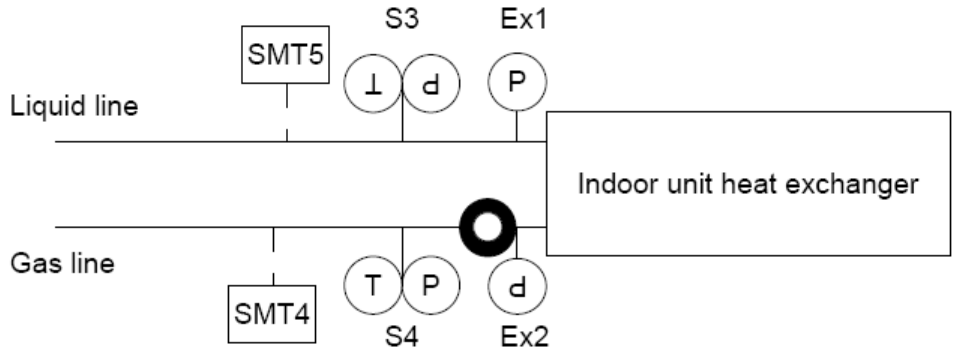


Figure 8 Refrigerant circuit schematic diagram of indoor unit

The states of refrigerant in the system were measured by 5 surface mounted OMEGA T-type thermocouples, 6 immersion OMEGA T-type thermocouples, 3 SETRA M207 pressure transducers and 9 OMEGADYNE PX32B1-2.5KAV millivolt pressure transducers ("S" for surface mounted thermocouple and OMEGADYNE pressure transducers, "EX" for SETRA pressure transducers and "SMT" for surface mounted thermocouples in Figure 6, Figure 7 and Figure 8. A Coriolis-type mass flowmeter measured the refrigerant liquid flow under heating operation. No refrigerant flow was measured in cooling operation because the liquid line piping at the condenser exit is too short for mass flow meter installation. The system was charged with 2.58lbs of R410a refrigerant for all tests.

The air-side capacity of the indoor unit was computed using dry-bulb temperature, humidity, and airflow measurements on the indoor unit. Airflow was measured with a standard nozzle. An array of 9 T-type thermocouples on the inlet and 8 T-type thermocouples on the outlet of the indoor unit were used to measure the average inlet and discharge air temperatures. Airflow was corrected for density at the nozzle as a function of the humidity and temperature measurements measured with a humidity sensor and 3 RTD sensors. Humidities at the inlet and outlet of the indoor unit were measured using two Vaisala HMP 230 sensors as shown in **Error! Reference ource not found.** and T-type thermocouples. A General Eastern Model SSM-1 dewpoint sampling monitor was used to measure the humidity at the air inlet of the outdoor unit. Atmospheric pressure was measured by a mercury barometer, and power meters measured the total power to the indoor and outdoor units.

Data were collected at 10 second intervals and processed using an Agilent 34980A Multifunction Switch/Measure Unit and an Agilent HPE1326B unit. A Labview program is also generated specifically for this setup.

Appendix C. Test Matrix

Tables of full test suite performed on Fujitsu 12RLS and Mitsubishi FE12NA.

12RLS Heating

Table 1 Test matrix for steady state tests

Test No.	Indoor Air		Outdoor Air		Indoor Fan Speed (rpm)	Number of tests at different compressor power
	Dry-Bulb (F)	Wet-Bulb (F)	Dry-Bulb (F)	Wet-Bulb (F)		
H-SS-62-H	70	<60	62	<56.5	1320 (Hi)	1
H-SS-62-M			62	<56.5	1130 (Me)	3
H-SS-62-L			62	<56.5	890 (Low)	3
H-SS-47-H			47	<43	1320 (Hi)	1
H-SS-47-L			47	<43	890 (Low)	2
H-SS-35-H			35	<33	1320 (Hi)	1
H-SS-35-M			35	<33	1130 (Me)	1
H-SS-35-L			35	<33	890 (Low)	1
H-SS-27-H			27	<25	1320 (Hi)	2
H-SS-27-M			27	<25	1130 (Me)	1
H-SS-17-H			17	<15	1320 (Hi)	2
H-SS-17-M			17	<15	1130 (Me)	1
H-SS-07-H			7	<6	1320 (Hi)	1
H-SS-N3-H			-3	--	1320 (Hi)	1

Table 2 Test matrix of cyclic test

Test No.	Indoor Air		Outdoor Air		Indoor Fan Speed (rpm)	Compressor speed range
	Dry-Bulb (°F)	Wet-Bulb (°F)	Dry-Bulb (°F)	Wet-Bulb (°F)		
H-CY-62-H-MX	70	<60	62	<56.5	1320 (Hi)	Maximum
H-CY-62-L-MN	70	<60	62	<56.5	890 (Lo)	Minimum

Table 3 Test matrix for defrost test

Test No.	Indoor Air		Outdoor Air		Indoor Fan Speed (rpm)	Compressor speed range
	Dry-Bulb (°F)	Wet-Bulb (°F)	Dry-Bulb (°F)	Wet-Bulb (°F)		
H-DF-35-M	70	<60	35	33	1130 (Me)	Maximum
H-DF-17-M	70	<60	17	15	1130 (Me)	Maximum

Table 4 Test matrix for morning warm-up test

Test No.	Indoor Air		Outdoor Air		Indoor Fan Speed (rpm)	Compressor speed range
	Dry-Bulb (°F)	Wet-Bulb (°F)	Dry-Bulb (°F)	Wet-Bulb (°F)		
H-MW-47	64 → 70	<60	47	<43	890 (Lo)	Default
H-MW-35	64 → 70	<60	35	<33	1130 (Me)	Default

12RLS Cooling

Table 5 Cooling Steady State Test Matrix

Test no.	Outdoor condition		Indoor condition		Indoor fan	Compressor
	Dry Bulb Temp (°F)	Wet Bulb Temp (°F)	Dry Bulb Temp (°F)	Wet Bulb Temp (°F)		
C-SS-110-H-MX	110	Dry coil	80	67	Hi	Maximum
C-SS-095-H-MX	95				Hi	Maximum
C-SS-095-M-MX					Me	Maximum
C-SS-095-M-INT						Intermediate
C-SS-095-L-MX					Lo	Maximum
C-SS-095-L-INT						Intermediate
C-SS-095-L-MN						Minimum
C-SS-090-H-MX	90				Hi	Maximum
C-SS-087-H-MX	87				Hi	Maximum
C-SS-087-H-INT						Intermediate
C-SS-087-M-MX					Me	Maximum
C-SS-087-M-INT						Intermediate
C-SS-087-M-MN						Minimum
C-SS-087-L-INT					Lo	Intermediate
C-SS-087-L-MN						Minimum
C-SS-082-H-MX	82				Hi	Maximum
C-SS-082-M-MX					Me	Maximum
C-SS-082-M-INT						Intermediate
C-SS-082-L-INT					Lo	Intermediate
C-SS-082-L-MN						Minimum
C-SS-075-H-MX	75				Hi	Maximum
C-SS-067-H-MX	67				Hi	Maximum
C-SS-067-M-MX					Me	Maximum
C-SS-067-M-INT						Intermediate
C-SS-067-L-INT					Lo	Intermediate
C-SS-067-L-MN						Minimum
C-SS-067-H-MX-D				Dry coil	Hi	Maximum
C-SS-067-L-MN-D					Lo	Minimum

Table 6 Cooling Cycling State Test Matrix

	Outdoor condition		Indoor condition		Indoor fan	Compressor
Test no.	Dry Bulb Temp (°F)	Wet Bulb Temp (°F)	Dry Bulb Temp (°F)	Wet Bulb Temp (°F)		
C-CY-067-H-MX-D	67	Dry coil	80	Dry coil	Hi	Maximum
C-CY-067-L-MN-D					Lo	Minimum

Table 7 Test matrix for evening cool-down tests

	Outdoor condition		Indoor condition		Indoor fan
Test no.	Dry Bulb Temp (°F)	Wet Bulb Temp (°F)	Dry Bulb Temp (°F)	Wet Bulb Temp (°F)	
C-ED-095-M	95	Dry coil	80	67	Me
C-ED-082-L	82				Lo

FE12NA Heating

Table 8 Heating steady state test matrix

Test code	Indoor temperature (°F)	Outdoor temperature (°F)	Fan speed	Compressor speed
H-SS-62-H-MX	70	62	High	Maximum
H-SS-62-H-MN	70	62	High	Minimum
H-SS-62-M-MX	70	62	Med	Maximum
H-SS-62-M-INT	70	62	Med	Intermediate
H-SS-62-L-MX	70	62	Low	Maximum
H-SS-62-L-MN	70	62	Low	Minimum
H-SS-47-H-MX	70	47	High	Maximum
H-SS-47-L-INT	70	47	Low	Intermediate
H-SS-47-L-MN	70	47	Low	Minimum
H-SS-35-H-MX	70	35	High	Maximum
H-SS-35-M-INT	70	35	Med	Intermediate
H-SS-27-H-MX	70	27	High	Maximum
H-SS-27-H-MN	70	27	High	Minimum
H-SS-27-M-INT	70	27	Med	Intermediate
H-SS-27-L-MN	70	27	Low	Minimum
H-SS-17-H-MX	70	17	High	Maximum
H-SS-17-M-MX	70	17	Med	Maximum
H-SS-17-M-INT	70	17	Med	Intermediate
H-SS-7-H-MX	70	7	High	Maximum

H-SS-n3-H-MX	70	-3	High	Maximum
H-SS-35-M-MX	70	35	Med	Maximum
H-SS-7-L-MX	70	7	Low	Maximum
H-SS-62-H-MX-75	75	62	High	Maximum
H-SS-62-H-MX-60	60	62	High	Maximum
H-SS-47-H-MX-75	75	47	High	Maximum
H-SS-47-H-MN-75	75	47	High	Minimum
H-SS-47-L-INT-75	75	47	Low	Intermediate
H-SS-35-M-INT-64	64	35	Med	Intermediate
H-SS-35-H-MX-60	60	35	High	Maximum
H-SS-27-H-MX-75	75	27	High	Maximum
H-SS-27-H-MX-60	60	27	High	Maximum

Table 9 Heating Cycling test matrix

Test code	Test method	Indoor temperature (°F)	Outdoor temperature (°F)	Fan speed	Compressor speed
H-CY-62-H-MX	Cyclic	70	62	High	Maximum
H-CY-62-L-MN	Cyclic	70	62	Low	Minimum

Table 10 Test matrix for defrost test

Test code	Indoor temperature (°F)	Outdoor temperature (°F)	Fan speed	Compressor speed
H-DF-17-M	70	17	Med	Maximum
H-DF-35-M	70	35	Med	Maximum
H-DF-47-M	70	47	Med	Maximum

FE12NA Cooling

Table 11 Cooling Steady State Test Matrix

Test code	Indoor dry-bulb temperature (°F)	Indoor wet-bulb temperature (°F)	Outdoor temperature (°F)	Fan speed	Compressor speed
C-SS-110-H-MX	80	67	110	High	Maximum
C-SS-095-H-MX			95	High	Maximum
C-SS-095-H-MX-76		76		High	Maximum
C-SS-095-H-MX-65		65		High	Maximum
C-SS-095-H-MX-85-D	85	Dry coil		High	Maximum
C-SS-095-H-MX-70-D	70			High	Maximum

C-SS-095-M-MX	80	67		Medium	Maximum
C-SS-095-M-INT				Medium	Intermediate
C-SS-095-L-MX				Low	Maximum
C-SS-095-L-INT				Low	Intermediate
C-SS-095-L-MN				Low	Minimum
C-SS-090-H-MX				High	Maximum
C-SS-087-H-MX			87	High	Maximum
C-SS-087-H-INT				High	Intermediate
C-SS-087-M-MX				Medium	Maximum
C-SS-087-M-MX-75-D	75	Dry coil		Medium	Maximum
C-SS-087-M-INT	80	67		Medium	Intermediate
C-SS-087-M-MN				Medium	Minimum
C-SS-087-L-INT				Low	Intermediate
C-SS-087-L-MN				Low	Minimum
C-SS-082-H-MX			82	High	Maximum
C-SS-082-M-MX				Medium	Maximum
C-SS-082-M-INT				Medium	Intermediate
C-SS-082-L-INT				Low	Intermediate
C-SS-082-L-MN				Low	Minimum
C-SS-082-M-MX-62		62		Medium	Maximum
C-SS-075-H-MX		67	75	High	Maximum
C-SS-075-L-INT-D		Dry coil		Low	Intermediate
C-SS-075-L-INT-58		58		Low	Intermediate
C-SS-067-H-MX		67	67	High	Maximum
C-SS-067-H-MX-72		72		High	Maximum
C-SS-067-H-MX-65		65		High	Maximum
C-SS-067-H-MX-85-D	85	Dry coil		High	Maximum
C-SS-067-H-MX-70-D	70			High	Maximum
C-SS-067-M-MX	80	67		Medium	Maximum
C-SS-067-M-INT				Medium	Intermediate
C-SS-067-L-INT				Low	Intermediate
C-SS-067-L-MN				Low	Minimum
C-SS-067-H-MX-D		Dry coil		High	Maximum
C-SS-067-L-MN-D				Low	Minimum

Table 12 Cooling Cycling Test Matrix

Test code	Indoor dry-bulb temperature (°F)	Indoor wet-bulb temperature (°F)	Outdoor temperature (°F)	Fan speed	Compressor speed
C-CY-67-H-MX	80	Dry coil	67	High	Maximum
C-CY-67-L-MN	80			Low	Minimum

Appendix D. Additional Heating Mode Graphs

Figure D1.

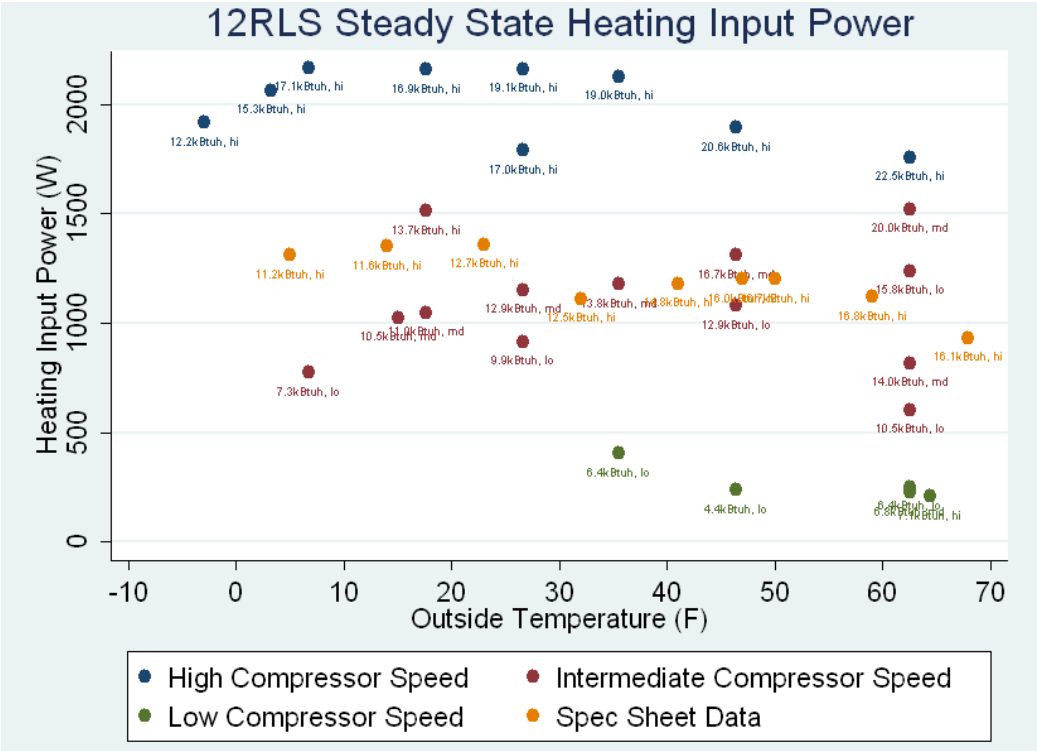
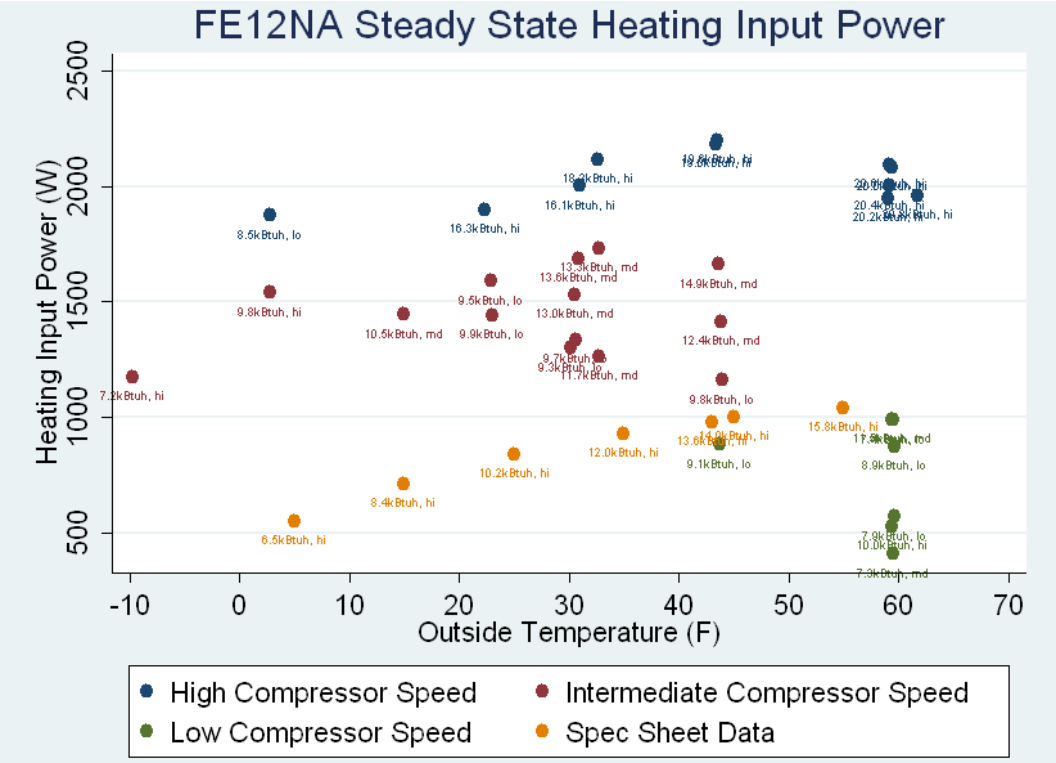


Figure D2.



Appendix E. Heating and Cooling Model from Herrick Labs

What follows is the heating and cooling model developed by Herrick Labs from the measured data. Both Howard Cheung and Simbarashe Nyika worked to develop the model and should be credited where ever it is used. Ecotope independently developed a heating mode model which was presented in the main body of the report. The Herrick Labs heating mode model is given here for comparison purposes for the interested reader.

Excerpted from Monthly Progress report for February 2011:

1. Model consolidation and improvement

During this past month, additional work has been performed in developing a more general empirical modeling approach for DHP performance that works well for both the Fujitsu 12RLS and Mitsubishi FE12NA units. The indoor unit power consumption, the sensible heat ratio (SHR) and the total power consumption of the unit are characterized using empirical relationships that are described in this section. The new test results will be uploaded to the server.

The indoor unit power consumption is dominated by fan electricity and is assumed to be a quadratic function of indoor unit airflow as shown by equation (1).

$$W_{in} = g_0(V) = a_0 V^2 + a_1 V + a_2 \tag{1}$$

where

a_i is the ith coefficient

W_{in} is the indoor unit power consumption

V is the volumetric air flow rate

The coefficients in equation (1) were calculated using regression applied to the experimental data. The estimated coefficients of equation (1) are shown in Table 4. Comparisons of model and measurements are presented in the appendix.

Table 4 Coefficients for equation (1)

Model	Fujitsu 12RLS		Mitsubishi FE12NA	
Mode	Heating	Cooling	Heating	Cooling
a0 ($W/(m^3/s)^2$)	1521.2	1321.8	888.95	1321.9
a1 ($W/(m^3/s)$)	-226.87	-200.71	-2.0047	-108.19
a2 (W)	18.044	17.059	1.3398	6.6958
Coefficient of determination	0.9988	0.9959	0.9813	0.9909

A sensible heat ratio model was then built for each unit operating in cooling mode. The sensible heat ratio model is mainly based on the ASHRAE Secondary Toolkit [4]. Equations (2) to (7) form the basic model along with psychrometric routines.

$$h_{adp} = h_{ent} - \frac{h_{ent} - h_{lvg}}{1 - BF} \tag{2}$$

$$SHR = \frac{h(t_{ent}, w_{adp}) - h_{adp}}{h_{ent} - h_{adp}} \tag{3}$$

$$BF = e^{-Ntu} \tag{4}$$

$$BF = \frac{h_{lvg} - h_{adp}}{h_{ent} - h_{adp}} = \frac{w_{lvg} - w_{adp}}{w_{ent} - w_{adp}} \tag{5}$$

$$h_{adp} = h(\omega_{adp}, r = 1) \tag{6}$$

$$Q = \dot{m}_{lvg}(h_{ent} - h_{lvg}) \tag{7}$$

where

h_{adp} is the effective surface enthalpy
h_{ent} is the air-water mixture enthalpy at the air inlet
h_{lvg} is the air-water mixture enthalpy at the air outlet
BF is the bypass factor
SHR is the sensible heat ratio
t_{ent} is the dry-bulb air temperature at the air inlet
ω_{adp} is the effective surface humidity ratio
ω_{ent} is the humidity ratio at the air inlet
ω_{lvg} is the humidity ratio at the air outlet
Ntu is the number of transfer units
r is the relative humidity
Q is the load delivered by the unit
$\dot{m}_{lvg}$ is the air mass flow rate

Equations (2), (4), (5) and (6) were used to find the Ntu for a single rating condition (C-SS-095-H-MX[17]). The Ntu is assumed to be constant under other scenarios and equations (2), (3), (4), (6) and (7) are used to obtain the SHR in all other cases. The Ntu values determined for the two units are shown in Table 5 and the comparisons between values of SHR determined from measurements and model predictions are presented in Figure 6 and Figure 7.

Table 5 Ntu for SHR model

Model	Fujitsu 12RLS	Mitsubishi FE12NA
Ntu	4.098	2.26

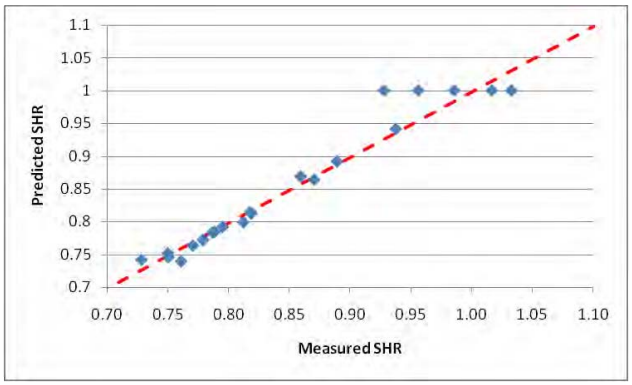


Figure 6 Fujitsu 12RLS SHR model performance

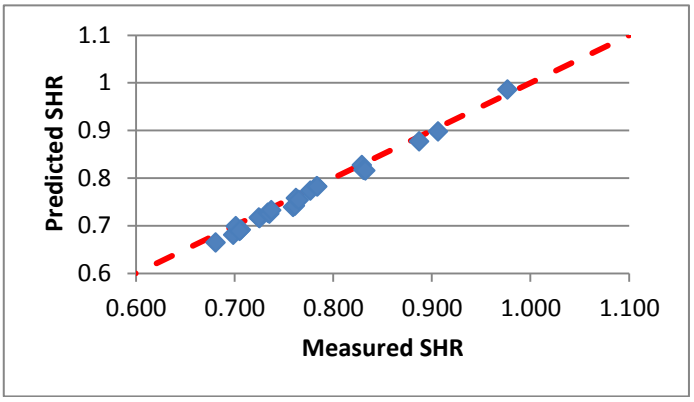


Figure 7 Mitsubishi FE12NA SHR model performance

[17] A steady-state test with outdoor dry-bulb temperature 95°F, indoor dry-bulb temperature 80°F, indoor wet-bulb temperature 67°F, high fan and maximum compressor speed.

The deviation in Figure 6 near unity SHR is a result of dry coil operation. Due to measurement uncertainties, dry conditions in experiments may be recorded to have SHR values less than one (or even higher than one). A predicted dry condition will give a unity SHR and will not provide values greater than unity.

The capacity and the power at capacity models capture the capacity and its power consumption at the highest indoor fan and compressor speeds at various conditions, resulting in expressions (8) and (9), dependent on environmental variables only.

$$Q_{max} = g_1(T_{amb}, T_{in}) \tag{8}$$

$$W_{max} = g_2(T_{amb}, T_{in}) \tag{9}$$

where

T_{in} is indoor coil inlet wet-bulb temperature in cooling and dry-bulb temperature in heating in °C

T_{amb} is the outdoor ambient dry-bulb temperature in °C

Q_{max} is the capacity in kW

W_{max} is the outdoor unit power consumption at Q_{max} in W

The expressions (8) and (9) are assumed to be quadratic as shown in equation (10). Regression was implemented on data with high indoor fan speed and maximum compressor speed to find the coefficients in the expressions.

$$g(T_{in}, T_{amb}) = b_0 + b_1 T_{amb} + b_2 T_{amb}^2 + b_3 T_{in} + b_4 T_{in}^2 + b_5 T_{in} T_{amb} \tag{10}$$

where b_i is the ith coefficient in equation (10)

To obtain a compact and well-behaved performance model, backward elimination [5] was utilized to reduce the number of coefficients in (8) and (9) and a Matlab function *stepwisefit* was used to conduct the analysis. Initially, all regression coefficients in (10) were computed with the residual sum of squares of the model (Model I) recorded. Each coefficient, except the intercept, was removed one at a time from Model I and another residual sum of square (RSS) was recorded for each model with a removed coefficient (Model II). A partial F, given in equation (11), was calculated and the smallest among all Model II results is compared against an F-value[18] defined by a Type I error (α)[19] and the degree of freedom of residuals of Model I. Should the partial F be

[18] F-value is the F-statistic given by the F distribution, a kind of distribution function similar to normal distribution. F distribution is a distribution function to compare variances and hence degrees of freedom for both variances are needed for computation. For this project, the F-statistic is dependent on the numerator degree of freedom, 1, the denominator degree of freedom, ν, and the Type I error α

[19] α is the Type I error stating the probability of one hypothesis being accepted though the hypothesis is false in reality.

smaller than the F-value, the coefficient was eliminated and the Model II with the smallest F-value replaces Model I. The step was repeated by having another set of Model II based on the new Model I until the smallest partial F within the Model IIs was larger than the F-value. In this case, the Model I for this step was the final model. For this project, α was set to be 0.05.

$$\text{partial F} = \frac{RSS(\text{Model I}) - RSS(\text{Model II})}{RSS(\text{Model II})/\nu} \tag{11}$$

$$RSS = \Sigma(y_p - y_i)^2 \tag{12}$$

where

RSS is the residual sum of squares
ν is the degree of freedom of residuals of Model I = N – p – 1
y_p is the predicted value of the model
y_i is the measured value, in this case, Q_{max} and W_{max}
N is the total number of data
p is the number of coefficients

The coefficients and the coefficient of determination are tabulated in Table 6 and Table 7. Comparisons of measurements and predictions are provided in the appendix.

Table 6 Coefficients of (10) for Q_{max}

Model	Fujitsu 12RLS		Mitsubishi FE12NA	
Mode	Heating	Cooling	Heating	Cooling
b_0 (kW)	5.50517	2.28654	5.37617	2.5418364
b_1 (kW/°C)	0.12761	0.1692	0.24503	0
b_2 (kW/(°C)^2)	0	-0.0038	-0.0035	-0.002708
b_3 (kW/°C)	0	0.05686	0	0
b_4 (kW/(°C)^2)	0	0	0	-0.006535
b_5 (kW/(°C)^2)	-0.0036	0	-0.0075	0.010183

Table 7 Coefficients of (10) for W_{max}

Model	Fujitsu 12RLS		Mitsubishi FE12NA	
Mode	Heating	Cooling	Heating	Cooling
b_0 (W)	2050.971	-1420.2	1347.497	528.3236
b_1 (W/°C)	-11.8019	133.1013	91.64779	0
b_2 (W/(°C)^2)	-0.45836	-2.05742	-1.3067	0.157459
b_3 (W/°C)	2.310661	31.52992	37.60286	0
b_4 (W/(°C)^2)	0	0	0	-0.28755
b_5 (W/(°C)^2)	0	0	-3.81417	0.418263

The Mitsubishi unit exhibits a non-intuitive trend for capacity as a function of the temperatures, as demonstrated in Figure 8.

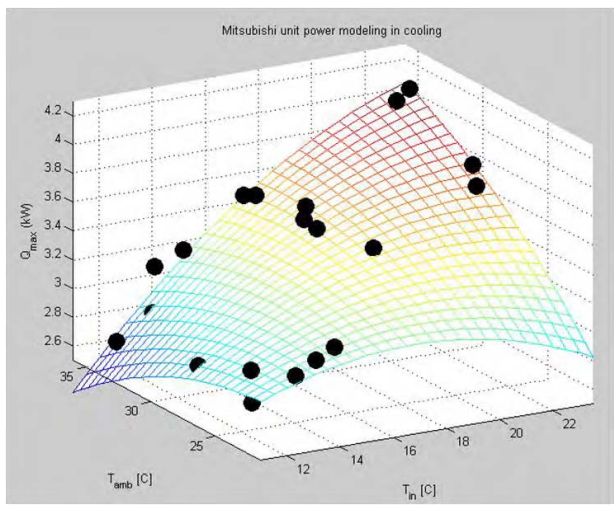


Figure 8 Mapping of capacity of Mitsubishi unit in cooling

At low ambient, the capacity decreases with increasing indoor wet bulb for values greater than about 18°C. The cause is the equipment safety algorithms that lead to auto-shutdown of the unit. When the indoor room temperature is higher than the ambient, the unit may switch off automatically. There is one data point at T_{in} = 22.31°C and T_{amb} = 23.49°C, but two other test points around this region experienced a continuous drop of capacity, followed by an auto-shutdown and operation in 10 minute on-off cycles. Care should be taken in applying the model for ambient temperatures below the indoor dry bulb temperature in cooling mode.

Typically, cooling capacity decreases with increasing ambient temperature. However, the capacity in Figure 8 actually increases with ambient temperature for high indoor wetbulb temperatures. The cause is also a consequence of a controller. A plot in Figure 9 helps to understand the reason.

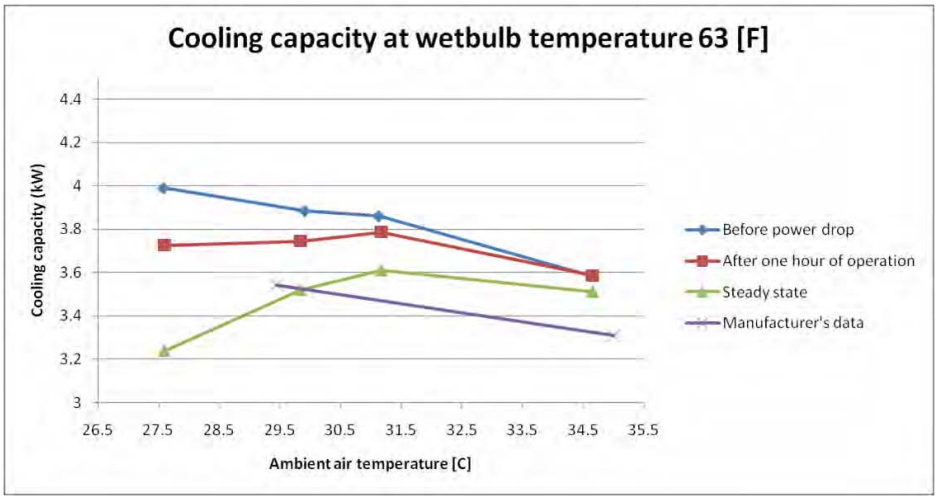


Figure 9 Capacity of Mitsubishi FE12NA at different times under 63°C indoor wet-bulb temperature and different ambient

During startup, the unit usually ramps up to a higher than normal compressor speed for that condition, leading to a relatively high outdoor unit power consumption for the first 30 minutes of operation. At the end of this initial startup period, the capacity shown in Figure 9 shows an expected trend: the higher the ambient, the lower the capacity. However, then the maximum compressor speed is reduced and the EEV controller adjusts the valve opening to maintain a discharge temperature from the compressor around 74°C. The lower the ambient temperature, the more that the EEV needs to close in order to maintain the discharge temperature setpoint. Throttling the refrigerant flow to maintain a relatively high compressor discharge temperature results in a significant capacity penalty at lower ambient temperatures. It is reasonable since low ambients require less capacity. However, it creates a trend that is quite different from systems which employ expansion valves controlling the superheat exiting the evaporator rather than the compressor discharge temperature.

In addition to the maximum heating or cooling capacity and associated power consumption, it is necessary to model the power consumption for a specified heating or cooling load requirement to provide a useful model for building simulation programs. The power consumption is a function of airflow and the required building load according the equation (13) to ensure that W_{total} equals to the sum of W_{max} and $W_{in}(V_h)$ when the building load equals to the capacity and V equals to V_h.

$$\frac{W_{total}}{W_{max}+W_{in}(V_h)} = d_1\left(\frac{Q}{Q_{max}} - 1\right) + d_2\left(\frac{V}{V_{max}} - \frac{V_h}{V_max}\right) + d_3\left(\frac{Q}{Q_{max}} - 1\right)^2 + d_4\left(\frac{V}{V_max} - \frac{V_h}{V_max}\right)^2 + d_5\left(\frac{Q}{Q_{max}} - 1\right)\left(\frac{V}{V_{max}} - \frac{V_h}{V_max}\right) + 1 \quad (13)$$

where

d_i is the ith empirical coefficient in equation (13)
W_{total} is the power consumption of the unit
Q is the required building load
V_{max} is the highest airflow of the unit
V_h is the highest airflow for the given operation mode which may be different from V_{max}

Some of the coefficients in the equation (13) are eliminated based on the aforementioned backward elimination. The coefficients of the final equation, together with the coefficient of determination, are listed in Table 8. Other relevant diagrams can be found in the appendix.

Table 8 Coefficients in (13) and the coefficient of determination for different units in both cooling and heating

Model	Fujitsu 12RLS		Mitsubishi FE12NA	
Mode	Heating	Cooling	Heating	Cooling
d_1	1.6684	1.9918	1.1792	1.6580
d_2	0	0	0	0
d_3	0.5166	1.1113	0	0
d_4	0.6393	-0.1264	1.5487	0
d_5	0	0	-1.1758	1.2331
r^2	0.9948	0.9966	0.9835	0.9907

To use the model for cooling, cautions are needed for T_{in} in Q_{max} and W_{max} when the evaporator is dry. For modeling dry cooling, a hypothetical wet-bulb temperature that would result in a SHR of one according to the SHR model is needed. The hypothetical wet bulb temperature is used within the Q_{max} and W_{max} equations. A flow chart for the overall model is given in the appendix.

Table 9 to Table 11 provide limits on the operating range for the models based on the range of testing along with the safety and auto-shutdown conditions for the units.

Table 9 Applicable range of temperatures and important parameters for modeling

Model	Mode	Temperature	Minimum	Maximum
Fujitsu 12RLS	Heating	Indoor dry-bulb temperature [°C]	15.6	24
		Outdoor dry-bulb temperature [°C]	-14	17
Fujitsu 12RLS	Cooling	Indoor wet-bulb temperature [°C]	19	22.09
		Outdoor dry-bulb temperature [°C]	19	43.33
Mitsubishi FE12NA	Heating	Indoor dry-bulb temperature [°C]	13.82	23.53
		Outdoor dry-bulb temperature [°C]	-16.23	15.98
Mitsubishi FE12NA	Cooling	Indoor wet-bulb temperature [°C]	11.47	23.25
		Outdoor dry-bulb temperature [°C]	21.66	35.3

Table 10 Values for V_h and V_{max} in (13) for different models

Model	Mode	Airflow	Value
Fujitsu 12RLS	Heating	V_h [m3/s]	0.1975
		V_{max} [m3/s]	0.2138
Fujitsu 12RLS	Cooling	V_h [m3/s]	0.2131
		V_{max} [m3/s]	0.2138
Mitsubishi FE12NA	Heating	V_h [m3/s]	0.1585
		V_{max} [m3/s]	0.16
Mitsubishi FE12NA	Cooling	V_h [m3/s]	0.1599
		V_{max} [m3/s]	0.16

Table 11 Applicable range of Q/Qmax and V/Vmax for different models

Model	Mode	V/Vmax	Q/Qmax
Fujitsu 12RLS	Heating	0.9236	0.79 - 1.05
		0.7662	0.31 - 0.91
		0.5564	0.22 - 0.72
Fujitsu 12RLS	Cooling	0.9968	0.77 - 1.00
		0.8182	0.34 - 0.71
		0.5997	0.35 - 0.62
Mitsubishi FE12NA	Heating	0.9906	0.19 - 1.00
		0.6795	0.36 - 0.89
		0.4447	0.36 - 0.87
Mitsubishi FE12NA	Cooling	0.9994	0.64 - 1.00
		0.5867	0.25 - 0.84
		0.4267	0.21 - 0.50

July 14, 2011
REPORT #E11-224

Northwest Ductless Heat Pump Pilot Project

MARKET PROGRESS EVALUATION REPORT #2

Prepared by:
Research Into Action, Inc.
PO Box 12312
Portland, OR 97212

Northwest Energy Efficiency Alliance
PHONE
503-688-5400
FAX
503-688-5447
EMAIL
email@neea.org

Northwest Energy Efficiency Alliance

research/into/action inc

Final Report

Northwest Ductless Heat Pump Pilot Project MPER #2

Funded By:

neea

Prepared By:

research/into/action inc

Marjorie McRae, Ph.D.
Ned Harris
April Armstrong
Research Into Action, Inc.

March 28, 2010

ACKNOWLEDGEMENTS

The market progress evaluation team would like to thank Anu Teja, Northwest Energy Efficiency Alliance (NEEA) evaluation manager, for providing support and direction to this research, as well as Poppy Storm of Ecotope, Inc., the prime contractor for the pilot evaluation. We thank NEEA's Jeff Harris, Stephanie Fleming, and Alexis Allan for their interest in this research and willingness to be interviewed. We appreciate the implementation contractor staff of Fluid Market Strategies (special thanks to Selena Bell Heise and Erica Thompson) and Smashing Ideas (special thanks to Ben Yenter) for providing their time and the time of their staffs to answer our many questions, provide us with extensive program documents, and help us contact program participants. Finally, we are grateful to the many participant consumers, installers, manufacturer contacts, and utility program managers who participated in this research study through responding to in-depth telephone interviews and surveys.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS I

TABLE OF CONTENTS I

EXECUTIVE SUMMARY I

KEY EVALUATION FINDINGS PERTINENT TO PROJECT OBJECTIVES **ERROR! BOOKMARK NOT DEFINED.**

CONCLUSIONS AND RECOMMENDATIONS II

1. INTRODUCTION 1

DHP PILOT THEORY AND LOGIC 3

2. EVALUATION ACTIVITIES 7

3. MARKET CHARACTERIZATION 9

TARGET MARKET DESCRIPTION 9

SUPPLY SIDE CHARACTERISTICS 10

4. FINDINGS FROM IN-DEPTH INTERVIEWS 11

NORTHWEST DUCTLESS HEAT PUMP PILOT PROJECT ACHIEVEMENTS 11

Manufacturer Engagement 11

Retail Channel 13

Building an Installer Infrastructure 13

Increased Consumer Awareness 14

LESSONS LEARNED BY PILOT STAKEHOLDERS 15

Engaging Manufacturers 15

Engaging Installers 16

Engaging Utilities 17

BARRIERS AND OPPORTUNITIES IN MARKET SEGMENTS NOT TARGETED BY THE PILOT 17

New Construction 17

Remodels/Conversions 18

Manufactured Homes 19

Homes with Electric Forced Air Furnaces 19

Multifamily Dwellings 20

Small Commercial Buildings 20

5. PARTICIPATING CONSUMERS 23

DHP USAGE 23

Other Heating Equipment 24

Coverage of the Home 26

Temperature and Comfort 27

Settings 28

Maintenance 29

PARTICIPANT ENERGY ACTIONS AND EQUIPMENT PURCHASES 29

SATISFACTION WITH THE DHP 30

6. NONPARTICIPATING INSTALLERS 33

RECOMMENDING DHPS TO CUSTOMERS 33

BARRIERS TO INSTALLATION 34

SATISFACTION 34

PROJECT ORIENTATION AND MANUFACTURER TRAINING 34

SUGGESTIONS FROM NONPARTICIPATING INSTALLERS 34

7. FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS 35

SUMMARY OF FINDINGS 35

CONCLUSIONS AND RECOMMENDATIONS 39

APPENDICES 1

APPENDIX A: PILOT PARTICIPANTS – SURVEY METHODOLOGY AND FINDINGS 1

APPENDIX B: NONPARTICIPATING INSTALLERS 1

APPENDIX C: WAVE 2 INTERVIEW GUIDES 1

APPENDIX A: PILOT PARTICIPANTS – SURVEY METHODOLOGY AND FINDINGS A-1

DHP CONSUMER SURVEY, 2010 SURVEY EFFORT (WAVE TWO) A-1

Introduction and Other Participation A-1

DHP Experience A-3

Expectations and Satisfaction A-11

APPENDIX B: NONPARTICIPATING INSTALLERS B-1

NONPARTICIPANT SUGGESTIONS B-1

NONPARTICIPATING INSTALLERS SURVEY - WAVE TWO B-2

Installer Background B-2

Prior Experience B-3

Installer Orientation B-5

Installer Support B-5

APPENDIX C: WAVE 2 INTERVIEW GUIDES C-1

MANUFACTURER/DISTRIBUTOR INTERVIEW GUIDE - WAVE TWO C-1
- NW Ductless Heat Pump Project Impressions C-1
- Interaction C-1
- DHP Sales C-2
- DHP Marketing C-3
- Pricing C-3
- Technology C-4
- Future Projections C-4
- Moving Forward C-4
- General C-5

UTILITY INTERVIEW GUIDE - WAVE TWO C-6
- NW Ductless Heat Pump Project Impressions C-6
- Interaction C-6
- DHP Installations C-7
- Marketing C-8
- Future Projections C-9
- General C-10

NEEA PROJECT STAFF INTERVIEW GUIDE (NEEA AND FLUID) - WAVE TWO C-11
- Project Management C-11
- Marketing C-12
- Interactions C-13
- General Comments C-14

ES EXECUTIVE SUMMARY

This document constitutes the second market progress evaluation report (MPER) of the Northwest Energy Efficiency Alliance's (NEEA) Northwest Ductless Heat Pump Pilot Project, which ran from October 2008 to December 2009. This MPER reports on the pilot project's accomplishments and is part of comprehensive research underway on DHP technical performance and market acceptance. Since the conclusion of pilot project, NEEA has undertaken a region-wide market transformation initiative for ductless heat pumps. The first MPER for that initiative is expected in Q4 of 2011.

This report concludes that the pilot solidified early-period achievements with continued progress through 2009 and into 2010. Quality assurance efforts and continuing contractor education as the project progressed appears to have addressed many of the problems identified with some of the early DHP installations.

Key findings of this report, by market actor, include:

Manufacturers: Manufacturer contacts frequently cited the activities of the pilot project as a primary driver of growth in the residential DHP market and reported they view the Northwest as an important market for DHPs. One contact reported that Oregon and Washington ranked 8th and 9th respectively in 2010 national data in terms of the total number of DHP units sold, as compared with rankings of 19th and 20th in 2008. Manufacturers also reported that the availability of DHPs had increased in the Northwest, including the most up-to-date cold-temperature products, which manufacturers had previously offered almost exclusively in Scandinavia.

Installers: To further develop the installer infrastructure and thereby sustain and accelerate growth in the market, project staff reported development of a *Master Installer Program* to increase the degree to which installers understand and promote DHPs to displace zonal electric heat equipment.

Utilities: Eighty-six utilities offered DHP programs and 76 utilities had at least one installed DHP. Multiple utility contacts reported that despite reduced DHP marketing efforts in 2010, consumer demand for DHPs continued to grow. Most of the utility contacts attributed the increased consumer demand for DHPs to substantial word-of-mouth advertising resulting from the high level of consumer satisfaction with DHPs.

Installations: In 2010, DHP installations meeting parameters outlined by the pilot project continued at the same pace as they had during the pilot implementation period. As of November 15, 2010, 7,116 DHP installations met parameters outlined by the pilot project.

CONCLUSIONS

We conclude that the NEEA Northwest Ductless Heat Pump Pilot Project has been a success in terms of market acceptance and progress. (The pilot's technical evaluation has yet to conclude.) By directly intervening with market actors, the pilot appears to be effective in strengthening DHP marketing, training, and distribution networks, and in increasing consumer awareness of DHPs. By offering an incentive on DHP installations, utilities overcame many participants' first-cost hurdle for DHP installation.

- ➡ ***Conclusion 1:* The project has been very successful creating consumer interest in and demand for the previously unknown technology.** The pilot attained exceeded its 2009 installation goals by 55% and as of November 15, 2010, 7,116 DHP installations met parameters outlined by the pilot project.

- ➡ ***Conclusion 2:* NEEA is attaining its goals and objectives for the Northwest Ductless Heat Pump Pilot Project.** It has offset electric energy use through an approach of "displace, not replace" existing electric heating equipment. Through work with manufacturers and stimulating demand for DHPs, the pilot has greatly expanded the regional DHP supply, placing Oregon and Washington 8th and 9th in sales nationally, up from 19th and 20th. Through installer training and program quality control activities, the pilot has developed a competent installer workforce, as evidenced by a significant drop in poor DHP installations over the pilot period. The pilot has encouraged DHP sales through all its activities, resulting in continuing DHP installations in 2010 in spite of reduced utility marketing.

- ➡ ***Conclusion 3:* Many supply-side actors evidence some lack of understanding of, or appreciation for, the intended DHP target market and role of displacement theory.** Supply-side actors expressed interest in fully heating the home through DHPs, rather than displacing electric resistance heat.

- ➡ ***Conclusion 4:* Although the project has effectively engaged DHP manufacturers and distributors, their objectives are not fully in line with those of the project**. Manufacturers and distributors appear to have rushed right past the concept that the Northwest single-family electric-resistance-heat market is large (estimated at one-half to one-and-one-half million homes) and barely tapped; instead of this market, manufacturers and distributors expressed most enthusiasm for the high-end markets of custom homes, multi-headed DHPs, and multiple DHPs per home.

- ➡ ***Conclusion 5:* Rural nonparticipating installers indicated difficulty getting attention from distributors who are more interested in working with installers the contacts characterized as installing higher volumes of systems and the more profitable multi-zone systems**. Rural nonparticipating installers most commonly serve modest homes, fully within the DHP target market but outside the high-end market of most apparent interest to the manufacturers and distributors.

RECOMMENDATIONS

- ***Recommendation 1:*** **NEEA should further capitalize on the word-of-mouth advertising success by developing and disseminating to installers and in media campaigns customer case studies.**
- ***Recommendation 2:*** **NEEA should continue to support the region by working with supply-side actors (manufacturers, distributors, and installers) to increase the availability of DHPs and the quantity and quality of DHP installations.**
- ***Recommendation 3:*** **NEEA should develop marketing materials targeted to distributors and installers that demonstrate the capabilities of DHPs through case studies and facts, as well as developing marketing materials appropriate for consumers. In addition, marketing to supply-side actors should convey the potential market size for single-zone units, to counter perceptions that this market continues to be less attractive than other DHP markets.**
- ***Recommendation 4:*** **NEEA and the region should consider making units with multiple air handlers ineligible for incentives or, at a minimum, ensure no incremental incentive for such units.**
- ***Recommendation 5:*** **NEEA should investigate ways to effectively motivate distributors to actively promote single-head DHPs in smaller markets and should ensure smaller contractors in rural areas have access training.**

1 INTRODUCTION

The Northwest Energy Efficiency Alliance (NEEA) is a non-profit corporation supported by electric utilities, public benefits administrators, state governments, public interest groups, and energy efficiency industry representatives that operate in the states of Idaho, Montana, Oregon, and Washington. These entities work together to make affordable, energy-efficient products and services available in the marketplace.[1]

NEEA hired the team of Ecotope, Inc., supported by Research Into Action, Inc., to evaluate the Northwest Ductless Heat Pump Pilot Project. The pilot project ran from October 2008 to December 2009. The DHP Pilot Project sought to displace zonal electric heating equipment, such as baseboards, with DHPs, so that the DHPs serve as the homes' primary heating equipment and the original equipment is kept in place to provide supplemental heat. The DHP Program, which succeeded the pilot project in 2010, continues to address this goal.

Research on ductless heat pump (DHP) technical performance – conducted by Ecotope – and market acceptance among participants – conducted by Research Into Action and reported in part in this document – is being conducted through 2012. NEEA, Fluid Market Strategies (the implementation contractor), and utilities in the region continued in 2010 to support DHPs through customer incentives, installation tracking and quality assurance activities, contractor training, and interactions with manufacturers; thus, DHP installations and market development have continued subsequent to the pilot period.

This market progress evaluation report (MPER), prepared by Research Into Action, outlines the pilot project accomplishments, both during and one year after the pilot implementation period, and constitutes a second-year MPER. The research described herein comprises just a portion of the numerous research activities to assess the value of the technology to the region.

The first-year MPER reported on participants' reasons for installing a DHP, satisfaction with the DHP and program processes, use of heating and cooling equipment prior to installation of the DHP, and intended use of the DHP. It also reported on: the activities of manufacturers in support of the pilot; DHP installers' experiences with the pilot and the technology; and activities and experiences of utilities participating in the pilot, as well as those of the NEEA and program implementation staffs.

This second-year MPER reports on participants' use of DHPs over the prior year, use of other heating and cooling equipment, and their longer-term satisfaction with the DHP. It reports on the evolving experiences and perspectives of manufacturers, utilities, and NEEA, as well as those of

[1] See the website at *www.neea.org*.

program implementation staff and their opinions about the suitability of DHPs as an efficiency measure in markets other than those targeted by the pilot. The MPER also explores responses to the technology and pilot, and intentions to install DHPs among nonparticipating installers.

Historically, DHP manufacturers perceived the United States as constituting a limited market for sales of residential DHPs. However, due to recent technology improvements, manufacturers have introduced variable-speed ductless heat pumps (DHPs) with advanced individual controls to the U.S. market. A number of major manufacturers offer this equipment, both in the U.S. and worldwide; in the U.S., the technology's use has been in limited applications with a small overall market niche.

Given manufacturers' reported efficiency values, this technology appears to be a promising energy efficiency measure to displace the use of electric heat in the Northwest.[2] NEEA is leading a regional project intended to implement, demonstrate, and evaluate energy savings and market acceptance of this new generation of DHPs. The focus of this pilot project is to understand the impact of the technology when applied as a retrofit in single-family residences.

For the retrofit, existing electric resistance heating equipment remains in place for the occupant to use as needed. The DHP serves the main living areas of the home and displaces the need for heat from the existing electric heat source. The contractor does not remove the existing heating equipment, which the participating consumer (participant) might continue to use in addition to the DHP, particularly during periods of colder weather.

The pilot includes marketing and implementation activities to coordinate installations of DHPs with Northwest utility programs that provide residential incentives. The primary goals of the pilot project are to:

- **Demonstrate the effectiveness of inverter-driven ductless heat pumps to displace electric heat in existing Northwest homes;**
- **Support evaluation efforts to document project implementation, and to determine the costs and potential energy savings of DHPs in this application;**
- **Examine other non-energy benefits and potential barriers to large-scale implementation of DHPs through the market research elements of the evaluation; and,**
- **Define the future of the DHP market, and build an infrastructure to sustain and accelerate its growth**.

---

2 A pilot-provided comparison of the cost of heat in the Northwest suggests that DHPs offer heat more efficiently and at a lower delivered-cost than any other available heating technology.

3 NAHB Research Center. 2008. *Ductless Heat Pump Market Research and Analysis.* Report #08-190.

The *Project Implementation Document* specifies several objectives related to these goals, including to:

- **Engage the ductless heat pump industry (manufacturers, distributors, and contractors) and create cooperative relationships and leverage resources to support the project;**
- **Accomplish up to 2,500 quality installations of inverter-driven ductless heat pumps in existing homes with electric resistance space heat in the Northwest;**
- **Understand customer satisfaction and develop recommendations for future program implementation strategies;**
- **Address potential first-cost barriers associated with ductless heat pumps;**
- **Ensure HVAC contractors are trained in the technical nuances of installing ductless heat pumps correctly and install accordingly;**
- **Provide HVAC contractors with an understanding of the basis of the project, the applications, and what is in it for them (new market and increased profits);**
- **Ensure ductless heat pump products installed through the project are among the best available and are well supported by the distribution channel in the Northwest; and**
- **Pave the way for future ductless heat pump programs by testing program designs and marketing messages.**

The Bonneville Power Administration (BPA) agreed to sponsor the installation of DHPs in 1,500 homes across the region by December 2009. Parallel efforts by other regional utilities, who agreed to sponsor the installation of an additional 1,000 units during the same period, augmented BPA's commitment. In total, the project sought to install 2,500 DHP units between October 2008 and December 2009. The pilot exceeded this goal in early November 2009. By the pilot project's conclusion on December 31, 2009, it had installed 3,899 DHP units. As of November 15, 2010, 7,116 DHP installations met parameters outlined by the pilot project.

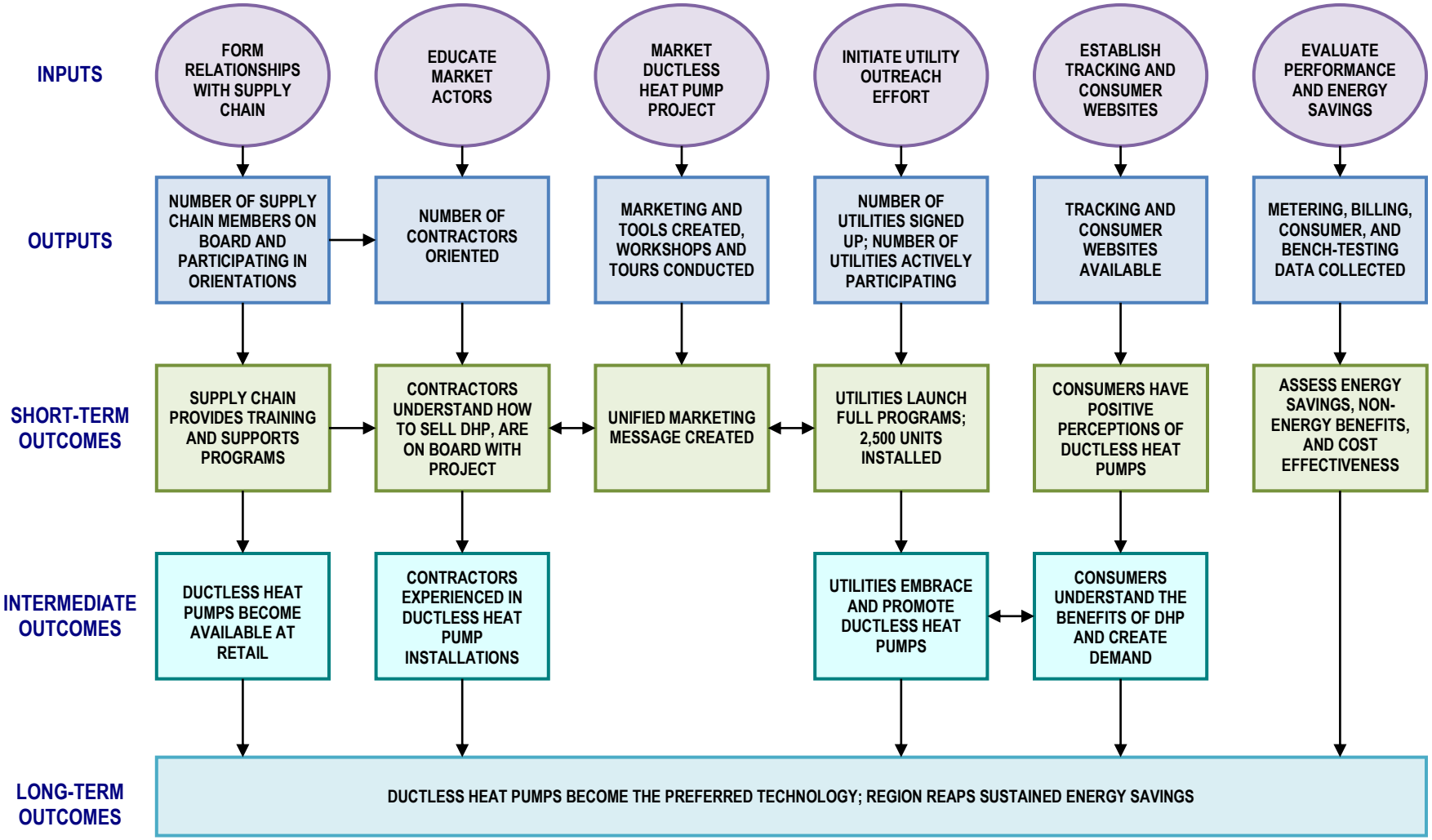
DHP PILOT THEORY AND LOGIC

Historically, DHP manufacturers' perception that the U.S. represents a limited market for sales of residential DHPs resulted in a lack of manufacturer marketing activities for DHPs and limited availability of DHPs through distributors. Consumer barriers to the uptake of DHPs included lack of familiarity with DHP technology, aesthetic concerns, and cost. Related to these factors, installers had minimal experience with DHP installation and limited access to training.

The pilot project theory (see Figure 1.1) posits that by directly intervening with market actors, DHP marketing, training, and distribution networks would strengthen and consumer awareness

of DHPs would increase. The theory further assumed that by offering an economic stimulus on DHP installations, utilities across the region would overcome participants' first-cost hurdle for DHP installation, persuading them to participate in the project.

Figure 1.1: Logic Model for Northwest Ductless Heat Pump Pilot Project



2 EVALUATION ACTIVITIES

The DHP Pilot Project evaluation, led by Ecotope, addresses five primary objectives; thissecond-year MPER, prepared by Research Into Action, addresses two of those objectives:

- Assess both market response from participants in the pilot project and general market conditions in response from suppliers, distributors, and installers as the program and marketing are developed; and
- Develop a process evaluation of the program as delivered and review alternatives as required for a larger-scale implementation of the DHP program.

Table 2.1 illustrates the Wave 1 (first year) and Wave 2 (second year) MPER activities. In both waves of research, we interviewed program stakeholders (including NEEA program staff, implementation contractor staff, and utility and energy agency stakeholders), manufacturer contacts, and installers. With few exceptions (described in Table 2.2), we interviewed the same contacts during both Wave 1 and Wave 2 interviews.

Table 2.1: MPER Activities

ACTIVITIES		WAVE 1 2009	WAVE 2 2010
Interviews and Surveys	NEEA Staff	X	X
	Implementation Contractor Staff	X	X
	Manufacturers / Distributors	X	X
	Utility Project Managers	X	X
	Participating Installers	X	
	Nonparticipating Installers		X
	Participating DHP Consumers	X	X
Document Review	Logic Model	X	X
	Project Tracking Data	X	X
	NAHB Research Center, *Ductless Heat Pump Market Research and Analysis*, June 2008	X	X

Table 2.2 presents our Wave 2 sampling plan for pilot DHP consumers; the numbers we surveyed in Wave 2 meet or exceed 90/10 confidence/precision for the first three groups. We contacted Wave 2 participant respondents roughly one year after the initial Wave 1 interviews (between August and October 2010). We called the sampled participants up to five times to reduce the likelihood of convenience sampling bias.

Table 2.2: Participating DHP Consumer Sampling Groups

SAMPLING GROUP	NUMBER SURVEYED IN WAVE 1	NUMBER REPEATED IN WAVE 2	NEW CONTACTS	WAVE 2 QUOTA	NUMBER SURVEYED IN WAVE 2
1: Western Oregon and Clark County	92	65	0	65	65
2: Western Washington	60	60	4	64	75
3: Eastern Washington & Most of Idaho	54	54	3	57	57
4a: Montana	13	13	0	13	13
4b: Other – Idaho Cooling Zone 1, Oregon CZ 1 & 3	19	13	0	13	14
TOTAL	**238**	**192***	**7**	**199**	**223**

* Of this initial sample frame of 192 contacts surveyed in Wave 1, 7 did not yield a completed Wave 2 survey (they had moved or refused to participate a second time). We selected at random 7 new contacts to replace them.

Table 2.3 summarizes the data collection undertaken for the MPER. We conducted interviews with a subset (10 of the 20) manufacturer contacts (including DHP manufacturers, manufacturer representatives, and distributors) that we interviewed during Wave 1. During Wave 1 interviews, we surveyed contractors that installed DHPs through the pilot (participating installers). In contrast, during Wave 2 interviews, we surveyed contractors that NEEA oriented to the DHP Pilot Project, but who did not install any DHPs through the pilot (nonparticipating installers)

Table 2.3: Second-Year MPER Sampling Plan

GROUP	SAMPLE SIZE	POPULATION	CONFIDENCE/ PRECISION
Participants	223	3,899	Exceeds 90/10 for consumer sampling groups 1, 2, and 3
Manufacturer Contacts*	10	80	Exceeds 80/20
Participating Installation Contractors	N/A	N/A	N/A
Nonparticipating Installation Contractors	15	304	Exceeds 85/15
NEEA Project Staff	3	3	Census
Implementation Contractor Staff	3	3	All key staff
Utility, Energy Agency Project Staff	20	20	Approaches 90/15

* Population and contact information provided by NEEA pilot project manager. During Wave 1, contacts represented all six DHP brands in list provided by NEEA: Comfort Star, Daikin, Fujitsu, LG, Mitsubishi, and Sanyo. During Wave 2, contacts represented only those brands that had 10 or more installations through the pilot project (Daikin, Fujitsu, LG, Mitsubishi, and Sanyo). In 2010, consumers installed five additional brands of DHPs (Amcor, Comfort Aire, Samsung, and Toshiba-Carrier).

Appendix A provides the DHP participant survey; Appendix C provides the remaining data collection instruments.

3 MARKET CHARACTERIZATION

TARGET MARKET DESCRIPTION

The primary target market for the pilot project consists of single-family, site-built homes using electric resistance zonal heating systems as the primary source of heat. NEEA program staff estimate there are approximately 534,842 homes in the Northwest in the target market. The secondary target market for the pilot project includes single-family, site-built homes using central forced-air electric furnaces (593,341) and manufactured homes using central forced-air electric systems (385,310). Altogether, NEEA program staff estimate there are approximately 1.5 million single-family homes eligible for the pilot project. Note that the energy savings from and cost-effectiveness of DHPs is being established through the pilot research and was not known at the launch of the pilot; the research team anticipates a lower cost-effectiveness of DHPs in residences with forced-air furnaces.

Prior research reported that as of 2008, DHPs represented only 1% of the $15 billion U.S. commercial and residential market for HVAC equipment and found that only 5% of the American public was aware of the existence of DHPs.[3] The source does not provide residential saturations. However, installer respondents who had installed DHPs prior to the pilot had installed twice as many commercial units as residential units.

The pilot project sought to identify barriers to market acceptance of residential DHPs and to explore methods to overcome those barriers. Pilot staff reported that prior to the project, consumer barriers to uptake of DHPs included lack of familiarity with DHP technology, aesthetic concerns, and cost; additionally, distribution networks for residential DHPs were weak.

To address these issues – and roughly coincident with the efficiency improvements in DHP technology undertaken by the manufacturers – program stakeholders engaged utilities, manufacturers, distributors, and installers in a cooperative relationship to leverage their resources in support of the project. These relationships were vital for building awareness about the project. By offering an incentive for DHP installations, utilities across the region sought to motivate their customers to participate.

In addition to evaluating market barriers and progress in the primary and secondary markets targeted by the pilot project, Wave 2 research further explores the potential for application of DHPs into additional submarkets, including residential new construction, residential remodels

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[3] NAHB Research Center. 2008. *Ductless Heat Pump Market Research and Analysis*. Report #08-190. Portland, Ore.: Northwest Energy Efficiency Alliance. p. 7. See: *http://www.nwductless.com/images/pdf/neea%20dhp%20analysis.pdf.*

and conversions, manufactured homes, homes with forced air furnaces, multifamily dwellings, and small commercial applications.

SUPPLY SIDE CHARACTERISTICS

Five brands comprised the majority of DHP installations conducted through the project: Daikin, Fujitsu, LG, Mitsubishi, and Sanyo (each of the five were associated with over 400 project-qualifying DHP installations). Although the evaluation team was unable to locate definitive data on market share, contacts (both those related to the pilot effort and interviewed manufacturers) suggest these five manufacturers dominate ductless heat pump sales in the U.S.[4] Amcor, Comfort Aire, Samsung, and Toshiba-Carrier brand DHPs were also installed through the project, but each of the brands received 10 or fewer qualifying installations.

All of the installers interviewed in Wave 1 (30 participating installers) and Wave 2 (15 nonparticipating installers) reported that they provide heating and cooling equipment sales, installation, repair, and maintenance. The majority (26 of the 30 in Wave 1) also sell water heaters.

The majority of both participating (86%) and nonparticipating (87%) installers reported having completed at least one DHP installation (either residential or commercial) prior to the pilot. However, consistent with prior research indicating low market penetration of DHPs, over half of both groups of installers reported ten or fewer pre-pilot DHP installations of any type. Only four installers – all participants – had extensive DHP experience (more than 100 pre-pilot installations, largely commercial). Also consistent with prior research indicating particularly low penetration of residential DHPs, installer respondents reported that the majority of their pre-pilot DHP installations (473 of 800 units, or 60%) had occurred in commercial applications.[5]

Prior research indicates that a large majority of pre-pilot residential DHPs provided heating or cooling to a space that previously had no heating/cooling, as opposed to displacing existing zonal heat.[6] Somewhat in contrast with these earlier findings, responses from installer respondents indicate that approximately half (46%) of their pre-pilot residential DHP installations were put in to displace existing zonal heat and about half (54%) were installed to provide heating or cooling to a previously unconditioned space. Altogether, installer respondents provided information suggesting that over 85% of their pre-pilot DHP installations occurred outside of the pilot's target market of residential electric heat displacement.

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4 During Wave 1 interviews, a contact for Mitsubishi estimated it supplies 50% of the DHP market; a Sanyo contact estimated Sanyo supplies 10% to 15% of sales in the West; a Daikin contact estimated Daikin was the third largest provider.

5 NAHB Research Center. 2008. *Ductless Heat Pump Market Research and Analysis*. Report #08-190. Portland, Ore.: Northwest Energy Efficiency Alliance. p. 14.

6 Op. Cit., pp. 22-24.

4 FINDINGS FROM IN-DEPTH INTERVIEWS

This chapter presents findings from in-depth interviews with NEEA staff, DHP Pilot Project implementation staff, contacts from utilities that participated in the pilot, and contacts at DHP manufacturers, manufacturer representatives, and distributors. Table 2.3 provides the sample sizes.

The chapter explores DHP Pilot Project achievements, including engagement with manufacturers, steps toward the development of a retail market, building an installer infrastructure, and increasing consumer awareness of and demand for DHPS. Among the purposes of the pilot was to learn how to engage with and stimulate the market, and we describe pilot achievements in this arena under the heading *Lessons Learned*. While the pilot addressed a specific target market – existing homes with zonal electric resistance heat – NEEA is also interested in the potential for DHPs in other markets. The chapter concludes with findings from the in-depth interviews related to market barriers and opportunities for DHPs in the submarkets of new construction, remodels, manufactured homes, homes with electric forced-air furnaces, multifamily dwellings, and small commercial buildings.

NORTHWEST DUCTLESS HEAT PUMP PILOT PROJECT ACHIEVEMENTS

Manufacturer Engagement

DHP manufacturers have historically thought of the U.S. as a limited market for residential DHP sales. The leading manufacturers of DHPs sold in the U.S. perceived them as a solution for problem zones, bonus rooms, or add-ons rather than whole-house heating and cooling systems. In addition, prior to recent technological innovations, the previous generation of DHPS did not provide heating below 40° F. Therefore, manufacturers did not promote DHPs as an energy efficiency measure or as an alternative to zonal electric heat.[7] Additionally, DHP availability through distributors was limited.

A primary goal of the pilot project is to displace the use of electric heat in the Northwest. Project staff contacts reported that despite manufacturers' initial hesitancy about *displacement theory*,[8] the manufacturers' involvement and interest in the pilot project increased over time. Notably,

[7] *Ductless Heat Pump Market Research and Analysis Market Research Report*, prepared by NAHB Research Center, June 2008.

[8] Displacement theory suggests consumers can maximize cost-effective energy savings by installing a single indoor unit in the main living area of the house (living/family room, dining room, or kitchen) to displace the use of electric resistance heat in the primary zone of a home.

contacts reported that at the time the pilot launched, there were three involved manufacturers, and that by late 2009, there were five.[9]

During 2009, representatives from each of the five participating DHP manufacturers adjusted marketing activities in response to the pilot project. The reported changes included advertising the pilot project and the available rebates, increasing the number of installer DHP trainings, and emphasizing the heating (as opposed to cooling) capabilities of DHPs to appeal to northern climates.[10] Table 4.1 summarizes some of the reported changes in marketing.

Table 4.1: Pre- and Post-Pilot DHP Marketing Activities Among Manufacturer Contacts

BRAND	PRE-PILOT MARKETING MESSAGE	CHANGES IN MARKETING RELATED TO PILOT
Mitsubishi	Manufacturers reported emphasis on energy efficiency, zonal control, and simple installation. Distributors reported emphasis on energy efficiency and environmental attributes.	Manufacturers reported increased emphasis on heating attributes of DHPs to appeal to pilot participants. Distributors reported working to increase contractor participation in the pilot.
Fujitsu	Manufacturers and manufacturer representatives reported emphasis on energy efficiency, energy savings, comfort, and environmental attributes.	Manufacturers reported increased advertisement. Distributors reported changing marketing messages to emphasize available rebates.
Daikin	Manufacturers reported emphasis on energy efficiency and environmental attributes.	Manufacturers and distributors reported increased marketing.
LG	Manufacturers focused on public recognition of the LG brand (90% brand recognition in the U.S.).	Distributors conducted direct mailings to potential pilot participants.
Sanyo	Sanyo's marketing slogan is: *Think Gaia*. Manufacturers reported, "The entire focus of Sanyo is green and Mother Earth."	Sanyo distributors reported increasing contractor DHP trainings.

Manufacturer contacts reported that their degree of involvement with the pilot project in 2010 has either remained at the same level or increased since 2009. Representatives from three of the five participating DHP manufacturers reported collaboration with utilities to provide cooperative marketing. Manufacturer contacts frequently cited the activities of the pilot project as a primary driver of growth in the residential DHP market and reported that they would like continued incentives for DHPs.

In addition, manufacturer contacts reported that they increasingly view the Northwest as an important market for DHPs. One of these contacts reported that Oregon and Washington ranked eighth and ninth respectively in 2010 national data in terms of the total number of DHP units

9 *Northwest Ductless Heat Pump Pilot Project First Market Progress Evaluation Report*

10 Op. cit.

sold, as compared with 2008 when they ranked nineteenth and twentieth respectively. Manufacturers also reported that the availability of DHPs had increased in the Northwest, including the most up-to-date cold-temperature products, which manufacturers had previously offered almost exclusively in Scandinavia

Retail Channel

Project staff reported that they intend to approach retailers such as Costco, Sears, Home Depot, and Lowes about retail sales of DHPs. Project staff aim to establish retail sales of DHPs as a milestone for 2011.

Project staff noted that the current distribution, marketing, and sales channels add cost and complexity to achieving the outcome of increased saturation of DHPs. Staff reported that retail sales of DHPs would help to reduce the cost of DHPs by leveraging retailers' economies of scale and avoiding the middle-man present in the current sales model. Project staff contacts also believe that the presence of DHPs in retail establishments would dramatically increase consumer awareness of DHPs, particularly among demographic groups that are currently unaware of this alternative. Staff members plan to approach independent hardware companies, as well as large retailers, about retail DHP sales in order to better reach consumers in rural areas.

Regarding their interest in initiating retail sales of DHPs, two manufacturer contacts declined to reveal their plans, referring the question to their corporate offices. The remaining three manufacturer contacts reported that their companies do not plan to expand into retail markets, at least in the near term. Regarding their reluctance to initiate retail sales of DHPs, the manufacturer contacts explained that professional installation is required because DHPs use refrigerant. According to one contact, "It's an applied product and when you put it in a retailer's hand, you run the risk of the product being misapplied and not installed properly."

Project staff reported that the potential for misapplication and improper installation of DHPs could be addressed by implementing a sales model similar to that which is currently applied to retail sales of water heaters. Retail water heater sales include the cost of installation through a network of professional installers.

Building an Installer Infrastructure

To address barriers to DHPs NEEA identified prior to launching the pilot, the DHP Pilot Project recruited DHP manufacturers and distributors to deliver technical trainings and pilot project orientations to contractors across the region, and in doing so, increased supply chain awareness of the displacement theory for DHP installation (that is, displacing the use of electric zonal heat rather than replacing the equipment). By the end of 2009, the Pilot Project had trained nearly 1,000 installers from more than 600 companies through nearly 50 in-person and 30 web-based installer orientations, and created a quality assurance process to ensure proper installations. Also by the end of 2009, 325 firms had completed at least one DHP installation through the pilot.

Quality Assurance

Responses from interviewed utilities in 2009 revealed problems with some of the early DHP installations, including line sets that when left uncovered resulted in ugly wiring outside the home and components exposed to ultraviolet (UV) ray damage. Quality assurance efforts and continuing contractor education as the project progressed appears to have addressed many of these issues. Utility contacts reported that, with very few exceptions, installers are providing quality DHP installations within their service territories.[11] Several of the utility contacts reported that DHP installation has improved over time. Representative responses from utility contacts regarding the quality of DHP installations included:

- *"We had some problems early on with the line sets – they didn't look good. That has improved; they've cleaned up their act."*
- *"When the program first started, it was a bit rough, but it has cleaned up since then."*
- *"On a one-to-ten scale, our customer ratings of contractors are typically all 10s."*

Project staff contacts reported that, because of an increase in the overall quality installations, the project has been able to reduce the proportion of quality assurance inspections and still observe a high proportion of high quality installations.

Additionally, multiple utility contacts reported reductions in the installed costs of DHPs within their service territories. The contacts attributed the price reductions to installers' increased level of comfort with DHP installation, the ability of installers to install DHPs in less time, and increased market competition among installers.

Master Installer Training

To further develop the installer infrastructure and thereby sustain and accelerate growth in the market, Project staff contacts reported that they are currently developing a *Master Installer Program*. Staff explained that the goal of the Master Installer Program is to increase the degree to which installers understand and promote displacement of zonal electric heat with DHPs by showcasing and rewarding installers who employ best practices in completing a large number of installations through the pilot project. Master Installers will receive priority listings on the web interface that helps consumers find installers (*goingductless.com*).

Increased Consumer Awareness

Multiple utility contacts spontaneously reported that despite reduced DHP marketing efforts in 2010, consumer demand for DHPs continued to grow. Most of the utility contacts attributed the

[11] Seventeen of twenty utility contacts provided valid responses.

increased consumer demand for DHPs to substantial word-of-mouth advertising resulting from the high level of consumer satisfaction with DHPs. Several contacts noted that word-of-mouth is particularly effective, because it often affords prospective customers opportunities to see and experience working DHP units.

Representative responses from utility contacts that noted a high degree of word-of-mouth advertising within their service territories included:

- *"We haven't done a whole lot of marketing; it's marketing itself."*
- *"The biggest difference is word-of-mouth is spreading, because we have enough DHPs out there now that people can talk about them."*
- *"When you get these installed in neighborhoods with similar homes, that's when it really starts to catch on. It's like someone throwing gasoline on a dry field."*

Additionally, eighteen out of the twenty interviewed utility contacts reported that DHPs constitute a viable market within their service territories and expect consumer demand to grow. These responses from utility contacts suggest the potential for self-sustaining DHP markets in the Northwest at the conclusion of incentive programs.

Market transformation is attained when an intervention brings about market change that persists or is sustained even after the intervention ends. The intervention of the DHP pilot suggests that market transformation might be achievable. Nonetheless, several utilities cautioned against changing the DHP incentive levels, particularly changing them before the impact of the expiring federal tax credit on DHP sales is understood.

LESSONS LEARNED BY PILOT STAKEHOLDERS

Engaging Manufacturers

Project staff reported that their increased emphasis in 2010 on affecting DHP manufacturers' regional and national marketing efforts has resulted in an increased understanding of how best to engage with the manufacturers. Staff reported that their efforts to affect manufacturers 2010 marketing messages during the second quarter of 2010 were "a little late to the table." Staff reported that, when attempting to affect marketing within a given fiscal year, it is necessary to engage the manufacturers during the fourth quarter of the prior fiscal year so that the manufacturers can incorporate the additional items into their budget for the upcoming year.

Additionally staff now understands that it is more effective to engage with employees at higher levels of the organizations, rather than with regional salespersons. According to one staff contact, "We are just now in the midst of talking to the decision-makers towards the top of manufacturing organizations."

Project staff noted some challenges concerning development of unified messaging with the manufacturers, which staff attributed to the goals of manufacturers not being in complete

alignment with those of the pilot project. For instance, although the pilot project promoted DHPs to displace zonal electric resistance heat, manufacturers are interested in marketing to "any and all" customers, including customers who currently heat their homes using nonelectric sources. Additionally, to support *cost-effective* displacement of electric resistance heat in the primary zone of homes, the pilot project primarily promotes ductless systems comprised of one compressor with a single indoor unit,[12] whereas manufacturers are frequently interested in promoting their top-selling multi-port DHP systems.[13]

Staff anticipate being able to engage manufacturers more aggressively once the DHP metering study is complete.[14] Staff explained that, assuming that the results of the metering study are positive, DHPs are likely to receive the "full blessing of the utility world," enabling staff to approach manufacturers more aggressively on the displacement theory, development of messaging that advertises the savings potential for displacement of electric resistance heat, and integration of DHPs into retail sales channels.

Engaging Installers

Despite positive reviews from utility contacts and project staff regarding the overall high quality of DHP installations, staff noted that there continues to be both satisfactory and unsatisfactory manufacturer trainings. Project staff reported the need to ensure that "all of the manufacturers are bringing high quality training to the region."

Additionally, one manufacturer contact questioned the pilot project's policy that qualifies an entire installation firm's staff to install DHPs through the pilot project once a single member of the firm has attended a project orientation session and manufacturer training. According to this contact, "Training one person at a contractor's office may not be enough; the information is not flowing from one person to the next."

Two utility contacts reported that the interface to locate eligible installers (*goingductless.com*) needs updating. The contacts reported that the webpages listing eligible installers includes installers that are either unaware that they are registered with the pilot project and/or use the opportunity to attempt to sell customers standard HVAC equipment.

To improve *goingductless.com*, project staff reported that they are currently developing an installer removal protocol that will initiate quarterly updates to the website, removing contractors

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12 Multi-zone ductless heat pump systems are allowed in the pilot project. However, the project incentive is per consumer/home and only one incentive payment (e.g., $1,500) will be made, regardless of how many indoor units are installed or how many zones are served.

13 Each of the manufacturer contacts reported that their multi-zone DHPs currently outsell one-to-one ductless systems.

14 The metering study is another facet of the umbrella research project that includes this MPER. It is anticipated that the metering study will be completed in the first half of 2012.

that have both not attended a project orientation within the preceding 12 months and have never completed a DHP installation through the pilot project. Staff further reported that despite their removal from *goingductless.com*, the contractors would continue to be eligible to complete installations through the pilot project. Additionally, staff initiated a mechanism to remove problematic installers from the project. Grounds for installer removal include multiple installation-related deviations (two major or four minor) and the support of all affected utilities.

Engaging Utilities

Project staff noted that there are currently 83 utilities in the region participating in the pilot project. Staff reported that positive results from the metering study would be likely to elicit increased participation among Northwest utilities.

Most interviewed utility contacts reported meeting or exceeding their utility's DHP installation goals. Utility contacts who reported having not met their DHP installation goals attributed the shortfall of installations either to climatic conditions within their service territory and/or a lack of marketing.

Utility contacts said that the most effective marketing approaches were contractor marketing, consumer word-of-mouth, utility bill inserts, and newspaper articles. Project staff suggested that newspaper ads were not effective.

Some of the participating utilities have changed their program requirements to allow participation by people with zonal electric resistance equipment who nonetheless use wood or propane as their primary source of heat. These utilities believe many of these customers will sooner or later move away from wood or propane due to cost and convenience. The utilities want these customers have DHPs and not increase their use of their electric resistance equipment.

BARRIERS AND OPPORTUNITIES IN MARKET SEGMENTS NOT TARGETED BY THE PILOT

This section provides a synthesis of our findings relating to the potential for DHPs in applications other than the displacement of electric resistance zonal heating equipment in existing single-family, site-built homes. Note that the region has yet to establish the energy savings potential and cost-effectiveness of the applications discussed in this section; BPA is currently investigating some of these applications.

New Construction

The pilot project's logic model identifies the installation of DHPs into high-profile model homes as a pilot project objective. Towards this end, project staff reported that each of the homes in the *2010 Clark County Parade of Homes* featured DHPs. Staff further noted, "We attribute much of the knowledge-base of contractors and builders to the efforts of the pilot project."

A utility contact noted that increasingly stringent energy codes have resulted in the construction of homes with minimal heat loss, making the newly constructed homes a good fit for DHPs.[15] The contact further reasoned that these homes are built so tight that most of the unitary equipment that is available is oversized for such homes. The contact advocated for the development of utility incentive programs for DHPs in new construction as a means to dramatically increase market adoption of DHPs among builders.

Within new construction, manufacturer contacts noted that in the custom home market, consumers are willing to spend more money to obtain a higher efficiency product, whereas, in the tract home market, consumers are typically *not* willing to spend more money. To address the cost hurdle among tract home customers, manufacturer contacts recommended coordinating with realtors to emphasize the energy cost savings potential of DHPs. Note that these views of manufacturers suggest they believe higher-cost houses constitute the main market for DHPs, which differs from the views of program stakeholders.

One manufacturer contact reported that in new construction, there is greater potential for multi-port DHP systems and ducted inverter than for one-to-one DHP systems. The contact added, "It is not always easy to convince architects and builders of the value of one-to-one DHP systems." The contact noted a trend in new construction towards building taller, multi-story homes with minimal square footage on each floor. According to the contact, such homes are not suitable applications for one-to-one DHP systems.

Remodels/Conversions

As noted, DHP manufacturers traditionally viewed remodels and conversions as the primary application for DHPs within the residential sector. Consistent with this perspective, manufacturer contacts unanimously reported that substantial opportunities exist within the Northwest residential remodel and conversion market.

One manufacturer contact noted that the economic downturn has, to some degree, increased remodel and conversion opportunities by extending the average length of home ownership, thus increasing homeowners' interest in improving their homes.

According to one manufacturer contact, the primary barrier within the remodel and conversion submarket is a lack of awareness among builders and HVAC contractors. The contact also noted that builders frequently partner with HVAC firms that install standard equipment because of their pre-existing relationships with the firms. The contact further noted, "You have to remember that our business is so relationship-based."

[15] Both Washington and Oregon residential building energy codes as currently proposed include a direct mention of the DHP as an alternative to meeting code requirements.

Manufactured Homes

Existing Manufactured Housing

Project staff reported that existing manufactured homes might present an excellent application for DHPs, because such homes are frequently equipped with electric forced air furnaces.[16] Additionally, one utility contact suggested there is substantial opportunity to displace the use of window AC units within the subsector. However, a manufacturer contact cautioned that the cost of DHPs might present a barrier to the existing manufactured homes market, noting that manufactured housing represents a price-sensitive residential submarket.

New Manufactured Housing

One DHP manufacturer contact noted that manufactured homes are typically single-story, have an open floor plan, and comprise three to four rooms. Therefore, according to the contact, "They are a perfect fit for ductless multi-zone systems."

However, two manufacturer contacts cited Housing and Urban Development (HUD) regulations as a barrier to proliferation of DHPs in new manufactured housing. According to the contact, "HUD requires that a source of heat be installed in new manufactured housing prior to shipment and you cannot install a ductless system and have it travel very well."

Homes with Electric Forced Air Furnaces

Multiple utility contacts indicated an interest in exploring opportunities for application of DHPs in site-built and manufactured homes with electric forced air furnaces. Project staff indicated a need for additional market research, as well as exploration of the technical potential of DHPs in the electric forced air furnace market. Staff suggested that market research should provide both estimates of the size of the Northwest forced air furnace market and identify effective marketing messages tailored to this segment. Staff suggested that technical research on DHP energy savings and cost-effectiveness should clarify the interactive effects of DHPs and forced air furnaces, both in applications where DHPs are being used as primary and as secondary sources of heat.[17]

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16 BPA utilities currently provide incentives for DHP installations in existing homes (manufactured, single-family, and multifamily) with zonal electric resistance heat. BPA, *Energy Efficiency Implementation Manual,* April 1, 2010.

17 "BPA discontinued reimbursement for DHPs in single-family homes with electric forced-air-furnaces effective April 1, 2010. BPA is currently working with NEEA to identify potential savings from DHPs in single family residences, manufactured homes, and multifamily applications with electric forced air furnaces." BPA'S *Energy Efficiency Implementation Manual,* page 75.

Multifamily Dwellings

Current Market

BPA utilities currently provide incentives for DHP installation in multifamily homes with zonal electric heat.[18] Utility contacts reported a small number of DHP installations in multifamily buildings, such as low-income housing and retirement homes.

Market Barriers and Opportunities

Several utility contacts noted substantial potential for the application of DHPs in the multifamily sector. According to project staff, the majority of both new and existing multifamily buildings are heated with zonal electric baseboard heat. Additionally, apartments within multifamily buildings are typically smaller than site-built homes and have an open floor plan, rendering them (in theory) ideal candidates for the application of DHPs.

However, project staff cited several barriers to market adoption of DHPs within the multifamily market. A key barrier is that adoption is hindered by the split incentive, because only the property owner will pay for heating equipment (and tenants are frequently barred from making significant upgrades), yet it is the renter who pays the utility bills. In addition, the low cost of zonal heat in multifamily units makes DHPs less cost-effective. On the other hand, apartments with cooling command a rent premium, which increases the cost effectiveness of the DHP.

Project staff indicated a need for additional research into the market and technical potential of the application of DHPs in multifamily buildings. Staff suggested that technical research should consider the cost-effectiveness of DHPs when applied to the multifamily market and resolve technical questions about DHP installation, including where to place outdoor DHP units for apartments that are located on the upper stories of buildings and how to integrate DHPs into older buildings with antiquated wiring and insufficiently sized service panels. Staff suggested that market research should identify effective marketing strategies for the multifamily market.

Small Commercial Buildings

Current Market

Project staff noted that the majority of pre-pilot installations of DHPs in the Northwest were installed in commercial buildings as a method to add cooling where ductwork was not cost-effective. This observation is consistent with our findings from interviews with participating contractors that we conducted for the first MPER. According to one manufacturer contact, uptake of DHPs in small commercial buildings is currently experiencing a growth phase because, "the cost of goods is one-half that of traditional type systems."

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[18] BPA'S *Energy Efficiency Implementation Manual.*

Market Barriers and Opportunities

Regarding market potential in the small commercial sector, project staff reported that there are a large number of small commercial buildings that are currently heated with electric resistance heat, primarily within BPA utility service territories. Staff cautioned that this number is "large in terms of numbers, but not in terms of load."

Manufacture contacts reported potential for DHPs in strip malls. According to the manufacturer contact, retail establishments frequently prefer high ceilings with no ductwork. The contact also noted that DHP installations in strip malls result in increased occupant comfort and (in some cases) reduced installation costs.

5 PARTICIPATING CONSUMERS

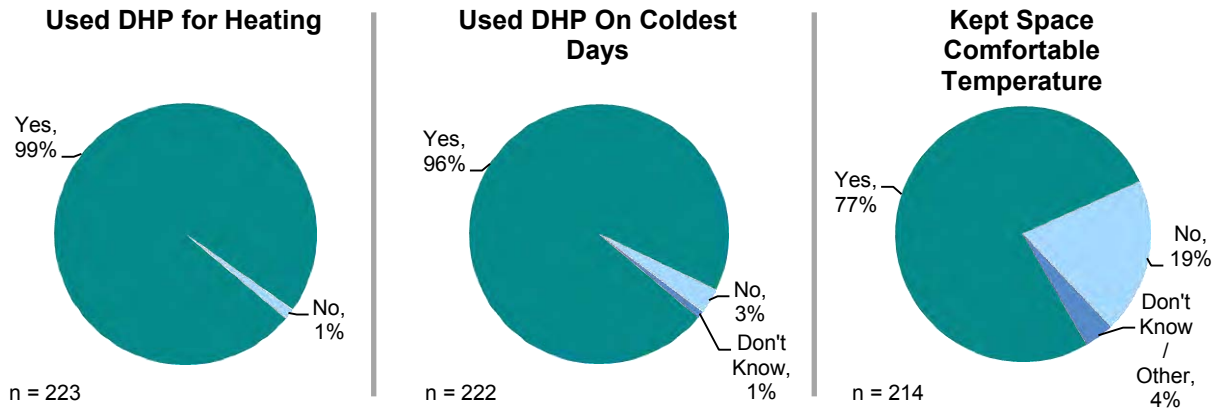
The evaluation team completed 223 surveys with participating DHP consumers between July 7, 2010, and September 15, 2010. The surveys lasted 20 to 30 minutes. The team placed up to five calls to each potential respondent in an attempt to complete surveys with the previous respondents from Wave 1 research. The survey design represented all cooling zones in the project service territory. We created four groups based on cooling zone and sampled for a 90/10 confidence and precision within each group, excluding Group 4 (Miscellaneous). Wave 2 data collection met or exceeded the quotas for all four groups. Table 2.2 in Chapter 2 provides the groups and the number of completes needed for each wave of data collection.

We used the Pearson χ^2 test to identify statistically significant differences across the four groups and between each group and the other three groups collectively. We found only two significant differences among groups; these findings are called out in our presentation of results.

DHP USAGE

Since installing the DHP, 99% of respondents had used it for heating (Figure 5.1) and 93% had used it for cooling (Figure 5.2). The majority (96%) of respondents reported having used the DHP on the coldest days of the year and slightly over three-quarters (77%) indicated that the DHP was able to keep their space at a comfortable temperature despite the cold. Respondents described the heat from the DHP as more "even, "consistent," and "efficient" than their previous heat.

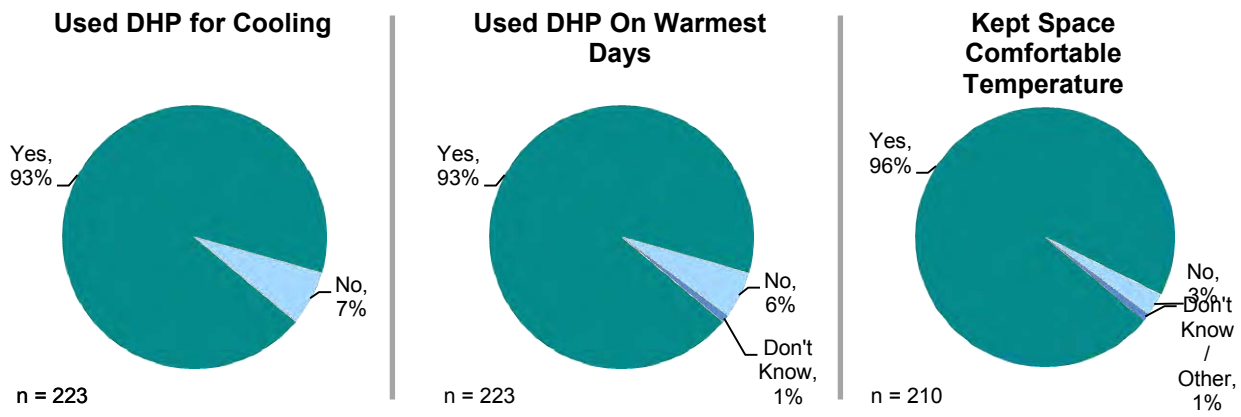
Figure 5.1: Use of DHP for Heating



Similar to heating, 208 (99%) of the respondents who had used the DHP for cooling used the DHP on the hottest days of the year, and 96% of those respondents found that the DHP was able

to keep their space at a comfortable temperature (Figure 5.2). Respondents who did not use the DHP for cooling reported that they either never need cooling (12 responses) or they do not use cooling to save energy (1 response).[19]

Figure 5.2: Use of DHP for Cooling



In Wave 1 surveys, which we conducted within a month or two of DHP installation, 99% respondents reported they intended the DHP to be their primary heating equipment. In Wave 2, 93% identified the DHP as their primary heating equipment. Of the 14 respondents who reported a primary heat source aside from the DHP, most indicated their actions stemmed from personal preference and not a dissatisfaction with the DHP performance: 6 indicated wood was their primary source, 2 indicated baseboards, and the remaining 5 respondents reported using ceiling heat, electric furnace, wall heaters, a ducted heat pump, or a gas fireplace.

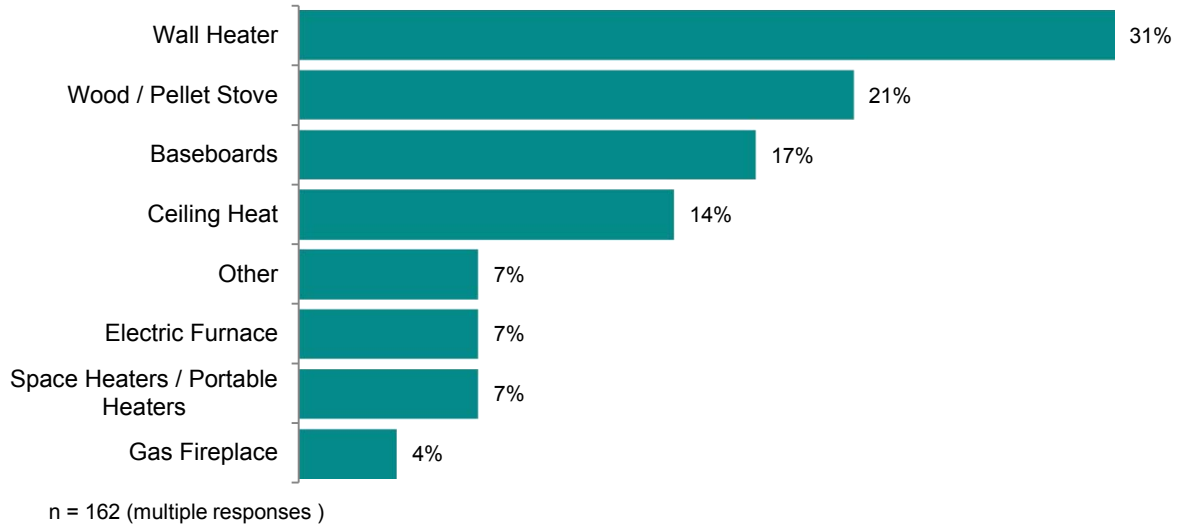
Other Heating Equipment

Just over one-quarter (27%) of respondents reported the DHP was the only equipment they had used for heating during the prior heating season. The remaining 73% (165) of respondents had used, in addition to their DHP, their existing heating equipment at least part of the year. Participants in Eastern Washington and Idaho (Group 3) were more likely than participants in other regions to report using additional heat; yet, even so, less than half (42%) reported using it more than rarely (compared to 28% for the other participants, χ^2 at $p<.05$).

Customers augmented their DHP heat by using the equipment they had prior to the DHP's installation: wall heaters (31%), followed by wood (21%), baseboards (17%), and miscellaneous other equipment (4%) (Figure 5.3).

[19] Two respondents could not provide a reason.

Figure 5.3: Heating Equipment Used in Addition to DHP



As shown in Figure 5.4, slightly over half (51%) of respondents who used backup heat did not use it in the same room as the DHP, although some respondents reported that the heat from their other sources may spill over into the room where the DHP is located. Of the 165 respondents who used backup heat, 60% reported using it rarely or almost never, 16% used it sometimes, and 12% used it often or always.[20] Respondents reported using these other types of heating equipment less than (89%) or the same amount (11% – 18 respondents or 8% of the total sample of 223) as they did before they got the DHP. Respondents who previously used wood universally reported using less wood, with some using wood only in emergencies or for ambiance on special occasions.

Nearly all (96%) of the respondents identified the DHP as their primarily cooling equipment. Only 10% (20 respondents) had used any other cooling equipment since installing the DHP. Of those 20, 11 used additional cooling equipment rarely or never (9 used it sometimes or often/always) and only 1 used it in the same room as the DHP (Figure 5.5). Participants in Group 4 were less likely than other participants to have used their DHPs for cooling, as might be anticipated given the location of Group 4 participants (78% compared with 95%, χ^2 at $p<.01$).

[20] The remaining 12% of respondents could not answer the question accurately because they were only in the home with the DHP part of the year, ran their backup heat for ambiance, or used their backup heat only for specific purposes such as showering.

Figure 5.4: Use of Additional Heating

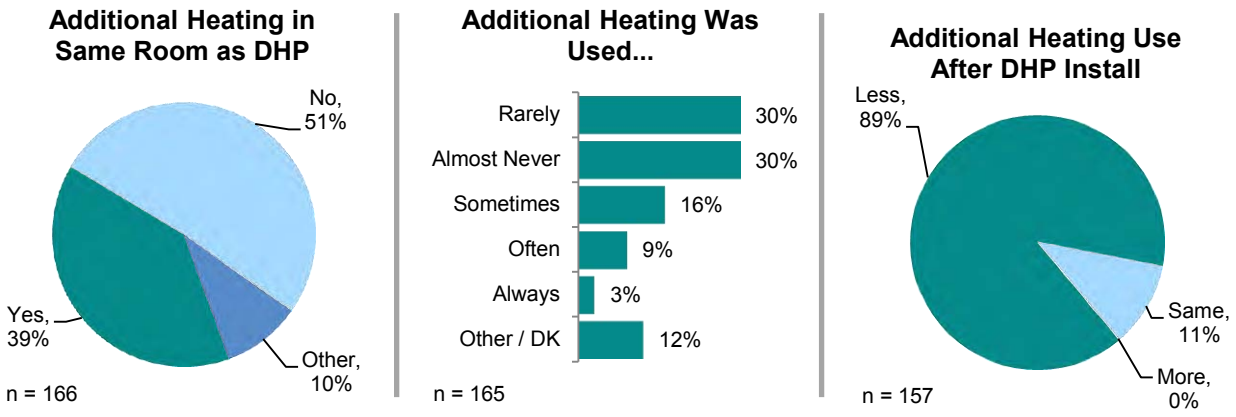
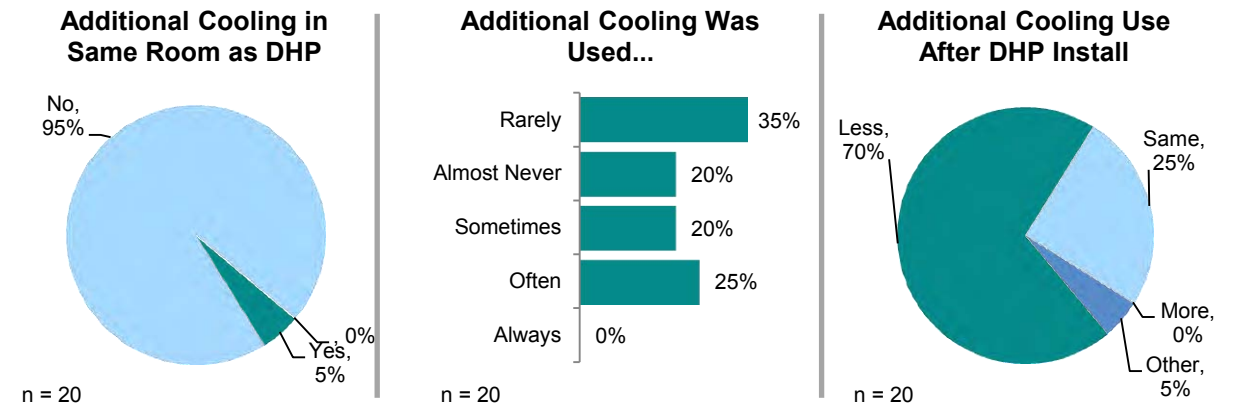


Figure 5.5: Use of Additional Cooling

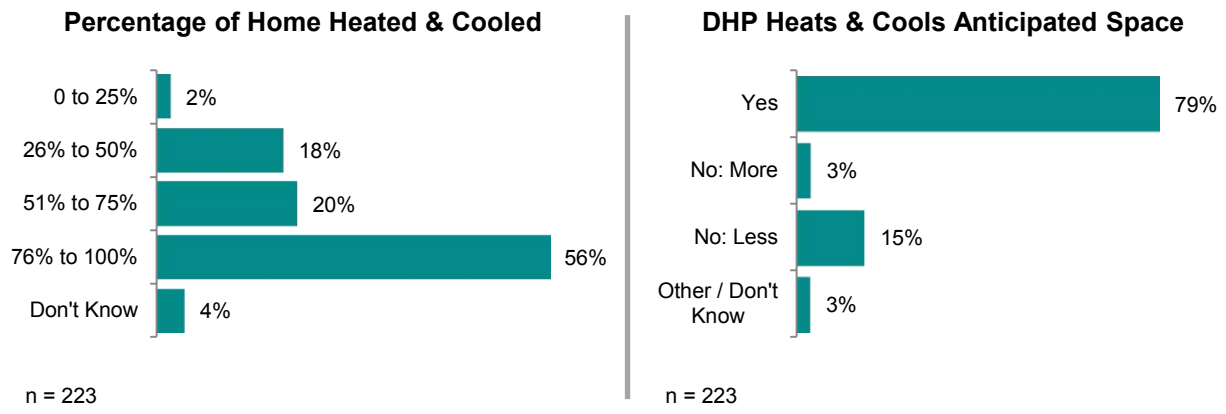


Coverage of the Home

The DHP Pilot Project promoted DHPs as an appropriate space conditioning technology for homes where the residents spend most of their time in a single zone, such as the living room or kitchen area. However, many respondents reported that the DHP conditioned nearly their entire home. Over half (125, 56%) of respondents indicated that the DHP heats and cools three-quarters of their home or more (Figure 5.6). Another 44 (20%) reported that the DHP conditioned between half and three-quarters of their home.

In nearly all reports, the DHP met or even exceed the participating consumer expectations regarding the amount of conditioned space. The DHP heated and cooled the amount that 79% of respondents expected; for 15% (33 respondents) it provided heating and cooling for less than the anticipated space, and for 3% (7 respondents) it provided conditioning for more space than anticipated.

Figure 5.6: DHP Coverage



Temperature and Comfort

The average heating temperature for heating among respondents was 70° (219 respondents). This is similar to the Wave 1 average of 69°. The average cooling temperature was 74° (68 respondents). Far fewer respondents were able to recall the temperature setting for cooling, as many used the DHP for cooling on an as-needed basis.

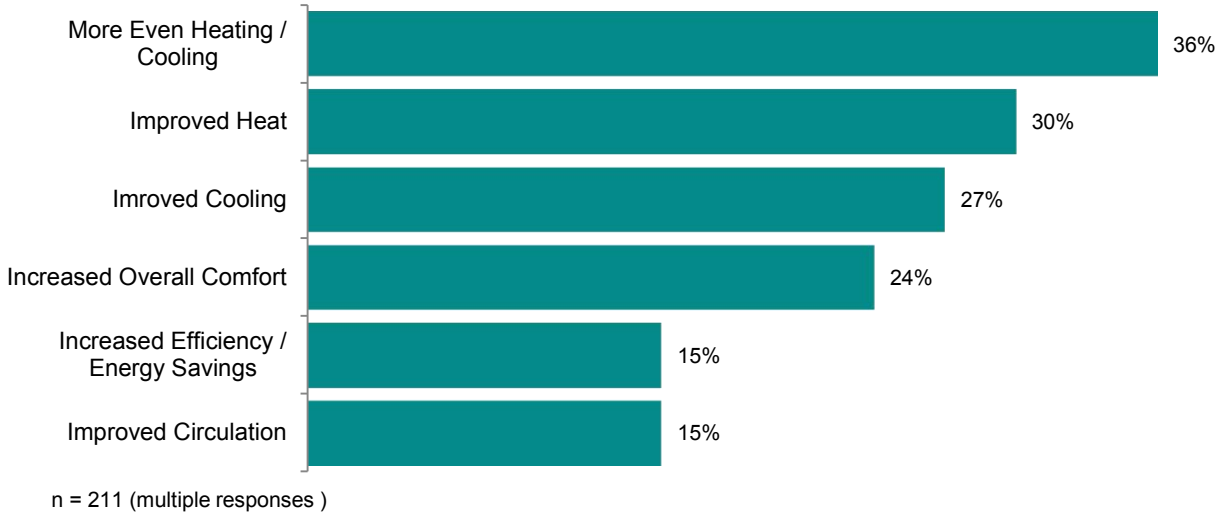
Most participants reported not changing the DHP settings since they installed the DHP (70%), although some had experimented with airflow, temperature settings, and programming (30%).

Nearly all (97%) of respondents reported that their home was more comfortable (91%) or equally comfortable (6%) than it was prior to installing the DHP. Only two respondents (1%, one in Group 1 and one in Group 2) indicated that the home was less comfortable (2%, four respondents, did not provide valid information). Respondents gave a variety of ways in which their comfort was improved by the DHP (Figure 5.7).

Participants explained that using the DHP made their homes less drafty and gave them better control over their comfort. Representative comments include:

- *"Before, we had the ceiling heat and we were never comfortable – there was a drafty feeling and we had to use blankets and space heaters to keep warm. For cooling, we had two window AC's and it was very hot in the house still. This had made a night and day difference."*
- *"With the ceiling heat, we kept the house uncomfortably cold. Now we keep it around 68 degrees, so we are much more comfortable."*
- *"My comfort is about the same, but I'm using less energy"*

Figure 5.7: Sources of Improved Comfort by the DHP

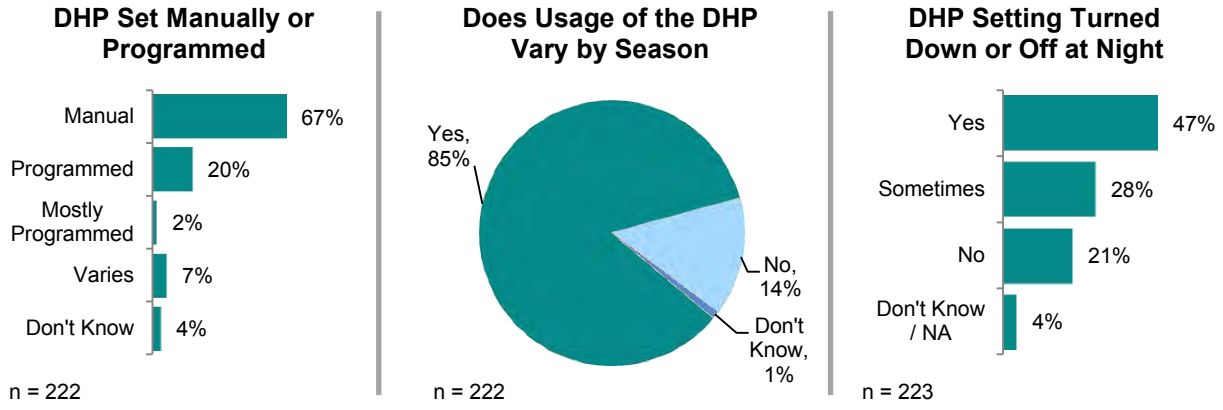


Respondents were less likely to say that the DHP had improved the air quality in their home. Sixty percent (131 respondents) reported that the air quality in their homes was the same, while 33% (73 respondents) reported that it was better. The top two reported reasons for better air quality were the filtration (24%) and reduced dust (23%). Seventeen respondents reported that the DHP had reduced their allergies or contributed to another health improvement.

Settings

The majority (67%) of respondents indicated they turn the DHP on and off manually and adjusting it as needed (Figure 5.8). Fewer (20%) reported that they run the DHP on a program, and another 9% sometimes program the DHP and sometimes use in on the manual setting. These respondents explained that they use the DHP "as needed," which meant more use in the winter, often on a program, and reduced use in the summer on a day-by-day basis. Over three-quarters (85%) of respondents reported that their usage of the DHP varied by season. In addition to turning the DHP off in the summer if they did not need cooling, 78% of respondents turned the DHP off for other reasons. Nearly half of respondents (47%) turn the DHP down or off at night all the time; another 28% do so sometimes. Respondents offered many other reasons for turning the DHP off occasionally. These reasons included wanting to open windows in the summer for fresh air, simply not needing conditioning of any kind, and going out of town.

Figure 5.8: DHP Settings



Contractors typically gave respondents instructions on how to use the DHP throughout the year in various temperatures; 90% of the 210 respondents who could remember the interaction with the contractor indicated they had received such instructions. Of these, 49 respondents mentioned that the contractors described potential limitations of the DHP in extremely cold weather. An additional five respondents turned to the manual for information about very cold weather. In open-ended comments, respondents mentioned the manual as a helpful tool for understanding their DHP.

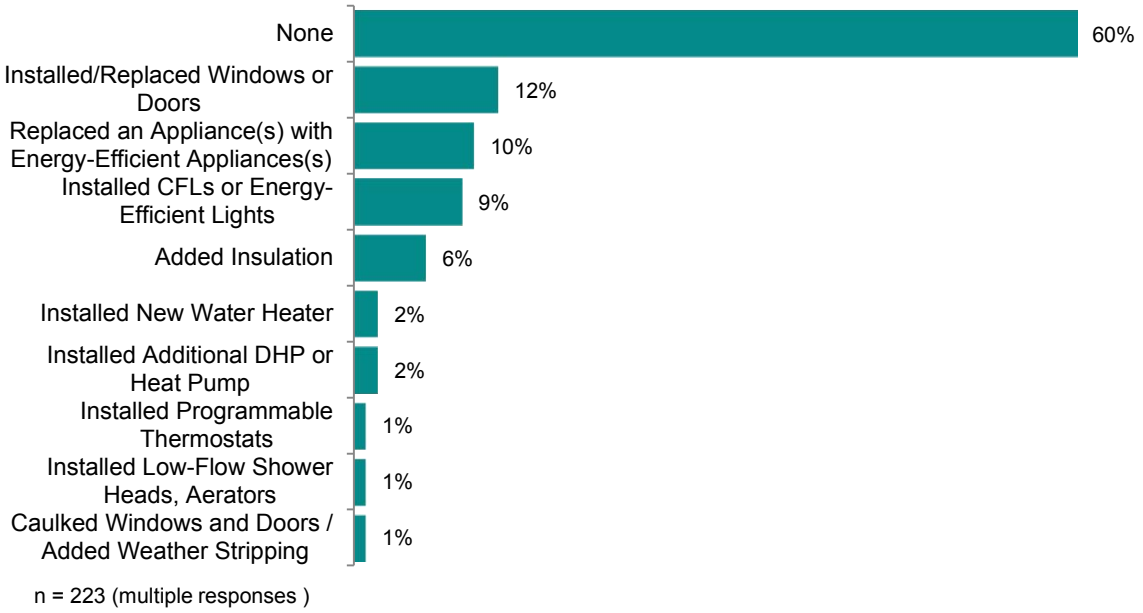
Maintenance

Respondents had owned their DHP for a year or more at the time of the Wave 2 data collection. They reported minimal maintenance concerns. Slightly over half (54%) had not had any kind of service visit since the DHP was installed. Of the 100 respondents (46%) who had been visited by a DHP contractor, nearly all indicated that the service visits were due to minor problems or were one-year check-up visits. Respondents reported taking an active role in the maintenance of their DHPs. Many (79%) had cleaned the filters in their DHP themselves. Another 3% had someone else clean the filter. About one-in-seven respondents (14%) had not cleaned the DHP filter at all, although all but one of these respondents knew the filter needed to be cleaned. Only 2% of respondents had experienced any issues with the filters in their DHP. Overall, participating consumers found the level of maintenance associated with owning a DHP to be reasonable.

PARTICIPANT ENERGY ACTIONS AND EQUIPMENT PURCHASES

Since the previous survey, 40% of respondents had taken additional actions to reduce their energy use (Figure 5.9). Of respondents who had taken additional actions to reduce energy use, 79% had not received an incentive for their action. Only 11 of the 223 respondents had purchased additional heating or cooling equipment since installing their DHP. Three respondents (2%) had installed an additional heat pump. Nine respondents (20%) reported that they had plans to purchase additional heating or cooling equipment.

Figure 5.9: Additional Energy-Efficient Measures Taken Since DHP Installation



SATISFACTION WITH THE DHP

In Wave 1, participating consumers expressed universally high levels of satisfaction with the DHP. The same trend continued in Wave 2. Respondents continued to be satisfied with the performance, maintenance, and sound level of the DHP, and with their energy bills compared to their bills before installing the DHP. Table 5.1 shows participating consumer satisfaction ratings.

More than half (53%) of respondents had already recommended a DHP to someone and an additional 45% would recommend a DHP if asked. Illustrative comments about satisfaction include:

- *"We are saving $100 a month on electricity. With the savings on wood included, I saved $1,000 this winter."*
- *"In the winter time the bill is down about 60%."*
- *"The sound level is fantastic."*

We asked participant respondents if there was *anything* at all they did not like about the DHP. Most dislikes were minor. The most common dislike was the appearance of the DHP or the physical presence of it on the household wall (37 respondents). Other dislikes included the controls or remote (9 respondents), maintenance (7 respondents), and noise (5 respondents). Even when prompted, 48 respondents reported having nothing they disliked about the DHP.

Several participants spontaneously commented that the benefits of owning a DHP outweighed any dislikes they had.

Table 5.1: Participant Consumer Satisfaction

AREA OF SATISFACTION	LEVEL OF SATISFACTION					
	1- Very Dissatisfied	2	3	4	5- Very Satisfied	Don't Know/NA
Maintenance the DHP Requires (n=222)	1 (0%)	2 (1%)	4 (2%)	27 (12%)	182 (82%)	6 (3%)
Comfort of the New Cooling (n=221)	0 (0%)	0 (0%)	4 (2%)	28 (13%)	175 (79%)	14 (6%)
Sound Level of Indoor Unit (n=222)	1 (<1%)	2 (1%)	2 (1%)	48 (22%)	168 (76%)	1 (<1%)
Comfort of the New Heat (n=222)	1 (<1%)	1 (<1%)	7 (4%)	50 (23%)	161 (73%)	2 (1%)
Electricity Bill Using the DHP, Compared with Before (n=222)	1 (1%)	3 (2%)	14 (6%)	57 (26%)	126 (56%)	21 (9%)

6 NONPARTICIPATING INSTALLERS

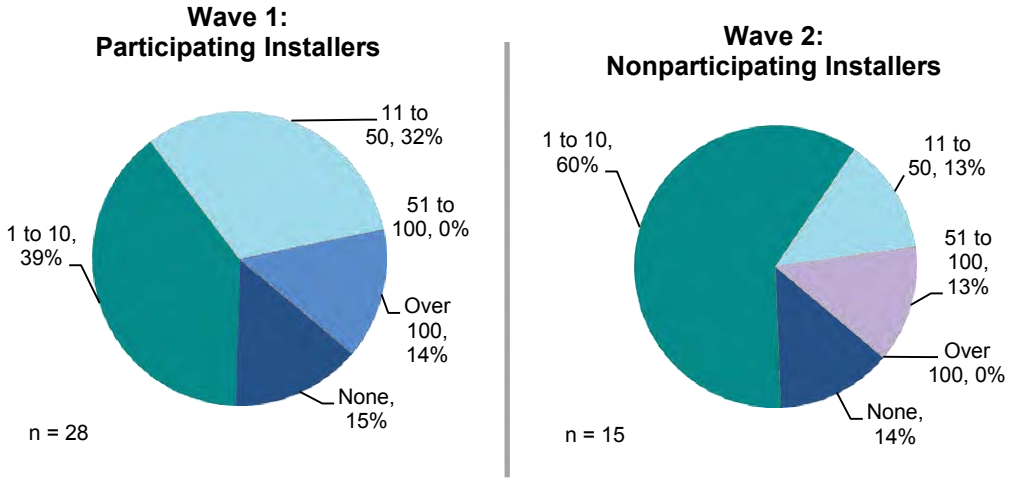
The research team interviewed 15 installers who had attended an orientation to the Northwest Ductless Heat Pump Project, but never installed any DHPs through the project

RECOMMENDING DHPS TO CUSTOMERS

The nonparticipating installers reported varying levels of familiarity with DHPs; nonetheless, all indicated they had recommended a DHP to at least one of their residential customers. The most common reasons for recommending a DHP were its appropriateness for a small or disconnected space and cost effectiveness. All surveyed nonparticipating installers indicated that they plan to install DHPs in the future.

Eleven of the fifteen interviewed installers had installed at least one residential DHP themselves, although no installations were made through the pilot project. One of the installers who had never installed a residential DHP reported being uncomfortable with installing DHPs; all other contacts indicated they were comfortable. As shown in Figure 6.1, the nonparticipating installers had comparable pre-pilot experience installing DHPs, as did participating installers (interviewed in Wave 1).

Figure 6.1: Installation of DHPs Prior to the Pilot – Participating vs. Nonparticipating Installers



Nonparticipating installers reported they were able to get DHPs from the various manufacturers without difficulty. Mitsubishi was the most common company from which nonparticipating installers had ordered DHPs (14 installers), followed by LG (7 installers) and Daikin (4 installers).

BARRIERS TO INSTALLATION

Although the respondents had faith in the DHP technology, none had installed any qualifying DHPs. Five respondents explained that the DHPs are expensive for their customers. In one case, the installer had encountered several customers who wanted multiple head systems, making the cost much greater than the intended one-to-one installation. The second most common reason for not installing DHPs was a lack of customers who were both interested and qualified. Four installers had found no qualified customers. Two installers had not been able to get any customers interested in the DHP. One installer reported each of the following barriers: getting underbid by other installers or alternative systems, choosing to install concealed units instead, lack of training, and not being able to convince customers of DHP performance capability.

SATISFACTION

Nonparticipating installers had confidence in the DHP technology; 14 of 15 reported that the DHP was reliable in their area. All of the installers indicated that DHPs can meet the heating needs of customers and 14 of 15 indicated DHPs meet the cooling needs of their customers. Only 1 of 15 installers reported that DHPs are difficult to install correctly. Nearly all (13 nonparticipating installers) indicated that DHPs make economic sense to their customers and 11 of 15 considered DHPs to be suitable for their customers.

PROJECT ORIENTATION AND MANUFACTURER TRAINING

The most popular motivations for attending the NW Ductless orientation included: learning about the project, to meet the project requirement of attending, and hopes of branching into more efficiency work. The installers viewed the orientation as a step towards "a business opportunity" and "incentives to help make sales." Eight of the interviewed nonparticipating installers reported that the NW Ductless orientation taught them at least one new thing about DHPs. Six respondents indicated that they did not learn anything new (and one could not recall). Only one of fifteen surveyed installers indicated that the orientation did not meet their expectations. Respondents reported receiving manufacturer training in addition to the NW Ductless workshop. Only three installers indicated that they would like more manufacturer training beyond what they have. Mitsubishi was the most common source for manufacturer training (14 installers) followed by LG (6 installers), Daikin (3 installers), Fujitsu (2 installers), and Sanyo (1 installers).

SUGGESTIONS FROM NONPARTICIPATING INSTALLERS

All nonparticipating installers indicated an interest in installing DHPs through the program. Many of the comments suggested a limited understanding on the part of installers of the pilot's target market, pilot-appropriate applications for the DHP, and how to market the technology. (See Appendix B for representative comments of this type.) The pilot project staff might want to consider the following suggestion: *"The program needs to showcase studies where they put one into a house and show how it influences the bills. There needs to be proof so people can see it."*

7 FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

This chapter summarizes the findings and presents the conclusions and recommendations we draw from our second-year evaluation of the Northwest Ductless Heat Pump Pilot Project.

SUMMARY OF FINDINGS

Our findings relating to the pilot's goals and objectives follow; we also include relevant findings from MPER 1.

➡ ***Goal 1:* To demonstrate the use of inverter-driven DHPs to displace electric resistance space heat in existing Northwest homes.**

***Findings:* During Wave 2 interviews, the majority (96%) of respondents reported having used the DHP on the coldest days of the year and slightly over three-quarters (77%) indicated that the DHP was able to keep their space at a comfortable temperature despite the cold.** Respondents described the heat from the DHP as "more even," "more consistent," and "more efficient" than their previous heat.

➡ ***Goal 2:* To support evaluation efforts to document project implementation and determine the costs and potential energy savings of ductless heat pumps in this application.**

***Findings:* NEEA facilitated Research Into Action's efforts to document for this report project implementation processes among the pilot implementation contractor and the participating utilities.** Ecotope's technical assessment, underway, includes an evaluation of costs and potential energy savings.

➡ ***Goal 3:* Market research elements of the evaluation will examine other non-energy benefits and potential barriers to large-scale implementation of ductless heat pumps**.

***Findings:* During both Wave 1 and Wave 2 interviews, most participants reported receiving non-energy benefits from their DHPs, including increased comfort, ease of control, and air filtration**. Wave 1 identified that potential barriers to large-scale implementation of DHPs include concerns about their ability to provide adequate heat in colder temperatures (a research question to be addressed by Ecotope's technical analysis) and the cost of DHPs; Wave 2 findings suggest the cost of DHPs installed with a single interior head may be falling. However, Wave 2 interviews revealed a possible additional barrier: comments made by nonparticipant installers suggest they may have a limited

understanding of the pilot's target market, pilot-appropriate applications for the DHP, and how to market the technology.

➡ ***Goal 4:* To define the future of the ductless heat pump market and build an infrastructure to sustain and accelerate growth in the market.**

NEEA identified eight objectives in support of this goal. Table 7.1 lists the objectives and our related findings from Wave 1 and Wave 2 evaluation activities.

Table 7.1: Goal 4 Objectives and Related Findings

OBJECTIVES FOR GOAL 4	WAVE 1 FINDINGS	WAVE 2 FINDINGS
1. Engage the ductless heat pump industry (manufacturers, distributors, contractors); create cooperative relationships; leverage resources to support the project.	*As of December 31, 2009:* • Number of installer orientations: 46 in-person and 27 web-based • Number of oriented installers: 906 • Number of oriented installation firms: 602 • Number of firms completing at least one pilot installation: 320 • Number of manufacturers/brands installed in pilot: 5 • Number of manufacturers increasing marketing in response to the pilot: 5 • Proportion of interviewed installers planning to promote DHPs after pilot: 87%	NEEA, Fluid, and utilities in the region continued in 2010 to support DHPs through customer incentives, installation tracking and quality assurance activities, contractor training, and interactions with manufacturers. Manufacturer contacts frequently cited the activities of the pilot project as a primary driver of growth in the residential DHP market and reported they view the Northwest as an important market for DHPs. Manufacturer contacts implicitly underestimate the market size for single-head units, as they explicitly describe the market for multi-zone systems as more attractive. Program staff reported that they aim to establish retail sales of DHPs as a "milestone" for 2011.
2. Accomplish up to 2,500 quality installations of inverter-driven ductless heat pumps in existing Northwest homes with electric resistance heat.	As of December 31, 2009: • DHP pilot installations: 3,899 • Number of utilities registered to participate: 80 • Number of utilities having at least one installed DHP: 59	Utility DHP programs and qualifying DHP installations continued in 2010. As of November 15, 2010: • DHP installations meeting parameters outlined by the pilot project: 7,116 • Number of utilities offering DHP programs: 86 • Number of utilities having at least one installed DHP: 76

OBJECTIVES FOR GOAL 4	WAVE 1 FINDINGS	WAVE 2 FINDINGS
3. Understand customer satisfaction and develop recommendations for future program implementation strategies.	Participants reported high levels of satisfaction with DHPS and with pilot project implementation processes, including: ease of understanding incentive qualification requirements; ease of finding an installer; ease of locating program information; and the speed with which they received their incentive checks.	Multiple utility contacts reported that despite reduced DHP marketing efforts in 2010, consumer demand for DHPs continued to grow. Most of the utility contacts attributed the increased consumer demand for DHPs to substantial word-of-mouth advertising resulting from the high level of consumer satisfaction with DHPs.
		Continued
4. Address potential first-cost barriers associated with ductless heat pumps.	The incentive appeared to overcome participants' first-cost hurdle. Participants recalling the utility rebate who "would not" or "might not" have purchased their DHP without the incentive: 66% Participants receiving lowest incentive ($400) who "would have" or "might have" not purchased their DHP without the incentive: 11%	Utility incentive programs appeared to continue to overcome participants' first-cost hurdle in 2010. In 2010, DHP installations meeting parameters outlined by the pilot project continued at the same pace as they had during the pilot implementation period.
5. Ensure HVAC contractors are trained in the technical nuances of installing ductless heat pumps correctly and install them accordingly.	The majority of both participant and installer respondents reported that DHP installations were quick, minimally invasive, and did not require installer follow-up. The majority of manufacturers estimated that 90% to 100% of residential DHPs installed in the Northwest are installed properly and function optimally. However, several interviewed utility staff, installers, and participants reported issues with the installation of DHP line sets.	Quality assurance efforts and continuing contractor education as the project progressed appears to have addressed many of the problems identified with some of the early DHP installations. Program contacts reported that because of the increase in high quality installations, the project has been able to reduce quality assurance inspections to a sub-sample of completed installations without reducing the proportion of high quality installations.

OBJECTIVES FOR GOAL 4	WAVE 1 FINDINGS	WAVE 2 FINDINGS
6. Provide HVAC contractors with an understanding of the basis of the project, the applications, and what is in it for them (new market and increased profits).	The majority of installer respondents provided high ratings regarding the project orientation sessions. However, installers requested additional information on general project requirements, utility-specific project requirements, and the displace, not replace theory. Some installers suggested the webinar question-and-answer period was awkward because "only one person could speak at a time" and "Internet connection problems resulted in unanswered questions and issues that were left unaddressed." The majority of installers reported having viewed pages from the project's websites, which they assessed as useful. However, manufacturer contacts reported that the pilot's reliance on the Internet to communicate program information represented a barrier to increased installer participation in the pilot project and project staff reported some installers did not want to access the Internet.	In 2010, project and implementation staff continued to provide installer orientations that described the basis of the project. To further develop the installer infrastructure and thereby sustain and accelerate growth in the market, project staff reported development of a *Master Installer Program* to increase the degree to which installers understand and promote displacement of zonal electric heat.
		Continued
7. Ensure ductless heat pump products installed through the project are among the best available and are well supported by the distribution channel in the Northwest.	Comments from installer respondents indicate that the activities of the pilot project have strengthened DHP supply chains, resulting in increased availability of DHPs. Nearly all of the installer respondents reported that obtaining DHPs is "easier" or "the same degree of difficulty" as obtaining other types of space-conditioning equipment. According to one DHP manufacturer, "If there is one thing the pilot has taught me, it's that the target market is so much bigger than we had thought."	Manufacturer contacts reported that they increasingly view the Northwest as an important market for DHPs. One of these contacts reported that Oregon and Washington ranked 8th and 9th respectively in 2010 national data in terms of the total number of DHP units sold, as compared with 2008 when they ranked 19th and 20th respectively. Manufacturers also reported that the availability of DHPs had increased in the Northwest, including the most up-to-date cold-temperature products, which manufacturers had previously offered almost exclusively in Scandinavia.
8. Pave the way for future ductless heat pump programs by testing program designs and marketing messages.	About 70% of applicants had at least one member of their home who was over the age of 65, suggesting the pilot's marketing efforts were successful in reaching an older demographic, but less successful in reaching younger participants. The second wave of this evaluation will further explore marketing messages and reaching a younger demographic.	Project staff projected that retail sales of DHPs will increase awareness among demographic groups that are not currently aware of DHPs. Additionally, staff reported initiation of radio and internet ads targeting younger audiences in 2010.

CONCLUSIONS AND RECOMMENDATIONS

We make the following conclusions and recommendations.

➡ ***Conclusion 1:* The project has been very successful creating consumer interest in and demand for the previously unknown technology.** Consumer satisfaction is very high. Throughout all stages of the project, participants have embraced the DHP technology. Participants reported high levels of satisfaction with the performance, effectiveness, and operating costs of the DHP. Participants spoke enthusiastically about the increased comfort that the DHP has brought to their homes. While most of the participants had never heard of DHPs before the onset of the pilot, they have since become strong advocates for DHP technology. Word-of-mouth has proven to be a powerful method of disseminating information and promoting the DHP. The performance of the technology speaks for itself and participants continue to recommend the technology to others.

***Recommendation 1:* NEEA should further capitalize on the word-of-mouth advertising success by developing and disseminating customer case studies to installers and in media campaigns.**

➡ ***Conclusion 2:* NEEA is attaining its goals and objectives for the Northwest Ductless Heat Pump Pilot Project.** By directly interacting with the supply-side of the market, the project appears to be strengthening DHP training, marketing, and distribution networks, and increasing consumer awareness of DHPs. By offering incentives for qualifying DHP installations, utilities overcame many participants' first-cost hurdle for DHP installation.

***Recommendation 2:* NEEA should continue to support the region by working with supply-side actors (manufacturers, distributors, and installers) to increase the availability of DHPs and the quantity and quality of DHP installations**. Assuming favorable results from Ecotope's technical evaluation of DHPs, NEEA should plan to actively market the technical findings: to utilities both active and inactive in the pilot; to manufacturers, manufacturer representatives and distributors; and to nonparticipating installers and installers with low participation rates.

➡ ***Conclusion 3:* Many supply-side actors evidence some lack of understanding of or appreciation for the intended DHP target market and role of displacement theory**. Many installers and distributors report promoting multi-zone systems because they are more profitable or sought to use DHPs to provide heating throughout the house. These comments implicitly convey a belief that the single-zone market is smaller or less attractive. Nonparticipating installers are interested in installing DHPs through the program, but do not understand how to turn the project requirements into selling points. In contrast, the most successful installers, interviewed in Wave 1, reported that the pilot project opened up new markets to them. They perceived that the pilot gave them new

customers who they could now target with the intention of displacing the heating source in the customers' primary zone of occupancy.

Recommendation 3: **NEEA should develop marketing materials targeted to distributors and installers that demonstrate the capabilities of DHPs through case studies and facts, as well as developing marketing materials appropriate for consumers**. The documentation of results from actual installations was particularly appealing to nonparticipating installers. Offer follow-up training for rural and low activity installers, demonstrating the value of the displacement theory and how displacement of zonal electric heat can open new consumer markets for them. In addition, marketing to supply-side actors should convey the potential market size for single-zone units, to counter perceptions that this market continues to be less attractive than other DHP markets.

➡ ***Conclusion 4:*** **Although the project has effectively engaged DHP manufacturers and distributors, their objectives are not fully in line with those of the project**. Manufacturers and distributors are happy to have new and expanded markets for DHPs, yet they are driven by the profit motive and have no particular interest in displacing electrical load in the target market. The manufacturers and distributors are interested in pushing higher end and multi-headed units, and entering markets not relevant to NEEA's goals.

Recommendation 4: **NEEA and the region should consider making multi-headed units ineligible for incentives or, at a minimum, ensure no incremental incentive for such units**. Program materials should clearly explain to utilities the basis of any such policy, which is the cost-effectiveness of the DHP energy savings. NEEA should frequently and clearly present its objectives to manufacturers, distributors, and installers.

➡ ***Conclusion 5:*** **Rural nonparticipating installers indicated difficulty getting attention from distributors** who are more interested in working with installers the distributors characterized as installing higher volumes of systems and the more profitable multi-zone systems. Interview findings suggest a willing HVAC installation force exists that can be mobilized to install DHPs.

Recommendation 5: **NEEA should investigate ways to effectively motivate distributors to actively promote single-head DHPs in smaller markets**. NEEA and/or the participating utilities should tailor an approach to market development activities in rural areas, which likely have a larger proportion of qualifying residences than do other locations. Installers might collaborate to obtain support from distributors, or utilities might offer distributors a small incentive to compensate them for a more difficult market environment.

APPENDICES

APPENDIX A: PILOT PARTICIPANTS – SURVEY METHODOLOGY AND FINDINGS

APPENDIX B: NONPARTICIPATING INSTALLERS

APPENDIX C: WAVE 2 INTERVIEW GUIDES

A PILOT PARTICIPANTS – SURVEY METHODOLOGY AND FINDINGS

DHP CONSUMER SURVEY, 2010 SURVEY EFFORT (WAVE TWO)

Interviewee Name:

Date:

Interviewer:

Hello, may I speak to _____[name from call list]_____? (attempt to reach same person as last round)

Hi, my name is _____ calling from Research Into Action on behalf of [utility]. I am calling about your ductless heat pump for which you received an incentive. As you may recall, we spoke last year. This follow-up call will be shorter, and your responses will be kept confidential. It should take about 15-20 minutes.

Is this a good time?

Introduction and Other Participation

Table 1.1: Cooling Zone

COOLING ZONE	COUNT OF RESPONDENTS
1	100
2	110
3	13
Total	223

First, some general background.

1. What, if any, steps have you taken in the past year to reduce your energy use? [DO NOT READ] (n=?)

NONE 133 (60%)
Added insulation 13 (6%)
Installed/replaced windows or doors 27 (12%)
Installed programmable thermostats ..... 1 (<1%)
Replaced an appliance(s) with energy efficient appliance(s) 23 (10%)
Installed CFLs or energy efficient lights 20 (9%)
Installed new water heater 4 (2%)

Installing additional DHP or heat pump	3	(2%)
Caulked windows and doors, weather stripping	2	(1%)
Installed low-flow shower heads, aerators	2	(1%)
Behavior changes	10	(5%)
Installed ceiling fans	0	(0%)
Installed solar panels	0	(0%)
Other (please specify)	20	(9%)

2. If you selected other, please specify

_____

3. Have you received an incentive for any other energy efficient product in the past year? (n=223)

Yes	45	(20%)
No	175	(79%)
Don't Know	3	(1%)

4. Since you bought the DHP, have you bought any other heating or cooling equipment? (n=221)

Yes	11	(5%)
No	210	(95%)

5. [If yes] What did you purchase? [open ended responses] (n=10)

Another heat pump	3	(30%)
Central air or portable AC	2	(20%)
Attic or whole house fan	1	(10%)
Baseboard heater	1	(10%)
Wood stove insert	1	(10%)
Pellet stove	1	(10%)
Radiant heater	1	(10%)

6. [If yes] Why did you purchase this? (n=9)

- "Building air gets stale, doesn't have a lot of air flow. We need air filtration more than anything"
- "DHP doesn't cover all the space"
- "For cooling upstairs"
- "Our other heating broke"
- "Want a full house system"
- "The layout of the house needs 2 heat pumps, L shaped house"
- "The space we need to heat is off the main house"

- "We had a fireplace and we used to burn wood during the winter but it's harder to get the wood now so we decided to go to the pellet stove because we like that kind of heat"
- "We had old baseboard heaters and we thought something new would be more efficient, we wanted something smaller."

7. [If no] Do you have plans to purchase any heating or cooling equipment? (n=221)

Yes	9 (20%)
No	210 (79%)
Don't Know	2 (1%)

DHP Experience

Now I'd like to ask about how you have used the DHP since you installed it.

8. Since it was installed, have you used the DHP for: (N=223)

Heating	220 (99%)
Cooling	208 (93%)

9. [If 9 includes heating] Did you use the DHP on the coldest days of the year? (N=222)

Yes	213 (96%)
No	7 (3%)
Don't Know	2 (1%)

10. [If 10 is yes] Did you find the DHP was able to keep the space a comfortable temperature? (N=214)

Yes	164 (77%)
No	42 (20%)
Don't Know	2 (1%)
Other	6 (3%)

Respondents who answered "other" had extenuating circumstances, such as malfunctioning backup heat, which made them unable to answer the question clearly.

11. [If 10 is no] Why didn't you use the DHP on the coldest days?

- "I was told you can't run that when it gets below a certain temperature."

- "We use our electric baseboards then because it's not efficient on very colds days and occasionally a wood insert. Contractor just told us it's not efficient to use the DHP on very cold days so we just turn it off and go back to our baseboards."
- "I had to turn it off and go onto secondary heat. Don't hold me to it, but once it gets down to around 20, I don't think we can get any heat out of it."
- "When it gets down to 10 or 20 degrees it just doesn't cut it so we turn on our wall heaters. The DHP does not maintain the temperature as well, but with the boost from the wall heathers we do ok"
- "We use a wood stove insert that we use instead"
- "It wasn't installed yet"
- "House is rental but wasn't rented till spring 2010."
- "We are not there during the heating season- it's a cabin we stay at in the summer with west facing windows- so it actually just gets really hot. This is used for cooling"

12. [If 9 includes cooling] Did you use the DHP on the hottest summer days?
(n=223)

Yes	208	(99%)
No	13	(0%)
Don't Know	2	(1%)

13. [If 13 is yes] Did you find the DHP was able to keep the space a comfortable temperature?
(n=210)

Yes	202	(96%)
No	6	(3%)
Don't Know	2	(1%)

14. [If 13 is no] Why didn't you use the DHP on the hottest days?
(n=13)

Do not ever need cooling	12	(92%)
To save energy	1	(8%)

15. Is the DHP your primary heating equipment?
(n=223)

Yes	207	(93%)
No	13	(6%)
Don't Know	3	(1%)

16. [If not primary] What is primary?
(n=13)

Wood (including wood stove insert and pellets	6	(46%)

Baseboards 2 (14%)
Ceiling Heat 1 (8%)
Electric Furnace 1 (8%)
Wall Heater 1 (8%)
Ducted Heat Pump 1 (8%)
Gas Fireplace 1 (8%)

17. When you purchased the DHP, were you intending to use it as your primary heating equipment?
(n=223?)

Yes 207 (93%)
No 13 (6%)
Don't Know 3 (1%)

18. [If primary and have used DHP for heating] Have you ever supplemented your DHP heat with heat from other equipment?
(n= 223)

Yes 162 (73%)
No 60 (27%)
Don't Know ..... 1 (<1%)

19. [If 19 is yes] What type of equipment? [multiple responses allowed]
(n=162)

Wall Heater 50 (31%)
Wood (including wood stove insert and pellets 34 (21%)
Baseboards 28 (17%)
Ceiling Heat 23 (14%)
Space heaters/portable heaters 11 (7%)
Electric Furnace 11 (7%)
Gas Fireplace 6 (4%)
Other 11 (7%)

20. [If 19 is yes] Do you use this supplemental heating equipment in the same room as the DHP or in other rooms in the house?
(n=166)

Yes 65 (39%)
No 85 (51%)
Other 16 (10%)
Other:

- Duct systems and therefore is in the same room and other rooms (3)
- Multiple back-ups, some in the same room and some elsewhere (3)
- Other comments unrelated elaboration (10)

21. [If 19 is yes] How often did you use the supplemental heating equipment? (N=165)

Almost Never	49 (30%)
Rarely	50 (30%)
Sometimes	27 (16%)
Often	15 (9%)
Always	5 (3%)
Don't Know	1 (1%)
Other:	18 (11%)

Others included respondents who were only in the home where the DHP is part of the year, ran their backup heat randomly for ambience, or only when doing certain activities such as showering.

22. [If 19 is yes] Is this less, more, or the same amount as you used before you got the DHP? (n=157)

Less	140 (89%)
Same	17 (11%)
More	0 (0%)

23. [If 20 includes wood/ pellets] How much wood/ pellets have you used for this other heat source in the past year?

_____

24. [If 20 includes wood/ pellets] Is this less, more, or the same amount of wood/ pellets as you used before you got the DHP?

_____

25. Is the DHP your primary cooling equipment? (N=223)

Yes	214 (96%)
No	4 (2%)
Other	5 (2%)

26. [If not primary] What is primary?

- 6 respondents who did not use any cooling by choice
- 1 attic fan
- 1 ducted heat pump
- 1 window air conditioner

27. [If not primary] When you purchased the DHP, were you intending to use it as your primary cooling equipment?
(N=223?)

Yes	200	(90%)
No	8	(2%)
Don't know	3	(2%)
Other	12	(6%)

28. Have you ever supplemented your DHP cooling with cooling from other equipment?
(N=218)

Yes	20	(9%)
No	197	(90%)
Don't know	1	(1%)

29. [If 29 is yes] How often did you use the supplemental cooling equipment?
(N=20)

Almost Never	4	(20%)
Rarely	7	(35%)
Sometimes	4	(20%)
Often	5	(25%)

30. [If 29 is yes] Is this less, more, or the same amount as you used before you got the DHP?
(N=20)

Less	14	(70%)
Same	5	(25%)
More	0	(0%)
Other	1	(5%)

31. [If 29 is yes] Do you use this supplemental cooling equipment in the same room as the DHP or in other rooms in the house?
(N=20)

Yes	1	(5%)
No	19	(95%)

32. What percentage of your home does the DHP heat and cool?
(N=223)

0 to 25	5	(2%)
26% to 50	41	(18%)
51% to 75	44	(20%)
76% to 100	125	(56%)
Don't know	8	(4%)

33. Does the DHP heat or cool the amount of space you anticipated it would? (N=223)

Yes 176 (79%)
No 40 (18%)
Don't Know.....3 (1%)
Other 4 (2%)

Others: Meetings heating expectations but exceeds cooling expectations, thought it would get into the corners more than it does, the unit in the living room could have been a little bigger but the one in the rec room cools off in a matter of minutes, I thought it might do less on cold days but I'm confident in it now.

34. [If 34=no] Does it heat or cool **more** or **less** space than you expected? Please elaborate (n=40)

More 7 (18%)
Less 33 (83%)

35. What temperature do you typically keep the DHP set at?

Heating: (n=219)

Less than 60 degrees .....1 (<1%)
60 to 68 degrees..... 56 (26%)
Over 68 degrees 162 (74%)

Average: 70

Cooling: (N=68)

60-65 .....0 (0%)
66-70 ..... 10 (15%)
71-75 ..... 32 (47%)
Over 75 ..... 26 (38%)

Average: 74

36. Have you changed the way you set it since you got it? (n=222)

Yes 65 (29%)
No 153 (69%)
Don't Know.....4 (2%)

Those who had changed the way they use the DHP had made adjustments to air flow, experimented with various temperatures, and explored the automatic and manual modes. Changes were primarily made to suit the individuals comfort needs.

37. Since installing the DHP, is your home more comfortable, less comfortable, or about the same as before?
(n=221)

More	202	(91%)
Same	13	(6%)
Less	2	(1%)
Don't Know	4	(2%)

38. Why do you say that? [multiple responses allowed]
(n=211)

More even heat/cooling	77	(36%)
Improved heat	63	(30%)
Improved cooling	57	(27%)
Increased overall comfort	50	(24%)
Improved circulation	31	(15%)
Increased efficiency/saving energy	32	(15%)
Easy to use	9	(4%)

39. Since installing the DHP, is your home air quality better, the same, or worse than before?
(N=223)

Better	73	(33%)
Same	66	(30%)
Worse	2	(1%)
No change	65	(30%)
Don't Know	17	(6%)

40. Why do you say that? [Multiple responses allowed]
(n=82)

Filter makes a difference	20	(24%)
Reduced dust	19	(23%)
Reduced allergies/improved health	17	(21%)
Reduced smells	7	(8%)
Replaced wood	3	(4%)
Unspecified/Other	16	(20%)

41. Do you use the DHP manually so that it runs only when you need it, or is it set on a program?
(n=222)

Manual	149	(67%)
Programmed	44	(20%)
Mostly Programmed	5	(2%)
Varies	15	(7%)
Don't know	9	(4%)

42. Do you turn the DHP down or off at night?
(n=223)

Yes 105 (47%)
Sometimes 62 (28%)
No 46 (21%)
Don't know/NA 10 (4%)

43. Do you turn it off for any other reason?
(n=136)

Yes 106 (78%)
No 30 (22%)

44. Does your usage of the DHP vary by season?
(n=222)

Yes 188 (85%)
No 32 (14%)
Don't know 2 (1%)

45. [If yes] How so?

_____

46. Have you had any service visits or other interactions with the contractors since they installed the DHP?
(n=221)

Yes 100 (45%)
No 118 (53%)
Don't know 3 (1%)

47. Did the contractor give you any instructions on how to use the DHP? [Probe] Any specific instructions on how to use it in various temperatures?
(N=218)

Yes 196 (90%)
No 4 (2%)
Don't know 5 (2%)
Other 13 (6%)

48. Have you cleaned the filter in your DHP?
(n=223)

Yes, they cleaned it personally.....176 (79%)
Yes, contractor cleaned it 7 (3%)
No 32 (14%)
Don't know 6 (3%)
Other 2 (1%)

49. [If 49 yes] How often do you clean it?

_____

50. Did your contractor explain how to clean the filter?
(N=218)

Yes 194 (89%)
No 16 (7%)
Don't know 8 (4%)

51. [If 49 no] What are some of the reasons why you haven't cleaned the filter?

_____

52. Have you experienced any filter related issues?
((N=222)

Yes 5 (2%)
No 214 (97%)
Don't know 3 (1%)

Expectations and Satisfaction

Now I'd like to ask you about your satisfaction with the DHP.

53. to 59. Please rate your satisfaction with the following aspects on a 5-point scale, where 1 means "very dissatisfied" and 5 means "very satisfied":

	1	2	3	4	5	DK/REF
54. Sound level of indoor unit	1 (<1%)	2 (1%)	2 (1%)	48 (22%)	168 (76%)	1 (<1%)
55. Your electricity bill using the DHP, compared with before	1 (1%)	3 (2%)	14 (6%)	57 (26%)	126 (56%)	21 (9%)
56. The comfort of the new heat	1 (<1%)	1 (<1%)	7 (4%)	50 (23%)	161 (73%)	2 (1%)
57. The comfort of the new cooling	0 (0%)	0 (0%)	4 (2%)	28 (13%)	175 (79%)	14 (6%)
58. The indoor air quality in your home since installing the DHP	0 (0%)	1 (<1%)	15 (7%)	32 (14%)	83 (37%)	91 (41%)
59. The maintenance the DHP requires	1 (0%)	2 (1%)	4 (2%)	27 (12%)	182 (82%)	6 (3%)

60. Have there been any unexpected benefits to owning a DHP?

Cleaner air, cooling, AC, covers more space than expected, saves more electricity than expected,

61. Have you, or would you, recommend the DHP to a friend or colleague?
(N=221)

Already have	117 (53%)
Yes	100 (45%)
No	2 (1%)
Don't Know	2 (1%)

62. Can you elaborate on why?

_____

63. Overall, is there anything you do not like about your DHP?
(N=221)

Nothing	138 (62%)
Appearance	37 (17%)
Controls	9 (4%)
Coverage or air circulation	9 (4%)
Size or location	8 (4%)
Maintenance	5 (2%)
Noise level	3 (1%)
Other	12 (5%)

64. Thinking back over your whole experience with the DHP and the pilot program- is there anything you would change?

65. Do you think your contractor or utility could have better informed you about the DHP?

_____

[If yes] In what way?

_____

Almost done. Now I have just a few more general household questions.

First, I'd like to ask a few things about your water heater.

66. Is your water heater gas or electric?
(n=215??)

Electric	209 (97%)
Gas	2 (1%)
Solar	2 (1%)
Heat pump	1 (<1%)
Don't know	1 (<1%)

67. How old is your water heater?
(n=215??)

0-5 years	82 (38%)
6-10 years	55 (26%)
11-15 years	18 (8%)
16-20 years	26 (12%)
20 years or more	12 (6%)
Don't know	22 (10%)

Nine respondents were unable to specify but knew their water heat was at least 10 years old.

68. Did it come with your house or did you buy it since you got the house?
(n=217)

Purchased	148 (68%)
Came with house	67 (31%)
Don't know	2 (1%)

69. [If bought] When? Where did you get it?
(n=148)

Local contractor or installer	74 (50%)
Big box store (Home Depot, Lowe's, Ace)	31 (21%)
Sears	26 (18%)
Utility	6 (4%)
Don't Know	11 (7%)

70. Is your water heater located somewhere in your home that is heated- such as off your kitchen- or is it in space that is not heated, like a garage?
(n=205)

Heated	100 (49%)
Unheated	101 (49%)
Don't know	4 (2%)

To wrap up, have there been any major changes in your household in the past year- such as people moving in or out? Anything like that?

B NONPARTICIPATING INSTALLERS

The research team interviewed 15 installers who had attended an orientation to the Northwest Ductless Heat Pump Project, but never installed any DHPs through the project. We allocated the 15 sample points across states in rough approximation to the proportion of total pilot DHP installations by state. Table B.1 displays the percent of DHP pilot installations in each state and the count of interviewed nonparticipant installers by state.

Table B.1: Installs and Interviews by State

STATE	PERCENT OF INSTALLS	COUNT OF INTERVIEWED NON-PARTICIPATING INSTALLERS
Washington	51%	6
Oregon	38%	5
Idaho	6%	3
Montana	5%	1

All 15 interviewed nonparticipating installers reported that their companies provided sales, installation, services, maintenance, and repair of HVAC equipment. The average firm size was three people. The largest company interviewed had eleven employees, the smallest had one. Four of the companies had not installed any residential DHPs prior to attending the NW Ductless orientation. Table B.2 shows the number of DHPs each nonparticipant company had installed prior to attending the orientation.

Table B.2: Number of Installs

NUMBER OF INSTALLS	RESIDENTIAL	COMMERCIAL
None	4	8
One to Five	6	4
Six to Ten	1	2
More than Ten	3	0
Over 100	1	1

NONPARTICIPANT SUGGESTIONS

All of the non-participating installers indicated an interest in installing DHPs through the program. The following are suggestions from non-participating installers for how the program could make it easier for them to participate:

- *"The program needs to educate homeowners. Convince customers about how efficient DHPs are and that they actually work. The program needs to showcase studies where they put one into a house and show how it influences the bills. There needs to be proof so people can see it and follow through with it."*
- *"Establish reasonable expectations for customers; some want to rip out their whole house systems and it just becomes expensive"*
- *"Somehow we need to give customers reasonable expectations. They expect it to blow down hallways and stuff"*

Comments on marketing resources:

- *"The program should offer sales literature, color brochures, anything you can hand to the customer explain the program"*
- *"Marketing is something that the contractors could use help with because it's an expense – it takes time and money. The utility companies are not as contractor friendly as I would like. They cater to the bigger companies."*

NONPARTICIPATING INSTALLERS SURVEY - WAVE TWO

Interviewee Name:

Date:

Interviewer:

Hi my name is _____ calling from Research Into Action on behalf of the NW Ductless Heat Pump Project. May I please speak to _____?

The Northwest Energy Efficiency Alliance (NEEA) is conducting an evaluation of the NW Ductless Heat Pump Pilot Project and I have you on the list of contractors who attended an orientation but didn't install any ductless heat pumps through the project. Is this correct? [Terminate if no]

I'm hoping to ask you about ten minutes of questions about your experiences with the orientation and your opinions about the ductless heat pumps. Is this a good time?

Installer Background

1. First, I would like to get a general idea of the types of work that you do:

   Do you do:

a. Sales
b. Installation
c. Repair
d. Maintenance
e. Other: _____

2. How many people are employed by your firm? _____

Prior Experience

Next, I'd like to ask about your experiences with ductless heat pumps.

3. Prior to attending a Northwest Ductless Heat Pump Project orientation last year, had you or anyone in your firm installed ductless heat pumps in either residences or commercial applications?
    - Number of home DHPs installed:
    - Number of commercial:

    a. [IF YES] Had you personally installed a DHP, or someone else in your firm, or both you and others?
        i. Did you learn anything new at the project orientation about DHPs?

    b. [IF NO] Had you heard of ductless heat pumps or mini-split heat pump systems before you attended a Northwest Ductless Heat Pump Pilot Project orientation last year?
        i. [IF YES] What are some of the reasons you had not installed any DHPs?
            - Did anything you learned at the orientation change the way you think about DHPs? [applications for them, displacement]
        ii. [IF NO] From what you learned at the orientation, did you think there is a market for DHPs in your area?

4. Since attending the orientation, have you recommend DHPs to any customers?
    a. [IF YES] Did they take that recommendation and install one?

5. Do you ever have any calls from residential customers who are interested in heating or cooling spaces where ducts cannot be installed at a reasonable price?
    a. [IF YES] What products do you typically recommend to them?
        iii. Why do you recommend that equipment?

6. Can you get DHPs from your suppliers?
    a. [IF YES] What brands?

- ☐ Daikin
- ☐ Fujitsu
- ☐ LG
- ☐ Mitsubishi
- ☐ Sanyo
- ☐ Other_____

7. Have you or anyone else at your company received any manufacturer training on ductless heat pumps?
   a. [IF YES] What brands?
      - ☐ Daikin
      - ☐ Fujitsu
      - ☐ LG
      - ☐ Mitsubishi
      - ☐ Sanyo
      - ☐ Other_____

   b. [IF NO] Do you have any plans to receive such training in the next year?

8. Do you feel comfortable installing a DHP (from a technical standpoint)? (if no, probe for reasons)

9. What types of homes do you think are candidates for DHPs?
   a. Are there any other types of customers that might be good candidates for DHPs? [PROBE: New and existing manufactured housing, residential new construction, home remodels and conversions, and small commercial property owners)?]

10. To what extent do you agree with the following statements. Please use a four-point scale where 1 means "strongly disagree," and 4 means "strongly agree." You can also indicate "don't know" or "no opinion."
    a. DHPs do not have proven reliability for my region
    b. DHPs cannot meet the heating needs of my customers
    c. DHPs cannot meet the cooling needs of my customers
    d. DHPs are difficult to install correctly
    e. DHPs seldom make good economic sense for most customers
    f. DHPs aren't suitable for my customers

11. [Probe any agreement ("3" or "4") with the negative attributes Q12 by saying: You indicated you agreed with xxx. What are your reasons for that rating?

a. [lack reliability]_____
b. [difficult to install] _____
c. [unsuitable] _____
d. [heating]_____
e. [cooling] _____
f. [economic] _____

Installer Orientation

12. Why did you attend the Project orientation?
    a. What were you expecting to learn?
    b. Did the orientation meet your expectations?

13. When you left the Project orientation, did you plan to install DHPs through the program?
    a. [IF YES] Why do you suppose you did not install any DHPs through the program?)

Installer Support

14. Have you looked for any information about the NW Ductless Heat Pump Project in addition to attending the orientation?
    a. [IF YES] What information?

15. Have you contacted NW Ductless Project staff?
    b. [IF YES] How responsive was the Project staff on a four-point scale with 1 meaning "not at all responsive and 4 meaning "extremely responsive?"
    - ☐ 1
    - ☐ 2
    - ☐ 3
    - ☐ 4

16. Have you visited the NW Ductless Heat Pump Project website? [NOTE: THE ADDRESS IS NWDUCTLESS.COM]
    a. Yes
    b. No
    c. Not sure
    d. Other: _____

17. [If not answered] Do you plan to install any DHPs in the future? [Probe: Why? Why not?]

18. Is there any additional **training** that would make you more likely to install DHPs?

19. Are there any **resources or support** that might help you to increase the number of ductless heat pumps that you install? [Probe] Specifically, are there any resources that the Project could provide?

20. Do you have any comments- positive or negative- about the Northwest Ductless Heat Pump Project or ductless heat pump technology that you would like the Project sponsors to hear?

Thank you for your time.

C WAVE TWO INTERVIEW GUIDES

MANUFACTURER/DISTRIBUTOR INTERVIEW GUIDE - WAVE TWO

Interviewee Name:

Date:

Interviewer:

NW Ductless Heat Pump Project Impressions

1. We spoke to you last year about the Northwest Ductless Heat Pump Project. Have you had any involvement with the Project in 2010?
    a. [IF YES] How has your involvement changed in the past year, if at all?
    b. How has the Project changed or market reaction to the Project changed? [PROBE FOR POSITIVE AND NEGATIVE RESPONSES, INCLUDING RESERVATIONS ABOUT PARTICIPATION PROCESS, INCENTIVE LEVELS, INSTALLER RESPONSE, CONSUMER RESPONSE, OTHER]
    c. How has the Project changed the way you view the DHP market in the NW? How about the overall US market?

2. What do you see as being the major successes or achievements of the Project to date? [PROBE: Evidence of market progress, enhanced understanding of market barriers and opportunities.]
    a. What do you think contributed to these successes?

Interaction

3. Have you had any recent interactions with Project staff related to the Project?

4. [IF MANUFACTURER] Have you made any changes to your post-pilot DHP installation training activities for contractors? [INTERVIEWER LISTEN FOR: IS TRAINING CONDUCTED FACE TO FACE? DO THEY HAVE A NW TRAINING FACILITY? DO THEY CONDUCT TRAININGS VIA THE WEB? DO THEY FIND IN-PERSON TRAINING TO BE MORE EFFECTIVE THAN WEB-BASED? WHO IS QUALIFIED TO DELIVER TRAININGS? HAVE THEY EXPERIENCED AN INCREASED INTEREST IN TRAININGS AMONG INSTALLERS? HAS INSTALLER INTEREST IN TRAININGS CHANGED FROM 2009 TO 2010?] [PROBE: What is necessary to improve the effectiveness of DHP installation training?]
    a. [IF MANUFACTURER] Have you made any changes to your post-pilot sales training, technical support, and/or service support? [PROBE: What is necessary to improve sales training, technical support, and/or service support?]

5. Have you had any post-pilot issues during 2010? [PROBES: With the rebate mechanism? With NEEA/Fluid management? With the activities of installers? With DHP equipment? Anything else?]

6. Have you had any recent interactions with utilities related to their DHP efforts?

    a. What benefits do the utilities provide through their DHP programs, aside from their provision of incentives?
    b. Have there been any instances in which the messaging or marketing efforts of the utilities have conflicted with the marketing or messaging efforts of your company?
    c. In your opinion, what are the components of an "ideal" utility DHP program?
        i. [PROBE: Would you prefer to reduce your interactions with installers or to defer installer interactions concerning the pilot to the utilities, Fluid, and/or NEEA? Anything else?]

DHP Sales

7. How many DHP models do you have that qualify for NW Ductless Heat Pump Project incentives?

8. What are your most popular DHP models [GET MODEL NAMES]?

9. Has the market share of any of the DHP brands changed in the past year? How so? [PROBE TO GET NUMERICAL ESTIMATES]
    a. What were your projections for the market before the DHP pilot? How about now?
    b. How active were your DHP sales and marketing efforts before the pilot? How has this changed, if at all?

10. Are DHPs cutting into the market share of other HVAC products? If so, which products? [PROBE: Cadet Heaters, ducted systems, others?]

11. What impact has the Project had on sales of residential DHPs?
    a. Since its inception, has the Project impacted the number of DHP units that you…
        I. [MANUFACTURERS ONLY] Manufacture/distribute? [PROBE TO GET NUMERICAL ESTIMATES]
        ii. [MANUFACTURER REPS ONLY] Distribute? [PROBE TO GET NUMERICAL ESTIMATES]
        iii. [DISTRIBUTORS ONLY] The variety of DHP brands/models you carry?

iv. [DISTRIBUTORS ONLY] How many DHP units you keep in stock? [PROBE TO GET NUMERICAL ESTIMATES]

b. [ALL] Have you had any difficulty meeting demand?

12. Has the impact of the Project on residential DHP sales increased, decreased, or stayed the same, since January 1, 2010?
    c. [IF INCREASED OR DECREASED] Why is that?

13. [MANUFACTURERS AND MANUFACTURER REPS ONLY]: What is [COMPANY NAME] thinking about working with retailers to sell DHPs?

DHP Marketing

14. How do you currently market residential DHPs [PROBE: internet, TV, radio, newspaper, magazines?]
    a. Now that the pilot is over, have you altered your marketing? [IF YES] In what ways? [PROBE FOR TYPES AND AMOUNT]
    b. In your opinion, do the utilities or NEEA have opportunities unavailable to manufacturers and distributors to promote DHPs?
        i. [IF YES] What opportunities?
    c. [MANUFACTURER AND MANUFACTURER REPS ONLY] What types of marketing support do you provide to dealers/distributors for marketing residential DHPs?
    d. Do you also rely on contractors to market residential DHPs?
        i. [IF YES] How do you assist contractors in their marketing of residential DHPs? [PROBE: Buy downs/rebates, printed marketing materials, etc.]

Pricing

15. What role did the existing incentive play with regards to the price you charge for DHPs? [PROBE: If there was no incentive, how would the price have changed? If there is a wide range of DHP prices, why?]

16. Do you see any evidence that incentives result in higher prices charged to consumers for DHPs?

17. How have the tax credits influenced your business? [Probe: is this any different now that 2 ton units are included? Have the tax credits had any impact on which models are being sold?]

18. What do you think is the right incentive amount for DHPs? Why?

Technology

19. [MANUFACTURERS] Since the beginning of 2009, what activities has [COMPANY NAME] engaged in to improve DHP performance? [PROBE: Cold weather performance, etc.?]
    a. What entities do you work with to identify performance issues and to improve DHP performance? [[PROBE: NEEA, Fluid, AHAM, DHP installers, manufacturer representatives, distributors?]
    b. Our consumer interviews have identified problems with consumers obtaining replacement remotes and replacement DHP components. Do you offer replacement of all DHP components? What process must the customer follow to get replacement parts?

Future Projections

20. What are your expectations for the future regarding sales volume and/or market share?

    a. Do you anticipate that your company will be able to keep up with market-demand for DHPs?

21. Do DHPs constitute a viable market for you? Do you think the market interest will grow or fade over time?

22. What is your business model with respect to DHPs in the Northwest? Do you see them as an important product line?

23. [DISTRIBUTORS ONLY] Do you currently stock heat pump water heaters? What is your opinion of the market- viability for heat pump water heaters?

Moving Forward

I would like to ask a little about the current state and future of the DHP market.

24. For each of the following market segments I would like to know about the existing market and the market potential.
    - New construction
        a) Current level:
        b) Market barriers and opportunities:
    - Manufactured Housing (new/old)
        a) Current level:
        b) Market barriers and opportunities:
    - Remodels/conversions
        a) Current level:

b) Market barriers and opportunities:

- Small commercial
  a) Current level:
  b) Market barriers and opportunities:

25. How is your company positioning itself moving forward in the DHP market? [Probe: Do they see DHP as a growing opportunity? Do they plan to expand?]

26. So would you say your involvement in the DHP market going forward – is strong/moving forward or cautious?

27. What conditions are necessary or market barriers need to be addressed, to increase market adoption of DHPs in the Pacific Northwest?
    a. [IF NOT ADDRESSED] What is your role in this regard? [IF NOT ADDRESSED] What activities should NEEA engage in?
    b. [IF NOT ADDRESSED] What role(s) should Fluid play in this regard? What activities should Fluid engage in?
    c. [IF NOT ADDRESSED] What role(s) should utilities play in this regard? What activities should utilities engage in?
    d. [IF NOT ADDRESSED] What role(s) should DHP installers play in this regard? What activities should installers engage in?

28. Are you aware of any market opportunities that the pilot has not addressed? [Missed opportunities].

General

29. What have you learned from the Project? [PROBE: Project staff, utility involvement, manufacturers, distributors, manufacturer representatives, installers, residential customers]
    a. What aspects of the Project have been most beneficial for your company? Any issues?

30. Do you have any other thoughts or comments about the NW Ductless Heat Pump Project?

UTILITY INTERVIEW GUIDE - WAVE TWO

Interviewee Name:

Date:

Interviewer:

NW Ductless Heat Pump Project Impressions

1. How has your role as manager of your utility's DHP program changed since we last spoke in the fall of 2009? [PROBE FOR DETAIL]

2. Have any changes been made to your utility's DHP program since we last spoke?
    a. [PROBES: Changes to incentive amount? Changes to customer application process? Pre-approval process changes? Changes to customer eligibility requirements? Changes to customer application? Changes to or new marketing initiatives?]

3. What do you see as being the major successes or achievements to date in promoting DHPs to the region?
    a. What factors do you think contributed to these successes?

4. What are the main challenges you are facing in 2010?
    a. How have you addressed these challenges?
        i. Have any new challenges developed since we last spoke? How have you addressed these challenges?

Interaction

5. Have you had any interactions in 2010 with NEEA and/or Fluid staff related to your utility's DHP program? [CLARIFY IF INTERACTION WAS WITH FLUID OR NEEA STAFF].
    a. [IF YES] Have your interactions with Project staff changed since we last spoke?

6. Have you had any interactions in 2010 with DHP installers?
    a. [IF YES] How have your interactions with DHP installers changed since we last spoke? [Probe for detail]

7. Does your utility designate "preferred contractors" or recommend any contractors to customers?
    a. Do you think the installers in your territory are providing quality installations?

8. Have you had any interactions in 2010 with DHP manufacturers or their reps and distributors?
    a. [IF YES] Have your interactions with DHP manufacturers (and reps and distributors) changed since we last spoke? [Probe for detail]

9. Do you interact with other utilities concerning their DHP programs?
    a. What about?
    b. How frequently?
    c. Have you engaged in any activities to help other utilities with their DHP programs?
    d. How do other utilities keep you informed of their DHP program activities?
    e. Have your interactions with other utilities changed since we last spoke?

DHP Installations

10. Has your utility met its DHP pilot goals regarding the total number of DHPs installed?
    a. [IF YES] What factors contributed to meeting the goals?
    b. [IF NO] What factors do you attribute your utility having not met the goals?
        i. [COLDER CLIMATE UTILITIES] Do you think that the climatic conditions within your service territory are a barrier to DHP sales?

11. Do you have 2010 goals in addition to the pilot goals?
    a. [IF YES] What are these goals (numerically, or simply "higher/lower" than pilot, perhaps with percentage)?
    b. Are you on track to meeting your 2010 goals?

12. Have you attended a Project QA onsite DHP installation inspection?
    a. [IF YES] What is your feedback about the inspection?
    b. The inspector?

13. Can you describe your interactions with these installers during 2010? Any issues? [PROBE: Level of quality of DHP installations? Installers degree of knowledgeability about DHPs and DHP installation? Adequacy of DHP training?]

14. How would you describe the level of consumer demand for DHPs been in your service territory? [PROBE: Does utility receive a large volume of inquiries regarding DHPs and the utility DHP program?] Has your utility program been able to meet this level of consumer demand?
    a. [IF YES] What factors contributed to your utility program being able to meet consumer demand for DHPs in your service territory? [PROBE: Sufficient number of installers and other market actors marketing DHPs? Adequate DHP supply relative to consumer demand for DHPs, etc]

b. [IF NO] Why was your utility program not able to meet consumer demand for DHPs in your service territory? PROBE: Insufficient number of installers and other market actors marketing DHPs? Inadequate DHP supply relative to consumer demand for DHPs, etc.]
c. How closely are the resources provided through the NW Ductless Heat Pump Project aligned with consumer demand for DHP technology in your service territory?

15. What is the typical cost of a DHP installation in your territory?
    a. Have you noticed any factors that lead to differing costs, such as brand, installer, location?
    b. Has the typical cost changed over the past year?
        i. [IF YES] What factors have contributed to this change? [PROBE: DHP brand? Inflation? Contractor cost?]
    c. Is the typical cost of a DHP installation in your service territory different from other service territories or regions?
        i. [IF YES] Do you have any insights or concerns as to why your costs may differ from that of other service territories or regions?

16. What do you think is the right incentive amount for DHPs in the residential sector? Why?
    a. What market conditions do you think should be tracked to inform a decision about changing the incentive?

17. What feedback have you received from consumers?
    a. Which of this feedback, if any, occurred since we last spoke in fall 2009?

Marketing

18. What additional marketing activities have you done for the heat pump program in 2010?
    a. Considering your marketing activities in both 2009 and 2010, which have been most successful?
    b. Which activities in 2009 and 2010 have been least successful?
    c. Have these activities led to any "lessons learned" regarding marketing DHPs?
        i. [IF YES] What?
    d. Have there been any efforts to market DHPs to specific demographics?
        i. [IF YES] Why? What have you learned about the targeted demographic(s)?
        ii. [ASK ALL] Do you maintain demographic information for your DHP customers?

19. Have there been any changes to your utility's use of the Project implementation team for assistance and support since we last spoke in the fall of 2009?

Future Projections

20. Do DHPs constitute a viable market in your utility's service territory? Do you think the market interest in your utility's service territory will grow or fade over time?

21. What do you consider to be "good" and "cost-effective" applications for DHPs?
    a. [IF NOT ANSWERED] What do you think are good subsectors within the residential sector—by housing type, heating equipment type, etc?
    b. Do you have any information concerning the demographic characteristics of individuals that have participated in your utility's DHP program?
        a. [IF YES] Can you provide this information?

22. The Project primarily targets existing single-family, site-built homes using electric heat and secondarily targets existing manufactured homes using electric heat. Does your utility intend to target additional types of homes post-pilot?
    a. Is your utility targeting commercial customers for DHP installations?
    b. Multi-family residences?
    c. Manufactured homes?
23. [IF NOT ANSWERED] Which additional market segments have potential for uptake of DHPs? What conditions are necessary or market barriers need to be addressed, to increase market adoption of DHPs in the Pacific Northwest and in your service territory in particular?
    a. [PROBES: Continued (or modified) consumer incentive program? Continued upstream market support targeting installers and manufacturers (and manufacturer reps and distributors)? Additional training to enable/motivate contractors to market and install DHPs? Marketing activities (targeting consumers and/or installers)?]
    b. [PROBES: Market research into the technical potential, market constraints, and market needs of DHP submarkets (including new and existing manufactured housing, residential new construction, home remodels and conversions, and small commercial property owners)?]
        i. [IF NOT ADDRESSED] With regards to addressing each of the market barriers, what roles and activities do you see for the various actors in the Project—that is NEEA, Fluid, the utilities, the manufacturers (and manufacturer reps and distributors), the installers?
    c. [IF NOT ADDRESSED] How can NEEA design programs to meet the needs of the market?
    d. [IF NOT ADDRESSED] What types of marketing activities would be most helpful for NEEA to engage in?

General

24. Aside from the issues we have already talked about, what lessons have you learned from your involvement with the Project so far? [PROBE: Project staff, utility involvement, the manufacturers (and reps and distributors), installers, residential customers]

25. Do you have any final comments – either positive or negative, that you'd like to share about your utility's involvement in the Project?

NEEA PROJECT STAFF INTERVIEW GUIDE (NEEA AND FLUID) - WAVE TWO

Interviewee Name:

Date:

Interviewer:

Project Management

1. NEEA: How has your role as a manager of the Northwest Ductless Heat Pump Project changed in this second phase of the Project?
   FLUID: How has Fluid's role in the Northwest Ductless Heat Pump Project changed in this second phase of the Project? [Probe for detail]
   a. FLUID: Related to these changes, how has *your* role changed, specifically?[Probe for detail]

2. What do you see as being the Project's major successes or achievements to date? [PROBE: Evidence of market progress, enhanced understanding of market barriers and opportunities, successes associated with metering effort to address energy savings performance questions, strengthened relationships with market actors, etc.]
   a. What do you think contributed to these successes?

3. What are the main challenges you have faced? [PROBE: Challenges regarding market barriers and opportunities, challenges associated with metering effort to address energy savings performance questions, challenges associated with strengthening relationships with market actors, etc.]
   a. How have you addressed these challenges?
   b. [If not addressed] Do you anticipate any future challenges associated with market adoption of DHPs in the Pacific Northwest? [PROBE: Issues that may arise further along the market adoption curve? How might these challenges be addressed?]

4. The first phase of the Project primarily targeted existing single-family, site-built homes using electric heat and secondarily targeted existing manufactured homes using electric heat. Have there been any changes to the market sector(s) targeted in phase II? What changes?
   a. [IF YES] What prompted these changes?

5. What are the plans for phase II of the Project? [IF NOT ADDRESSED] What role does NEEA expect to play in regards to increased market adoption of DHPs in the Pacific Northwest? What assistance will FLUID provide?
    a. Related to these activities, what will *your* role be, specifically?

6. What conditions are necessary or market barriers need to be addressed, to increase market adoption of DHPs in the Pacific Northwest?
    a. [PROBES: Continued (or modified) consumer incentive program? Continued upstream market support targeting installers and manufacturers (and reps and distributors)? Marketing activities (targeting consumers and/or installers)?]
    b. [PROBES: Market research into the technical potential, market constraints and market needs of DHP submarkets (including new and existing manufactured housing, residential new construction, home remodels and conversions, and small commercial property owners)?]
        i. [IF NOT ADDRESSED] With regards to addressing each of the market barriers, what roles and activities do you see for the various actors in the Pilot—that is NEEA, Fluid, the utilities, the manufacturers (and reps and distributors), and installers?

7. What is NEEA's/FLUID's thinking about working with retailers to sell DHPs?

Marketing

8. What marketing activities have you conducted or will you be conducting for the second phase of the Project?
    a. Which activities have been most successful?
    b. Which activities have been least successful?
    c. Have the activities led to any "lessons learned" regarding marketing DHPs? [If yes] What?
        i. [IF NOT ADDRESSED, PROBE: Have the marketing activities of individual utilities led to any "lessons learned" regarding marketing DHPs? Targeting manufactured homes, for instance.]
    d. How are these marketing activities different from phase 1 efforts?
        ii. [PROBES: Have there been any efforts to reach a younger demographic? To provide prospective customers with the ability to see functioning DHP units? To promote targeted marketing during weather extremes?]

9. What do you consider to be the ideal incentive amount for DHPs marketed through the Project?
    a. PROBE: Does the ideal incentive amount vary by geographic area, etc?

Interactions

10. Have your interactions with FLUID/NEEA changed in the second phase of the Project? Any issues?
    a. FLUID: Have management directives been clear and reasonable?
    b. FLUID: Have expectations been clear and reasonable?
    c. BOTH: Have any issues come up?
        i. [If yes] How have the issues been resolved?

11. Have your interactions with installers changed in the second phase of the Project? Any issues?

12. During the second phase, how frequently are installer orientation sessions offered? [PROBE: Has the frequency with which orientation sessions are offered changed in the second phase?]
    a. Have there been any changes made to the orientation sessions during the second phase of the Project?

13. FLUID: Have your interactions with installers changed in the second phase of the Project? Any issues?
    a. [IF NOT ADDRESSED] How would you describe the types of feedback you have received from installers during the second phase of the Project?
        i. [PROBES: regarding the DHP market, regarding DHP orientation sessions, regarding DHP manufacturer training, regarding current market conditions, regarding their interaction with utilities, regarding consumer satisfaction, etc.]
14. Have your interactions with utilities changed in the second phase of the Project? Any issues?
    a. How have the utility DHP programs changed in the second phase of the Project?
    b. The evaluation of phase I of the Project found that pre-approval processes received more negative reviews than positive ones in terms of their effectiveness and efficiency. What is the current status of pre-approval processing of DHP Project applications? Has anything changed?

15. Have your interactions with DHP manufacturers (also: manufacturer representatives or distributors) changed in the second phase of the Project? Any issues?
    a. Are you aware of any changes that have been made to DHP manufacturer trainings? [PROBE: Have manufacturers provided an increased emphasis on the importance of

conveying to consumers proper maintenance of DHP units (specifically how/when to clean the filters?)

16. How well do you think the 2009 DHP Workshop met your goals for the workshop?
    a. [IF SOME WORKSHOP GOALS WERE NOT ADDRESSED] How might the Project address these goals in the future?

17. Have you received any feedback from consumers during the second phase of the Project? [IF SO, please describe what they said].

General Comments

In this final set of questions, think about what the market needs in order to increase market adoption of DHPs in the Pacific Northwest.

18. How effective do you think the second phase of the Project has been?

19. Aside from the issues we have already talked about, what lessons have you learned from your involvement with the Project so far?

20. Aside from the obstacles we have already talked about, have you noticed any additional obstacles with the program so far?

21. Do you have any final comments – either positive or negative, that you'd like to share about the Project?

November 30, 2011
REPORT #E11-232

Northwest Residential Code Savings for Idaho, Montana and Washington

Prepared by:
Ecotope, Inc.
4056 9th Avenue NE.
Seattle, WA 98105

Northwest Energy Efficiency Alliance
PHONE
503-688-5400
FAX
503-688-5447
EMAIL
info@neea.org

ECOTOPE
CONSULTING
RESEARCH
DESIGN

4056 9TH AVENUE NE SEATTLE, WA 98105
(206) 322-3753 FAX: (206) 325-7270

Date: 3/01/2011
To: Aaron James, Northwest Energy Efficiency Alliance
From: Ben Larson and Virginia Mugford, Ecotope
Re: NW Residential Code Savings Contract #: 40320

Overview

Ecotope has completed a final estimate of the site energy savings realized in 2010 for new Idaho, Washington, and Montana houses. Houses built in 2010 under the code effective in each state for 2010 were evaluated and compared to results for the same houses built under the previously effective code. The relevant codes were as follows:

Table 1. State by State Code History and Savings Estimate.

State	Code in 2010	Previous Code	Savings
Idaho	IECC 2006	IECC 2003	1.8%
Washington	WSEC 2006	WSEC 2003	4.6%
Montana	IECC 2003 w/ MT amend.	MEC 1996 w/ MT amend.	7.4%

Using census[1] data and other sources[2] to characterize the three states' new construction markets, the analysis showed how much less energy would be consumed by houses built in 2010 to the code in force, as compared to the previously effective code. The energy end-uses considered in the house were space heating, space cooling, ventilation, domestic water heating, and lighting. Ecotope's analysis shows a predicted three-state savings of 4.2% from code improvements (accounting only for heating, cooling, ventilation, lighting, and water heating energy use). In energy terms, this amounts to a total savings of about 4,704 MWh (537 average kW) and 732,483 therms for the approximately 27,000 housing units expected to be completed in 2010.

This memo explains the methodology and results for the code analysis of Idaho, Washington and Montana. It contains the deliverables for Tasks 1, 2 and 3.

[1] http://censtats.census.gov/bldg/bldgprmt.shtml

[2] Single-Family Residential New Construction Characteristics and Practices Study. March 27, 2007. Prepared for Northwest Energy Efficiency Alliance by RLW Analytics. http://neea.org/research/reportdetail.aspx?ID=191

Multi-Family Residential New Construction Characteristics and Practices Study. June 14, 2007. Prepared for Northwest Energy Efficiency Alliance by RLW Analytics. http://neea.org/research/reportdetail.aspx?ID=193

The analysis approach used here is the same methodology approved by the Regional Technical Forum to estimate savings of the proposed 2011 ORSC[3]. Where necessary, it has been adapted to suit the investigated codes. Broadly, the analysis methodology is to develop a representative set of prototypical houses whose energy use can be estimated through simulation tools. These representative characteristics include climate, single or multi- family occupancy, house size, ground contact type (slab, crawl, or basement), and heating system type. Since we are analyzing the 2010 construction year, we used the same housing stock characteristics for both the old and in-force codes. The housing population consists of the number and geographic distribution of houses specific to 2010 within each state.

Energy Use Calculations

The building energy use was predicted by a combination of numerical simulations and engineering calculations. SEEM (Simplified Energy and Enthalpy Model) was used to simulate heating, cooling, and ventilation energy use. The program combines building shell characteristics, thermostat settings, occupant behavior inputs, descriptions of heating and cooling systems, and duct distribution efficiency to develop an overall estimate of energy requirements of a house. Additionally, engineering calculations calibrated by field studies were employed to determine the energy use for lighting and water heating. Lighting energy calculations were done using a lighting power density method corresponding to the level of regular and high efficacy lights required by the codes. This method assumes all lamps in the house operate 1.5 hours per day throughout the year[4]. Water heating energy was calibrated to the equivalent of 22 gals per day per occupant. Occupancy varies with house size and construction type (either single family or multi-family).

Importantly, this analysis includes only regulated loads: space heating and cooling, water heating, lighting and ventilation. Loads not regulated by the code, including appliances and plug loads are excluded from the analysis. Since they are not regulated, there will be no savings from them year over year due to code changes. Ventilation, while not specifically regulated, is included because it is part of our standard energy-use modeling suite. No savings are attributed to ventilation savings but they do contribute to the total predicted energy use of the home.

SEEM (version 0.93), the residential energy-simulation program used for the analysis was developed by and for the Northwest Power and Conservation Council and the Northwest Energy Efficiency Alliance (NEEA), and written by Larry Palmiter of Ecotope. It is the simulation engine used to provide heating and cooling energy savings estimates for the residential sector in the Northwest Power Plan, for the Performance Tested Comfort System (PTCS) incentive program, as well as numerous other utility program offerings. SEEM is also used extensively to support state building energy code revisions including, most recently, the revised Washington State Energy Code and Oregon Residential Specialty Code.

The SEEM program consists of an hourly thermal simulation and an hourly moisture (humidity) simulation that interact with ducts, equipment, building shell and weather parameters to calculate the space conditioning requirements of the building. It is based on algorithms consistent with current American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), American Heating and Refrigeration Institute (AHRI), and International Organization for Standards (ISO) calculation standards. The simulation generates outputs used in this analysis; they include building heat

[3] RTF Meeting 9/2010. http://www.nwcouncil.org/energy/rtf/meetings/2010/09/Default.htm

[4] RTF Meeting 9/2010: http://www.nwcouncil.org/energy/rtf/meetings/2010/09/Default.htm

loss (UA), heating equipment input energy, and cooling equipment input energy.

The weather files used in all savings simulations are composite TMY weather files corresponding to the heating and cooling climate zones assigned to each Northwest county by the Regional Technical Forum (RTF).[5]

Four distinct building prototypes were used in the SEEM simulations: a 1344 ft^2 (square foot) ranch style home, a 2200 ft^2 split level home, a 2688 ft^2 home with a full conditioned basement, and 952 ft^2 unit in an eight-unit townhouse structure. These are standard analytical prototypes used by the Northwest Power and Conservation Council to develop and evaluate energy forecasts and conservation plans for the region's utilities. The 952 ft^2 prototype is a special case in this analysis which represents multifamily construction. The state codes regulate multifamily structures three stories or less which the 952 ft^2 prototype represents well. This type of construction has many shared walls so the overall heating load per unit is less than for a single family detached dwelling.

Estimation of 2010 New Building Stock

At the time of this analysis, monthly housing starts census data for 13 of the 139 state counties were available for January through December of 2010.

Table 2. Counties Reporting 2010 Housing Starts by State.

State	Reporting Counties	Total Counties
Idaho	5	44
Washington	6	39
Montana	2	56

The totals covering all counties in 2010 will be available in May 2011. In lieu of these totals, we conducted an estimate of the 2010 totals based upon the known data from 2010, scaling it in proportion to 2009 data. The total number of units estimated to be built in 2010 is 27,123 (21,578 single family units and 5,545 multifamily units). Throughout the analysis, the single family units are detached structures while the multifamily units come eight to a building. The breakdown by state is as follows:

Table 3. Housing Start Estimates by State.

State	Single Family	Multifamily (units)	Total
Idaho	4042	421	4463
Washington	16299	4923	21222
Montana	1238	200	1438

* Note that in Montana, only the housing starts in the 23 counties served by NEEA utilities were totaled above and evaluated in the code analysis, although all Montana counties were used in determining the ratio for housing allocation in 2010.

The total yearly figures for every county in each state were available for 2009. Using the 2009 and 2010 datasets, the expected total new single family housing stock for 2010 was estimated as follows.

The counties for which no 2010 data was available were estimated based upon their 2009 figures. A ratio

[5] http://www.nwcouncil.org/energy/rtf/zones/zonemapsx.htm

between each state's characterized county totals in 2009 and the entire statewide 2009 total was determined and used to extrapolate total 2010 total housing starts, based upon the 2010 subtotals for the known counties. The percentage of housing starts in each county during 2009 over the 2009 state total was then determined. Using this ratio, the extrapolated 2010 total was apportioned to each county in the state following the 2009 distribution. These extrapolated totals were then compared to historical behavior for each state, and it was noted that while distributions in Montana remained consistent with historical figures, multifamily housing starts increased drastically and were highly variable in urban Washington and Idaho counties in 2010. Multifamily starts were noted to have varied widely from year to year in these states, however, applying 2010 behavior in known counties to all counties' 2009 ratios resulted in multifamily housing increases of three times any historical figure in these states. The best prediction of current multifamily housing starts behavior in rural counties was assumed to be rural counties' past behavior and not present behavior of urban counties, and so the 2009 multifamily figures were used for all counties in Idaho and Washington that did not report monthly data in 2010.

The estimated new housing in each county was assigned to an appropriate representative heating and cooling climate zone combination as designated by the Regional Technical Forum.[6]

Savings from New Building Construction

The history of change to each state's building codes is outlined by the US Department of Energy[7] in the state's "BACKGROUND/HISTORY' section. In general, code changes include prescribed improvements of envelope insulation as well as lighting, heating and cooling efficiency. While insulation requirements changed in each evaluated code cycle, lighting was not regulated in the state codes considered in this analysis. Regulation of residential lighting does not start to occur until the 2008 OR, 2010 WA, and 2009 IECC codes. Lighting power density was therefore calculated using an assumption of zero percent high efficiency lighting (CFLs). Heating and cooling system efficiencies did change with code adoptions in each state; however, these codes are superseded by the National Appliance Energy Conservation Act (NAECA) which required HSPF 7.7 / SEER 13 or better and AFUE of 0.78 or better in 2010. These federal standards are not attributable to state code improvements, and so heating and cooling efficiencies were held constant at 2010 federal levels in all analyses. Water heater efficiency standards are similarly regulated under NAECA. Likewise, the federal requirements for water heating equipment in 2010 were used in the analysis. The changes in each code cycle due to envelope improvements were thus the only source of energy savings in each state. A summary of these envelope changes by state is included in Table 4.

[6] Ibid.

[7] http://www.energycodes.gov/states/

Table 4. State by State Code Mandated Envelope Insulation.

Envelope Component	Idaho		Washington		Montana	
	IECC 2006	IECC 2003	WSEC 2006	WSEC 2003	IECC 2003	MEC 1996
Glazing U-value	0.35	0.35	0.35	0.35-0.40	0.35	0.4
Door U-value	0.70	0.70	0.20	0.46	0.35	.5
Ceiling insulation*	R-45.74*	R-40.67*	R-38	R-38	R-38 Adv Rsd Heel	R-38
Wall Insulation*	R-19	R-20.1*	R-21	R-19	R-21	R-19
Floor Insulation	R-30	R-21	R-30	R-30	R-21	R-19
Slab Insulation	R-10	R-10	U-0.36	U-0.54	R-19	R-19
Basement Wall Insulation	R-13	R-10	R-15	R-10	R-11	R-10

* A change in the IECC climate zones classifications for Idaho counties between 2003 and 2006 necessitated the calculation of a composite insulation value here. See discussion below.

With adoption of the 2006 IECC, Idaho counties were redistricted into less detailed climate zone assignments. This redistricting reduced wall insulation requirements in many counties. To account for this unusual circumstance, net weighted insulation values for ceilings and walls were calculated and are included above. These weighted values take into account the county based climate assignment, the insulation level for that climate and the number of houses built in each county in 2010. As seen above, there was a net loss in wall insulation due to this reclassification of climate zones. Effective ceiling insulation increased under this change; however ceilings represent both a smaller percentage of house area exposed to heat loss, and a diminishing return in terms of effectiveness of increased insulation at these high R values. This net loss in insulation is reflected in the lower code savings results for Idaho state.

A side by side comparison of energy use in each state under the existing and previous code follows. Idaho realized the least energy savings from code improvements, at 1.8%. Idaho showed the least savings due to the net loss of insulation value under climate rezoning. Washington's energy savings was 4.6%. Montana realized a savings of 7.4%, a larger value that reflects the gap of approximately nine years between the two code changes in this state.

Table 5. Idaho Statewide Residential 2010 New Construction Energy Use IECC 2006/IECC 2003

Idaho	IECC 2006 Code			IECC 2003 Code		
	Gas (therms)	Electric (kWh)	**Total (kBtu)**	Gas (therms)	Electric (kWh)	**Total (kBtu)**
State Total	3,359,826	26,820,138	427,492,873	3,427,957	27,040,833	435,059,042
Per ft^2 Built	0.374	2.989	47.645	0.382	3.014	48.488
Per Unit Built	753	6,009	95,775	768	6,058	97,471

Table 6. Idaho Site Energy Savings for 2010 New Construction IECC 2006/IECC 2003

Idaho	Gas (therms)	Electric (kWh)	**Total (kBtu)**
State Total	68,132	220,695	7,566,169
Per ft^2 Built	0.008	0.025	0.843
Per Unit Built	15	49	1,695
% Savings	2.0%	0.8%	1.8%

Table 7. Washington Statewide Residential 2010 New Construction Site Energy Use WSEC 2006/WSEC 2003

Washington	WSEC 2006 Code			WESC 2003 Code		
	Gas (therms)	Electric (kWh)	**Total (kBtu)**	Gas (therms)	Electric (kWh)	**Total (kBtu)**
State Total	11,037,993	124,137,724	1,527,357,260	11,607,782	127,907,990	1,597,200,232
Per ft^2 Built	0.281	3.163	38.918	0.296	3.259	40.698
Per Unit Built	520	5,850	71,971	547	6,027	75,262

Table 8. Washington Site Energy Savings for 2010 New Construction WSEC 2006/WSEC 2003

Washington	Gas (therms)	Electric (kWh)	**Total (kBtu)**
State Total	569,788	3,770,266	69,842,972
Per ft^2 Built	0.015	0.096	1.780
Per Unit Built	27	178	3,291
% Savings	5.2%	3.0%	4.6%

Table 9. Montana Statewide Residential 2010 New Construction Site Energy Use IECC 2003/MEC 1996

Montana	IECC 2003 Code			MEC 1996 Code		
	Gas (therms)	Electric (kWh)	**Total (kBtu)**	Gas (therms)	Electric (kWh)	**Total (kBtu)**
State Total	1,287,479	9,249,092	160,305,853	1,382,043	9,961,988	172,194,552
Per ft^2 Built	0.457	3.285	56.931	0.491	3.538	61.153
Per Unit Built	895	6,431	111,469	961	6,927	119,736

Table 10. Montana Site Energy Savings for 2010 New Construction IECC 2003/MEC 1996

Montana	Gas (therms)	Electric (kWh)	**Total (kBtu)**
State Total	94,563	712,895	11,888,699
Per ft^2 Built	0.034	0.253	4.222
Per Unit Built	66	496	8,267
% Savings	7.3%	7.7%	7.4%

Formulas for State Code Calculations: Idaho, Washington and Montana

The state-wide energy use for houses built under either code can be calculated on a square-foot or unit construction basis using the information from Tables 5, 7, & 9 for Idaho, Washington, and Montana Respectively. These formulas will be particularly useful if the total housing starts reported for 2010 (expected announcement in May 2011) differ substantially from our predictions. In that case, a new total energy use can be calculated by using the new total number of units built in 2010. This assumes the distribution of houses by climate remains similar between predicted and reported value, which, given the way in which we determined the distribution is likely to be the case

Idaho

2003 Code Energy Use Formulas:

0.382 therms/ ft^2 * Total New Construction Area (ft^2) = Total therms in 2010
3.014 kWh/ ft^2 * Total New Construction Area (ft^2) = Total kWh in 2010

768 therms/unit * Total Number of Units Built = Total therms in 2010
6,058 kWh/unit * Total Number of Units Built = Total kWh in 2010

2006 Code Energy Use Formulas:

0.374 therms/ ft^2 * Total New Construction Area (ft^2) = Total therms in 2010
2.989 kWh/ ft^2 * Total New Construction Area (ft^2) = Total kWh in 2010

753 therms/unit * Total Number of Units Built = Total therms in 2010
6,009 kWh/unit * Total Number of Units Built = Total kWh in 2010

Washington

2003 Code Energy Use Formulas:

0.296 therms/ ft^2 * Total New Construction Area (ft^2) = Total therms in 2010
3.259 kWh/ ft^2 * Total New Construction Area (ft^2) = Total kWh in 2010

547 therms/unit * Total Number of Units Built = Total therms in 2010
6,027kWh/unit * Total Number of Units Built = Total kWh in 2010

2006 Code Energy Use Formulas:

0.281 therms/ ft^2 * Total New Construction Area (ft^2) = Total therms in 2010
3.163 kWh/ ft^2 * Total New Construction Area (ft^2) = Total kWh in 2010

520 therms/unit * Total Number of Units Built = Total therms in 2010
5,850 kWh/unit * Total Number of Units Built = Total kWh in 2010

Montana

1996 Code Energy Use Formulas:

0.491 therms/ ft^2 * Total New Construction Area (ft^2) = Total therms in 2010
3.538 kWh/ ft^2 * Total New Construction Area (ft^2) = Total kWh in 2010

961 therms/unit * Total Number of Units Built = Total therms in 2010
6,927 kWh/unit * Total Number of Units Built = Total kWh in 2010

2003 Code Energy Use Formulas:

0.457 therms/ ft^2 * Total New Construction Area (ft^2) = Total therms in 2010
3.285 kWh/ ft^2 * Total New Construction Area (ft^2) = Total kWh in 2010

895 therms/unit * Total Number of Units Built = Total therms in 2010
6,431 kWh/unit * Total Number of Units Built = Total kWh in 2010

Reference Analysis Files

The spreadsheets used to conduct the analysis for both the OR code savings and EnergyStar savings are attached to this memo transmittal. The “Tables” sheet in the file contains the summary data used to produce the tables in this memo.

2010 Code Savings:
WA_ID_MT_code_comparison.xls

Housing Census Data:
WA_Monthly_Data.xls
ID_Monthly_Data.xls
MT_Monthly_Data.xls

Appendix: Detailed Tables and Discussion of Results

The following Appendices give detailed tables of codes savings and system type distributions amongst climate zones for each state based upon 2010 housing starts. Not all climate zone combinations are present in every state. Of the nine possible combinations of heating and cooling climate zones, each state analyzed had counties assigned to six. In several cases, there were no estimated 2010 housing units built in a given climate zone combination. These fields are left blank in the tables below. In addition, electrically heated zonal and heat pump houses use no gas so the therm usage for these fields in the table are also left blank.

In Tables A3 and B3 which follow, it is noted that code changes between IECC 2003 and 2006 in Idaho, and between WSEC 2006 and 2003 in Washington have resulted a slight electricity loss rather than savings for some houses employing gas furnaces with air conditioning. Although the simulations predict an overall decrease in combined energy (gas and electricity site consumption) for every prototype, the interaction of the cooling system with the changes in insulation requirements have resulted in moderately increased electricity use. For example, buildings with little insulation between the house and ground benefit from cooler earth in the summer and require less cooling. Therefore, increasing the insulation in the floor, slabs, and basements of houses can have the effect of increasing the cooling load. Heating dominates the energy use of the houses in our simulations, however, and that use is always reduced by increasing insulation levels. Further, in these code cycles, the only changes effecting electricity use in gas furnace houses were items which reduced cooling use and heating system (furnace fan) run time. There are no other changes influencing electricity use which is why we see the slight negative numbers for some houses. In contrast, houses with electric heating: heat pumps and zonal resistance, the insulation effects on heating load are large and show significant electric savings. Lastly, these effects are present in all of the code models (ID, WA, and MT) and all climate zones but are only apparent in certain situations when individual end uses are examined separately.

In Summary:
Appendix Tables A1 through A7 outline Idaho Code Savings in 2010.
Appendix Tables B1 through B7 outline Washington Code Savings in 2010.
Appendix Tables C1 through C7 outline Montana Code savings in 2010.

The tables are arranged as follows in each section:
Table 1: Total Electric Energy Use
Total energy use by each system type in each climate zone for the state under the then extant code and the preceding code.

Table 2: Per Unit Electric Energy Use
Per unit energy use by each system type in each climate zone for the state under the then extant code and the preceding code.

Table 3: Total and per Unit Electric Energy Savings
Total energy savings from code change for each system type in each climate, followed by per housing unit savings for each system type in each climate.

Table 4: Total Gas Energy Use
Total energy use by each system type in each climate zone for the state under the then extant code and the preceding code.

Table 5: Per Unit Gas Energy Use
Per unit energy use by each system type in each climate zone for the state under the then extant code and the preceding code.

Table 6: Total and per Unit Gas Energy Savings
Total energy savings from code change for each system type in each climate, followed by per housing unit savings for each system type in each climate.

Table 7: Total Housing Units per state
The distribution and counts of estimated housing units built as each system type in each climate zone in 2010.

Table A1. 2010 Idaho New Construction Site Energy Use by System Type and Climate: Electric Energy Totals

Electric Site Energy 2010		Idaho IECC 2006						Total Units per System Type
		Heating Zone1	Heating Zone2			Heating Zone3		
		Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	
Single Family KWh	Gas	296,231	21,139	261,852	34,557	80,499	46,415	263
	Gas with AC	5,575,656	290,145	4,057,248	623,863	1,083,941	701,845	3,214
	Heat pump	1,725,742	140,827	1,785,405	243,434	618,665	363,517	283
	Zonal	1,795,019	151,096	1,871,650	247,001	632,342	364,607	283
Multi Family KWh	Gas	8,513	34,798	14,499		19,040		51
	Gas with AC	28,033	72,039	35,860		37,873		84
	Heat pump	25,824	116,886	50,171		73,036		21
	Zonal	305,561	1,482,048	617,520		885,742		265

Electric Site Energy 2010		Idaho IECC 2003						Total Units per System Type
		Heating Zone1	Heating Zone2			Heating Zone3		
		Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	
Single Family KWh	Gas	297,826	21,276	263,543	34,780	81,082	46,752	263
	Gas with AC	5,570,440	290,250	4,055,488	623,759	1,085,243	702,088	3,214
	Heat pump	1,743,472	142,529	1,806,219	246,192	626,541	368,014	283
	Zonal	1,833,194	154,405	1,912,632	252,410	646,598	372,827	283
Multi Family KWh	Gas	8,555	34,995	14,581		19,158		51
	Gas with AC	27,943	71,817	35,747		37,784		84
	Heat pump	25,985	117,725	50,515		73,562		21
	Zonal	310,470	1,506,270	627,613		900,556		265

Table A2. 2010 Idaho New Construction Site Energy Use by System Type and Climate: Electric Energy per Unit

Electric Unit Energy 2010		Idaho IECC 2006					
		Heating Zone1	Heating Zone2			Heating Zone3	
		Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2
Single Family per Unit KWh	Gas	2,650	2,890	2,890	2,890	3,088	3,088
	Gas with AC	4,078	3,243	3,661	4,266	3,399	3,817
	Heat pump	14,336	17,877	18,297	18,904	22,035	22,454
	Zonal	14,912	19,181	19,181	19,181	22,522	22,522
Multi Family per Unit KWh	Gas	1,339	1,510	1,510		1,653	
	Gas with AC	2,645	1,876	2,241		1,973	
	Heat pump	9,745	12,176	12,543		15,216	
	Zonal	9,151	12,252	12,252		14,645	

Electric Unit Energy 2010		Idaho IECC 2003					
		Heating Zone1	Heating Zone2			Heating Zone3	
		Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2
Single Family per Unit KWh	Gas	2,664	2,909	2,909	2,909	3,110	3,110
	Gas with AC	4,075	3,244	3,659	4,265	3,403	3,819
	Heat pump	14,484	18,093	18,510	19,118	22,315	22,732
	Zonal	15,229	19,601	19,601	19,601	23,030	23,030
Multi Family per Unit KWh	Gas	1,345	1,519	1,519		1,663	
	Gas with AC	2,636	1,870	2,234		1,968	
	Heat pump	9,806	12,263	12,629		15,325	
	Zonal	9,298	12,453	12,453		14,890	

Table A3. 2010 Idaho New Construction Site Energy Savings by System Type and Climate: Electric Energy

Electric Total Energy Savings 2010		Idaho Total Savings						Total Units per System Type
		Heating Zone1	Heating Zone2			Heating Zone3		
		Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	
Single Family KWh	Gas	1,594	137	1,691	223	583	336	263
	Gas with AC	-5,216	105	-1,760	-105	1,302	243	3,214
	Heat pump	17,730	1,702	20,814	2,758	7,876	4,497	283
	Zonal	38,176	3,308	40,982	5,408	14,256	8,220	283
Multi Family KWh	Gas	42	197	82		118		51
	Gas with AC	-91	-222	-113		-89		84
	Heat pump	161	839	345		525		21
	Zonal	4,910	24,222	10,092		14,815		265

Electric Unit Energy Savings 2010		Idaho per Unit Savings					
		Heating Zone1	Heating Zone2			Heating Zone3	
		Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2
Single Family per Unit KWh	Gas	14	19	19	19	22	22
	Gas with AC	-4	1	-2	-1	4	1
	Heat pump	147	216	213	214	281	278
	Zonal	317	420	420	420	508	508
Multi Family per Unit KWh	Gas	7	9	9		10	
	Gas with AC	-9	-6	-7		-5	
	Heat pump	61	87	86		109	
	Zonal	147	200	200		245	

Table A4. 2010 Idaho New Construction Site Energy Use by System Type and Climate: Gas Energy Totals

Gas Site Energy 2010		Idaho IECC 2006						Total Units per System Type
		Heating Zone1	Heating Zone2			Heating Zone3		
		Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	
Single Family therms	Gas	86,297	7,354	91,096	12,022	31,300	18,047	263
	Gas with AC	1,060,349	90,264	1,118,111	147,557	383,840	221,322	3,214
	Heat pump							283
	Zonal							283
Multi Family therms	Gas	3,196	15,495	6,456		9,372		51
	Gas with AC	5,355	25,933	10,805		15,654		84
	Heat pump							21
	Zonal							265

Gas Site Energy 2010		Idaho IECC 2003						Total Units per System Type
		Heating Zone1	Heating Zone2			Heating Zone3		
		Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	
Single Family therms	Gas	7,502	92,928	12,264	31,921	18,405	7,502	263
	Gas with AC	92,085	1,140,666	150,533	391,533	225,757	92,085	3,214
	Heat pump							283
	Zonal							283
Multi Family therms	Gas	15,708	6,545		9,498	15,708		51
	Gas with AC	26,294	10,956		15,867	26,294		84
	Heat pump							21
	Zonal							265

Table A5. 2010 Idaho New Construction Site Energy Use by System Type and Climate: Gas Energy per Unit

Gas Unit Energy 2010		Idaho IECC 2006					
		Heating Zone1	Heating Zone2			Heating Zone3	
		Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2
Single Family per Unit therms	Gas	772	1,005	1,005	1,005	1,201	1,201
	Gas with AC	776	1,009	1,009	1,009	1,204	1,204
	Heat pump						
	Zonal						
Multi Family per Unit therms	Gas	502	673	673		814	
	Gas with AC	505	675	675		815	
	Heat pump						
	Zonal						

Gas Unit Energy 2010		Idaho IECC 2003					
		Heating Zone1	Heating Zone2			Heating Zone3	
		Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2
Single Family per Unit therms	Gas	788	1,026	1,026	1,026	1,224	1,224
	Gas with AC	792	1,029	1,029	1,029	1,228	1,228
	Heat pump						
	Zonal						
Multi Family per Unit therms	Gas	510	682	682		824	
	Gas with AC	513	685	685		826	
	Heat pump						
	Zonal						

Table A6. 2010 Idaho New Construction Site Energy Average Savings by System Type and Climate: Gas Energy

Gas Total Energy Savings 2010		Idaho Total Savings						Total Units per System Type
		Heating Zone1	Heating Zone2			Heating Zone3		
		Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	
Single Family therms	Gas	1,814	148	1,832	242	621	358	263
	Gas with AC	22,359	1,821	22,555	2,977	7,692	4,435	3,214
	Heat pump							283
	Zonal							283
Multi Family therms	Gas	47	213	89		125		51
	Gas with AC	80	361	150		213		84
	Heat pump							21
	Zonal							265

Electric Unit Energy Savings 2010		Idaho per Unit Savings					
		Heating Zone1	Heating Zone2			Heating Zone3	
		Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2
Single Family per Unit therms	Gas	16	20	20	20	24	24
	Gas with AC	16	20	20	20	24	24
	Heat pump						
	Zonal						
Multi Family per Unit therms	Gas	7	9	9		11	
	Gas with AC	8	9	9		11	
	Heat pump						
	Zonal						

Table A7. 2010 Idaho New Construction Housing Distribution by System Type and Climate

Distribution of Housing Units by Climate*		Idaho 2010 Housing Units						Total Units per System Type
		Heating Zone1	Heating Zone2			Heating Zone3		
		Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	
Single Family	Gas	112	7	91	12	26	15	263
	Gas with AC	1367	89	1108	146	319	184	3,214
	Heat pump	120	8	98	13	28	16	283
	Zonal	120	8	98	13	28	16	283
Multi Family	Gas	6	23	10	0	12	0	51
	Gas with AC	11	38	16	0	19	0	84
	Heat pump	3	10	4	0	5	0	21
	Zonal	33	121	50	0	60	0	265

* See Table 3 for the grand totals by house type and state.

The preceding set of seven tables gives the predicted site energy use and savings by system type and climate within Idaho.

Table B1. 2010 Washington New Construction Site Energy Use by System Type and Climate: Electric Energy Totals

Electric Site Energy 2010		WSEC 2006						Total Units per System Type
		Heating Zone1			Heating Zone2		Heating Zone3	
		Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone1	
Single Family KWh	Gas	22,839,322	1,013,240	3,615,754	609,055	3,591,855	52,707	8,889
	Gas with AC	13,304,362	649,000	2,617,545	348,896	2,255,983	29,817	4,643
	Heat pump	20,846,208	951,610	3,533,201	691,172	4,166,586	69,908	2,107
	Zonal	6,785,262	301,020	1,074,193	221,256	1,304,842	21,608	658
Multi Family KWh	Gas	1,006,425	16,663	1,282		251,506		591
	Gas with AC	2,038,467	38,131	3,412		558,380		985
	Heat pump	1,759,464	30,232	2,446		563,194		246
	Zonal	20,232,424	334,974	25,767		6,380,554		3,102

Electric Site Energy 2010		WSEC 2003						Total Units per System Type
		Heating Zone1			Heating Zone2		Heating Zone3	
		Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone1	
Single Family KWh	Gas	22,991,839	1,020,006	3,639,899	614,488	3,623,901	53,262	8,889
	Gas with AC	13,338,266	651,163	2,630,385	350,311	2,266,552	29,974	4,643
	Heat pump	21,422,759	977,486	3,627,859	714,408	4,304,629	72,497	2,107
	Zonal	7,076,285	313,931	1,120,266	231,156	1,363,225	22,596	658
Multi Family KWh	Gas	1,018,838	16,868	1,298		255,681		591
	Gas with AC	2,028,487	38,054	3,417		558,480		985
	Heat pump	1,836,270	31,525	2,548		592,745		246
	Zonal	21,788,931	360,744	27,750		6,889,214		3,102

Table B2. 2010 Washington New Construction Site Energy Use by System Type and Climate: Electric Energy per Unit

Electric Unit Energy 2010		WSEC 2006					
		Heating Zone1			Heating Zone2		Heating Zone3
		Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone1
Single Family per Unit KWh	Gas	3,546	3,546	3,546	3,723	3,723	3,869
	Gas with AC	3,954	4,348	4,914	4,083	4,477	4,190
	Heat pump	13,654	14,050	14,618	17,826	18,222	21,652
	Zonal	14,220	14,220	14,220	18,258	18,258	21,413
Multi Family per Unit KWh	Gas	2,136	2,136	2,136		2,258	
	Gas with AC	2,596	2,933	3,412		3,009	
	Heat pump	8,963	9,302	9,783		12,138	
	Zonal	8,180	8,180	8,180		10,914	

Electric Unit Energy 2010		WSEC 2003					
		Heating Zone1			Heating Zone2		Heating Zone3
		Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone1
Single Family per Unit KWh	Gas	3,569	3,569	3,569	3,756	3,756	3,910
	Gas with AC	3,964	4,362	4,938	4,100	4,498	4,212
	Heat pump	14,032	14,432	15,010	18,425	18,825	22,454
	Zonal	14,830	14,830	14,830	19,075	19,075	22,393
Multi Family per Unit KWh	Gas	2,163	2,163	2,163		2,296	
	Gas with AC	2,583	2,927	3,417		3,009	
	Heat pump	9,354	9,700	10,192		12,775	
	Zonal	8,809	8,809	8,809		11,784	

Table B3. 2010 Washington New Construction Site Energy Average Savings by System Type and Climate: Electric Energy

Electric Total Energy Savings 2010		Washington Total Savings					
		Heating Zone1			Heating Zone2		Heating Zone3
		Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone1
Single Family KWh	Gas	152,516	6,766	24,145	5,434	32,046	555
	Gas with AC	33,904	2,163	12,840	1,415	10,569	157
	Heat pump	576,550	25,876	94,658	23,237	138,043	2,589
	Zonal	291,023	12,911	46,073	9,900	58,383	988
Multi Family KWh	Gas	12,412	206	16		4,175	
	Gas with AC	-9,980	-77	5		100	
	Heat pump	76,807	1,294	102		29,551	
	Zonal	1,556,506	25,770	1,982		508,659	

Electric Unit Energy Savings 2010		Washington per Unit Savings					
		Heating Zone1			Heating Zone2		Heating Zone3
		Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone1
Single Family per Unit KWh	Gas	24	24	24	33	33	41
	Gas with AC	10	14	24	17	21	22
	Heat pump	378	382	392	599	604	802
	Zonal	610	610	610	817	817	980
Multi Family per Unit KWh	Gas	26	26	26		37	
	Gas with AC	-13	-6	5		1	
	Heat pump	391	398	409		637	
	Zonal	629	629	629		870	

Table B4. 2010 Washington New Construction Site Energy Use by System Type and Climate: Gas Energy Totals

Gas Site Energy 2010		WSEC 2006						Total Units per System Type
		Heating Zone1			Heating Zone2		Heating Zone3	
		Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone1	
Single Family therms	Gas	4,707,701	208,852	745,289	155,636	917,851	15,471	8,889
	Gas with AC	2,469,956	109,577	391,025	81,585	481,140	8,101	4,643
	Heat pump							2,107
	Zonal							658
Multi Family therms	Gas	208,860	3,458	266		66,089		591
	Gas with AC	350,220	5,798	446		110,673		985
	Heat pump							246
	Zonal							3,102

Gas Site Energy 2010		WSEC 2003						Total Units per System Type
		Heating Zone1			Heating Zone2		Heating Zone3	
		Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone1	
Single Family therms	Gas	4,938,139	219,075	781,770	163,349	963,336	16,241	8,889
	Gas with AC	2,591,688	114,977	410,297	85,639	505,049	8,508	4,643
	Heat pump							2,107
	Zonal							658
Multi Family therms	Gas	226,801	3,755	289		71,768		591
	Gas with AC	380,167	6,294	484		120,156		985
	Heat pump							246
	Zonal							3,102

Table B5. 2010 Washington New Construction Site Energy Use by System Type and Climate: Gas Energy per Unit

Gas Unit Energy 2010		WSEC 2006					
		Heating Zone1			Heating Zone2		Heating Zone3
		Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone1
Single Family per Unit therms	Gas	731	731	731	951	951	731
	Gas with AC	734	734	734	955	955	734
	Heat pump						
	Zonal						
Multi Family per Unit therms	Gas	443	443	443		593	
	Gas with AC	446	446	446		596	
	Heat pump						
	Zonal						

Gas Unit Energy 2010		WSEC 2003					
		Heating Zone1			Heating Zone2		Heating Zone3
		Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone1
Single Family per Unit therms	Gas	767	767	767	998	998	1,192
	Gas with AC	770	770	770	1,002	1,002	1,196
	Heat pump						
	Zonal						
Multi Family per Unit therms	Gas	481	481	481		644	
	Gas with AC	484	484	484		647	
	Heat pump						
	Zonal						

Table B6. 2010 Washington New Construction Site Energy Average Savings by System Type and Climate: Gas Energy

Gas Site Energy Savings 2010		Washington Total Savings						Total Units per System Type
		Heating Zone1			Heating Zone2		Heating Zone3	
		Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone1	
Single Family therms	Gas	230,438	10,223	36,481	7,713	45,485	770	8,889
	Gas with AC	121,732	5,400	19,272	4,054	23,909	406	4,643
	Heat pump							2,107
	Zonal							658
Multi Family therms	Gas	17,941	297	23		5,679		591
	Gas with AC	29,948	496	38		9,483		985
	Heat pump							246
	Zonal							3,102

Gas Unit Energy Savings 2010		Washington per Unit Savings					
		Heating Zone1			Heating Zone2		Heating Zone3
		Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone1
Single Family per Unit therms	Gas	36	36	36	47	47	57
	Gas with AC	36	36	36	47	47	57
	Heat pump						
	Zonal						
Multi Family per Unit therms	Gas	38	38	38		51	
	Gas with AC	38	38	38		51	
	Heat pump						
	Zonal						

Table B7. 2010 Washington New Construction Housing Distribution by System Type and Climate

Distribution of Housing Units by Climate*		Washington 2010 Housing						Total Units per System Type
		Heating Zone1			Heating Zone2		Heating Zone3	
		Cooling Zone1	Cooling Zone2	Cooling Zone3	Cooling Zone1	Cooling Zone2	Cooling Zone1	
Single Family	Gas	6442	286	1020	164	965	14	8,889
	Gas with AC	3365	149	533	85	504	7	4,643
	Heat pump	1527	68	242	39	229	3	2,107
	Zonal	477	21	76	12	71	1	658
Multi Family	Gas	471	8	1	0	111	0	591
	Gas with AC	785	13	1	0	186	0	985
	Heat pump	196	3	0	0	46	0	246
	Zonal	2473	41	3	0	585	0	3,102

* See Table 3 for the grand totals by house type and state.

The preceding set of seven tables gives the predicted site energy use and savings by system type and climate within Washington.

Table C1. 2010 Montana New Construction Site Energy Use by System Type and Climate: Electric Energy Totals

Electric Site Energy 2010		Montana IECC 2003				Total Units per System Type
		Heating Zone3		Heating Zone2		
		Cooling Zone1	Cooling Zone2	Cooling Zone1	Cooling Zone2	
Single Family KWh	Gas	935,027	183,509	65,769	10,228	391
	Gas with AC	1,773,620	390,614	127,133	22,301	661
	Heat pump	1,461,540	292,339	89,187	14,197	87
	Zonal	1,501,035	294,593	95,986	14,927	87
Multi Family KWh	Gas	37,524	750			24
	Gas with AC	74,184	1,763			40
	Heat pump	140,226	2,875			10
	Zonal	1,686,046	33,721			126

Electric Site Energy 2010		MEC 1996				Total Units per System Type
		Heating Zone3		Heating Zone2		
		Cooling Zone1	Cooling Zone2	Cooling Zone1	Cooling Zone2	
Single Family KWh	Gas	958,589	188,133	67,166	10,445	391
	Gas with AC	1,855,381	411,249	132,738	23,445	661
	Heat pump	1,557,031	311,671	94,514	15,060	87
	Zonal	1,599,864	313,990	101,964	15,857	87
Multi Family KWh	Gas	40,713	814			24
	Gas with AC	77,965	1,865			40
	Heat pump	150,130	3,080			10
	Zonal	1,990,514	39,810			126

Table C2. 2010 Montana New Construction Site Energy Use by System Type and Climate: Electric Energy per Unit

Electric Unit Energy 2010		Montana IECC 2003			
		Heating Zone3		Heating Zone2	
		Cooling Zone1	Cooling Zone2	Cooling Zone1	Cooling Zone2
Single Family per Unit KWh	Gas	3,066	3,066	2,873	2,873
	Gas with AC	3,378	3,791	4,704	3,638
	Heat pump	21,635	22,050	17,585	17,999
	Zonal	22,220	22,220	18,925	18,925
Multi Family per Unit KWh	Gas	1,595	1,595		
	Gas with AC	1,892	2,248		
	Heat pump	14,307	14,666		
	Zonal	13,653	13,653		

Electric Unit Energy 2010		MEC 1996			
		Heating Zone3		Heating Zone2	
		Cooling Zone1	Cooling Zone2	Cooling Zone1	Cooling Zone2
Single Family per Unit KWh	Gas	3,143	3,143	2,934	2,934
	Gas with AC	3,534	3,991	4,912	3,825
	Heat pump	23,049	23,508	18,635	19,094
	Zonal	23,683	23,683	20,104	20,104
Multi Family per Unit KWh	Gas	1,731	1,731		
	Gas with AC	1,989	2,379		
	Heat pump	15,318	15,711		
	Zonal	16,118	16,118		

Table C3. 2010 Montana New Construction Site Energy Savings by System Type and Climate: Electric Energy

Electric Total Energy Savings 2010		Montana Total Savings				Total Units per System Type
		Heating Zone3		Heating Zone2		
		Cooling Zone1	Cooling Zone2	Cooling Zone1	Cooling Zone2	
Single Family KWh	Gas	23,562	4,624	1,397	217	391
	Gas with AC	81,761	20,635	5,605	1,145	661
	Heat pump	95,491	19,332	5,326	863	87
	Zonal	98,830	19,396	5,979	930	87
Multi Family KWh	Gas	3,188	64			24
	Gas with AC	3,781	103			40
	Heat pump	9,904	205			10
	Zonal	304,468	6,089			126

Electric Unit Energy Savings 2010		Montana per Unit Savings			
		Heating Zone3		Heating Zone2	
		Cooling Zone1	Cooling Zone2	Cooling Zone1	Cooling Zone2
Single Family per Unit KWh	Gas	77	77	61	61
	Gas with AC	156	200	207	187
	Heat pump	1,414	1,458	1,050	1,095
	Zonal	1,463	1,463	1,179	1,179
Multi Family per Unit KWh	Gas	136	136		
	Gas with AC	96	131		
	Heat pump	1,010	1,045		
	Zonal	2,465	2,465		

Table C4. 2010 Montana New Construction Site Energy Use by System Type and Climate: Gas Energy Totals

Gas Site Energy 2010		Montana IECC 2003				Total Units per System Type
		Heating Zone3		Heating Zone2		
		Cooling Zone1	Cooling Zone2	Cooling Zone1	Cooling Zone2	
Single Family therms	Gas	359,098	70,477	22,587	3,513	391
	Gas with AC	619,792	121,641	39,019	6,068	661
	Heat pump					87
	Zonal					87
Multi Family therms	Gas	17,703	354			24
	Gas with AC	26,694	534			40
	Heat pump					10
	Zonal					126

Gas Site Energy 2010		MEC 1996				Total Units per System Type
		Heating Zone3		Heating Zone2		
		Cooling Zone1	Cooling Zone2	Cooling Zone1	Cooling Zone2	
Single Family therms	Gas	384,298	75,422	24,104	3,748	391
	Gas with AC	664,562	130,427	41,700	6,485	661
	Heat pump					87
	Zonal					87
Multi Family therms	Gas	21,085	422			24
	Gas with AC	29,206	584			40
	Heat pump					10
	Zonal					126

Table C5. 2010 Montana New Construction Site Energy Use by System Type and Climate: Gas Energy per Unit

Gas Unit Energy 2010		Montana IECC 2003			
		Heating Zone3		Heating Zone2	
		Cooling Zone1	Cooling Zone2	Cooling Zone1	Cooling Zone2
Single Family per Unit therms	Gas	1,178	1,178	987	987
	Gas with AC	1,181	1,181	1,444	990
	Heat pump				
	Zonal				
Multi Family per Unit therms	Gas	753	753		
	Gas with AC	681	681		
	Heat pump				
	Zonal				

Gas Unit Energy 2010		MEC 1996			
		Heating Zone3		Heating Zone2	
		Cooling Zone1	Cooling Zone2	Cooling Zone1	Cooling Zone2
Single Family per Unit therms	Gas	1,260	1,260	1,053	1,053
	Gas with AC	1,266	1,266	1,543	1,058
	Heat pump				
	Zonal				
Multi Family per Unit therms	Gas	896	896		
	Gas with AC	745	745		
	Heat pump				
	Zonal				

Table C6. 2010 New Construction Site Energy Savings by System Type and Climate: Gas Energy

Gas Total Energy Savings 2010		Montana Total Savings				Total Units per System Type
		Heating Zone3		Heating Zone2		
		Cooling Zone1	Cooling Zone2	Cooling Zone1	Cooling Zone2	
Single Family therms	Gas	25,200	4,946	1,517	236	391
	Gas with AC	44,770	8,787	2,681	417	661
	Heat pump					87
	Zonal					87
Multi Family therms	Gas	3,381	68			24
	Gas with AC	2,512	50			40
	Heat pump					10
	Zonal					126

Gas Unit Energy Savings 2010		Montana per Unit Savings			
		Heating Zone3		Heating Zone2	
		Cooling Zone1	Cooling Zone2	Cooling Zone1	Cooling Zone2
Single Family per Unit therms	Gas	83	83	66	66
	Gas with AC	85	85	99	68
	Heat pump				
	Zonal				
Multi Family per Unit therms	Gas	144	144		
	Gas with AC	64	64		
	Heat pump				
	Zonal				

Table C7. 2010 New Construction Site Distribution by System Type and Climate: Montana State

Distribution of Housing Units by Climate*		Montana 2010 Housing				Total Units per System Type
		Heating Zone3		Heating Zone2		
		Cooling Zone1	Cooling Zone2	Cooling Zone1	Cooling Zone2	
Single Family therms	Gas	305	60	23	4	391
	Gas with AC	525	103	27	6	661
	Heat pump	68	13	5	1	87
	Zonal	68	13	5	1	87
Multi Family therms	Gas	24	0	0	0	24
	Gas with AC	39	1	0	0	40
	Heat pump	10	0	0	0	10
	Zonal	123	2	0	0	126

* See Table 3 for the grand totals by house type and state.

The preceding set of seven tables gives the predicted site energy use and savings by system type and climate within Montana.

November 22, 2011
REPORT #E11-231

Long-Term Northwest Residential Lighting Tracking and Monitoring Study

Prepared by:
KEMA, Inc.
155 Grand Avenue Suite 500
Oakland, CA 94612

Northwest Energy Efficiency Alliance
PHONE
503-688-5400
FAX
503-688-5447
EMAIL
info@neea.org

Long-Term Northwest Residential Lighting Tracking and Monitoring Study

Prepared by: KEMA, Inc.
Oakland, California

Supported by: Evergreen Economics
Berkeley, California

Prepared for: Northwest Energy Efficiency Alliance
Portland, Oregon

August 2, 2011

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Table of Contents

E.1 Program History 1
E.2 Conclusions and Recommendations 1
1. Introduction 5
1.1 Project Overview 5
1.2 Evaluation Overview 6
2. CFL Sales and Market Share Assessment 8
2.1 ENERGY STAR CFL Sales 8
2.2 ENERGY STAR CFL Market Share 12
2.2.1 Approach 12
2.2.2 Results 13
3. Shelf Surveys 14
3.1 Approach 14
3.2 Affordability 14
3.3 Availability 15
3.3.1 Total Shelf Space 15
3.3.2 Share of Shelf Space 15
3.3.3 Percentage of Stores Carrying (Any) CFLs 16
3.3.4 Percentage of Stores Carrying CFLs by Style (Twister and Non-Twister) 16
3.4 Diversity 17
3.4.1 Average Number of Models per Store 17
3.4.2 LEDs 17
4. Consumer Surveys 19
4.1 Approach 19
4.2 CFL Awareness and Purchase Rates 20
4.3 CFL Disposition 21
4.4 Satisfaction with CFLs 21
4.5 2007 Energy Independence and Security Act (EISA) 23
4.6 Compact Fluorescent Fixtures 23
5. Market Actor Interviews 24
5.1 National Market 24
5.1.1 General Market Changes 24
5.1.2 Sales 25
5.1.3 CFL Prices 26
5.2 Northwest Market 26
5.2.1 General Market Changes 26
5.2.2 Sales 27
5.2.3 CFL Prices 28

Table of Contents

5.2.4 Supplying the Northwest Market 28
5.3 Effects of the Energy Independence and Security Act of 2007 (EISA) 28
5.4 LEDs 29
6. Utility Program Manager Interviews 30
6.1 Approach 30
6.2 Northwest Lighting Programs 31
6.2.1 Current Lighting Programs 31
6.2.2 Change Since 2007 31
6.2.3 Education for Specialty CFLs 32
6.3 Northwest CFL Market Since 2007 33
6.4 CFL Market Barriers 34
6.5 Future Outlook for CFLs 35
6.6 LED Market 36
6.7 NEEA's Role 36
7. Synthesis of Findings 38
8. Conclusions and Recommendations 42
8.1 Conclusions 42
8.2 Recommendations 43
A. Bibliography A-1
B. Data Collection Instruments B-1
C. Additional Shelf Survey Findings C-1
C.1 Sample Frame C-1
C.2 Sample Sizes, 2006-2010 ..... C-2
C.3 Affordability C-3
C.3.1 Average Price C-3
C.3.2 Range of Prices C-5
C.3.3 Average Price Paid by Consumers C-7
C.4 Availability C-8
C.4.1 Total Shelf Space C-8
C.4.2 Average Shelf Space C-10
C.4.3 Percentage of Stores Carrying (Any) CFLs C-14
C.4.4 Percentage of Stores Carrying CFLs by Style (Twister and Non-Twister) C-15
C.5 Diversity C-17
C.5.1 Average Number of Models per Store C-17
C.5.2 CFL Style C-19
C.5.3 CFL Wattage Category C-22
D. Additional Consumer Survey Results D-1

Table of Contents

D.1 CFL Awareness and Purchases D-1
D.1.1 CFL Awareness and Purchases – Overall D-1
D.1.2 Awareness and Purchase Rates by State D-2
D.1.3 Where CFLs Have Been Purchased D-3
D.1.4 Lamp Disposition in Purchaser Households by Geographic Region D-5
D.2 Satisfaction with CFLs D-5
D.2.1 General Satisfaction D-5
D.2.2 CFL Satisfaction by Purchaser Group D-6
D.2.3 Satisfaction with CFL Attributes D-7
D.2.4 Factors Preventing Additional CFL Installations D-9
D.2.5 Influences on CFLs Installation Patterns D-10
D.2.6 Best Features of CFLs D-11
D.2.7 CFL to CFL Replacement Intentions D-12
D.2.8 Incandescent to CFL Replacement Intentions D-13
D.3 CFL Purchase Intentions D-14
D.3.1 Likelihood of CFL Purchases within a Year D-14
D.4 Fixture Usage D-15
D.4.1 Awareness and Purchase D-15
D.4.2 Satisfaction D-17
D.5 2007 Energy Independence and Security Act D-17
D.5.1 Awareness D-17
D.5.2 Planned Activities Once EISA is in Effect D-18
E. Consumer Survey Banner Tables E-1
F. Consumer Focus Group Findings F-1
F.1 Overview F-1
F.2 CFL Description F-1
F.3 CFL Purchase, Installation, and Disposal Behaviors F-2
F.4 Impressions of CFL Attributes F-4
F.5 Barriers to Increasing CFL Installations F-5
G. Rural Urban Continuum Codes (RUCC) Memo G-1
H. Review of NEEA's ACE Model Inputs H-1

List of Figures:

Figure 1: Estimated ENERGY STAR CFL Sales in the Northwest, 2001-2010 9
Figure 2: Tracked Promotional CFL Sales by Store Category and Year, 2007-2010 9
Figure 3: ENERGY STAR CFL Sales by Store Type, Lamp Type and Year, 2010 10

Table of Contents

Figure 4: Estimated Residential ENERGY STAR CFL Sales in the Northwest by State, 2006-2010 11
Figure 5: Estimated ENERGY STAR CFL Sales in the Northwest by Store Type, 2006-2010*† 12
Figure 6: Estimated CFL Market Share of Total Lamp Sales for the Northwest and U.S., 2001-2010 13
Figure 7: Average Price Paid for CFLs by Geography and Year, 2006–2010 ..... C-4
Figure 8: Average Price Paid for CFLs by Store Category and Year, 2006–2010 ..... C-4
Figure 9: Average Price Paid for CFLs by Geography, Store Category, and Year, 2006–2010 C-5
Figure 10: Average Range of CFL Prices Over Time – Twisters Less than 18 watts, 2005–2010 ..... C-6
Figure 11: Average Range of CFL Prices Over Time – Twisters 18-30 watts, 2005–2010 ..... C-6
Figure 12: Average Range of CFL Prices Over Time – Sales Weighted, 2005–2010 ..... C-7
Figure 13: Average Price Paid by Customers for Twisters, Non-Twisters and CFLs, 2005–2010 ..... C-8
Figure 14: Allocation of Total Lighting Shelf Space by Store Type, 2005–2010 ..... C-9
Figure 15: Average Shelf Space Allocation by Store Type in Linear Feet, 2005–2010 ..... C-11
Figure 16: Percentage of Shelf Space Dedicated to CFLs by Geography and Year, 2005–2010 ..... C-13
Figure 17: Percentage of Shelf Space Dedicated to CFLs by Store Category and Year, 2005–2010 ..... C-13
Figure 18: Percentage of Shelf Space Dedicated to CFLs by Geography, Store Category, and Year, 2005–2010 ..... C-14
Figure 19: Percentage of Stores Carrying CFLs by Geography and Year, 2006–2010 ..... C-14
Figure 20: Percentage of Stores Carrying CFLs by Store Category and Year, 2006–2010 ... C-15
Figure 21: Percent of Stores Carrying CFLs by Geography Store Category, and Year, 2006–2010 ..... C-15
Figure 22: Percentage of Stores That Carry Twister and Non-Twister CFLs by Geography and Year, 2006–2010 ..... C-16
Figure 23: Percentage of Stores That Carry Twister and Non-Twister CFLs by Store Category and Year, 2006–2010 ..... C-16
Figure 24: Percentage of Stores That Carry Twister and Non-Twister CFLs by Geography, Store Category, and Year, 2006–2010 ..... C-17
Figure 25: Average Number of Twister and Non-Twister CFL Models per Store by Geography and Year, 2006–2010 ..... C-18
Figure 26: Average Number of Twister and Non-Twister CFL Models per Store by Store Category and Year, 2006–2010 ..... C-18

Table of Contents

Figure 27: Average Number of Twister and Non-Twister Models per Store by Geography, Store Category, and Year, 2006–2010 ..... C-19
Figure 28: Percentage of Stores that Carry CFLs by Style, 2005--2010 ..... C-20
Figure 29: Average Number of CFL Models Stocked by Style, 2005–2010 ..... C-21
Figure 30: Percentage of Models with ENER GY STAR Label by Style, 2005–2010 ..... C-22
Figure 31: Percentage of Stores that Carry CFLs by Wattage Category, 2005–2010 ..... C-22
Figure 32: Percentage of CFL Models Stocked by Wattage Category, 2005–2010 ..... C-23
Figure 33: Average Number of CFL Brands Stocked by Wattage Category, 2005–2010 ..... C-23
Figure 34: Average Number of CFL Models Stocked by Wattage Category, 2005–2010 ..... C-24
Figure 35: Consumer CFL Awareness and Purchaser Categories, 2004–2011 ..... D-1
Figure 36: Consumer Awareness of CFLs by State, 2004–2011 ..... D-2
Figure 37: Consumer CFL Purchase Rates by State, 2004–2011 ..... D-3
Figure 38: Where CFLs Are Purchased Among CFL Purchasers, 2004–2011 ..... D-4
Figure 39: General Satisfaction with CFLs Over Time Among CFL Purchasers, 2001–2011 ... D-6
Figure 40: General Satisfaction with CFLs Among CFL Purchasers, 2011 ..... D-7
Figure 41: Level of Agreement with Statements Regarding CFLs, 2011 ..... D-8
Figure 42: Main Factors Preventing Additional CFL Installations Among CFL Purchasers Who Have CFLs Installed in Their Homes, 2006–2011 ..... D-10
Figure 43: CFL Purchaser Impressions of Best CFL Features Over Time, 2005–2011†‡ D-12
Figure 44: CFL Purchaser Likelihood of Replacing a CFL with a CFL Upon Burnout, 2004–2011 ..... D-13
Figure 45: Likelihood of Replacing an Incandescent Lamp with a CFL Upon Burnout, 2011‡ D-14
Figure 46: Likelihood of CFL Purchase within the Next Year Among All Respondents, 2011 D-15
Figure 47: Compact Fluorescent (CF) Fixture Awareness and Purchase Rates, 2006-2011 . D-16
Figure 48: Compact Fluorescent (CF) Fixture Awareness and Purchase Rates, 2006-2011 . D-17

List of Tables:

Table 1: Data Collection Activities, 2010-11 Long-Term Northwest Residential CFL Tracking Study 7
Table 2: Consumer Survey Sample Frame and Completed Surveys by Strata, 2011 19
Table 3: Lamp Disposition in Purchaser Households by Survey Year, 2004–2011 21
Table 4: Main Factors Preventing Additional CFL Installations Among CFL Purchasers Who Have CFLs Installed in Their Homes by Percent Saturation, 2011 22
Table 5: Range of Reported Northwest Prices for Twister-Style CFLs by Promotion Availability, 2008—2010 28
Table 6: Sample Frame of Utilities by State, Size, and Ownership, 2011 30

Table of Contents

Table 7: Utilities Interviewed by State, Size, and Ownership, 2011 31
Table 8: Retailer Shelf Survey Sample Frame, 2011 .....C-1
Table 9: Retailer Shelf Survey Completes by Strata, 2011 .....C-2
Table 10: Shelf Survey Store Visits by Store Type and Year, 2006–2010 .....C-3
Table 11: Shelf Survey Store Visits by Region and Year, 2006–2010 .....C-3
Table 12: Shelf Survey Store Visits by Store Type, Region and Year, 2006–2010 .....C-3
Table 13: Where CFLs Are Purchased Among CFL Purchasers by Metro/Non-Metro, 2010 and 2011* D-5
Table 14: Bulb Disposition in Purchaser Households by Geographic Region, 2011 .....D-5
Table 15: Mean Satisfaction with CFL Attributes Among CFL Purchasers, 2004–2011 .....D-8
Table 16: Mean Level of Agreement with Statements Regarding CFLs, by Percent Saturation, 2011 .....D-9
Table 17: Mean Likelihood of Replacing a CFL with a CFL Upon Burnout by Date of Most Recent Purchase, 2005–2011 .....D-13
Table 18: Reasons for Choosing CF Fixture Over Standard Screw-Based Fixture, 2006-2011* D-16
Table 19: Awareness of EISA and Its Implications, 2010–2011 .....D-18
Table 20: Plans for Phase-Out of Low-Efficacy 100 Watt Incandescent Lamps, 2010–2011 . D-19
Table 21: Number of Focus Group Participants by Group Location and Time, 2010 ..... F-1
Table 22: Participant Agreement/Disagreement with Statements Regarding CFL Attributes .. F-4

Executive Summary

E.1 Program History

The Northwest Energy Efficiency Alliance (NEEA) began its consumer lighting market initiatives in 1997 to advance consumer awareness and use of compact fluorescent lamps (CFLs) and fluorescent light fixtures throughout the region. In 2000, NEEA began targeting retailers (by providing salesperson training as well as advertising and marketing support) and shifted its focus to manufacturers in 2005, coordinating a regional manufacturer buydown promotion. The promotion provided broad geographic sales coverage (including rural markets) through distribution channels including grocery, drug, hardware, mass merchandise, do-it-yourself, and wholesale chains.

NEEA coordinated similar promotions in 2006 and 2007, emphasizing smaller CFL distribution channels (such as drug and grocery stores) and CFL sales in non-metropolitan areas. In 2007 alone, participating retail chains sold approximately 1.8 million ENERGY STAR CFLs through NEEA's promotions and total regional sales of ENERGY STAR CFLs exceeded 18 million lamps. NEEA concluded that additional support of the Northwest lighting market was no longer necessary and ceased its active interventions in the market in early 2008.

E.2 Conclusions and Recommendations

Conclusions from the study include the following:

- **In general, there were minor changes over the last year in availability, affordability and diversity of CFLs in Northwest retail stores.** There was an increase in the fraction of stores that carry specialty CFLs (from 82 to 91% of stores), but a slight decrease in the average number of specialty CFL models stocked (from 17.6 to 16.8 models). The average estimated CFL retail price increased 10 percent (from $3.76 to $4.06)– mostly due to price increases in non-metro areas and among big box stores. Retailers are stocking twice as many LED models in 2010 (approximately 7 per store) compared to 2009.
- **In non-metropolitan areas in particular, however, there have been greater declines in CFL affordability, availability, and diversity than stores in metropolitan areas.** CFL prices increased more dramatically in non-metro areas than metro areas (by 41 cents and 24 cents, respectively) while share of shelf space dedicated to CFLs declined in non-metro areas (from 29% to 21% of total shelf space) and stayed the same in metro areas. The average number of general purpose CFL models increased in both metro and non-metro stores, but by only 2.7 models per store in non-metro stores compared to 4.1 in metro stores. Specialty lamp diversity remained fairly constant in metro stores (increasing by 0.2 models per store) but declined by 2.7 models per store in non-metro stores.
- **CFL promotions offered by energy-efficiency program sponsors throughout the Northwest are providing support to the market for both standard and specialty CFLs.** These ongoing promotions likely helped to maintain fairly consistent CFL market prices, availability and diversity over the past several years, but as evidenced by the drop in market

share among non big box stores since 2008 (from 30% in 2007 to roughly 14% in subsequent years), NEEA's more widespread past promotions may have helped provide the additional support that smaller retail channels may need.

- **Northwest CFL sales rebounded by about 5 percent between 2009 and 2010 after a major drop of 26 percent between 2008 and 2009.** There were approximately 19 million CFLs sold in 2010, but sales are still far from the 2008 peak of nearly 25 million CFLs. Northwest CFL market share also experienced a small uptick between 2009 and 2010 (from 30% to 31%) after dropping from nearly 40 percent in 2008.
- **We expect CFL sales levels to plateau as most consumers do not plan to install more CFLs until their existing CFLs burn out** – instead they will buy them when they are on sale or when one of their installed lamps burns out. Most consumers use CFLs in a handful of sockets – and they avoid using them in certain applications and rooms, depending on their aesthetic and use preferences. A small fraction of consumers use CFLs throughout their homes and think the environmental/economic savings outweigh any aesthetic or application issues.
- **As EISA phases in, there is a risk that the majority of CFL users who are not completely committed to the technology may revert back to incandescent technology**, at least for some of their applications, if suppliers promote these products as energy saving/EISA compliant. Persistent concerns around mercury could also hurt sales of CFLs if consumers who have those concerns think they have a new -energy-efficient" incandescent lamp option that does not contain mercury. CFL program sponsors have not convinced the majority that the energy savings associated with CFLs outweighs mercury concerns.
- **There remains potential for additional general purpose and specialty CFL installations.** However, consumers lack awareness of specialty CFLs (only 32% of CFL purchasers are aware of specialty lamps), specialty CFLs are more expensive and less available, and dimmable CFLs in particular do not perform well. There are major market barriers to significantly increasing specialty CFL sales and to address the barriers will require a multi-pronged approach due to the wide variety of products and issues.
- **There remains a small fraction of consumers who are either unaware or have never tried CFLs** (approximately 8% of Northwest consumers were unaware of CFLs in 2010, and 17 percent were aware but had never purchased CFLs)**.** California utilities have had success reaching previously under-served populations by promoting CFLs in ethnic supermarkets and discount stores. These efforts have been funded by large-scale resource-acquisition programs and they take advantage of the density of under-served populations and the prevalence of ethnic and discount stores that serve them.
- **Utility program managers see a role for a regional representative such as NEEA in supporting national efforts on consumer education** around mercury, CFL disposal, use of specialty CFLs, integrated messaging around the various technology options available as EISA takes effect.
- **Utility program managers also see a role for a regional representative such as NEEA in supporting national efforts regarding quality testing and labeling** for LED products.

Based on these conclusions, we recommend the following:

1. As recommended in prior tracking study reports, we recommend that NEEA consider engaging with the regional lighting suppliers. From the 2010 study[1]:

   > **NEEA should continue to strengthen its relationship with CFL suppliers** (manufacturers and retailers) in the absence of a formal CFL incentive program. Ongoing dialogue with these stakeholders may help NEEA and its sponsors influence the mix of products these suppliers will produce and market in response to impending EISA requirements."

   The 2010 study also suggests the value of maintaining supplier relationships because they may be difficult to reestablish should NEEA decide to pursue future lighting market interventions – such as educational efforts or incentive programs – that would require (or benefit from) supplier support. These recommendations are particularly relevant now, given that EISA requirements will begin to phase in soon (January, 2012).

2. **NEEA should consider further discussion with regional stakeholders regarding whether the Northwest would benefit from having a regional representative in national efforts to promote energy-efficient lighting products**. Findings from the utility program manager interviews in particular suggest a desire for a regional entity to coordinate utility input to help develop consistent messaging regarding energy-efficient lighting products at the national level (including messages regarding mercury and CFL disposal). From the utility program managers' perspectives, messaging priorities include decreasing consumer confusion regarding new lighting technology options and increasing consumer understanding of lumens to aid comparison shopping. Program managers also expressed the desire for a voice in supporting the U. S. Department of Energy's efforts to further assess effective useful life and lumen degradation of LEDs and efforts lead by the Consortium for Energy Efficiency and U.S. Environmental Protection Agency to support LED product labeling standards. Engaging in these activities could facilitate staying abreast of current market trends and innovations. NEEA may be able to fill such a role, and further dialogue with utility program managers and other regional stakeholders may help NEEA decide whether to pursue this arrangement.
3. **NEEA should consider further discussion with regional stakeholders regarding whether some form of market support is necessary for CFLs in non-metropolitan areas.** As mentioned above, lighting retailers in non-metro areas have experienced greater declines in CFL affordability, availability, and diversity than metro stores. It may benefit the non-metro regions for NEEA to have dialogue with stakeholders to determine whether additional support is necessary and the best form of support that could be provided.

[1] KEMA, 2010. 2009-10 Residential Lighting Market Research Study. Prepared for NEEA. Supported by ECONorthwest. May 18, 2010. Page 50.

4. **NEEA should consider efforts to educate consumers regarding the full range of installation potential for energy-efficient lamps in their homes.** The 2010 study includes a similar recommendation for CFLs, and current study results suggest a broader need across energy-efficient lamp types. Whether these efforts are conducted under the umbrella of the national efforts suggested above or through a distinct effort, study findings suggest a lack of awareness among consumers regarding the impending phase-out of traditional incandescent lamps (as suggested by the consumer surveys), lingering confusion regarding CFL applicability for different purposes (as suggested by the consumer surveys and focus groups), and a desire among the region's utilities for educational efforts regarding new lighting technology options.
5. **NEEA should consider developing materials and information to help Northwest utilities determine if and when they should start promoting new lighting products including LEDs**. Study results suggest this information is of particular interest to lighting program managers at some of the region's smaller utilities.
6. **NEEA should continue to regularly monitor the Northwest residential lighting market to provide timely data on the Northwest** to help shape local utility, regional and national lighting promotions and efforts to maintain the gains in CFL market acceptance achieved over the last two decades.

1. Introduction

This report represents KEMA's seventh assessment of the Northwest residential lighting market for the Northwest Energy Efficiency Alliance (NEEA). KEMA has conducted evaluations and market research studies roughly on an annual basis since 2005, beginning with the 2005 Market Progress Evaluation Report (MPER1) for NEEA's ENERGY STAR® Consumer Products Project and most recently the 2009-10 Residential Lighting Market Research Study published in May, 2010.[2]

1.1 Project Overview

NEEA launched its first residential lighting market initiatives in 1997 to advance awareness and use of energy-efficient compact fluorescent lamps (CFLs) and fluorescent light fixtures among Northwest residential customers. The project was designed to address market barriers including high first cost; lack of product availability; lack of consumer awareness; incompatibility of CFLs with existing fixtures, dimmers, timers and photocells; performance problems; poor aesthetics of energy-efficient lighting products; and consumer dislike of fluorescent technologies. The project provided financial incentives to manufacturers; retailer education; marketing and mass advertising; and branding.

During the late 1990s, the number of products that qualified for inclusion in NEEA's initiatives expanded. As a result, the project strategy evolved from targeting manufacturers to retailers in 2000. The project provided retailers with salesperson training as well as advertising and marketing support to encourage ENERGY STAR product promotion and marketplace acceptance. NEEA leveraged local utility activities and regional and national initiatives to encourage improvements in ENERGY STAR product quality.

In response to market data suggesting consumer dissatisfaction with product performance, the project shifted its focus in 2004 toward achieving improvements in CFL quality and consumer acceptance. The project provided cooperative marketing opportunities and field services to retailers to promote ENERGY STAR products and coordinated financial incentive offerings for these products. The project also coordinated with national efforts such as ENERGY STAR's Change a Light, Change the World campaign and the lighting quality research conducted by the Program for Evaluation and Analysis of Residential Lighting (PEARL). Finally, the project supported advancement of new lighting technologies (e.g., dimmable/reflector CFLs) and efforts to encourage proper disposal of broken or burned-out CFLs.

In 2005, the project coordinated a regional manufacturer buydown promotion to reduce the market price of CFLs in the region and to establish promotional distribution channels for moving high-quality, low-priced products into the market. The promotion provided broad geographic sales coverage (including rural markets) through distribution channels including grocery, drug, hardware, mass merchandise, do-it-yourself, and wholesale chains.

[2] KEMA, 2005, 2006, 2007, 2008, 2009, and 2010. Please refer to the Bibliography (Appendix A) for complete citations.

NEEA expanded upon the success of the project in 2005 by coordinating similar promotions in 2006 and 2007 with a focus on consumers who had had limited access to high-quality, low-priced CFLs as well as those who had never purchased CFLs. The 2006 and 2007 promotions emphasized non-traditional CFL distribution channels (such as drug and grocery stores) and rural areas, and excluded large do-it-yourself chains and wholesale clubs from participating.

In 2007 alone, participating retail chains sold approximately 1.8 million ENERGY STAR CFLs through NEEA's promotions and total regional sales of ENERGY STAR CFLs exceeded 18 million lamps.[3] NEEA concluded that additional support of the Northwest lighting market was longer necessary and ceased its active interventions in the market in early 2008. Several other energy-efficiency program sponsors have continued to offer CFL incentives in the region since then.

1.2 Evaluation Overview

The goal of this study is to assess the current status of the CFL market and key objectives are to:

1. Track and monitor current availability, affordability and diversity of CFLs in Northwest retail stores;
2. Analyze residential ENERGY STAR CFL sales and market share of total residential medium screw-base lamp sales in the Northwest;
3. Through a consumer telephone survey, investigate current awareness of CFLs; purchase, installation, and storage rates; perceptions of CFLs; and motivations for recent CFL purchases (or lack thereof);
4. Review and comment on NEEA's cost effectiveness model and baseline assumptions; and
5. Report on retailer/manufacturer attitudes and expectations regarding future sales trends (particularly with regard to the potential impacts of the 2007 Energy Independence and Security Act [EISA]).

NEEA's market tracking reports present results for the region as a whole as well by geographic location where possible. Geographic results are typically divided into metropolitan statistical areas (MSA) east and west of the Cascades mountain range versus nonmetropolitan areas in the region based on classifications defined by the United States Office of Management and Budget as published by the United States Census Bureau. For consistency with previous reports, geographic results are presented within the metro east, metro west, and non-metro categories within this report.

In 2011, NEEA shifted its focus toward a different set of classifications of metropolitan versus nonmetropolitan areas utilized by the United States Department of Agriculture Economic Research Service (ERS). The ERS utilizes Rural Urban Continuum Codes (RUCC) that further classifies counties based on population sizes and functional adjacency to one or more metropolitan areas. While the MSA/Non-MSA classifications described above include many suburban areas in the ~~n~~on-

[3] Fluid Market Strategies, 2009.

metropolitan" category, the RUCC deem many suburban areas to be in the ~~"u~~rban" category (provided that they meet minimum population thresholds). Because of this re-categorization of suburban areas, the RUCC ~~"r~~ural" designation comprises a smaller proportion of the total Northwest population than the MSA ~~"n~~on-metropolitan" designation. For a summary of key results from this study by RUCC, please refer to Appendix G.

Table 1 provides more detail on the major data collection activities conducted in support of this study. The table provides information about the sample design, sample size, and data collection dates (see Appendix 0 for the data collection instruments). The study also included a review of inputs to NEEA's ACE model (which can be found in Appendix H) and analyses of regional ENERGY STAR CFL sales and market share of total regional medium screw-base (MSB) lamp sales. Appendix F provides the consumer focus group results.

Table 1: Data Collection Activities, 2010-11
Long-Term Northwest Residential CFL Tracking Study

Data Collection Activity	Sample Frame Source	Sample Design Overview	Number of Completes	Data Collection Dates
Consumer Focus Groups	Random digit dialing of consumers in the selected geographic areas	Conduct two focus groups each in Portland, Seattle and Spokane	6 focus groups with 47 Northwest consumers	December 2010
Retail Store Shelf Surveys (in-store surveys)	List of stores provided by Portland Energy Conservation Institute	Complete retail store shelf surveys stratified across 3 geographic regions (metro east, metro west, non-metro), 3 store categories (national chain, regional chain, independent), and 5 store types (do-it-yourself, drug/grocery, mass merchandise, small hardware, warehouse)	58 retail stores	December 2010
Consumer Surveys (computer-aided telephone surveys)	List of Northwest zip codes from US Census Bureau	Complete surveys with Northwest consumers stratified across 3 regions	1,000 consumers	January—February 2011
Market Actor Interviews (in-depth telephone interviews)	List of manufacturers and retailers provided by Fluid Market Strategies	Complete interviews with representatives of CFL retailers and manufacturers that participated in past NEEA promotions	5 retailer representatives; 4 manufacturer representatives	February 2011
Utility Program Staff Interviews (in-depth telephone interviews)	List of utility program staff provided by NEEA	Complete interviews with all of the investor-owned and large utilities and a random sample of the remaining utilities	16 utility program managers	January—March 2011

2. CFL Sales and Market Share Assessment

This chapter provides an overview of ENERGY STAR CFL sales and an assessment of residential ENERGY STAR CFL market share of total residential medium screw-base lamp sales in the Northwest and nationwide. While data are not available by metro/non-metro designation, this section does include a discussion of sales by state.

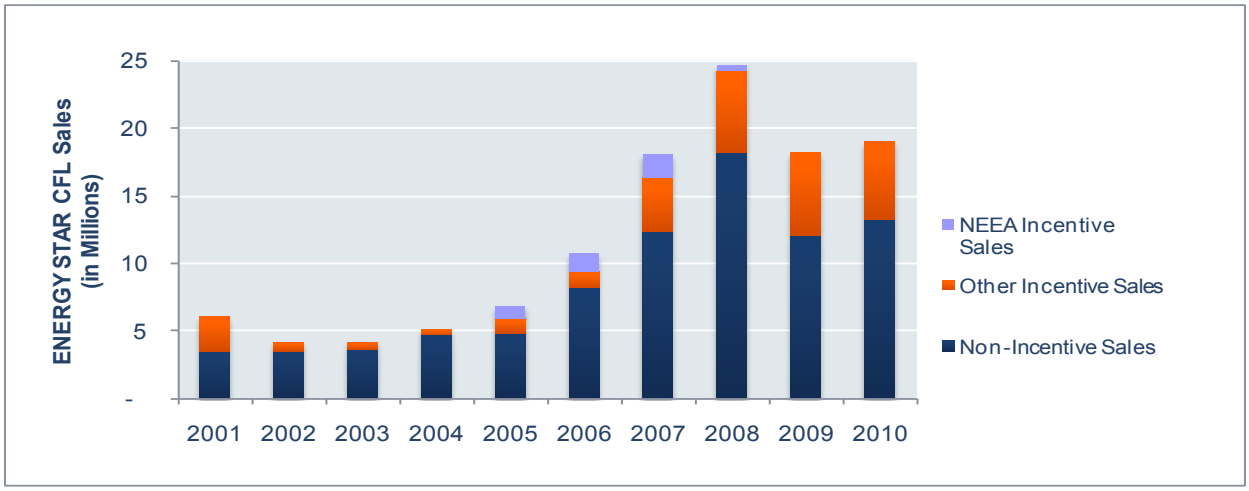
2.1 ENERGY STAR CFL Sales

As described in prior ENERGY STAR Consumer Products residential lighting studies, NEEA's implementation contractors have tracked CFL sales throughout the region for several years. The current method relies upon reports of actual CFL sales through several major retail channels in the Northwest, reports from local utilities and other energy-efficiency program sponsors, and extrapolation of these data to retailers representing the Northwest region.[4] In 2010, NEEA's contractor, Fluid Market Strategies, increased the proportion of tracked sales versus extrapolated sales in their sales database and also began tracking specialty CFL sales as a fraction of total CFL sales in the region.

Figure 1 shows ENERGY STAR CFL sales for the region broken down by utility incentive versus non-incentive sales. Total ENERGY STAR CFL sales increased by approximately 5 percent between 2009 and 2010, reaching more than 19 million CFLs sold in 2010. This is noteworthy given the 26 percent decline in ENERGY STAR CFL sales between 2008 and 2009. The number of CFLs sold with utility incentives decreased by 5 percent between 2009 and 2010, and the number sold without incentives increased by 10 percent. CFLs sold with utility incentives comprised a slightly smaller proportion of overall regional sales in 2010 as they did in 2009 (31% and 34%, respectively).

[4] Note that because tracking methods have improved over time, it is likely that annual estimates from earlier years tracked a smaller proportion of the overall Northwest CFL sales than estimates for later years. Also note that Fluid Market Strategies is in the process of revising and improving the current extrapolation methods.

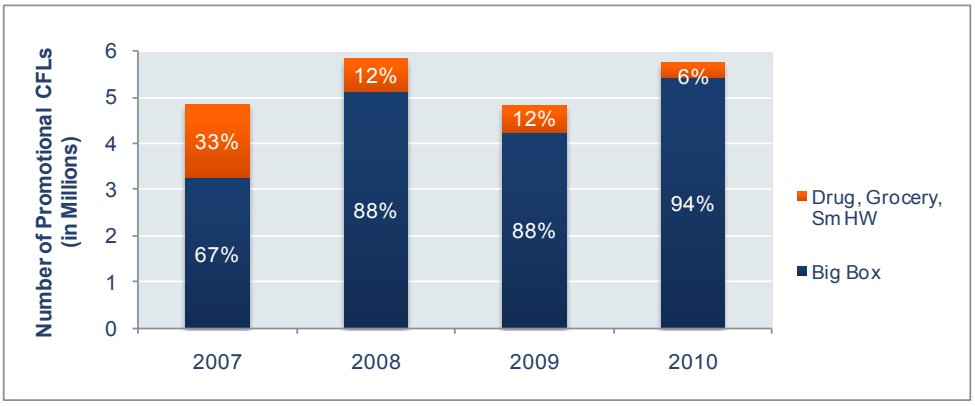
Figure 1: Estimated ENERGY STAR CFL Sales in the Northwest, 2001-2010



Sources: PECI, 2001–2006 (from 2006 report); Fluid Market Strategies, 2011, 2010, 2009, 2008a, 2008b, and 2007b.

While the proportion of total regional sales for which utility incentive sales accounted stayed about the same between 2009 and 2010, the proportion of overall tracked incentive CFL sales by channel shifted toward big box stores (do-it-yourself [DIY], mass merchants, and wholesale clubs) between 2009 and 2010 (Figure 2).[5] Big box stores represented 88 percent of total tracked promotional sales in 2009 but represented 94 percent of total tracked promotional sales in 2010. Non big box (drug, grocery, and small hardware) stores dropped from 12 percent of total tracked promotional sales in 2009 to only 6 percent in 2010.

Figure 2: Tracked Promotional CFL Sales by Store Category and Year, 2007-2010

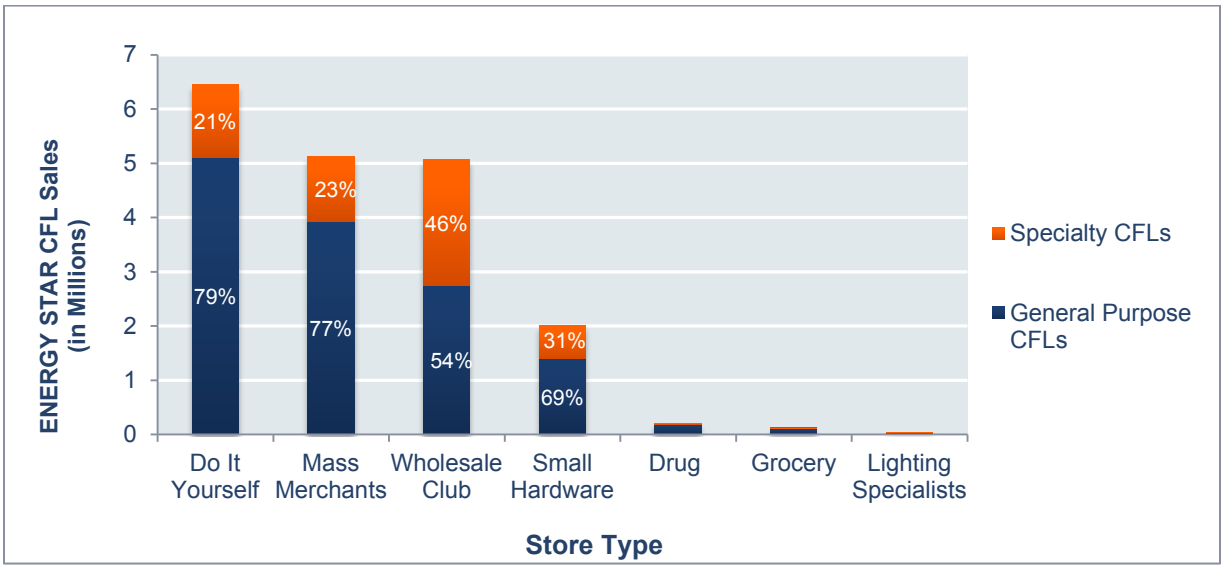


Source: Fluid Market Strategies, 2011, 2010 and 2009.
Number of Northwest promotional CFLs tracked with details on retail channel: 2010 n= 5,766,284; 2009 n=4,827,010; 2008 n=5,811,229; 2007 n=4,868,350. For consistency with data from prior years, the 2010 data excludes 38,207 CFLs sold in lighting specialty stores and the 2009 data excludes 519 promotional CFLs sold through this channel.

[5] Less than one percent of promotional sales were not tracked by channel.

NEEA's data collection contractor also tracked ENERGY STAR CFL by general purpose and specialty designation, with the ~~-~~general purpose CFLs" category including all twisters and a-lamps and the ~~-~~specialty CFLs" category including all other lamp types. At the store category level, there is little difference in the proportion of lamps sold by store type in these two categories (29% specialty in big box, 28% specialty in non big box), but the differences are more pronounced at the store type level. Figure 3 shows total 2010 Northwest residential ENERGY STAR CFL sales by store type broken into general purpose versus specialty CFLs. As shown, wholesale clubs sold the highest proportion of specialty CFLs (46%) with the next highest at 23 percent (mass merchandise) and 21 percent (do it yourself). Among the non big box stores, small hardware stores had the highest sales volume and also the greatest proportion of specialty lamps sold (31%), compared to 11 percent in drug stores, 9 percent in grocery stores, and only 2 percent specialty lamps in lighting showrooms.

Figure 3: ENERGY STAR CFL Sales by Store Type, Lamp Type and Year, 2010

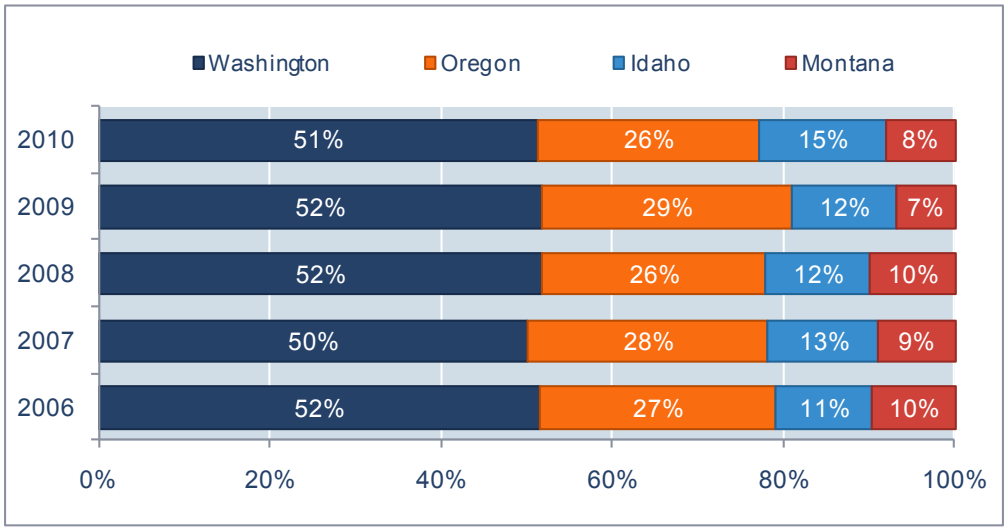


Source: Fluid Market Strategies, 2011.
Do It Yourself n=6,448,303; Mass Merchants n=5,128,418; Wholesale Club n=5,065,408; Small Hardware n=2,011,230; Drug n=210,270; Grocery n=123,230; Lighting Specialists n=39,029.

Figure 4 shows the proportion of ENERGY STAR CFL sales by state in the Northwest for 2006 through 2010. For the past five years, sales in Washington have comprised approximately half of the region's total ENERGY STAR CFL sales. Total ENERGY STAR CFL sales in 2010 were approximately 9.8 million in Washington, nearly 4.9 million in Oregon, more than 2.8 million in Idaho, and more than 1.5 million in Montana.

The proportion of total regional CFL sales comprised by sales in Oregon declined between 2009 and 2010 to 2008 levels, while Idaho increased from 12 to 15 percent of regional sales. Washington and Idaho remained constant between 2008 and 2009. The allocation of 2010 CFL sales by state closely mimics the distribution of the region's 2010 population.

Figure 4: Estimated Residential ENERGY STAR CFL Sales in the Northwest by State, 2006-2010



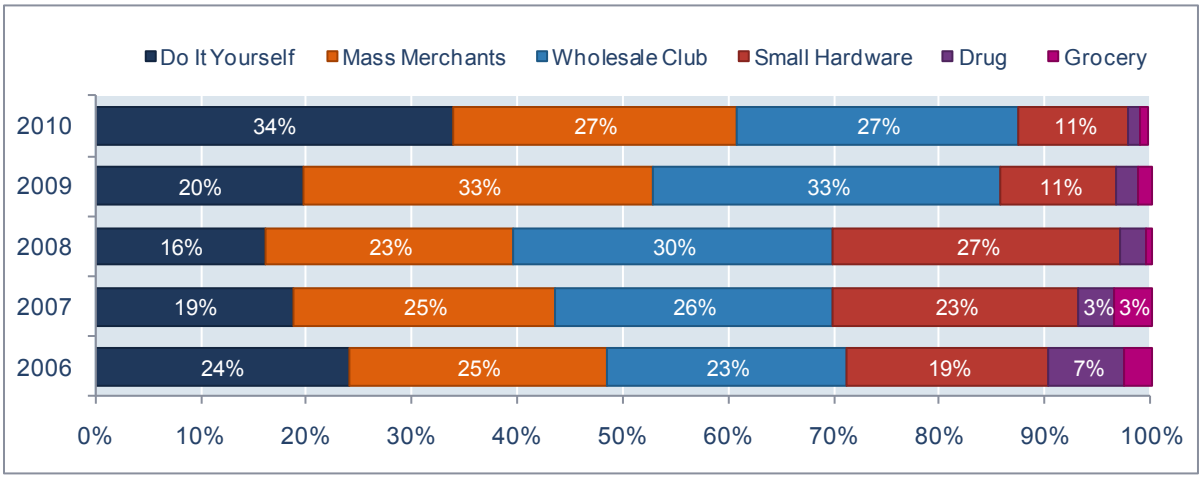
Sources: Fluid Market Strategies, 2011, 2010, 2009, 2008b and 2007b.
2010 n=19,025,888; 2009 n=16,898,484; 2008 n=24,710,098; 2007 n = 18,157,300; 2006 n = 10,751,907.

Figure 5 shows the proportion of Northwest CFL sales across store types for 2006 through 2010. The proportion of regional CFL sales through big box stores versus non big box stores remained fairly constant between 2006 and 2008 (roughly 70% big box, 30% non big box), the proportion of sales through big box stores increased from 70 percent in 2008 to 86 percent in 2009. These proportions held constant between 2009 and 2010 (87% big box, 13% non big box), but the distribution of sales within the big box channel shifted substantially:

- Market share of total ENERGY STAR CFL sales for do-it-yourself stores increased by approximately 70 percent between 2010 and 2010 (from 20% to 34%).
- Sales through mass merchandise and wholesale clubs both declined from 33 percent of the total market to 27 percent (a 22% decline).

Market share of total Northwest ENERGY STAR residential CFL sales for non big box stores remained relatively unchanged between 2009 and 2010.

Figure 5: Estimated ENERGY STAR CFL Sales in the Northwest by Store Type, 2006-2010*†



Sources: Fluid Market Strategies, 2011, 2010, 2009, 2008b, and 2007b.
2010 n= 19,025,888; 2009 n=16,898,484; 2008 n= 23,988,695; 2007 n = 18,157,300; 2006 n = 10,751,907.
* Sales in 2010, 2009, and 2006 include CFLs sold through lighting specialty stores which represent less 1% of total sales in each year. Sales through lighting specialty stores were not tracked in 2007 or 2008.
† Note that 2010, 2009, and 2008 data exclude promotional sales from utilities including Snohomish PUD, Energy Trust of Oregon, and Northwestern Energy that were not tracked by retail channel.

2.2 ENERGY STAR CFL Market Share

2.2.1 Approach[6]

D&R International provides annual estimates of CFL market share for the United States through 2009 in its annual CFL Market Profile reports.[7] To estimate Northwest ENERGY STAR CFL market share, we began with the estimates of lamp shipments for CFLs and incandescent lamps by year used by D&R International to estimate CFL market share at the national level through 2010.[8] We then assumed (based on discussions with D&R International staff) that annual lamp sales in the U.S. equal approximately 85 percent of total lamp shipments into the U.S. on an annual basis. We multiplied total U.S. shipments on an annual basis by 85 percent to estimate annual lamp sales for the U.S.

To estimate the share of national-level lamp sales comprised by Northwest lamp sales, we used population data from the U.S. Census to estimate the percentage of the U.S. population residing in

[6] Note that the approach described herein is greatly simplified from those used in previous lighting tracking studies for NEEA and is based on updated data. Thus, annual market share estimates in this report may differ slightly from those reported in previous NEEA lighting studies. For details on methods used in previous studies, see KEMA, 2009.

[7] D&R International, 2010.

[8] KEMA obtained the 2010 data through personal communication with D&R International staff (D&R International, 2011).

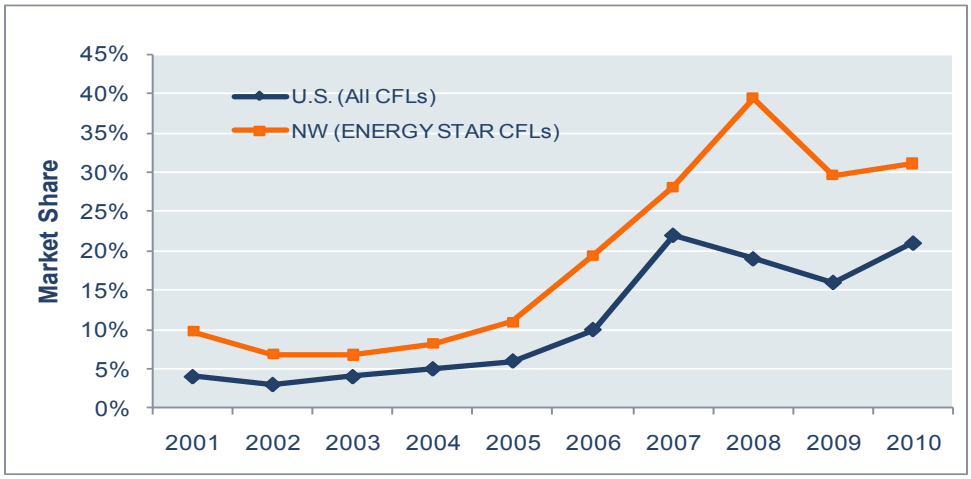
the Northwest by year.[9] We then applied these percentages to the annual estimates of total U.S. lamp sales to arrive at an estimate of total Northwest lamp sales per year.

To estimate Northwest ENERGY STAR CFL market share of total Northwest lamp sales, we calculated the percentage of total Northwest lamp sales comprised by annual ENERGY STAR CFL sales estimates provided by NEEA's data collection contractors.[10, 11]

2.2.2 Results

Based on the methods described above, we estimated Northwest residential ENERGY STAR CFL market share and national CFL market share for 2010. Results suggest that Northwest ENERGY STAR CFL market share increased to 31 percent in 2010 after declining from 39 percent in 2008 and to 30 percent in 2009 (Figure 6). At the national level, market share rebounded to approximately 21 percent after dropping from 19 percent in 2008 to 16 percent in 2009. Northwest market share also continues to exceed the national average.

Figure 6: Estimated CFL Market Share of Total Lamp Sales for the Northwest and U.S., 2001-2010



Sources: NW ENERGY STAR CFL sales: PECI, 2001–2006 (from 2006 report); Fluid Market Strategies, 2010, 2009, 2008b and 2007b.
U.S. CFL market share and lamp shipments: D&R International, 2010 and 2011.
U.S. and NW population estimates 2000-2010: U.S. Census, 2010.

[9] U.S. Census, 2010.

[10] PECI, 2001–2006; Fluid Market Strategies, 2011, 2010, 2009, 2008b and 2007b.

[11] It is important to note that the national-level lamp shipments/sales estimates provided by D&R International include *all* CFL sales, while the Northwest data includes only ENERGY STAR CFL sales. NEEA's data collection contractor (Fluid Market Strategies) did have some data on Northwest sales of non-ENERGY STAR CFLs for the 2008 and 2009 sale years, but did not actively seek this data from retailers until the 2010 sales year. Thus, the CFL market share comparison is between all CFL sales the national and ENERGY STAR CFL sales in the Northwest and is not a strictly -apples-to-apples" comparison.

3. Shelf Surveys

This section of the report focuses on the lighting retailer shelf surveys and includes a brief description of the methodology and presentation of key findings from survey data analysis. It provides results for the current (2010) surveys compared to results from 2006, 2008, and 2009. Appendix 0 provides the data collection instrument used for the 2010 shelf surveys, and Appendix F provides more detailed results including tables and comparisons with prior years broken down by region (metro versus non-metro) and store type.

Store classifications include "big box" which refers to warehouse, mass merchandise, and do-it-yourself (DIY) stores and "non big-box" which refers to grocery, drug, and small hardware stores. Appendix C contains results by all store types as well as results by store category.

3.1 Approach

Field staff visited a total of 58 lighting retailers in the Northwest region during December of 2010. Staff members recorded shelf space measurements and performed an inventory of all CFLs, incandescent lamps, and Light-Emitting Diode lamps (LEDs) found on shelves throughout each store.

With the exception of a couple closures, visits were made to stores that were recorded in past years. More details on approach, location, sample frame, and store type can be found in Appendix F. Researchers calculated sample expansion weights by strata and applied them to each sample retailer such that findings presented in this section represent the population of lighting retailers in the region that sell CFLs (as approximated by PECI's 2006 database). For affordability results across store types in the Northwest, we also applied sales weights based on regional CFL sales data gathered by Fluid Market Strategies.[12]

3.2 Affordability

Field staff collected pricing information for every CFL model observed on the shelf. As in prior evaluations, field staff recorded price (before and after utility program discounts or other discounts, when applicable) and number of CFLs per package. Results suggest that the average CFL price in the Northwest increased between 2009 and 2010:

- Overall increase of 30 cents per CFL, from $3.76 to $4.06.
  - Increase of 35 cents per CFL in big box retailers, from $3.56 to $3.91.
  - Decrease of two cents per CFL in non-big box stores, from $4.70 to $4.68.
  - Increase of 24 cents per CFL in metro areas, from $3.69 to $3.93.
  - Increase of 41 cents per CFL in non-metro areas, from $3.79 to $4.20.

[12] Fluid Market Strategies, 2010.

The highest increase between 2009 and 2010 occurred in non-metro areas, in which prices were only 10 cents more than in metro areas in 2009. At the end of 2010 a CFL in a non-metro area cost an additional 27 cents compared to one in a metro area. For further detail on the price trends over time, see the Affordability section in Appendix C (section C.3).

3.3 Availability

To assess the availability of lighting products, field researchers collected information on the total linear feet of shelf space and number of shelves for all lamp types, all CFLs, and ENERGY STAR labeled CFLs specifically. These data enabled calculation of total lighting shelf space in the region, average shelf space per store dedicated to CFLs, the percentage of stores carrying any CFLs, and the percentage of stores carrying CFLs of specific styles. We present results below for all CFLs by store category and geographic location. See Appendix C (section C.4) for additional detail on CFL availability over time.

3.3.1 Total Shelf Space

The quantity of linear space dedicated to lighting increased from 2009 to 2010, but the proportional allocation of this space to CFLs declined by 4.5 percent over the past year. While new shelf space allowed for the presentation of additional CFLs, it was also utilized to shelve non CFLs. The increase in ENERGY STAR CFLs was not proportional to the overall CFL growth (i.e., growth in ENERGY STAR CFLs was lower).

When looking at CFL shelf space as part of the total shelf space dedicated to lighting, the most significant drop occurred in non metro stores, where CFLs shelf space decreased by 28 percent (from 29% in late 2009 to 21% in late 2010).

3.3.2 Share of Shelf Space

The percentage of lighting shelf space allocated to CFLs in Northwest retail stores did not change dramatically over the last year:

- Decreased slightly from 24 to 23 percent of lighting shelf space is allocated to CFLs.
- No change from last year for metro areas (still 27 percent).
- Decrease from 29 to 21 percent in non-metro areas.
- Decrease from 30 to 25 percent in big box areas.
- Decrease from 25 to 22 percent in non big box areas.

These decreases are the first in the past four years across the board, which until now, have shown a steady rise from 16 percent in 2006. Metro and big box stores have generally had the largest ratio of CFLs to all lamps, and this currently remains true.

3.3.3 Percentage of Stores Carrying (Any) CFLs

For the first time in the past four years, all of the stores visited had CFLs in stock. The largest jump occurred in big box stores.

- Overall, 100 percent of stores carry CFLs (an increase of three percentage points over 2009).
  - Increase of four percentage points in metro stores to a total of 100 percent.
  - One hundred percent of non-metro stores carry CFLs, unchanged from last year.
  - Increase of eight percentage points in big box stores to a total of 100 percent.
  - Increase of one percentage point in non big box stores to a total of 100 percent.

3.3.4 Percentage of Stores Carrying CFLs by Style (Twister and Non-Twister)

As shown above, all Northwest lighting retailers carried CFLs in 2010. Examining CFLs further by style (twister versus non-twister) shows the following for twisters:

- Overall, approximately 96 percent of stores carry twisters (no change between 2009 and 2010).
- Ninety-six percent of metro stores carry twisters, an increase from 93 percent in 2009.
- Ninety-six percent of non-metro stores carry twisters, a decrease of four percentage points from 2009.
- Ninety-six 93 percent of big box stores carry twisters, a six percentage point increase from last 2009.
- Ninety-six 97 percent of non big box stores carry twisters, a two percentage point drop from 2009.

For twister CFLs, big box stores recovered the six percentage points in 2010 that they lost between 2008 and 2009 and returned to 2008 levels. While big box and metro stores both saw increases, non metro and non big box stores saw their first slight decrease in proportional shelf space for twisters since 2006.

Non-twister CFLs can also be found at the majority of stores and experienced significant gains this past year:

- After an increase of nine percentage points from 2009, 91 percent of stores currently carry non-twisters.
- After an 8 percentage point increase from 2009, 96 percent of in metro stores carry non-twisters.
- A six percentage point increase in non metro stores from 79 percent in 2009 to 82 percent in 2010.
- An eleven percentage point increase in big box stores from 83 percent in 2009 to 94 percent in 2010.
- A seven percentage point increase in non-big box stores from 83 percent in 2009 to 90 percent in 2010.

3.4 Diversity

Field researchers recorded data on lamp style (twister, three-way, reflector, etc.) and wattage as part of the shelf surveys to assess the diversity of CFLs available to Northwest consumers. Below we discuss diversity in terms of the average number of twister and non-twister CFL models available in each store. Appendix C (section C.5) provides additional information on CFL diversity.

3.4.1 Average Number of Models per Store

The average number of CFL models per store – a measure of CFL diversity – increased between 2009 and 2010. Examining the average number of CFL models per store by style (twister versus non-twister) shows the following results.

The overall average number of twisters increased by 3.5 models per store, from 19.9 to 23.4, including:

- Increase of 4.1 models per store at metro stores, from 20.5 to 24.6.
- Increase of 2.7 models per store at non-metro stores, from 18.8 to 21.5.
- Increase of 5.1 models per store at big box stores, from 27.8 to 32.9.
- Increase of 2.9 models per store at non big box stores, from 17.5 to 20.4.

The average number of non-twisters per store has decreased slightly, with an overall decrease of approximately 0.8 models per store (from 17.6 to 16.8 models). Other details include:

- Increase of 0.2 models per store at metro stores, from 16.3 to 16.5.
- Decrease of 2.7 models per store at non-metro stores, from 20.0 to 17.3.
- Decrease of 2 models per store at big box stores, from 27.3 to 25.3.
- Decrease of 0.6 models per store at non big box stores, from 14.3 to 13.7.

Once again, big box stores exhibited the largest increase in average number of models per store for twisters. Non-twister models decreased the most in non-metro stores, which was a turnaround from last year's increase in non-metro stores for this product type.

3.4.2 LEDs

LEDs are available at approximately 27 percent of stores in NEEA's territory, down two percentage points from last year. Of these, approximately 48 percent are in metro areas and 52 percent in non-metro areas which is a more even distribution than last year (in which metro areas had 60 percent of the share of LEDs). In late 2010, 60 percent of the stores that carried LEDs were small hardware, grocery, and drug stores, and 40 percent were big box. Stores that carried LEDs doubled between late 2009 and late 2010 and averaged approximately seven models per store.

Field researchers found LEDs primarily in spotlight and reflector (flood lamp) styles, with a few other styles available (including globes and a-lamps). The overall average price for LEDs was $27.59 per lamp, with spot lights averaging $34.75 per lamp, reflectors averaging $41.78 per lamp, and other styles averaging $16.39 per lamp. Spot light prices increased over $10 in the past year, other styles prices dropped by nearly 50 percentage points, and the overall average cost of LEDs increased less than a dollar.

4. Consumer Surveys

This section of the report presents key findings from 1,000 consumer telephone surveys conducted in early 2011. These consumer survey efforts build upon surveys that have been conducted in the region since 2001. The survey effort was further enhanced by consumer focus groups, which elicited detailed perspectives on consumer decision-making and enabled qualitative testing of telephone survey questions. Appendix F provides detailed consumer focus group results.

4.1 Approach

KEMA conducted the 2011 consumer survey with a stratified random sample of households in Idaho, Montana, Oregon and Washington. We oversampled non-metropolitan areas based on classification of counties as inside of outside of Metropolitan Statistical Areas (MSA), location east or west of the Cascades mountain range, and state. We also oversampled eastern metropolitan areas. Table 2 shows the sample frame and survey completes by strata. We conducted a total of 222 surveys in Idaho, 194 in Montana, 229 in Oregon, and 355 in Washington.

Table 2: Consumer Survey Sample Frame and Completed Surveys by Strata, 2011

Segment	Metro West	Metro East		Non-Metro	
		(a) Washington	(b) Idaho /Montana	(a) Washington /Oregon	(b) Idaho /Montana
Population[13]	7,254,556	933,082	922,279	2,151,646	1,568,977
% of Population	57%	7%	7%	17%	12%
Final Number of Completes	300	100	200	200	200
Final % of Survey Completes	30%	10%	20%	20%	20%

We created and applied sample expansion weights to the data such that the results are representative of the Northwest residential population. We analyzed the 2011 survey data using both time series[14] and cross-sectional comparisons to understand longitudinal changes in the market as well their underlying causes. We compared results by various categories of consumers, including based on their awareness and purchases of CFLs in the past. We also looked at the date of their first CFL purchase and most recent CFL purchase. We looked at respondents who are aware of CFLs by their intentions to replace burned-out incandescent lamps in their homes with CFLs. We also analyzed results by geographic region. We looked for meaningful and statistically significant time series or cross-sectional differences (at the 90% level of confidence).

[13] US Census, 2010.

[14] The 2011 survey included many of the same questions as those conducted in previous years back to 2004.

Appendix 0 provides the data collection instrument used for the 2010 consumer surveys, and Appendix D provides more detailed results. Appendix E provides cross-tabulations of each survey question in banner table format.

4.2 CFL Awareness and Purchase Rates

The telephone survey addressed CFL awareness and purchase rates, as well as CFL purchase rates by channel. Appendix D (section D.1) provides additional details on consumer awareness and purchase rates.

- Overall awareness of CFLs dropped from 95 percent in 2010 to 92 percent in 2011, a small but statistically significant change.[15] This decline seems driven by a small but statistically significant drop in awareness in Washington (from 96% in 2010 to 91% in 2011). Changes in awareness among consumers in other Northwest states were not significant.
- The proportion of Northwest consumers who have purchased CFLs has decreased by a small but statistically significant margin from 81 percent in early 2010 to 75 percent in early 2011. All states except Oregon demonstrated small declines in consumer purchase rates between 2010 and 2011, but none of the changes were statistically significant.
- Concurrently, the proportion of consumers who are unaware of CFLs and the proportion that is aware but has not purchased CFLs have both increased slightly since 2010. Aware non-purchasers currently represent 17 percent of the Northwest population and only 8 percent of the population is currently unaware of CFLs.
- Do-it-yourself (DIY) stores such as Home Depot and Lowe's continue to be the most common store category in which consumers purchase CFLs. Approximately 45 percent of metro consumers report that they purchase CFLs in DIY stores compared with 31 percent of non-metro consumers (a statistically significant difference).
- When purchase locations are examined by geography (metro versus non-metro), 2010 survey results show a much more even distribution of purchase locations between geographies than 2006 results.
- Approximately 32 percent of CFL purchasers in the Northwest report that they are aware of specialty CFLs.[16] Among CFL purchasers who are aware of specialty CFLs, a statistically equal distribution currently have them installed and currently do not have them installed (47% and 53%, respectively). There was no difference in awareness of specialty CFLs between metro and non-metro consumers.

[15] We report statistical significance at the 90 percent level of confidence throughout.

[16] The survey asked, "Other than CFLs that look like a twisty, spiral or curlicue shape, are you aware of any other types of CFLs?" If the respondent answered, "Yes," a follow-up question asked the respondent to describe the CFL shapes with which they were familiar. Respondents who were familiar with only spiral CFLs and/or a-lamps were characterized as "unaware" of specialty CFLs, and respondents who were familiar to other CFL shapes (in addition to spirals and/or a-lamps) were characterized as "aware" of specialty CFLs.

4.3 CFL Disposition

Table 3 presents results on CFL installation, removal, and storage for CFLs acquired by CFL purchasers in the Northwest over time. As of early 2011, Northwest consumers who have purchased CFLs have, on average, 11 CFLs installed at their home with 6 in storage. In 2006, the Consumer Products Market Progress Evaluation Report 3 (MPER3) cited a then-recent study which suggested significant potential for expansion of CFL usage in the Northwest.[17] Since 2010, however the proportion of CFLs installed in purchaser households has decreased significantly from 64 percent in 2010 to 53 percent in 2011 – suggesting that consumers have removed a relatively high proportion between the 2010 and 2011 survey, despite still having opportunities for additional CFL installations.

This does not necessarily mean that consumers in the Northwest have changed their installation habits and remove CFLs at a higher rate than in the past because all CFLs ever removed are included in this result. Over time, we expect the number of CFLs removed to increase relative to their time in use, rated life, and other factors. However, this may reflect the slight decline in CFL purchase rates as described in section 4.2 above.

Within the 2011 results, there were no significant differences by geographic region (see Appendix D, Table 14 for additional detail).

Table 3: Lamp Disposition in Purchaser Households by Survey Year, 2004–2011

Disposition of All CFLs Ever Acquired by Purchaser Household	2004 Survey (n=554)		2005 Survey (n=220)		2006 Survey (n=411)		2010 Survey (n=399)		2011 Survey (n=646)	
	Mean # of lamps	% of lamps	Mean # of lamps	% of lamps	Mean # of lamps	% of lamps	Mean # of lamps	% of lamps	Mean # of lamps	% of lamps
CFLs currently installed	5.2	71%	6.1	70%	6.3*	68%	10.9†	64%	11.0	53%†
CFLs ever removed	0.3	4%	0.3	4%	0.4	4%	1.4	8%†	3.8†	18%†
CFLs currently stored	1.8	25%	2.3	26%	2.6*	28%	4.8†	28%	6.0	29%
Total CFLs ever acquired	7.3	100%	8.7	100%	9.3*	100%	17.1†	100%	20.7	100%
Purchaser base	**32%†**		**58%†**		**67%†**		**81%†**		**75%†**	

* Difference from 2004 is statistically significant.
† Difference from prior study period is statistically significant.
Purchaser base: 2004 n=1,530; 2005 n=560; 2006 n=667; 2010 n=500; 2011 n=646.

4.4 Satisfaction with CFLs

The telephone survey included questions addressing CFL satisfaction, including general satisfaction as well as satisfaction with specific CFL attributes (such as color of light and how long they last). The telephone survey also asked about likelihood of replacing CFLs with CFLs as an indirect measure of

[17] Based on a study of single-family homes in the Northwest (RLW Analytics, 2007. Single Family Residential Existing Construction Stock Assessment).

consumer satisfaction. These results are summarized below with additional detail provided in Appendix D (section D.2).

- Consumer satisfaction with CFLs remains high and there were no statistically significant differences between early 2010 and early 2011 or between metro and non-metro purchasers. The mean satisfaction rating remained statistically unchanged from 2010 (7.6) to 2011 (7.4). This sustained level of consumer satisfaction is noteworthy given the waning satisfaction with specific CFL attributes such as color of light, light-up time, and how long CFLs last (all of which declined by statistically significant margins from 2010 to 2011). Survey results also suggest that recent purchasers are more satisfied with CFLs than consumers who have not purchased CFLs within the past year.
- CFL purchasers who have CFLs installed in their homes continue to cite a mixed-bag of reasons for not increasing their CFL installations, but approximately one-third report that they are waiting for incandescent lamps to burn out before installing more CFLs (consistent with 2006 and 2010 results). When results are further examined based on CFL saturation in purchaser households (Table 4), results suggest few significant differences among respondents grouped by the level of CFL saturation in their homes (that is, the percent of total sockets filled with CFLs). The only significant differences based on saturation are:
  - Respondents with 33 percent saturation or less cite issues with the brightness of light and the way CFLs fit in fixtures more often than those with saturation ranging from 34 to 100 percent of their household sockets (a statistically significant difference); and
  - Respondents who have more than two-thirds of their sockets currently filled with CFLs are significantly less likely to cite price as a barrier than those with saturation between zero and 67 percent of sockets.
- There were no statistically significant differences between 2010 and 2011 regarding CFL purchaser likelihood of replacing a CFL with another CFL upon burnout.

Table 4: Main Factors Preventing Additional CFL Installations Among CFL Purchasers Who Have CFLs Installed in Their Homes by Percent Saturation, 2011

Main Factor	Percent Saturation			
	0%	1-33%	34-67%	68%+
Waiting for incandescent bulbs to burn out	10%	19%	22%	23%
Storing incandescent bulbs	4%	4%	3%	3%
Operating hours (don't use the other bulbs enough)	2%	3%	0%	1%
CFL price (too expensive)	12%	11%	15%	5%
Need dimmable bulbs	0%	9%	6%	7%
Need 3-way bulbs	2%	3%	4%	4%
Don't like the way CFLs look in fixtures	9%	10%	2%	4%
Don't like the way CFLs fit in fixtures	2%	4%	10%	5%
CFLs aren't bright enough	15%	12%	7%	2%
Don't like the color of light from CFLs	13%	5%	4%	0%
CFLs take too long to light up	1%	1%	2%	2%
Other	24%	13%	11%	19%
Don't Know / Refused	7%	5%	14%	25%
n	70	239	157	257

4.5 2007 Energy Independence and Security Act (EISA)

The 2010 and 2011 consumer telephone surveys included several questions designed to gauge Northwest consumers' awareness of Energy Independence and Security Act (EISA) of 2007.

- Approximately 26 percent of 2011 survey respondents report that they are aware of legislation that will affect lamp availability (up from 16% in 2010; a statistically significant change).
- One-third (33%) of 2011 survey respondents report that they are aware of legislation that will ban most traditional incandescents by 2014, up more than 40 percent from 2010 (23%; a statistically significant change).
  - A slightly higher proportion of metro west respondents report awareness of the legislation than metro east respondents (74% versus 68% percent, respectively; a statistically significant difference).
- Less than 20 percent of 2011 respondents are aware that traditional 100-watt incandescents will no longer be available by 2012 (18%), up from only 11 percent in 2010 (a statistically significant change).

The survey also included a follow-up question to gauge behavior in response to the new legislation: "When traditional 100-Watt light bulbs are eliminated, which one of the following things are you most likely to do: switch to a new type of light bulb, keep using traditional light bulbs but switch to a lower wattage, or something else?" Just less than half of Northwest consumers said they are most likely to switch to a new type of lamp to replace their 100 Watt incandescent lamps once the latter are phased out, and this proportion declined from 55 percent in 2010 to 46 percent in 2011 (a statistically significant change).[18] Of these, more than four out of five reported that they are most likely going to switch to CFLs. In both 2010 and 2011, nearly a quarter of consumers said they are most likely going to replace their 100 Watt incandescent lamps with incandescent lamps of a lower wattage. Only around 1 percent of the population said they are most likely to stock up on low-efficacy 100 Watt incandescent lamps before they are phased out.

4.6 Compact Fluorescent Fixtures

Appendix D (section D.4) provides details regarding compact fluorescent (CF) fixture awareness and purchase rates, reasons for choosing CF fixtures over standard fixtures, and consumer satisfaction with CF fixtures.

[18] Note that if this survey question allowed more than one response, it is possible that a higher proportion of respondents (for example) may have stated that they would stockpile low-efficacy incandescent lamps in advance of the phase-out.

5. Market Actor Interviews

In the beginning of 2011, researchers conducted ten interviews with lighting market actors. Four of these interviews were with representatives from CFL and LED manufacturers and the remaining five were with representatives from retail chains that sell CFLs in the Northwest. Appendix 0 provides the guides used for these interviews.

Below we divide findings between the national and Northwest CFL markets and then further into topics including:

- Sales (overall, promotional vs. non-promotional, and forward looking sales expectations);
- CFL price;
- Perceived current and future effects of the Energy Independence and Security Act of 2007 (EISA); and
- Future of LEDs.

Where possible, we also compared this year's findings to that of the past two years. We give particular attention to challenges faced in the Northwest within the past year.

5.1 National Market

Below we review CFL manufacturer and retailer representatives' perspectives on general market movements as well as changes in CFL sales and prices between 2009 and 2010. Where possible, we compare results to prior years.

5.1.1 General Market Changes

Interviewers discussed general CFL market changes with manufacturer and retailer representatives during the market actor interviews conducted in early 2011 and have tracked responses on this issue for two prior years. After two years of little consensus among the representatives regarding market changes, there now seems to be a common observation of decreasing sales of CFLs (although it is important to note that one interviewee noticed an increase in sales). The estimated decrease in sales ranged from one to fifteen percent among respondents, a shift from interviews in the two prior years in which respondents predicted continuing increases in CFL sales.

While the trends this year were more widely agreed upon, there was less of a consensus on the reasons for the decline. Explanations included the status of the economy, the need for further education, the possibility that people may have already stocked up on CFLs, and the lack of utility incentives.

In prior years' findings, views on the economy were both pessimistic and optimistic, but this year the economy was a much less prominent part of the discussion. Two representatives mentioned the economy as the main influence on the decrease in CFL sales in the past year. Others used the economy as a predictor for the future direction of CFL sales and diversity. The overall consensus was

that the economy isn't recovering very quickly and until it improves, CFL sales have reached a plateau.

Despite varied explanations for sales trends, a common theme emerged from the interviews regarding the need for education of consumers on the benefits of all types of CFLs. While many noted an increase in popularity of specialty lamps, they noted a continuing lack of knowledge about the benefits and savings that can encourage consumers to purchase these more expensive CFL styles.

5.1.2 Sales

Below we review the supplier representatives' perspectives on overall CFL sales at the national level as well as promotional (i.e., utility incentive) sales versus non-promotional sales during 2010. Where possible, we compare perspectives from the 2011 interviews with those from previous years.

5.1.2.1 Nationwide

Interviewers asked retailer and manufacturer representatives to describe how their overall sales of CFLs in 2010 compared to sales in 2009. Interviewers also asked this question of representatives regarding overall sales trends between 2007, 2008 and 2009 as part of previous evaluations. Regarding sales in 2008, representatives were inconsistent in their comments with sales trends ranging from an 18 percent increase over 2007 sales to a 20 percent decrease. Similarly, representatives reported inconsistent trends between 2008 and 2009, ranging from a 10 percent increase over 2008 sales to a 25 percent decrease. This year's results offer the first near consensus with only two manufacturers' representatives noting an increase in sales with the remaining respondents listing a decrease in the range of one to 15 percent. These differences may be the result of varied levels of involvement with promotional programs throughout the country, lamp types sold, regional consumer behavior patterns coupled with variations in regional supply distributions, and (for manufacturers) the types of retail chains through which they sold CFLs.

During the 2011 interviews, in addition to the economy's effects on sales volume, representatives acknowledged a variety of other trends related to the economy in terms of lighting sales, including:

- Lack of education for customers;
- Fewer incentives on twister CFLs;
- Raising popularity of specialty CFLs;
- Rising popularity of halogen lamps; and
- Declining CFL sales in areas without incentive programs.

5.1.2.2 Sales Expectations

Of the seven representatives that provided commentary on sales expectations at the national level (including the Northwest), and as a contrast to last year's positive expectations, this years' interviews produced split results for sales beyond 2011. Three respondents predicted a flattening of sales and another four respondents still hold the same optimistic outlook from prior years.

Those that predicted a flattening of sales cited the following reasons:

- Status of the economy;
- EISA legislation filling in incentive gaps by pushing consumers towards CFL purchases; and
- Consumer replacement of old incandescents.

Those that predicted a raise in sales credited:

- Adoption of more specialty CFLs as they gain popularity; and
- Improvements in lighting quality and ability to dim lamps.

Many of the representatives steered the conversation toward LEDs and believe these products to be both much more recognizable to consumers while acknowledging that they still have a long way to go in both price and in technological advances before mainstream customers will be ready to purchase them.

5.1.3 CFL Prices

Interviewers asked supplier representatives to compare Northwest CFL prices over the past year with pricing throughout the United States during the interviews conducted in 2011, 2010 and 2009. The overwhelming response from both manufacturer and retailer representatives in past years was that their regular prices for CFLs are consistent nationwide. This year's group did not comment on differences between national and local prices. While the prices for promotional CFLs tend to differ depending on the location, the representatives attribute this to varying levels of promotional assistance among the local or regional entities that provide incentives.

5.2 Northwest Market

Similar to the above review of general market movements and changes in CFL sales and prices for the national market, we conduct a similar review below for the Northwest market. We include comparisons between prior years as possible.

5.2.1 General Market Changes

Respondents believed the Northwest market differed from the national market in two ways:

- Higher CFL sales rates; and
- CFL specialty lamps sales were more resilient than they were on the national level.

Both respondents who claimed that the Northwest had higher sales rates than at the national level represented manufacturers and stated that generally, CFL sales in the region were five to ten percent

higher than the rest of the country. One of these manufacturer's representatives credited regional promotions and the other credited utility-sponsored energy-efficiency programs.

Retail representatives were less able to compare their regional sales levels to national statistics as two of the retailers only have stores in the Northwest region. The two retailer representatives who were able to comment on the market both shared that there are less Northwest rebates and promotions for CFLs than there have been in prior years. One visible change, noted by two respondents, was a decrease in promotional offers.

5.2.2 Sales

Below we review the supplier representatives' perspectives on CFL sales in the Northwest as well as promotional (i.e., utility incentive) sales versus non-promotional sales during 2010. Where possible, we compare their perspectives regarding prior years.

5.2.2.1 Overall

In early 2011, we asked supplier representatives to describe any differences in sales between 2009 and 2010 in the Northwest. There were few responses and little consensus. Two manufacturer's representatives reported increases of up to ten percent when comparing to national sales (crediting utility assistance and promotions) but the retail respondents felt that promotional assistance was lower than it had been in past years and that sales were flattening out or lowering. The two local independent retailers estimated CFL sales declines of ten and 25 percent. Additional retailer representatives claimed that sales were initially higher in past years and have since decreased in popularity similarly to what they perceived at the national level.

During the interviews conducted in early 2010 (regarding 2009 activity), the manufacturer representatives offered similar opinions: two reported an increase in Northwest CFL sales during 2009. One of these manufacturer representatives claimed that sales were up by ten percent, while the other could not quantify the increase but attributed it to participation in regional promotional programs. The retailer representative stated that his firm showed strong growth in 2009, but that the growth was not quite as strong as in 2008. Another past retailer representative claimed that the Northwest was one of their highest performing regions in the nation, but this representative was unable to compare sales with previous years to estimate growth.

Two retailer representatives commented that specialty CFLs have been more resilient than twister CFLs in sales. One representative supported this with the observation that specialty CFLs are becoming more of the focus of utility rebates and that consumers are more aware of their applications.

5.2.2.2 Promotional vs. Non-Promotional

Multiple retailer representatives provided information regarding regional promotions in the four Northwest states. When asked directly about the loss of NEEA incentives and subsequent effects, retail representatives mentioned that sales have suffered, end-cap promotions have disappeared, and that NEEA's promotions were helpful in educating customers, a role that one retailer is attempting to fill on its own. While there was a general consensus that sales dwindled after 2007, there was a split

opinion on whether or not the variety of lamps has increased or decreased. Manufacturer representative perspectives offered consensus on the need for promotions to support sales and provide regional uniformity that is so desired by retailers.

5.2.3 CFL Prices

Supplier representatives estimated prices for promotional and non-promotional twister-style CFLs in the Northwest for 2010.[19] Representatives report higher price ranges for both promotional and non-promotional twister-style CFLs during 2010 than they did during 2009. A comparison of price estimates in years past can be found in Table 5. Comparing results across all 2011 interviewees yields an average non-promotional price of $1.70 for twister-style CFLs in 2010 and an average non-promotional price of $2.81. These results suggest an average discount of approximately $1.11 for twister-style CFLs with promotional pricing in 2011.

Table 5: Range of Reported Northwest Prices for Twister-Style CFLs by Promotion Availability, 2008—2010

Description	Range of Reported Prices		
	2008	2009	2010
Promotional twister CFL	$0.66 – $2.00	$0.46 – $1.50	$0.99 - $3.25
Non-promotional twister CFL	$1.25 – $4.99	$1.30 – $3.44	$2.15 - $3.74

5.2.4 Supplying the Northwest Market

Interviewers asked retailer and manufacturer representatives if they had experienced any difficulties supplying the Northwest CFL market during 2010 or meeting market demand. As in the previous year's interviews, the majority of CFL suppliers claimed that they had no difficulty supplying the market. The only issue mentioned had to do with electrical component supplies and hasn't been a problem since this particular manufacturer's representative found a new component supplier in 2009.

5.3 Effects of the Energy Independence and Security Act of 2007 (EISA)

Interviewers asked supplier representatives to comment on the effects of the Energy Independence and Security Act (EISA) on their stocking or manufacturing practices and the stocking and manufacturing practices of lighting suppliers in general. Recall that the EISA sets an energy-efficiency standard for general service incandescent lamps and governs the phase-out of many of the low-efficacy incandescent lamps that are currently on the market, beginning in 2012.

[19] Given the broad range of non-twister styles, the interviews did not include questions regarding non-twister CFL prices.

Similar to past results, none of the retailers or manufacturers claimed that they would sell certain inefficient lamps in the United States if the law does not permit. However, expectations of stocking effects varied; while one retailer representative predicted that there are incentives to stock up on incandescent lamps pre-2012, they also noted that these products have a high warehousing cost. Another retail representative predicted that it would be a big adaptation while another predicted that the legislation will not affect them much. One thing they all seem to agree upon is that halogens will be in demand, as three of the four responding retailer representatives have begun stocking high-efficiency halogen lamps on their shelves. None of the five retail representatives noted any noteworthy increase in sales of these higher efficiency incandescent lamps since they were introduced.

The manufacturers' perspectives were just as fragmented. Two out of the three commenting manufacturer representatives predicted that other lamps (such as CFLs and LEDs) will fill the void created when traditional incandescent lamps are no longer available, and one of these representatives believed that there will need to be new education on the shelves to inform consumers of the changes. (Only one of the five retailers mentioned making significant changes to how they advertise lamps before the 2012 change.) The low response rate from manufacturers can be attributed to the fact that only two out of the four interviewed produce incandescent lamps and only one out of the four is producing the higher efficiency halogen.

5.4 LEDs

Interviews this year contained additional questions regarding LEDs. There is much excitement among those in the industry about the fast advance of this technology, although all agreed that the technology is not at a price-point that will push customers to purchase these lamps for general purpose use. All four of the manufacturers are making LEDs but currently only two out of the five retailers stock them (citing successful sales to early adopters), with two waiting for a lower price-point and better technology.

While recognition of LEDs is not cited as a barrier, problems still exist with the technology and with the price-point. One manufacturer representative noted issues with electrical components and another pointed out that they are having difficulty findings suppliers that make a quality chip. When asked about key barriers, every single interview subject named price. Despite the discussed barriers, three retail and two manufacturing representatives expected short-term sales to increase for LEDs with residential applications first in decorative, outdoor, and specialty applications.

6. Utility Program Manager Interviews

6.1 Approach

Between January and March 2011, senior evaluation staff conducted in-depth interviews with lighting program managers at 16 utilities in the Northwest. The interviews had four distinct objectives:

- **Identify and discuss effectiveness of recent utility activities to promote energy-efficient lighting**. The interview guide included questions about the utilities' current lighting promotions and the utilities' reasons for offering those programs.
- **Understand market progress since NEEA's withdrawal**. We asked all the utilities how the market lighting market had changes since the end of 2007.
- **Obtain utility staff perspectives on expected changes in the residential lighting market and potential market barriers**. We asked the utilities about the existing market barriers in their service areas and the trends they have observed.
- **Understand whether utility staff desire NEEA's assistance to overcome existing or expected market barriers**. Our interview guide asked the utilities to offer their views on NEEA's role in the regional lighting market.

NEEA provided a list that identified the utilities as an investor-owned (IOU), or a large, medium, or small publicly owned utility (see Table 6). Evaluators included all of the IOUs and the large publicly owned utilities (a total of ten) in the sample. To select the remaining six utilities, evaluators assigned a random number and selected the six utilities with the highest random numbers. The final sample and completed calls are shown in Table 7. The sample included a mix of utility ownership and sizes as well as both metro and non-metro service areas.

Table 6: Sample Frame of Utilities by State, Size, and Ownership, 2011

State	Publicly Owned[20]			Investor Owned	Total
	Small	**Medium**	**Large**		
Oregon	20	14	0	3	37
Washington	32	16	4	1	53
Montana	18	3	0	1	22
Idaho	18	5	0	1	24
Total	**88**	**38**	**4**	**6**	**136**

[20] Sizes based on program staff and implementation contractor assessment of utility residential customer base.

Table 7: Utilities Interviewed by State, Size, and Ownership, 2011

State	Publicly Owned Utiilities[20]			Investor-Owned Utilities	Total
	Small	**Medium**	**Large**		
Oregon	1	1	0	3	5
Washington	1	2	4	1	8
Montana	1	0	0	1	2
Idaho	0	0	0	1	1
Total	**3**	**3**	**4**	**6**	**16**

6.2 Northwest Lighting Programs

6.2.1 Current Lighting Programs

The utilities included in the program staff interviews offer a variety of lighting programs, including point-of-sale (POS) incentives, coupons for discounted CFLs, CFL giveaways at community events, rebates for efficient fixtures, and direct-installation of CFLs implemented during energy audits or weatherization. Only one utility included in the interviews is currently offering no residential lighting programs.

The most common lighting program type offered by the interviewed utilities was POS incentives, and ten of the sixteen interviewees explicitly mentioned working with the Bonneville Power Administration (BPA) ―Simple Steps, Smart Savings" POS program. The utilities in more isolated areas reported that the BPA's program was their only POS program. Utilities in the Puget Sound area offer their own independent programs, some coordinating with BPA to minimize leakage across service areas or to ensure the entire area is covered.

Three utilities offer no POS programs for residential lighting. All three are publicly-owned and relatively isolated. These staff indicated the impression that market transformation had occurred in their service territories and that their customers' homes have many CFLs in them. Also, the cost of CFLs had declined enough so that the rebates mattered less. Another utility representative explained that they have very little retail in their service area and most household purchase consumer goods outside the area and a POS program made little sense for that service territory.

The second most common program type among the interviewed utilities is give-away programs. Nine representatives noted that their organizations give away CFLs at events. Only one of these representatives mentioned that the utility's giveaways were specific to low-income customers. The others reported giving away lamps at community events, often as part of an educational program (discussed in more detail below). A handful of utility representatives mentioned that they offer rebates for compact fluorescent fixtures.

6.2.2 Change Since 2007

Almost all the utility representatives reported that their programs have changed very little since NEEA withdrew from the CFL market. One large metro utility representative reported that they established

their own program in place of NEEA's program, but the majority of the utilities shifted from the NEEA program to the BPA program. Utility representatives perceive that the two programs are very similar; for example, one utility representative reported that only change made by the utility since the end of 2007 was that they had added light fixtures to their rebate program. That utility had actually shifted its whole POS program from NEEA to BPA—but from this representative's perspective, the POS program continued to operate and no change had really occurred.

All of the utility representatives interviewed for this task stated that the CFL promotions have had a positive impact on the CFL market. They mentioned that the promotions have been able to achieve:

- Reduction in CFL price;
- Increased market share;
- Increased customer adoption;
- Increased socket penetration; and/or
- Increased customer satisfaction.

Utility representatives outside the Puget Sound or Portland regions noted that specialty CFLs are more difficult to obtain, asserting that smaller hardware stores lack the shelf space and volume to stock a wide variety of lamps.

6.2.3 Education for Specialty CFLs

Just over half of the interviewed utility representatives reported that their organizations offer education or training materials for specialty CFLs. Educational activities for specialty CFLs include point-of-purchase materials, information on the utility website, bill inserts, and information at community events.

The utilities that offer education for specialty lamps plan to continue those educational programs in some way. The materials will continue to be available on the website and for in-store displays. The number of community events may change in the next year—with some utilities decreasing activity and others increasing. The utility staff who provide information at community events noted that customers learn about CFLs during the events. The use of display CFLs and information about appropriate uses generate positive reaction from customers during the face-to-face interaction. The interviewees who had been in the position to directly inform the public reported that further education is needed as there is quite a bit of confusion of appropriate application of specialty lamps (and the inappropriate use of basic CFLs).

Generally, the non-metro utilities do not offer educational materials for specialty lamps and do not plan to offer any. For some, it is matter of the lack of staff time. Two interviewees stated that their respective organizations planned to let the market ~~"~~take care of itself" and would not seek to direct it.

6.3 Northwest CFL Market Since 2007

The interviewees noted a few key trends in the CFL market in the last few years:

- **Increased availability.** Interviewees assert that CFLs are available at more stores on a regular basis across the four-state region. They report that big-box retailers all carry CFLs and many smaller retailers, such as small hardware stores in non-metro areas, now carry CFLs.
- **Increased diversity.** Interviewees also have the impression that a wider variety of lamps are now available in metro and non-metro areas. Some interviewees cautioned that although the variety of lamp types has expanded, consumer understanding of appropriate use of different lamp types has not kept pace.
- **Decreased prices.** Almost all the interviewees noted that prices for CFLs have declined over time. One utility representative (whose organization has exceptionally low electricity rates) explained that the utility has difficulty providing incentives for energy-efficiency programs because the payback period is too long. But even for that utility, CFL prices had declined enough to be attractive to their customers.
- **Increased customer awareness and acceptance.** Interviewees noted that across the region, consumers have grown to accept CFLs and consider them a ―standard" good to use in their homes. The interviewees indicated that basic CFLs have become accepted but that specialty lamps are not accepted to the same degree; however, they noted that consumers are slowly learning about the appropriate applications for specialty CFLs.

Interviewees had varying opinions regarding the importance of the POS programs, some stating that they are ―a little important." Two utility representatives had unique experiences that suggest the POS programs are quite important: one reported that the utility had to remove incentives from one store and the CFL sales experienced a dip at that store but not at others. Another utility with service inside and outside the BPA region—where there is no POS program—found that CFLs have a dramatically larger market share in the BPA region than its territory outside the BPA region.

A few of the interviewees stated that NEEA's work did impact the CFL market, but at this time it is the BPA program that is moving sales forward. The interviewee at one metro utility stated that NEEA's relationship with manufacturers remains important because individual utilities lack the clout to influence them. Interviewees generally acknowledge that NEEA ―laid the groundwork" for consumer acceptance of CFLs.

Utility representatives report that other factors have affected the Northwest CFLs market. For example, some interviewees mentioned that more households make an effort to be environmentally responsible now than in the past, and they feel that this has positively affected sales. A few interviewees reported that the economic downturn has caused some households to take long-term savings into account and that these customers may expect more value from consumer goods. Finally, some interviewees asserted that the quality of CFLs has improved. They feel that CFLs switch on faster and the colors are more appealing, and that these changes have increased consumer satisfaction, making the product more appealing to a broader range of households.

6.4 CFL Market Barriers

Most of the barriers identified by utility representatives pertained to the CFLs themselves, and the following were mentioned in roughly equal proportion:

- High first cost, slow start ups (interviewees report that these barriers are present but declining);
- Wrong color, ~~"~~greenish hue" (because consumers are not educated about color temperature);
- Shorter than expected actual life (because CFLs may be placed in applications that are frequently switched on and off);
- Inadequate light (because consumers can't distinguish between lumens and watts);
- Poor quality of dimmers;
- Incompatibility with timers, photo-sensors; and/or
- Lingering disappointment with initial purchases and aforementioned problems.

Overall, several interviewees noted that it is ~~"~~too easy" to install CFLs in the wrong application and/or use the wrong color temperature. In addition, interviewees feel that many buyers understand that CFLs should be recycled but find this a hassle to do, and many non-metro customers will not purchase CFLs since they are ~~"~~promoted by the government."

To overcome these barriers, some larger utilities have increased customer education regarding lumens and recent improvements in CFL quality, and one small utility representative reports that his organization gave away cool white CFLs to try to increase color acceptance. In general, however, most of the utility representatives recommended increased national education on:

- Improving CFL quality and new uses for specialty CFLs;
- Lumens and color temperatures;
- How to compare lighting types as EISA regulations take effect; and/or
- General information regarding EISA (so misinformation is not disseminated in non-metro areas).

Almost all of the interviewees stated that customers have an inadequate understanding of specialty CFLs and the full range of CFL applications, although most interviewees feel that customer knowledge is slowly improving. Interviewees feel that there is still not enough CFL information in the market, and that it has been difficult to overcome the simplicity and habit of installing incandescent lamps. Several interviewees claimed that changing consumers to a totally new product and terminology requires a concerted, national campaign.

According fifteen of the sixteen interviewees, mercury concerns remain a persistent barrier to consumers. These interviewees assert that these concerns had a slight-to-moderate negative impact on sales while at the same time increasing interest in LED products. To address this issue, many utilities have distributed bill inserts and other materials comparing CFL mercury content to other common household items (cosmetics, jewelry), or similar literature from third parties like the Sierra Club, the United States Environmental Protection Agency (EPA), or state Departments of Environmental Quality.

6.5 Future Outlook for CFLs

A few interviewees expect CFL sales to continue increasing because consumers appreciate their long life and cost-effectiveness, and because socket penetration is still lagging behind store stocking. In addition, interviewees feel that there is a high growth opportunity in non-metro areas if more context-sensitive education can be delivered and that there is also a large untapped market for dimmable CFLs if this technology can be improved.

Most of the interviewees, however, expect growing competition from other technologies with uncertain impacts on CFLs. Some interviewees expect LEDs to capture CFL market share, particularly if LED heat dissipation can be improved. Other interviewees believe that new halogen lamps and CFL-halogen combinations are best positioned to capture CFL market share. In the broader picture, many interviewees believe that the EISA requirements will only increase market uncertainty as CFLs increasingly compete with LEDs, halogen incandescents, and lower wattage standard incandescents, which will exacerbate buyer confusion. In this environment, there is a high risk that CFLs could lose market share if market barriers persist. Similarly, CFLs could lose market share if California's Super Lamp initiative or subsidized research and development efforts promote other technologies.[21]

For CFLs to gain significant market share, utility representatives expressed that a broad range of CFL quality issues and market barriers still need to be addressed. The issues they mentioned include:

- Frequent failures of 3-way lamps;
- High cost of specialty lamps;
- Slow starts for globes and a-lamps ;
- Lamp size still too large;
- Cannot be used in enclosed fixtures;
- Flickering when cold; and/or
- Dimmers flicker/hum at lower illumination.

Regarding the prospects of manufacturers addressing these issues, one interviewee expects strong, continued technological progress based on the significant color and start-up improvements that have occurred since 2007. Most of the other interviewees, however, perceived that lighting manufacturers are shifting their focus to efficient incandescents and LEDs, and that CFL technology will not make significant strides. While ballasts could still be improved to go on faster, the prevailing sentiment is that fluorescents bulbs are now close to their optimum performance and a wide range of colors is

[21] The Super Lamp initiative is a technology development initiative including several California utilities, the Natural Resources Defense Council and the California Lighting Technology Center (CLTC). The initiative promotes the introduction and dissemination of high-quality screw-base light sources that address issues consumers have raised about technologies such as CFLs. The goal of the initiative is to make high-efficacy technologies (the CFL, LED, or others) the mainstream choice for screw-base sockets in California. The initiative promotes the market introduction of products that are technically feasible but not yet available. For more information about the Super Lamp technical specifications, see: http://cltc.ucdavis.edu/content/view/652/342/.

available and CFLs will never perform as tested because they are turned on/off much more in real applications.

6.6 LED Market

Interviewees at the large utilities reported that a growing number of retail chains in larger metropolitan areas are offering LEDs for the residential and general markets. Some large home improvement stores, for instance, now offer 40-watt directional down lights for $20 to $30, and most stores carry LED nightlights and a limited selection of LED desk lamps. Most large-utility staff noted that residential LED lighting remains a slowly growing niche product. One interviewee at a medium-sized utility reported that local retailers were only stocking LEDs for commercial refrigeration and not residential uses. Interviewees at small utilities serving non-metro customers had noticed no growth in general LED stocking, although LEDs are available for outdoor solar kits and Christmas lighting.

The interviewees were consistent in naming current barriers to LED sales and utilization: LEDs are poor for general/diffused illumination, are only available at low lumen levels (insufficient for most reading lamps), and only work with some dimmers (requiring new screw-in kits that cost $50). From an aesthetics perspective, LEDs incorporate a lot of metal to facilitate cooling, which can deter some buyers, and better heat dissipation is still needed. In addition, LED color temperatures and consistency require improvement. Overall, however, the main barrier to LED adoption is high retail costs, especially in light of their performance limitations. On a positive note, representatives feel that LEDs appear to have long useful lives (though exactly how long is unclear), provide decent light quality, and are good for focused lighting and providing visibility.

Utility representatives expect LED sales to increase slowly over the next 2 to 5 years unless retail costs decline significantly. Interview participants characterized current LED buyers as ―high-end," ―early adopters" and/or ―technology fans" that seem to be aware of the technology limitations and are probably satisfied with their initial purchases. Interviewees expect LED lighting to remain a niche product for the foreseeable future because of its highly directional nature.

6.7 NEEA's Role

When asked to assess the impact of NEEA's withdrawal from the CFL market, nine interviewees gave an overall rating of ―neutral," although their reasons varied. Larger utilities perceived that NEEA had effectively ―primed the pump" or begun to transform their market and that most utilities are capable of promoting CFLs after NEEA's departure. In addition, some noted that the BPA's regional program has adequately filled the gap left by NEEA.

A small number of interviewees perceived that NEEA's withdrawal had led to generally negative impacts. Some stated that market transformation was only achieved among wholesalers in cities, and feel that NEEA did not focus enough on transforming non-metro areas. Some interviewees perceived that NEEA had done a lot to help smaller utilities that could not run their own programs, but withdrew 1 to 2 years too early and did not do enough to promote specialty lamps.

Most interviewees did not perceive a need for NEEA to re-enter the market with a region-wide CFL promotion, claiming that the BPA's CFL incentive program is sufficient and two regional players may create confusion. Most of the interviewees believed that NEEA could play an important role in the areas of testing as well as regional advocacy and education. Specifically, NEEA could:

- Assist federal DOE testing efforts by sponsoring installations and metering. In particular, contribute to studies that further assess useful effective life and LED lumen degradation over time.
- Work with the Consortium for Energy Efficiency and the EPA to develop LED product labeling standards. Some interviewees were concerned that Internet promotions and product labeling are over-stating the potential energy savings because they are not based on lumen equivalents.
- Coordinate input from the Northwest utilities to help develop *consistent, national* messaging to reduce customer product confusion and maximize energy savings in light of EISA regulations (standard incandescent lamp phase-outs) and increasing technology options (LEDs, halogen incandescents). Importantly, utility representatives feel that consumer education about all lighting options needs to be integrated.
- Provide more consumer education about lumens in general (to facilitate comparison shopping).
- Distribute LED product information (which may be most helpful to smaller utilities).
- Provide some LEDs for utilities to distribute on a limited scale, but only conduct broad promotions if the BPA does not.

7. Synthesis of Findings

Below we summarize key study findings by research task.

- CFL Sales and Market Share Analysis
  - Northwest CFL sales increased 5 percent since last year – even though utility incented sales declined 5 percent. The increase follows a 26 percent decline in sales from 2008 to 2009.
  - The big box retail channel accounted for a larger fraction of promotional sales than in prior years (from 88% in 2009 to 94% in 2010). Big box's share of overall CFL sales was unchanged from 2009, but DIY stores increased their share with a commensurate decrease in mass merchandise sales.
  - Northwest CFL market share increased from 30 to 31 percent from 2009 to 2010 after a decline in market share from 39 percent in 2008. National CFL market share also increased from 16 to 21 percent between 2009 and 2010.
- Shelf Surveys
  - The estimate of average retail CFL price paid by consumers increased 10 percent over the last year, to about $4 per lamp. Prices increased more in non-metro areas and in big box retailers.
  - There was little change in the amount of shelf space that retailers dedicate to lighting, CFLs and ENERGY STAR CFLs.
  - More Northwest retailers carry specialty CFLs (from 82 to 91%) – with 96 percent of metro, 82 percent of non-metro, 94 percent of big box and 83 percent of non-big box retailers carrying specialty CFLs in 2010.
  - Retailers increased the unique models of twister-style CFLs from 2009 to 2010, while there was a slight decrease in the number of specialty CFL models stocked. This was due to a decline among non-metro stores in specialty CFL stocking. Big box stores increased their CFL diversity more than non-big box.
  - Northwest retailers are stocking twice as many LED models compared to a year ago – with an average of seven models per store. The average retail price for LEDs is $28, similar to 2009.
- Consumer Surveys
  - The rate of CFL purchase and awareness may have peaked in 2009 with a small but statistically significant decline in both the purchase and awareness rate (to 75% and 91%, respectively) in 2010. While it may be counter-intuitive for the share of the population who has reportedly bought or heard of CFLs to decline, these results may reflect declining use of the term ―CFL" in the retail setting, more lighting technologies available to consumers and less significance placed on CFLs being a stand-alone technology.
  - About one-third of Northwest households are aware of specialty CFLs – and half of those currently have them installed in their homes. There was no difference in awareness of specialty CFLs between metro and non-metro consumers.
  - Since 2010, the proportion of CFLs installed in purchaser households of all CFLs ever acquired has decreased significantly from 64 percent among 2010 survey respondents to 53 percent of CFLs ever acquired by 2011 survey respondents. These results suggest that consumers have removed a relatively high proportion between the 2010 and 2011 survey (whether due to lamp failure, dissatisfaction, or other reasons); however, we'd expect to see this proportion increase over time (as it represents the proportion of all lamps *ever acquired*).

These results may also reflect the slight decline in CFL purchase rates between 2009 and 2010.

- Overall satisfaction with CFLs is unchanged from 2009, but there was a decrease in satisfaction with the color of light, light-up time and how long CFLs last. (Average satisfaction ratings are similar between metro and non-metro CFL purchasers.) These barriers may be the reason that some households have only two or three CFLs installed, whereas households that have more CFLs installed than average are typically waiting for CFLs to burn out to install more.
- More Northwest households are aware of federal lighting legislation in 2010 (from 23% to 33%), with a slightly higher proportion of metro west respondents reporting awareness than metro east respondents (74% versus 68% percent, respectively; a statistically significant difference). Around half of survey respondents say they will switch to CFLs once traditional 100-watt incandescent lamps are no longer available, unchanged from last year.
- CF fixture awareness and purchase rates in 2011 remained statistically unchanged since 2010. CF fixture awareness and purchase rates are similar among metro and non-metro consumers. CF fixture awareness and purchase is positively correlated with CFL awareness and purchases, and satisfaction with fixtures among fixture purchasers remains high. Respondents in the 2011 survey were significantly more likely to cite electric bill reductions as motivations for purchasing CF fixtures than respondents to the 2010 surveys who purchased CF fixtures.

- Market Actor Interviews
  - National suppliers expect to see a continued plateau in CFL sales nationwide due to stocking of CFLs, less utility incentives, increased halogen lamp sales, bad economy and the need to educate consumers on how to appropriately use CFLs (to expand CFL saturation beyond the handful of sockets in which most households use them.) The economy cited less frequently as compared to last year, and suppliers were more enthusiastic about the potential for LED sales this year. Some said that the Northwest had higher rates of CFL sales due to the ongoing utility promotions.
  - Suppliers felt that having consistent promotions was important, and NEEA's past promotions increased consistency across the region and increased in-store education through end caps and other educational displays.
  - Suppliers expect to sell more halogen lamps once EISA phases in (particularly since they can be marketed as mercury-free), and LED sales may also increase over the long run once prices go down and the technology improves for general purpose lamps. There is a need for consumer education on what types of lamps to use once certain categories of incandescent lamps are phased out.
- Utility Program Manager Interviews
  - Many utilities continue to offer point-of-sale CFL programs either in conjunction with BPA or on their own.
  - Most utilities feel that NEEA's prior promotions impacted the market by increasing sales through lowering the price, and that BPA and utility promotions have stepped in to fill the gap to continue CFL market progress. Some mentioned that better CFL quality has also helped to drive Northwest CFL sales in addition to concerns about the environment and cost savings.

- Existing market barriers cited include higher upfront cost, lack of CFL diversity in rural areas, few CFLs in grocery stores (which typically do not want to deal with the hassle of point-of-sale programs), CFL consumer acceptance issues (color, delayed start-up, shorter than expected life, inadequate light levels, poor quality of dimmable CFLs, incompatibility with controls)
- Many program managers mentioned that consumers are confused about how and where to use specialty CFL lamps. About half (typically larger and serving metro populations) provide some form of consumer education, but many said they would like to see a consistent nationwide response to improving CFL quality and expanding their applicability, clarifying lumens and color temperatures and educating consumers on how to appropriately select and use CFLs.
- CFL disposal issues were mentioned as a barrier, with concerns about mercury and lack of sufficient safe disposal sites. Utilities provide their own literature to assuage mercury concerns and/or refer their customers to third party claims (e.g., Sierra Club or EPA) about the relative safety of CFLs.
- A few utility program managers expect to see continued increases in CFL sales since there is still so much potential for them. However most felt that CFLs will be competing against incandescent (including halogen) lamps that meet EISA and LEDs. These other products may be more popular than CFLs with consumers since they are not associated with quality, performance and mercury issues.
- Utility program managers believe that stakeholders must address the quality, performance and applicability issues to maintain CFL market shares. Some feel that manufacturers had made some progress towards addressing these issues but have since turned their R&D efforts to incandescent lamps that will meet EISA and LEDs.
- Utilities will begin to provide incentives for LEDs once the price comes down, the technology improves and specifications and standards are put in place for residential uses. Most have learned their lesson from the early promotions of CFLs and are cautiously approaching LEDs for general purpose applications.
- Some utilities feel that NEEA could help rural areas increase CFL sales, but generally the existing BPA/utility promotions are adequately addressing the CFL market. Some felt that NEEA could provide consumer education on specialty CFLs and address concerns about mercury. Most felt NEEA could play a role in the emerging LED market by working with national organizations to developing testing and labeling standards, develop a consistent national message for consumers on what lamps to choose as EISA phases in (e.g., integrate the messaging around the various technology options) and help utilities develop and launch LED promotions in the future.

- Consumer Focus Groups
  - Focus group participants were generally aware of CFLs including non-twister styles. Many voiced opinions and concerns that reflected a consensus that CFLs are an inferior technology versus incandescent lamps. They are too dim, they take awhile to reach full brightness, they contain mercury, they are not appropriate for certain tasks that require focused light, the light color/quality is inferior and they do not last as long as they claim. However it seems consumers have gotten used to the issues with CFL performance and they use them at least to some extent since they feel the savings outweighs the issues. But the performance barriers do prevent the majority from using them more widespread in their homes.

- About half the participants say they buy CFLs when they see them on sale – whether they need them or not. The other half tended to buy them when they needed them. Most try to keep at least one CFL on hand in case one burns out.
- A few participants said they have installed CFLs in all possible sockets to save money and/or energy.
- The majority said they had several CFLs (but not all their sockets) – they were mixed in how they use CFLs:
  - High-use fixtures – to yield more energy savings;
  - Difficult-to-reach fixtures – to take advantage of the longer lifetime; and/or
  - Avoiding using CFLs where aesthetics and application are suitable for CFLs – e.g., some do not like to use them in bathrooms, others do not like to see the CFL in the fixture, some do not put them in enclosed fixtures due to performance concerns, some avoid putting them in fixtures used for reading or other close tasks, most do not like using them where they use controls such as dimmer switches.
- Most participants were aware that CFLs contain mercury but that had not prevented them from buying and using CFLs. There was not a uniform understanding of the issues or how to handle disposal – though a few knew there were some retailers and events where CFLs can be disposed.
- Most participants prefer to wait for an incandescent lamp to burn out first before replacing it with a CFL – they feel it is wasteful to remove a working lamp.
- Some participants were aware that CFLs are sold in varying color temperatures.
- A negligible number of focus group participants use dimmable CFLs – most state that CFLs cannot be used in dimmable fixtures.

8. Conclusions and Recommendations

8.1 Conclusions

Conclusions from this study include the following:

- **In general, there were minor changes over the last year in availability, affordability and diversity of CFLs in Northwest retail stores.** There was an increase in the fraction of stores that carry specialty CFLs (from 82 to 91% of stores), but a slight decrease in the average number of specialty CFL models stocked (from 17.6 to 16.8 models). The average estimated CFL retail price increased 10 percent (from $3.76 to $4.06)– mostly due to price increases in non-metro areas and among big box stores. Retailers are stocking twice as many LED models in 2010 (approximately 7 per store) compared to 2009.
- **In non-metropolitan areas in particular, however, there have been greater declines in CFL affordability, availability, and diversity than stores in metropolitan areas.** CFL prices increased more dramatically in non-metro areas than metro areas (by 41 cents and 24 cents, respectively) while share of shelf space dedicated to CFLs declined in non-metro areas (from 29% to 21% of total shelf space) and stayed the same in metro areas. The average number of general purpose CFL models increased in both metro and non-metro stores, but by only 2.7 models per store in non-metro stores compared to 4.1 in metro stores. Specialty lamp diversity remained fairly constant in metro stores (increasing by 0.2 models per store) but declined by 2.7 models per store in non-metro stores.
- **CFL promotions offered by energy-efficiency program sponsors throughout the Northwest are providing support to the market for both standard and specialty CFLs.** These ongoing promotions likely helped to maintain fairly consistent CFL market prices, availability and diversity over the past several years, but as evidenced by the drop in market share among non big box stores since 2008 (from 30% in 2007 to roughly 14% in subsequent years), NEEA's more widespread past promotions may have helped provide the additional support that smaller retail channels may need.
- **Northwest CFL sales rebounded by about 5 percent between 2009 and 2010 after a major drop of 26 percent between 2008 and 2009.** There were approximately 19 million CFLs sold in 2010, but sales are still far from the 2008 peak of nearly 25 million CFLs. Northwest CFL market share also experienced a small uptick between 2009 and 2010 (from 30% to 31%) after dropping from nearly 40 percent in 2008.
- **We expect CFL sales levels to plateau as most consumers do not plan to install more CFLs until their existing CFLs burn out** – instead they will buy them when they are on sale or when one of their installed lamps burns out. Most consumers use CFLs in a handful of sockets – and they avoid using them in certain applications and rooms, depending on their aesthetic and use preferences. A small fraction of consumers use CFLs throughout their homes and think the environmental/economic savings outweigh any aesthetic or application issues.
- **As EISA phases in, there is a risk that the majority of CFL users who are not completely committed to the technology** may revert back to incandescent technology, at least for some of their applications, if suppliers promote these products as energy saving/EISA compliant. Persistent concerns around mercury could also hurt sales of CFLs if consumers who have those

concerns think they have a new ―energy-efficient" incandescent lamp option that does not contain mercury. CFL program sponsors have not convinced the majority that the energy savings associated with CFLs outweighs mercury concerns.

- **There remains potential for additional general purpose and specialty CFL installations.** However, consumers lack awareness of specialty CFLs (only 32% of CFL purchasers are aware of specialty lamps), specialty CFLs are more expensive and less available, and dimmable CFLs in particular do not perform well. There are major market barriers to significantly increasing specialty CFL sales and to address the barriers will require a multi-pronged approach due to the wide variety of products and issues.
- **There remains a small fraction of consumers who are either unaware or have never tried CFLs** (approximately 8% of Northwest consumers were unaware of CFLs in 2010, and 17 percent were aware but had never purchased CFLs)**.** California utilities have had success reaching previously under-served populations by promoting CFLs in ethnic supermarkets and discount stores. These efforts have been funded by large-scale resource-acquisition programs and they take advantage of the density of under-served populations and the prevalence of ethnic and discount stores that serve them.
- **Utility program managers see a role for a regional representative such as NEEA in supporting national efforts on consumer education** around mercury, CFL disposal, use of specialty CFLs, integrated messaging around the various technology options available as EISA takes effect.
- **Utility program managers also see a role for a regional representative such as NEEA in supporting national efforts regarding quality testing and labeling for LED products.**

8.2 Recommendations

Based on the conclusions described above, we recommend:

1. As recommended in prior tracking study reports, we recommend that NEEA consider engaging with the regional lighting suppliers. From the 2010 study[22]:

   > ―**NEEA should continue to strengthen its relationship with CFL suppliers** (manufacturers and retailers) in the absence of a formal CFL incentive program. Ongoing dialogue with these stakeholders may help NEEA and its sponsors influence the mix of products these suppliers will produce and market in response to impending EISA requirements."

   The 2010 study also suggests the value of maintaining supplier relationships because they may be difficult to reestablish should NEEA decide to pursue future lighting market interventions – such as educational efforts or incentive programs – that would require (or benefit from) supplier support. These recommendations are particularly relevant now, given that EISA requirements will begin to phase in soon (January, 2012).

[22] KEMA, 2010. 2009-10 Residential Lighting Market Research Study. Prepared for NEEA. Supported by ECONorthwest. May 18, 2010. Page 50.

2. **NEEA should consider further discussion with regional stakeholders regarding whether the Northwest would benefit from having a regional representative in national efforts to promote energy-efficient lighting products.** Findings from the utility program manager interviews in particular suggest a desire for a regional entity to coordinate utility input to help develop consistent messaging regarding energy-efficient lighting products at the national level (including messages regarding mercury and CFL disposal). From the utility program managers' perspectives, messaging priorities include decreasing consumer confusion regarding new lighting technology options and increasing consumer understanding of lumens to aid comparison shopping. Program managers also expressed the desire for a voice in supporting the U. S. Department of Energy's efforts to further assess effective useful life and lumen degradation of LEDs and efforts lead by the Consortium for Energy Efficiency and U.S. Environmental Protection Agency to support LED product labeling standards. Engaging in these activities could facilitate staying abreast of current market trends and innovations. NEEA may be able to fill such a role, and further dialogue with utility program managers and other regional stakeholders may help NEEA decide whether to pursue this arrangement.
3. **NEEA should consider further discussion with regional stakeholders regarding whether some form of market support is necessary for CFLs in non-metropolitan areas.** As mentioned above, lighting retailers in non-metro areas have experienced greater declines in CFL affordability, availability, and diversity than metro stores. It may benefit the non-metro regions for NEEA to have dialogue with stakeholders to determine whether additional support is necessary and the best form of support that could be provided.
4. **NEEA should consider efforts to educate consumers regarding the full range of installation potential for energy-efficient lamps** in their homes. The 2010 study includes a similar recommendation for CFLs, and current study results suggest a broader need across energy-efficient lamp types. Whether these efforts are conducted under the umbrella of the national efforts suggested above or through a distinct effort, study findings suggest a lack of awareness among consumers regarding the impending phase-out of traditional incandescent lamps (as suggested by the consumer surveys), lingering confusion regarding CFL applicability for different purposes (as suggested by the consumer surveys and focus groups), and a desire among the region's utilities for educational efforts regarding new lighting technology options.
5. **NEEA should consider developing materials and information to help Northwest utilities determine if and when they should start promoting new lighting products including LEDs.** Study results suggest this information is of particular interest to lighting program managers at some of the region's smaller utilities.
6. **NEEA should continue to regularly monitor the Northwest residential lighting market** to provide timely data on the Northwest to help shape local utility, regional and national lighting promotions and efforts to maintain the gains in CFL market acceptance achieved over the last two decades.

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B. Data Collection Instruments

C. Additional Shelf Survey Findings

Below are the detailed results for the Lighting Retailer Surveys conducted in late 2010 and analyzed in early 2011.

C.1 Sample Frame

The sample frame for the lighting retailers was taken directly from the third Market Progress Evaluation Report (MPER3) of NEEA's ENERGY STAR Consumer Products – Lighting project[23], the original source of which was the prior project implementation contractor's 2006 lighting retailer database.[24] To make direct comparisons between current results and those from 2006 and 2008, and 2009, our 2010 effort focused on stores that were surveyed during the previous evaluation effort. Consistent with the approach used for the last three shelf surveys, we stratified the sample by Metro West, Metro East and Non Metro; store type; and within store type, by store ownership type (national, regional or franchise chain versus independent store).[25] Table 8 shows the distribution of retailers in the sample frame by strata.

Table 8: Retailer Shelf Survey Sample Frame, 2011

Store Type	Store Ownership Category (Number of Chains)	Geographic Location							
		Number of Stores				Percent of Stores			
		Metro West	Metro East	Non-Metro	Total	MSA West	MSA East	Non-Metro	Total
Club/ Warehouse	National chain (1)	21	3	9	33	1%	0%	0%	1%
DIY	National chains (3)	83	26	46	155	3%	1%	2%	6%
Drug and Grocery	National chains (4)	528	125	184	837	21%	5%	7%	33%
	Regional chains (6)	126	15	55	196	5%	1%	2%	8%
Mass Merchandise	National chains (4)	181	61	121	363	7%	2%	5%	14%
	Regional chains (7)	6	12	28	46	0%	0%	1%	2%
	Independents	15	1	28	44	1%	0%	1%	2%
Small Hardware	Franchises (3)	147	55	308	510	6%	2%	12%	20%
	Regional chains (20)	46	13	26	85	2%	1%	1%	3%
	Independents	89	38	154	281	3%	1%	6%	11%
Total		1,242	349	959	2,550	49%	14%	38%	100%

Table 9 shows the completed retailer shelf surveys by strata. During 2010/2011 we conducted a total of 58 surveys including 19 in Idaho, 7 in Montana, 20 in Oregon, and 12 in Washington.

[23] KEMA, 2007.

[24] PECI, 2006.

[25] See MPER3 (KEMA, 2007) for more details on these categories.

Table 9: Retailer Shelf Survey Completes by Strata, 2011

Store Type	Store Ownership Category (Number of Chains)	Geographic Location							
		Number of Stores				Percent of Stores			
		Metro West	Metro East	Non-Metro	Total	MSA West	MSA East	Non-Metro	Total
Club/ Warehouse	National chain (1)	1	1	1	3	1%	2%	2%	5%
DIY	National chains (4)	3	3	2	8	2%	5%	3%	14%
Drug and Grocery	National chains (3)	3	3	3	9	2%	5%	5%	16%
	Regional chains (4)	3	2	2	7	2%	3%	3%	12%
Mass Merchandise	National chains (5)	2	2	3	7	1%	3%	5%	12%
	Regional chains (2)	1	1	1	3	1%	2%	2%	5%
	Independents	1	0	2	3	1%	0%	3%	5%
Small Hardware	Franchises (3)	2	1	2	5	1%	2%	3%	9%
	Regional chains (5)	2	1	2	5	1%	2%	3%	9%
	Independents	2	2	4	8	1%	3%	7%	14%
Total		**20**	**16**	**22**	**58**	**13%**	**28%**	**38%**	**100%**

Researchers calculated sample expansion weights by strata and applied them to each sample retailer such that the findings presented in this section represent the population of lighting retailers in the region that sell CFLs (as approximated by PECI's 2006 database). For affordability results across store types in the Northwest, we also applied sales weights based on regional CFL sales data gathered by Fluid Market Strategies.[26]

C.2 Sample Sizes, 2006-2010

Researchers conducted shelf surveys at 58 retail establishments in the Northwest during December 2010. Most of these locations were visited during the 2006, 2008 and 2009 survey periods, during which 58, 88 and 78 sites were surveyed, respectively. The breakdown of stores surveyed by region, store type, and by each combination of geography and store type is presented below in Tables 11 through 12.

[26] Fluid Market Strategies, 2009.

Table 10: Shelf Survey Store Visits by Store Type and Year, 2006–2010

Store Type	Year			
	2006	2008	2009	2010
Big Box	36	24	31	24
Drug, Grocery, Small Hardware	52	34	47	34
Total Visits	**88**	**58**	**78**	**58**

Table 11: Shelf Survey Store Visits by Region and Year, 2006–2010

Region	Year			
	2006	2008	2009	2010
Metro	52	36	47	36
Non-Metro	36	22	31	22
Total Visits	**88**	**58**	**78**	**58**

Table 12: Shelf Survey Store Visits by Store Type, Region and Year, 2006–2010

Store Type	Region	Year			
		2006	2008	2009	2010
Big Box	Metro	22	15	19	15
	Non-Metro	14	9	12	9
Drug, Grocery, Small Hardware	Metro	30	21	28	21
	Non-Metro	22	33	19	13
Total Visits		**88**	**58**	**78**	**58**

C.3 Affordability

Field staff collected pricing information for every CFL model observed on the shelf. As in prior evaluations, field staff recorded price (before and after utility program discounts or other discounts, when applicable) and number of CFLs per package.

C.3.1 Average Price

The average CFL price in the Northwest increased by an average of $0.30 between 2010 and 2011 to reach the price of $4.06 Average price of CFLs rose in both metro and non-metro areas by 24 and 41 cents respectively within the past year (Figure 9).

As shown below in Figure 8, the price increase was primarily in big box stores where prices increased by 10 percentage points and reached their four-year high. While big box CFL prices are higher than they have been in the past four years, they still offer lamps at a price below drug, grocery, and small hardware stores where prices this year decreased by a very small percentage.

When broken down by geography and store type, it is apparent that prices have stayed very similar in non-big box stores (Figure 8) while rising in both rural and non-rural stores (Figure 7). The difference in cost between the stores is growing smaller as big box prices rise.

Figure 7: Average Price Paid for CFLs by Geography and Year, 2006–2010

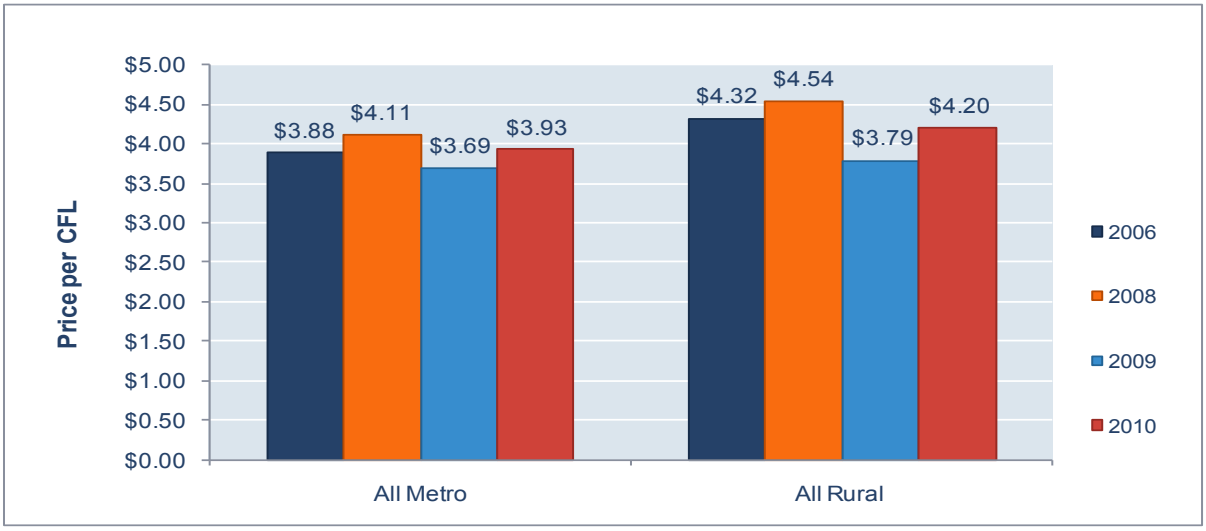


Figure 8: Average Price Paid for CFLs by Store Category and Year, 2006–2010

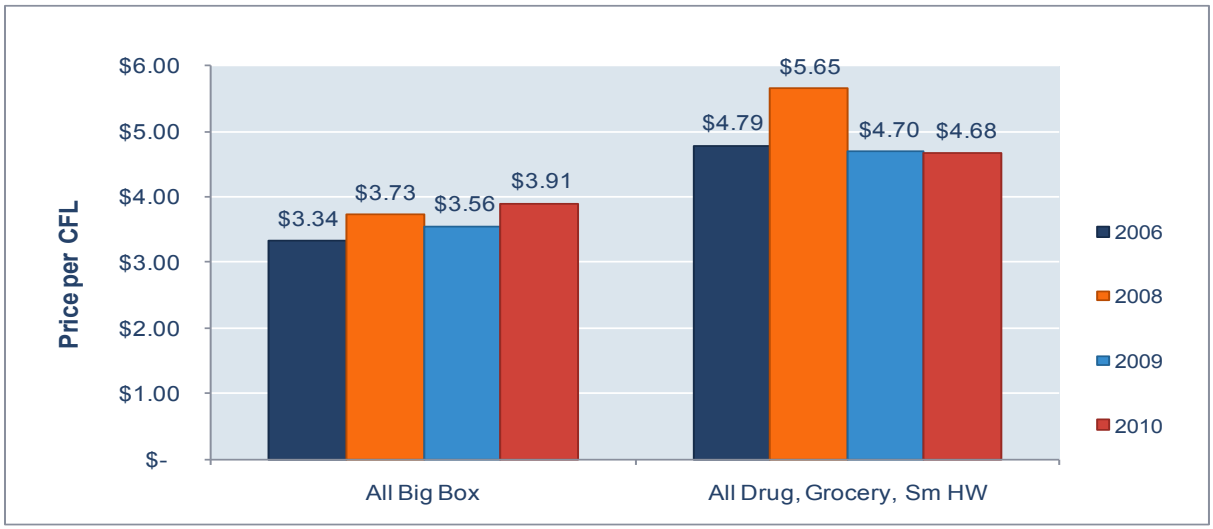
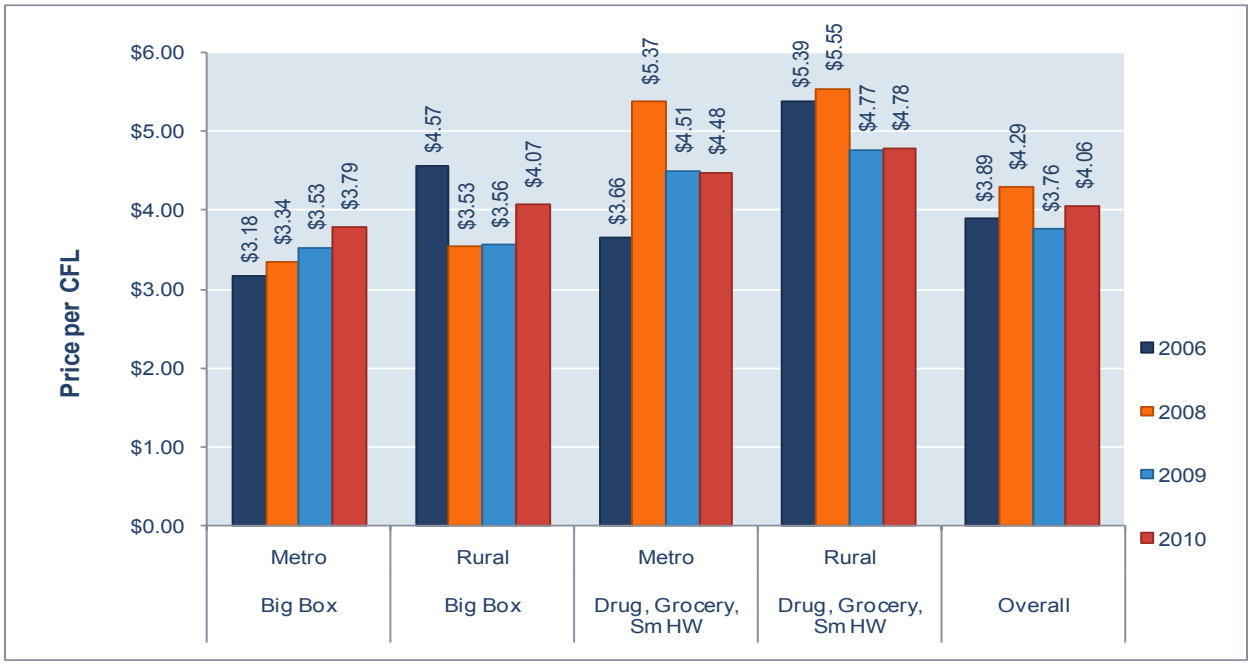


Figure 9: Average Price Paid for CFLs by Geography, Store Category, and Year, 2006–2010



C.3.2 Range of Prices

In this section, we present the range of CFL prices by category of bulb: twisters less than 18 watts, twisters 18-30 watts, twisters greater than 30 watts and non-twisters.

Figure 10 below shows the average range in prices (after any discounts) of twister-style CFLs that are less than 18 watts that were displayed on store shelves during the four study periods.[27] For each store type, the first data point or range is for spring 2005, the second for fall 2005, the third for fall 2006, the fourth for winter 2008, the fifth for winter 2009, and the sixth and final range of data is for 2010. The bars at the top and bottom of the range are the average maximum and minimum, and the diamond is the midpoint of the range. Over the last year, the price range of twisters less than 18 watts stocked by Northwest lighting retailers barely changed for warehouse, dropped for DIY and increased for drug and grocery stores, mass merchandise stores, and small hardware stores.

[27] Note that the Savings With a Twist (SWAT) promotion explicitly excluded this wattage range.

Figure 10: Average Range of CFL Prices Over Time – Twisters Less than 18 watts, 2005–2010

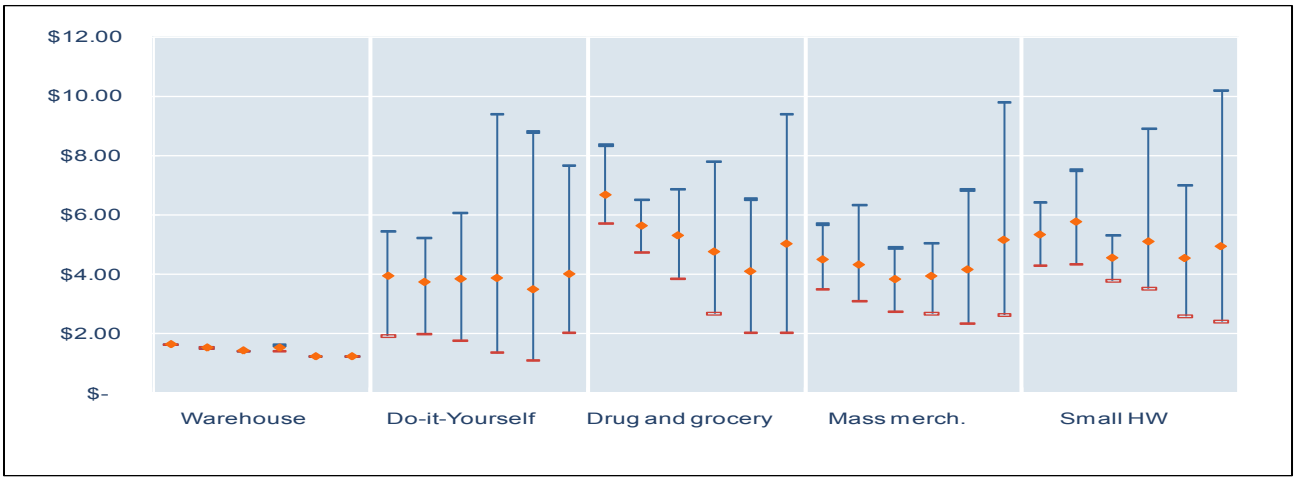
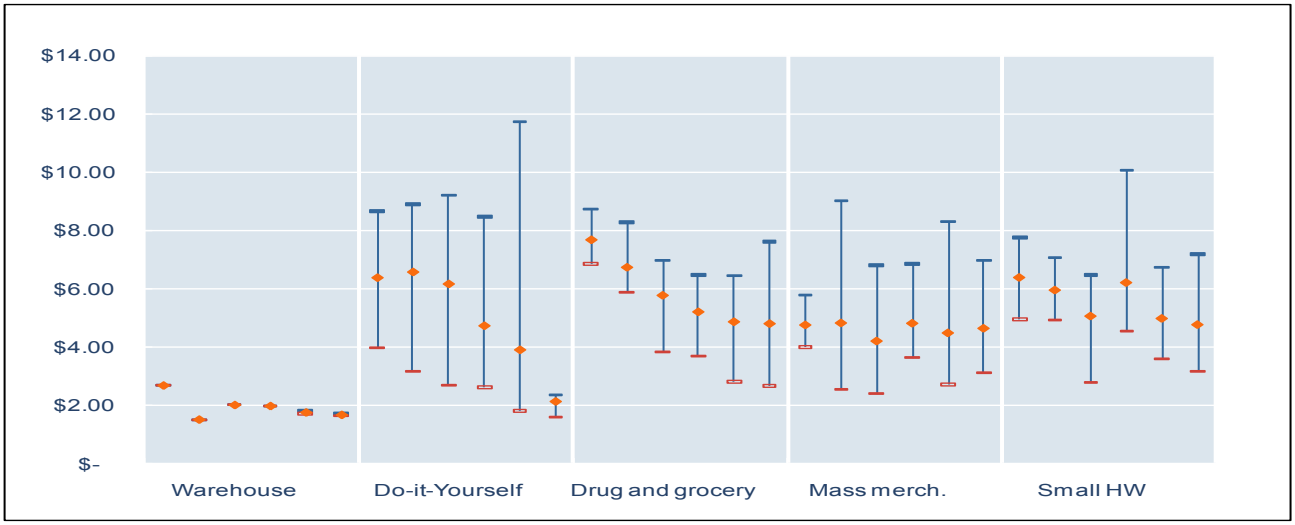


Figure 11 shows the average range of prices of twister-style CFLs between 18 and 30 watts.[28] Over the last year, the range of prices for this category of twisters widened on both ends for drug and grocery and small hardware stores, and shrank for DIY and mass merchandise. For the second year in a row, the range stayed about the same for warehouse stores similar to twisters with less than 18 watts.

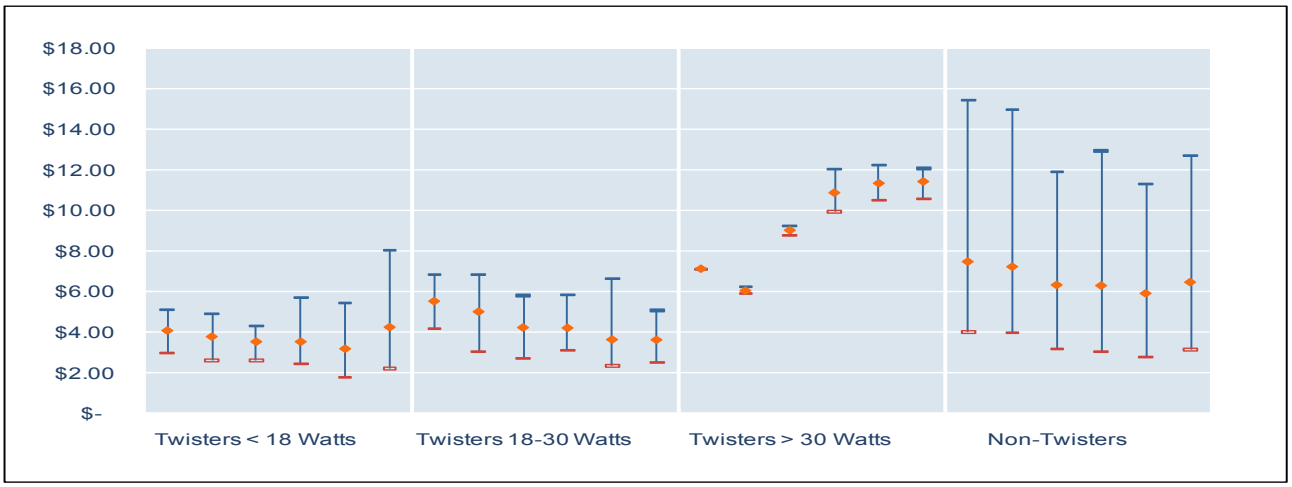
Figure 11: Average Range of CFL Prices Over Time – Twisters 18-30 watts, 2005–2010



[28] This wattage category was the target of the SWAT promotion, which was active in some Northwest stores in the fall of 2005 and 2006. Note that in 2006, SWAT explicitly excluded warehouse and Do-it-Yourself stores and included only CFLs less than 23 watts

The average price for twisters greater than 30 watts ranged from $6 to $14 during prior evaluations. During the 2009 survey, the range increased to $9 to $14 and stayed roughly the same this past year. While the range of prices for 18-30 watt twisters decreased slightly, twisters with less than 18 watts saw the largest increase in price range, going from a high under $6 in 2009 to a recorded high of $8 this year (Figure 12).

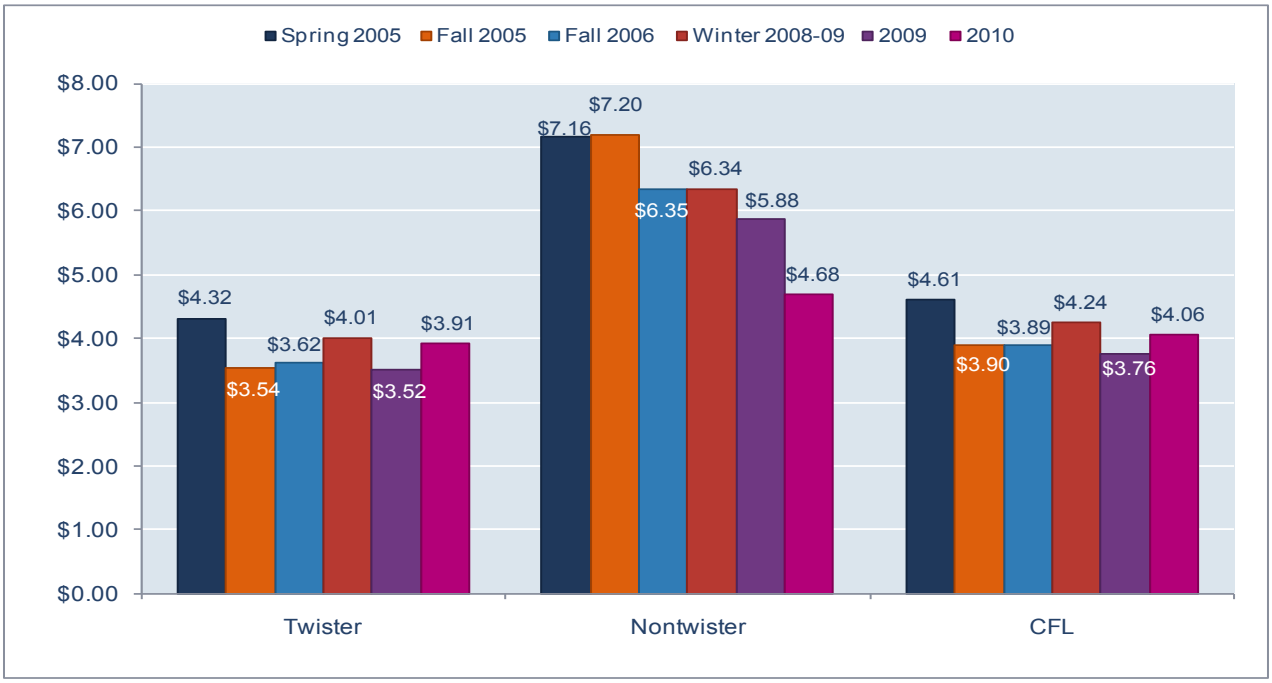
Figure 12: Average Range of CFL Prices Over Time – Sales Weighted, 2005–2010



C.3.3 Average Price Paid by Consumers

Figure 13 below shows estimates of the average price paid by customers for twisters, non-twisters, and CFLs in general for the five data collection periods. CFL prices (as estimated using the shelf survey combined with sales weights) have moved back up by eight percentage points after dropping by 11 percentage points in the previous year. This overall adjustment represents both an increase in the cost of a twister, and a rather large decrease in the price of specialty CFLs.

Figure 13: Average Price Paid by Customers for Twisters, Non-Twisters and CFLs, 2005–2010



C.4 Availability

To assess the availability of lighting products, field researchers collected information on the total linear feet and number of shelves for all light bulbs, all CFLs, and ENERGY STAR labeled CFLs specifically. These data enabled calculation of total lighting shelf space in the region, average shelf space per store dedicated to CFLs, the percentage of stores carrying any CFLs, and the percentage of stores carrying CFLs of specific styles. We present results below for all CFLs by store category and geographic location.

C.4.1 Total Shelf Space

Total shelf space dedicated to CFLs increased by ten percentage points over the last year down to just under 100,000 linear feet, or 23 percent of total lighting. The total shelf space dedicated to ENERGY STAR CFLs increased by three percentage points last year to over 79,000 linear feet, or 19 percent of total lighting. The total shelf space dedicated to lighting in general increased by 12 percentage points during the same period. Each increase was a turnaround from decreases the prior year.

Figure 14 below shows the allocation of total shelf space by store type during each study period. In 2010, drug and grocery stores in aggregate account for the largest fraction of total CFL and ENERGY STAR CFL shelf space just as they did in 2009. Small hardware stores still account for the largest fraction of total bulb space. This year, mass merchandise has replaced drug and grocery store as the type of store with the second most shelf space allocated to all bulbs as shown in Figure 14. Despite

this shift, drug and grocery stores still take second place in regards to shelf space allocated to CFLs, and are first in regards to total shelf space allocated to ENERGY STAR CFLs.

Figure 14: Allocation of Total Lighting Shelf Space by Store Type, 2005–2010

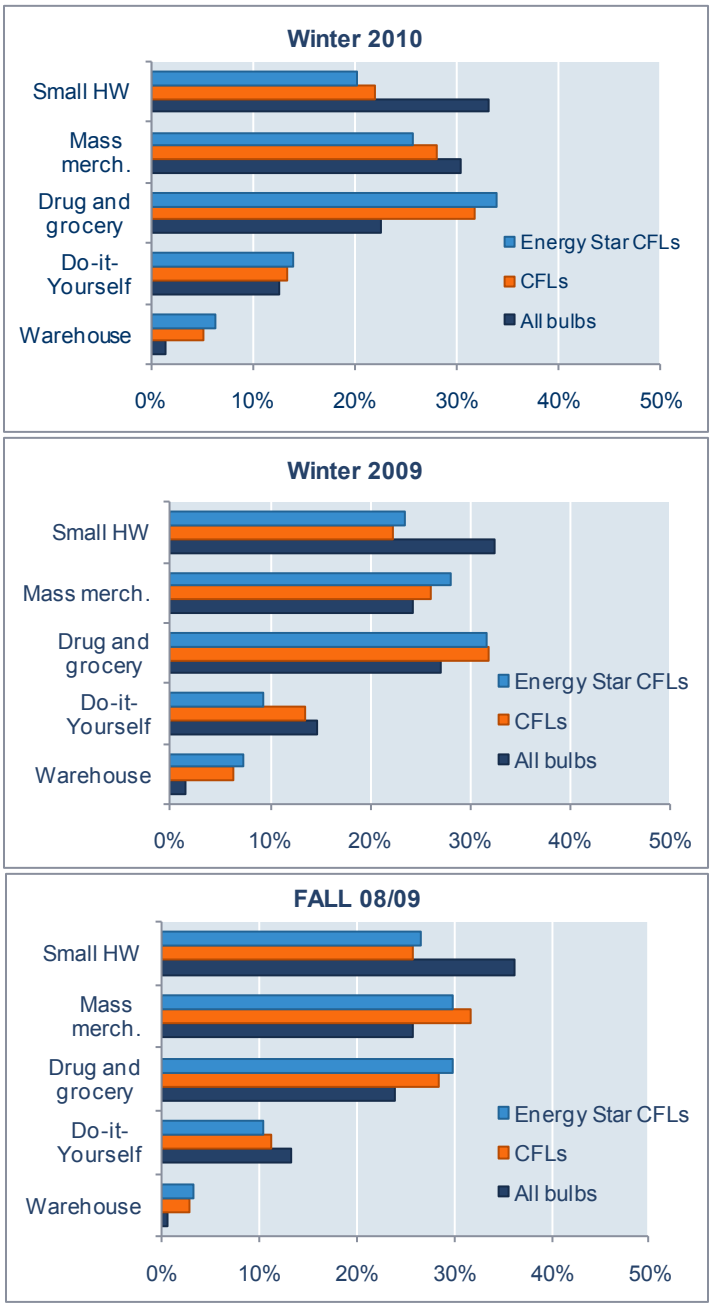
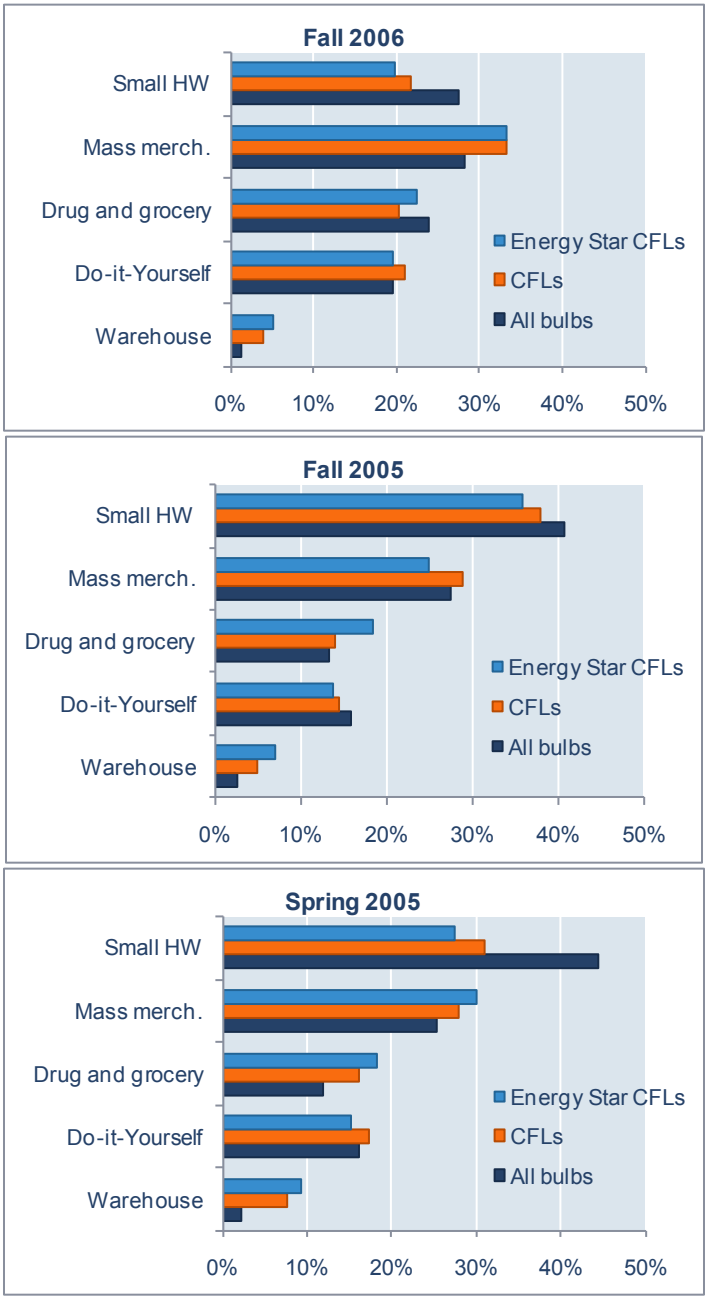


Figure 14 (continued): Allocation of Total Lighting Shelf Space by Store Type



C.4.2 Average Shelf Space

Figure 15 shows the average shelf space allocation by store type during each study period in linear feet. Warehouse stores have continuously stocked only ENERGY STAR CFLs, with the other channels devoting shelf space to other types of lighting products. Mass merchandise saw a decrease in the amount of CFLs that were ENERGY STAR while seeing an overall increase in total lighting shelf space.

The percentage of lighting shelf space allocated to CFLs in Northwest retail stores decreased slightly over the last year, from 24 to 23 percent (Figure 18), but still hasn't returned to 2008 levels. When looking at alterations in CFL shelf space allocation declines occurred in every geographic region and every store type except drug and grocery stores in metro areas as seen in Figure 18.

Most of this decline occurred in metro stores (which had a drop of nine percentage points over the past year) and in big box stores (which had a drop of five percentage points over the past year) as can been seen in Figure 16 and Figure 17. also shows that by the end of 2010, the prior gap in the proportion of shelf space dedicated to CFLs between metro and non-metro stores has returned, with metro stores at 27 percent of shelf space and non-metro stores at 21 percent of shelf space dedicated to CFLs. Big box stores dedicate an additional three percentage points of lighting shelf space to CFLs than non big box stores which represents a shrinking of the gap between big box and non box stores.

Figure 15: Average Shelf Space Allocation by Store Type in Linear Feet, 2005–2010

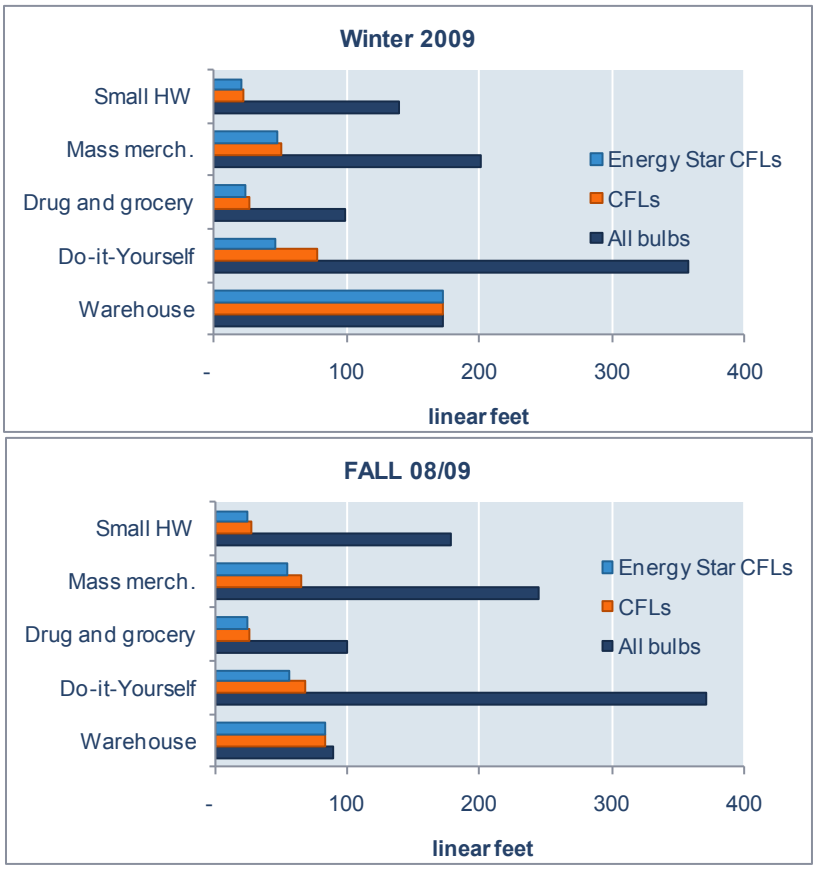


Figure 15 (continued): Average Shelf Space Allocation by Store Type in Linear Feet, 2005–2010

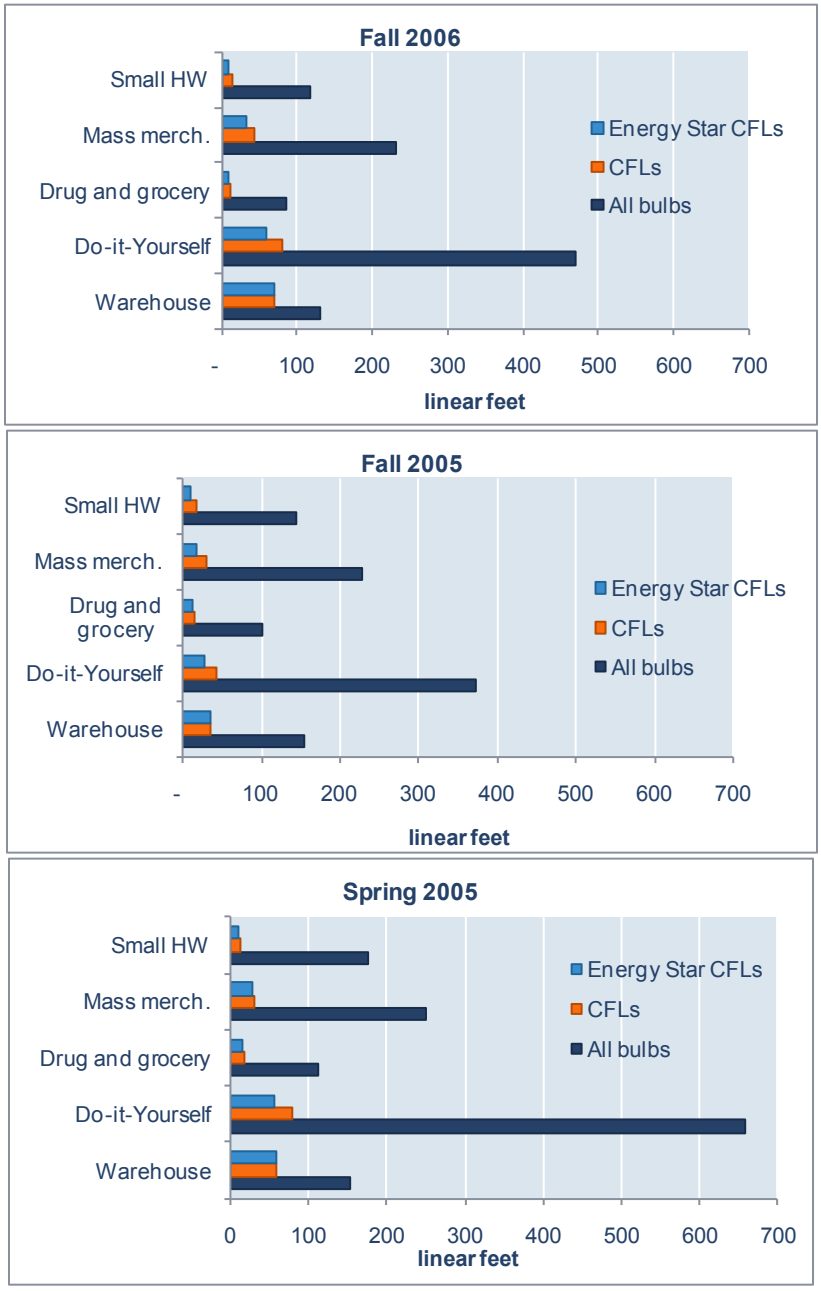


Figure 16: Percentage of Shelf Space Dedicated to CFLs by Geography and Year, 2005–2010

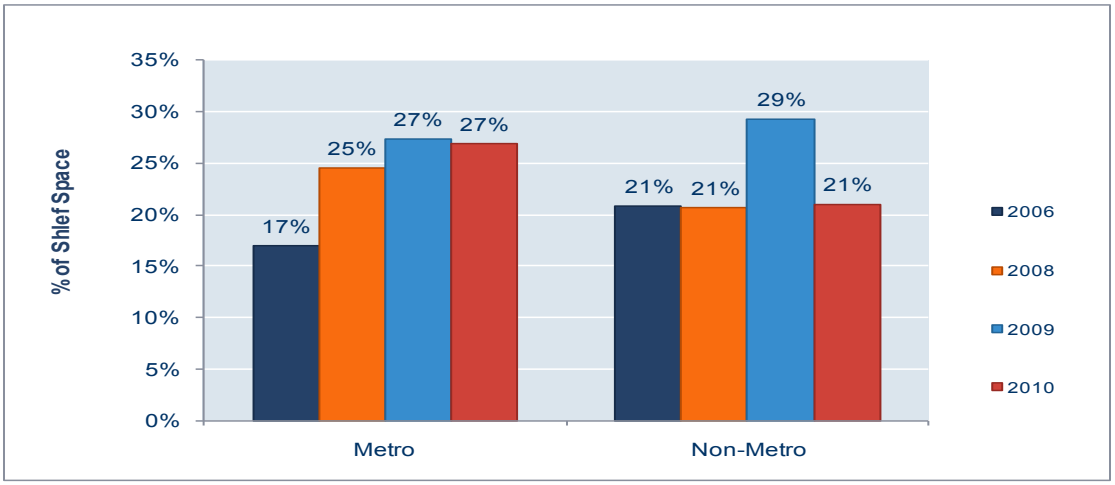


Figure 17: Percentage of Shelf Space Dedicated to CFLs by Store Category and Year, 2005–2010

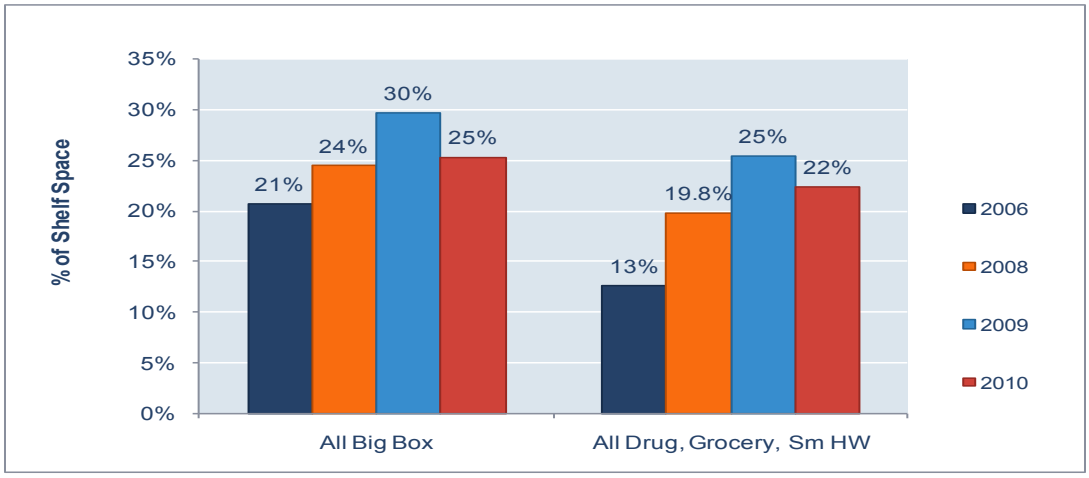
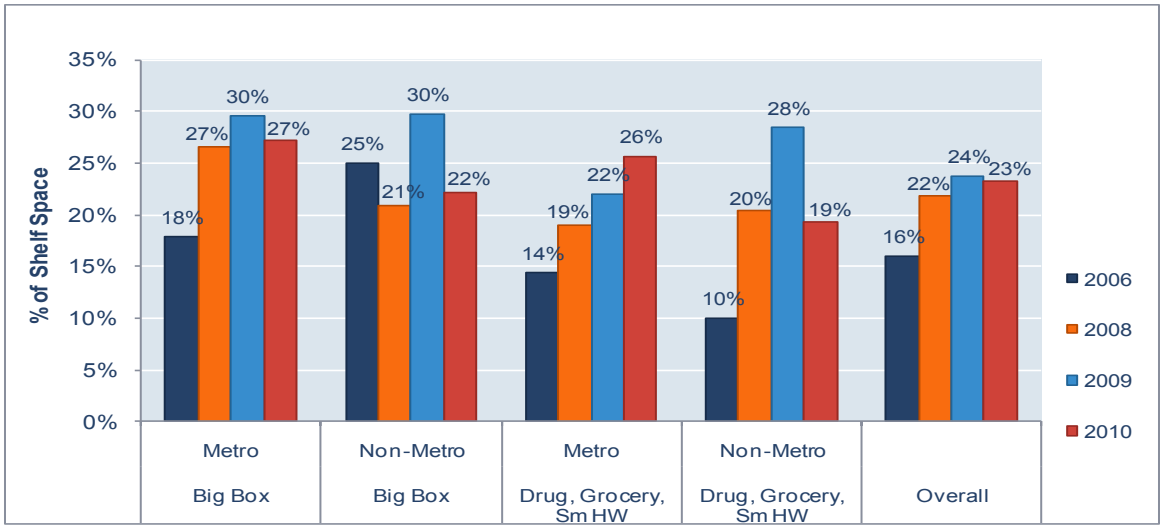


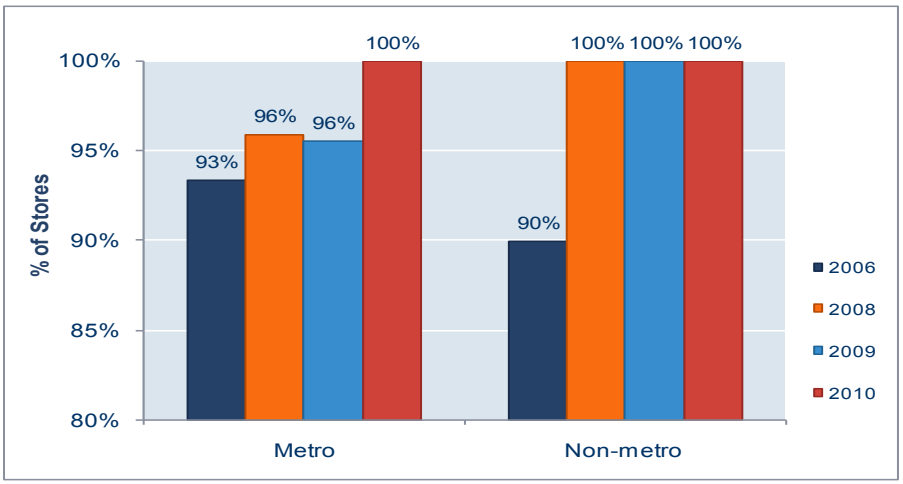
Figure 18: Percentage of Shelf Space Dedicated to CFLs by Geography, Store Category, and Year, 2005–2010



C.4.3 Percentage of Stores Carrying (Any) CFLs

Up three percentage points from last year, the Northwest market now has CFLs available in each of the 58 stores sampled (Figure 21). This jump seems to be driven by metro big box stores where there was a jump of eight additional percentage points in stores now carrying CFLs when compared to last year. Figure 19 shows the percentage of stores carrying CFLs by geography and year, and Figure 20 shows the percentage of stores carrying CFLs by store category and year.

Figure 19: Percentage of Stores Carrying CFLs by Geography and Year, 2006–2010



* Difference from prior study period is statistically significant.

Figure 20: Percentage of Stores Carrying CFLs by Store Category and Year, 2006–2010

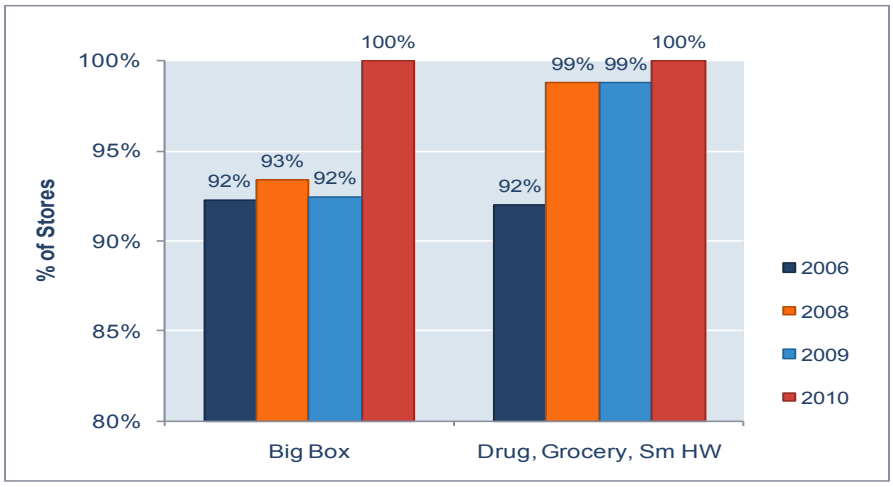
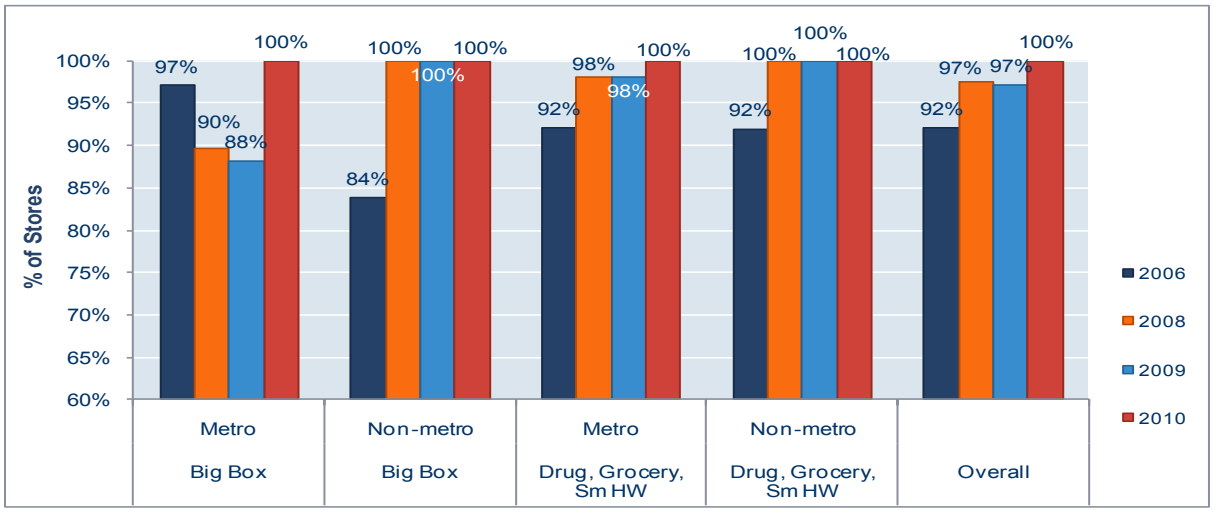


Figure 21: Percent of Stores Carrying CFLs by Geography Store Category, and Year, 2006–2010



C.4.4 Percentage of Stores Carrying CFLs by Style (Twister and Non-Twister)

When CFLs are further examined by style (twister versus non-twister), the proportion of stores carrying twisters declined slightly in non-metro areas while raising in metro areas and big box stores. As shown above, all Northwest lighting retailers carried CFLs in 2010. When CFLs are further examined by style (twister versus non-twister), the proportion of stores carrying twisters increased slightly in metro areas (Figure 22) and big box stores (Figure 23) while continuing to decline in non-metro stores and drug, grocery, and small hardware stores. When the geographic and store category characteristics are examined all together (Figure 24), it is apparent that these trends are driven by the

increase of eleven percentage points of metro big box stores that carry twisters and by the decrease in percentage of rural drug, grocery, and small hardware stores that carry twisters.

Non-twister CFLs can also be found at the majority of stores but are still less prevalent when compared to twisters (carried at 96% of stores versus 91% for non-twisters). Unlike twisters, non-twisters saw increases in all geographies and in all store types. For non-twisters, this year showed a significant jump from last year's 83 percent of stores. This was largely driven by big box stores, which had an additional 11 percentage points of stores with non-twister CFLs. For both twisters and non-twisters, the largest increase in CFLs occurred in big box stores.

Figure 22: Percentage of Stores That Carry Twister and Non-Twister CFLs by Geography and Year, 2006–2010

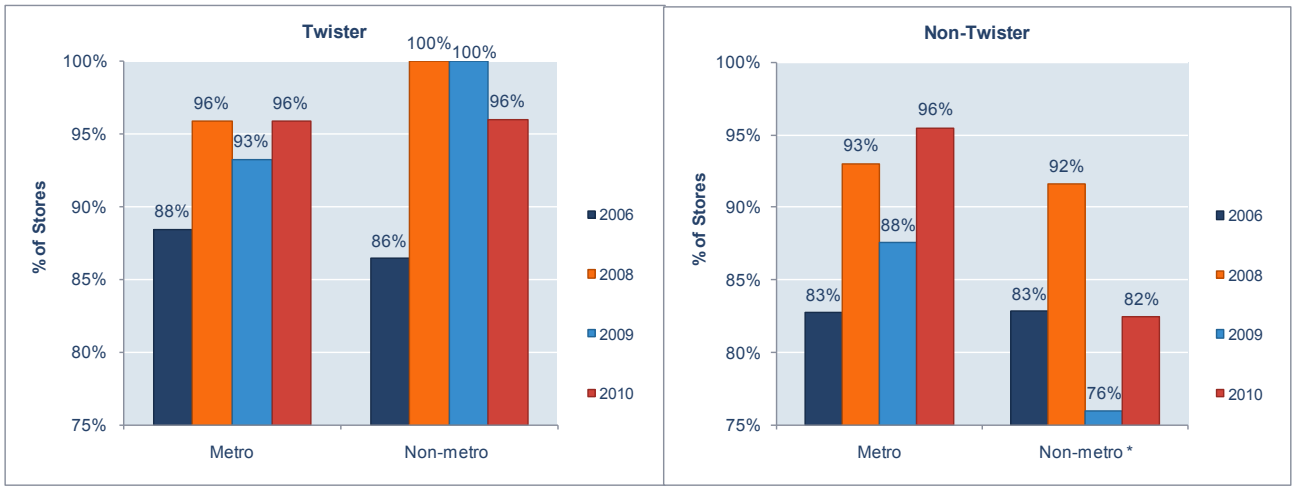


Figure 23: Percentage of Stores That Carry Twister and Non-Twister CFLs by Store Category and Year, 2006–2010

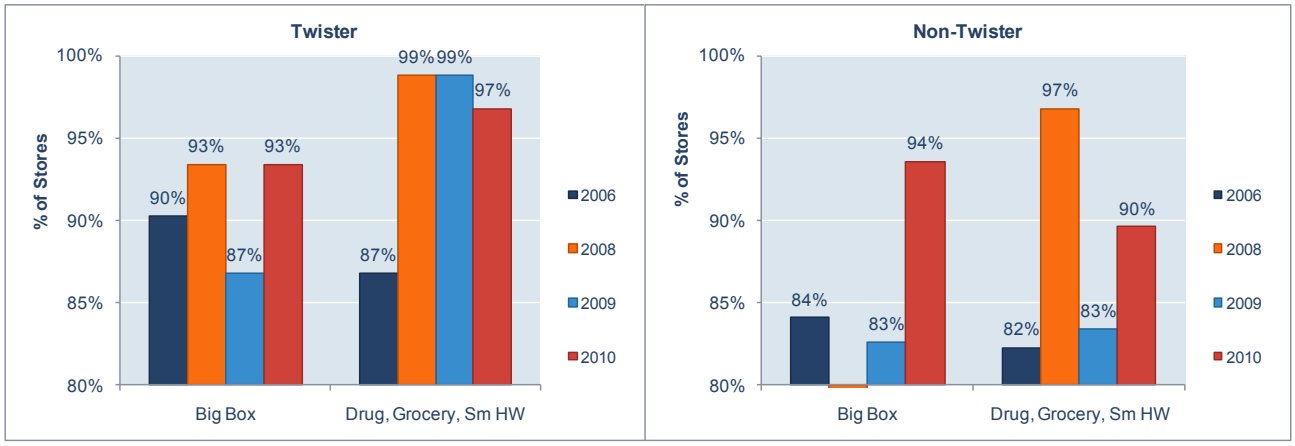
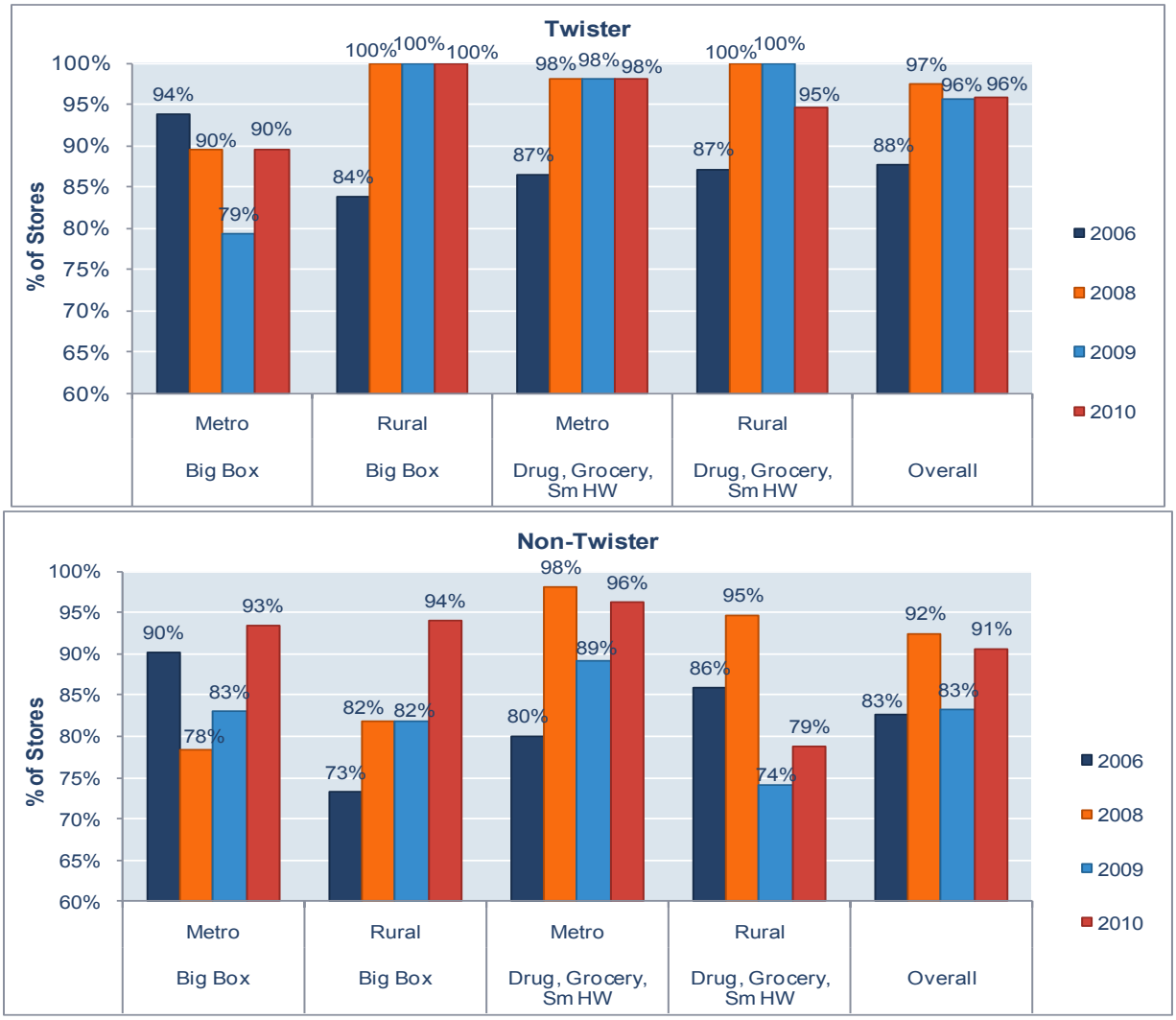


Figure 24: Percentage of Stores That Carry Twister and Non-Twister CFLs by Geography, Store Category, and Year, 2006–2010



C.5 Diversity

Field researchers recorded data on lamp style (twister, three-way, reflector, etc.) and wattage as part of the shelf survey to assess the diversity of CFLs available to Northwest consumers. Below we discuss diversity in terms of the average number of twister and non-twister CFL models available in each store.

C.5.1 Average Number of Models per Store

The average numbers of CFL models per store – a measure of CFL diversity – increased between 2009 and 2010 for twisters, and had a slight decrease for non-twisters. The average number of twister

models carried by each store increased by approximately three models (from 19.9 per store in 2009 to 23.4 in 2010) and decreased slightly for non-twisters (from 17.6 in 2009 to 16.8 in 2010; see ―Overall" columns in Figure 27).

Twisters have shown a continued increase in diversity each year that this study has been done, across all store types and geographies. One reason for this may be an increase in lighting technology, allowing people to purchase CFLs that give off light in a manner that matches more with their preferences. For the past two years, big box stores have increased their twister models more than any other store type. This is not surprising given the way in which big box stores had the highest increase in availability of twisters within the last year.

The non-twister market, while experiencing an increase in allocated shelf space, experienced a slight decline in diversity. The slight decrease occurred in non metro areas and across all store types (Figure 25, Figure 26). The largest decline occurred in non metro big box stores, which, on average, had five fewer non-twister models than they did at the end of 2009. This drop returned non metro big box diversity to a level that still remains higher than that of 2008.

Figure 25: Average Number of Twister and Non-Twister CFL Models per Store by Geography and Year, 2006–2010

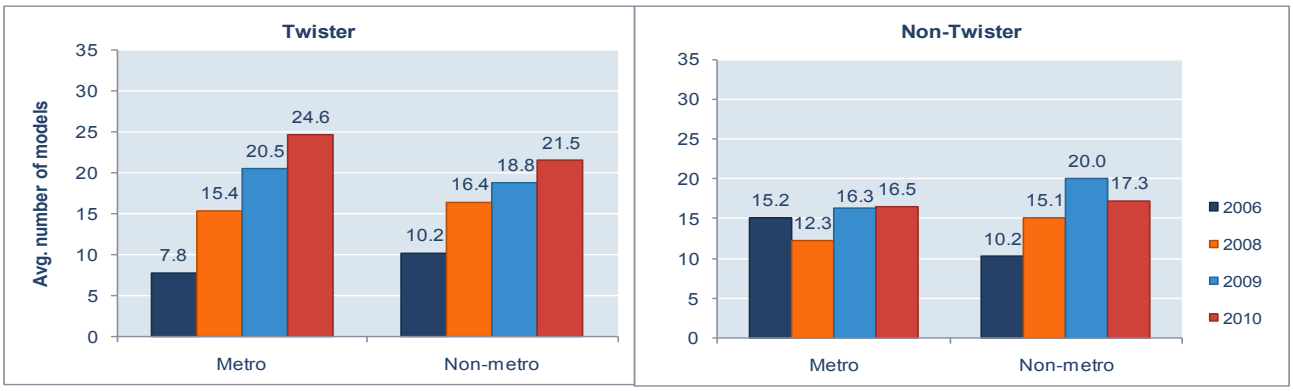


Figure 26: Average Number of Twister and Non-Twister CFL Models per Store by Store Category and Year, 2006–2010

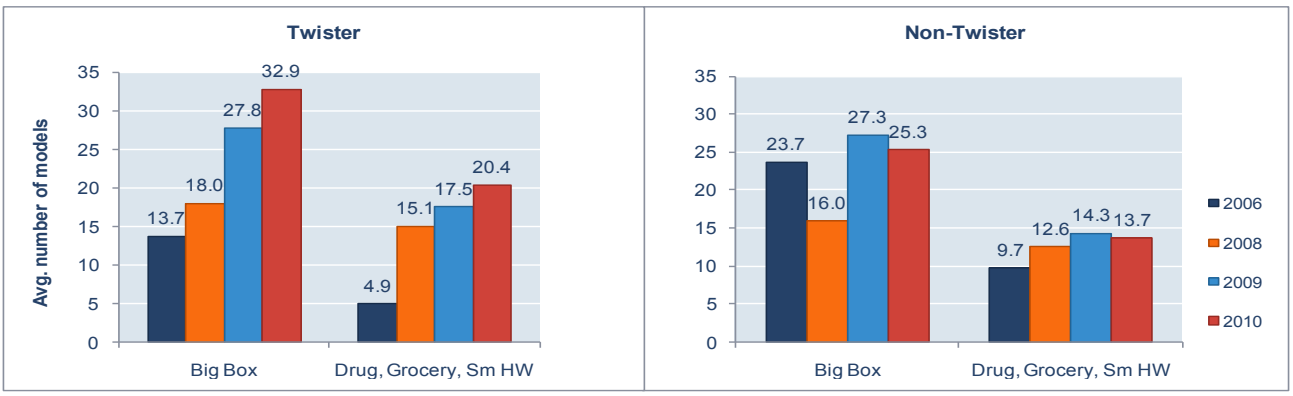
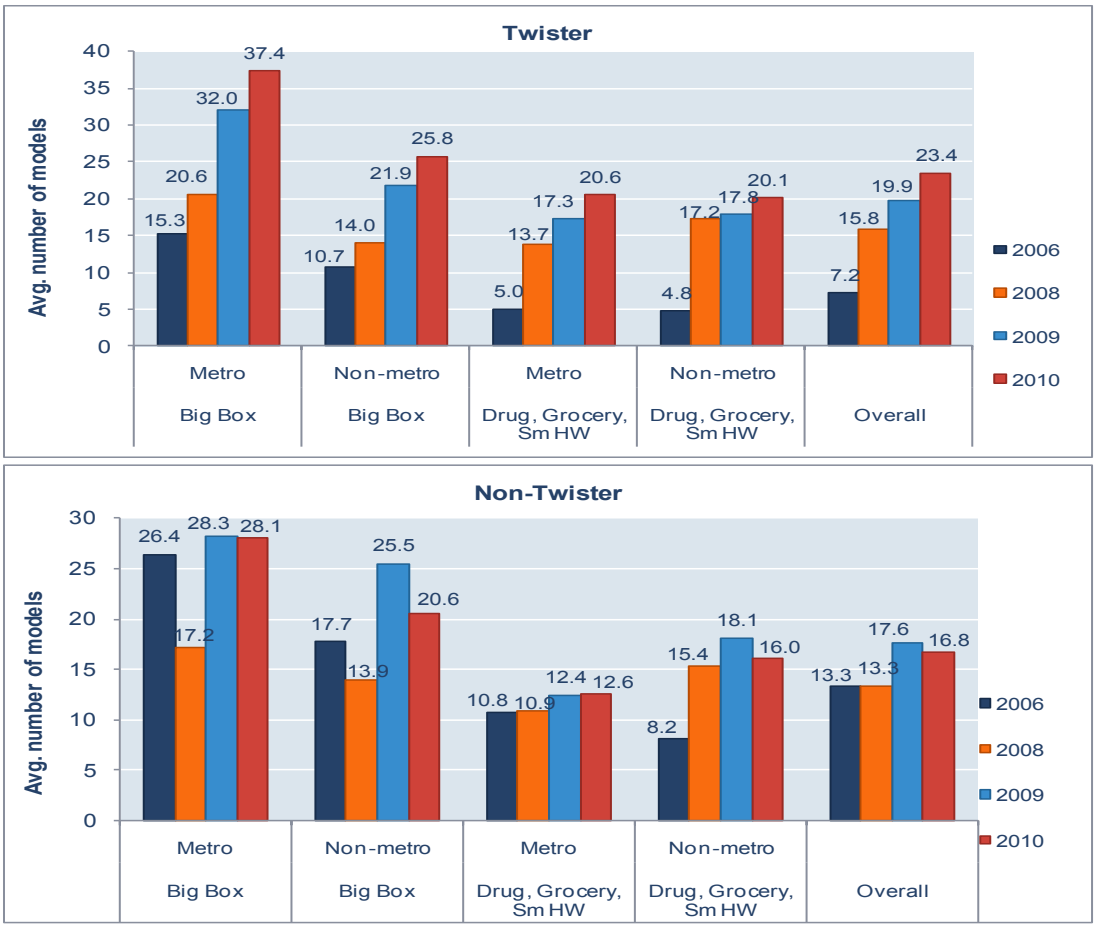


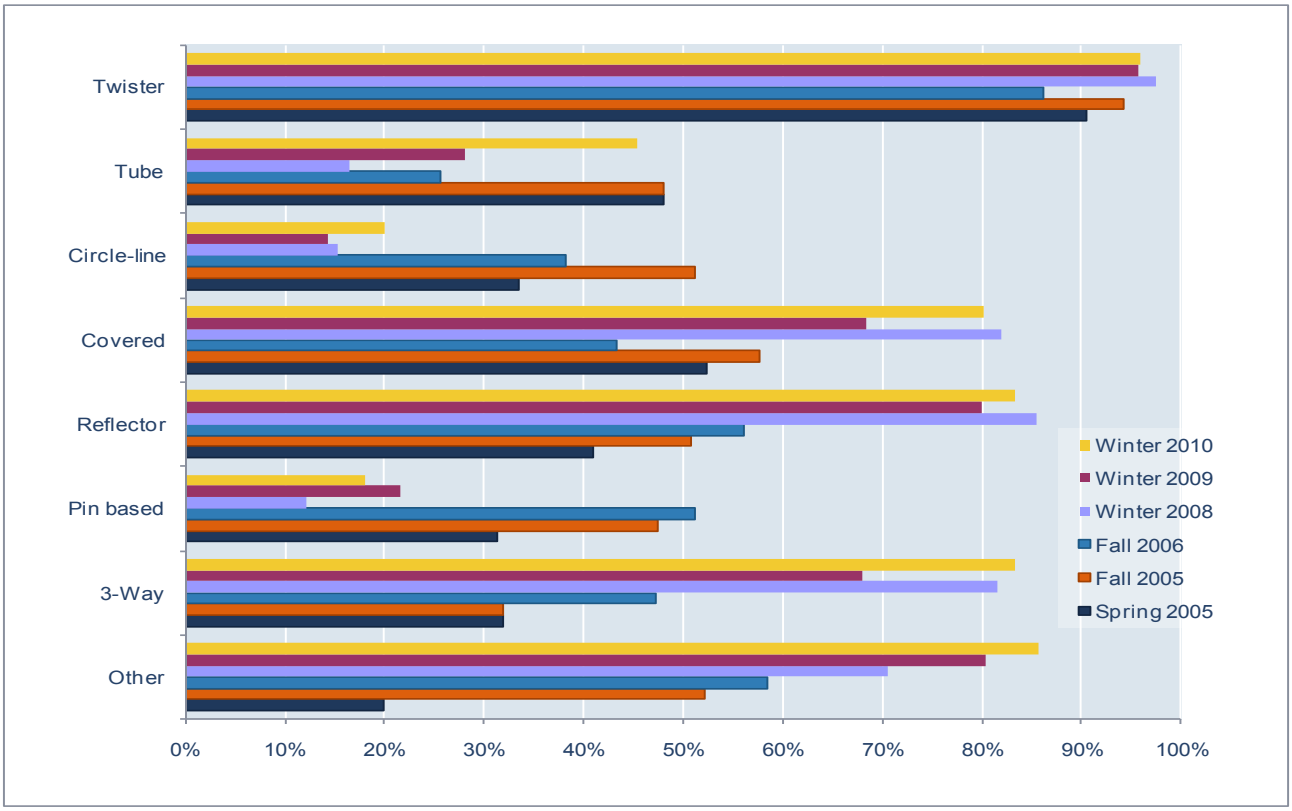
Figure 27: Average Number of Twister and Non-Twister Models per Store by Geography, Store Category, and Year, 2006–2010



C.5.2 CFL Style

The lighting shelf survey also studied CFL diversity by lamp style (twister, 3-way, reflector, etc.) and wattage category. Figure 28 shows the percentage of stores in the Northwest that carry each different style of CFL. As reported in the main shelf survey section (Section 3), almost every Northwest lighting retailer in our sample carries twister-style CFLs. About 20 percent carry circle-line and pin-based CFLs. There were both large and small shifts in non-twister style diversity over the last year, with slightly more stores carrying tube, circle-line, covered, reflector, 3-way, and other styles and slightly fewer stores carrying pin-based styles.

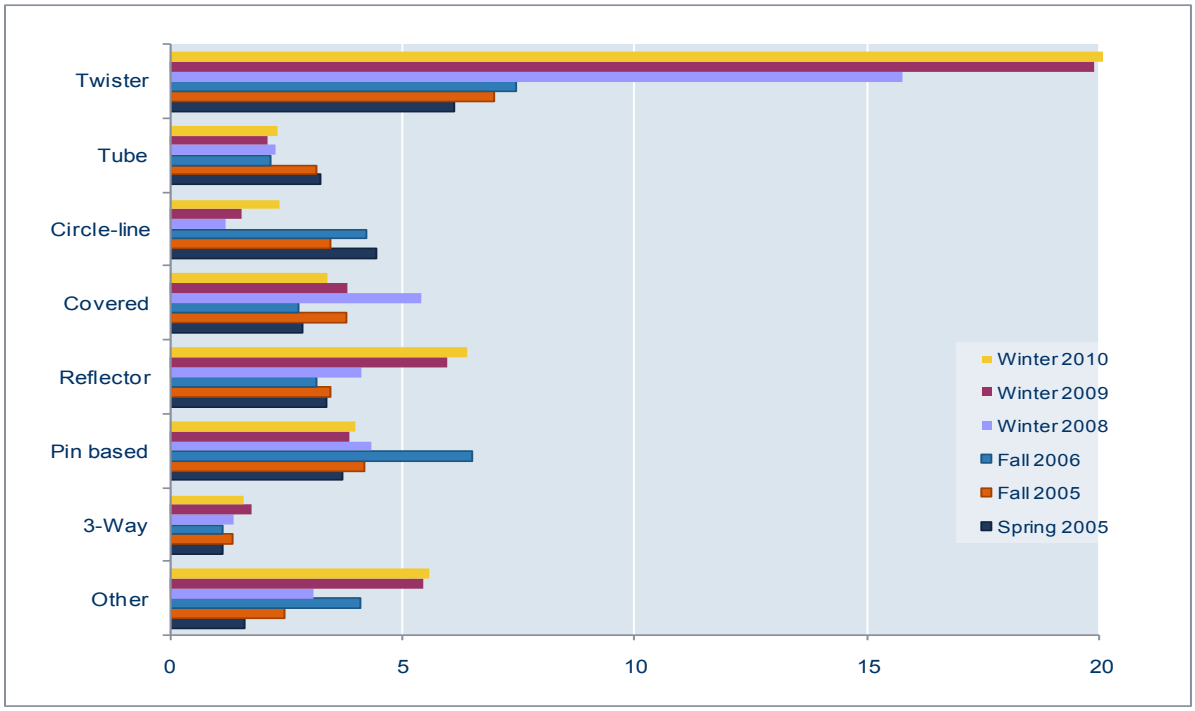
Figure 28: Percentage of Stores that Carry CFLs by Style, 2005--2010



There were more increases in types of CFLs carried this year than there were in prior years which contrasts the above observation that there were slightly less models per store. This can be explained by the following graph (Figure 29) which shows that brand variety is much more prevalent in twisters and is considered less important to have a variety of brands for each type of non-twister.

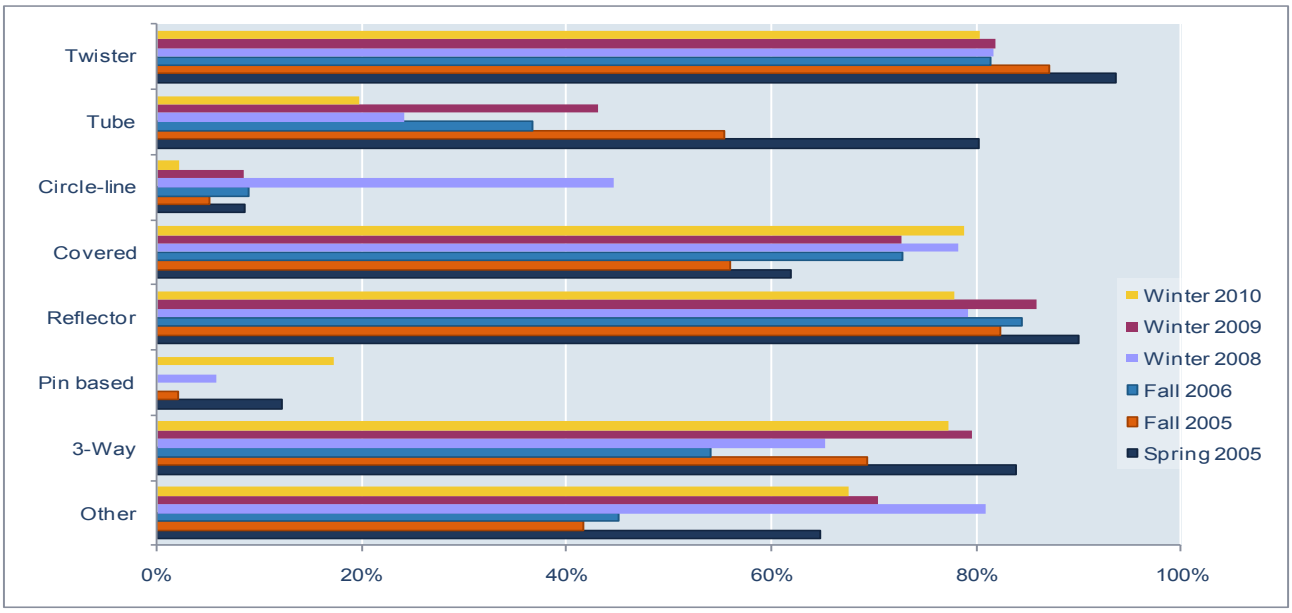
Figure 29 shows the average number of CFL models stocked in lighting retailers across the Northwest, by style. As shown, there was a slight increase in twister style diversity over the last year. This represents a large slow down given the large jumps in previous years. There were only slight changes in diversity for the non-twister styles, with stores stocking on average between one and six models.

Figure 29: Average Number of CFL Models Stocked by Style, 2005–2010



The percentage of models with ENERGY STAR labels encountered in Northwest lighting retailers is presented by style in Figure 30. About 80 percent of twister models have ENERGY STAR labels, unchanged from last year. A significant decrease in ENERGY STAR labeled tubes occurred which declined to a level more than half that of last year, as did Circle-line ENERGY STAR labels. The opposite effect was seen in pin-based bulbs, which went from not having any ENERGY STAR labeled bulbs to having nearly 20 percent. Covered bulbs were the only other type to see an increase in percentage of models with ENERGY STAR labels, although it was rather slight. A decrease of no more than five percentage points occurred for reflectors, 3-ways, and miscellaneous bulbs.

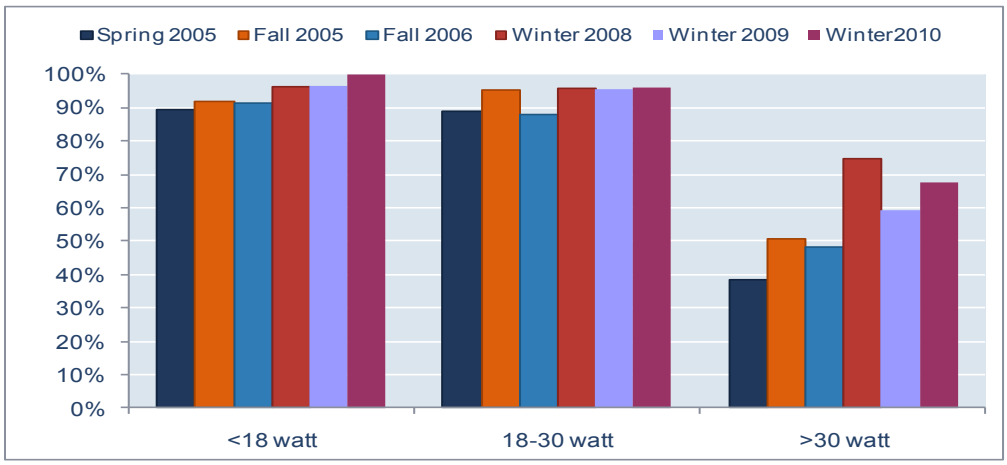
Figure 30: Percentage of Models with ENER GY STAR Label by Style, 2005–2010



C.5.3 CFL Wattage Category

The percentage of stores carrying CFLs, by wattage category, is presented in Figure 31. As shown, more than 95 percent of Northwest lighting retailers carry CFLs of 30 watts or less – unchanged from last year. A smaller fraction carries CFLs greater than 30 watts – about 70 percent, up from about 60 percent in 2009.

Figure 31: Percentage of Stores that Carry CFLs by Wattage Category, 2005–2010



The percentage of CFL models stocked at lighting retailers in the Northwest is presented in Figure 32, by wattage category. About 60 percent of all models stocked in our sample were less than 18 watts, a decrease from just over 75 percent of models last year. Stocking levels for less than 18 watt bulbs and bulbs in the 18 to 30 watt range returned to their 2008 levels after increases in 2009. The percentage of over 30 watt bulbs stocked has remained the same over the past three years.

Figure 32: Percentage of CFL Models Stocked by Wattage Category, 2005–2010

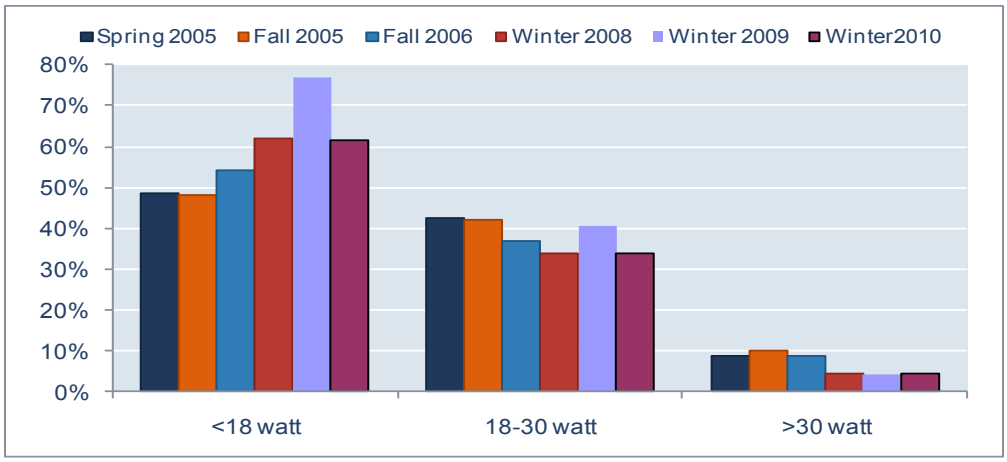
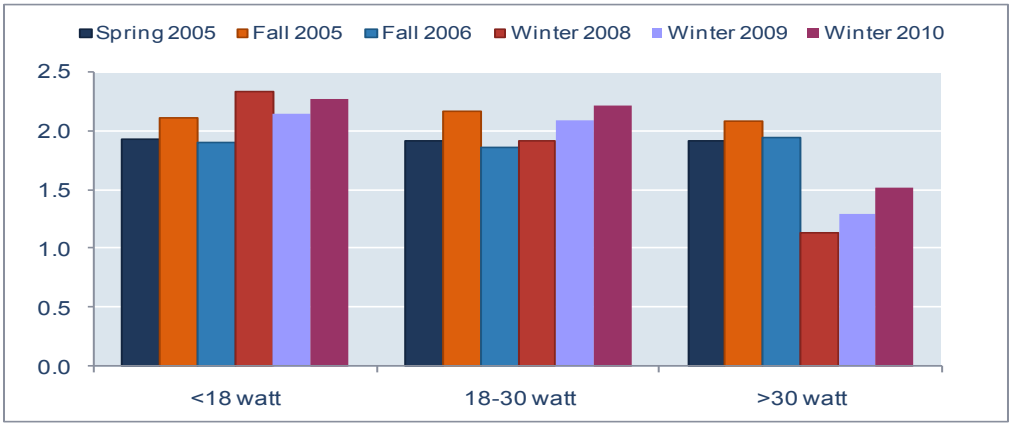


Figure 33 shows the average number of CFL brands at lighting retailers in the Northwest, by wattage category. While the number of models is skewed towards less than 18 watt CFLs, the various wattage categories are equally represented by brand, with a little over two brands each for CFLs less than 18 watts and 18-30 watts and just over one and a half brands for greater than 30 watts, with just a slight increase over last year, across the board.

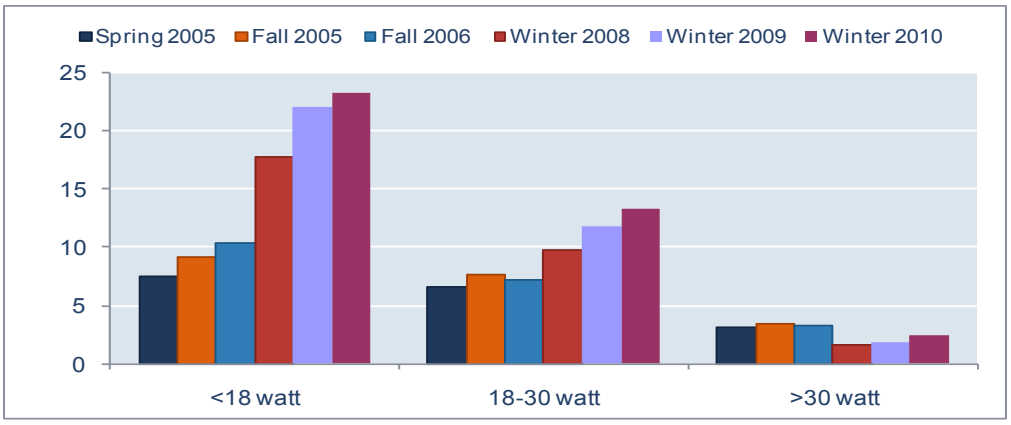
Figure 33: Average Number of CFL Brands Stocked by Wattage Category, 2005–2010



The average number of CFL models stocked by wattage category is presented in Figure 34 below. There are over 22 models of CFLs less than 18 watts stocked by the average Northwest lighting retailer, just over 13 models 18-30 watts and about two models greater than 30 watts. These results mirror those presented in

Figure 33 above, with an increase in the stocking of models of all wattage rates.

Figure 34: Average Number of CFL Models Stocked by Wattage Category, 2005–2010



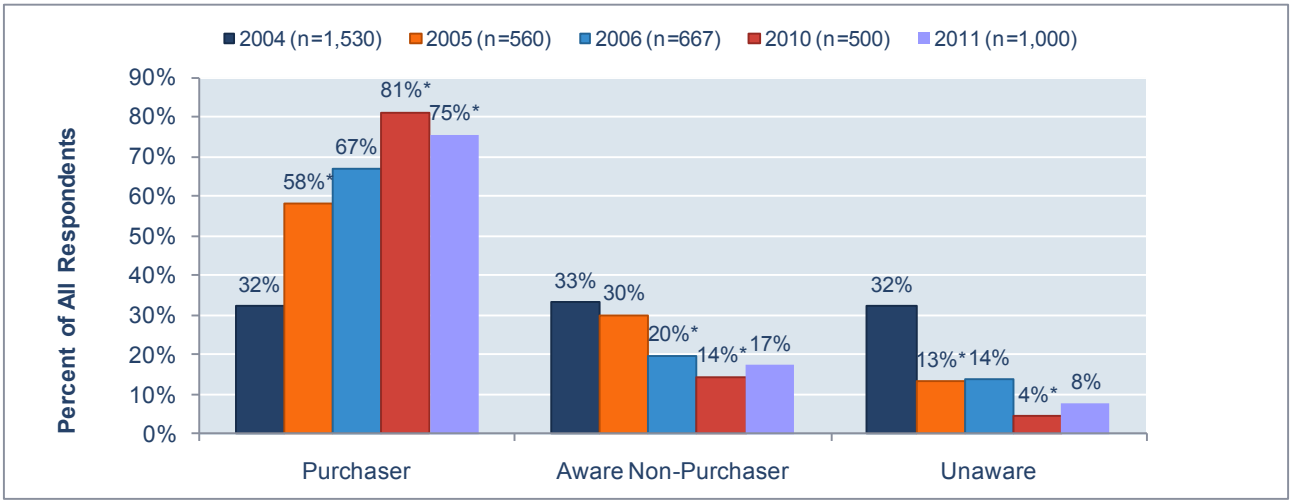
D. Additional Consumer Survey Results

D.1 CFL Awareness and Purchases

D.1.1 CFL Awareness and Purchases – Overall

Figure 35 shows changes in awareness and purchaser categories over time for consumers in the Northwest. Purchasers are consumers who have bought one or more CFLs at any time. Aware non-purchasers are consumers who are aware of CFLs, but have never purchased them. Unaware consumers are those who have never heard of CFLs even when prompted with a description.[29] As shown, overall awareness of CFLs has dropped from 95 percent in 2010 to 92 percent in 2011, a small but statistically significant change.[30]

Figure 35: Consumer CFL Awareness and Purchaser Categories, 2004–2011



* Difference from previous study period (within awareness/purchaser category) is statistically significant.

Approximately 68 percent of CFL purchasers in the Northwest are unaware of specialty CFLs.[31] Among CFL purchasers who are aware of specialty CFLs, a statistically equal distribution currently

[29] The CFL description reads, ~~"~~Compact fluorescent bulbs, or CFLs, are small fluorescent bulbs that fit in regular light bulb sockets. CFL look different from standard bulbs. They are often made out of thin tubes of glass bent into loops."

[30] Statistical significance is reported at the 90 percent level of confidence throughout.

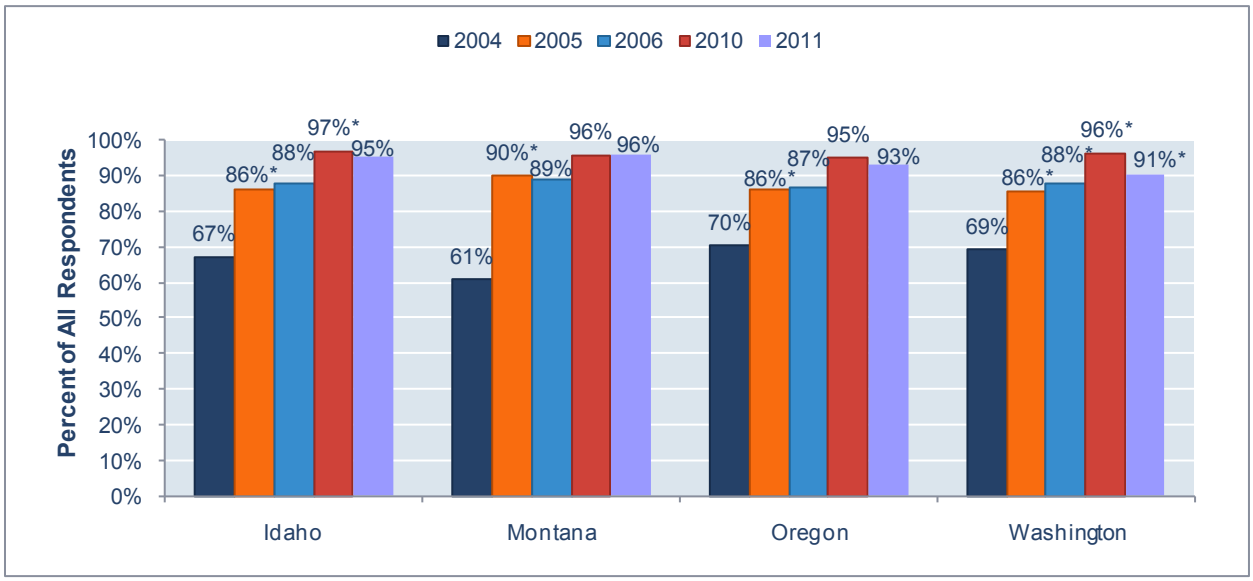
[31] The survey asked, ~~"~~Other than CFLs that look like a twisty, spiral or curlicue shape, are you aware of any other types of CFLs?" If the respondent answered, ~~"~~Yes," a follow-up question asked the respondent to describe the CFL shapes with which they were familiar. Respondents who were familiar with only spiral CFLs and/or a-lamps were characterized as ~~"~~unaware" of specialty CFLs, and respondents who were familiar to other CFL shapes (in addition to spirals and/or a-lamps) were characterized as ~~"~~aware" of specialty CFLs.

have them installed and currently do not have them installed (47% and 53%, respectively). There were no statistically significant differences among states in the Northwest.

D.1.2 Awareness and Purchase Rates by State

As shown in Figure 36, consumer awareness of CFLs has not increased over 2010 levels among any of the four Northwest states. There was no significant change in awareness among residents of Idaho, Montana or Oregon. Awareness dropped from 96 to 91 percent in Washington (a statistically significant change).

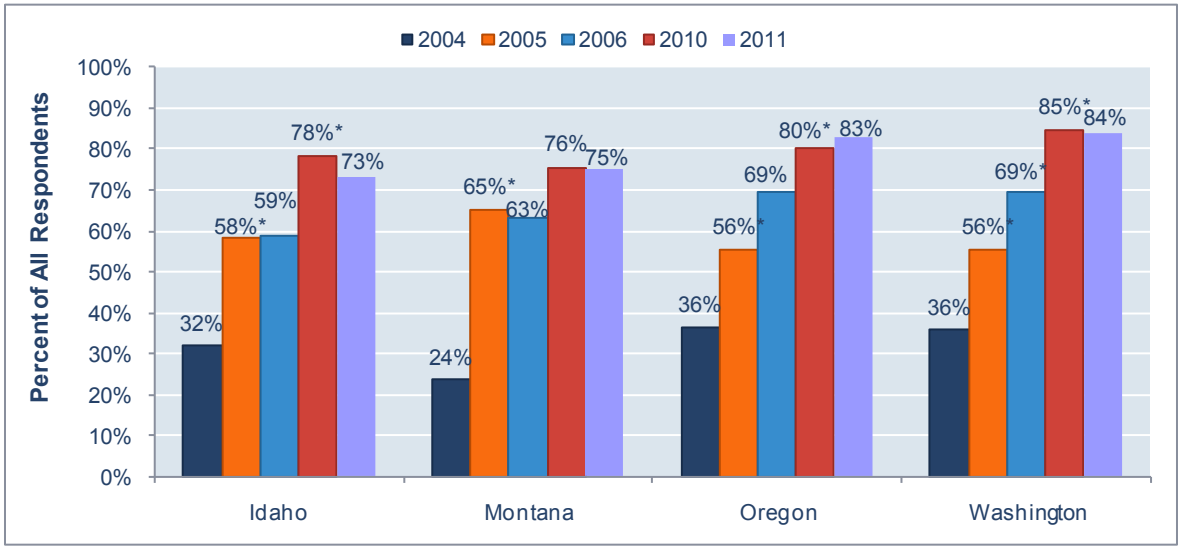
Figure 36: Consumer Awareness of CFLs by State, 2004–2011



* Difference from previous study period (within state) is statistically significant.
2004 n: ID n=197; MT n=189; OR n=426; WA n=786. 2005 n: ID n=63; MT n=60; OR n=162; WA n=275; 2006 n: ID n=273; MT n=94; OR n=110; WA n=190. 2010 n: ID n=54; MT n=43; OR n=175; WA n=228. 2011 n: ID n=108; MT n=101; OR n=313; WA n=478

As shown in Figure 37, there was no significant change in CFL purchase rates from 2010 to 2011 among any of the four Northwest states.

Figure 37: Consumer CFL Purchase Rates by State, 2004–2011



* Difference from previous study period (within state) is statistically significant.
2004 n: ID n=133; MT n=119; OR n=305; WA n=554; 2005 n: ID n= 54; MT n= 55; OR n=141; WA n=240; 2006 n: ID n=238; MT n= 84; OR n= 95; WA n=164; 2010 n: ID n= 52; MT n= 41; OR n=166; WA n=219. 2011 n: ID n=103; MT n=96; OR n=292; WA n=433

D.1.3 Where CFLs Have Been Purchased

The consumer survey asked all CFL purchasers where they purchased CFLs most recently. As shown in Figure 38, do-it-yourself (DIY) stores such as Home Depot and Lowe's continue to be the most common store category in which CFLs are purchased. There has been a small but statistically significant increase in the proportion of consumers in the Northwest who report purchasing CFLs at pharmacies or drug stores (from 1% in 2010 to 3% in 2011). There were no other statistically significant changes between 2010 and 2011.

Figure 38: Where CFLs Are Purchased Among CFL Purchasers, 2004–2011

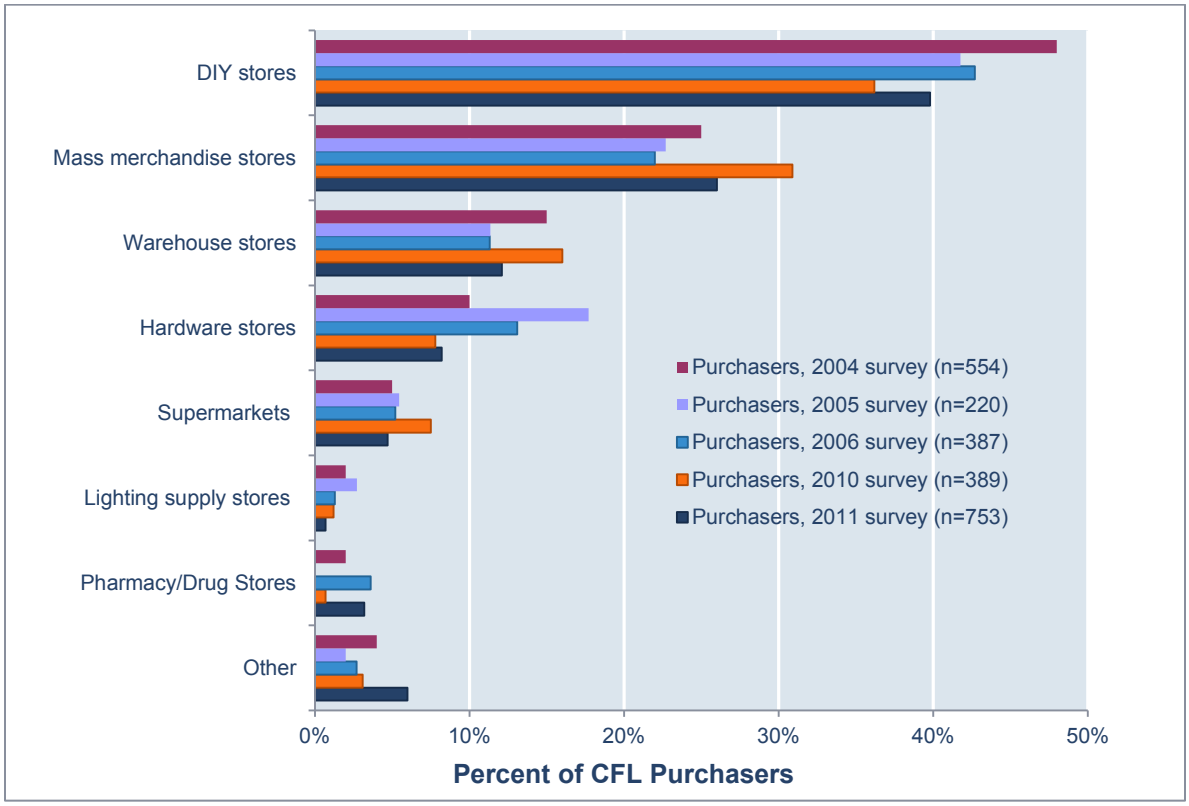


Table 13 shows the distribution of CFL purchase locations for metro versus non-metro purchasers in 2010 and 2011. As shown, 45 percent of metro consumers in 2011 report purchasing CFLs at DIY stores, compared to 31 percent of non-metro consumers. The difference is accounted for in mass merchandise stores, where 39 percent of non-metro consumers purchased CFLs, compared to less than one-quarter of metro consumers (23%).

Compared to 2010, a significantly higher proportion of Metro consumers in 2011 report purchasing CFLs at drug or grocery stores (10% in 2011; less than 1% in 2010).

Table 13: Where CFLs Are Purchased Among CFL Purchasers by Metro/Non-Metro, 2010 and 2011*

Store Type	2011 Survey		2010 Survey	
	Metro (n=527)	Non-Metro (n=195)	Metro (n=284)	Non-Metro (n=106)
Do-it-Yourself stores	45%††	31%	38%	32%
Mass merchandise stores	23%††	39%	29%	36%
Hardware stores	8%	10%	7%	11%
Warehouse stores	13%	12%	17%	15%
Drug/grocery stores	10%†	5%	<1%	2%
Lighting supply stores	<1%	<1%	1%	1%
Other	6%	7%	11%	9%

* Question allowed multiple responses; totals may exceed 100%.
† Difference from 2010 Metro results is statistically significant.
†† Difference from 2011 Non-Metro results is statistically significant.

D.1.4 Lamp Disposition in Purchaser Households by Geographic Region

Table 14 shows CFL distribution by geographic region within the Northwest from the 2011 survey. There are no statistically significant differences among the geographic regions.

Table 14: Bulb Disposition in Purchaser Households by Geographic Region, 2011

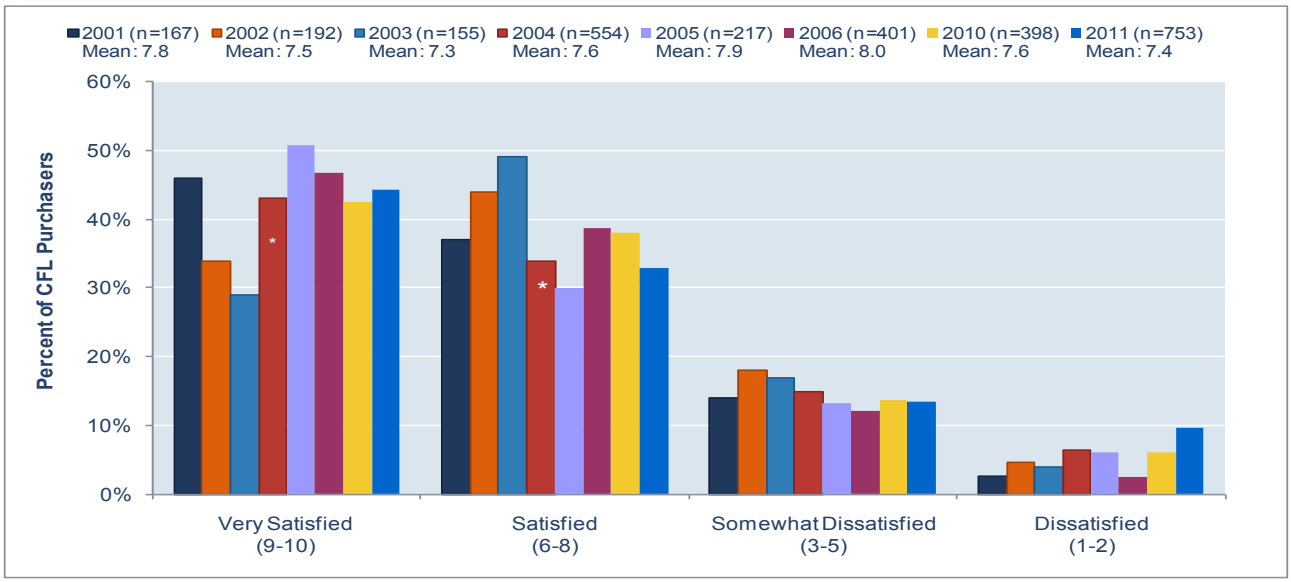
Disposition of All Bulbs Ever Acquired	Metro East (n=108)		Metro West (n=441)		Non-Metro (n=204)	
	Mean # of lamps	% of lamps	Mean # of lamps	% of lamps	Mean # of lamps	% of lamps
CFLs currently installed	12.1	57%	10.5	51%	11.4	56%
CFLs ever removed	3.5	16%	4.0	19%	3.2	16%
CFLs currently stored	5.6	26%	6.3	30%	5.6	28%
Total number of CFLs ever acquired	21.1	100%	20.8	100%	20.2	100%
Purchaser base	80%		85%		75%	

D.2 Satisfaction with CFLs

D.2.1 General Satisfaction

CFL purchasers rated their general satisfaction with CFLs on a ten-point scale, with 1 being ―not at all satisfied" and 10 being ―very satisfied." Results presented in Figure 39 show that consumer satisfaction remains high, and there was no statistically significant difference in consumer satisfaction with CFLs between 2010 and 2011. The mean satisfaction rating remained statistically unchanged from 2010 (7.6) to 2011 (7.4), although the change since 2006 (8.0) is statistically significant.

Figure 39: General Satisfaction with CFLs Over Time Among CFL Purchasers, 2001–2011 (Where 1=Not at all Satisfied, 10=Very Satisfied)



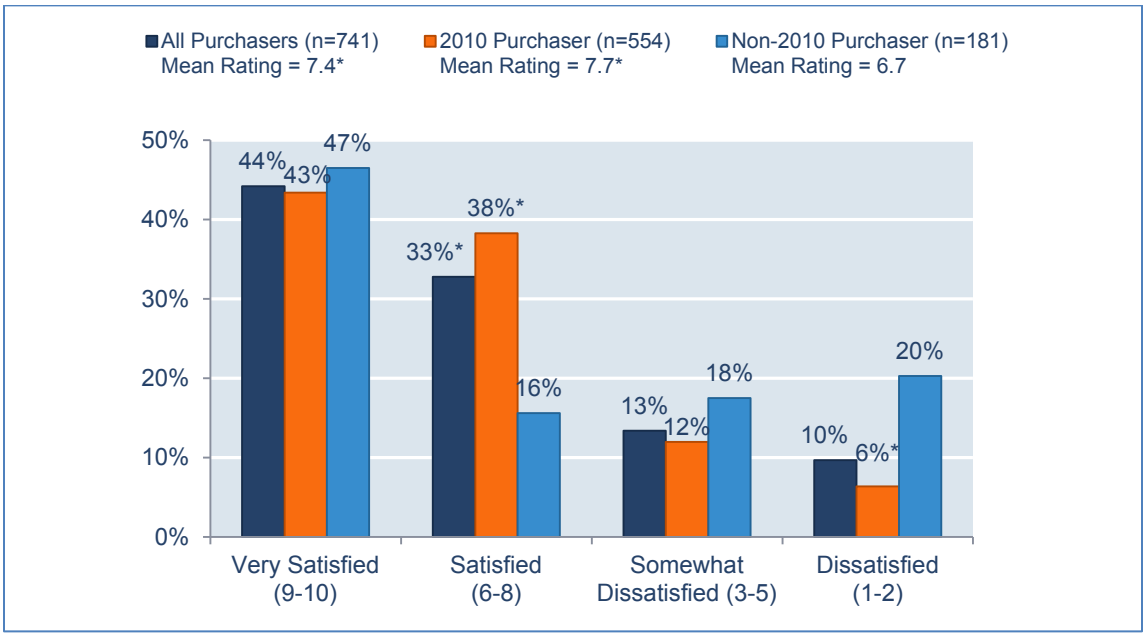
* Difference from previous study period is statistically significant.

D.2.2 CFL Satisfaction by Purchaser Group

Figure 40 shows overall satisfaction with CFLs for CFL purchasers in general, as well as for purchasers who bought CFLs in 2010 and purchasers who did not buy any in 2010 (but purchased CFLs in prior years). CFL purchasers who did not purchase CFLs in 2010 reported a significantly lower mean satisfaction rating than 2010 purchasers and purchasers in general.

Figure 40: General Satisfaction with CFLs Among CFL Purchasers, 2011

(Where 1=Not at all Satisfied, 10=Very Satisfied)



* Difference from non-2010 purchasers is statistically significant

D.2.3 Satisfaction with CFL Attributes

The consumer survey addressed consumer satisfaction with specific CFL attributes in two ways:

(1) by asking CFL purchasers to rate their level of satisfaction with various CFL attributes (such as color of the light and appearance in light fixtures) on a 5-point scale where 1 means, ~~"n~~ot at all satisfied" and 5 means, ~~"v~~ery satisfied; " and

(2) by asking CFL purchasers to indicate their level of agreement or disagreement with a series of statements regarding CFLs on a 5-point scale where 1 means, ~~"n~~ot at all likely" and 5 means, ~~"v~~ery likely."

We utilized the first approach in each round of consumer surveys from 2004 through 2011, and utilized the second approach starting in 2011.

Results from the first approach (in which interviewers asked CFL purchasers to rate their satisfaction with specific CFL attributes) suggested a statistically significant decline in average satisfaction with the color of light, light up time, and how long CFLs last between 2009 and 2010 (Table 15).

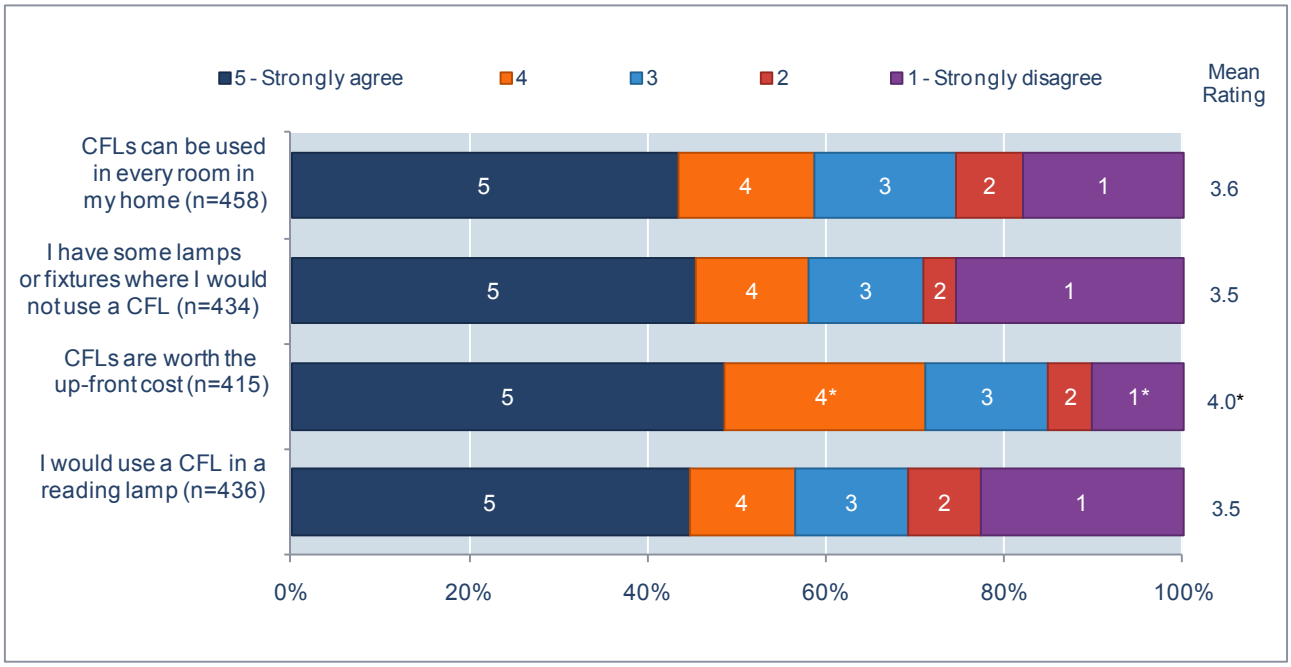
Table 15: Mean Satisfaction with CFL Attributes Among CFL Purchasers, 2004–2011
(Where 1=Not at all Satisfied, 10=Very Satisfied)

Lamp Attribute	Mean Rating Among All Purchasers				
	2004 (n=554)	2005 (n=220)	2006 (n=217)	2010 (n=230)	2011 (n=349)
Ability to work with a dimmer and 3-way applications	3.5	3.2	*	*	*
Appearance in fixture	3.8	3.8	3.9	3.8	3.7
Brightness of light	3.9	4.0	4.0	4.0	3.9
Color of light	4.0	4.0	4.0	4.2	3.9†
Light up time	4.0	3.8	4.2†	4.0	3.6†
Light fixture fit	4.0	4.2	4.5	4.4	4.3
How long they last	4.3	4.4	4.5	4.8	4.3†

* Data not collected in 2006, 2010, or 2011.
† Difference from previous study period is statistically significant.

Results from the second approach (in which we asked CFL purchasers to indicate their agreement or disagreement with various statements regarding CFLs) suggest that consumers tend to agree with the statement, ―CFLs are worth the up-front cost" significantly more than the other statements (Figure 41). The mean agreement rating for the other three statements – which include, ―CFLs can be used in every room in my home," ―I have some lamps or fixtures where I would not use a CFL," and ―I would use a CFL in a reading lamp" – were lower by statistically significant margins.

Figure 41: Level of Agreement with Statements Regarding CFLs, 2011
(Where 1=Strongly Disagree, 5=Strongly Agree)



* Difference from other statements is statistically significant.

As expected, respondents' levels of agreement with the statements mentioned above tend to vary according to the saturation of CFLs in their homes (that is, the percentage of total household sockets currently filled with CFLs). As shown in Table 16, the mean level of agreement with the statements "I would use a CFL in a reading lamp," "CFLs are worth the up-front cost," and "CFLs can be used in every room in my home" are significantly lower among respondents with no CFLs than among all other groups (i.e., among everyone with 1 or more CFL installed). Additionally, respondents with 68 percent or higher saturation rate their level of agreement with the statements "I would use a CFL in a reading lamp" and "CFLs can be used in every room in my home" significantly higher than all other groups. These highly saturated CFL users also rate their level of agreement with the statement, "I have some lamps or fixtures where I would not use a CFL" significantly lower than all other groups.

Table 16: Mean Level of Agreement with Statements Regarding CFLs, by Percent Saturation, 2011

(Where 1=Strongly Disagree, 5=Strongly Agree)

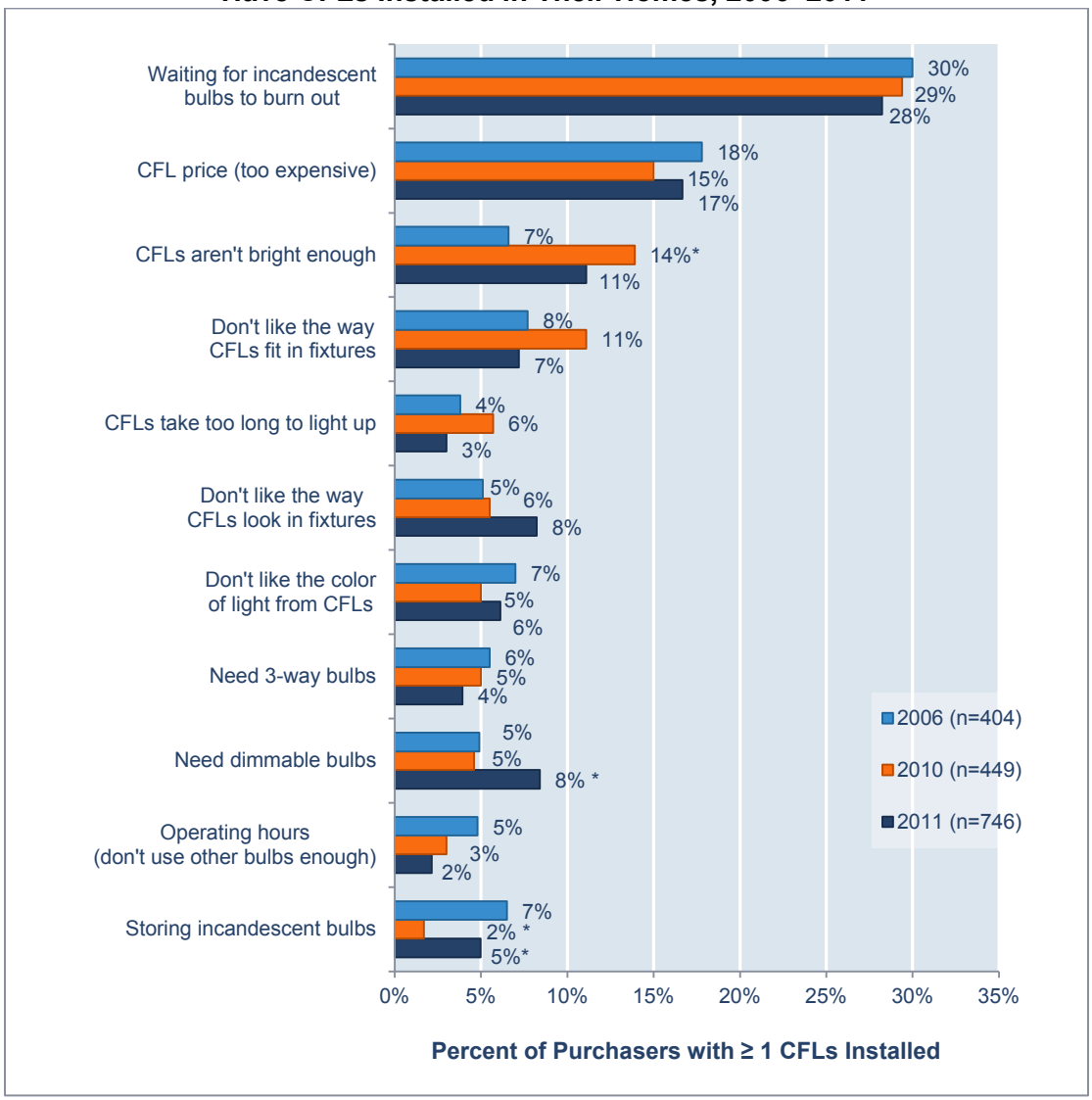
Mean Rating	Percent Saturation			
	0%	1-33%	34-67%	68% +
I would use a CFL in a reading lamp	2.0*	3.2	3.5	4.2*
CFLs are worth the up-front cost.	2.1*	3.6**	4.1	4.4
I have some lamps or fixtures where I would not use a CFL.	4.0	3.9	3.8	2.9*
CFLs can be used in every room in my home	2.2*	3.2	3.5	4.4*

* Difference from all other saturation groups is statistically significant.
** Difference from 68%+ saturation group is statistically significant.

D.2.4 Factors Preventing Additional CFL Installations

Furthermore, we asked CFL purchasers what were the main factors preventing them from installing more CFLs in their homes. As shown in Figure 42, the main factor continues to be that consumers are waiting for incandescent lamps to burn out (30%), followed by the perception that CFLs are too expensive (18%). A slightly higher proportion of CFL users in 2011 (8%) are reporting a need for dimmable CFLs as the main factor preventing installing more CFLs (compared to 5% in 2010 and 2006; a statistically significant change). Slightly fewer 2011 CFL users cited low operating hours (2%) compared to 2006 (5%), and more than twice the proportion report that their incandescent storage is preventing them from installing CFLs in 2011 compared to 2010 (from 2 percent in 2010 to 5 percent in 2011). There were no other statistically significant differences in 2011.

Figure 42: Main Factors Preventing Additional CFL Installations Among CFL Purchasers Who Have CFLs Installed in Their Homes, 2006–2011



* Difference from prior year is statistically significant

D.2.5 Influences on CFLs Installation Patterns

The 2011 survey included questions to address specific influences on CFL usage within the home based on focus group results which suggested that consumers may make choices about where to install CFLs in their homes based on how they use a particular fixture, the type of fixture in which the lamp will be installed, or other factors. This section presents results from those survey questions.

D.2.5.1 How a Fixture is Used

Interviewers asked CFL purchasers the following question: ~~"~~Does the way you use a particular light fixture – say, for reading versus general lighting – affect whether you'd use a CFL in that fixture?" Forty-three percent of CFL purchasers responded in the affirmative. Of these, more than half of the respondents suggested that they prefer not to use CFLs in lamps used for reading (most often because respondents believe CFLs are not bright enough for this purpose).

Not surprisingly, a significantly higher proportion of CFL users with at least two-thirds of their household sockets filled with CFLs report that the way they use a fixture has no impact on whether or not they would use a CFL in that fixture (71%, compared to less than 49% for households with lower levels of penetration).

D.2.5.2 Fixture Type

Interviewers also asked CFL purchasers whether the type of lamp or fixture affects whether they would use a CFL in that lamp or fixture. While these results are somewhat difficult to interpret (because fixture type often dictates how one uses a fixture), approximately 31 percent of respondents said that the type of lamp or fixture does affect whether or not they'd use a CFL in that fixture (a significantly smaller proportion of purchasers than those who report that the way they use a fixture influences whether they'd use a CFL in a particular fixture). Of these, table lamps and ceiling lamps were the most-cited lamp type in which purchasers prefer not to install CFLs (each mentioned by approximately one-third of purchasers who indicated that fixture type has an influence on whether they'd install a CFL).

Not surprisingly, households with higher levels of CFL penetration in their homes appear to discriminate less among fixture types when installing CFLs.

D.2.5.3 Other Factors

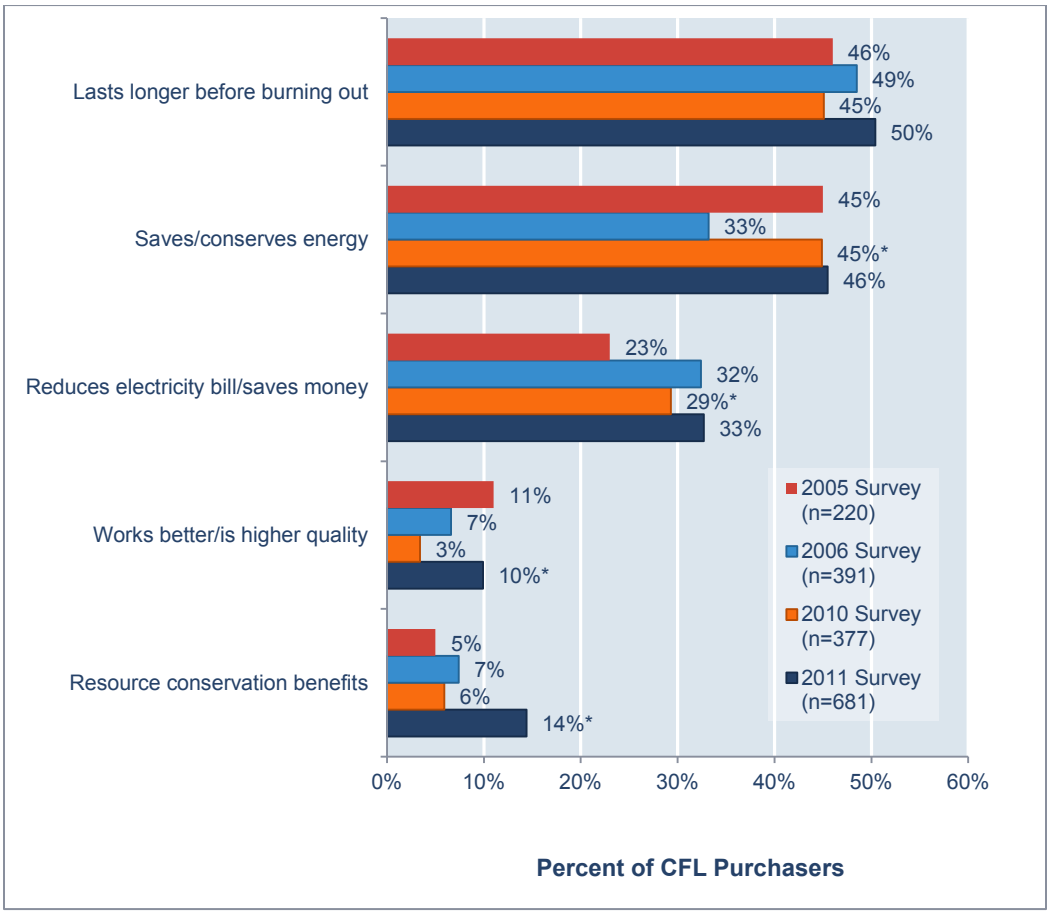
Interviewers also asked CFL purchasers, ~~"~~is there anything else that affects whether you'd use a CFL in a particular fixture?" The vast majority (80 percent) reported that there were no other factors that affect whether they would use a CFL in a particular fixture.

D.2.6 Best Features of CFLs

Figure 43 shows purchasers' impressions of the best features of CFLs. The two features most consistently cited as best in each year from 2005 through 2011 are that CFLs last longer and that CFLs save energy. In 2011, half of respondents mentioned the relatively longer lifespan of CFLs as the best feature, and 46 percent mentioned their energy savings. While these proportions are statistically unchanged since 2010, statistically higher proportions reported that CFLs are higher quality and their resource conservation benefits in 2010 (10% and 14%, respectively), compared to 2010 (3% and 6%, respectively).

Interviewers also asked purchasers about their impressions of the worst features of CFLs. Respondents cited two features most: that CFLs are not bright enough and that they take too long to light up (each mentioned by more than 20 percent of respondents).

Figure 43: CFL Purchaser Impressions of Best CFL Features Over Time, 2005–2011†‡

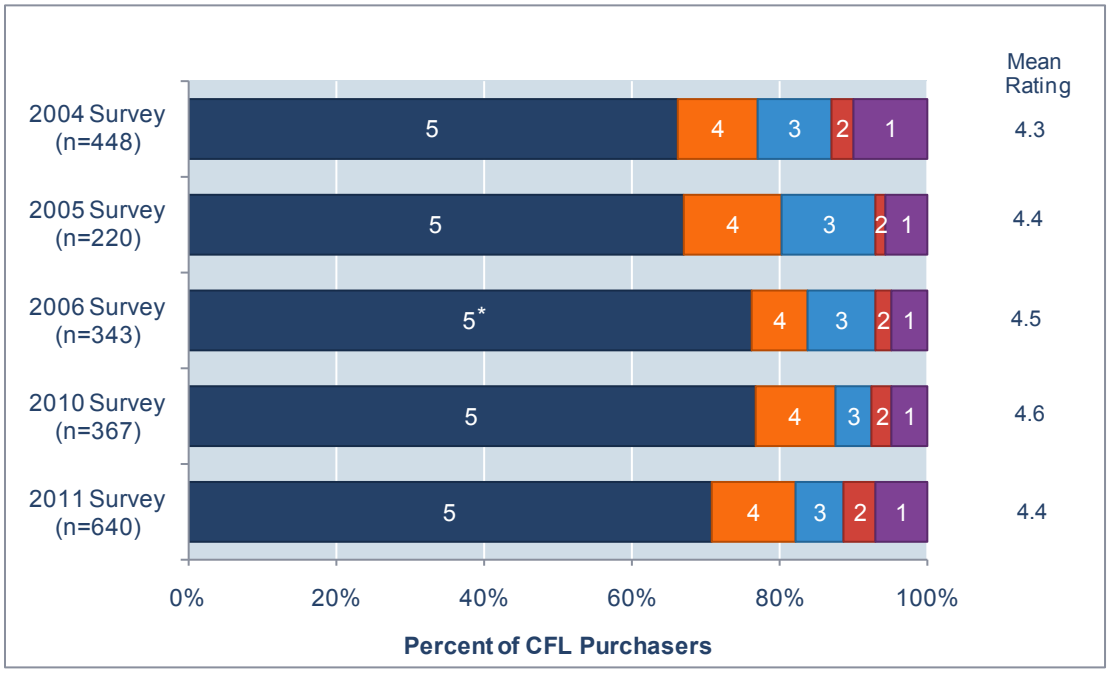


† Question allowed multiple responses; results may not total 100 percent.
‡ Question Wording: ~~"In~~ general, what are the best features of CFLs?"
* Difference from prior study period is statistically significant.

D.2.7 CFL to CFL Replacement Intentions

We asked respondents to rate how likely they would be to replace a burned out CFL with another CFL using a 5-point scale where 1 means, ~~"n~~ot at all likely" and 5 means, ~~"v~~ery likely." As shown in Figure 44, there are no statistically significant changes in results between 2010 and 2011. Roughly three-quarters of CFL purchasers report that they are very likely to replace CFLs with CFLs (a ~~"5~~" rating).

Figure 44: CFL Purchaser Likelihood of Replacing a CFL with a CFL Upon Burnout, 2004–2011
(Where 1=Not at all Likely, 10=Very Likely)



* Difference from prior study period is statistically significant.

In past years, likelihood ratings were significantly higher among respondents who made their most recent purchases within the past year than among those whose most recent purchase was more than one year prior. However, as shown in Table 17, the likelihood rating among recent purchasers and those who purchased CFL over a year ago are statistically similar.

Table 17: Mean Likelihood of Replacing a CFL with a CFL Upon Burnout by Date of Most Recent Purchase, 2005–2011
(Where 1=Not at all Likely, 10=Very Likely)

Date of Most Recent Purchase	Purchasers				Number of Respondents			
	2011 Survey	2010 Survey	2006 Survey	2005 Survey	2011 Survey	2010 Survey	2006 Survey	2005 Survey
Within the Past Year	4.4	4.6	4.6	4.5	499	293	258	55
1 or More Years Ago	4.2	4.2*	4.3*	4.1*	135	67	73	125

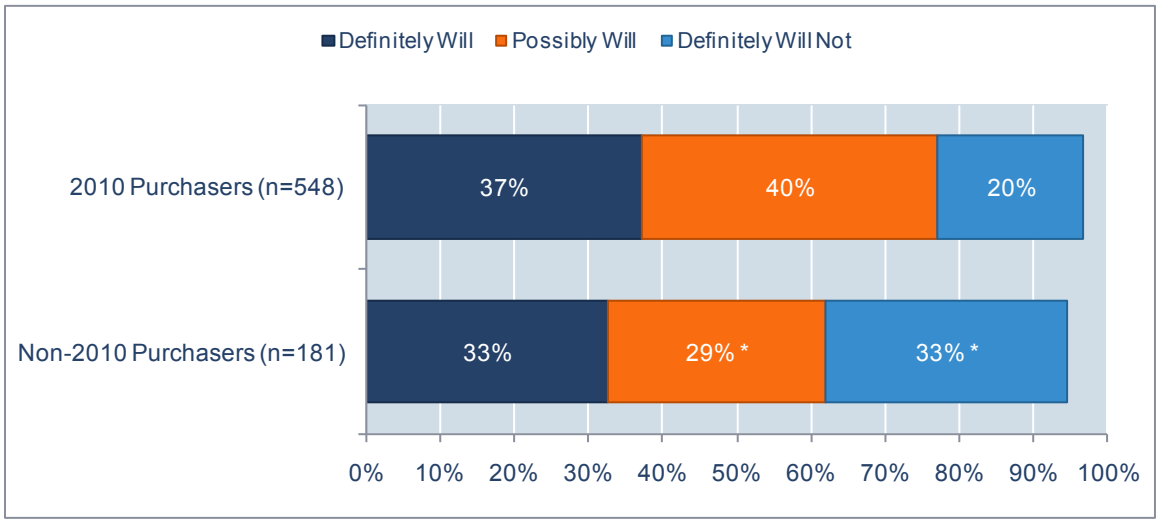
* Difference within survey year among purchasers who bought CFLs within the past year is statistically significant.

D.2.8 Incandescent to CFL Replacement Intentions

We asked all respondents who were aware of CFLs whether they would definitely, would possibly, or would definitely *not* replace a burned-out incandescent lamp with a CFL. As shown in Figure 45, more than two in three 2010 purchasers are at least somewhat likely to replace a burned-out incandescent

lamp with a CFL (37% ―definitely will" and 40% ―possibly will"), compared to 62 percent of non-2010 purchasers, a statistically significant difference.

Figure 45: Likelihood of Replacing an Incandescent Lamp with a CFL Upon Burnout, 2011‡



‡ Question allowed multiple responses; results may not total 100%.
* Difference from 2010 Purchasers is statistically significant.

D.3 CFL Purchase Intentions

D.3.1 Likelihood of CFL Purchases within a Year

We asked respondents to rate the likelihood that they would purchase a CFL in the next year using a scale of 1 to 5 in which 1 means, ―not at all likely" and 5 means, ―very likely." Respondents who were unaware of CFLs prior to the survey were first read a description of CFLs[32] before they were asked this question; these respondents are referred to as ―Informed Unaware".[33]

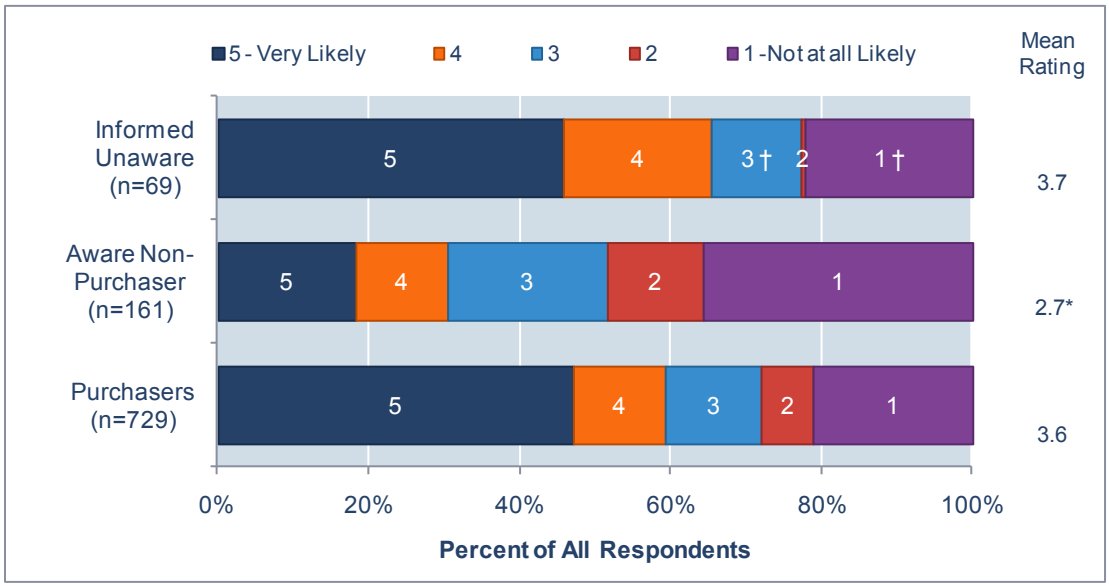
As shown in Figure 46, responses differ across purchase categories, with Aware Non-Purchasers the least likely to purchase CFLs in 2011. Informed Unaware respondents and Purchasers were statistically equally likely to purchase a CFL in 2011, with mean ratings of 3.7 out of 5 and 3.6 out of 5, respectively. This same trend across purchase categories was reported in 2005, 2006, and 2010,

[32] The CFL description read, ―CFLs use two-thirds less energy than a standard bulb, and last up to 10 times as long. Some styles of CFLs are available for $2 or less – and they are about the same size and color as a standard bulb and can be installed in almost any fixture where you would put a standard bulb. They can be purchased at the same places you purchase standard bulbs, including some drug and grocery stores. CFLs save about $30 in electricity costs over the life of the bulb. By using less energy, CFLs also help the environment."

[33] At this point in the survey, Purchasers and Aware Non-Purchasers have not been read the same CFL description as Unaware respondents and may thus actually be somewhat less informed about current CFL pricing, availability, and so on than Unaware respondents.

further suggesting there may be CFL purchase potential within the Informed Unaware population.

Figure 46: Likelihood of CFL Purchase within the Next Year Among All Respondents, 2011



* Difference from other categories is statistically significant.
† Difference from Aware Non-Purchasers is statistically significant.

D.4 Fixture Usage

D.4.1 Awareness and Purchase

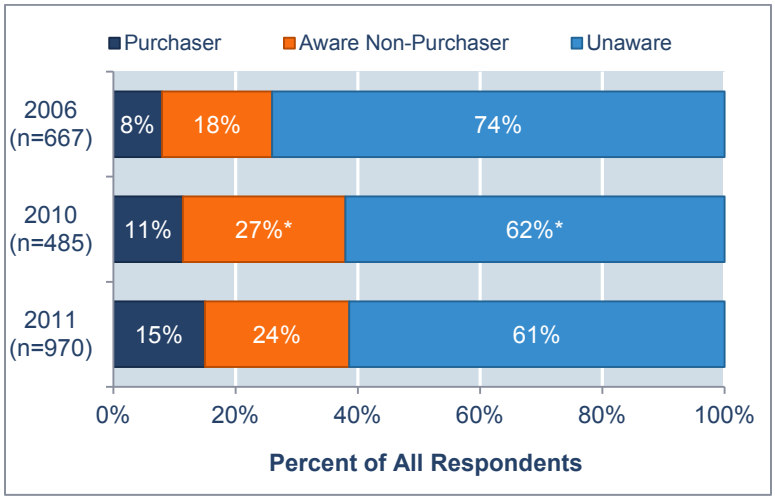
The 2006, 2010, and 2011 surveys included questions regarding compact fluorescent (CF) fixtures. The questions address awareness and purchase of CF fixtures, also known as ENERGY STAR light fixtures. Unlike standard incandescent light fixtures that use screw-based lamps, CF fixtures use special pin-based CFLs that plug into the fixtures. In 2011:

- Forty-three percent of CFL purchasers are aware of compact fluorescent (CF fixtures), compared with only 32 percent of respondents who are aware of CFLs but have not purchased them (aware non-purchasers) and 13 percent of respondents who are unaware of CFLs.
- Seventeen percent of CFL purchasers have also purchased CF fixtures. Among non-purchasers of CFLs, 9 percent of aware non-purchasers and 5 percent of unaware respondents have purchase CF fixtures.
- CF fixture awareness and purchase rates are similar among metro and non-metro consumers.

Figure 47 compares the distribution of respondents by awareness and purchases of CF fixtures from 2006 to 2011. Awareness and purchase rates in 2011 remained statistically unchanged since 2010.

Similar to both the 2006 and 2010 study, CF fixture awareness and purchase is positively correlated with CFL awareness and purchases.

Figure 47: Compact Fluorescent (CF) Fixture Awareness and Purchase Rates, 2006-2011



* Difference from other categories is statistically significant.

We asked CF fixture purchasers why they purchased a CF fixture as opposed to a ―regular" fixture that use screw-based lamps. Table 18 shows that CF fixture purchasers decided to purchase a CF fixture for reductions in their electric bills significantly more in 2011 (18%) than in 2010 (7%). Interestingly, the proportion of CF fixture respondents who cited this reason in 2011 is statistically the same as the proportion citing reductions in their electric bills in 2006 (23%). In 2011 the most frequently mentioned reason for purchasing CF fixtures as opposed to incandescent fixtures is to save or conserve energy (19%).

Table 18: Reasons for Choosing CF Fixture Over Standard Screw-Based Fixture, 2006-2011*

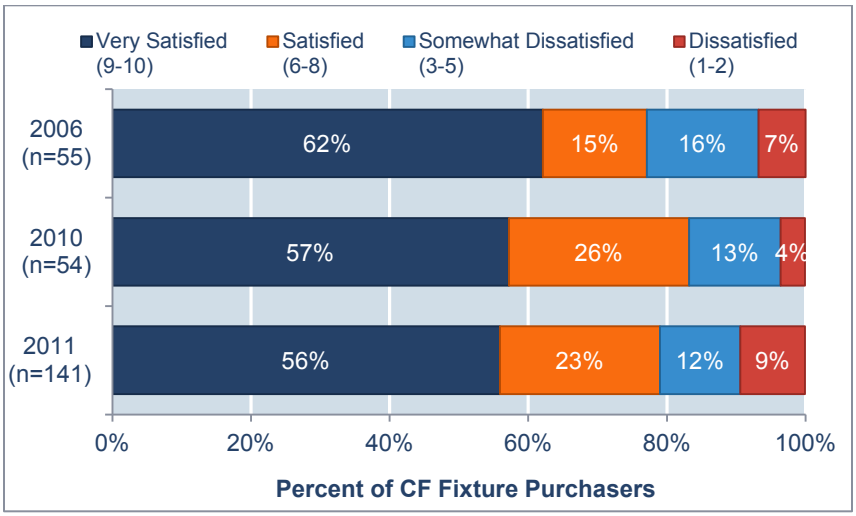
Reason	% of CF Fixture Purchasers		
	2006 (n=55)	2010 (n=54)	2011 (n=141)
Higher quality product	27%	11%	3%
Reduce electric bill	23%	7%†	18%†
Save/conserve energy	13%	13%	19%
Remodeling	8%	15%	13%
Energy cost savings worth the extra upfront cost	7%	0%	2%†
Energy savings worth the extra upfront cost	5%	4%	4%
Extra cost was minimal	3%	1%	1%
Had a coupon	2%	2%	0%
Like to have new, high-tech products	2%	11%	4%
Other	8%	48%†	43%
Don't Know	15%	5%	12%

* Question allowed multiple responses; results may not total 100%.
† Difference from prior study period is statistically significant.

D.4.2 Satisfaction

The consumer phone surveys asked CF fixture purchasers to rate their satisfaction with the fixtures on a scale of 1 to 10 with 1 being ―not at all satisfied" and 10 being ―very satisfied." The average rating among CF fixture purchasers in 2011 was 7.9, slightly lower than in 2010 (8.4), although not statistically significant. As shown in Figure 48, more than half of respondents in 2011 (56%), 2010 (57%), and 2006 (62%) are very satisfied with CF fixtures. While there is some variation in the reported proportions in the figure, there are no statistically significant differences among respondents across study periods. This indicates a sustained high level of satisfaction among CF fixture purchasers.

Figure 48: Compact Fluorescent (CF) Fixture Awareness and Purchase Rates, 2006-2011



D.5 2007 Energy Independence and Security Act

D.5.1 Awareness

The 2010 and 2011 consumer telephone surveys included the following three questions to gauge Northwest consumers' awareness of various elements of the Energy Independence and Security Act of 2007 (EISA):

- Are you aware of any legislation in the United States that may affect the availability of certain types of light bulbs?
- In 2007 Congress passed legislation that will ban most traditional incandescent light bulbs by 2014. Before today, were you aware of this legislation?
- As part of the legislation, traditional 100-Watt light bulbs will no longer be sold by 2012. Before today, were you aware that 100-Watt light bulbs will no longer be available by 2012?

Each of these questions allowed responses of ~~y~~es," ~~n~~o," or ~~d~~on't know." Table 19 shows the percent who replied ~~y~~es" – that they are aware – for each of these questions. In 2010, less than one quarter of consumers in the Northwest was aware of any of the EISA elements mentioned in the survey. In 2011, statistically higher proportions of consumers in the Northwest are aware of each element queried by the survey.

Table 19: Awareness of EISA and Its Implications, 2010–2011

Aware…	Percent Aware	
	2010 (n=500)	2011 (n=1,000)
…of legislation that will affect lamp availability?	16%	26%*
…of legislation that will ban most traditional incandescents by 2014?	23%	33%*
…that traditional 100-watt incandescents will no longer be available by 2012?	11%	18%*

* Difference from prior study period is statistically significant.

D.5.2 Planned Activities Once EISA is in Effect

Following the questions described above, the 2010 and 2011 survey asked the following two additional questions (each allowing only one response):

- When traditional 100-watt light bulbs are eliminated, which one of the following things are you most likely to do: switch to a new type of light bulb, keep using traditional light bulbs but switch to a lower wattage, or something else?
  (Among respondents who answered ~~s~~witch to a new type of light bulb") Which type of light bulb are you most likely to switch to - would you say LED, halogen, or CFL?

As shown in Table 20, significantly fewer Northwest consumers in 2011 said they are most likely to switch to a new type of lamp to replace their 100-watt incandescent lamps once the latter are phased out, compared to 2010.[34] In both 2010 and 2011, more than four out of five of these consumers reported that they are most likely going to switch to CFLs. In both 2010 and 2011, approximately one quarter of consumers said they are most likely going to replace their 100-watt incandescent lamps with incandescent lamps of a lower wattage. Only around 1 percent of the population in both years said they are most likely to stock up on low-efficacy 100-watt incandescent lamps before they are phased out.

[34] Note that if this survey question allowed more than one response, it is possible that a higher proportion of respondents (for example) may have stated that they would stockpile low-efficacy incandescent lamps in advance of the phase-out.

Table 20: Plans for Phase-Out of Low-Efficacy 100 Watt Incandescent Lamps, 2010–2011

Planned Action	Percent Aware	
	2010 (n=500)	2011 (n=1000)
Switch to a new type of light bulb	55%	46%*
Keep using traditional light bulbs but switch to a lower wattage	24%	27%
Stock up on 100-Watt lamps before the phase-out	1%	1%
Other	3%	6%
Don't know / Refused	17%	21%

* Difference from prior study period is statistically significant.

E. Consumer Survey Banner Tables

F. Consumer Focus Group Findings

F.1 Overview

In December 2010, KEMA's project manager conducted six focus groups with consumers in Portland, OR; Seattle, WA; and Spokane, WA. Each group consisted of 7 to 8 participants as shown in Table 21 below. The purpose of the focus groups was to closely examine consumer choices with regard to CFL purchase, installation, and usage patterns and to probe consumers regarding the on the barriers to replacing incandescent lamps with CFLs.[35]

Table 21: Number of Focus Group Participants by Group Location and Time, 2010

Location	Group Time		Total Participants
	5:30-7:00pm	7:30-9:00pm	
Portland	8	8	**16**
Seattle	8	8	**16**
Spokane	7	8	**15**
Total Participants	**23**	**24**	**47**

The groups began with a brief discussion of how participants would describe CFLs to others who were unfamiliar with them. The moderator then led participants in discussions regarding their light bulb shopping, installation, and usage behaviors; and impressions of various CFL attributes. Each session closed with a discussion of barriers to increasing CFL installations in participants' homes.

F.2 CFL Description

The moderator started each focus group discussion with a conversation about how one might describe CFLs to others who are not familiar with them. In more than half of the groups, the first response related to the general shape of the lamps: participants referred to them as ~~"~~pigtail-shaped," ~~"~~squiggly," ~~"~~swirly," ~~"~~twisty," and so on. At least one participant in each group mentioned CFLs in shapes other than the standard twister shape (including a-lamp, u-tube, globe, and others). A handful of participants also mentioned base types other than the standard screw-base lamp (such as pin-based).

After mentioning the shape of CFLs, however, the discussion quickly moved to CFL attributes with which participants were especially disappointed (or, in a few cases, pleased). Many focus group

[35] The focus groups also assisted with scoping for the consumer telephone surveys by helping to understand how consumers frame issues regarding CFL selection and use, which provided useful insights into appropriate wording for telephone survey questions.

participants voiced impressions that CFLs are not bright enough when describing them, and a slightly smaller proportion mentioned that CFLs take longer to reach full brightness:

- "The swirly ones don't light up very much – you know the dark rooms in my house? Those are the ones with swirly bulbs in them."
- "They're dimmer than the regular ones."
- "You'll be waiting a little longer for them to warm up."
- "[My son] refused to use it because when he first turns it on, it's too dull."
- "They don't get bright as quickly as other lights."

Because of issues with brightness, some participants also mentioned the impression that CFLs are not good for reading or other "close work" (such as sewing or needlepoint).

A handful mentioned that CFLs have a "different kind of light" or a "different color of light" as compared to traditional incandescent lamps, and a small number mentioned that CFLs can't be used in enclosed fixtures and/or that they're difficult to dispose of because they contain hazardous materials (i.e., mercury).

Not surprisingly, the initial discussion regarding how to describe CFLs also revealed some disagreement within the group about certain CFL characteristics – for example, some participants mentioned that CFLs last a long time, while others asserted that they don't last as long as they should. Some participants also had differing perspectives over whether CFLs can or cannot be used outdoors.

F.3 CFL Purchase, Installation, and Disposal Behaviors

Focus group participants reported purchasing CFLs in a variety of store types (primarily large home improvement and mass merchandise stores), and a small number of participants reported that they received some CFLs free of charge from their energy utility (e.g., Seattle City Light, Inland Power) or other organizations such as Energy Trust of Oregon.

When shopping for CFLs, focus group participants were split fairly evenly between those who purchase CFLs when they're on sale (whether they need them or not) and those who purchase them as needed. Many participants mentioned that they have at least one CFL on hand (in storage) in case another CFL burns out. Some also mentioned the impression that retail store salespeople are not knowledgeable about CFLs.

The vast majority of focus group participants had several CFLs installed in their homes, and a handful had all (or nearly all) of their sockets filled with CFLs. Installation behaviors differed among respondents. For example, a small proportion of participants reported that they made a conscious decision or effort to transition all or most of their light bulbs to CFLs (either gradually or all at once), and most of these individuals were motivated by potential money and energy savings. Most participants reported other CFL installation strategies, however, including focusing their CFLs installations in:

- **Fixtures with high hours of operation (for energy savings)** – e.g., ―For awhile we didn't put them in the bathroom because we're only in there [for] a few minutes at a time, but [we put them] in the kitchen where you might be for an hour or so."
- **Difficult-to-reach fixtures (based on the long life expectancy of CFLs)** – in other words, to reduce the need to access these fixtures to replace burned-out lamps. For example, one participant noted, ―I use them in the entryway because it's high and I don't want to pull out the ladder all the time."
- **Specific rooms, fixture types, control types, or applications** (see below).

Of the strategies described above, the majority of focus group participants mentioned that they prefer not to use CFLs in certain rooms or fixture types or for specific applications. However, there was no consensus on these issues:

- **Room type**. Several focus group participants mentioned that they prefer not to use CFLs in bathroom vanity fixtures in particular (typically because they dislike the color or quality of the light). Interestingly, a smaller number of participants mention that they especially like to use CFLs in their bathrooms.
- **Fixture type.** Several participants mentioned that they do not like to use CFLs in fixtures where the lamps are visible, while others mentioned that they dislike using CFLs in fixtures that are totally enclosed. The former group explained their reasoning based on aesthetics while the latter mentioned fit and performance issues.
- **Application.** Many focus group participants mentioned a preference for non-CFL light sources for ―close work" such as reading or sewing, but a handful of others mentioned that CFLs are fine for these applications.
- **Control types.** Some focus group participants mentioned dissatisfaction with CFLs used in sockets controlled by dimmer switches, explaining that the lamps flickered, hummed, or buzzed when in use. All of the focus group participants who mentioned using CFLs with dimmer switches reported some trouble in these circumstances.

In five of the six focus groups, participants mentioned that CFLs contain mercury and/or that they need to be disposed of differently than ―regular" (incandescent) lamps. None of the participants seemed to be particularly frightened by these facts, but a small number were concerned. None of the participants reported that they had stopped using CFLs (or planned to stop) as a result of these issues. Not surprisingly, some of the participants who weighed in on the mercury issue were ill-informed – for example:

- ―I've heard that if one breaks in your home you're supposed to evacuate your house for 24 hours."
- ―You put them in a couple of plastic bags and seal them up and [then] they go in the trash."

In all of the groups where CFL disposal was mentioned, one or more participants mentioned various disposal or collection sites for CFLs. These included specific retail chains, waste transfer stations, and/or local household hazardous waste collection events.

F.4 Impressions of CFL Attributes

During the focus groups, the moderator provided a worksheet to each participant. The worksheet included 7 statements regarding CFLs, and next to each statement the moderator asked participants to write the letter ~~D~~" if they mostly disagreed with it, ~~A~~" if they mostly agreed, or both letters if they were neither agreed nor disagreed (i.e., if they were unsure of how to respond).[36] Table 22 below shows the statements included on the worksheets as well as the participants' responses to each of the seven statements.

Table 22: Participant Agreement/Disagreement with Statements Regarding CFL Attributes

Statements	Participant Response			Total Responses
	Agree	Disagree	Unsure	
CFLs come in a variety of shapes and sizes	36	8	3	**47**
When installing CFLs, it makes sense to wait until the bulbs I have installed burn out first	31	13	3	**47**
CFLs take a long time to reach full brightness	30	12	5	**47**
CFLs provide good light quality	31	11	5	**47**
CFLs fit well in my light fixtures	24	14	9	**47**
CFLs can be used in every room in my home	20	25	2	**47**
CFLs take a long time to turn on when I flip the light switch	14	27	6	**47**

Below we summarize the discussions that occurred with regard to each statement on the worksheet:

- **CFLs come in a variety of shapes and sizes.** As mentioned above (in section F.2), the majority of participants were familiar with CFL shapes in addition to the standard spiral.
- **When installing CFLs, it makes sense to wait until the bulbs I have installed burn out first.** Most focus group participants agreed with this statement. Many participants stated that they prefer not to remove or discard working lamps – in other words, they will retain their working incandescent lamps if they replace them with CFLs, or they will wait until the incandescents lamps burn out to replace them with CFLs. A small number of participants expressed no difficulty with removing or discarding working incandescent lamps, but most reported that they feel ~~g~~uilty" or ~~w~~asteful" when they remove or discard working incandescent lamps regardless of the potential to save energy or money from CFLs.
- **CFLs take a long time to reach full brightness.** More than half of focus group participants mentioned that CFLs don't reach their full brightness right away:
  - ~~It~~ takes [CFLs] a minute to get to full brightness."
  - ~~I~~don't have the patience to wait for [CFLs] to get bright. I want it on right away so I can see what I'm doing."
  - ~~I~~'ve noticed that it takes a little longer for [CFLs] to get brighter."

[36] Worksheets included the same set of seven statements arranged in a different order for each focus group. Evaluators determined the order of phrases at random for each focus group worksheet.

- **CFLs provide good light quality.** About two-thirds of focus group participants agreed with this statement. There was some discussion regarding the "different" quality of the light emitted by CFLs, and a handful of participants mentioned having seen CFLs of different color temperatures using terms like "full-spectrum," "daylight color," "yellower," "warm," "greenish," and other terms to describe some CFLs. Others related light quality to brightness.
- **CFLs fit well in my light fixtures.** Roughly half of the focus group participants agreed with the statement that CFLs fit well in their light fixtures. Many mentioned that the lamps "stick out" of their fixtures in a way that "looked tacky" or "isn't fashionable." Others mentioned that some CFLs are simply too bulky to fit inside their enclosed fixtures.
- **CFLs can be used in every room in my home.** Less than half of the focus group participants agreed that CFLs can be used in every room in their homes. In all of the groups, participants discussed the distinction between the idea that CFLs "can" be used (technical suitability) versus where they would prefer to use CFLs. They explained that while CFLs could technically be used in any room, they have preferences that guide their installation patterns by room type:
  - "I wouldn't put them in my bedroom. I read in bed a lot."
  - "I won't put them in my living room or bedroom; I don't like the way the light looks in there."
  - "I don't like a bright light in my bathroom so I won't use them [in the bathroom]."

  As evidenced by some of the participants' quotes above, these preferences may be related to perceptions of light quality, brightness and/or how participants use the fixtures in which the CFLs are installed.

- **CFLs take a long time to turn on when I flip the light switch.** About one-quarter of participants agreed that CFLs take a long time to start up when they are first switched on. There was some discussion about the meaning of the phrase "a long time," and most participants agreed that they might not consider it a "long" time but that the delay is noticeable and/or is longer than they would associate with incandescent lamps.

F.5 Barriers to Increasing CFL Installations

When the focus group moderator turned the discussion toward barriers to increasing the number of CFLs installed in participant's homes, focus group participants mentioned many of the same issues described above in terms of preferences to use or not use CFLs in certain room types or fixture types, for specific applications, or with dimmer controls. When participants moved into deeper discussions regarding barriers to increasing CFL installations in their homes, participants began talking about their satisfaction with specific CFL attributes

From the perspective of barriers to increasing CFL installations, these include:

- **Brightness.** Several participants reported dissatisfaction with CFL brightness, reporting that CFLs are not bright enough. In many cases, this affected participants' choices regarding the rooms or applications for which they prefer non-CFL light sources. Many mentioned that some CFLs can take awhile to reach full brightness. The perception that CFLs are not bright enough appears to be more of a barrier to increased CFL installations than the slow start-up times, as most participants

who mentioned the latter also mentioned that they've adjusted to this issue or aren't really bothered by it.

- **Light color or light quality.** A small number of participants expressed dissatisfaction with the color or quality of the light from CFLs – and again, this affected some participants' choices regarding the rooms or applications for which they'd prefer to use or not use CFLs.
- **Length of life.** A small number of participants mentioned dissatisfaction with how long their CFLs last, explaining that some CFLs burned out long before the life expectancy stated on the lamp packaging.
- **Incompatibility with dimmer switches.** All of the focus group participants who mentioned using CFLs with dimmer switches reported some trouble in these circumstances. Interestingly, few explicitly expressed dissatisfied with CFLs as a result of this trouble, however – many simply stated matter-of-factly that CFLs cannot be used in applications where dimming was required.

G. Rural Urban Continuum Codes (RUCC) Memo

memo

To: Anu Teja and Rob Russell, NEEA Date: July 21, 2011

From: Jenna Canseco, KEMA Inc.
Tami Rasmussen, Evergreen Economics

Subject: 2010-11 Long-Term Northwest Residential Lighting Tracking Study Results by Rural-Urban Continuum Code Classifications

Background

In its market tracking reports, the Northwest Energy Efficiency Alliance (NEEA) typically presents results for the region as a whole as well by geographic location where possible. For the past several years, NEEA has presented geographic results at the state level and by metropolitan areas east and west of the Cascades mountain range versus nonmetropolitan areas in the region. These designations were based upon Metropolitan Statistical Area (MSA) classifications defined by the United States Office of Management and Budget (OMB) as published by the United States Census Bureau. For residential lighting market tracking efforts, NEEA reported results by MSA and Non-MSA designation, further subdividing ―Metro" into ―metro east" (metropolitan areas east of the Cascades mountain range) and ―metro west" (metropolitan areas west of the Cascades), and presenting ―Non-Metro" (nonmetropolitan areas throughout the region) to enable comparisons among population centers and less populated areas within the region.

In 2011, NEEA shifted its focus toward a different set of classifications of metropolitan versus nonmetropolitan areas utilized by the United States Department of Agriculture Economic Research Service (ERS). The ERS utilizes Rural Urban Continuum Codes (RUCC) that further classifies counties based on population sizes and functional adjacency to one or more metropolitan areas. These RUCC are comprised of nine categories based on population size, with category 1 indicating the greatest degree of urbanity (i.e., largest population centers) and category 9 indicating the greatest degree of ruralness (i.e., smallest populations). Based on these definitions, NEEA has grouped categories 1 through 5 as ―urban" and categories 6 through 9 as ―rural."

While the MSA/Non-MSA classifications described above include many suburban areas in the ―nonmetropolitan" category, the RUCC deem many suburban areas to be in the ―urban" category (provided that they meet minimum population thresholds). Because of this re-categorization of suburban areas, the RUCC ―rural" designation comprises a smaller proportion of the total Northwest population than the MSA ―nonmetropolitan" designation.

Objective

Because NEEA has shifted its focus toward the RUCC classifications versus MSA/Non-MSA classifications, NEEA has asked the residential lighting research team (comprised of KEMA, Inc. and Evergreen Economics) to revisit results from the 2010-11 Long-Term Northwest Residential Lighting Tracking Study to examine the extent to which the data can be presented in the ~urban" versus ~rural" categories based on the RUCC. There were three data collection and analysis efforts in the study that included data at the zip code level and are thus potentially feasible candidates for this reexamination: the 2010 retail lighting store shelf survey data, the 2011 consumer telephone survey data, and the 2010 compact fluorescent lamp (CFL) sales data. Thus, the purpose of this memorandum is to review the extent to which these data can be presented in terms of ~urban" versus ~rural" designation and present results where feasible.

Datasets

Below we present the available data for characterizing the urban versus rural results for the shelf survey, consumer survey, and CFL sales data.

Shelf Survey

Overview

During late 2010, experienced field researchers conducted 58 shelf surveys in Northwest retail stores that carry residential lighting products. Researchers followed the same sampling protocol as used in previous years. Table 1 shows that of the 58 sites visited, 36 were categorized as ~metro" based on the MSA classifications and 22 were categorized as ~non-metro." When the zip code data for these sites are reexamined based on the RUCC classifications (Table 2), 53 of the sites are categorized as ~urban" while only 5 are categorized as ~rural."

Table 1: Disposition of Shelf Surveys by State and MSA Classification

State	MSA Classification		Total
	Metro	Non-Metro	
Idaho	12	7	19
Montana	2	5	7
Oregon	12	8	20
Washington	10	2	12
Total	**36**	**22**	**58**
Percent of Total	**62%**	**38%**	**100%**

Table 2: Disposition of Shelf Surveys by RUCC Classification

State	RUCC Classification		Total
	Urban	Rural	
Idaho	16	3	19
Montana	7	0	7
Oregon	18	2	20
Washington	12	0	12
Total	**53**	**5**	**58**
Percent of Total	**91%**	**9%**	**100%**

Based on these results, this memo does not present additional analyses of the shelf survey data (given the small sample size associated with rural stores). However, a brief review of results based on the rural/urban classifications suggests some substantial differences in results between stores in these locations. To determine whether these differences truly exist between rural and urban areas (i.e., are statistically significant[37]), analyses based on larger sample size would be necessary.

Consumer Survey

Overview

KEMA hired an experienced survey research firm to conduct 1,000 surveys with residents of Idaho, Montana, Oregon and Washington in early 2011. The sampling approach was the same as in previous rounds of consumer surveys, oversampling residents in non-metropolitan areas. Results were weighted to reflect the population. As shown in Table 3, 71 percent of the respondents were in metropolitan areas and 29 percent in nonmetropolitan areas. When the results were reclassified

[37] Statistical significance is reported at the 90 percent level of confidence throughout this memorandum.

based on RUCC, 88 percent of the respondents were in urban areas and 12 percent of respondents were in rural areas.

Table 3: Disposition of Consumer Surveys by State and MSA Classification

State	MSA Classification		Total
	Metro	Non-Metro	
Idaho	46	62	108
Montana	28	73	101
Oregon	228	86	314
Washington	408	69	477
Total	**710**	**290**	**1,000**
Percent of Total	**71%**	**29%**	**100%**

Table 4: Disposition of Consumer Surveys by RUCC Classification

State	RUCC Classification		Total
	Urban	Rural	
Idaho	75	33	108
Montana	65	35	100
Oregon	285	29	314
Washington	458	20	478
Total	**883**	**117**	**1,000**
Percent of Total	**88%**	**12%**	**100%**

Although the number of respondents for rural areas is fairly small (n=117), the sample size is still robust enough to reveal statistically significant differences between some results for urban versus rural respondents.

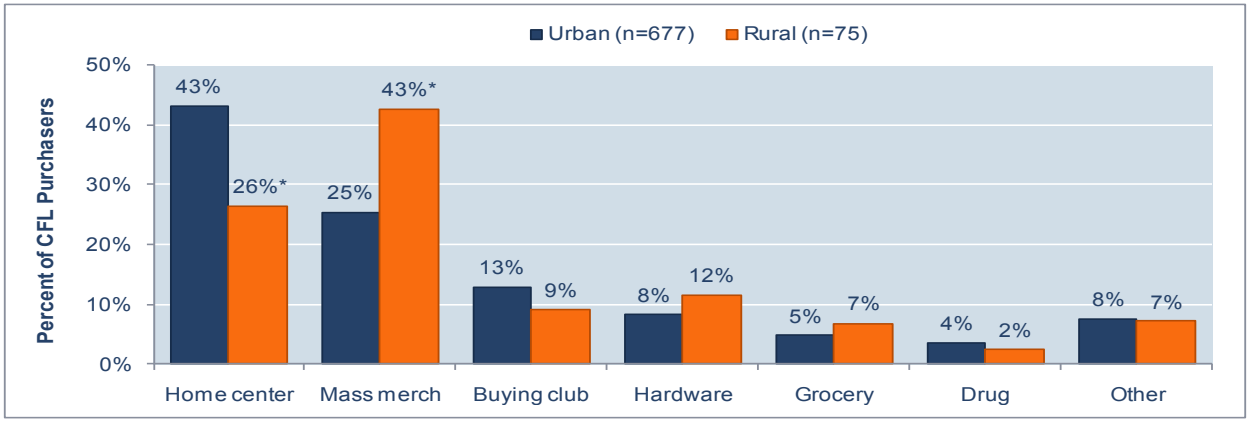
Key Findings from Consumer Surveys

Key findings for urban versus rural consumer telephone survey respondents include the following:

- There is no statistically significant difference in CFL awareness between urban and rural consumers in the Northwest. Of consumers who are aware of CFLs, a significantly higher proportion of urban consumers report having purchased CFLs as compared to rural consumers (84% versus 70 percent, respectively) but purchasers in both areas report having purchased similar quantities of CFLs within the past year (approximately 11 lamps).
    - There is no difference in awareness of specialty lamps among CFL purchasers in urban versus rural areas, with 39 percent of urban CFL purchasers aware of specialty lamps and 38 percent of rural purchasers.

- Among CFL purchasers, there is no statistically significant difference in the proportion of respondents who have CFLs installed in their homes among urban versus rural respondents (91% and 89% of purchasers, respectively). The average number of lamps installed per household is also fairly consistent between urban and rural areas (roughly 11 to 12 lamps, on average).
- Among CFL purchasers, the proportion of respondents storing CFLs does not differ between urban and rural areas (75% of urban respondents have CFLs in storage versus 73% of rural respondents). The average number of CFLs stored per household is also fairly consistent between urban and rural areas (roughly 5 to 6 lamps, on average); however, urban respondents store more incandescent lamps on average than rural respondents (roughly 7 versus 4 lamps, respectively).
    - Urban purchasers reported that, on average, they have purchased CFLs on approximately 9.1 occasions, while rural purchasers report having purchased CFLs on an average of approximately 5.7 occasions. These results may help explain the higher storage rates for urban versus rural purchasers
- Results suggest that urban CFL purchasers typically buy CFLs in home centers (such as Lowes and The Home Depot) while rural purchasers tend to buy CFLs in mass merchandise stores (such as Wal-Mart and KMart; see Figure 1).
    - Forty-three percent of urban CFL purchasers report that their most recent CFL purchase occurred in a home center compared to only 26 percent of rural purchasers.
    - The opposite is true for mass merchandise stores: 43 percent of rural CFL purchasers report that their most recent CFL purchase occurred in a mass merchandise store compared to only 25 percent of urban purchasers.
    - There were no other statistically significant differences in CFL purchase locations between urban and rural purchasers.

Figure 1: Most Recent CFL Purchase Location by Store Type and RUCC, 2011

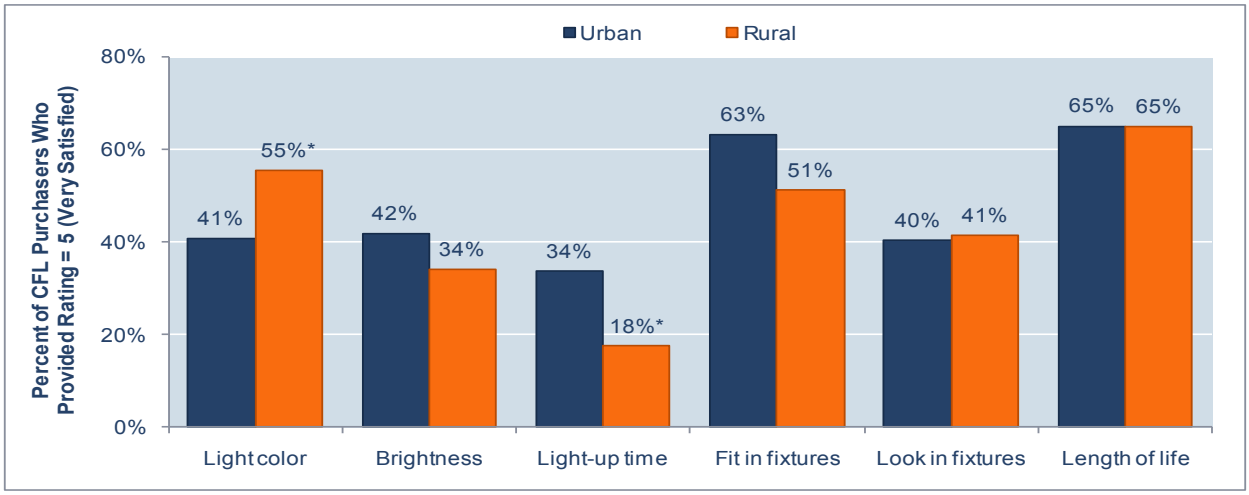


* Difference between Urban and Rural is statistically significant.

- Among CFL purchasers, average satisfaction ratings with the most recently-purchased CFLs are fairly high among both urban and rural consumers. When asked to rate their level of satisfaction with CFLs on a 10-point scale where 1 means ~~"n~~ot at all satisfied" and 10 means ~~"v~~ery satisfied," the average satisfaction rating for urban CFL purchasers was 7.4 compared to 7.8 for rural purchasers.
- When asked about satisfaction with specific CFL attributes, there are some noteworthy differences in responses between urban and rural CFL purchasers on a scale of 1 to 5 where 1 means ~~"n~~ot at all satisfied" and 10 means ~~"v~~ery satisfied" (Figure 2).
    - In terms of the color of the light CFLs provide, the average overall rating was similar between urban and rural purchasers, but a significantly greater proportion of rural consumers provided the highest satisfaction rating (55% of rural purchasers, 41% of urban).
    - The opposite pattern is apparent with regard to satisfaction with the amount of time it takes for CFLs to light up, with 34 percent of urban purchasers providing the highest satisfaction rating (5) compared to only 18 percent of rural purchasers.

There were no noteworthy differences among urban versus rural purchaser satisfaction with CFL brightness, the way they fit into light fixtures, the way they look in light fixtures, or how long they last.

Figure 2: Percent of Respondents Who Provided Highest Satisfaction Rating (5) by CFL Attribute and RUCC, 2011
Satisfaction Scale: 1 = Not at all satisfied; 5 = Very satisfied



* Difference between Urban and Rural is statistically significant.

- The surveys included other questions to gauge satisfaction with CFLs, including questions that asked consumers to rate their level of agreement or disagreement with a series of statements. Respondents were asked to use ratings on a 5-point scale where 1 means ―strongly disagree" and 5 means ―strongly agree."
    - There were no significant differences between urban and rural respondents for the statements, ―I would use a CFL in a reading lamp," ―CFLs are worth the up-front cost," and ―I have some lamps or fixtures where I would not use a CFL."
    - For the statement, ―CFLs can be used in every room in my home," the overall average rating was similar between urban and rural CFL purchasers, but a larger proportion of rural purchasers provided the highest level of agreement (5) with this statement than urban purchasers (55% and 42%, respectively).
- Urban and rural CFL purchasers provided similar ratings for likelihood of replacing a CFL with another CFL upon burnout and for likelihood of replacing an incandescent lamp with a CFL upon burnout. There were no significant geographic differences in the reasons that consumers don't have more CFLs installed in their homes.
- Awareness and purchase rates for compact fluorescent fixtures are similar between consumers in urban and rural areas, as are satisfaction levels with fixtures among fixture purchasers.
- Urban and rural survey respondents had similar levels of awareness of the 2007 Energy Independence and Security Act. A statistically higher proportion of rural respondents, however, reported that they were aware before the survey that ―traditional 100-watt light bulbs will no longer be sold by 2012" (24% of rural respondents versus 18% of urban).

When taken together, these results suggest that there are few differences between urban and rural consumers in the Northwest with regard to CFL and compact fluorescent fixture awareness, purchase, and installation rates and behaviors. Of note, however, is the higher purchase rate among urban versus rural purchasers, the fact that rural and urban shoppers tend to purchase CFLs in different store types, that urban purchasers have purchased CFLs on more occasions and are storing more CFLs in general than rural purchasers, and some differences in satisfaction with specific CFL attributes between rural and urban purchasers (although there is no discernible pattern in these results).

CFL Sales Data

Overview

Fluid Market Strategies has collected CFL sales data throughout the region on behalf of NEEA for several years. The current method relies upon reports of actual CFL sales through several major retail channels in the Northwest, reports from local utilities and other energy-efficiency program sponsors, and extrapolation of these data to retailers representing the Northwest region. Fluid Market Strategies collects data on sales through seven retail channels: do-it-yourself, mass merchants, wholesale clubs, small hardware, drug, grocery and lighting specialty stores.

In early July 2011, KEMA staff requested CFL sales by zip code from Fluid Market Strategies to examine the possibility of analyzing sales data by RUCC for NEEA. KEMA received an Excel workbook from Fluid Market Strategies that included partial data for a subset of the retail channels (because data is not available for all channels by zip code). The data file included sales in the do-it-yourself, mass merchandise, wholesale club, and small hardware channels.

As shown in Table 5, the CFL sales with zip code data for do-it-yourself stores represent 99 percent of total tracked CFL sales in the region. Closer examination of these data reveals that these sales are distributed among both urban and rural stores. This cursory review suggests that the data for which zip code information is available (and thus for which RUCC classification is possible) are relatively representative of sales through do-it-yourself channels in the Northwest.

For mass merchandise stores, sales for which RUCC classification is possible represent approximately two-thirds of total sales through these stores in the region. However, further examination of these data suggests that the zip code data represents only urban stores. This suggests that the data for which zip code information is available are not representative of total regional sales for the region through mass merchandise stores.

For the other two store types for which zip code level data is available—wholesale club and small hardware stores—the percent of total sales represented by the zip level data are much smaller. These data cannot be said to be representative of sales through wholesale club and small hardware stores in the Northwest.

These analyses suggest that at this time, the only sales data from 2010 for which zip code information is available (and thus for which RUCC classification is possible) with a high degree of representativeness of total regional sales would be sales through the do-it-yourself channel, which accounts for approximately one-third of 2010 total Northwest CFL sales (34%).

Table 5: Total 2010 Northwest Residential ENERGY STAR CFL Sales and Sales for Which RUCC Classification is Possible

Store Type	2010 Total CFL Sales	2010 CFL Sales with Zip Code Data	Percent of 2010 CFL Sales with Zip Code Data	Analyze sales by RUCC?
Do It Yourself	6,448,303	6,380,479	99%	Yes
Mass Merchants	5,128,418	3,437,438	67%	No; sample includes urban only
Wholesale Club	5,065,408	1,596,364	32%	No; sample too small
Small Hardware	2,011,230	52,630	3%	No; sample too small
Drug	210,270	0	0%	No; no zip codes
Grocery	123,230	0	0%	No; no zip codes
Lighting Specialty	39,029	0	0%	No; no zip codes
Total / Overall	**19,025,888**	**11,466,911**	**60%**	**34%**

Key Findings from CFL Sales Data

Key findings for do-it-yourself (DIY) stores in the Northwest are as follows:

- Approximately 99 percent of all CFLs sold through DIY channels in the Northwest are sold in urban stores (see Table 6).

Table 6: Northwest Residential ENERGY STAR CFL Sales in DIY Stores by RUCC, 2011*

RUCC	2010 DIY CFL Sales	Percent of Sales
Urban	69,174	1%
Rural	6,311,305	99%
Total / Overall	6,380,479	100%

* Note that 2010 sales for which RUCC classification is possible for the DIY channel represent 99% of total 2010 sales for DIY stores (6,380,479 of 6,448,303 total CFLs sold).

- Four out of five CFLs sold through DIY stores in the Northwest are general purpose CFLs, while approximately 21 percent are specialty CFLs (Table 7).
    - Urban and rural DIY stores in the Northwest sell similar proportions of specialty CFLs – 21 percent of CFLs sold in urban stores are specialty lamps compared to 18 percent in rural stores.

Table 7: Northwest Residential CFL Sales in DIY Stores by CFL Type and RUCC, 2011*

RUCC	2010 DIY CFL Sales			Percent of 2010 DIY CFL Sales		
	Urban	Rural	Total	Urban	Rural	Total
General Purpose	4,991,082	56,687	5,047,769	79%	82%	79%
Specialty	1,320,223	12,487	1,332,710	21%	18%	21%
Total / Overall	6,311,305	69,174	6,380,479	100%	100%	100%

* Note that 2010 sales for which RUCC classification is possible for the DIY channel represent 99% of total 2010 sales for DIY stores (6,380,479 of 6,448,303 total CFLs sold).

- Seventeen percent of CFLs sold in the region are sold with energy efficiency program incentives (Table 8).
    - A higher proportion of CFLs sold in rural DIY stores are sold with incentives (26%) than in urban DIY stores (17%).

Table 8: Northwest Residential CFL Sales in DIY Stores by Incentive/Non-Incentive and RUCC, 2011*

RUCC	2010 DIY CFL Sales			Percent of 2010 DIY CFL Sales		
	Urban	Rural	Total	Urban	Rural	Total
Incentive Sales	1,069,007	17,834	1,086,841	17%	26%	17%
Non-Incentive Sales	5,242,298	51,340	5,293,638	83%	74%	83%
Total / Overall	6,311,305	69,174	6,380,479	100%	100%	100%

* Note that 2010 sales for which RUCC classification is possible for the DIY channel represent 99% of total 2010 sales for DIY stores (6,380,479 of 6,448,303 total CFLs sold).

H. Review of NEEA's ACE Model Inputs

memo

To:	Anu Teja, Northwest Energy Efficiency Alliance	Date:	April 22, 2011
From:	Jenna Canseco, KEMA Inc. Tami Rasmussen, Evergreen Economics		
Subject:	Review of ACE Model Key Assumptions – final results		

This memorandum provides independent estimates of key NEEA lighting ACE model assumptions[38] based on the primary and secondary research that is underway for the Long-Term Northwest Residential Lighting Market Tracking Study. This memorandum completes an earlier preliminary version.

1. Total Market Size – Northwest CFL and Incandescent Sales

1.1 Sales and Market Share data analysis

Fluid generates estimates of total and ENERGY STAR CFL sales in the Northwest. For 2010, the estimate of total CFL sales was 20,195,963 – 19,025,888 of those were ENERGY STAR CFLs.

2. Total Market Size – Northwest Specialty CFLs

We do not have a primary or secondary data source that provides an estimate of Northwest specialty CFLs. However, we use the consumer survey and supplier interviews to provide an estimate of the share of total Northwest CFL sales that are specialty lamps. Fluid also broke out their CFL sales estimate for specialty CFLs. We will apply an estimate of the fraction of specialty CFL sales to the total Northwest CFL sales to provide an estimate of Northwest specialty CFL sales.

2.1 Share of Total CFLs that are Specialty CFLs

Consumer Surveys

The 2010 consumer lighting survey included the following questions regarding recent CFL purchases:

- M1. When was your most recent CFL purchase? Would you say it was either during 2010 or 11, or sometime before 2010?

[38] For standard CFLs, *Assumptions Table 10.25.2010.xls*, provided by NEEA in October 2010 and for specialty CFLs, *Assumptions_Table_20101227.xls*, provided by NEEA in January 2011.

- M2. Thinking about your most recent CFL purchase, how many did you buy? If a package contained more than one bulb, please count each one separately.
- M2a. How many of the CFLs you bought during your most recent purchase were the spiral, twisty, or curlicue shape?
- M2b. How many of the CFLs you bought during your most recent purchase were shaped like regular light bulbs?

To estimate the fraction of CFLs purchased within the last year that were specialty lamps versus standard CFLs (twisters and a-lamps), we first and excluded all respondents who did not purchase CFLs in 2010 or 2011 (based on responses to question M1). Using data from these respondents only, we calculated the fraction of specialty CFLs purchased in two ways:

(1) Method 1 (weighted average): We calculated the total number of CFLs purchased in the past year for each survey respondent individually (question M2). We then compared these results to the total number of twisters and a-lamps purchased by each respondent (questions M2a and M2b) and excluded all inaccurate responses (e.g., cases in which respondents said they said they purchased more twisters in the past year than the total number of CFLs purchased in the last year). We then calculated the percentage of standard versus specialty CFLs purchased by each respondent and took the weighted average of these percentages to estimate standard versus specialty CFL purchases in the past year.

(2) Method 2 (un-weighted average): We calculated the total number of CFLs purchased in the past year across *all* survey respondents (sum of all responses to M2). We then totaled the number of standard spiral and a-lamp CFLs purchased across all respondents and added these two numbers together to represent total standard CFLs purchased in the past year (sum of M2a and M2b), eliminating the same cases as described in Method 1 above. We then divided the latter estimate by the former to yield the percentage of CFLs purchased that were standard CFLs, and subtracted this estimate from 1 to yield the percentage of specialty CFLs purchased over the past year.

As shown in Table 1 below, these two methods yielded similar results, suggesting that approximately 8 to 10 percent of CFLs purchased by consumers in 2010 were specialty lamps.

Table 1: Percentage of Lamps Purchased in 2010 for Standard and Specialty CFLs by Method

CFL Type	Method	
	Method 1	Method 2
Standard (Twister and A-lamp)	92%	90%
Specialty	8%	10%
All CFL Types	**100%**	**100%**

Source: Preliminary results from the 2010 Consumer Lighting Survey. Results will be included in the 2010-11 Long Term Northwest Residential CFL Tracking Study report (2011).

Supplier Interviews

In January of 2011 we reached out to nine people involved in the process of supplying retail stores, both from within the store and as outside manufacturers. Our survey included the following questions:

- Q1a. Did the extent of theses (national CFL sales from 2009 to 2010) changes differ by lamp type, retailer type, geography, or anything else?
- Q1b. What do you think caused the changes in sales?
- Q1c. Have you seen changes in the proportion of sales that are standard CFLs versus specialty CFLs? (IF NECESSARY: standard CFLs are spirals, twisters, and a-lamps)
- Q6. Have you seen changes in the proportion of sales that are standard CFLs versus specialty CFLs in the Northwest between 2009 and 2010? (IF NECESSARY: standard CFLs are spirals, twisters, and a-lamps)
- Q6a (If Q6=yes) What do you think caused that shift?

While it was difficult to get hard sales figures, those interviewed commended on directional trends, mentioning that the past year has brought a decline in CFL twister (spiral) sales and an increase in the sale of floods and decorative CFLs. Many of those interviewed lacked sales figures but maintained a general consensus that specialty lamps are lagging behind twisters in sales, but are becoming more popular as awareness grows.

Only one manufacturer was able to give sales figures related to the portion of CFL sales that are specialty versus standard, and they said that on a nationwide level, 25% of their CFL sales are specialty.

Fluid Sales Estimate

Fluid estimated specialty CFL sales based on SKU data and extrapolation. They estimate that 30.4 percent of Northwest CFL sales in 2010 were specialty CFLs – or 6,133,258.

2.2 Northwest Specialty CFL Sales

We combined the average of consumer survey estimates and Fluid specialty CFL sales estimate to yield an estimate of the fraction of Northwest CFL sales in 2010 that were specialty CFLs. We use a weighted average, with the Fluid estimate weight equal to 2/3 since it is considered more reliable (mostly based on actual SKU data, but with some extrapolation) and the consumer survey estimate weight equal to 1/3.

2/3 [weight on Fluid estimate] * 30.4% [Fluid estimate] + 1/3 [weight on consumer survey estimate] * 9% [consumer survey estimate] = 23%

We combines the 23 percent estimate to Fluid's overall estimate of Northwest CFL sales for 2010 to yield an independent estimate of 2010 Northwest specialty CFL sales:

23% * 20,195,963 [Fluid estimate of 2010 Northwest CFL sales] = 4,694,718 CFLs

3. Total Market Size – Technical Market Potential for CFLs

3.1 Literature Review

As part of the 2006-2008 Upstream Lighting Evaluation[39] conducted for the California Public Utilities Commission (CPUC), the KEMA CFL hours of use study included a detailed inventory of lighting sockets in California homes. Field inspectors recorded information on every type of lighting in the home – regardless of base type or lamp type – except for lamps in electric garage door openers, lamps built into appliances, plug-in nightlights, and fixtures with incandescent lamps of fewer than 20 watts. These data will provide a basis for estimating the fraction of sockets that may be filled with CFLs and specialty CFLs.

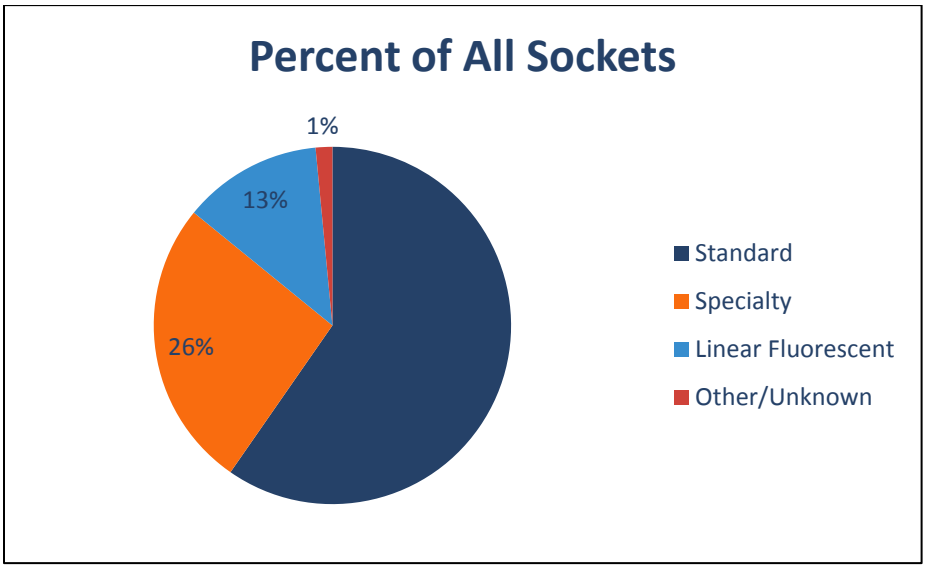
As shown in Figure 1, approximately 60 percent of household sockets in California are suitable for standard[40] lamps. Approximately 26 percent of sockets are specialty sockets[41], 13 percent are linear fluorescents, and 1 percent is other or unknown.

[39] KEMA, Inc., 2010. Final Evaluation Report: Upstream Lighting Program - Volume 1. Supported by The Cadmus Group, Inc.; Itron, Inc.; PA Consulting Group; and Jai J. Mitchell Analytics. Prepared for the California Public Utilities Commission, Energy Division. February 8, 2010.

[40] "Standard" consists of all sockets which are medium screw-based, non-dimmable, and non-three-way sockets.

[41] "Specialty" consists of all sockets which are either small screw-based, pin-based, dimmable, or three-way sockets (or any combination).

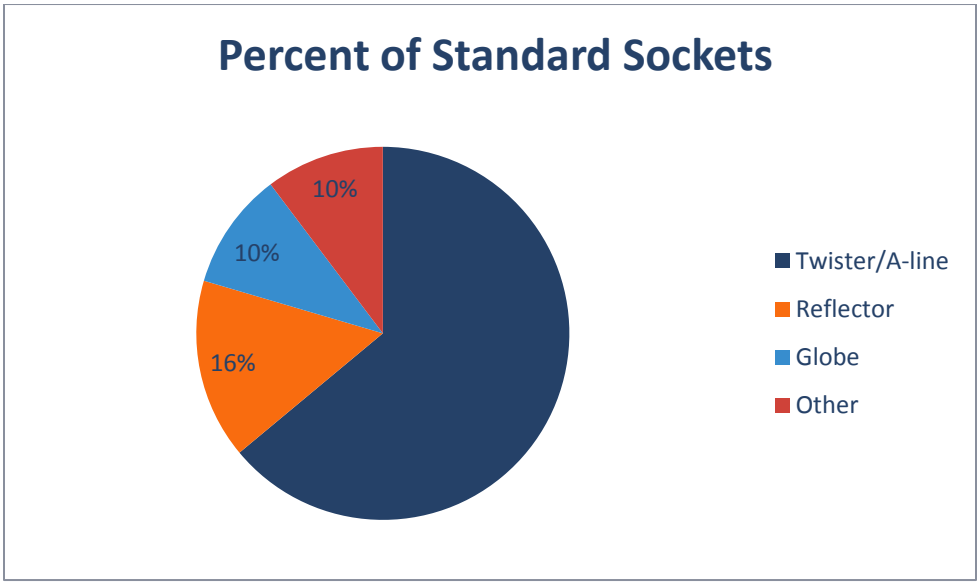
Figure 1: Percentage of Sockets by Socket Type



As shown in Figure 2, approximately 64 percent of Standard sockets in California were found to contain twister or A-line lamps. Sixteen percent contained reflectors, 10 percent contained globes, and 10 percent contained other lamp styles.[42]

[42] These —other" bulb styles include empty sockets, U-shaped, decorative, bullet/post, and circline bulbs.

Figure 2: Percentage of Standard Sockets by Lamp Type



4. Baseline Market Share

4.1 Overall CFLs

The baseline estimate is the theoretical level of CFL sales that would have occurred in absence of regional market interventions. The baseline is theoretical and difficult to estimate because there is no way to really know what would have happened in the absence of NEEA, utility and other regional promotions.

Last year, we provided NEEA with an estimate of 2009 CFL baseline sales that extrapolated 2008 CFL baseline estimates from various regional sources based on assumptions that the change in baseline was roughly equivalent to the change in overall CFL sales. [43]

Similar to the past two years, we will apply a rate of change equal to that of the CFL market over the past year to yield an estimate of 2010 CFL baseline sales. 2010 national CFL sales data will come from ENERGY STAR's contractor, D&R International, that compiles sales and market share data.

Sales and Market Share data analysis

The rate of change in CFL sales for the nation from 2009 to 2010 was 39 percent, per estimates provided by D&R International on April 18, 2011.[44] The estimate of Northwest CFL baseline sales for

[43] ECONorthwest memorandum on 2009 CFL ACE model assumptions from Tami Rasmussen to NEEA on May 3, 2010.

[44] Personal correspondence from Toby Swope to Jennifer Canseco and Tami Rasmussen.

2009 was 9.58 million CFLs, or 1.868 CFLs per household.[45] The 2010 Northwest baseline CFL estimate is equal to:

1.039 * 1.868 CFLs per household * 5,170,832 NW households[46] = <u>13,417,525 CFLs</u>

Literature Review

A review of recent reports and papers on the federal lighting legislation (EISA) indicates that the legislation will lead to slower market transformation than previously thought, with less aggressive energy savings than anticipated.[47] For example, in 2012, the least efficient lamp will be only about 30 percent more efficient than the today's least efficient lamp. Moorefield predicts that the actual increased efficiency will be closer to 22 percent because the same standard is applied across multiple lighting output levels.[48] The literature does not provide quantitative data. However, the emerging industry consensus on EISA impacts may argue for NEEA to increase the timeframe during which the maximum achievable potential is met. NEEA may also adjust the shape of its curve such that the near-term naturally occurring baseline market share (e.g., through 2015) ramps up much slower than the later years (e.g., 2016-2020) to reflect the fact that the near-term EISA impacts are quite modest and the substantial impacts are expected in later years as the legislation is phased into effect.

4.2 Specialty CFLs

We will work with NEEA under separate contract to develop a scope of work for assessing the assumption for the baseline market share of specialty CFLs.

5. Savings Rate

5.1 Literature Review

California's *Final Upstream Lighting Report,Volume 1* includes estimates of the average daily hours of use for residential CFLs. Evaluators derived these estimates from analyses of lighting logger data

[45] ECONorthwest May 3, 2010.

[46] From US Census 2010 population estimates by state and US Census 2000 number of people per household by state.

[47] First Tracks Consulting Service, Inc., Applied Proactive Technologies, and Opinion Dynamics Corporation. EISA Lighting AESP Brown Bag Presentations. Association of Energy Service Professionals. January, 2011.

[48] Moorefield, L., 2010. Residential Lighting at a Crossroads: Why Next-Generation Technologies Are More Important than Ever. Presented at the ACEEE Summer Study on Energy Efficiency in Buildings. August, 2010.

collected through the Residential Lighting Metering Study.[49] The Metering Study included approximately 8,400 lighting loggers installed in 1,232 homes throughout California from July 2008 through June 2009. The Residential Lighting Metering Study utilized a sample stratified by investor-owned utility (IOU) service territory and geographic region. Researchers selected sample through a simple random sampling process within each region giving each residential account in the IOU records an equal probability of selection into the sample. The sample included single-family, multi-family, and manufactured homes.

Table 2 below shows the average daily hours of use reported in the *Final Upstream Lighting Report*. As shown, the average daily hours of use for standard (twister and a-lamp style) CFLs is approximately 2.0 hours per day, and the average across all CFL types is approximately 1.9 hours per day. The analyses also included hours of use estimates for CFLs discounted through IOU programs and found slightly lower hours of use for standard CFLs (1.9 hours) and all CFL styles (1.8 hours) as compared to all CFLs purchased and installed by Metering Study participants.

The estimates from California are very close to those used in the current ACE model (1.8) and we recommend that NEEA continue to use their estimates.

[49] KEMA, Inc., 2010. Final Evaluation Report: Upstream Lighting Program - Volume 1. Supported by The Cadmus Group, Inc.; Itron, Inc.; PA Consulting Group; and Jai J. Mitchell Analytics. Prepared for the California Public Utilities Commission, Energy Division. February 8, 2010.

Table 2: Average Daily Hours of Use for California CFLs by Style for All CFLs and IOU-Discounted CFLs

CFL Style	Average Daily Hours of Use - California	
	All CFLs	IOU-Discounted CFLs
Twister and A-lamp	2.0	1.9
Globe	1.5	1.6
Reflector	1.9	1.8
All CFL Styles	**1.9**	**1.8**

Source: —Table 38: Average Statewide Residential Daily Hours-of-Use (HOU) – By CFL Type" (KEMA, 2010).

6. Incremental Cost

6.1 Shelf Survey

In December of 2010, we conducted a fourth round of shelf surveys in the Northwest. Field staff conducted 58 surveys including 19 in Idaho, 7 in Montana, 20 in Oregon and 12 in Washington. During these surveys, field staff recorded the price per package for all CFLs they found in each store.

Based on these data, the cost in the past year appears to have increased by an average of 30 cents per lamp. Average price of CFLs rose in both metro and non-metro areas by 24 and 41 cents respectively within the past year. The average price for standard CFLs (including a-lamps) is estimated at $3.79 and specialty CFLs (excluding a-lamps) is $6.63.