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Long-Term Monitoring and Tracking Report on 2010 Activities

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LONG-TERM MONITORING AND TRACKING REPORT ON 2010 ACTIVITIES

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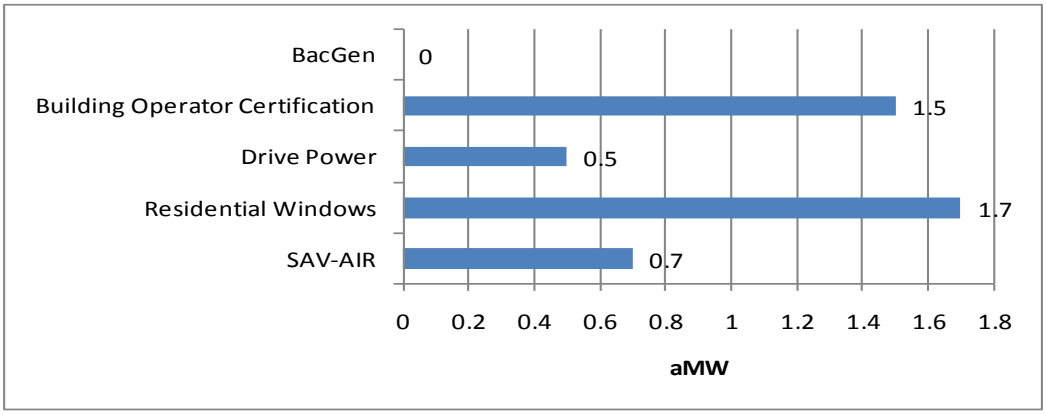
Executive Summary

Market transformation initiatives, by their nature, create change over the long term. An S-shaped diffusion curve can represent the developing and launching of new products and services, which have relatively little market impact in the initial years, and the major market effects occurring several years after the initiative's launch. The Northwest Energy Efficiency Alliance (NEEA) tracks the progress of its market transformation initiatives during their implementation phase through periodic Market Progress Assessment Reports (MPERs). However, because market diffusion often occurs after NEEA funding has ceased, NEEA also needs a mechanism for tracking ongoing market progress in the post-funding period so that it can verify key assumptions in its cost-effectiveness models.

ES.1 Results by Initiative

Of the five initiatives assessed in the 2010 long-term monitoring and tracking (LTMT), Building Operator Certification represents the greatest incremental savings at 1.5 average megawatts (aMW) in 2010. Residential Windows follows in second place with 0.8 aMW. Drive Power reports 0.5 aMW of incremental savings, while SAV-AIR resulted in 0.1 aMW. BacGen created no incremental energy savings. The five initiatives resulted in 2010 incremental savings (due to new activity occurring in 2010) of 2.9 aMW (Figure ES-1).[1]

Figure ES- 1 2010 Incremental Energy Savings from the 2010 LTMT Assessment (aMW)



Source: Navigant analysis 2011.
Note: 2010 incremental savings are due to new activity occurring in 2010 and represent estimated savings from market activity less estimated savings from baseline activity. NEEA's reported values might not match those presented here because NEEA adjusts for the effect of utility incentives and other factors not taken into account in this LTMT analysis.

[1] In all cases, savings represent total estimated savings from market activity (as defined for each initiative) less estimated savings from baseline activity. Savings figures include savings from market activity for which utilities provided incentives.

ES.1.1 BacGen

BacGen created no incremental energy savings in 2009 or 2010, continuing a trend that began in 2008. Because of the Northwest region's economic conditions, this trend is likely to continue unless external project funding increases. The company supported by NEEA's initiative remains the only company in the Northwest that targets small- to medium-size wastewater treatment plants with process-related energy efficiency. The project team recommends applying a 14 percent realization rate to the energy savings from previous years to incorporate relevant findings from a study published by Energy Trust of Oregon in 2009. The project team recommends discontinuing LTMT of BacGen in the future.

ES.1.2 Building Operator Certification

Building Operator Certification (BOC) represented the largest energy savings in 2010, accounting for 1.5 aMW of incremental energy savings. This savings estimate represents participation in BOC through the Northwest Energy Efficiency Council (NEEC) through 2010 and through the International Building Operators Association (IBOA) through 2009; IBOA declined to document participation for 2010. The number of active certifications increased to 1,166 in 2010, an 8 percent increase over 2009. Navigant recommends maintaining an estimate of zero for baseline market activity and for baseline energy savings in 2010; primary research during the 2011 LTMT effort will provide new data from which to develop revised estimates of baseline in the 2012 report. Per-unit energy savings in 2010 remained 119 MWh per operator per year, which was the same as 2009 but a 4 percent increase over 2008; an increase in the amount of energy consumption by the buildings managed by certified building operators drove this shift in 2009.

ES.1.3 Drive Power

The Drive Power Initiative reported energy savings of 0.5 aMW in 2010, remaining roughly constant since the economic downturn began in 2008. Market penetration has remained constant since 2006 at about 39 percent; Navigant estimates that this resulted in 20,615 new sales in 2010. Baseline remained constant from 2008 to 2010 as well, representing about two-thirds of the new sales. Per-unit energy savings from Drive Power increased by nearly 20 percent compared to the 2009 LTMT estimate due to a shift in the sales of NEMA Premium™ motors towards larger units, which generate higher per-unit energy savings than their smaller counterparts.

ES.1.4 ENERGY STAR Residential Windows

NEEA's ENERGY STAR Windows market transformation initiative continued to achieve significant incremental energy savings in 2010 (0.8 aMW). Effective January 4, 2010, ENERGY STAR revised the qualification for windows from a U-Factor of 0.35 Btu/h. ft^2 ºF to a U-Factor of 0.30 Btu/h. ft^2 ºF; NEEA did not take credit for the modification in 2010 but does plan to claim credit for the revised standard in 2011 and beyond. The total area of ENERGY STAR windows shipped in the Northwest increased to just over 35 million square feet in 2010. Baseline activity of 56 percent in 2010 reflects new data about the overall market share of ENERGY STAR windows. Per-unit energy savings decreased to 0.5 aMW per square foot in 2010 due to

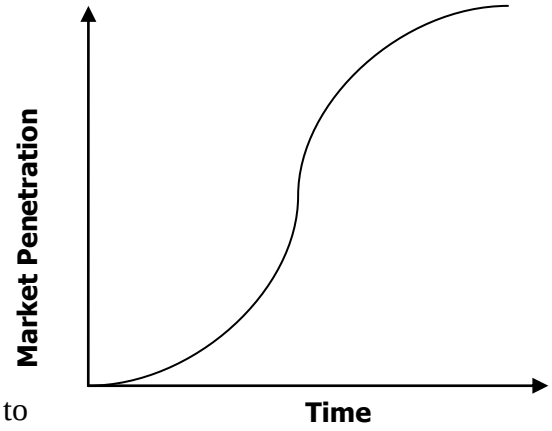
changes in the demands placed on heating, ventilation, and air conditioning equipment in the typical Northwest home.

ES.1.5 SAV-AIR

Market activity due to the SAV-AIR initiative has varied since the last LTMT effort. Activity resulting from the SAV-AIR initiative in the Northwest ceased from 2006 through 2008 due in part to the broad economic slowdown. Activity resumed in 2009 when Pneu-Logic (the company that succeeded SAV-AIR) incorporated the initiative-funded technology into its flagship product. Baseline market activity, defined as the number of projects using a technology that directly competes with SAV-AIR, remains at zero. Competition from indirect sources, those that create energy savings at air compressor sites that use simple control schemes or that address different components of the systems, effectively reduces the per-unit energy savings by 34 percent. Incremental energy savings in 2009 and 2010 were 0.6 aMW and 0.8 aMW, respectively.

1. Introduction

Market transformation initiatives, by their nature, create change over the long term. An S-shaped diffusion curve can represent the developing and launching of new products and services, which have relatively little market impact in the initial years, and the major market effects occur several years after the initiative's launch. The Northwest Energy Efficiency Alliance (NEEA) tracks the progress of its market transformation initiatives during their implementation phase through periodic Market Progress Evaluation Reports (MPERs). However, because market diffusion often occurs after NEEA funding has ceased, NEEA also needs a mechanism for tracking ongoing market progress in the post-funding period so that it can verify key assumptions in its cost-effectiveness models.



In 2004, NEEA developed a process for tracking and monitoring the market progress of initiatives that it no longer funds. The goal of this long-term monitoring and tracking (LTMT) is to measure and track critical market progress indicators and Alliance Cost-Effectiveness (ACE) model assumptions that NEEA uses to estimate long-term electricity savings. LTMT uses methods that provide estimates with a reasonable and sufficient level of confidence in a timely and cost-effective manner. During the data gathering and analysis process, the review team seeks to leverage existing data sources and to identify areas where additional data collection would enhance the precision of the market effects estimates. Long-term monitoring and tracking is not intended to be an exhaustive evaluation of initiative impacts but rather a relatively brief and conservative assessment of the market effects of these initiatives.

The 2010 LTMT effort applied a market-wide, top-down approach where feasible and appropriate. Using this approach, the project team estimates market penetration rates for the product or activity that NEEA promoted, rather than counting individual sales or actions. For example, the early stages of many NEEA market transformation initiatives include tracking the adoption of a vendor's energy efficiency product or documenting a finite number of demonstration projects. However, once the promoted product/activity has begun to transform the market, its impact cannot easily be "counted." For this reason, the LTMT assessments generally use a market-wide view of adoption rates, with baseline estimation, to estimate impacts. In some cases, such as certification of building operators, the evaluation team performed a "bottom-up" accounting of market activity, because NEEA believes that this approach directly quantifies all relevant market activity.

1.1 Monitoring and Tracking Methodology

The LTMT process used the following approach:

1. **Review of the NEEA ACE model, or other documentation, for each initiative.** This included a review of the critical assumptions, inputs to energy savings calculations, and progress indicators.

2. **Assessment of data collection options and identification of variables to track.** Assessing the options entailed a brief review of the feasibility and cost of collecting the data to track market transformation and energy savings. Based on this review, the project team identified specific data inputs and initiative indicators for tracking.

3. **Development of a data collection/analysis work plan for each initiative.** Reviews of the LTMT approach recommended by MPERs or by past LTMT assessments informed preliminary work plan development. Recent market research and insights from NEEA staff familiar with the various markets provided additional input to the work plans. The work plans served as guides to the individual LTMT assessments and included the following elements:

    - Background on the initiative
    - Assumptions, market indicators, and inputs to energy savings calculations
    - Methodology for data collection and analysis

4. **Execution of the work plans and reporting of findings and recommendations.** Individual LTMT assessment reports include findings on market activity, baselines, and energy savings as well as recommendations for changes in the assumptions/inputs and for approaches to future LTMT efforts.

After NEEA and the project team finalize the LTMT report, NEEA staff will present the findings and recommended changes to the NEEA Cost-Effectiveness Committee. Once the changes receive approval, NEEA will incorporate them into the ACE models. Some initiatives will require greater data collection efforts than others as NEEA initiates monitoring and tracking procedures for each NEEA initiative after its active funding cycle. LTMT efforts will continue to focus on developing reliable estimates of real market transformation at the state and regional levels and the energy savings resulting from these initiatives. High uncertainty surrounding energy savings for a particular initiative with significant savings may warrant additional data collection. For those with limited impacts, or with good tracking data, existing sources may provide sufficient data. Each initiative assessment in the following chapters contains recommendations for ongoing data collection activities.

1.2 LTMT Review for 2010

The 2010 LTMT effort reviewed the following five NEEA initiatives, all of which updated previous LTMT assessments:

1. BacGen
2. Building Operator Certification (BOC)
3. Drive Power Initiative
4. ENERGY STAR Residential Windows
5. SAV-AIR

For each initiative, the LTMT project team focused on tracking activity in the market, examining NEEA's baseline assumptions (to varying degrees, depending on the initiative and past LTMT efforts), and assessing energy savings. Sections 2 through 6 of this report present background, methodologies, findings, and recommendations for each NEEA initiative in the order listed above.

1.3 LTMT for 2011 and Beyond

Future long-term monitoring and tracking efforts may include updates to some of the initiatives assessed in this 2010 LTMT report, as well as updates to previous LTMT assessments and additional NEEA initiatives that no longer receive funding. Table 1-1 includes a tentative schedule for each of the initiative tracking efforts for 2011 along with the LTMT assessments from the past five years. NEEA's project manager will discuss the list of initiatives up for review in 2011 with the contractor and present them to the Cost-Effectiveness Committee of the NEEA board for review before finalizing the 2011 plan.

Table 1-1. Time Line for Conducting/Updating Long-Term Monitoring and Tracking

Initiative	2006	2007	2008	2009	2010	2011
ENERGY STAR Residential Windows		U		U	U	
Building Operator Certification		U	U	U	U	U
SAV-AIR	U		2008 LTMT cancelled		U	
Just Enough Air	LTMT discontinued					
Evaporator Fan VFDs	U	U		U		U
Siemens (Shell Solar)	U	U	Assess need annually			
BacGen	U		U		U	*
Verdiem		U		U		U
Commissioning in Public Buildings		U		U		U
Small Commercial HVAC (AirCare Plus)	LTMT discontinued					
ENERGY STAR Home Products		C		U		U
MagnaDrive	C		U	U		U
Dendritic Polysilicon (ASiMi) Production			C		Assess need annually	
Electric Motor Management (Drive Power)		C	U	U	U	U
Optichill (Microelectronics)			C		Recommended to discontinue	
SIS/AM400	C		U		Recommended to discontinue	
Compact Fluorescent Lamps (CFLs)[#]				C	U	U

Notes: C = Conduct initial analysis; U = Update to initial analysis; * = Navigant recommends discontinuing LTMT; [#] = LTMT for CFLs completed by KEMA

2. BacGen

In 1997, BacGen Technologies, Inc. (BacGen) approached NEEA with a proposal to reduce the energy consumption of small- to medium-size wastewater treatment facilities with a proprietary mix of micronutrients and process control technologies.[2] BacGen's proposal differed from previous energy efficiency efforts in the wastewater market in that it focused exclusively on optimizing the wastewater treatment process instead of improving building performance (e.g., lighting, and heating, ventilating, and air conditioning [HVAC]). BacGen and NEEA signed an initial three-year project contract to develop and demonstrate the technologies' capabilities beginning in January 1999. NEEA extended the contract in 2001 with a renewed focus on aeration process control. The goal of the project was for BacGen to succeed as a business serving the wastewater treatment market and for potential competitors to show interest in BacGen's technical approach.

The 2005 LTMT report presented the findings of the first BacGen LTMT effort. The 2006 and 2008 LTMT reports included the results of two subsequent BacGen LTMT analyses. The 2010 BacGen "update" report builds upon the data collection activities undertaken for 2008. This section discusses the methodology used to assess the market's progress toward transformation, key findings, and the resulting major conclusions and recommendations.

2.1 Assumptions and Indicators for Review

For calculation of BacGen's gross energy savings, Navigant Consulting, Inc. (Navigant), used wastewater project-specific savings for the projects completed in 2009 and 2010. Navigant calculated the gross energy savings impact of BacGen by summing the wastewater project-specific savings, as done and recommended in the 2008 LTMT report. Specifically, Navigant calculated gross energy savings for a given calendar year as the product of two factors:

- Total design capacity of BacGen's wastewater process optimization projects in the Northwest (million gallons per day [MGD])
- Adjusted annual average energy savings per unit capacity (kilowatt-hours [kWh]/MGD/yr)[3]

[2] The single BacGen measure, referred to by NEEA as "Process Controls", consists of continuous monitoring to optimize the aeration process, thereby allowing reduced motor use while maintaining or improving effluent quality. For this report, "wastewater optimization" refers to the BacGen measure.

[3] MGD is the wastewater treatment capacity at design conditions, quantified in millions of gallons treated per day. To find the annual energy savings per unit capacity of all BacGen's projects, Navigant adjusted the savings estimate (kWh/yr) provided by BacGen for each optimization project by the total design capacity of the project (MGD). Additionally, Navigant aggregated the project-specific per-unit savings (kWh/yr/MGD) on an annual basis.

The adjusted annual average energy savings reflect an adjustment for the realization rate achieved by similar projects in the Northwest.[4]

2.2 *Methodology*

The 2010 LTMT effort for the BacGen initiative provides an update to the market activity and a baseline for energy-efficient process technology for small- to mid-size wastewater treatment plants. Specifically, Navigant conducted data collection and analysis activities that involved many of the same sources of information that Navigant used for the 2008 LTMT report, including the following:

1. **Contact the NEEA manager for the BacGen initiative.** Navigant contacted the BacGen initiative manager, Andy Ekman, for updates to the post-project tracking database provided for the 2008 LTMT effort. This task included a high-level discussion about the current status of BacGen.

2. **Contact the project contractor (President and Engineer at BacGen).** BacGen's president provided a wealth of information for the 2006 and 2008 LTMT efforts. Specifically, Navigant requested an updated project-tracking tracking and information about broader market trends, specifically the level of market activity, extent of competition, and effects of local policies on BacGen's business model.

3. **Review current U.S. Environmental Protection Agency (EPA) wastewater capacity database.** Navigant acquired the latest database to update design capacity for BacGen's most recent installations and to assess the overall size of the wastewater market in the Northwest.

4. **Investigate the assumptions used for the gross energy savings of wastewater process optimization projects by BacGen.** Navigant interviewed internal staff to better understand the findings of a Summit Blue Consulting-produced report to the Energy Trust of Oregon. The report examined savings of improved controls at wastewater treatment plants in the Northwest.

5. **Research secondary sources for other companies implementing wastewater process controls.** Navigant conducted web searches for companies offering competing wastewater optimization services. Navigant interviewed the sole company that appeared to compete with BacGen. The interview explored the region in which they operate, when the company began offering wastewater optimization services, and the extent to which the BacGen initiative had any influence on their decision to enter the market.

Table 2-1 summarizes the primary data collection activities conducted for the 2010 BacGen LTMT.

[4] Summit Blue Consulting, LLC, *Production Efficiency Program Evaluation Report*, August 14, 2009. Prepared for Energy Trust of Oregon.

Table 2-1. Primary Data Collection Activities for 2010 BacGen LTMT

Interviewee Group	Number of Interviews/Surveys	Topic/Issues
NEEA	One phone interview with NEEA's manager for the BacGen initiative	• Updated project-tracking tracking • Level of market activity • Extent of competition • Effects of local policies on BacGen's business model
BacGen	Two phone interviews with BacGen staff	• Updates to the post-project tracking database • High-level discussion about the status of BacGen
Navigant	Two phone conversations with Navigant staff	• Gathering additional detail on the analysis and findings related to Navigant's evaluation of a related program for Energy Trust of Oregon

Source: Navigant analysis 2011.

2.3 *Findings*

This section presents the findings of the 2010 LTMT efforts for the BacGen initiative. Section 2.3.1 discusses related market activity for BacGen in 2009 and 2010. Section 2.3.2 outlines the baseline activity assumptions. Section 2.3.3 highlights recommended changes to the per-unit energy savings associated with BacGen.

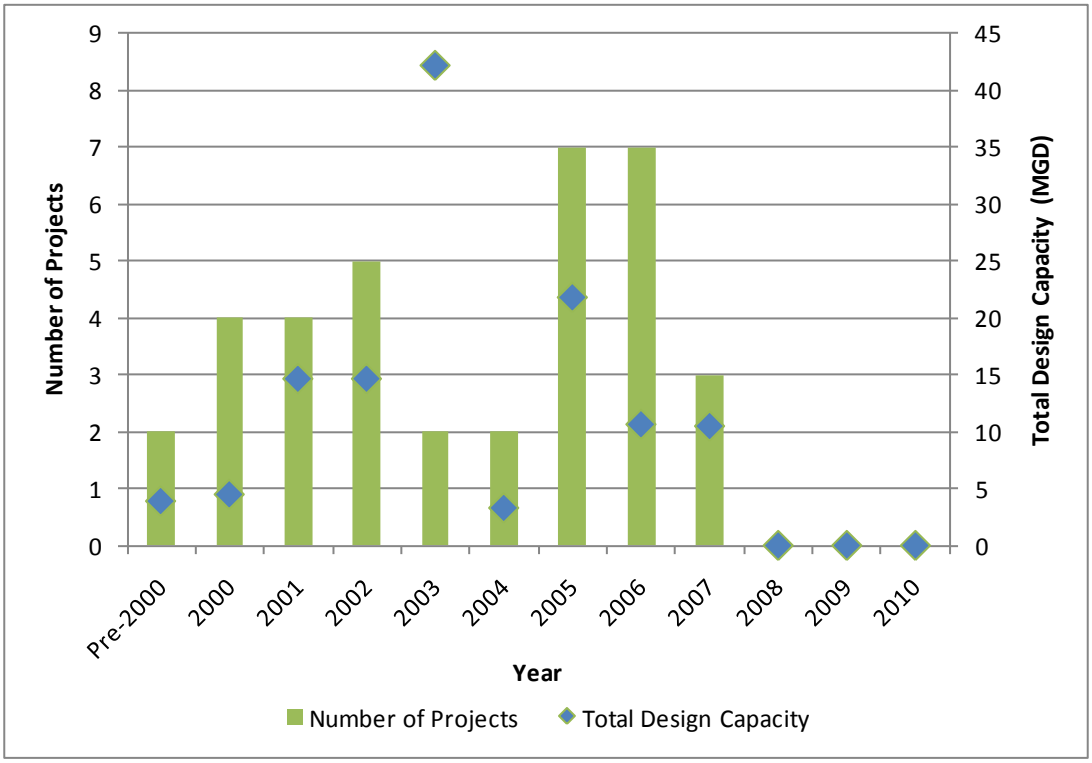
2.3.1 Market Activity

In the 2008 LTMT report, Navigant reported that BacGen observed a marked decline in regional optimization project activity during 2007 and 2008. This trend continued in 2009 and 2010. BacGen implemented zero wastewater process optimization projects in the Northwest during 2009–2010. The related market activity for wastewater optimization in the Northwest remains at 126 MGD, as illustrated in Figure 2-1. The reduced availability of incentives from Bonneville Power Administration (BPA) and Energy Trust of Oregon, combined with tight capital budgets among municipal wastewater agencies, continues to drive this decline.[5]

BacGen's role in the wastewater optimization market has shifted to that of an engineering consultation model. Although BacGen completed no wastewater optimization projects in the Northwest since 2007, the firm played an active role in three feasibility studies in 2010. All three projects are currently in process, but not one has been completed. All of the projects have received ARRA funding.

[5] Interview with BacGen president, November 29, 2010.

Figure 2-1. BacGen Wastewater Optimization Projects and Capacities in the Northwest by Year Completed



Source: 2008 BacGen database and e-mail from Maud de Bel, BacGen (2010).

PRESENCE OF POTENTIAL COMPETITORS

BacGen appears to be the only company in the Northwest that promotes process optimizations at small to medium-size wastewater treatment plants for the sake of energy efficiency. Wastewater treatment plant optimization projects continue to happen nationally, but most occur at larger facilities with bigger capital budgets and greater energy savings.

Navigant identified and interviewed a single company that appeared to compete with BacGen. BioChem Technology, Inc. (BioChem), provides process consultation services, specializing in the monitoring, optimization, and control of wastewater treatment processes.[6] BioChem, based in King of Prussia, Pennsylvania, has completed six wastewater optimization projects on the East Coast of the United States as well as many in China. BioChem projects occur at wastewater treatment plants with capacities that range from 1.5 to 528 MGD. Although BioChem has not completed any projects in the Pacific Northwest, they have begun to move west, recently completing a wastewater treatment plant optimization project in Phoenix, Arizona.

[6] Interview with BioChem Technology, Inc., Vice President of Sales, March 3, 2011. Unless otherwise stated, this source provided all information about BioChem Technology, Inc.

BioChem had not heard of BacGen before Navigant's interview with them, nor do they view BacGen as a competitor. Additionally, BioChem favors projects at larger wastewater treatment facilities due to the availability of funding and greater opportunity for energy savings. BacGen continues to differentiate itself by focusing on the smaller facilities that have fewer available resources; other companies that serve wastewater treatment plants typically pass up projects of this scale in favor of more profitable, larger facilities.

Navigant concludes that no other company in the Northwest actively provides process optimizations to facilities in the 0.1–5 MGD size range and that few companies provide process optimization services to 5–20 MGD facilities.[7] An extensive web search revealed one potential competitor, and BacGen's leadership did not identify any competitors. As such, it appears that BacGen alone seeks to serve this market.

2.3.2 Baseline Activity

Baseline activity reflects the energy savings attributable to wastewater treatment efficiency measures that would have occurred in the absence of the BacGen project. The 2008 LTMT report recommended increasing baseline activity estimates to reflect the growing emphasis on energy efficiency by facility operators and by other wastewater companies together with their primary services. The 2008 LTMT report provides additional details on these recommendations. Navigant recommends that the NEEA ACE model continue to reflect the following baseline values:

- 0.1–5 MGD: Navigant recommends a 10 percent baseline for projects under 5 MGD.
- 5–20 MGD: Navigant recommends a 20 percent baseline for 5–20 MGD projects.
- Greater than 20 MGD: Navigant recommends a 95 percent baseline for large facilities.

When all completed projects have these baseline assumptions applied to them, Navigant calculates a baseline market activity of 7.0 MGD. The most recent ACE model obtained from NEEA in 2010 correctly reflects this baseline market activity.

[7] Because other companies in the Northwestern market typically only provide process optimizations to 5–20 MGD facilities as part of more significant upgrades, Navigant does not consider them direct competitors.

2.3.3 Per-Unit Energy Savings

New information has become available since the 2008 LTMT report regarding the realized per-unit energy savings for water and wastewater optimization projects in the Northwest. For the 2010 LTMT, Navigant reviewed a study completed for Energy Trust of Oregon in 2009. This study provided Energy Trust of Oregon and program stakeholders with information about the effectiveness of the Production Efficiency program by evaluating energy efficiency services for a variety of industrial processes served by the program. One segment of the report deals specifically with energy efficiency projects at water/wastewater treatment facilities. The report details realization rates of energy savings for four plants in Oregon.

This report found that water/wastewater treatment plant optimization projects realize only 14 percent of projected energy savings. The report includes results from the evaluation of three wastewater and one freshwater treatment plants that had completed projects with some funds from Energy Trust. Table 2-2 illustrates verified savings. The methodology included a comprehensive review of equipment and controls and energy billing analysis. The monitoring and verification analysis consisted of end-use monitoring with data loggers and use of data collected by the automation systems.

Table 2-2. 2007 Production-Level Realization Rates as Reported to the Energy Trust

Site ID	End-Use Category	Working Savings (kWh)	Economy Adjusted		Full Capacity	
			Verified Savings	Realization Rate	Verified Savings	Realization Rate
14	Water Treatment	1,189,928	79,400	7%	79,400	7%
20	Water Treatment	1,480,968	256,879	17%	256,879	17%
21	Water Treatment	396,449	37,993	10%	37,993	10%
22	Water Treatment	261,801	100,200	38%	100,200	38%
Total	**4**	**3,329,146**	**474,472**	**14%**	**474,472**	**14%**

Source: Summit Blue Consulting, LLC. October 2009. *Production Efficiency Program Evaluation Report*. Prepared for Energy Trust of Oregon.

Navigant recommends applying the 14 percent realization rate to BacGen's per-unit energy savings estimates for all projects retroactively. The four water/wastewater treatment plant optimization projects included in the study for Energy Trust all overstate the energy savings consistently. This recommendation maintains consistency with NEEA's conservative approach to representing energy savings.

Table 2-3 presents energy savings data for BacGen projects in the Northwest, both in aggregate and normalized for design capacity. The average energy savings per unit design capacity remains 209,860 kWh/MGD/yr through 2010; however, Navigant reduced the realized per-unit energy savings to 14 percent of BacGen's estimated savings, based upon evaluation data of wastewater treatment optimization projects in the Northwest.

Table 2-3. BacGen Savings from Wastewater Optimization Projects in the Northwest by Year

Year	Number of Projects	Total Design Capacity (MGD)	Estimated Annual Energy Savings (kWh/yr)	Estimated Per-Unit Savings (kWh/MGD/yr)	Recommended Per-Unit Savings (kWh/MGD/yr)
Pre-2000	2	3.90	2,497,660	640,430	89,660
2000	4	4.49	2,515,260	560,190	78,427
2001	4	14.65	2,201,470	150,270	21,038
2002	5	14.65	1,920,250	131,080	18,351
2003	2	42.18	4,261,830	101,040	14,146
2004	2	3.30	1,211,740	367,190	51,407
2005	7	21.80	4,143,430	190,070	26,610
2006	7	10.64	4,781,460	449,390	62,915
2007	3	10.49	2,932,700	279,570	39,140
2008	0	0	0	0	0
2009	0	0	0	0	0
2010	0	0	0	0	0
Total	**36**	**126.1**	**26,465,790**	**209,860**	**29,380**

Source: 2008 BacGen database and e-mail from BacGen (2010).
Summit Blue Consulting, LLC. October 2009. *Production Efficiency Program Evaluation Report*. Prepared for Energy Trust of Oregon.

2.4 Conclusions and Recommendations

To summarize, the main findings of the 2010 LTMT effort for the BacGen initiative include the following:

- BacGen's wastewater optimization project activity has declined in the Northwest. Because of the region's economic conditions, this trend is likely to continue unless external project funding increases. BacGen has reported no wastewater treatment plant optimization market activity in the years 2008 through 2010.

- BacGen appears to be the only company in the Northwest that promotes wastewater process optimizations to smaller facilities (0.1–5 MDG) or to medium-size facilities (5–20 MGD) expressly for energy efficiency. At least one other company in the nation performs wastewater optimization projects of this scale; small-scale projects comprise a small part of the firm's business, and the firm currently has no plans to expand into the Pacific Northwest.

- Navigant recommends applying a 14 percent realization rate to BacGen's estimated energy savings for all projects. Other water and wastewater plants in the Northwest that carried out comparable energy efficiency projects showed an energy savings realization rate of 14 percent based on a study completed for Energy Trust of Oregon. Applying this realization rate to NEEA's estimates of energy savings reflects a more realistic estimate of energy savings from these projects.

Navigant recommends discontinuing LTMT of BacGen in the future. Without a significant change in energy prices in the Northwest, utility incentive levels, federal stimulus, some other external funding source, or a significant leap in technology, it is unlikely that the region will see additional energy efficiency project activity among small- to medium-size wastewater treatment facilities. In addition, the realized energy savings from such projects are much lower than BacGen estimates indicated. Finally, BacGen's consulting activities have not yet led to any completed projects. As such, future LTMT research focused solely on wastewater process optimization projects in the Northwest is unlikely to result in additional energy savings for NEEA.

Prior to discontinuing the BacGen LTMT, however, NEEA may consider reviewing the results of evaluations of similar technologies in other parts of the country. This would enable NEEA to assess the relevance of implementation or evaluation practices that are used in other parts of the country to achieve higher realization rates. These other regions may also indicate higher levels of market activity, which may lead NEEA to consider alternative strategies for promoting technologies like BacGen in the Northwest. NEEA should take care to compare technologies that serve similar markets to BacGen (i.e., small- to mid-size wastewater treatment facilities).

Table 2-4 presents the incremental changes in market activity, baseline activity, per-unit energy savings, and implied energy savings between the values for 2009 and 2010 for wastewater process optimization projects only.

Table 2-4. LTMT Recommendations for Key Indicators

Key Indicators Reviewed	2009 Incremental (Due to *new* activity occurring in 2009)	2010 Incremental (Due to *new* activity occurring in 2010)	2010 Cumulative (Calendar year 2010 values due to all activity since program inception)	Source
Market Activity				
Wastewater Optimization Total Design Capacity (MGD)	0	0	126.1	Section 2.3.1
Baseline Activity				
Wastewater Optimization Total Design Capacity (MGD)	0	0	7.0	Section 2.3.2
Per-Unit Energy Savings				
Wastewater Optimization (kWh/MGD/yr)	0	0	29,380	Section 2.3.3
Implied Energy Savings (aMW)*				
Wastewater Optimization Implied Energy Savings (aMW)	0	0	0.4	Market activity minus baseline activity, times per-unit savings, divided by 8,760 hours, divided by 1,000

* Implied Energy Savings represent estimated savings from market activity less estimated savings from baseline activity. NEEA's reported values might not match those presented here, because NEEA adjusts for the effect of utility incentives and other factors not taken into account in this LTMT analysis.
Source: Navigant analysis 2011.

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3. BOC

NEEA funded the Building Operator Certification (BOC) initiative from 1997 through 2003. NEEA offered a professional development program to teach facility managers, building operators, maintenance personnel, and others who monitor commercial building systems how to reduce energy and resource consumption in the facilities that they operate. With the BOC initiative, NEEA intended to achieve lasting improvement in the energy-efficient operation and maintenance (O&M) of commercial buildings by developing a market for educated and certified building operators.

After the establishment of the BOC curriculum and delivery mechanism several years ago, the Northwest Energy Efficiency Council (NEEC) and the International Building Operators Association (IBOA) have continued to offer BOC as self-supporting ventures since 2000. The program offerings include an initial set of courses that constitute the Level 1 curriculum, while Level 2 is comprised of a second set of somewhat more advanced courses. Many prominent organizations accredit the BOC as an approved means of continuing education, including the U.S. Green Building Council, which approved the Level 1 BOC courses as continuing education for Leadership in Energy and Environmental Design (LEED) certification in 2010.[8]

Starting in 2009 and continuing in 2010, NEEA's commercial sector began promoting BOC to various market sectors through the BetterBricks initiative, supplying marketing support to the Oregon BOC provider, Northwest Energy Education Institute (NEEI), and scholarships and tuition assistance for attendees across the region working in healthcare and property management. In 2010, the U.S. Department of Energy (DOE) awarded a grant to NEEC to enhance and expand the BOC curriculum. NEEA provided matching funding for this project, which will continue through 2011 while being piloted in the Northwest. In 2009 and 2010, NEEA's Commercial sector also sponsored the BOC Webinar Series. Through the combination of these investments and efforts, the number of classes, certifications, and renewals for BOC has increased.

This sixth LTMT report for the BOC will update NEEA's internal tracking numbers based on the latest database from NEEC. The corresponding IBOA database was not available during the time of this report. The 2010 energy savings estimates use the same methodology used for the 2009 analysis.

[8] Northwest Energy Efficiency Council. 2011. "Building Operator Certification: Recognition and Accreditation." http://www.theboc.info/w-recognition.html

3.1 Assumptions and Indicators for Review

As established in recent LTMT analyses, the energy savings impact of the BOC venture depends on the number of operators receiving certification and a series of assumptions regarding the size of the facilities and the percentage reduction in energy consumption. Specifically, Navigant calculates energy savings for a given calendar year as follows:

Annual Energy Savings (kWh/year) =

(1) Number of operators certified or renewed within the past five years
x (2) Square footage per operator
x (3) Electricity consumption per square foot of participating facilities
x (4) Savings from certification (as a percentage of electricity consumption)

where:

1. **Number of operators certified within the past five years originates** from NEEC and IBOA records.[9]

2. **Square footage per operator** is the average number of square feet of building space uniquely managed by operators receiving certification.

3. **Electricity or gas consumption per square foot of participating facilities** depends on a weighted average of building types operated by those receiving BOC training.

4. **Savings from certification (as a percentage of electricity consumption)** is a measure of the reduction in facility energy consumption resulting from operator certification.

The assumed measure life is five years, meaning that the methodology assigns savings for five years beginning in the year of certification for each operator. If a student receives a Level 2 certification or a certification renewal, then the measure life extends for five years from the most recent date of certification. For the remainder of this report, the term "active building operators" refers to building operators who have obtained a new certification or renewed a previous certification within the past five years.

3.2 Methodology

Previous LTMT work has established methods for collecting and analyzing data on certifications. Navigant used the 2009 methodology to evaluate the BOC initiative in 2010, and repeated and refined these methods as described below.

[9] 2010 data from IBOA are not included in this report, but data from previous years were available.

3.2.1 Data Collection

Navigant conducted the following data collection activities:

1. **Contacted NEEC and IBOA staff to obtain current database of certification activity.** NEEC provided an Excel file containing the names, contact information, company name, company type, and certification and recertification dates for BOC participants through the end of 2010. IBOA provided a verbal count of 2010 participants but had not provided a database for verification at the time of this report.

2. **Interviewed NEEC and IBOA staff to assess views on BOC activity, drivers, impacts, and market perceptions.** Navigant drafted an interview guide for NEEC and IBOA staff, as well as for NEEA's program members. Navigant interviewed senior staff at NEEC and NEEI as well as the BetterBricks initiative manager at NEEA.

3. **Reviewed literature on building energy consumption and operations and maintenance activities.** The review resulted in no findings to suggest changing from the energy consumption value of 16.7 kWh per square foot used in the 2009 LTMT analysis.[10]

4. **Reviewed evaluations of other BOC programs**. Navigant reviewed other BOC program evaluations for any updated findings, and encountered no significant new reports published in 2010. This included a report that Navigant completed for the Midwest Energy Efficiency Alliance that is in the publication process at the time of publication of this LTMT report.

5. **Reviewed ACE Model**. Navigant reviewed the most recent ACE model to assess key inputs, assumptions, and outputs used in reporting annual savings. The review suggested no changes to the model for this project year because the evaluation process replicated the 2009 methodology in 2010.

Table 3-1 summarizes the primary data collection activities conducted for the 2010 BOC LTMT.

[10] Sources are listed in the Bibliography.

Table 3-1. Primary Data Collection Activities for 2010 BOC LTMT

Interviewee Group	Number of Interviews/Surveys	Topic/Issues
NEEA	One phone interview with management of the BetterBricks program	• Updated database of certifications • Program developments • The emergence of competitors • Changes in the marketplace • Reinvestment in BOC • Updates to the ACE model
NEEC	One phone interview with management of the NEEC BOC program	• Updated database of certifications • Program developments • The emergence of competitors • Changes in the marketplace
NEEI	One phone interview with management of IBOA's BOC program	• Program developments • The emergence of competitors • Changes in the marketplace

Source: Navigant analysis 2011.

3.3 Findings

The information and data collected created a framework for understanding the current state of the market for BOC and trends in that market; section 3.3.1 discusses this "market activity." Establishing the role of the NEEA initiative in the evolution of the market requires understanding the scenario that would have ensued in the absence of the initiative; section 3.3.2 discusses this "baseline activity." Establishing the energy savings associated with each building operator who receives certification provides the final input needed to calculate the energy savings associated with NEEA's initiative; section 3.3.3 includes this discussion on "per-unit energy savings."

3.3.1 Market Activity

Navigant used data from the NEEC certification database to update the number of Level 1 and Level 2 certifications and the number of operators having received their last certification or renewal in the past five years (i.e., within the period of the assumed measure life). Navigant was not able to add 2010 information regarding IBOA certifications, as the database was not available.

As shown in Table 3-2, NEEC certified 112 new building operators in the Northwest during 2010, bringing the total number of certified operators since 1997 to 1,331. IBOA certified 389 building operators through the end of 2009, but 2010 data were not available. Of the 1,331 operators certified by NEEC, 891 (67 percent) remained active at the end of 2010, which means they have been certified or recertified within the last five years. IBOA had 275 active operators at the end of 2009, bringing the combined total from NEEC and IBOA to 1,166 active operators

at the end of 2010.[11] Navigant estimates that the combined total for annual new certifications in 2010 would be roughly 50 percent higher if IBOA data were available to include.[12] This would also increase the total number of active operators to the extent that the 2010 activity consists of new certifications and renewals of certifications that would otherwise be more than five years old.

Table 3-2. Market Status of Active Certified Building Operators

	NEEC			IBOA			Combined Total		
Year	Annual New	Annual Retired*	Total Active**	Annual New	Annual Retired*	Total Active**	Annual New	Annual Retired*	Total Active**
1997	1	0	1	2		2	3	0	3
1998	45	0	46	12	0	14	57	0	60
1999	120	0	166	22	0	36	142	0	202
2000	124	0	290	21	0	57	145	0	347
2001	96	0	386	9	0	66	105	0	452
2002	155	1	540	42	1	107	197	2	647
2003	108	22	626	60	3	164	168	25	790
2004	58	54	630	35	9	190	93	63	820
2005	120	63	687	30	11	209	150	74	896
2006	77	62	702	53	13	249	130	75	951
2007	88	93	697	23	22	250	111	115	947
2008	142	70	769	28	32	246	170	102	1,015
2009	85	51	803	52	23	275	137	74	1,078
2010* **	112	24	891	N/A	N/A	N/A	112	24	1,166
Total	**1,331**	**440**	**891**	**389**	**114**	**275**	**1,720**	**554**	**1,166**

* Annual Retired refers to certified building operators whose measure lives have expired because they did not receive a new certification or renewal within five years of the year (table row) in which the data is presented.
** Total Active is the number of certified building operators who have received a new certification or renewal within five years of the year (table row) in which the data is presented. Total active (present year) = Total active (previous year) + Annual new – Annual net retired.
*** 2010 totals represent incremental increases from NEEC only, as 2010 IBOA data were not available.
Source: Navigant analysis of 2010 NEEC certification database and 2009 IBOA certification database.

The 2010 market activity from NEEC showed two noteworthy trends: an increase in new certifications and a decrease in retirements. NEEC BOC program administrators offered roughly the same number of courses in 2010 as in 2009, yet experienced increased demand. As demonstrated by Figure 3-1, the number of new certifications in 2010 is approximately 24 percent higher than in 2009 and slightly exceeds the average over the last five years, which may

[11] As noted above, the 2010 figures do not include 2010 IBOA data, which was not available as of the time of this LTMT analysis.
[12] This estimate comes from discussions with IBOA staff, who indicated that IBOA completed roughly 60 certifications in 2010. Without the program-tracking database, however, Navigant could not verify the figure and did not include that estimate in the calculation of market activity for 2010.

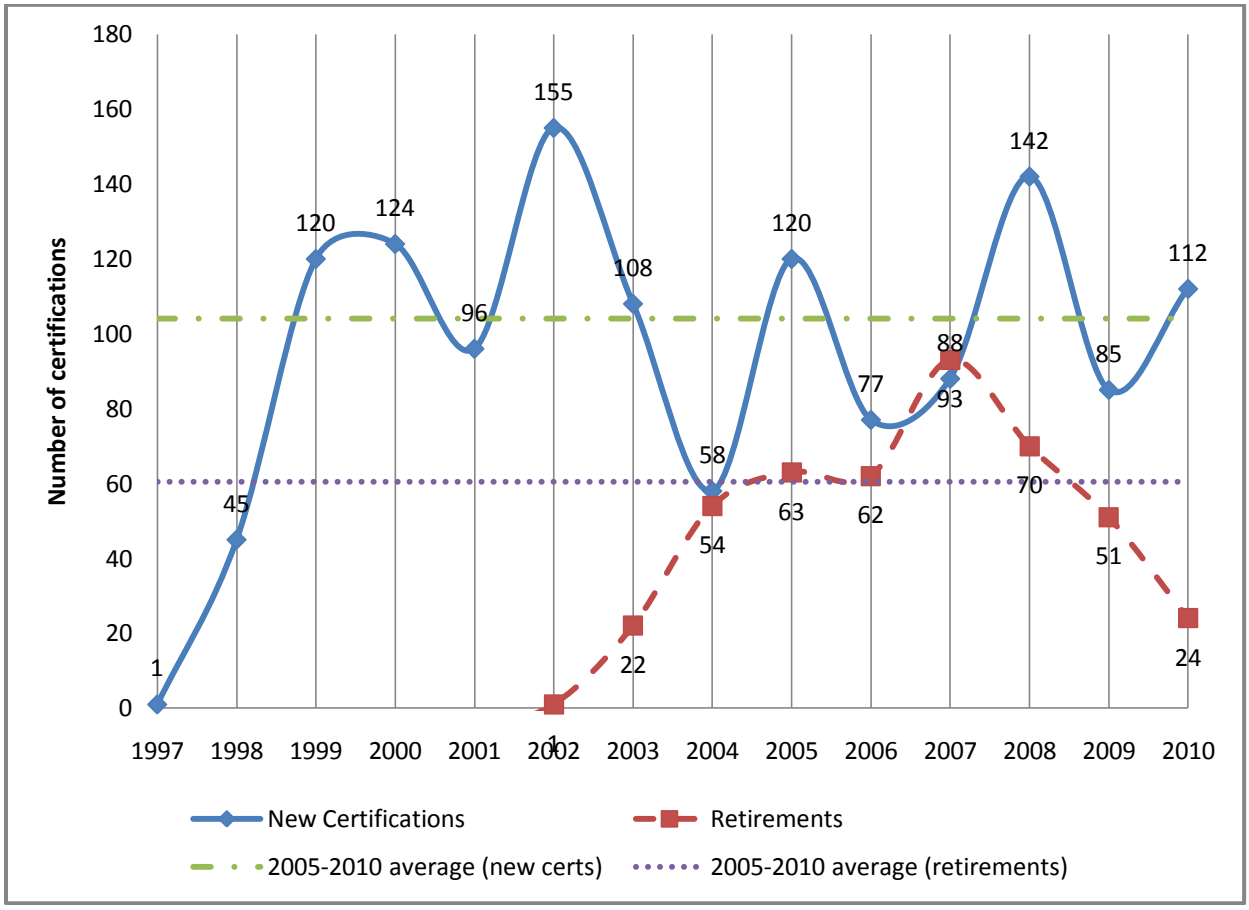
suggest increased value of BOC in the marketplace and a decreased impact from the economic hardships of the last several years.[13] Nearly 53 percent fewer operators allowed their certifications to retire in 2010 than the previous year,[14] even though a large number of operators initially achieved certification in 2005, which potentially set them up for retirement in 2010. The 2010 retirements are well below the five-year average. This finding suggests that operators may be realizing value in maintaining certification.

Program administrators from NEEC actively communicate recertification as a means for building operators to gain continuing education and maintain a credential that makes them more valuable to the industry. NEEC believes these efforts are partially responsible for the decreasing rate of retirement.

The fluctuating number of new certifications from year to year (refer to Figure 3-1) may be due to an assortment of contributing factors, although a definitive link has not been established for this LTMT report. Program administrators from NEEA and NEEC have suggested the possibility that the fluctuating numbers reflect the availability of rebates or perhaps are coincident with course starting dates and durations, which can vary from year to year. For example, in some years NEEC has offered more courses beginning in the fall with durations that can last seven months, which would result in certifications awarded the following year. However, in other years more courses began in the spring resulting in certification the same year.

[13] For purposes of comparison to recent trends, Navigant used a five-year average to allow for the market activity ramping up that occurred during the first several years of the initiative.
[14] Retirements refer to those who have reached the five-year measure life.

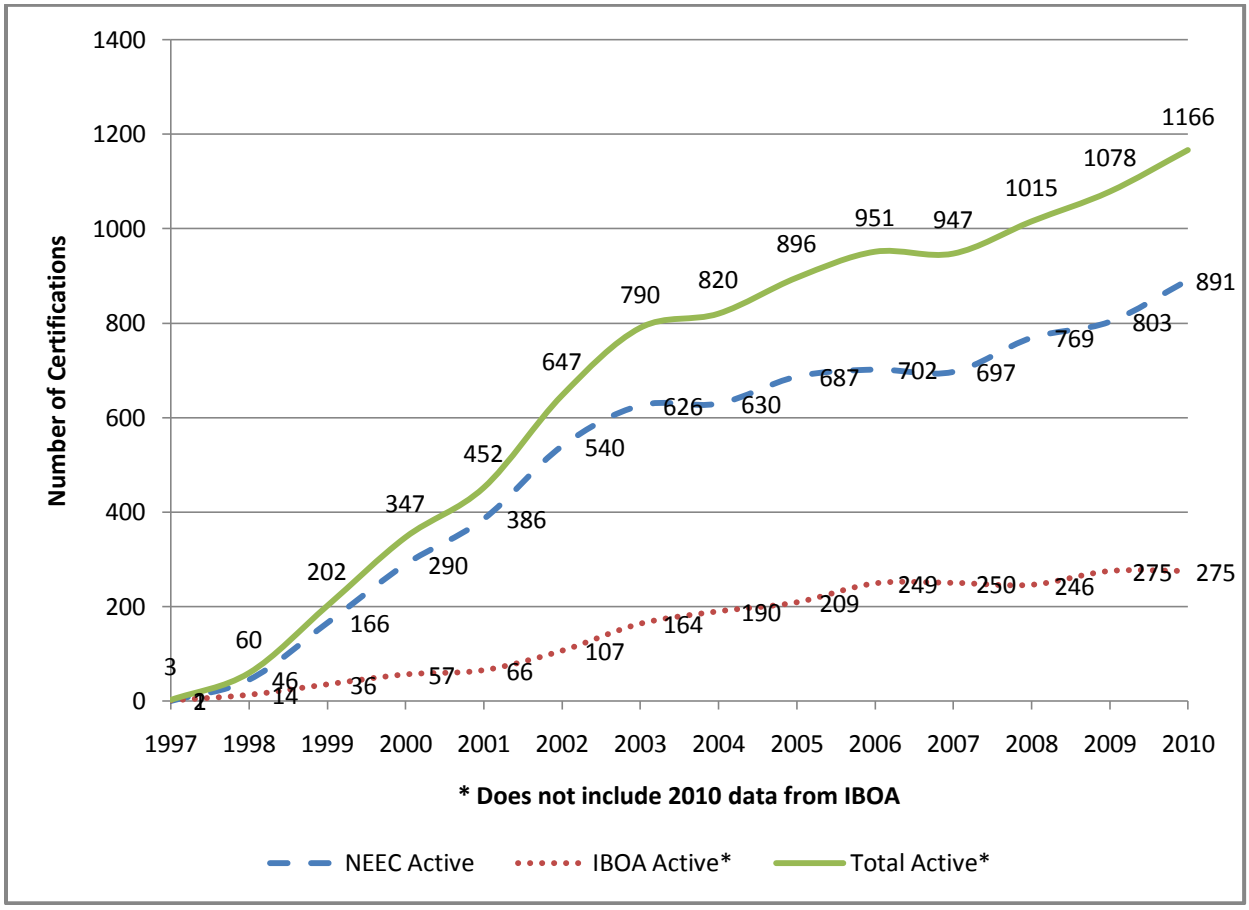
Figure 3-1. Market Activity for NEEC BOC Certifications



Source: Navigant analysis of 2010 NEEC database.

Overall, the total number of active operators continues to rise. Figure 3-2 demonstrates an increasing trend in the number of active, certified building operators in the Northwest. The data does not include data from IBOA about 2010 certifications, which likely would increase the total number of active operators.

Figure 3-2. Total Active BOC Participants by Year



Source: Navigant analysis of 2010 NEEC database and 2009 IBOA database.

EFFECTS OF NEEA'S RECENT REINVESTMENT IN MARKETING BOC

Beginning in 2009, NEEA's commercial sector increased efforts to promote BOC to various market sectors through the BetterBricks initiative by supplying marketing support for the program, providing grant funding to enhance the curriculum, sponsoring informational webinars, and providing some tuition subsidies across the region. The curriculum enhancements incorporate material for building tune-ups, advanced technologies for high-performance buildings, and training modules developed with NEEA. These efforts primarily targeted property management and healthcare sectors with programs such as the "Kilowatt Crackdown" that challenges property owners to reduce energy consumption, or the "E2C" program relating to hospital energy use. NEEA staff believe that these "reinvestments" in the BOC initiative have contributed to the increased demand for BOC certification and at the very least a more robust curriculum.

The rate of increase in certifications in the target sectors, namely healthcare and property management, may serve as one indicator of the effectiveness of the recent BetterBricks marketing efforts. NEEC certified 23 operators in 2010 from the healthcare and property management sectors, representing about a 17 percent increase over the 19 certifications in 2009. This is slightly below the overall increase of 24 percent in certifications across all building types in 2010. It is also noteworthy that the 2009 NEEC database contained several blank entries under the "Company Type" category. It is difficult to say with certainty whether the 17 percent increase in certifications in the healthcare and property management sectors can be traced to the reinvestments. Many other factors, such as an improving economic outlook, come into play.

The 2009–2010 increase in healthcare and property management certifications may not have fully demonstrated the impact of NEEA's efforts to target those two sectors. For example, the recent BetterBricks marketing efforts may have influenced some operators that may still be in the certification process; their certifications will appear in future LTMT analysis. Additionally, some participants influenced by these efforts may not have grouped themselves into the healthcare or property management company type categories specified in the NEEC database.

NEEA's reinvestment efforts did not only target healthcare and property management, and it is difficult to quantify the impacts of these efforts on the increased number of certifications in 2010. Senior staff members at NEEA, NEEC, and NEEI all speculate that these efforts played a role in the increased demand for BOC participation in 2010. The detailed survey questionnaire developed for the 2011 LTMT effort will further assess the impacts of NEEA's marketing and curriculum development initiatives by asking BOC participants to explain the factors that influenced them to enroll in the program.

3.3.2 Baseline Activity

Navigant defines the baseline activity for the BOC initiative as the number of certified building operators that would exist without programs that NEEA influenced. This concept is highly subjective, and difficult to quantify since baseline activity would depend on the existence of an alternative certification program as well as participation in such a program. The current methodology assumes zero baseline activity for building operator certifications before NEEC and IBOA training started in the 1990s, as these were the first programs of their kind when they were developed. Studies of nationwide BOC training indicate that NEEC and IBOA started BOC training in the Northwest and that NEEA championed and supported the program in the early stages.[15] BOC training has now expanded to the Northeast, Midwest, and Southwest, using curricula developed by NEEC and IBOA. *It is clear from the literature that formal building operator training has its roots in the Northwest and continues to grow nationally from this base*.

[15] Marjorie McRae and Beatrice Mayo, *What Building Operators are Saying about BOC Training*, ACEEE 2006 Summer Study.

However, it is likely that other types of educational outreach and training activities have captured some of the same savings as formal training of building operators. The ideas and strategies for saving energy presented in the BOC curricula are not necessarily unique; the organizational structure and delivery method are. It is possible that a certain fraction of building operators *with or without* formal BOC training would have adopted some of these same ideas and strategies for saving energy via informal educational delivery methods, such as best practices guides, articles in trade publications, and in-house sharing of knowledge from self-motivated champions of energy efficiency.

Additional sources for education in energy-efficient building operations include union training, community college courses, and independent organizations such as Building Owners Management Institute (BOMI) International. Although the first two methods do not necessarily provide a credential, they can be a source of education relating to energy-efficient building operations. BOMI International offers a Systems Maintenance Technician certificate structured toward energy-efficient building operations, but the process is not prominent in the Northwest.[16]

It is not clear whether the existing BOC programs in the Northwest influenced these other sources of education. Interviews with NEEC partners revealed that NEEC views these other programs as complementary rather than competitive with the BOC program. Interviews with NEEI staff revealed that these other sources of energy-efficient building operations are fundamentally different from the BOC, primarily as a result of the high-quality classroom delivery of the BOC curriculum.

3.3.3 Per-Unit Energy Savings

Navigant defines per-unit energy savings as the amount of electricity saved during the project year by each active, certified operator as a result of the BOC program. For the 2010 analysis, Navigant used the same methods as in 2009 to estimate savings. Three factors determine the per-unit energy savings:

- Square footage per operator
- Electricity consumption per square foot of participating facilities
- Savings from certification (as a percentage of electricity consumption)

[16] Website for BOMI International, http://www.bomi.org/default.aspx

SQUARE FOOTAGE PER OPERATOR

The 2008 LTMT team performed an in-depth assessment of the square footage for which an average building operator is responsible. This analysis resulted in a value of 286,000 square feet per operator. This assumption remained constant for 2010.

ELECTRICITY CONSUMPTION PER SQUARE FOOT

Navigant replicated the 2009 process to estimate electricity use per square foot of building space. The process matched building types from the NEEC database with corresponding types from the 2009 Commercial Building Stock Assessment (CBSA), resulting in an annual average of 16.7 kWh/ft^2. The 2009 CBSA includes updated energy use intensities (EUIs) for a range of commercial building types. The NEEC certification database includes a facility type for most certified building operator entries. Navigant used the following method to derive an updated energy use intensity value:

1. Navigant extracted a distribution of building types from the NEEC database, giving the number of certified operators that run each type of building. The fraction of total operators in each building category was calculated.

2. The next step mapped the building types in the NEEC database to analogous building types in the 2009 CBSA, thus allowing the EUI for each mapped building type to be calculated. The process easily mapped each building type, aside from manufacturing facilities, which can vary significantly.

3. The final step calculated a weighted average of the building type EUIs using the relative weights from step (1) and the EUIs from (2), with manufacturing assumed at the same size as the average of all others.[17]

The results of this analysis showed an average annual energy consumption of 16.7 kWh/ft^2.

SAVINGS FROM CERTIFICATION

The assumed energy savings realized as a result of BOC certification is 2.5 percent of a facility's energy consumption. Previous LTMT reports have established this value, and Navigant did not change from the 2008 analysis. Multiplying this value by the assumed energy intensity (above) of 16.7 kWh/ft^2 yields an estimate of 0.42 kWh of savings per square foot. This value is consistent with a study prepared for Northeast Energy Efficiency Partnerships by RLW Analytics[18] that calculated minimum annual savings of 0.4 kWh/ft^2 for non-schools. The process used engineering estimates for savings associated with certain O&M actions and previous

[17] The literature often does not address EUIs at manufacturing facilities as they vary dramatically.
[18] RLW Analytics, *Impact and Process Evaluation: Building Operator Training and Certification (BOC) Program Final Report*, Prepared for Northeast Energy Efficiency Partnerships, June 2005.

surveys of certified building operators to determine the frequency that they carried out these O&M actions.

As stated above, the **energy savings per certified building operator** is the product of the following factors:

- 286,000 square feet per operator
- 16.7 kWh electricity consumption per square foot per year
- 2.5 percent savings

This equates to roughly 119,000 kWh of annual savings per operator.[19] This is roughly a 4 percent increase in savings per operator compared to the 2008 LTMT report, due to the finding that the energy use intensity of applicable buildings is higher than previously assumed. For comparison, the annual kWh per operator decreased by nearly 20 percent in the 2008 LTMT report due to the analysis of square footage managed by each operator.

MEASURE LIFE

The measure life assumption of five years is likely conservative. The intent behind the five-year expiration of BOC training is that building operators who do not continue training and certification activities gradually forget material and stop generating energy savings. Alternatively, they may transfer to new positions or to new facilities outside the Northwest. Operators must conduct some O&M measures every year to be successful in saving energy; however, other activities, especially equipment upgrade decisions, may have much longer lives.

These equipment upgrades represent a large, unknown, potential source of energy savings. If certified building operators continue to push for more energy-efficient equipment upgrades, they could generate larger energy savings over a longer period of time than currently assumed. However, given the uncertainty (this LTMT review identified no available data in the literature on this point), it is reasonable to continue with the current five-year assumption for measure lifetime. If the rate of renewals among certified building operators continues to increase, the lifetime assumption will become less important.

3.4 Conclusions and Recommendations

Market activity for NEEC's Building Operator Certification program in the Northwest increased in 2010, adding to the number of active operators in the region. BOC program administrators from various organizations seem to agree that demand for certification will continue to rise. There are some concerns, however, relating to the availability of future funding assistance for program participants, and costs may remain prohibitive to potential students. Organizations in

[19] This savings rate applies to all active operators in 2010.

the Northwest actively promote recertification as a means to maintain a valuable credential and gain continuing education in the field of energy efficiency. Some of the specific findings from the 2010 evaluation effort include the following:

- **Incremental increases in BOC certifications were significant.** New certifications by NEEC in 2010 increased from the 2009 value by approximately 24 percent.

- **The number of annual retirements continues to fall**. NEEC retirements decreased over the previous year by approximately 53 percent, despite the fact that a large number of participants achieved certification five years prior. This signifies that more of the participants are maintaining their credential, as defined by the last certification date in the database.

- **The total number of active certified building operators continues to rise.** Although 2010 IBOA data were not available, the total number of active certified operators rose by roughly 7.5 percent, due to the fact that new NEEC certifications outnumbered NEEC retirements by 88 participants.

Table 3-3 summarizes the key indicators for market activity in 2010. NEEC certified 112 new building operators, bringing the total number of active operators to 1,166 excluding 2010 IBOA data. Incremental savings due to newly certified operators in 2010 reached approximately 1.5 aMW, and the cumulative impact in 2010 from all active certified operators reached nearly 16 aMW.

Table 3-3. Summary of 2010 Key Indicators

Key Indicators Reviewed	2010 Incremental * (Due to *new* activity occurring in 2010)	2010 Cumulative* (Calendar year 2010 values due to all activity since program inception)	Source
Current Market Activity			
Number of active certified building operators	112***	1,166***	Included information from 2010 NEEC database and 2009 IBOA database. 2010 incremental certifications from IBOA not included. Refer to Section 3.3.1.
Current Baseline Activity			
Number of certified building operators in the Northwest	0	0	Refer to Section 3.3.2.
Per-Unit Energy Savings			
Annual electricity savings per certified building operator	119,273	119,273	Refer to Section 3.3.3.
Implied Energy Savings (aMW)**			
Implied Energy Savings (aMW)	1.5***	15.9***	Market activity minus baseline activity, times per-unit savings, divided by 8,760 hours
*2010 IBOA data not included			
** Implied Energy Savings represent estimated savings from market activity less estimated savings from baseline activity. NEEA's reported values might not match those presented here since NEEA adjusts for the effect of utility incentives and other factors not taken into account in this LTMT analysis. ***Market activity and Implied Energy Savings will increase if NEEA is able to obtain IBOA's program tracking database for 2010.			
Source: IBOA and NEEC data and Navigant analysis.			

In the future, NEEA may consider removing BOC from the LTMT effort because NEEA is currently funding the initiative. The LTMT effort is typically reserved for initiatives that NEEA no longer funds; since additional investment is not at stake, NEEA uses a lower level of rigor for LTMT. BOC may warrant deeper analysis in the future.

Navigant recommends the following steps to guide future assessment of the BOC initiative:

- **Encourage NEEC and IBOA to track square footage for participants.** The square footage for which each certified operator is responsible is a driving factor in the energy savings estimates. NEEA should encourage NEEC and IBOA to track and include this information in the database. NEEA should also encourage NEEC and IBOA to track other building characteristics such as age (e.g. new construction vs. existing) to facilitate ongoing analysis and comparison in future LTMT years.

- **Conduct participant surveys to refine per-unit energy savings estimates and baseline energy savings estimates.** Using the survey questionnaire and scoring algorithm prepared as part of the 2010 LTMT effort, future evaluation teams will need to prepare a sample of certified operators and conduct the participant survey. This approach will incorporate a more comprehensive evaluation of pre- and post-certification behavior related to energy-efficient building operations by program participants.

- **Assess both aspects of the baseline, including baseline market activity and baseline energy savings.** *Baseline market activity* represents the number of building operators that would have received training in energy-saving practices similar to that offered by BOC. *Baseline energy savings* represents amount of energy that the participating building operators would have saved in the absence of their participation in the BOC training. Energy-saving practices that these building operators may have adopted due to influences other than the BOC training serve as one form of baseline for the BOC initiative. Navigant therefore recommends the following for establishing the baseline for BOC:

    - **Research baseline market activity.** Baseline market activity reflects the number of building operators who would have received training similar to that offered through BOC in the absence of NEEA's involvement in BOC. A future evaluation effort for BOC could explore the baseline market activity by assessing competitors to BOC and their offerings in the region and nationally. Exploring the factors in the development of their offerings, the timing of their programs' development, and the level of activity in the Northwest would help to assess the extent to which NEEA influenced such developments.

    - **Refine baseline energy savings estimates.** Surveys with non-participants will help to refine baseline energy savings estimates and possibly baseline market activity estimates. The future evaluation team will need to develop the survey questionnaires, an effort that should rely heavily on the participant survey questionnaire. In addition, the future evaluation team will need to adjust the scoring algorithm for participants to reflect the non-participant survey questionnaire. Finally, the future evaluation team will need to conduct the survey with the non-participants; the future evaluation team will work closely with NEEA to determine the appropriate number of respondents for this effort.

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4. Drive Power

NEEA funded the Drive Power Initiative (DPI) between 1999 and 2004, and the Electric League of the Pacific Northwest administered this electric motor market transformation effort, which sought to attain the following objectives:

- Increase the region's overall motor fleet efficiency
- Influence end users' repair/replace decision making for motors to encourage use of life-cycle costing in investment decisions
- Help motor service centers improve their repair practices and expand their motor management services.

The 2010 LTMT is the fourth such assessment of the DPI. The first effort, for 2007, focused on sales of National Electrical Manufacturers Association (NEMA) Premium™ motors and the share of these sales that NEEA influenced. The 2008 M&T effort updated these figures and attempted to quantify the impact of new services and changes in practices at motor repair centers. The 2009 effort established a baseline and market activity trend for the motor repair market through detailed motor service center and market actor interviews. The 2009 effort also updated savings from sales of NEMA Premium™ motors using the previously established methodology and newer motor shipment data.

The 2010 LTMT effort concentrated on updating savings from sales of NEMA Premium™ motors using the most recent shipment data available. The analysis did not cover the motor repair market.

4.1 Assumptions and Indicators for Review

To study the effect of the DPI on the motors market in the Northwest, Navigant identified a list of indicators that would help track the progress of the DPI. This section defines these indicators and describes how they support the market transformation effort. Navigant identified the following indicators:

1. **Sale of NEMA Premium™ motors in the Northwest.** NEEA helped form a premium efficiency motors brand (NEMA Premium™)[20,] and through outreach and education, NEEA encourages customers to purchase NEMA Premium™ motors.

[20] The 2007 report provided details of NEEA's efforts to help form the NEMA premium brand, and the report discussed the savings attributable to NEEA through the sale of NEMA premium motors in the Northwest.

2. **Energy-efficient repair and rewind activity.** Motor service centers in the Northwest are adopting energy-efficient repair methods consistent with Electrical Apparatus Service Association (EASA) best practices. Through these service centers, NEEA also tried to educate customers to request efficient rewinds. The 2007, 2008, and 2009 LTMT reports addressed this indicator. The 2010 report does not address this issue, but the 2011 report will revisit the topic next year.

3. **Effect of outreach activities.** Distribution of the Energy Motor Management (EM2) database and its effect on end-user repair and replacement decisions informed this analysis. The EM2 software helps its users keep track of motors in their facilities and make informed decisions regarding repair and replacements. The 2007 LTMT report discussed this indicator, but the LTMT efforts no longer address this topic.

An important assumption underlying the analysis of savings from sales of new motors is a measure life of at least ten years, roughly the average life of a motor before it is retired or rewound.[21] Since NEMA Premium™ motors first appeared in 2001, the LTMT analyses have assumed no degradation of energy savings due to retirements. Navigant will consider retirement of motors in future M&T efforts as the age of the first NEMA Premium™ motors approaches the assumed measure life.

4.2 Methodology

The 2010 LTMT research built on the activities conducted for the first three LTMT assessments of the DPI. Specifically, Navigant performed the following research activities:

- **Obtained motor shipment data from the Consortium for Energy Efficiency (CEE).** Motor sales data is not widely collected and is difficult to obtain, but shipment data is reasonably available and serves as a proxy for estimating sales. NEMA generates this data and the CEE distributes the NEMA data to its members. Navigant obtained shipment data for both standard and NEMA Premium™ motors.

- **Interviewed experts in the motor industry about motor sales trends and related issues.** Navigant interviewed staff from the Green Motors Practices Group and CEE, each of which contributed to the 2009 LTMT report through similar interviews. In addition, for 2010 Navigant interviewed a representative of BPA.

Table 4-1 summarizes Navigant's primary data collection efforts.

[21] According to DOE (September 2005), motors last between 30,000 and 40,000 hours. This translates to approximately ten years based on motor usage of 3,500 hours per year.

Table 4-1. Primary Data Collection Activities for 2010 Drive Power LTMT

Interviewee Group	Number of Interviews/Surveys	Topic/Issues
Green Motors Practices Group (GMPG)	One extended interview with GMPG management via telephone and email	• New motor sale trends in recent years • Effect of economic recession on new motor sales • State of the current motor repair market • Current motor repair market baseline
Consortium of Energy Efficiency	Two interviews with CEE staff via telephone	• Motor sales trends • Composition of NEMA data
Bonneville Power Administration	One interview with BPA management via telephone	• New motor sales trends in recent years • Effect of economic recession on new motor sales • State of the current motor repair market • Current motor repair market baseline

Source: Navigant analysis 2011.

4.3 Findings

Navigant focused on validating assumptions input directly into the ACE model, NEEA's tool for tracking energy savings associated with this initiative. The information and data collected created a framework for understanding the current state of the market for motors and trends in that market; section 4.3.1 discusses this "market activity." Establishing the role of the NEEA initiative in the evolution of the market requires understanding the scenario that would have ensued in the absence of the initiative; section 4.3.2 discusses this "baseline activity." Establishing the energy savings associated with each NEMA Premium™ motor sold provides the final input needed to calculate the energy savings associated with NEEA's initiative; section 4.3.3 includes this discussion on "per-unit energy savings."

4.3.1 Market Activity

Motor *sales data* are not widely collected and are difficult to obtain, but *shipment data* is reasonably available and serve as a proxy for estimating sales. National shipment data for NEMA Premium™ motors dates back to 2001, with 2008 the most recent year covered in the shipment data provided by CEE. Regional data is available only since 2004, and the reporting sources were not consistent apart from years 2005 through 2007. Navigant applied an adjustment

to the 2005 through 2007 data, and another to the 2008 data, in order to estimate the true number of motor shipments beyond 2004.[22]

In summary, the LTMT analysis used *regional* shipment data, combined with *national trends*, to estimate Northwest sales of NEMA Premium™ motors. The following explanation of LTMT finding begins with a discussion of motor shipment data, and addresses the national trends that form the basis of regional sales estimates.

REPORTED MOTOR SHIPMENT DATA

The raw shipment data, as reported by CEE, indicate that national shipments of NEMA Premium™ motors increased steadily between 2001 (the first year the branded motors were available) and 2006, dropping in 2007. Reported shipments in 2008 increased when compared to 2007, but the 2008 figures include one additional motor manufacturer relative to the prior three years.[23] Table 4-2 through Table 4-5 provide reported shipments of both NEMA Premium™ and standard efficiency motors for the nation and the Northwest from 2001 through 2008.

Table 4-2. Reported Shipments of NEMA Premium™ Motors, 2001–2004*

	2001	2002	2003	2004
Idaho				4,736
Montana				326
Washington		N/A		2,725
Oregon				2,834
Northwest				10,621
Nation	187,170	266,958	311,117	267,220

*Data on standard efficiency motors was not available prior to 2005. OEM motor shipment data were not available after 2003.

Source: NEMA motor shipment data as reported by the CEE.

[22] Motor shipment data does not include original equipment manufacturers (OEMs) in 2004, and one of the major motor manufacturers dropped out of the survey in 2005 (rejoining in 2008).

[23] The raw data for 2004 to 2007 are incomplete because the records exclude motors from OEMs, and at least one of the non-OEM manufacturers pulled out of the motor surveys beginning with the 2005 reporting year. (Sources: 2007 interviews with GMPG and Baldor Electric Co.) The data for 2008 includes all major motor manufacturers and no OEM motors.

Table 4-3. Reported Shipments of NEMA Premium™ and Standard Efficiency Motors, 2005-2006*

	2005				2006			
	Premium	Non-Premium	Total	% Premium	Premium	Non-Premium	Total	% Premium
Idaho	8,677	8,223	16,900	**51%**	8,732	9,428	18,160	**48%**
Montana	**(Included in Idaho)**				**(Included in Idaho)**			
Washington	1,926	7,787	9,713	**20%**	4,048	9,975	14,023	**29%**
Oregon	1,801	10,020	11,821	**15%**	6,536	9,753	16,289	**40%**
Northwest	12,404	26,030	38,434	**32%**	19,316	29,156	48,472	**40%**
Nation	216,852	668,522	885,374	**24%**	238,098	807,795	1,045,893	**23%**

Source: NEMA motor shipment data as reported by the CEE.

* One motor manufacturer stopped reporting shipments as of 2005.

Table 4-4. Reported Shipments of NEMA Premium™ and Standard Efficiency Motors, 2007

	Premium	Non Premium	Total	% Premium
Idaho	13,347	9,833	23,180	**58%**
Montana	**(Included in Idaho)**			
Washington	3,183	10,522	13,705	**23%**
Oregon	3,216	11,981	15,197	**21%**
Northwest	19,746	32,336	52,082	**38%**
Nation	217,604	838,621	1,056,225	**21%**

Source: NEMA motor shipment data as reported by the CEE.

Table 4-5. Reported Shipments of NEMA Premium™ and Standard Efficiency Motors, 2008*

Region	Premium	Non Premium	Total	% Premium
Idaho	9,143	6,521	15,664	**58%**
Montana	**(Included in Idaho)**			
Washington	3,028	8,046	11,074	**27%**
Oregon	3,475	9,724	13,199	**26%**
Northwest	15,646	24,291	39,937	**39%**
Nation	240,912	723,826	964,738	**25%**

Source: NEMA motor shipment data as reported by the CEE.

* The motor manufacturer that had previously dropped out of the survey reported motor shipments in 2008 for the first time since 2004.

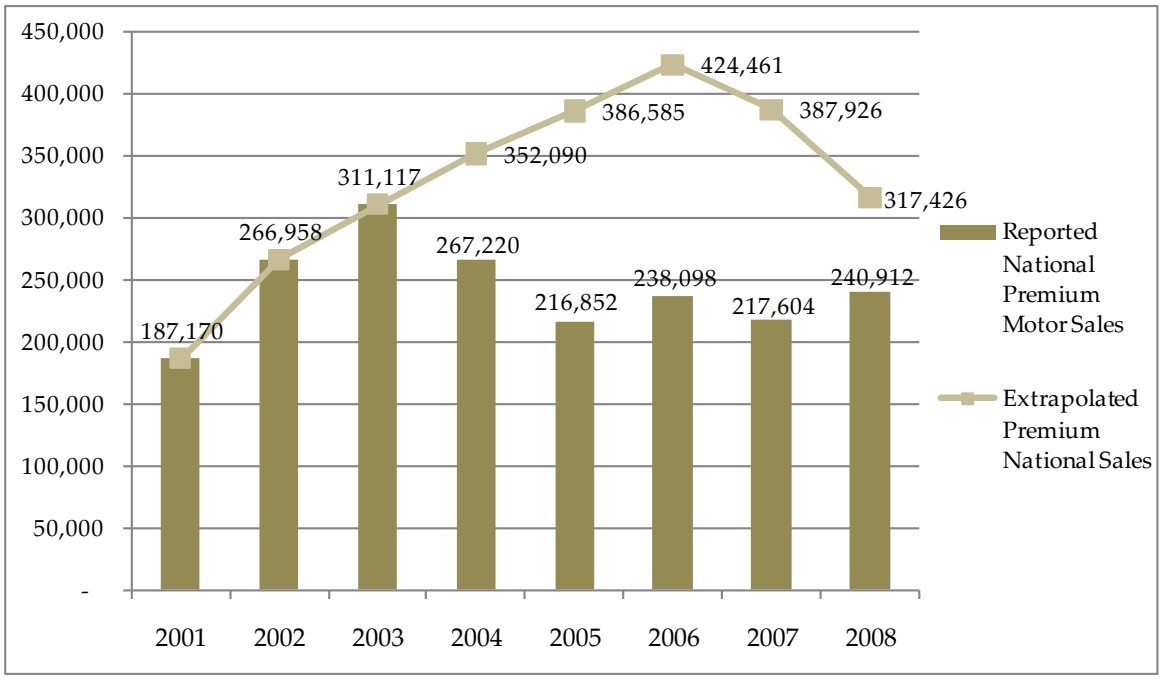
NATIONAL MOTOR SHIPMENT TRENDS

As in previous LTMT reports, Navigant used national motor shipment data from the CEE to estimate sales data for each year since 2001. Due to the data deficiencies described above, Navigant estimated the total number of NEMA Premium™ units shipped in 2004 through 2008 from the available data. This estimation proceeded as follows (see Figure 4-1 for estimated shipments):

1. **2004 NEMA Premium™ shipments.** The estimate of 2004 national shipments assumed the average of annual growth rates from the year before and after 2004. Data sources remained consistent between 2002 and 2003 and yielded a 17 percent growth rate. A consistent set of sources reported data in 2005–2006, during which premium motor sales grew nationally by 10 percent. Navigant applied the average of these two growth rates to 2003 reported shipments to derive an estimate of more than 350,000 motors shipped in 2004.
2. **2005–2007 NEMA Premium™ shipments.** The estimate of 2005 shipments used the annual growth rate of *reported* shipments between 2005 and 2006 (the nearest period with consistent reporting data), as applied to the 2004 motor shipment estimate. Building on this 2005 estimate, annual growth rates from reported data for 2006 and 2007 yielded estimates for shipments in these years. The result is a peak of nearly 425,000 NEMA Premium™ motors shipped in 2006, declining to less than 390,000 in 2007.
3. **2008 NEMA Premium™ shipments.** In 2008, the motor manufacturer that had dropped out of the survey in 2005 began reporting data to NEMA again. As a result, the reported data between 2007 and 2008 did not consist of a common set of companies, and any calculated growth rate would have little meaning. Instead, the LTMT analysis assumed that the ratio of actual shipments to reported shipments in 2008 was the same as in 2004—the last year for which all non-OEM motor manufacturers reported shipments. This ratio—which effectively adjusts for the missing OEM data—was 1.32 in 2004 and results in estimated shipments in 2008 of approximately 317,000 (Figure 4-1).[24]

[24] According to interviews with GMPG, OEMs account for approximately 33 percent of total motor sales. If this were accurate, then the required adjustment factor to correct for the incomplete reporting data would be 1.5. The LTMT estimated resulted in an adjustment factor of 1.32.

Figure 4-1. National NEMA Premium™ Shipments, 2001-2008



* Only non-OEM motor shipments were reported from 2004 onwards; one major manufacturer ceased reporting beginning in 2005, but began again in 2008.
Source: NEMA data reported by the CEE and Navigant analysis.

REGIONAL SALES

This subsection describes how the LTMT assessment estimated NEMA Premium™ motor sales in the Northwest using national and regional shipments through 2008. The following discussion describes the analytic methods and findings.

2001 NEMA Premium™ Sales: Navigant estimated NEMA Premium™ sales in the Northwest based on previous research. MPERs and previous LTMT reports indicated that NEEA's influence on the sale of NEMA Premium™ motors was minimal in 2001, the first year for which data is available.[25] Therefore, the baseline in 2001 includes all regional premium motor sales. Since regional motor shipment data was not available until 2004, the analysis assumed that premium motor shipments in the Northwest in 2001 could be estimated based on national premium motor shipment data and on the region's share of all motors (premium and non-premium) shipped nationally in that year. Navigant used the Northwest's share of the U.S. population in 2001 as a proxy for the ratio of total motors shipped in the Northwest to total

[25] NEMA premium motor sales only started in 2001, as documented in the 2007 M&T report. Until that time, the initiative was in a planning stage, and fieldwork was actively conducted only late in the year.

motors shipped nationally. This ratio of 4.8 percent translates into an estimate of approximately 9,000 NEMA Premium™ motors shipped and sold in the Northwest in 2001.[26]

2002–2004 NEMA Premium™ Sales: The assessment calculated sales based on linear interpolation between the 2001 and 2005 estimates.

2005–2007 NEMA Premium™ Sales: Regional shipment data for NEMA Premium™ motors is available back to 2004. However, similar to the national data, the regional data for these years does not include OEM motors (starting in 2004) or shipments from one of the major motor manufacturers (starting in 2005). Therefore, Navigant applied an adjustment factor to each year's data for Northwest premium motor shipments to convert from *reported* shipments to a projection of *actual* shipments. (See Table 4-3 for regional data from 2005 through 2007.) This adjustment factor equals the ratio of projected *national* shipments to reported *national* shipments (see Figure 4-1 above). Since 2006 and 2007 projections reflected annual growth in reported shipments, the adjustment factor of approximately 1.8 is the same value for each year between 2005 and 2007. The result is an estimate of more than 22,000 NEMA Premium™ motors shipped in 2005, rising to more than 35,000 in 2007.[27]

2008 NEMA Premium™ Sales: In 2008, one would expect the adjustment factor to be smaller than in previous years since the motor manufacturer that had dropped out of the survey in 2005 began reporting again. This change in reporting entities meant that the set of companies reporting in 2008 included all major motor manufacturers, but none of the OEMs—the same makeup of companies as in 2004 when the ratio of projected national shipments to reported national shipments was approximately 1.3 (see Figure 4-1 above). Applying this adjustment factor to the 2008 reported data yields an estimate of approximately 20,600 motors sold in the Northwest in 2008.

NEMA Premium™ motor shipments decreased by nearly half between 2007 and 2008, even though the market penetration of premium motors remained almost constant at just under 40 percent. Navigant learned from the BPA interview (corroborated by GMPG) that in 2008, due to the recession, large mills in the Northwest went out of business, resulting in inexpensive second-hand motors (including NEMA Premium™ motors) entering the market in the Northwest. As a result, new motor purchases decreased, effectively lowering sales of both standard and premium efficiency motors in the region.

It should be noted that whereas national shipments of NEMA Premium™ motors, *as reported by CEE,* dropped by 10 percent between 2004 and 2008 (owing to the factors discussed previously), reported shipments of premium motors in the Northwest increased by 47 percent. This suggests

[26] Navigant confirmed the appropriateness of using population as a proxy for motor sales by analyzing regional data for the first three years where it was available. Based on shipment data for 2005-2007, the Northwest accounted for 4.7 percent of total motor shipments nationally, compared to the proxy value of 4.8 percent used for 2001.

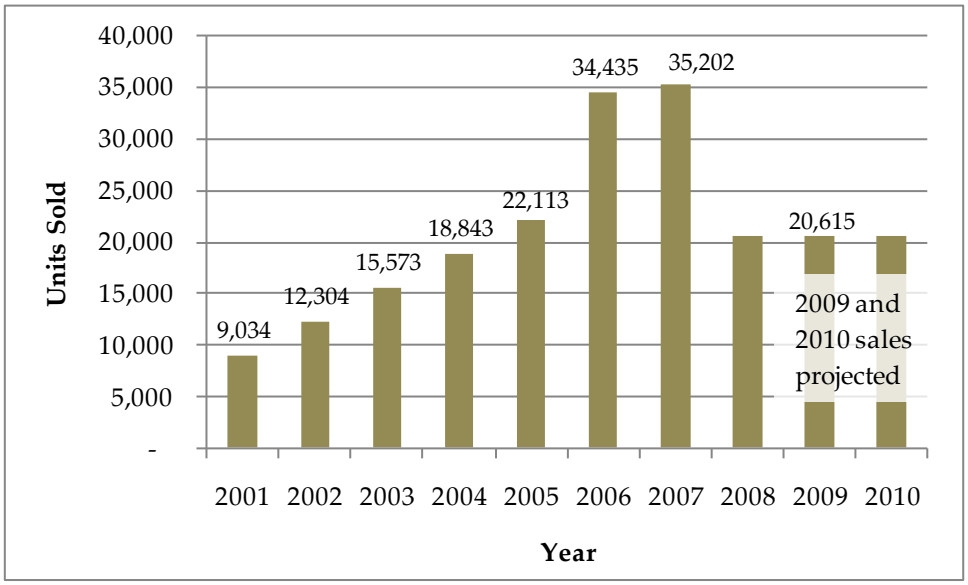
[27] The methodology used to determine adjustment factors implicitly assumes that the ratio of OEM to non-OEM motors is the same nationally and in the Northwest.

that premium motor sales in the Northwest have trended upward at a significantly higher rate than they have nationally.

2009–2010 NEMA Premium™ Sales: As noted above, sales of premium motors in the Northwest declined in 2008 to below 2005 levels, likely due to the economic recession. Despite the modest recovery of the past two years, Navigant assumes that sales in 2009 and 2010 remain flat.

Figure 4-2 illustrates the growth in NEMA Premium™ motor sales in the Northwest since 2001, followed by a leveling off in 2007 and a decline in 2008. Based on these estimates, total premium motor sales in the region since 2001 are nearly 210,000 units.

Figure 4-2. Estimated NEMA Premium™ Motor Sales in the Northwest, 2001–2010 *



*Navigant projects values based on reported national shipment data from 2001 through 2008 and on regional data from 2004 through 2008. Navigant assumes that premium motor sales remain flat between 2008 and 2010.
Source: CEE data and Navigant analysis.

Since 2005, CEE obtained sufficient data from motor manufacturers to publish a national and state motor shipment report for both NEMA Premium™ and non-NEMA Premium™ motors. The market share of NEMA Premium™ motors in 2008 was 39 percent in the Northwest, with larger motor sizes generally tending to have a greater market penetration (Table 4-6).

Table 4-6. NEMA Premium™ Shipments in the Northwest by Size, 2008

	1-5 HP	6-20 HP	21-50 HP	51 - 100 HP	101 - 200 HP	201-500 HP	Total
NEMA Premium™ Motors	7,043	5,003	2,180	828	440	152	15,646
Non-NEMA Premium™ Motors	14,856	6,086	2,158	605	328	258	24,291
Total Motor Shipments	21,899	11,089	4,338	1,433	768	410	39,937
NEMA Premium™ Share of All Motors	32%	45%	50%	58%	57%	37%	39%

* The CEE data provided the figure of 15,646 for total NEMA Premium™ motors shipped in 2008. As discussed above, Navigant estimated the total at 20,615, which accounts for missing data for OEM motors.

Source: NEMA data as reported by the CEE.

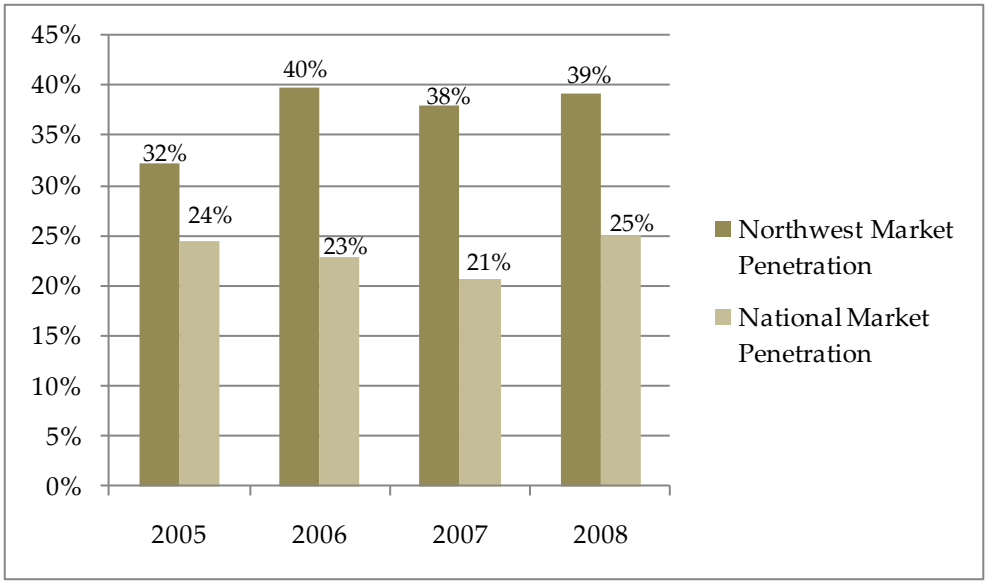
4.3.2 Baseline Activity

Baseline activity refers to sales of NEMA Premium™ motors that would have occurred even in the absence of NEEA's Drive Power effort. As discussed in the 2007 LTMT report, an existing standard for efficient motors existed prior to NEMA. However, this standard was often reported as unclear and confusing and was never a popular choice with consumers. This gave rise to the need for a new, easily recognizable specification. A summit held with NEEA, CEE, the U.S. Environmental Protection Agency, and various motor manufacturers in 1999 and 2000 led to the establishment of the NEMA Premium™ brand. NEMA Premium™ is an easily recognizable third-party brand that can provide credibility to an efficient motor product.

NEEA actively participated in all the decisions that led to the formation of the NEMA Premium™ brand; it also provided the working committee with some case studies. NEEA can claim some responsibility for the savings from the sale of NEMA Premium™ Motors, as NEEA was integrally involved in the formation of the NEMA Premium™ brand. Through other programs in which NEEA participated, such as one-on-one consumer outreach activities, the NEMA Premium™ brand awareness grew in the Northwest, leading to higher market penetration.

As previously discussed, the LTMT research indicated that NEEA's influence on the sale of NEMA Premium™ motors was minimal in 2001. Therefore, the 2001 baseline is the same as the estimated market activity of approximately 9,000 units. The analysis of baselines for 2002 through 2004 uses linear interpolation between the 2001 and 2005 values; *for 2005 through 2008, the baseline market share uses NEMA Premium™ motors' share of all motors shipped in the nation* as reported by NEMA to the CEE. The national market share for NEMA Premium™ motors was 24 percent of *all motors sold* in 2005, dropping to 21 percent in 2007 and increasing to 25 percent in 2008 (Figure 4-3). For comparison, the figure also presents the higher NEMA Premium™ market shares for the Northwest.

Figure 4-3. National NEMA Premium™ Motor Sales as Share of All Motor Sales, 2005–2008*



*Source: NEMA motor shipment data as reported by the CEE.

Based on the approach described above, the LTMT assessment calculated baseline sales of premium efficiency motors in the Northwest for 2005–2008 by multiplying each year's *national market share* (in percent) by the estimated *total motor sales* in the Northwest (see Market Activity, above). Navigant assumes that, for 2009 and 2010, the baseline value remains constant at the value calculated for 2008. (This assumption is consistent with the flat projection of sales of NEMA Premium™ motors, above.) This resulted in a 2010 baseline sales estimate of more than 13,000 motors and a cumulative baseline through 2010 of more than 142,000 units (Table 4-7).

Table 4-7. Estimated Baseline Sales of NEMA Premium™ Motors in the Northwest, 2001–2010*

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Northwest Regional Sales**					66,754	84,188	90,458	52,621			NA
National NEMA Premium™ Market Share		NA			24%	23%	21%	25%	NA		NA
Baseline Motor Sales	9,034	10,863	12,692	14,521	16,350	19,165	18,636	13,140	13,140	13,140	140,682

* All sales in 2001 were assumed to be part of the baseline. Complete regional shipment data (including non-premium motors) was not available until 2005; therefore, baseline sales values for 2002–2004 were based on linear interpolation between 2001 and 2005. Navigant assumed that baseline remained constant in 2008 and 2009 at the 2007 level.

* Navigant included all sales in 2001 in the baseline. Regional shipment data with consistent data sources were not available until 2005; therefore, baseline sales values for 2002–2004 were based on linear interpolation between 2001 and 2005. Navigant assumed that 2009 and 2010 baseline activity remained constant at the 2008 level.
Source: CEE and Navigant analysis.

4.3.3 Per-Unit Energy Savings

Estimation of per-unit savings values uses the approach from the 2009 LTMT report but with the most recent motor shipment data (for calendar year 2008). A per-unit savings of 620 kWh per year results. To estimate the savings from replacing standard efficiency motors with NEMA Premium™ motors, Navigant compiled data for hours of operation and average efficiency[28] for Energy Policy Act (EPAct) and premium efficiency motors.[29]

Annual energy consumption for a motor is the product of the following factors:

1) Motor horsepower multiplied by the kW conversion factor of 0.746 kW/hp[30]
2) Annual run-time hours[31]
3) Motor loading factor[32]
4) The number 1 divided by motor efficiency[33]

The savings due to use of a more efficient NEMA Premium™ motor is then the difference in energy consumption between the old motor and the premium efficiency motor. Table 4-8 presents per-unit energy savings due to the use of premium efficiency motors in the Northwest. Navigant weighted savings for various motor size categories according to regional sales volumes from the most recent year of available data (2008). For purposes of calculating energy consumption, Navigant assigned a representative horsepower value to each size category. For this representative horsepower value, Navigant used the average horsepower rating among all NEMA Premium™ motor sizes sold in the Northwest in each size category.[34] This approach resulted in a single per-unit savings estimate of 620 kWh/year for each premium motor sold. Navigant calculated total savings from sale of NEMA Premium™ motors from 2008 through

[28] Although motor efficiencies are available for each motor size that is commercially available, hours of operation are reported for six size ranges only. To calculate energy savings for motors in a given size range, an average efficiency for available motors in that size range was calculated using their respective nominal efficiencies.
[29] The source of the more operation and efficiency data was a DOE report titled *"United States Industrial Electric Motor Systems Market Opportunities Assessment,"* December 2002. Also, see CEE, "CEE Premium Efficiency Motors Initiative – Efficiency Specifications," 2010.
[30] One kilowatt is equal to 0.746 horsepower. The factor converts motor power ratings (reported in hp) to kilowatts, the units commonly used by NEEA for measuring energy savings.
[31] Run-time hours vary for motors of different sizes. Navigant obtained these values from the Green Motors Practices Group's July 2007 submittal to the Northwest Power and Conservation Council's Regional Technical Forum.
[32] Motor loading factor is the percentage of total operation hours that a motor runs on full load. Navigant assumed that the motor loading factor was 0.68. Source: "Quality Motor Rewinding an Energy Efficiency Measure." See RTP submittal from previous footnote.
[33] For each motor size, Navigant averages the efficiency figures across the values for three revolutions per minute (RPM) levels as well as both open and drip-proof motors. Base efficiency assumptions were for efficiencies of federal standard (EPAct) efficiency motors. NEMA Premium™ efficiencies were obtained from CEE. See Footnote 29.
[34] For example, available motor sizes in the 1 to 5 hp category include 1hp, 1.5hp, 2hp, 3hp, and 5 hp, for an average of 2.5 hp. By contrast, the 2008 M&T analysis assumed a simple average of the high and low values within the size category (i.e., the average of 1hp and 5 hp equals 3 hp). Source: DOE.

2010 by multiplying the per-unit savings value (620 kWh/year) to motor sales in those years. For each prior year where shipment data were available by horsepower (2005 through 2007), Navigant applied the per-unit savings calculated from that year's data. The analysis applied the per-unit savings value from 2005 to all previous years.

Table 4-8. Average Per-Unit Energy Savings from NEMA Premium™ Motors in the Northwest, 2008

Size Category (HP)	Size of Average Motor (HP) (A)	Average Annual Hours of Operation (B)	Average EPAct Efficiency * (C)	Average NEMA Efficiency * (D)	Average Per-Unit Savings ** *kWh* (E)	Annual Sales in the Northwest *** (F)	Annual Savings in the Northwest *MWh* (E*F/1000)
1 to 5	2.5	2,745	84.2%	86.2%	99	7,043	697
6 to 20	13.1	3,391	89.8%	91.2%	408	5,003	2,041
21 to 50	36.3	4,067	91.9%	93.0%	1,012	2,180	2,206
51 to 100	78.3	5,329	93.4%	94.4%	2,259	828	1,870
101 to 200	143.8	5,200	94.4%	95.2%	3,281	440	1,444
201 to 500	350.5	6,132	94.4%	95.2%	9,435	152	1,434
Total		**N/A**	**N/A**	**N/A**	**620**	15,646	9,693

* Motor Efficiency data were available for different motor sizes (hp). Navigant calculated an average efficiency for a particular size range to estimate per-unit energy savings. Navigant assumed that all sizes had equal weight.
** Navigant calculated per-unit energy savings according to the following formula (using lettered column labels above): kWh savings = A*(0.746)*B*(0.68)*(1/C – 1/D).
*** CEE shipment reports for 2008 provide the annual NEMA Premium™ sales by motor size.
Source: Navigant analysis and DOE. December 2002. *United States Industrial Electric Motor Systems Market Opportunities Assessment.* Table 1-15.

NEEA reviewed the Industrial Initiative's Continuous Energy Improvement (CEI) program data and identified three premium motors measures implemented in 2010 for which energy savings were validated. NEEA adjusted its ACE Model for NEMA Premium motors to account for these three measures to avoid an overlap with utility incentives. As CEI begins to diffuse into the market, NEEA will utilize evaluation methodologies that will estimate any overlap between CEI and NEMA Premium utility incentives.

4.4 Conclusions and Recommendations

NEEA's promotion of NEMA Premium™ motors led to a significant market transformation in the Northwest, as evidenced by the following:

- Sales of NEMA Premium™ motors in the Northwest grew continuously through 2007 before decreasing in 2008 back to roughly the 2006 level. The 2008 decline in premium motor sales is likely due to the significant decrease in total motor sales in the region due to the economic downturn. The market penetration of NEMA Premium™ motors has remained roughly constant since 2006 at approximately 39 percent.
- Through 2008, the sale of NEMA Premium™ motors has more than doubled since 2001. Before the recession, through 2007, the sale of sale of NEMA Premium™ motors had increased almost four-fold since 2001.
- NEMA Premium™ motors have comprised 37 percent of motor sales in the Northwest since 2005, while national market share has remained at only 23 percent.

Table 4-9 summarizes recommendations for the values of key indicators for both premium motor sales and energy-efficient rewinds. The LTMT analysis estimates that more than 20,000 NEMA Premium™ motors sold in the Northwest in 2010, bringing cumulative sales since 2001 to approximately 209,000 units. Navigant estimates baseline sales at approximately 13,140 in 2010, or just less than two-thirds (63 percent) of the projected total market activity. With an annual per-unit savings of 620 kWh, the incremental energy savings implied by these figures is 0.5 aMW in 2010, for a cumulative total of 4.4 aMW.

Table 4-9. Recommendations for Key Indicators—NEMA Premium™ Motor Sales

Key Indicators Reviewed	2010 Incremental (Due to new activity occurring in 2010)	2010 Cumulative (Calendar year 2010 values due to all activity since program inception)	Source
Current Market Activity			
NEMA Premium™ motors sold in the Northwest	20,615	209,348	Section 4.3.1
Current Baseline Activity			
NEMA Premium™ motors sold in the Northwest	13,140	142,760	Section 4.3.2
Per-Unit Energy Savings			
Annual energy savings per motor (kWh/motor per year)	620	574	Section 4.3.3
Implied Energy Savings			
Implied Energy Savings (aMW)	0.5	4.4	Market activity minus Baseline activity, times per-unit savings, divided by 8,760 hours, divided by 1000

* Implied Energy Savings represent estimated savings from market activity less estimated savings from baseline activity. NEEA's reported values might not match those presented here, because NEEA adjusts for the effect of utility incentives and other factors not taken into account in this LTMT analysis.
Source: Navigant analysis 2011.

Future LTMT efforts should continue tracking of new premium efficiency motor sales as newer data become available. In addition, future LTMT efforts should attempt to better quantify the rewind market and associated savings. Specifically, Navigant recommends the following steps for future LTMT efforts.

- **Conduct a streamlined update to the NEMA Premium™ motor sales assessment in the Northwest**, at least for one more year before CEE makes motor shipment data through 2010 available. New federal standards went into effect on December 19, 2010, that made NEMA Premium™ motors the new standard. CEE releases motor shipment data each year that can be used for these updates. Since data is from two years prior to the release date, the new data allows for a validation of the market activity projections made

in the LTMT analysis. This annual update should be focused on the new shipment data and include limited secondary research and interviews.

» **Develop a more robust characterization of market activity, baseline, and per-unit savings for efficient rewinds.** As part of the 2010 LTMT effort, Navigant conducted interviews with BPA and with GMPG to identify areas that warrant further investigation. These include the following:

- **Future LTMT efforts should continue efforts, begun in 2009, to quantify the rewinds actually performed according to EASA guidelines.** According to the BPA representative, only a minority of motor service centers in the Northwest that rewind motors according to EASA Tech Note 16 guidelines are reporting them to the GMPG. This is mainly due to lack of reporting and recordkeeping by the motor service centers.
- **Further interviews with market actors will help NEEA better understand the baseline for efficient motor rewinds.** According to the 2009 LTMT report, 10 percent of all motor service centers performed EASA-compliant rewinds before the DPI started exerting influence on the motors market. BPA believes that more than 10 percent of the motor service centers had the capability to conduct EASA-compliant rewinds at the time.
- **Future LTMT efforts should review per-unit energy savings through market actor interviews and analysis of GMPG records that track the number of rewinds performed.** Interviews with BPA and GMPG indicated that previous LTMT efforts' assumed per-unit motor rewind savings were conservative. The LTMT assumed that the size of the average rewound motor is 75 HP. According to the BPA and GMPG, the average rewound motor should be much larger than the assumed 75 HP motor.

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5. ENERGY STAR Residential Windows

The Northwest Energy Efficiency Alliance funded the ENERGY STAR Residential Windows initiative from February 1998 to June 2001. The key market actors targeted by the initiative included, among others, window manufacturers, regional utilities, builders, retailers, and wholesalers. The initiative intended to increase the market penetration for high-efficiency fenestration products in the residential market and to decrease at least two market barriers—lack of awareness and initial cost premiums.

The focus of the LTMT efforts to assess the ENERGY STAR windows initiative has evolved over the years. The early efforts focused on estimating the size of the market, determining the market penetration of ENERGY STAR windows in the Northwest, and estimating the expected energy savings due to reductions in the use of HVAC equipment caused by more efficient windows. More recent efforts involved updating both the national and regional data using market reports published by the Window and Door Manufacturers Association (WDMA) and the American Architectural Manufacturers Association (AAMA).

The primary improvement for the 2010 LTMT effort has been to update the regional market penetration figures using the latest comprehensive statistical analysis of the windows and doors report published by the WDMA/AAMA. Reports published by the WDMA/AAMA in odd years include nationally aggregated data, whereas reports published in even years have detailed regional data. The latest report, published in May 2010, provides aggregated data at a regional level. This year's LTMT assessment has put the schedule cycle "on track" with these more detailed reports. The 2010 LTMT analysis uses the complete report to update both national and regional sales figures.

5.1 Assumptions and Indicators for Review

The energy savings impact of the ENERGY STAR windows initiative broadly bases its analysis on the market penetration and baseline of ENERGY STAR windows as measured by the energy savings per unit of installed window area. The energy savings further depend on home type and vintage and the types of heating and cooling systems in the home. At a high level, Navigant calculates incremental energy savings for a given calendar year as follows:

Energy Savings =

(1) Windows shipped in the Northwest
x (2) Average area per window
x (3) Market penetration of ENERGY STAR windows
x (4) Market penetration of heating and cooling system types
x (5) Savings per unit of window area (stratified by heating and cooling types)

where

1. **Windows shipped in the Northwest** is the number of windows shipped by manufacturers in the Northwest each year based on data found in market research studies published by Ducker Research Company and the WDMA/AAMA.

2. **Average area per window** is the number of square feet for an average product, which varies by window type (e.g., windows, doors, and skylights).

3. **Market penetration of ENERGY STAR windows** is the percentage of residential windows shipped in the region that are ENERGY STAR.

4. **Market penetration of heating and cooling system types** comes from data supplied by the Northwest Power and Conservation Council (NW Council). The appropriate market penetration value used in the savings calculation depends on home type, home vintage, and the type of savings being calculated (e.g., electric or gas, heating or cooling).

5. **Savings per unit of window area** is the annual energy savings due to reduced HVAC energy consumption per unit of window area. Navigant uses values taken directly from analysis conducted by the NW Council; savings vary based on home type, vintage, fuel type, and the HVAC system component demonstrating reduced energy usage. The LTMT analysis includes:

   - Electricity savings due to reduced electric-heating usage
   - Electricity savings due to reduced central air conditioner usage
   - Gas savings due to reduced gas-heating usage
   - Electricity savings due to reduced gas furnace-fan operation

The LTMT effort only analyzes electric savings.

5.2 Methodology

The 2010 LTMT effort for the ENERGY STAR Windows initiative provides an update to the market activity and baseline for ENERGY STAR residential windows. Specifically, Navigant conducted the following data collection and analysis activities.

1. **Purchased the updated WDMA/AAMA Study of the U.S. Market for Windows, and Doors and Skylights.** This biannual publication contains research on windows, doors, and skylight markets and provides updated regional and national window shipment data.
2. **Contacted the NW Council.** NW Council staff provided updates to the per-unit savings estimates and market penetration of various HVAC system types by home type and vintage since the last LTMT effort.

3. **Updated estimates.** Updated market penetration and baseline estimates using the approach applied in the 2007 LTMT assessment.
4. **Calculated savings.** Applied the per-unit savings to the updated market penetration and baseline estimates to calculate the implied energy savings related to NEEA's involvement in this market.

Table 5-1 summarizes the primary data collection activities conducted for the 2010 Windows LTMT.

Table 5-1. Primary Data Collection Activities for 2010 Windows LTMT

Interviewee Group	Number of Interviews/Surveys	Topic/Issues
NW Council	Two phone interviews NW Council's expert on residential energy efficiency	• Updates to the per-unit energy savings estimates • Updates to the penetration levels of HVAC system types by home type and vintage

Source: Navigant analysis 2011.

5.3 Findings

Navigant focused on validating assumptions input directly into the ACE model, NEEA's tool for tracking energy savings associated with this initiative. The information and data collected created a framework for understanding the current state of the market for ENERGY STAR windows and trends in that market; section 5.3.1 discusses this "market activity." Establishing the role of the NEEA initiative in the evolution of the market requires understanding the scenario that would have ensued in the absence of the initiative; section 5.3.2 discusses this "baseline activity." Establishing the energy savings associated with each square foot of ENERGY STAR windows sold provides the final input needed to calculate the energy savings associated with NEEA's initiative; section 5.3.3 includes this discussion on "per-unit energy savings."

5.3.1 Market Activity

Navigant estimated the number and total area of windows shipped in the Northwest from 2001 to 2010, the market penetration of ENERGY STAR windows, and the penetration of different HVAC systems, including electric space heating, gas space heating, and central air conditioning.

WINDOWS SHIPPED IN THE NORTHWEST

The analysis of ENERGY STAR windows market activity has used window shipments as a proxy for sales since the first LTMT assessment of NEEA's ENERGY STAR windows initiative in 2004. Navigant uses market research reports published by Ducker Research Company and the WDMA/AAMA to document the number of windows shipped in the Northwest from 2001 to

2010. Ducker publishes complete reports with data disaggregated by region once every two years and summary reports with data aggregated at the national level for the in-between years. Before this year's analysis, the last complete report that NEEA purchased contained final data only through 2003. As a part of this year's evaluation efforts, NEEA purchased a complete version of the most current regional and national data.

Navigant uses population data to assess the amount of market activity in Idaho and Montana. The regional shipment data only covers Washington and Oregon as part of the Northwest region; Idaho and Montana are part of the Mountain region, which includes eight other states. The Northwest region's data is a starting point for assessing market activity in Idaho and Montana because the states in the Mountain region represent a much more diverse group of consumers than the Northwest. Navigant uses population data from the U.S. Census Bureau for Washington, Oregon, Idaho, and Montana to determine a population ratio between the states included in the Pacific Northwest. The population ratio is a proxy applied to the regional shipment data for Washington and Oregon that estimates the market size and the number of windows shipped to Idaho and Montana.

Table 5-2 shows the number of fenestration products shipped in the Northwest from 2007–2010. Navigant finds that the gross window shipments have steadily declined since 2005, but WDMA/AAMA forecasts an increase for 2010. A more detailed table that shows window shipments starting in 2001 is located in Appendix B.

Table 5-2. Fenestration Products Shipped in the Northwest from 2007–2010 (Thousands)

Year	New Construction			Existing Homes		
	Windows	*Skylights*	*Patio Doors*	*Windows*	*Skylights*	*Patio Doors*
2007	918	22	72	1,566	32	110
2008	671	16	93	1,386	24	81
2009	733	10	60	1,056	22	68
2010	862	12	70	1,140	23	73

Note: Ducker's report of actual market activity informs the data presented for 2007–2009; Ducker's forecast for 2010 informs data for that year.
Source: Navigant analysis of Ducker Research and WDMA/AAMA market reports 2009 and 2010.

The average area per window varies by window type established as a part of the 2007 LTMT effort:

- Windows – 16 square feet per unit shipped
- Skylights – 6 square feet per unit shipped
- Patio Doors – 40 square feet per unit shipped

Table 5-3 shows the total area of windows shipped in the Northwest from 2007 to 2010. A more detailed table with data starting from 2001 is located in Appendix B.

Table 5-3. Total Area of Windows Shipped in the Northwest from 2007–2009 (Thousand Square Feet)

	New Construction	Existing Homes	Total
2007	17,929	24,004	41,933
2008	14,624	19,582	34,206
2009	14,147	19,648	33,795
2010	15,759	21,886	37,646

Note: (1) Ducker's report of actual market activity informs the data presented for 2007–2009; Ducker's forecast for 2010 informs data for that year.
(2) Reported numbers may not reflect the exact values listed in previous tables due to rounding.
Source: Navigant analysis of data in Table 5-2 and assumptions regarding average area per window.

MARKET PENETRATION OF ENERGY STAR WINDOWS

Based on research conducted for the 2007 LTMT effort, Navigant found that the ENERGY STAR market penetration for windows continued to grow after NEEA ceased funding. By 2007, the market penetration had risen to 95 percent. This growth proceeded as follows:

- The evaluation of the initiative included research efforts to establish the market penetration of ENERGY STAR windows during the years 1997–2000.[35] Navigant based its estimates on interviews with window manufacturers, retailers, wholesalers, distributors, and builders. The results suggested that market penetration of ENERGY STAR in windows shipments had grown from just 13 percent in 1997 to 57 percent by the end of 2000, and to 66 percent by the second quarter of 2001.

- In the research conducted for the 2004 LTMT effort, Navigant found that ENERGY STAR market penetration continued to grow after NEEA ceased funding. By 2004, it had risen to 89 percent. Interviews with a small sample of window manufacturers in the Northwest formed the basis for the estimates for 2001–2004; Navigant estimates that this group of manufacturers accounts for more than 50 percent of the market.

- As a part of the 2007 effort, Navigant updated and confirmed the high level of market penetration through informal discussions with a group of regional manufacturers. These

[35] See the 2004 LTMT report for more details. Summit Blue Consulting, LLC. *NW Alliance Residential ENERGY STAR Windows Program – Draft M&T Findings.* March 11, 2005. Prepared for the Northwest Energy Efficiency Alliance.

interviews indicate that the market penetration for ENERGY STAR windows had increased to approximately 95 percent by the end of 2007.

In 2008, NEEA shared with ENERGY STAR the findings from the 2007 LTMT report, which showed that the penetration of ENERGY STAR windows in the Northwest was nearing 100 percent. NEEA urged ENERGY STAR to revise the qualification for windows from a U-Factor of 0.35 Btu/h. ft^2 ºF to a U-Factor of 0.30 Btu/h. ft^2 ºF As of January 4, 2010, ENERGY STAR revised the qualification for windows accordingly. Although this specification change may affect the market penetration of ENERGY STAR windows overall, NEEA did not take credit for the modification in 2010 in order to account for the consumption of remaining stock of the 0.35 Btu/h. ft^2 ºF; NEEA does plan to claim credit for the revised standard in 2011 and beyond. For 2010, NEEA plans to report the savings for windows with a U-Factor of 0.35.

Navigant proposes that the market penetration of residential windows for which NEEA counts savings stay constant at 95 percent. Market penetration of ENERGY STAR windows has already reached a very high level. In the absence of a detailed market penetration study, it is reasonable to assume that the market penetration stays at 95 percent. This recommendation is consistent with the current inputs in the ACE model for the ENERGY STAR residential windows initiative.

Table 5-4 shows the market penetration of ENERGY STAR windows as a percentage of all windows shipped and as total window area from 2007 through 2010. A detailed table with data from 1997 through 2010 is located in Appendix B.

Table 5-4. Market Penetration of ENERGY STAR Windows Shipped in the Northwest from 2007–2010

	ENERGY STAR Market Penetration (%)	New Construction (sq ft x 1,000)	Existing Homes (sq ft x 1,000)	Total (sq ft x 1,000)
2007	95%	17,032	22,804	39,836
2008	95%	13,892	18,603	32,496
2009	95%	13,440	18,665	32,105
2010	95%	14,971	20,792	35,764

Note: Ducker's report of actual market activity informs the data presented for 2007–2009; Ducker's forecast for 2010 informs data for that year.
These market penetration data reflect those units bearing the ENERGY STAR label through 2009. In 2010 and beyond, the market penetration reflects those units for which NEEA counts savings.
Source: Navigant analysis of interview data applied to gross window areas from Table 5-3.

MARKET PENETRATION OF HEATING AND COOLING SYSTEM TYPES

All of the assumptions regarding the market penetration of heating and cooling system types come directly from data supplied by the NW Council. The 2007 LTMT effort validated these estimates and detailed the approach to calculating them; the 2007 LTMT report provides

additional details. The NW Council updated these estimates for the Sixth Power Plan, and the LTMT for 2010 reflects those updated values. Table 5-5 shows the breakout of heating system fuel and home type by vintage. Although more than half of existing homes (52 percent) have electric heat, just one-third of new construction uses electric heat.

Table 5-5. Market Penetration of Heating Fuel and Home Type by Vintage

Heating Fuel	Home Type	New Construction	Existing Homes
Electric Heat	Single Family	9%	30%
	Multi-Family	15%	13%
	Manufactured	7%	9%
Gas Heat	Single Family	60%	36%
	Multi-Family	7%	2%
	Manufactured	1%	1%
All Other Heating	All Home Types	1%	10%
Total		**100%**	**100%**

Note: Reported numbers may not sum correctly due to rounding.
Source: Navigant analysis of NW Council's Conservation Supply Curves[36] updated December 4, 2009.

Table 5-6 shows the presence of central air conditioning in the Northwest by home type and vintage. According to the data from the NW Council, new homes are nearly twice as likely to have central air conditioning as existing homes.

Table 5-6. Market Penetration of Central Air Conditioning by Home Type and Vintage

Home Type	New Construction	Existing Homes
Single Family	40%	38%
Multi-Family	5%	8%
Manufactured	5%	5%
Total	**49%**	**51%**

Note: Reported numbers may not reflect the exact values listed in previous tables due to rounding.
Source: Navigant analysis of NW Council's Conservation Supply Curves updated December 4, 2009.

[36] NW Council, *Residential Supply Curve Housing and Appliance Units*, available at http://www.nwcouncil.org/energy/powerplan/6/supplycurves/default.htm

Navigant applied the percentages from Table 5-5 to the window area shipment data as presented in Table 5-4 to get the area of ENERGY STAR windows shipped to homes with electric and gas heat for 2010. Table 5-7 shows the ENERGY STAR window area for homes with electric heat, while Table 5-8 shows the ENERGY STAR window area for homes with gas heat.[37] This same method applies for homes with central air conditioning; Table 5-9 summarizes the results.[38] These tables present data from 2007 through 2010. Appendix B includes detailed tables.

Table 5-7. Area of ENERGY STAR Windows Shipped to Homes with Electric Space Heating from 2007–2010 (Thousand Square Feet)

Year	New Construction			Existing Homes		
	Single Family	Multi-Family	Manufactured	Single Family	Multi-Family	Manufactured
2007	1,557	2,569	1,545	5,715	2,731	1,507
2008	1,270	2,096	1,260	4,663	2,228	1,229
2009	1,229	2,027	1,219	4,678	2,235	1,233
2010	1,390	2,200	1,003	6,196	2,699	1,839

Note: (1) Ducker's report of actual market activity informs the data presented for 2007–2009; Ducker's forecast for 2010 informs data for that year.
(2) Reported numbers may not reflect the exact values listed in previous tables due to rounding.
(3) These market penetration data reflect those units bearing the ENERGY STAR label through 2009. In 2010 and beyond, the market penetration reflects those units for which NEEA counts savings.
Source: Navigant analysis of Ducker Research market reports (2004, 2007, 2009, and 2010) and data from the NW Council received March 24, 2011.

[37] This analysis assumes that window shipments are in the same proportion as the market share percentages of heating and cooling system types by home type and vintage. In reality, this assumed relationship between shipments and residential building stock may not be exactly proportional. Although Navigant finds this to be a reasonable assumption for this analysis, it may be prudent to explore this further in future efforts.

[38] The window area values presented in the heating and cooling end-use tables are not additive to the values in previous tables because a) not all heating end uses are represented in the heating end-use tables, and b) the values in the previous tables are actually a subset of the heating end-use tables; some window shipments that affect heating consumption also affect air-conditioning consumption.

Table 5-8. Area of ENERGY STAR Windows Shipped to Homes with Gas Space Heating from 2007–2010 (Thousand Square Feet)

Year	New Construction			Existing Homes		
	Single Family	Multi-Family	Manufactured	Single Family	Multi-Family	Manufactured
2007	9,135	1,731	258	9,353	332	161
2008	7,451	1,412	210	7,630	271	132
2009	7,208	1,366	203	7,655	272	132
2010	9,032	1,050	167	7,441	328	197

Note: (1) Ducker's report of actual market activity informs the data presented for 2007–2009; Ducker's forecast for 2010 informs data for that year.
(2) Reported numbers may not reflect the exact values listed in previous tables due to rounding.
(3) These market penetration data reflect those units bearing the ENERGY STAR label through 2009. In 2010 and beyond, the market penetration reflects those units for which NEEA counts savings.
Source: Navigant analysis of Ducker Research market reports (2004, 2007, 2009, and 2010) and data from the NW Council received March 24, 2011.

Table 5-9. Area of ENERGY STAR Windows Shipped to Homes with Central Air Conditioning from 2007–2010 (Thousand Square Feet)

Year	New Construction			Existing Homes		
	Single Family	Multi-Family	Manufactured	Single Family	Multi-Family	Manufactured
2007	4,536	1,143	766	3,916	369	448
2008	3,700	932	625	3,195	301	365
2009	3,579	902	605	3,205	302	366
2010	6,002	679	681	7,816	1,659	1,134

Note: (1) Ducker's report of actual market activity informs the data presented for 2007–2009; Ducker's forecast for 2010 informs data for that year.
(2) Reported numbers may not reflect the exact values listed in previous tables due to rounding.
(3) These market penetration data reflect those units bearing the ENERGY STAR label through 2009. In 2010 and beyond, the market penetration reflects those units for which NEEA counts savings.
Source: Navigant analysis of Ducker Research market reports (2004, 2007, 2009, and 2010) and data from the NW Council received March 24, 2011.

5.3.2 Baseline Activity

As a part of the 2010 LTMT effort, Navigant updated the baseline estimates using NEEA's methodology, which the 2007 LTMT team validated. NEEA's baseline estimates compare the analysis of regions with active promotions of ENERGY STAR windows ("active regions") to those regions of the country without active promotions ("inactive regions"). According to this analysis, the market penetration of ENERGY STAR windows in inactive regions would be a reasonable proxy for the baseline.

Navigant uses the following formula to determine market penetration in inactive regions:

IRMS = [(USPop * NMS) - (ARPop * ARMS)] / IRPop

where

IRMS = inactive region market penetration of ENERGY STAR windows
USPop = the population of people in the United States
NMS = national market penetration of ENERGY STAR windows
ARPop = the population of people in active regions
ARMS = active region market penetration of ENERGY STAR windows
IRPop = the population of people in inactive regions.

For this LTMT analysis, the active and inactive regional market penetration values remain unchanged from the values used in the 2007 LTMT report for the estimates in 2001 to 2009 (Table 5-10).[39] The analysis of 2010 data used the most recent U.S. Census information shown in Table 5-11.

Table 5-10. Active and Inactive Region Market Penetration of ENERGY STAR Windows for 2001–2009

Region	Population	Market Penetration
Active Region	95,785,531	67%
Nation	295,233,783	53%
Inactive Region	199,448,252	47%

Source: EPA 2007 and 2003 U.S. Census data.

[39] The underlying data is from the EPA ENERGY STAR 2007 partner resource guide for windows, doors, and skylights. http://www.energystar.gov/ia/partners/manuf_res/windows/Windows_PRG.pdf

Table 5-11. Active and Inactive Region Market Penetration of ENERGY STAR Windows for 2010–Future

Region	Population	Market Penetration
Active Region	98,249,878	67%
Nation	308,745,538	56%
Inactive Region	210,495,660	51%

Source: EPA 2007 and 2009 along with the 2010 U.S. Census data.

The method for calculating baseline has varied over the years based on the type of data available.

» For 1998–2006: After calculating the inactive region market penetration, NEEA uses the national market penetration growth rates from the ENERGY STAR Partner Resource Guide to determine the inactive region share. NEEA revised its initial growth estimates of 5 percent per year to begin using a diffusion of an innovation curve (S-curve) to estimate the rate at which the baseline would grow.

» For 2007–2010: Navigant used another method to calculate baseline values for 2007–2010. Actual data from the Ducker Research reports for 2007 and 2009 provided the inputs for these years. Then, Navigant used the average growth ratio between 2007 and 2009 to determine the baseline values for 2008 and 2010. This approach enables the analysis to consider the fundamental change in the market caused by the economic downturn of 2008–2010. NEEA's original S-curve would not have been able to do so since it is based on population density and market penetration rates prior to the downturn and expected rates of growth consistent with "business as usual" conditions.

  As a part of this year's LTMT report, Navigant updated the inactive market analysis to reflect 2010 U.S. Census data and 2009 market penetration provided by the 2010 Ducker report; Table 5-11 summarizes the results of this analysis. Table 5-12 shows the baseline market penetration recommended values derived by Navigant and those given in the current ACE model provided by NEEA.

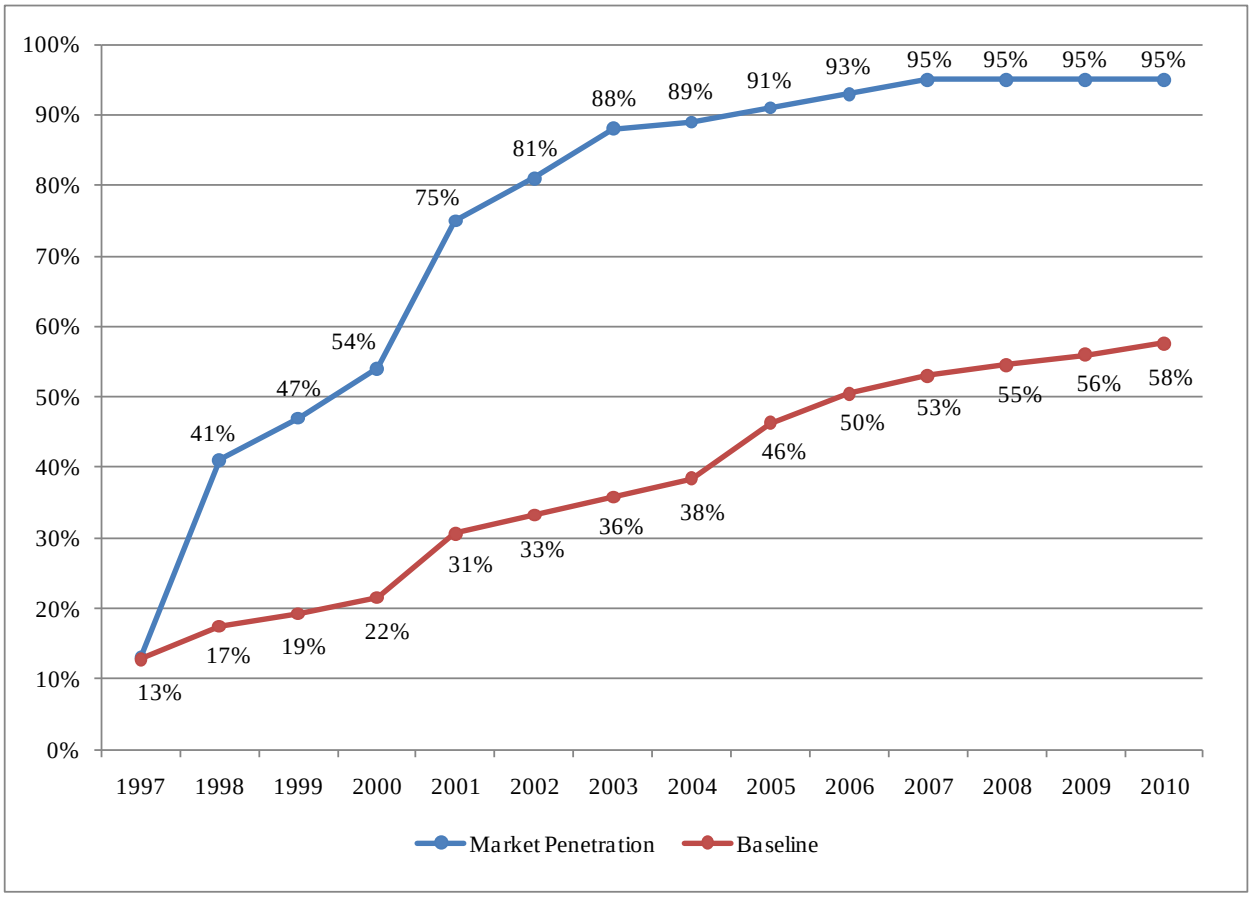
Table 5-12. Comparison of Updated Values for Baseline Market Penetration of ENERGY STAR Windows

Year	Baseline Percentage	
	NEEA ACE Model	Recommended Values
2007	56.4%	**53.0%**
2008	55.7%	**54.5%**
2009	57.2%	**56.0%**
2010	70.6%	**57.6%**

Note: Ducker's report of actual market activity informs the data presented for 2007–2009; Ducker's forecast for 2010 informs data for that year.
These market penetration data reflect those units bearing the ENERGY STAR label through 2009. In 2010 and beyond, the market penetration reflects those units for which NEEA counts savings.
The baseline estimates in NEEA's ACE model were inaccurate because they relied on growth rates that would have held under the "business-as-usual" scenario prior to the economic downturn.
Source: Navigant analysis of Ducker Research market report, May 2010.

Figure 5-1 shows the market penetration of ENERGY STAR windows in the Northwest compared to the baseline from 1997–2010. The baseline market penetration reflects the recommended values found in Table 5-12.

Figure 5-1. Comparison of the Market Share of ENERGY STAR Windows to the Baseline



Note: These market penetration data reflect those units bearing the ENERGY STAR label through 2009. In 2010 and beyond, the market penetration reflects those units for which NEEA counts savings.
Source: 2010 LTMT analyses and the 2010 ENERGY STAR Windows ACE model.

5.3.3 Per-Unit Energy Savings

The savings per unit of window area is the annual energy savings due to reduced HVAC energy consumption per unit of window area. HVAC savings comes in several forms:

- Electricity savings due to reduced electric-heating usage
- Electricity savings due to reduced central air conditioner usage
- Gas savings due to reduced gas-heating usage
- Electricity savings due to reduced gas furnace-fan operation

The LTMT effort only analyzes electric savings because NEEA only requested electric savings for its reporting purposes.

Per-unit savings have changed since the previous LTMT reports due to updated savings data modeled by the NW Council. The alterations are due to ENERGY STAR changing the qualification for U-Factor from 0.35 to 0.30 Btu/h. ft2°F. Navigant updated the energy savings estimates to determine appropriate values for savings per unit of window area for various heating and cooling types. Although this specification change may affect the market penetration of ENERGY STAR windows, NEEA currently plans not to take credit for the modification; NEEA plans to continue to report the savings to reflect the U-Factor of 0.35. Navigant used the per-unit savings with the 0.35 specification and updated the square footage of the average house size and window area using NW Council inputs. Table 5-13 shows the increase of the average house size and window area compared to the reported values used in the past LTMT reports.

Table 5-13. Comparison of Model Parameters Used to Derive Per-Unit Energy Savings

Type	Construction Type	2001–2009		2010	
		Window Area (sq ft)	House Size (sq ft)	Window Area (sq ft)	House Size (sq ft)
Single Family	New Construction	318	2110	360	2352
	Existing Construction	208	1600	291	1931
Multi-Family	New Construction	120	1000	169	1070
	Existing Construction	98	950	167	1030
Manufactured Housing	New Construction	212	1636	217	1737
	Existing Construction	128	1021	187	1492

Source: Updated per-unit savings from the NW Council reflecting the U-Factor specification change for ENERGY STAR windows, January 11, 2011.

This change in the model parameters directly affects the per-unit savings, which has decreased from a weighted average electricity savings of 0.63 kWh/sq ft-yr in 2009 to 0.524 kWh/sq ft-yr in 2010. Table 5-14 summarizes the updated per-unit savings based on the weighted average savings values by end use and vintage type.

Table 5-14. Comparison of Electric Weighted Average Per-Unit Savings for 2010 Sales

Savings End Use	New Construction	Existing Homes	Weighted Average
Electric Heating (kWh/sq ft-yr)	0.36	0.57	0.48
Central Air Conditioning (kWh/sq ft-yr)	0.02	0.02	0.01
Reduced Furnace Fan Operation (kWh/sq ft-yr)	0.02	0.02	0.02
Total Electricity Savings (kWh/sq ft-yr)	**0.41**	**0.62**	**0.52**

Source: Navigant analysis of per-unit savings values and heating and cooling system market shares based on NW Council's Conservation Supply Curve updated December 4, 2009.

5.4 Conclusions and Recommendations

NEEA's ENERGY STAR Windows market transformation initiative continues to achieve significant energy savings in 2010. Although total window shipments in the Northwest receded after 2005, WDMA forecasts an increase in window shipments starting in 2010. In addition, the market penetration of those windows with an efficiency level affected by NEEA's initiative continues to approach 100 percent and will likely remain constant. Specific findings from the 2010 LTMT effort include:

- The number of ENERGY STAR windows shipped in the Northwest is anticipated to rise in 2010. Although the total area of ENERGY STAR windows dropped from just over 45 million square feet in 2005 to under 25 million square feet in 2009, market experts expect an increase to more than 35 million square feet in 2010.

- Navigant recommends maintaining the 95 percent market penetration for windows with an efficiency level affected by NEEA's initiative. The market penetration remains unchanged from the last LTMT effort, given the absence of a detailed study or evidence to the contrary.

- Baseline activity represents 56 percent of the market in 2009 and 58 percent in 2010. Although the 2007 LTMT evaluation validated NEEA's innovation curve, Navigant recommends a thorough review of the methodology for the next LTMT evaluation.

Table 5-15 summarizes recommendations for the values of key indicators, characterized for ENERGY STAR windows sales in the Northwest. Baseline sales account for roughly two-thirds of the total market activity, yielding incremental savings of approximately 0.8 aMW in 2010.

Table 5-15. LTMT Recommendations for Key Indicators

Key Indicators Reviewed	2009 Incremental (Due to new activity occurring in 2009)	2010 Incremental (Due to new activity occurring in 2010)	2010 Cumulative (Calendar year 2010 values due to all activity since initiative inception)	Source
Current Market Activity				
ENERGY STAR Windows sold in the Northwest (sq ft x 1,000)	32,105	35,764	472,390	See section 5.3.1
Current Baseline Activity				
ENERGY STAR Windows sold in the Northwest (sq ft x 1,000)	18,925	21,760	212,228	See section 5.3.2
Per-Unit Energy Savings				
kWh/sf/year	0.6	0.5	0.5	See section 5.3.3
Implied Energy Savings (aMW)				
New ENERGY STAR Windows sold in the Northwest (aMW)	0.9	0.8	17.6	Market activity minus baseline activity, times per-unit savings, divided by 8,760 hours, divided by 1,000

* Implied Energy Savings represent estimated savings from market activity less estimated savings from baseline activity. NEEA's reported values might not match those presented here because NEEA adjusts for the effect of utility incentives and other factors not taken into account in this LTMT analysis.
Source: Navigant analysis 2011.

Navigant provides the following recommendations to guide future LTMT work.

» Continue to align LTMT efforts with the release of the complete Ducker report. Ducker Research releases a complete report with the data disaggregated by region in March or April of every even-numbered year, while summary reports with data aggregated at the national level are released in odd-number years. LTMT for ENERGY STAR Windows should therefore be conducted once every two years in the even-numbered years to take advantage of the most up-to-date and Northwest-specific data available. This report will update both baseline and market penetration assessments going forward.

- Update the baseline activity estimates. Navigant recommends a thorough review of the baseline methodology for the next LTMT evaluation. The baseline values use the market penetration in "inactive states" as one key input. EPA has provided this data in the past, but alternatives may be required for future LTMT analysis. Compare the results with the Ducker Research to evaluate the proper method for estimating baseline activity in the Pacific Northwest.

- Consider updating the market penetration of ENERGY STAR windows to reflect new specifications. The ENERGY STAR windows updated requirements for U-Factor, lowered from 0.35 to 0.3 Btu/h. ft2°F.[40]

- Obtain and use the most up-to-date equipment saturation levels and savings values from the NW Council. The NW Council provides conservation supply curves used to update per-unit savings figures and associates the different fuel groups by housing type and vintage.

[40] U.S. Department of Energy. ENERGY STAR. Undated. "Residential Windows, Doors, and Skylights." http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=WI

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6. SAV-AIR

The SAV-AIR initiative provided comprehensive compressed air management systems and engineering services to industrial customers. NEEA initiated funding for the SAV-AIR initiative in 1998 and continued funding until 2003. The SAV-AIR initiative aimed to change the way that compressed air end users and service providers viewed and managed compressed air in the industrial setting.[41] In addition, the SAV-AIR initiative sought to develop a company (then called SAV-AIR, now called Pneu-Logic[42)] into a self-sustaining business that specializes in the optimization of compressed air systems to help industrial facilities achieve energy benefits and increased system reliability. The initiative originally targeted compressed air systems in the Northwest with capacity greater than 300 horsepower, while the technology included monitoring and control with sensors, computers, and software.[43,44]

The technology funded by the SAV-AIR initiative served as the basis for PL4000, Pneu-Logic's flagship product.[45] The PL4000 offers a flow-based optimization control system that dispatches compressors in a variety of sequences in order to meet the actual demand for air. The PL4000 represents more than 80 percent[46] of Pneu-Logic's unit sales.[47] Pneu-Logic targets systems of eight or more compressors with the PL4000; however, any compressor system with two or more compressors can benefit from it.[48] Achievable savings increases with the number of compressors, total compressor capacity, and diversity[49] among compressors within the system. Pneu-Logic product lines can integrate across compressors of different types, makes, and manufacturers.[50] The PL4000 also offers data collection and storage capabilities as well as remote control and diagnostics.

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[41] Pacific Energy Associates. *Market Progress Evaluation Report: SAV-AIR Market Transformation Initiative, No. 2.* 2001. Prepared for NEEA. NEEA Report # E01-076.

[42] According to Pneu-Logic, SAV-AIR suffered from cash flow problems from 2002 to 2006, even though it continued to generate sales. In 2006, Pneu-Logic replaced SAV-AIR. Pneu-Logic initially licensed the SAV-AIR technology for its flagship PL4000 product. In 2010, SAV-AIR officially closed and Pneu-Logic now owns SAV-AIR's proprietary technology and patents.

[43] Northwest Energy Efficiency Alliance. *2003 Market Activities Report.* 2004. Prepared for NEEA.

[44] NEEA historically referred to the single SAV-AIR measure (consisting of the monitoring and controlling of compressed air systems using sensors, computers, and software) as "optimization." The 2010 LTMT report refers to the SAV-AIR measure as "compressed air optimization."

[45] An additional control system for industrial refrigeration is under development, which also relies on the underlying SAV-AIR initiative technology.

[46]The remaining sales are from the PL1000 and PL500, which are sequencer product lines not based on the SAV-AIR initiative technology.

[47] Based on personal communications with key market actors referenced in Section 6.2.

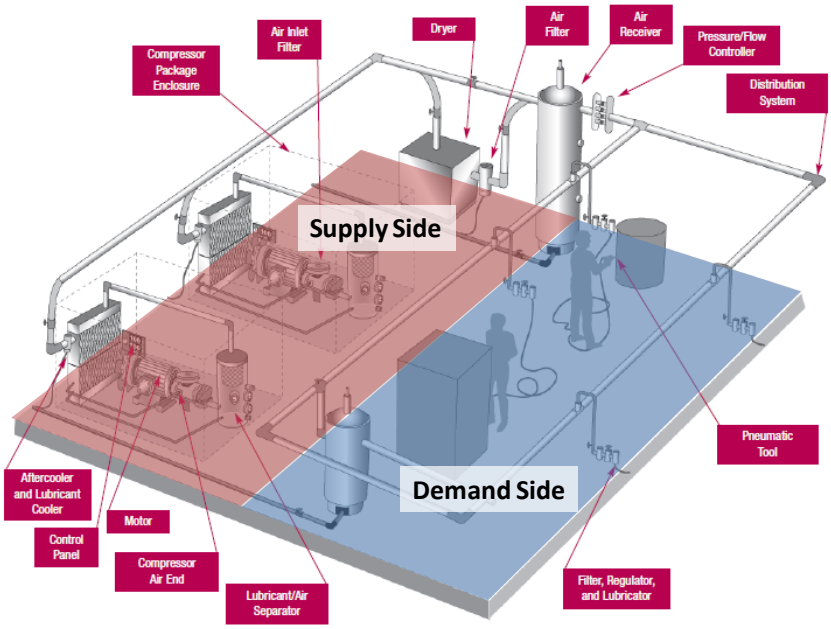
[48] Sequencers or VFDs can sometimes control systems with very few compressors (e.g., two to four compressors) as cost-efficiently as with optimizing controls.

[49] Diversity refers to variation in compressor capacity within the system.

[50] Compressor OEMs and vendors typically can only integrate across their own compressors.

Efficiency measures on compressed air systems fall into two categories – "supply-side" and "demand-side" measures. Supply-side measures are those that affect the air compression and treatment. Demand-side measures are those that affect the air use downstream of air compression and treatment.[51] The PL4000 is a supply-side measure because it controls the dispatch of compressors in a system. Figure 6-1 below shows the supply-side and demand-side components in a typical compressed air system.

Figure 6-1. Illustration of the Supply-Side and Demand-Side of a Compressed Air System



Source: Lawrence Berkeley National Laboratory. *Improving Compressed Air System Performance: a Sourcebook for Industry*. 2003. Prepared for the U.S. Department of Energy Compressed Air Challenge.

The LTMT effort last focused on SAV-AIR in 2005 and 2006. The 2005 and 2006 LTMT reports presented the findings of those research and analysis efforts.

The 2010 LTMT effort improves upon past efforts by applying a more direct methodology for quantifying energy savings, updating the baseline approach, quantifying progress toward transformation of the market for this technology, and identifying barriers and drivers to further market transformation.

[51] Lawrence Berkeley National Laboratory. *Improving Compressed Air System Performance: a Sourcebook for Industry*. 2003. Prepared for the U.S. Department of Energy Compressed Air Challenge.

6.1 Assumptions and Indicators for Review

The energy savings associated with the SAV-AIR initiative depends on the number of SAV-AIR projects completed, the energy savings from each project,[52] and several key assumptions about the market for compressed air efficiency. Navigant calculated annual incremental energy savings as the sum of reported new project annual energy savings by year. Navigant calculated the average per-project savings in a given year by dividing this annual incremental energy savings by the total number of newly installed projects and adjusting for baseline savings.

Annual Incremental Savings =

» **Reported annual incremental savings per project$_n$ (kWh per yr)** is the reported full-year savings from project n installed in a given year.[53]

This approach is more direct than the approach previously used. The previous approach multiplied the number of projects in a given year by the average savings per project. Because average savings per project can vary substantially from year to year, Navigant recommends calculating total savings by simply summing the reported full-year savings across projects implemented in each year.[54]

Average Per-Project Savings =

(A) Annual Incremental Savings

÷ (B) Number of Newly Installed Projects

× (C) (1-Baseline Savings Associated with Other Controls Technologies)

where

(A) **Annual Incremental Savings (kWh per year)** is the full-year savings of all Pneu-Logic and SAV-AIR projects in the Northwest installed in a given year.

(B) **Number of Newly Installed Projects (projects)** is the total number of new Pneu-Logic and SAV-AIR projects installed in the Northwest in a given year.

(C) **Baseline Savings Associated with Other Controls Technologies (%)** is a baseline adjustment factor that accounts for savings from technologies that compete indirectly with the SAV-AIR measure in a given year.

[52] Pneu-Logic reported engineering estimates of the annual energy savings for each project in the Northwest based on site-specific estimation and verification efforts.

[53] The project team applied full-year savings rather than first-year savings to indicate the size of each project installed in a year rather than to estimate the actual savings that occur in a year.

[54] In future years, the project team recommends adjusting savings by a verification rate. For the 2010 LTMT effort, no third-party-verified data was available.

Table 6-4 includes more detail on the calculation of Average Per-Project Savings.

6.2 Methodology

Data collection activities for the SAV-AIR LTMT effort seek to explain the current state of the market for compressed air optimization systems, to discern any recent changes or trends in this market, and to assess the effect of the SAV-AIR initiative on the market. The 2010 LTMT effort focuses primarily on the qualitative market characteristics. Interviews with Pneu-Logic management and other industry experts informed the analysis of the effect of the SAV-AIR initiative in the marketplace. Navigant conducted the following data collection activities:

- **Interviewed NEEA's Senior Manager for the Industrial Sector.** NEEA's Senior Manager for the Industrial Sector, John Wallner, provided insight into the historical market for compressed air optimization systems, the drivers for adoption of these systems, and general industrial sector trends.

- **Interviewed Pneu-Logic management.** Pneu-Logic's Chief Executive Officer and the Director of Sales provided data regarding the number of projects in the Northwest and the annual energy savings associated with those projects. Navigant used this information to estimate annual energy savings. Pneu-Logic management also helped establish the state of the market for compressed air optimization systems and the role of the SAV-AIR technology in the market.

- **Obtained sales data from Pneu-Logic.** Navigant obtained sales data from Pneu-Logic that covers the entire period of SAV-AIR and Pneu-Logic project installations. This information informed the market activity component of data analysis.

- **Interviewed key contractors and market actors.** Navigant interviewed program managers or engineers of five key market actors to gain a cross-sectional understanding of the state of the market for compressed air optimization systems and Pneu-Logic's role in the market. Table 6-1 identifies these market actors and the team's rationale for contacting them.

Table 6-1 summarizes the primary data collection activities conducted for the 2010 SAV-AIR LTMT.

Table 6-1. Primary Data Collection Activities for 2010 SAV-AIR LTMT

Interviewee Group	Number of Interviews/Surveys	Topic/Issues
Puget Sound Energy	One phone interview with a contractor to PSE who specializes in industrial efficiency	• Utility experiences with implementing the SAV-AIR measure
Portland General Electric	One phone interview with an engineer at PGE who specializes in industrial and agricultural EE	• Utility experiences with implementing the SAV-AIR measure
Vendors and Installation Contractors	Three phone interviews with staff of engineering firms that specialize in industrial efficiency and air compressors	• Technical and business perspectives on the SAV-AIR technology

Source: Navigant analysis 2011.

- **Review secondary sources.** In addition to reviewing the SAV-AIR initiative MPERs, Navigant reviewed several relevant secondary sources including articles and technical publications to validate the sensibility of the energy savings estimates from the SAV-AIR initiative and the related market potential. The key resources used to determine market potential included the following:
  - Northwest Power and Conservation Council. Sixth Northwest Conservation and Electric Power Plan. 2010.
  - Pacific Energy Associates, Inc. Market Progress Evaluation Report: SAV-AIR Market Transformation Initiative. June 2000. Prepared for the Northwest Energy Efficiency Alliance. Report #E00-053.
  - Pacific Energy Associates, Inc. Market Research Report: Compressed Air Efficiency. August 2000. Prepared for the Northwest Energy Efficiency Alliance. Report #00-058.
  - Xenergy. Assessment of the Market for Compressed Air Efficiency Services. 2001. Prepared for the U.S. Department of Energy.

Section 6.5 provides the comprehensive bibliography used in preparing this report.

6.3 Findings

Navigant focused on validating assumptions input directly into the ACE model, NEEA's tool for tracking energy savings associated with this initiative. The information and data collected established an understanding of the current state of the market for compressed air optimization systems and trends in that market; section 6.3.1 discusses this "market activity." Establishing the

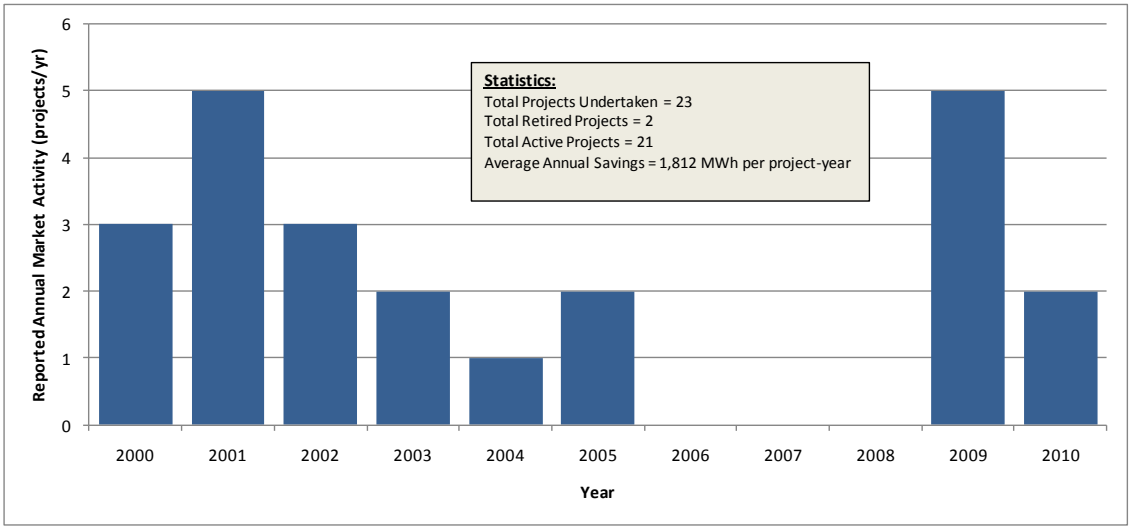
role of the SAV-AIR initiative in the evolution of the market requires understanding the scenario that would have ensued in the absence of the SAV-AIR initiative; section 6.3.2 discusses this "baseline activity." Navigant used reported energy savings to quantify the energy impacts of an average SAV-AIR installed project; section 6.3.3 discusses and quantifies the "per-project energy savings."

6.3.1 Market Activity

Navigant sought to describe the current state of the market for compressed air controls and the recent regional trends that have resulted in that development. The analysis used quantitative data collected regarding project implementation and estimated project savings, as well as qualitative information gathered through the interviews.

Figure 6-2 shows the number of projects completed in each year. The first project with reported savings occurs in 2000. Years 2006–2008 reported no market activity due to Pneu-Logic's re-incorporation and re-establishment of management.[55] Pneu-Logic market activity increased to five projects in 2009. From October of 2009 to July of 2010, no market activity occurred in the Northwest, largely due to the national economic downturn.[56] Downsizing affected the number of technical staff available to manage these types of projects, and reductions in capital spending limited their financial viability. Pneu-Logic completed two additional projects in the latter part of 2010 as capital budgets began to loosen. In addition, Pneu-Logic initiated two other projects in the Northwest that remained incomplete at year's end; as a result, the market activity included in this report does not include these incomplete projects.

Figure 6-2. Reported Annual Market Activity



Source: Navigant analysis of Pneu-Logic project data, February 3, 2011.

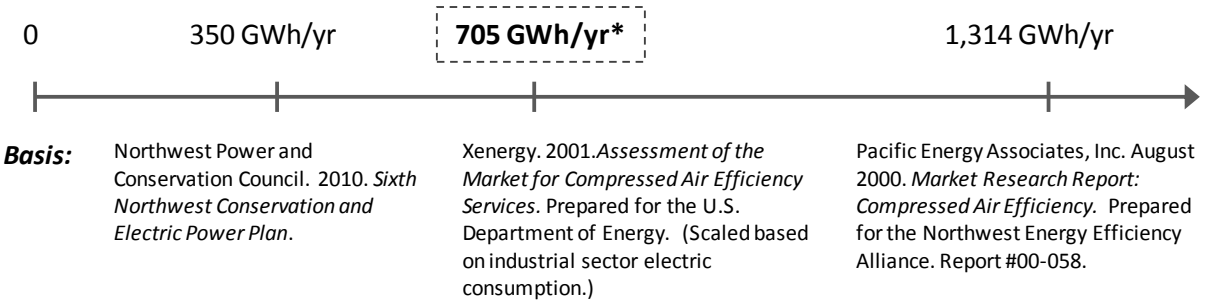
[55] Based on personal communications with NEEA staff.
[56] Based on personal communications with key market actors referenced in Section 6.2.

MARKET PENETRATION

Navigant reviewed several market assessment studies for compressed air efficiency to determine the potential for savings by the SAV-AIR initiative in the Northwest.[57] These studies range in scope and in results. Figure 6-3 depicts the range of market potential defined by these studies:

Navigant used the *DOE's Assessment's*[58] estimate of the energy savings potential for *all* compressed air measures based on the depth of the study. Industrial electricity consumption data[59] provided a reasonable basis for interpolating results from the national level to the Northwest region.[60] The resulting market potential savings estimate for *all* compressed air measures of 705 gigawatt-hours (GWh)/year falls in the middle of the range of other identified sources. The DOE estimate is roughly double the smallest savings estimate of 350 GWh/year[61] and is roughly half of the largest savings estimate of 1,314 GWh/year.[62]

Figure 6-3. Illustration of the Range of Savings Potential for All* Compressed Air Measures



*Market potential for all compressed air measures used in this analysis.

Navigant took the additional step of reducing the "savings potential" to the amount of energy savings that compressed air controls (such as SAV-AIR) can achieve. Navigant estimates that

[57] Navigant added the calculation of market potential to the 2010 LTMT effort to document the methodology used to address NEEA's Planning Department's request for an estimate of market potential.

[58] Xenergy. *Assessment of the Market for Compressed Air Efficiency Services.* 2001. Prepared for the U.S. Department of Energy.

[59] U.S. Energy Information Administration. 2009. *Retail Sales of Electricity to Ultimate Customers by End-Use Sector, by State*. www.eia.doe.gov/cneaf/electricity/epm/table5_4_a.html

[60] SAV-AIR MPER #1 arrives at a market potential estimate by scaling a national-level study based on employment. The project team believes that industrial sector electricity consumption is an improved basis for scaling national results. A scalar of 3.95 percent results from dividing industrial consumption in the Northwest (39,894 GWh/year) by U.S. industrial consumption (1,009,299 GWh/year).

[61] The *Sixth Power Plan's* 2025 target for energy savings from compressed air systems provides one indication of market potential; however, it does not necessarily reflect the full potential. Source: Northwest Power and Conservation Council. 2010. *Sixth Northwest Conservation and Electric Power Plan*.

[62] Pacific Energy Associates, Inc. August 2000. *Market Research Report: Compressed Air Efficiency.* Prepared for the Northwest Energy Efficiency Alliance. Report #00-058.

compressed air optimization systems can meet 17 percent[63] of the market potential for *all* compressed air measures. This results in a market potential for SAV-AIR-type controls of 120 GWh/year.

In the final step in the market penetration calculation, Navigant considered the extent to which SAV-AIR's active projects have addressed the savings potential for compressed air controls in the Northwest. SAV-AIR's project database indicates that active projects save 38 GWh/yr.[64] Using that estimate, Navigant used the following approaches to calculate the high- and low-end of the range of SAV-AIR's market penetration:

- *High-end estimate calculation:* Navigant divided the total savings from SAV-AIR projects (38 GWh/yr) by the estimate of savings potential derived from the *DOE Assessment* (120 GWh/yr). This represents approximately 32 percent of the estimated savings potential in the Northwest.

- *Low-end estimate calculation:* Navigant divided the total savings from SAV-AIR projects (38 GWh/yr) by the estimate of highest savings potential estimated (223 GWh/yr). This represents approximately 17 percent of the estimated savings potential in the Northwest.

Navigant suggests using the high-end of the market penetration range because of the lack of publicly available research within the last decade investigating the market potential for compressed air controls. In addition, some interviewees expressed their beliefs that the existing studies underestimate market potential.[65]

These market potential estimates exclude an indirect mechanism for savings that interviewees described. The SAV-AIR technology can increase savings achieved from other energy efficiency measures implemented on the demand side of compressed air systems. Demand-side measures cannot achieve their full potential unless the control scheme can react by reducing compressed air supply in response to reduced demand for the air. In many instances, demand-side measures such as leak reduction, do not achieve any net savings because compressors continue to work at the same levels, often venting excess air. More sophisticated controls, like those offered by SAV-AIR and Pneu-Logic, can help transform demand-side measures into full supply-side savings.[66]

Appendix C includes a discussion of barriers, drivers, and opportunities for further market transformation.

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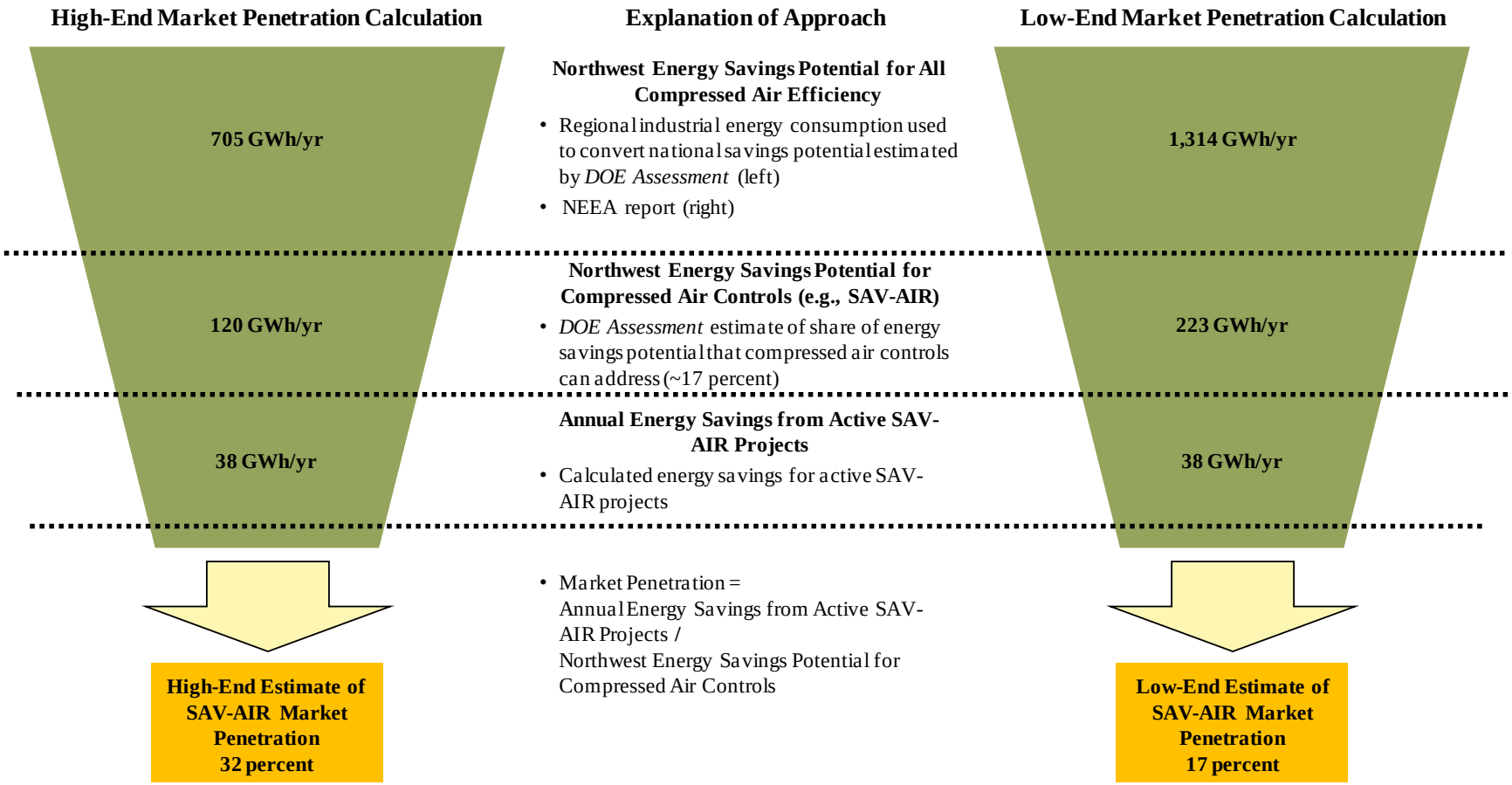
[63] Based on the fraction of savings from compressor controls in Table 1-3 in the 2001 DOE Compressed Air Market Assessment in the U.S. and adjusting for the increased potential savings from the SAV-AIR technology over simpler compressor controls technologies.

[64] See Figure 6-2 for additional information about the energy savings produced by active SAV-AIR projects.

[65] Based on personal communications with key market actors referenced in Section 6.2.

[66] Based on personal communications with key market actors referenced in Section 6.2.

Figure 6-4. Summary of Approach Used to Calculate Market Penetration



Sources: Navigant analysis of DOE Assessment of the Market for Compressed Air Efficiency Services (2001); EIA's Retail Sales of Electricity to Ultimate Customers by End-Use Sector, by State (2011); NEEA's Market Research Report: Compressed Air Efficiency (2000).

6.3.2 Baseline Market Activity

Navigant identified two types of baseline activity:

1. Baseline market activity: Baseline market activity reflects the degree to which projects in the Northwest using the SAV-AIR/Pneu-Logic technology or directly competing technologies would have occurred in the absence of the SAV-AIR initiative.

2. Baseline energy savings: Baseline energy savings account for energy that the industrial compressed air market would have saved in the absence of the SAV-AIR initiative. This category accounts for technologies that compete indirectly with the SAV-AIR/Pneu-Logic technology.

This section focuses on baseline market activity. Section 6.3.3 discusses the baseline energy savings because that category of baseline activity affects the per-unit energy savings.

Navigant recommends establishing a baseline market activity of zero due to two primary drivers:

» Market research and expert interviews indicate that SAV-AIR or Pneu-Logic served as the vendor for all compressed air optimizing controls systems implemented in the Northwest.[67] Although some interviewees indicated that they had seen custom optimizing controls in the field, these deployments were rare and were not recent.

» Pneu-Logic's management confirms that NEEA played a vital role in the development of the SAV-AIR/Pneu-Logic product offerings. Pneu-Logic's management asserts that SAV-AIR and Pneu-Logic would not have achieved the success that they have in the absence of NEEA's support. As such, NEEA affected all of the projects implemented by SAV-AIR and Pneu-Logic.

This recommendation remains consistent with the approach that NEEA has taken in the ACE model.

6.3.3 Per-Unit Energy Savings

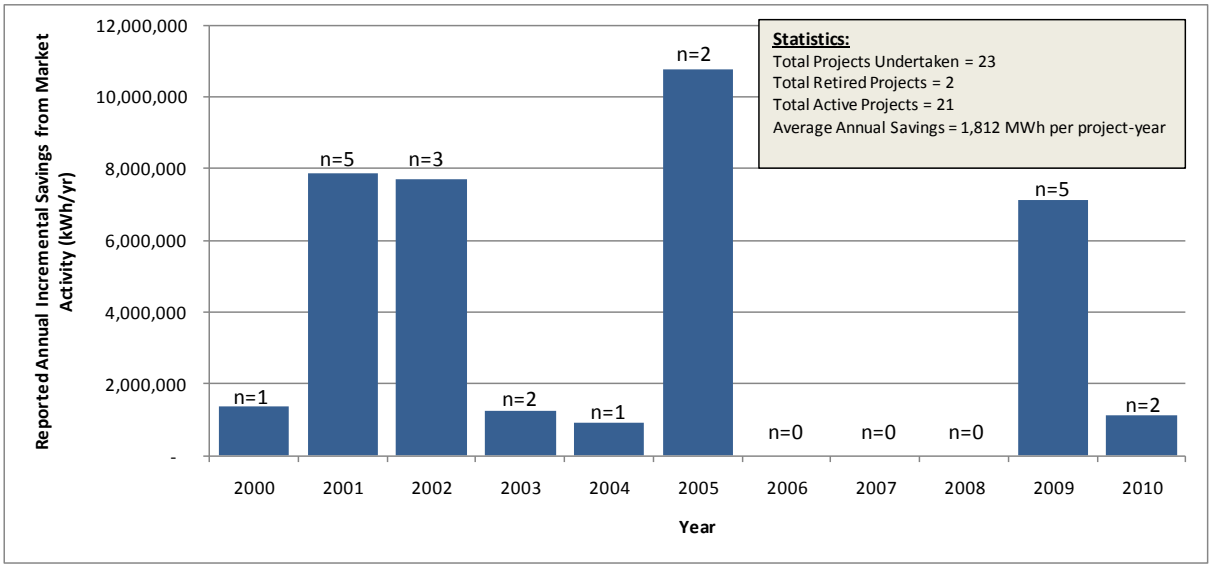
The average per-project energy savings incorporates the annual energy savings from projects implemented in a given year, the total number of projects implemented in that year, and the baseline energy savings associated with other controls technologies. This section first presents the energy savings by project; the second part of the section describes how Navigant recommends adjusting the preliminary per-unit energy savings for the baseline energy savings that would have likely occurred in the absence of NEEA's support of SAV-AIR.

[67] Based on personal communications with key market actors referenced in Section 6.2.

REPORTED PER-PROJECT ENERGY SAVINGS

Figure 6-5 shows the full-year annual incremental savings from projects installed in each year since the inception of the SAV-AIR initiative. The reported per-project energy savings for each year is the total reported annual incremental savings across all projects implemented in that year divided by the number of projects implemented. The final per-project energy savings reflect a reduction of these reported per-project savings to account for baseline energy savings.

Figure 6-5. Reported Annual Incremental Energy Savings from SAV-AIR Market Activity



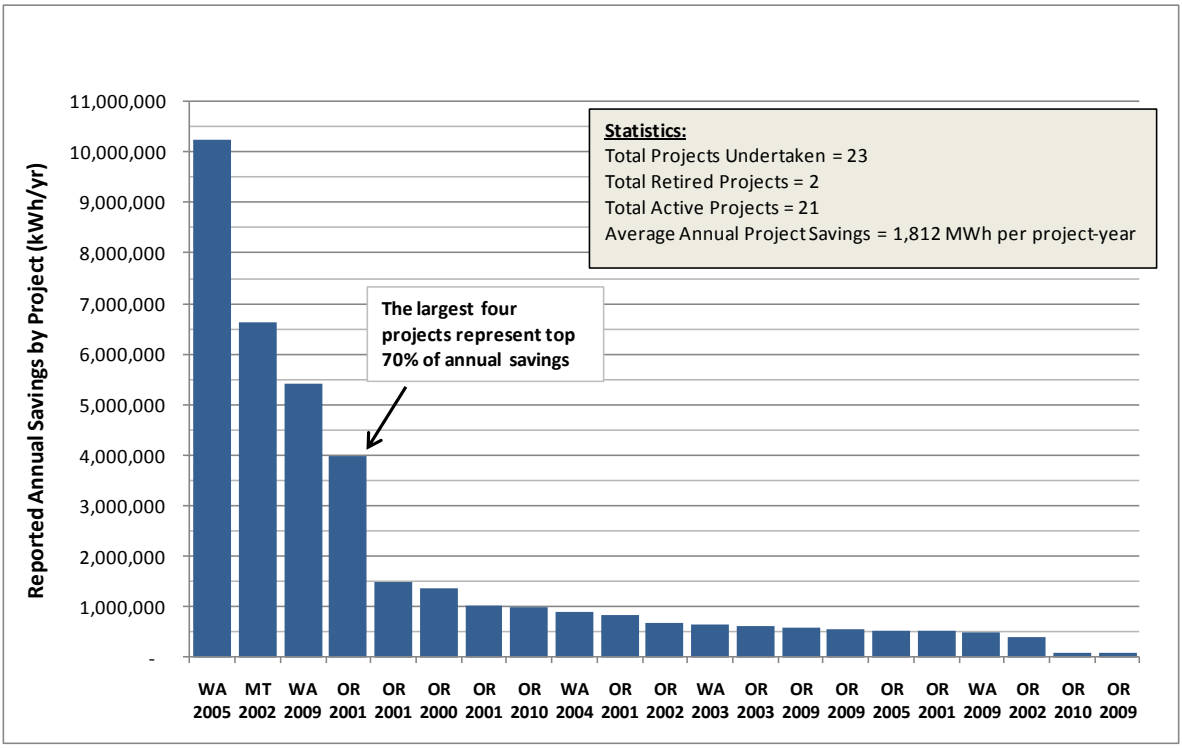
Note: Reported savings data did not include data for two retired projects from 2000.
Source: Navigant analysis of Pneu-Logic project data, February 3, 2011.

Figure 6-6 shows the reported full-year annual savings from each project, in decreasing order by savings. Out of 21 active projects with reported savings, the largest four account for approximately 70 percent of the total annual savings.[68] Although the largest potential for savings exists with the largest compressed air systems, Pneu-Logic has achieved cost reductions that have allowed penetration into smaller systems.[69]

[68] The largest savings occur at a site with ten compressors with total capacity of 9,950 HP. The project achieved energy savings of more than 30 percent.

[69] Based on personal communications with key market actors referenced in Section 6.2.

Figure 6-6. Reported Energy Savings Associated with Market Activity by Project



Note: This chart shows projects by state and installation year but not the specific values to preserve confidentiality of customer sites. Reported savings data did not include data for two retired projects from 2000.
Source: Navigant analysis of Pneu-Logic project data, February 3, 2011.

ADJUSTMENT FOR BASELINE ENERGY SAVINGS

As discussed in Section 6.3.2, Navigant recommends considering a second type of baseline for the SAV-AIR initiative. Baseline energy savings accounts for energy savings that would have likely occurred in the absence of NEEA's SAV-AIR initiative; in effect, this means considering the energy savings that would have likely occurred in the absence of SAV-AIR or Pneu-Logic because the companies' management indicates that NEEA's involvement with the technology contributed to all the success of the technology.

Table 6-2 describes the two categories of baseline energy savings that may affect the per-unit energy savings estimates for SAV-AIR and includes Navigant's recommendation for addressing each of them.

Table 6-2. Description of Baseline Energy Savings Recommendations

Type of Baseline	Description	Recommendation
Baseline Energy Savings from Indirect Competition – Other Compressed Air Controls	Other types of controls technologies (i.e., sequencers, variable-frequency drives [VFDs], and programmable logic controllers [PLCs]) may substitute in the role of the SAV-AIR technology in compressed air systems; however, these technologies do not provide the full functionality achieved by SAV-AIR. These other controls technologies are indirect competition. In many cases, customers would likely have otherwise implemented these technologies in the absence of SAV-AIR and therefore would have otherwise achieved some savings.*	Navigant recommends reducing the per-unit energy savings for SAV-AIR by the amount of energy saved by other supply-side compressed air controls because the end user would likely implement these alternatives in the absence of the SAV-AIR option.
Baseline Energy Savings from Indirect Competition – Compressed Air Demand Side	A variety of other compressed air measures exist, which customers typically implement on the demand side of the compressed air system. Demand-side measures reduce the demand upon the compressor. Some common demand-side measures include eliminating inappropriate uses of compressed air, optimizing end-use applications, and reducing air leaks. Interviews indicate that in practice, these measures do not generally compete for budget with the SAV-AIR measure.**	Navigant recommends a zero baseline for demand-side measures because end users do not consider these alternatives at the same time or in the same way that they consider SAV-AIR.

Sources:

* Personal communications with: Al Dunlap, Puget Sound Energy Contractor; Doug Findlay, Portland General Electric; Tim Dugan, Compression Engineering Corporation; Justin Ramsay, Compression Engineering Corporation; Patrick Sullivan, Energy Protection Systems. December 2010–March 2011.

** Personal communications with Tim Dugan and Justin Ramsay. January 2011–March 2011.

Table 6-3 shows the assumptions that lead to the recommended baseline savings assumptions. Navigant took a three-part approach to developing these values:

1. First, the table presents the baseline energy savings for indirect competition from other compressed air controls. Navigant determined the amount of energy savings that the project owner would have achieved by using other types of compressed air controls instead of SAV-AIR controls. A report prepared for DOE indicates that compressor controls can reduce consumption by 10 percent.[70] Since SAV-AIR sees an average of 25 percent savings, less sophisticated sequencers can achieve 40 percent (or 10 percent

[70] Xenergy. Assessment of the Market for Compressed Air Efficiency Services. 2001. Prepared for the U.S. Department of Energy.

divided by 25 percent) of SAV-AIR's savings.[71,72] Thus, Navigant used 40 percent as the baseline savings for indirect competition from other compressed air controls.

2. Next, Navigant assessed the extent to which SAV-AIR customers would have installed other controls technologies. This factor takes into account the fact that customer adoption of these indirect competitors varied over time as the technology moved out of demonstration and testing stages into the more competitive market for efficiency. Navigant used the following values to represent the share of SAV-AIR customers that would have adopted alternative controls technologies in the absence of SAV-AIR.

    » In 2000 and 2001, Navigant assumes that none of the SAV-AIR customers would have chosen alternative controls technologies because SAV-AIR carefully selected participants for its projects during this time period and the technology was not yet established in the marketplace. Without SAV-AIR's efforts, these projects would not have occurred.

    » For 2002–2003, Navigant assumes that 30 percent of SAV-AIR customers would have otherwise installed another control type. The 30 percent estimate is still within the range of 0 percent to 42 percent that the 2006 LTMT team provided for this time period. The 30 percent value for 2002–2003 serves as a transition from 0 percent in 2000-2001 to 80 percent after 2003; this is a conservative estimate of the adoption during that time.

    » After 2003, Navigant assumes that 80 percent of customers would have otherwise installed another control type. The market actors listed in Section 6.2 indicate that responses to customer-initiated inquiries and utility programs drive most sales in the Northwest (50–100 percent) rather than direct marketing efforts. This customer initiation indicates that the customer would have still implemented compressed air efficiency measures in the absence of SAV-AIR. Navigant applied 80 percent as a best estimate based on expert interviews until more concrete data are available to inform this assessment.[73]

    The market actors interviewed for this effort (as listed in Table 6-1), who are considered experts by their peers in the industry, confirmed these average savings estimates for SAV-AIR and baseline technologies. In the interviews, Navigant asked the market actors about their perceptions of the baseline for SAV-AIR projects during these time periods.

[71] Actual results from compressed air controls (i.e., SAV-AIR, sequencers, PLCs, and VFDs) can vary depending on the number of compressors, sizes of compressors, and end-use applications.

[72] Xenergy. 2001. *Assessment of the Market for Compressed Air Efficiency Services.* Prepared for the U.S. Department of Energy.

[73] The project team recommends tracking the sales mechanism for future sales to adjust this assumption as necessary.

Their responses compared favorably to the estimates that Navigant suggests in this analysis.

3. Finally, Navigant calculated the baseline energy savings associated with other controls technologies. Navigant applied the 40 percent assumption[74] about relative savings associated with other controls technologies to the anticipated customer adoption rates of alternative controls technologies. Navigant multiplied the 40 percent relative savings assumption by the likely adoption of the alternative technologies in the absence of the SAV-AIR technology in each time period:

    - In 2000, the baseline energy savings was zero (0 percent x 40 percent).
    - For 2002–2003, the baseline energy savings was 12 percent (30 percent × 40 percent).
    - After 2003, baseline energy savings is 32 percent (80 percent × 40 percent).

Table 6-3. Baseline Energy Savings from Indirect Competition—Other Compressed Air Controls

	Relative Savings Associated with Other Controls Technologies (A)**			Baseline Customers Implementing Other Controls Technologies (B)***			Baseline Savings Associated with Other Controls Technologies (C = A × B)		
	High	Low	**Rec'd***	High	Low	**Rec'd***	High	Low	**Rec'd***
Projects Before 2002	75%	25%	**40%**	0%	0%	**0%**	0%	0%	**0%**
Projects 2002–2003	75%	25%	**40%**	42%	0%	**30%**	32%	0%	**12%**
Projects Following 2003	75%	25%	**40%**	100%	50%	**80%**	75%	13%	**32%**

* "Rec'd" in the table above represent Navigant's recommended baseline values as a percentage of reported savings.
** Navigant derived 40 percent by dividing estimated savings from non-optimizing controls, 10 percent, by estimated savings from SAV-AIR controls, 25 percent.
*** Fraction of project implementations that would otherwise implement other controls technologies in the absence of SAV-AIR. The percentage of savings associated with indirect sales (e.g., initiated by customer, utility program) is a suitable proxy for this metric.
Source: Navigant analysis 2011 and Summit Blue analysis 2006.

Table 6-4 presents the calculations used to arrive at average per-project energy savings for the SAV-AIR initiative in 2009 and 2010. This table uses the equation outlined in Section 6.

[74] See discussion in the paragraph below Table 6-2 for the explanation of this assumption.

Table 6-4. Average Per-Project Energy Savings Calculations

Year	Total Annual Reported Savings (kWh/year)	Incremental Projects Implemented (projects) *	Baseline Savings Associated with Other Controls Technologies (%)	Average Per-Project Energy Savings (kWh/project-year)
2000**	1,361,388	1	0%	1,361,388
2001	7,868,868	5	0%	1,573,774
2002	7,696,776	3	12%	2,257,721
2003	1,242,252	2	12%	546,591
2004	896,004	1	32%	609,283
2005	10,769,040	2	32%	3,661,474
2006	0	0	32%	-
2007	0	0	32%	-
2008	0	0	32%	-
2009	7,114,032	5	32%	967,508
2010	1,100,796	2	32%	374,271
Calculation	*(A)*	*(B)*	*(C)*	$D = A \div B \times (1\text{-}C)$

* Implementations including only the optimizing controls technology developed by SAV-AIR (i.e., the PL4000) and not simple sequencer products not based on the original technology.
** SAV-AIR implemented three projects in 2000. Reported savings data did not include data for two retired projects from 2000.
Source: Navigant analysis 2011.

6.4 Conclusions and Recommendations

Market activity due to the SAV-AIR initiative has varied since the last LTMT effort. Activity resulting from the SAV-AIR initiative in the Northwest ceased from 2006 through 2008. Activity resumed in 2009 when Pneu-Logic incorporated the initiative-funded technology into its PL4000 product. Specific findings from the 2010 LTMT assessment include the following:

- Project-level savings estimates reported by Pneu-Logic provide sufficient fidelity to move to a more direct savings quantification approach. Rather than estimating the average project savings and multiplying by the reported number of project implementations, Navigant simply summed the reported savings from each individual project implemented in a given year.

- About 70 percent of the 2010 cumulative annual savings from the SAV-AIR initiative results from the largest four projects. Although Pneu-Logic implemented seven projects during 2009 and 2010 and increased the total number of active projects by 50 percent, the combined savings from these projects only represents an increase of 24 percent. Together, they do not surpass the savings of the single largest project completed to date.

» Project implementations increase as the economy recovers. The soft economy from late 2009 through 2010 briefly reduced project implementation, but the improving economy supports a recovery in project implementations. Several factors may contribute to future deployment of this technology, such as rising energy prices, opportunities for demand response, regulation and codes, corporate sustainability initiatives, increased awareness, and new markets for the technology such as bottling and refrigeration.

» The compressed air industry structure poses challenges to third-party vendors. Compressor OEMs or vendors design most compressed air systems in industrial settings. End users largely view OEMs and vendors as the one-stop shop to service compressed air needs. Most customers have strong relationships with their OEM/vendor and do not tend to go outside of this relationship for third-party products and services. Third-party products can have difficulty gaining traction simply because the companies lack the trust that the OEMs have garnered with the customers.

» Navigant recommends considering three types of baseline activity for SAV-AIR:

  - Baseline market activity: Baseline market activity reflects the degree to which projects in the Northwest using the SAV-AIR/Pneu-Logic technology or directly competing technologies would have occurred in the absence of the SAV-AIR initiative.

    Navigant recommends reporting zero baseline market activity.

  - Baseline energy savings: Baseline energy savings account for energy that the industrial compressed air market would have saved in the absence of the SAV-AIR initiative. This category accounts for technologies that compete indirectly with the SAV-AIR/Pneu-Logic technology. Two categories of baseline energy savings may affect NEEA's estimate of savings associated with the SAV-AIR initiative:

    - Baseline energy savings from indirect competition – other compressed air controls. Navigant recommends using an estimate of 34 percent for baseline energy savings for years following 2003, 12 percent for 2002 to 2003, and 0 percent for years preceding 2002. Table 6-3 presents the underlying recommended baseline assumptions for these results.

- Baseline energy savings from indirect competition – compressed air demand side. End users typically do not consider investments in demand-side compressed air measures at the same time or in the same manner as compressed air optimization systems. Therefore, savings from demand-side measures (e.g., leak repair, end-use design) are not applicable as a baseline for control systems savings.

  Navigant recommends using a value of zero for this category of baseline energy savings.

Improved controls increase the ability of demand-side measures to yield savings. Demand-side measures cannot achieve their full potential unless the control scheme can react by reducing compressed air supply according to the amount required. In many instances, demand-side measures such as leak reduction do not achieve any net savings because compressors continue to work at the same levels, often venting excess air. More sophisticated controls, such as those offered by SAV-AIR/Pneu-Logic, can help transform demand-side measures into full supply-side savings. The exclusion of this phenomenon from the quantification process results in conservative savings estimates. Table 6-5 shows that the addition of seven newly implemented projects during 2009 and 2010 has resulted in an annual increase in savings of 967,508 kWh per project year in 2009 and 374,271 kWh per project year in 2010.

Table 6-5. M&T Recommendations for Key Indicators

Key Indicators Reviewed	2009* Incremental (Due to new activity occurring in 2009)	2010 Incremental (Due to new activity occurring in 2010)	2010 Cumulative (Calendar year 2010 values due to all activity since program inception)	Source
Market Activity (Projects implemented)**				
Number of Pneu-Logic Project Implementations	5	2	21	See Section 6.3.1 *Market Activity*
Baseline Market Activity (Projects implemented)***				
Number of Other Optimizing Compressed Air Control Systems Projects	0	0	0	See Section 6.3.2 *Baseline Market Activity*
Per-Unit Energy Savings (kWh/project year)***				
Average Per-Project Energy Saving (reduced for baseline energy savings)	967,508	374,271	1,393,025	See Section 6.3.3 *Per-Unit Energy Savings*
Implied Energy Savings (aMW)****				
Total Implied Energy Savings	0.6	0.1	3.3	Market activity minus baseline activity, times per-unit savings, divided by 8,760 hrs

* LTMT last reviewed the SAV-AIR initiative in 2005. The reported data indicates no project installations for 2006–2008. Therefore, this table only presents results for 2009 and 2010.
** Implementations including only the optimizing controls technology developed by SAV-AIR (i.e., the PL4000) and not simple sequencer products not based on the original technology.
*** Navigant defines baseline activity as project implementations from direct competition using optimizing controls technology similar to that of SAV-AIR technology. Because no known direct competitors exist in the marketplace at the time of this report, baseline activity is zero. However, customers would have likely otherwise implemented indirect competitor technologies in the absence of the SAV-AIR technology. Navigant assumed the estimated savings from these indirect competitors to provide a baseline of 32 percent of reported savings as discussed in Section 6.3.3. The per-unit savings estimates presented include this 32 percent baseline reduction.
**** NEEA's reported values might not match those presented here since NEEA adjusts for the effect of utility incentives and other factors not taken into account in this analysis.
Source: Navigant analysis 2011.

Navigant recommends the following tasks to guide future LTMT work:

- Verify the accuracy of the Pneu-Logic reported savings and investigate the persistence of the measure with third-party evaluations. The 2010 LTMT effort assumes that SAV-AIR/Pneu-Logic reported accurate savings and that project savings do not degrade over time. Further investigation would either validate these assumptions or produce information to adjust reported savings estimates as appropriate.

- Update market research and analysis to better characterize the technical and economic potential for this technology. The most recent market research reports are more than a decade old. In addition, interviewees indicated that these studies likely underestimate the technical and economic potential for compressed air controls. Assessing the market potential would provide NEEA with better information with which to make decisions about future funding of LTMT efforts for the SAV-AIR initiative.

- Track project implementation sales methods as direct or indirect sales to establish a better baseline. Direct refers to sales initiated and driven by Pneu-Logic sales staff. Indirect refers to sales initiated by the customer, utility, or contractor (often through a Request for Proposals). The distinction between direct and indirect sales will provide a project-by-project indication of whether a customer would have otherwise installed a different control system in the absence of the SAV-AIR technology.

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Appendix A – Acronyms

AAMA	American Architectural Manufacturers Association
ACE	Alliance Cost-Effectiveness
aMW	Average Megawatt
ARMS	Active Region Market Share
ARPop	the Population of People in Active Regions
ARRA	American Re-investment and Recovery Act
BacGen	BacGen Technologies, Inc.
BioChem	BioChem Technologies, Inc.
BOC	Building Operator Certification
CEO	Chief Executive Officer
CWNS	Clean Watershed Needs Survey
DOE	Department of Energy
EPA	Environmental Protection Agency
GWh/yr	Gigawatt hours per year
HP	Horse Power
HVAC	Heating, Ventilation and Air Conditioning
IRMS	Inactive Region Market Share
IRPop	the Population of People in Inactive Regions
kWh/yr	Kilowatt Hours per Year
LTMT	Long-Term Monitoring and Tracking
M&V	Monitoring and Verification
MGD	Millions of Gallons per Day
MPERs	Market Progress Assessment Reports
NEEA	Northwest Energy Efficiency Alliance
NMS	National Market Share
NW Council	Northwest Power and Conservation Council
OEMs	Original Equipment Manufacturers
PLCs	Programmable Logic Controller
RFP	Request For Proposal
ROI	Return on Investment
USPop	the Population of People in the United States
VFDs	Variable Frequency Drives
WDMA	Window and Door Manufacturers Association

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Appendix B – ENERGY STAR Windows Supplemental Information

This chapter presents tables showing market activity for all years tracked. Section 5 presents similar tables but only for activity in 2007 through 2010.

Table B-1. Fenestration Products Shipped in the Northwest from 2001-2010 (Thousands)

Year	New Construction			Existing Homes		
	Windows	*Skylights*	*Patio Doors*	*Windows*	*Skylights*	*Patio Doors*
1997-2000	Data Not Available[75]					
2001	1,199	37	73	1,372	42	96
2002	1,137	38	78	1,446	43	103
2003	1,087	40	85	1,520	47	111
2004	1,157	31	92	1,629	37	116
2005	1,257	31	97	1,661	35	119
2006	1,191	26	88	1,575	34	116
2007	918	22	72	1,566	32	110
2008	671	16	93	1,386	24	81
2009	733	10	60	1,056	22	68
2010	862	12	70	1,140	23	73
Source: Summit Blue/Navigant analysis of Ducker Research market reports (2004, 2007, 2008, and 2010)						

[75] NEEA tracked the total area of windows shipped in the Northwest between 1998 and 2000, but the number of units shipped was not available to the LTMT project team.

Table B-2. Total Area of Windows Shipped in the Northwest from 1997-2010 (Thousand Square Feet)

	New Construction	Existing Homes	Total
1997	*	*	48,709
1998	*	*	48,709
1999	*	*	48,709
2000	*	*	48,709
2001	22,318	26,055	48,372
2002	21,534	27,495	49,030
2003	21,046	29,048	50,094
2004	23,913	29,083	52,996
2005	21,385	28,631	50,015
2006	20,250	27,113	47,363
2007	17,929	24,004	41,933
2008	14,624	19,582	34,206
2009	14,147	19,648	33,795
2010	15,759	21,886	37,646
Total	*	*	***640,286***

* Data disaggregated by vintage was not available to the LTMT project team for 1997-2000.
Source: Summit Blue/Navigant calculations and assumptions regarding average area per window.

Table B-3. Market Share of ENERGY STAR Windows Shipped in the Northwest from 1997-2010

	ENERGY STAR Market Share (%)	New Construction (sqft x 1,000)	Existing Homes (sqft x 1,000)	Total (sqft x 1,000)
1997	13%	*	*	6,218
1998	41%	*	*	19,971
1999	47%	*	*	22,893
2000	54%	*	*	26,303
2001	75%	16,738	19,541	36,279
2002	81%	17,443	22,271	39,714
2003	88%	18,521	25,562	44,083
2004	89%	21,282	25,884	47,166
2005	91%	19,460	26,054	45,514
2006	93%	18,833	25,215	44,048
2007	95%	17,032	22,804	39,836
2008	95%	13,892	18,603	32,496
2009	95%	13,440	18,665	32,105
2010	95%	14,971	20,792	35,764
Total		*	*	***472,390***

* Data broken out by vintage was not available to the LTMT project team for 1997-2000.
Source: Summit Blue/Navigant analysis of interview data applied to gross window areas.

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Table. B-4 Area of Windows Shipped to Homes with Electric Space Heating from 2001-2010 (Thousand Square Feet)

Year	New Construction			Existing Homes		
	Single Family	*Multi-Family*	*Manufactured*	*Single Family*	*Multi-Family*	*Manufactured*
1997-2000	Data Not Available*					
2001	1,530	2,525	1,519	4,898	2,340	1,291
2002	1,595	2,631	1,582	5,582	2,667	1,472
2003	1,693	2,794	1,680	6,407	3,061	1,689
2004	1,946	3,210	1,931	6,487	3,100	1,711
2005	1,779	2,935	1,765	6,530	3,120	1,722
2006	1,722	2,841	1,709	6,320	3,020	1,666
2007	1,557	2,569	1,545	5,715	2,731	1,507
2008	1,270	2,096	1,260	4,663	2,228	1,229
2009	1,229	2,027	1,219	4,678	2,235	1,233
2010	1,390	2,200	1,003	6,196	2,699	1,839

* Data broken out by vintage was not available to the LTMT project team for 1997-2000.
Source: Summit Blue/Navigant analysis of Ducker Research market reports (2004, 2007, 2009, and 2010) and data from the NW Council.

Table B-5. Area of Windows Shipped to Homes with Gas Space Heating from 2001-2010 (Thousand Square Feet)

Year	New Construction			Existing Homes		
	Single Family	*Multi-Family*	*Manufactured*	*Single Family*	*Multi-Family*	*Manufactured*
1997-2000	Data Not Available*					
2001	8,977	1,702	253	8,014	285	138
2002	9,355	1,773	264	9,134	324	158
2003	9,933	1,883	280	10,484	372	181
2004	11,414	2,163	322	10,616	377	183
2005	10,437	1,978	294	10,685	379	184
2006	10,100	1,914	285	10,341	367	179
2007	9,135	1,731	258	9,353	332	161
2008	7,451	1,412	210	7,630	271	132
2009	7,208	1,522	226	8,527	303	147
2010	9,032	1,050	167	7,441	328	197

* Data broken out by vintage was not available to the LTMT project team for 1997-2000.
Source: Summit Blue/Navigant analysis of Ducker Research market reports (2004,2007,2009, 2010) and data from the NW Council

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Table B-6. Area of Windows Shipped to Homes with Central Air Conditioning from 2001-2010 (Thousand Square Feet)

Year	New Construction			Existing Homes		
	Single Family	*Multi-Family*	*Manufactured*	*Single Family*	*Multi-Family*	*Manufactured*
1997-2000	Data Not Available*					
2001	4,458	1,123	753	3,356	316	384
2002	4,645	1,171	785	3,825	360	437
2003	4,933	1,243	833	4,390	414	502
2004	5,668	1,428	957	4,445	419	508
2005	5,183	1,306	875	4,474	422	511
2006	5,016	1,264	847	4,330	408	495
2007	4,536	1,143	766	3,916	369	448
2008	3,700	932	625	3,195	301	365
2009	3,579	902	605	3,205	302	366
2010	6,002	679	681	7,816	1,659	1,134

* Data broken out by vintage was not available to the LTMT project team for 1997-2000.
Source: Summit Blue/Navigant analysis of Ducker Research market reports (2004.2007, 2009, and 2010) and data from the NW Council.

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Appendix C – SAV-AIR Supplemental Information

This appendix includes a discussion of key market trends that will affect the further adoption of advanced compressed air controls equipment, such as that offered by SAV-AIR/Pneu-Logic. During the 2010 SAV-AIR LTMT effort, Navigant identified additional information that could help to inform further work in the area of compressed air efficiency. This information did not fit within the established structure of the LTMT report, but Navigant and NEEA agreed that the information could be valuable.

The first part of Appendix C describes barriers to further market transformation. The second part of Appendix C discusses drivers for future adoption of advanced compressed air controls and opportunities to leverage those drivers to achieve deeper market penetration.

BARRIERS TO FURTHER MARKET TRANSFORMATION

Interviewees identified three categories of barriers to further market transformation:

» Industry Structure Barriers – Compressor original equipment manufacturers (OEMs) or vendors design most compressed air systems in industrial settings. End users largely view OEMs and vendors as the one-stop shop to service compressed air needs. Most customers have strong relationships with their OEM/vendor and do not tend to go outside of this relationship for third-party products and services.[76] Often the OEMs do not attempt to sell even their own simple sequencers unless specifically requested by the customer, because their primary goal is to sell compressors.[77] Third-party products can have difficulty gaining traction simply because the companies lack the trust that the OEMs have garnered with the customers.[78]

  In addition, parties responsible for operating compressors often lack incentives to increase the efficiency of their operation. End users often view their compressors as simple cost centers and do not attempt to manage those costs. This often results in placing the responsibility of these systems under maintenance rather than engineering. Typically, end users do not reward the maintenance personnel for improvements, as their responsibilities do not extend beyond keeping the equipment running.[79]

» Financial Barriers – Budget issues dampen the transformation of this market. Two types of investment decision criteria affect the assessment of a SAV-AIR purchase opportunity:

[76] Based on personal communications with key market actors referenced in Section 6.2.

[77] Based on personal communications with key market actors referenced in Section 6.2.

[78] Based on personal communications with key market actors referenced in Section 6.2.

[79] Based on personal communications with key market actors referenced in Section 6.2.

- Capital budget constraints: Businesses operate with a limited amount of capital to invest to improve the company's competitive position. Many industrial customers direct their capital budgets toward production capacity rather than efficiency.[80] Because industrial customers view compressed air as a support system, it receives different priority than the equipment and systems that directly manufacture product. Even when industrial customers do allocate capital budgets for efficiency, the SAV-AIR system often competes for budget against a host of other measures. The SAV-AIR system costs more than other efficiency options, putting it at a competitive disadvantage.[81]

- Return on investment (ROI) thresholds: Businesses require that their investments generate sufficient future revenues to justify the costs of investment. Alternative methods for measuring ROI include net present value and simple payback period. Most SAV-AIR installations have produced very attractive simple payback periods of less than a year.[82]

  Although the SAV-AIR technology has an attractive ROI, capital budget constraints and priorities sometimes prevent sales of these systems. This means that the relatively high fraction of budget required for the SAV-AIR system frequently supersedes the high ROI typically seen by SAV-AIR installations, resulting in selection of less expensive control systems instead.[83]

- Educational Barriers – Lack of awareness of controls options and the benefits of installing SAV-AIR controls limits broader adoption of the technology. Several of the interviewees indicated that often customers express shock and surprise when learning the extent of the savings that the SAV-AIR system can achieve, especially the fact that the simple payback period is usually less than one year.[84] Although the relevant industry personnel know the SAV-AIR/Pneu-Logic name, they often do not know the potential benefits and the success stories.[85]

[80] Based on personal communications with key market actors referenced in Section 6.2.

[81] Based on personal communications with key market actors referenced in Section 6.2.

[82] Based on personal communications with key market actors referenced in Section 6.2.

[83] Based on personal communications with key market actors referenced in Section 6.2.

[84] Based on personal communications with key market actors referenced in Section 6.2.

[85] Based on personal communications with key market actors referenced in Section 6.2.

DRIVERS AND OPPORTUNITIES FOR FURTHER MARKET TRANSFORMATION

Navigant expects that demand for the SAV-AIR technology will increase in the near term and long term. Near-term growth will occur as the national economic situation improves and budgets begin to loosen. Pneu-Logic has already seen an increase in sales in the latter part of 2010 due to this shift. In the long term, several drivers will likely increase demand for the SAV-AIR technology:

- Rising energy prices
- Opportunities for demand response (Smart Grid)
- Regulation and codes
- Corporate sustainability
- Increased awareness

New industries will also likely provide opportunities for growth. In particular, interviewees mentioned bottling and industrial refrigeration as sectors whose growing presence in the Northwest creates opportunities for new Pneu-Logic projects.

NAVIGANT

Appendix D – Interview Guides

This appendix includes the main interview guides used to collect data from primary sources. Not every initiative required a formal interview guide. This appendix only includes guides for the initiatives for which NEEA requested them.

10.1 BacGen

Navigant completed interview guides for two types of market actors: NEEA's program manager and BacGen staff. This section presents the guides for each of the two types of market actors individually.

10.1.1 NEEA Program Manager

This interview guide will accomplish the following objectives:

- Clarify recent market activity for the larger industry in general.
- Explore extent to which BacGen's new business areas are related to its wastewater optimization process
- Identify BacGen's competitors.

GREETING

Hello, my name is Greg Ekrem and I am calling on behalf of NEEA. Navigant has been hired by NEEA for the purpose of updating NEEA's long-term monitoring and tracking program.

I would like to ask a brief number of questions regarding BacGen's 2009-2010 activities. Your participation in this effort is greatly appreciated and significantly contributes to the ongoing success of NEEA's projects. If possible, I would like to set up a short phone interview within the next week, at your convenience, to discuss your thoughts on the following questions:

MARKET ACTIVITY FOR BACGEN AND THE LARGER INDUSTRY

- How do you think the current economic conditions will impact short- and long-term market penetration of wastewater optimization projects?
- In general, what are your predictions for market activity for wastewater optimization in the industry as a whole over the next 2-3 years?

CONNECTION BETWEEN BACGEN'S NEW BUSINESSES AND WASTEWATER OPTIMIZATION

» To what extent was BacGen developing new lines of business during the time that the BacGen initiative was active?

» [If active]: Were they related to the wastewater optimization

» [If yes]: What were they?

EFFECTS OF LOCAL POLICIES AND INCENTIVES ON BACGEN'S BUSINESS MODEL

» During the last long-term monitoring effort conducted by Summit Blue Consulting, Martin Shain indicated that the success of small- to medium-sized wastewater optimization projects was tied, at least in part, to the level of utility incentives available. Are you aware of any utilities in the Northwest that have offered incentives since NEEA funded the project?

» [If yes]:Which utilities? During what time periods?

» [If yes]: Are you aware of any projects that took advantage of those programs?

» To what extent do you feel that further development of wastewater optimization projects is still dependent on utility incentives?

» What other local policies or outside market influences most significantly impact WW process optimization activity? (e.g., the economy?)

PRESENCE OF COMPETITORS

» Are you aware of any direct competitors to BacGen in the wastewater optimization market that have started operating since the last time we interviewed you in 2008, either in the Northwest or elsewhere? If so, who are they and where are they primarily operating?
Be clear that "direct competitors" should be targeting operators of small- to mid-size WWTP.

» Would you be willing to provide us with points of contact at those competing organizations? [If yes, write it down or follow up with email.]

I am happy to clarify any of these questions in advance. Please let me know if we can set up a phone interview at your convenience before January 14, 2010. I expect that the phone interview will last no longer than about 30 minutes. Again, your participation is very valuable to this project and greatly appreciated.

10.1.2 BacGen Staff

This interview guide will accomplish the following objectives:

- Secure an updated project tracking database for 2009-2010 from BacGen.
- Clarify recent market activity for BacGen and the larger industry in general.
- Explore extent to which BacGen's new business areas are related to its wastewater optimization process
- Discuss the effects of local policies and incentives on BacGen's business model.
- Identify BacGen's competitors.

GREETING

Hello, my name is Greg Ekrem and I am calling on behalf of the Northwest Energy Efficiency Alliance – NEEA. Navigant was by NEEA for the purpose of updating NEEA's long-term monitoring and tracking program.

I would like to ask a brief number of questions regarding BacGen's 2009-2010 activities. Your participation in this effort is greatly appreciated and significantly contributes to the ongoing success of NEEA's initiatives. If possible, I would like to set up a short phone interview within the next week, at your convenience, to discuss your thoughts on the following questions:

MARKET ACTIVITY FOR BACGEN AND THE LARGER INDUSTRY

- Are small- to medium-sized wastewater optimization projects still BacGen's target markets or has BacGen's current business focus shifted to other project types? If so, what are these other project types?
- Approximately what number and size of wastewater optimization projects do you predict that BacGen will complete throughout 2011-2012?
    - How many of these projects are already under construction?

- For how many of these projects are you already in negotiation with the facility owner/manager?
- How do you think the current economic conditions will impact short- and long-term market penetration of wastewater optimization projects?
- In general, what are your predictions for market activity for wastewater optimization in the industry as a whole over the next 2-3 years?

2009-2010 PROJECT DATABASES

» Have you provided NEEA with an updated database for all projects installed through December 2010? If not, could we get an updated database from you?

» [If not yet provided by Martin]: Would you be able to send over a database of the projects BacGen has completed in 2009 and 2010?

CONNECTION BETWEEN BACGEN'S NEW BUSINESSES AND WASTEWATER OPTIMIZATION

» What is the status of BacGen's freshwater optimization and design consultation businesses?

» Do you anticipate these lines of business contributing significantly to BacGen's future growth?

» During the last long-term monitoring effort conducted by Summit Blue Consulting, you indicated that BacGen is potentially entering the waste-to-energy market. What is the current status of this service offering?

- Is the development of that offering in any way related to BacGen's previous wastewater optimization work? If so, how so? To what extent?

» Is BacGen considering any other new service offerings or technology related to the wastewater optimization process?

EFFECTS OF LOCAL POLICIES AND INCENTIVES ON BACGEN'S BUSINESS MODEL

» During the last long-term monitoring effort conducted by Summit Blue Consulting, you indicated that the success of small- to medium-sized wastewater optimization projects was tied, at least in part, to the level of utility incentives available.

» Which utilities have offered incentives in the Northwest since NEEA funded the project?

» During what time periods?

» Did any of the projects with which you were involved take advantage of those incentives? If so, which ones? If not, why not?

» To what extent do you feel that further development of wastewater optimization projects is still dependent on utility incentives?

» What other local policies or outside market influences most significantly impact BacGen's WW process optimization activity? (e.g., the economy?)

» What has been the effect of available ARRA funds and have they played a role in your recent market activity?

PRESENCE OF COMPETITORS

» Are you aware of any direct competitors to BacGen in the wastewater optimization market that have started operating since the last time we interviewed you in 2008, either in the Northwest or elsewhere? If so, who are they and where are they primarily operating?
Be clear that "direct competitors" should be targeting operators of small- to mid-size WWTP.

» Would you be willing to provide us with points of contact at those competing organizations? [If yes, write it down or follow up with email.]

10.2 BOC

Navigant completed interview guides for one type of market actors: staff from the organizations involved in implementing BOC. That guide is included in this section.

» What significant new developments, if any, have you seen in the BOC program this year, including changes in interest/demand, or changes in program structure?

  - What factors are driving or affecting these changes?

  - What kind of impact would these changes have on the BOC program?

» Have you noticed any changes in demand or anything else this year that can be attributed to ARRA or other outside funding for job training in the energy efficiency realm? Please describe, if any changes.

- Describe any other programs or campaigns you aware of that are targeting the same market as this BOC program. This could include in-house corporate training, union training or any other alternative to the BOC program.

- In your opinion, would similar or more detailed Building Operator Education classes have been created in the region if the Building Operator Certification did not exist in the Pacific NW? What factors lead you to this conclusion?

- Do you expect changes in the market for BOC in the near future? If so, what?

- What challenges does the BOC program face?

- What efforts have you made to address the challenges facing the BOC program?

- Have you noticed any changing trends in program participation? If so, please describe these trends.

    - What factors are driving or affecting these changes?

- What trends, if any, have you noticed in terms of organizations striving to send all of their facilities personnel through BOC training?

NEEA SPECIFIC:

- What are the reasons for NEEA's "reinvestment" in the BOC program? To what extent will the reinvestment affect existing program delivery?

- Review with NEEA staff the most recent ACE model and any changes to inputs/assumptions?

NEEC SPECIFIC:

- What tasks or goals are targeted for use of the money you received from ARRA in June of 2010?

10.3 Drive Power

Navigant completed interview guides for industry experts. That guide is included in this section.

GREETING

Hello, my name is Mohit Singh-Chhabra and I am calling on behalf of the Northwest Energy Efficiency Alliance – NEEA. Navigant has been hired by NEEA for the purpose of updating NEEA's long-term monitoring and tracking program.

I would like to ask a brief number of questions regarding the Drive Power Initiative's 2009-2010 activities. Your participation in this effort is greatly appreciated and significantly contributes to the ongoing success of NEEA's initiatives. If possible, I would like to set up a short phone interview within the next week, at your convenience, to discuss your thoughts on the following questions:

INTERVIEW QUESTIONS

» Are you aware of any recent trends in the market for new motors in 2010 in the Pacific Northwest?

» (Yes / NO)

» (If NO, then skip to question 2; If YES then ask)

In particular,

- Have total new motor sales increased or decreased? If motor sales did increase/decrease, by approximately how much did they change (PROBE FOR PERCENTAGE)? What factors, in your opinion, have caused this change?

- Have NEMA Premium® motor sales increased or decreased? If NEMA Premium® motor sales did increase/decrease, by approximately how much did they increase/decrease by (PROBE FOR PERCENTAGE)? What factors, in your opinion, have caused this change?

» In your opinion, what percentage of total national motor sales can be attributed to Baldor Electric CompanyTM?

- Does the share of motors sold by the Baldor Electric CompanyTM in the northwest differ from that of the nation? If so, by how much does it differ? (PROBE FOR PERCENTAGE OF TOTAL SALES)

» In your opinion, what percentage of total national motor sales can be attributed to Original Equipment Manufacturers (OEMs)?

  - Does the share of motors sold by OEM's in the northwest differ from that of the nation? If so, by how much does it differ? (PROBE FOR PERCENTAGE OF TOTAL SALES)

» According to new motor sales data collected by NEMATM and released by the CEE; since 2006 NEMA Premium® motor sales have been decreasing, nationally and in the Northwest.

  - Do you believe that NEMA Premium® motor sales have actually been decreasing since 2006? If so, what factors may have contributed to these market dynamics? If not, is there an explanation for the data showing a decreasing sales trend?

  - When did the recession hit the new motors market? Did it start in 2008, or was there a different start time?

» <ONLY FOR THE CEE> Over the years, entities reporting motor sales have been changing. OEMs (Original Equipment Manufacturers) stopped reporting motor sales in 2004; Baldor Electric CompanyTM stopped reporting motor sales data in 2005 and resumed reporting motor sales data in 2008. This has made it difficult to establish a market activity and baseline trend based on reported motor sales data.

  - Can you help break down motor sales data from 2001 through 2004 to exclude motor sales reported by OEMs and Baldor Electric CompanyTM? This will help insure that we have a consistent set of data to assess trends over the years

  - Alternatively, what is the total share of motor sales reported by OEMs and Baldor Electric CompanyTM each year?

  - For each year of motor sales data reported, can we confirm the entities that are reporting sales data in that year?

  - How does the CEE handle this inconsistently reported data?

» Did the awareness of NEMA Premium® motors in the Pacific Northwest continue to grow through 2008 and beyond (till the code change in 2010)?

» Are there any additional comments regarding new motor sales in the Pacific Northwest that you would like to share with us?

QUESTIONS FOR DENNIS BOWNS AND ERIN HOPE ONLY

- Corrective actions for efficient rewinds: What are the problems that Erin has observed with respect to motor rewinds in the field?
- Current rewind procedures: What in Erin's opinion are the procedures that are currently being employed in the Northwest for rewinds.
- Testing equipment: What percentage of service centers actually own a core loss tester?
  - How are testing equipment calibrated. Is this done in-house?
- NEEA Trainings: What percentage of program participating service centers have taken part in NEEA sponsored trainings on motors? By participating center we mean a service center that claims incentives for performing efficient rewinds.
- Number of rewinds performed: What percentage of efficient rewinds are being incentivized?
  - Are rewinds on motors larger than 500 HP being tracked? If so – how can we get that information?

I am happy to clarify any of these questions in advance. Please let me know if we can set up a phone interview at your convenience. I expect that the phone interview will last no longer than about 30 minutes. Again, your participation is very valuable to this project and greatly appreciated.

10.4 SAV-AIR

Navigant conducted interviews with three types of market actors: NEEA's Industrial Sector Manager, Pneu-Logic staff, and other market actors. This section presents the guides for each of the three types of market actors individually.

10.4.1 NEEA's Industrial Sector Manager

This interview will accomplish the following objectives:

- Gather information about the current state of the market for controls systems for compressed air
- Discuss what would have happened in the absence of SAV-AIR initiative
- Identify other contacts to interview for this effort

NAVIGANT

GREETING

Hi, my name is _____, and I'm calling on behalf of the Northwest Energy Efficiency Alliance – NEEA. We're working on a report on compressed air control systems. I'd like to talk with you about your experiences with these control systems to help understand the market in the Northwest. This is part of a NEEA report that will be published later this year. I expect that this call will take about 15 minutes.

» Would you be willing to talk with me about these compressed air control systems?

» Is now a good time, or can we schedule a time to talk later this week/early next week?

STATE OF THE MARKET AND TRENDS

» Are compressed air optimization systems not common at all, somewhat uncommon, somewhat common, or very common in the industry?

  o Are there regions, sectors, or niches that warrant special consideration for compressed air controls? Which ones? How are they different?

» How large is the current market for compressed air optimization systems in the Northwest compared to other compressed air efficiency measures (sequencers, leak repair, end use design, etc)? ($, units, savings)

» Could you describe any trends in the market for compressed air optimization systems?

» What are the primary factors that limit the implementation of compressed air controls systems throughout the industry (e.g., technical, financial, educational)?

  o Have any of these factors changed recently that caused the market to contract or expand? If yes, how so?

» To what extent are any changes and trends related to Pneu-Logic?

BASELINE AND DISCERNING THE SAV-AIR INITIATIVE IMPACTS

[Describe interviewer's understanding of the relationship between Pneu-Logic and the SAV-AIR initiative.]

» To what extent are compressed air controls promoted in the Northwest outside of Pneu-Logic's efforts? How has Pneu-Logic fared in the market compared to others?

» What compressed air controls technologies other than Pneu-Logics exist in the market?

» Compared to other control technologies, do Pneu-Logic's proprietary control solutions yield less, the same, or more energy savings?

» Has the presence of Pneu-Logic in the market affected awareness of compressed air controls technology and its costs or benefits (e.g., marketing or educational effects, word of mouth from customers, referrals, positive or negative experiences)? Please explain.

» Did the presence of the SAV-AIR initiative affectawareness of compressed air controls technology and its costs or benefits (e.g., marketing or educational effects, word of mouth from customers, referrals, positive or negative experiences)? Please explain.

OTHER CONTACTS OR RESOURCES FOR INFORMATION

» [For NEEA Industrial Sector Manager only]: Did the SAV-AIR initiative work directly with contractors? Is there a database or a contact list?

» We will be conducting a small survey of contractors that work in the compressed air space. Can you point us to the larger contractors who serve these systems in the NW? (If so, get company names, individual names, and phone/email if possible. May need to follow up with email.)

» Do you know of any other people that could provide useful insight or experience? Names/Contact information?

CLOSING

Thank you very much for your time today. If I have a clarification question as I'm reviewing my notes, is it alright to call you back or email you?

Thanks again, and have a great day.

10.4.2 Pneu-Logic Staff

This interview will accomplish the following objectives:

- Better understand the relationship between SAV-AIR and Pneu-Logic and NEEA
- Understand Pneu-Logic's product offering and efforts to reach the market
- Gather information about the current state of the market for controls systems for compressed air
- Discuss what would have happened in the absence of SAV-AIR initiative
- Identify other contacts to interview for this effort

GREETING

Hi, my name is _____, and I'm calling on behalf of the Northwest Energy Efficiency Alliance – NEEA. We're working on a report on compressed air control systems. I'd like to talk with you about your experiences with these control systems to help understand the market in the Northwest. This is part of a NEEA report that will be published later this year. I expect that this call will take about 15 minutes.

- Would you be willing to talk with me about these compressed air control systems?
- Is now a good time, or can we schedule a time to talk later this week/early next week?

HISTORY OF PNEU-LOGIC

- In what year was Pneu-Logic (the company) established?
- What is the relationship to SAV-AIR?
- What was the reason for changing names?
- How did scope of products/services change from SAV-AIR to Pneu-Logic?

ABOUT THE PNEU-LOGIC BUSINESS

» What is the target market for Pneu-Logic?

» What is the ratio of their sales (by unit and by $) between the different control systems PL4000, PL1000, PL500, Services?

» What is the business/financial model? (OEM, Full Service House, Contractor Implementers?)

» What is the trend in sales/installations? Do they provide data to NEEA on a regular basis about their sales? (If not, we will likely need to get it.)

» Geographic region of customers?

» What are the primary customer markets? (Paper, general manufacturing, etc?)

» Who are Pneu-Logic's primary competitors? Are competitors typically regional or national level?

» To what extent are you actively marketing your product in the Northwest? Is there a targeted effort? Is it an approach that's more responsive to inquiries or more marketing based?

» Has Pneu-Logic engaged in any marketing or educational efforts? How effective have they been?

» Do you have any testimonials or letters from customers that would help confirm energy savings estimates?

ABOUT THE SAV-AIR INITIATIVE

» We understand that NEEA's SAV-AIR initiative lasted from 1998-2003. How did NEEA's initiative affect your business?

- Probe: To what extent did it contribute to the development of new products?
- Probe: To what extent did it help your company gain access to markets, distribution channels, or other strategic partnerships?
- Probe: How do those new products, partnerships, or access to market affect your business today?

» Who was your main point of contact at NEEA during the initiative?

STATE OF THE MARKET AND TRENDS

» Are compressed air optimization systems not common at all, somewhat uncommon, somewhat common, or very common in the industry?

  o Are there regions, sectors, or niches that warrant special consideration for compressed air controls? Which ones? How are they different?

» How large is the current market for compressed air optimization systems in the Northwest compared to other compressed air efficiency measures (sequencers, leak repair, end use design, etc)? ($, units, savings)

» Could you describe any trends in the market for compressed air optimization systems?

» What are the primary factors that limit the implementation of compressed air controls systems throughout the industry (e.g., technical, financial, educational)?

  o Have any of these factors changed recently that caused the market to contract or expand? If yes, how so?

» To what extent are any changes and trends related to Pneu-Logic?

BASELINE AND DISCERNING THE PNEU-LOGIC IMPACTS

» To what extent are compressed air controls promoted in the Northwest outside of Pneu-Logic's efforts? How has Pneu-Logic fared in the market compared to others?

» What compressed air controls technologies other than Pneu-Logics exist in the market?

» Compared to other control technologies, do Pneu-Logic's proprietary control solutions yield less, the same, or more energy savings?

» Has the presence of Pneu-Logic in the market affected awareness of compressed air controls technology and its costs or benefits (e.g., marketing or educational effects, word of mouth from customers, referrals, positive or negative experiences)? Please explain.

OTHER CONTACTS OR RESOURCES FOR INFORMATION

» We will be conducting a small survey of contractors that work in the compressed air space. Can you point us to the larger contractors who serve these systems in the NW? (If so, get company names, individual names, and phone/email if possible. May need to follow up with email.)

» Do you know of any other people that could provide useful insight or experience? Names/Contact information?

CLOSING

Thank you very much for your time today. If I have a clarification question as I'm reviewing my notes, is it alright to call you back or email you?

Thanks again, and have a great day.

10.4.3 Other Market Actors

This interview will accomplish the following objectives:

» Gather information about the current state of the market for controls systems for compressed air

» Discuss what would have happened in the absence of SAV-AIR initiative

» Identify other contacts to interview for this effort

GREETING

Hi, my name is _____, and I'm calling on behalf of the Northwest Energy Efficiency Alliance – NEEA. We're working on a report on compressed air control systems. I'd like to talk with you about your experiences with these control systems to help understand the market in the Northwest. This is part of a NEEA report that will be published later this year. I expect that this call will take about 15 minutes.

» Would you be willing to talk with me about these compressed air control systems?

» Is now a good time, or can we schedule a time to talk later this week/early next week?

CONTACT INFORMATION AND RELATION TO PNEU-LOGIC

» What is your title and organization?

» What is the best way to contact you in the future?

» Are you familiar with the Pneu-Logic or with compressed air control systems in general?

» Could you briefly describe your relationship with Pneu-Logic or with compressed air control systems in general?

STATE OF THE MARKET AND TRENDS

» Are compressed air optimization systems not common at all, somewhat uncommon, somewhat common, or very common in the industry?

  - Are there regions, sectors, or niches that warrant special consideration for compressed air controls? Which ones? How are they different?

» How large is the current market for compressed air optimization systems in the Northwest compared to other compressed air efficiency measures (sequencers, leak repair, end use design, etc)? ($, units, savings)

» Could you describe any trends in the market for compressed air optimization systems?

» What are the primary factors that limit the implementation of compressed air controls systems throughout the industry (e.g., technical, financial, educational)?

  - Have any of these factors changed recently that caused the market to contract or expand? If yes, how so?

» To what extent are any changes and trends related to Pneu-Logic?

BASELINE AND DISCERNING THE PNEU-LOGIC IMPACTS

[Describe interviewer's understanding of the relationship between Pneu-Logic and the SAV-AIR initiative.]

» To what extent are compressed air controls promoted in the Northwest outside of Pneu-Logic's efforts? How has Pneu-Logic fared in the market compared to others?

» What compressed air controls technologies other than Pneu-Logics exist in the market?

» Compared to other control technologies, do Pneu-Logic's proprietary control solutions yield less, the same, or more energy savings?

» Has the presence of Pneu-Logic in the market affected awareness of compressed air controls technology and its costs or benefits (e.g., marketing or educational effects, word of mouth from customers, referrals, positive or negative experiences)? Please explain.

» Did the presence of the SAV-AIR initiative affect awareness of compressed air controls technology and its costs or benefits (e.g., marketing or educational effects, word of mouth from customers, referrals, positive or negative experiences)? Please explain.

OTHER CONTACTS OR RESOURCES FOR INFORMATION

» Do you know of any other people that could provide useful insight or experience? Names/Contact information?

CLOSING

Thank you very much for your time today. If I have a clarification question as I'm reviewing my notes, is it alright to call you back or email you?

Thanks again, and have a great day.