# Industrial Behavior Change and Energy Savings

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## Abstract

This paper will describe an evaluation of an energy efficiency project in the industrial sector. As an "adaptive management" organization, the Northwest Energy Efficiency Alliance encourages its project managers and contractors to change tactics and techniques to achieve market transformation and energy savings goals. The adaptive nature of the project's implementation presents unique challenges to evaluators and their efforts to understand and explain the project's progress to goals. After three years of data collection and analysis, Northwest Energy Efficiency Alliance (NEEA) and its evaluation contractor, the Cadmus Group, has developed an initial set of conclusions and observations regarding implementing and evaluating behavior change, market transformation and energy savings in the industrial sector.

## NEEA and its Industrial Initiative

The Northwest Energy Efficiency Alliance (NEEA) is a non-profit organization that facilitates market transformation toward energy efficiency with a wide variety of programs and initiatives targeting the residential, commercial, agriculture, and industrial sectors as well as technologies used across sectors. The region's electric utilities, public benefits administrators, state governments, public interest groups and efficiency industry representatives support NEEA. This unique partnership has helped make the Northwest region a national leader in energy efficiency. Historically, NEEA's focus has been on developing and implementing "widget"-based programs intended to establish new energy efficiency technologies in the market and to transform the target markets by increasing market penetration rates of these new measures. As such, NEEA has traditionally followed a three-phased approach that includes planning, implementation, and evaluation. Under this approach, NEEA has developed energy savings estimates from market transformation via modeling techniques using the following formula:

$$\text{Energy Savings per Unit} \times \text{Market Penetration} = \text{Energy Savings from Market Transformation}$$

NEEA's Industrial Initiative was the first project focused on effecting market transformation through behavioral change, specifically by changing the perception and management of energy within the industrial sector. In particular, the Initiative encourages manufacturing companies to make energy efficiency an integral part of their corporate and plant operations. The Initiative currently focuses on the implementation of Continuous Energy Improvement (CEI) within the pulp and paper, and food processing industries. CEI helps companies lower their energy costs and reduce environmental impact by changing the way everyone in a company thinks about energy. Specifically, the Initiative staff and its contractors work with utility and trade association partners and provide the measurement resources, systems training, awareness programs, technical support, and coaching necessary to ensure that industrial personnel understand how their daily actions and decisions impact their company's operations. NEEA's funding criteria require that a project be cost effective and balance long-term market transformation with near term (electrical) energy savings. The guiding principles for the Initiative include: leveraging the intersection of interests between the vertical and crosscutting markets; an

incorporation of energy management into the natural business practices of each market; and coordination with local utilities, the Bonneville Power Administration, and state energy offices.

## Chronology of Planning and Implementation

**Planning Stage (2002 – 2004).** The Initiative has its roots in the Alliance's earlier work, beginning in 2002, to develop and implement a systematic plan to deliver a clear, consistent message on energy efficiency to the entire Pacific Northwest industrial sector. The Initiative's conceptual framework is grounded in the findings of a two-year research and development effort to characterize the industrial market in the Pacific Northwest and NEEA's interest in formulating a coherent market transformation strategy. This work resulted in the development of the "strategic plan" for the Initiative.[1] The initial project plan called for the transformation of five vertical industrial markets. As originally envisioned, the Initiative would start with the pulp and paper and food processing markets, along with the markets for five crosscutting technologies (motors, compressed air, pumps, refrigeration and lighting). From there, the Initiative would move on to the wood products, transportation, manufacturing, and electronic/computer manufacturing markets. As envisioned in the strategic plan, the Initiative had two primary goals:

1. Make energy efficiency a more integral part of corporate and plant decision making and business practices concerning plant expansions/improvements and operations within targeted vertical markets and thus creating a natural market demand for systems-oriented efficiency improvements.

2. Transform the industrial equipment and service suppliers so that they provide and market systems optimization services and equipment to their end customers.

The Initiative's market transformation strategy centered upon direct consultation with industrial firms and their trade allies to help mitigate identified market barriers and make energy efficiency an integral part of corporate decision-making and plant operations. This would result in a natural, market-based demand for system-oriented efficiency improvements. Specifically, NEEA envisioned the Initiative bringing about an ongoing process of education, training, and persuasion that has long-term impact on key industries and leaders, rather than expecting to yield immediate, measurable results typically found in a traditional, technology-focused program.

The plan was accepted, and the Alliance Board approved funding in July 2004. The total budget amounted to slightly more than $16,000,000 over five years.

**The Initial Market Approach (2005)**. The project charter, developed in early 2005, reduced the scope of the Initiative to two vertical markets (pulp and paper and food processing) and four crosscutting technologies (motors, compressed air, refrigeration and pumps) with an annual budget of approximately $3,000,000. In the targeted vertical markets (pulp and paper and food processing), the primary energy uses are motor-drive systems, facility lighting and HVAC, operations and maintenance (O&M), and, in the case of food processing, refrigeration. The vertical market intervention strategies were expected to reinforce the crosscutting intervention strategy by promoting a systems-based approach to energy management. Figure 1 shows a summary of the Initiative's intervention strategies for the vertical and crosscutting markets.

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[1] Northwest Energy Efficiency Alliance: Industrial Sector Initiative: "A Strategic Plan for Market Transformation in the Industrial Market in the Pacific Northwest 2004-2009," Final Report, July 12, 2004.

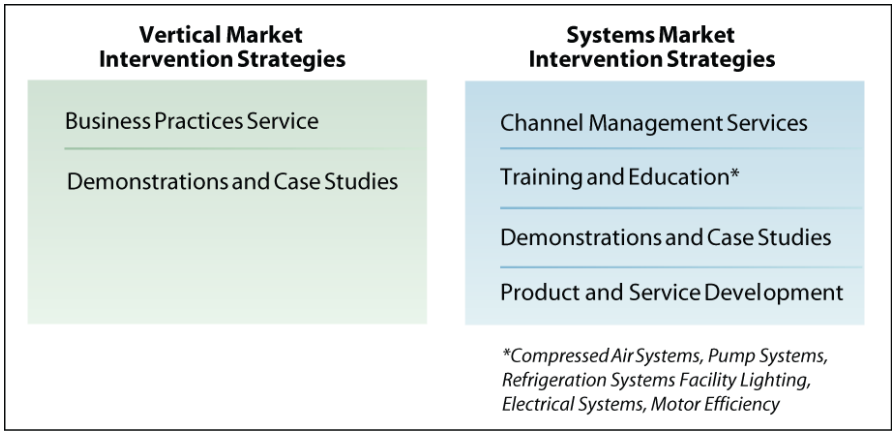


**Figure 1: Intervention Strategies**

After approval by NEEA's Board of Directors, NEEA staff set about selecting contractors to work on the Initiative. The initial management structure relied heavily on outside consultants for overall program management, technical consultants and specialists for the target markets, marketing consultants, and a consultant specializing in utility-relationship management. NEEA staff provided overall guidance and oversight, marketing and evaluation managers, and IT support. Upon assembling the team, the team immediately commenced work on establishing goals, identifying representative key performance indicators (KPI's), developing the organizational structure, developing necessary infrastructures for internal and external communication, and launching the different market intervention strategies. Specifically, the Initiative staff spent the first half of 2005 developing training curriculum and negotiating with two industry associations—the Northwest Food Processing Association (NWFPA) and the Technical Association for the Pulp and Paper Industry (TAPPI)—to promote the Initiative's message to their members. Initiative staff spent the remainder of the year contacting food processing companies and pulp and paper mills.

**First Experiences and Recalibration (2006).** After a year of implementation, the Initiative found itself pursuing a combination of technology-oriented training and account management. Reflecting back on the first year of taking the Initiative to the market, the implementation and evaluation staff had discovered several key challenges:

1. Initiative contractors had not coordinated their activities with energy efficiency managers from local utilities. The latter viewed the mills and processing plants as "their customers" and came to view the Initiative as unwelcome interlopers.

2. Due to perceived pressure of going to market quickly, the Initiative launched activities without sufficient market research. This haste resulted in a marketing message that lacked a value proposition relevant to each target audience.

3. Both Initiative staff and contractors were customizing their message for each facility. This made it difficult to define the Initiatives objectives as well as the benefits it had to offer industrial end-users.

4. The lack of a detailed program theory and logic model made internal communication and coordination challenging. Based on its observation of the Initiative's progress to date, the evaluation contractor, Quantec (now a part of the Cadmus Group) developed a detailed logic model (Figure 2).

5. NEEA staff had established 33 KPIs, most of which were poorly defined and/or were lacking data to report progress. The majority of the KPIs were activity-focused rather than focused on measuring market progress or energy savings.

6. Due to a lack of tracking data, NEEA's evaluation contractor was limited to quantifying energy from training events and could not estimate the impact of behavior or business practice change on energy consumption.

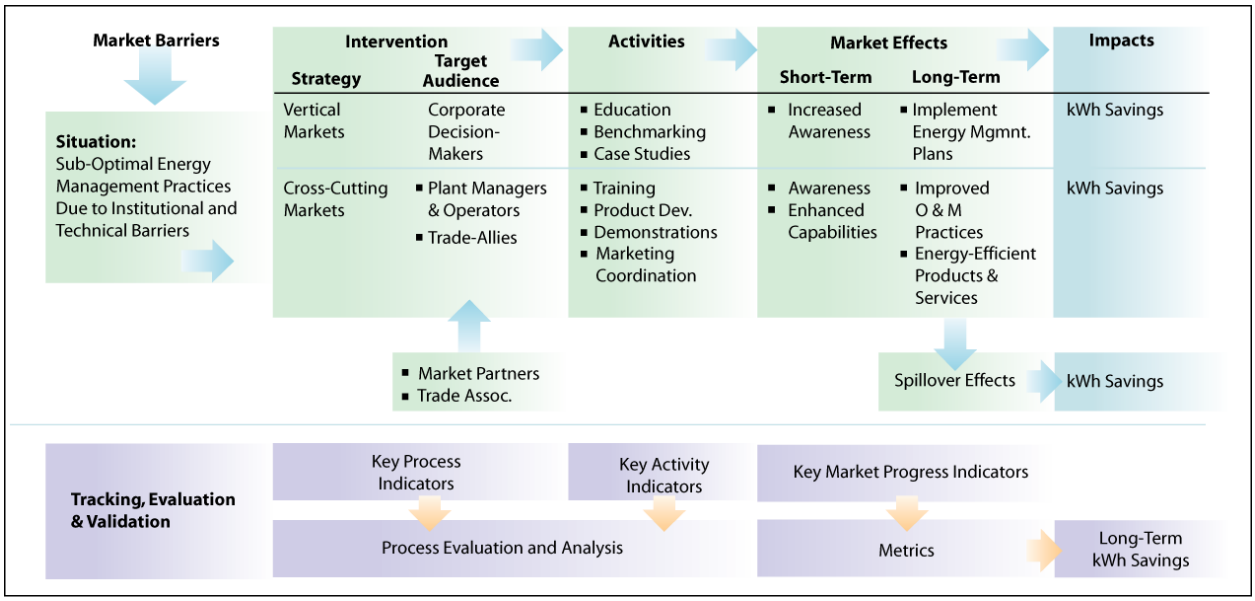


**Figure 2: Initial Program Logic Model**

In order to address these challenges, NEEA staff began to require that its implementation contractors follow a coordinated customer strategy with each industrial end-user that did not infringe on the local utilities' existing efficiency objectives. The Initiative began to revise its marketing into a more consistent format but disagreement between NEEA staff and contractors stymied this effort. The result was an Initiative that made significant inroads at individual plants and mills but quantification of energy savings simply did not occur. While it was possible to discuss the achievement (or lack thereof) for each "key performance indicator," it was unclear if and how the Initiative was transforming the target markets. This challenge resulted in the development of a set of market progress indicators used by the evaluation team.

**Retooling and Switching Gears (2007).** At the end of 2006, NEEA staff retirements led to the hiring of new leadership with experience in manufacturing. New management conducted detailed assessments of the program theory, markets, internal management structure, and available implementation infrastructure. One of the key results of this assessment was that the Initiative's primary reliance on the connections and abilities of individual subject matter experts had resulted in ad-hoc approaches and solutions that could not be easily applied to other facilities, and thus, were difficult to package for the industry at large. While the initial project managers focused on developing customized solutions for each facility and promoting technical trainings generated initial successes in behavioral change, the new management did not consider this approach as a sustainable path to get to their goal of market transformation. . As a result, new management began to develop a new implementation strategy akin to

a more traditional product development and launch process used in the manufacturing sector. Specifically, new management instituted the following changes:

1. Focus solely on the two vertical markets and address the crosscutting markets only in support of energy management activity at food processing plants and pulp/paper mills.

2. Conduct detailed market studies and analysis of target audiences to assess needed and desired products, services, and structure. Based on the results, relaunch all marketing efforts, including a rebranding of the Industrial Efficiency Alliance (IEA) to the Industrial Initiative.

3. Reduce reliance on outside contractors for key strategic decisions by hiring additional NEEA staff to maintain sole control over strategy and product development. This resulted in the current management structure of a Program Manger, Marketing Manager, Product Manager, an Operations Manager, and an Evaluation Manager. This team managed a team of consultants and contractors that conducted most of the day-to-day functions of implementing and evaluating the Initiative.

4. Begin standardizing the Initiative's energy management as a product known as Continuous Energy Improvement (CEI). Develop detailed documentation of product.

5. Refocus key effort on regional or national levels to promote CEI at the corporate level rather than on a facility-by-facility basis. Specifically, focus heavily on leveraging the support and market connections of regional market players (Northwest Food Processor's Alliance and utilities) to promote CEI.

6. Significantly enhance data management and quality practices to ensure tracking and validation of savings by the evaluation team.

NEEA staff formalized these changes to the program theory and implementation strategy in two market-specific logic models that are now serve as the implementation team's to guide to current and future activities (see figures 3 and 4).

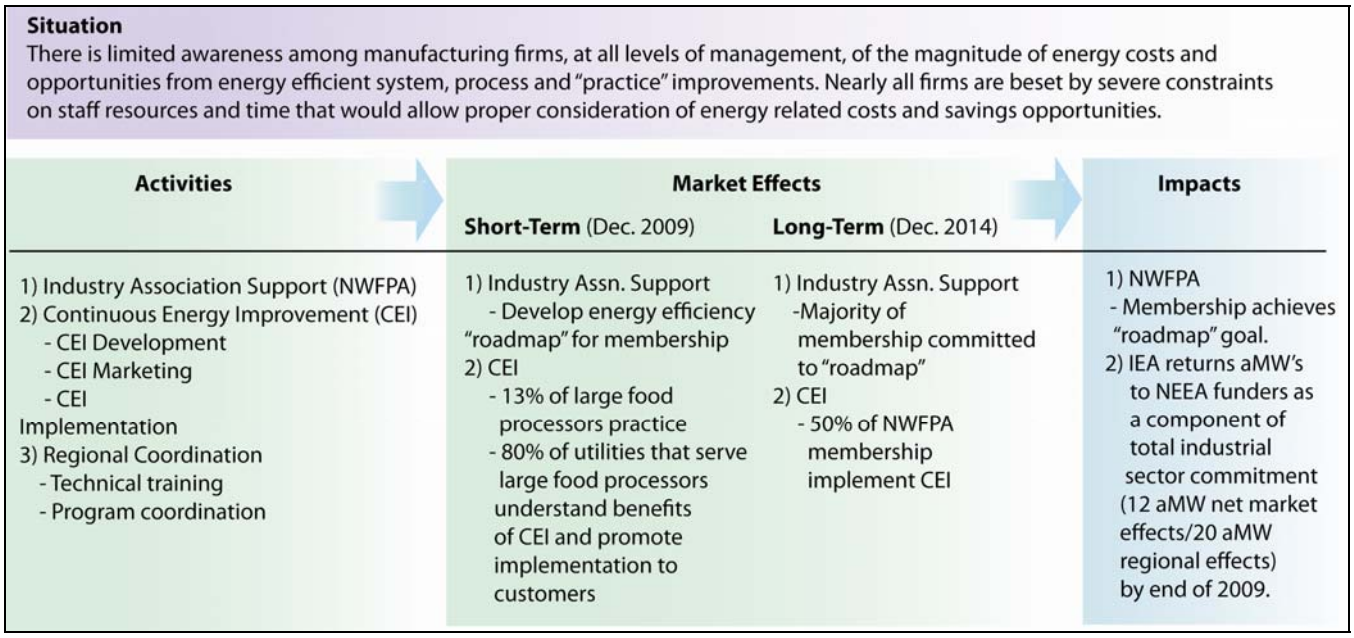


**Figure 3: Logic Model for Food Processing Market**

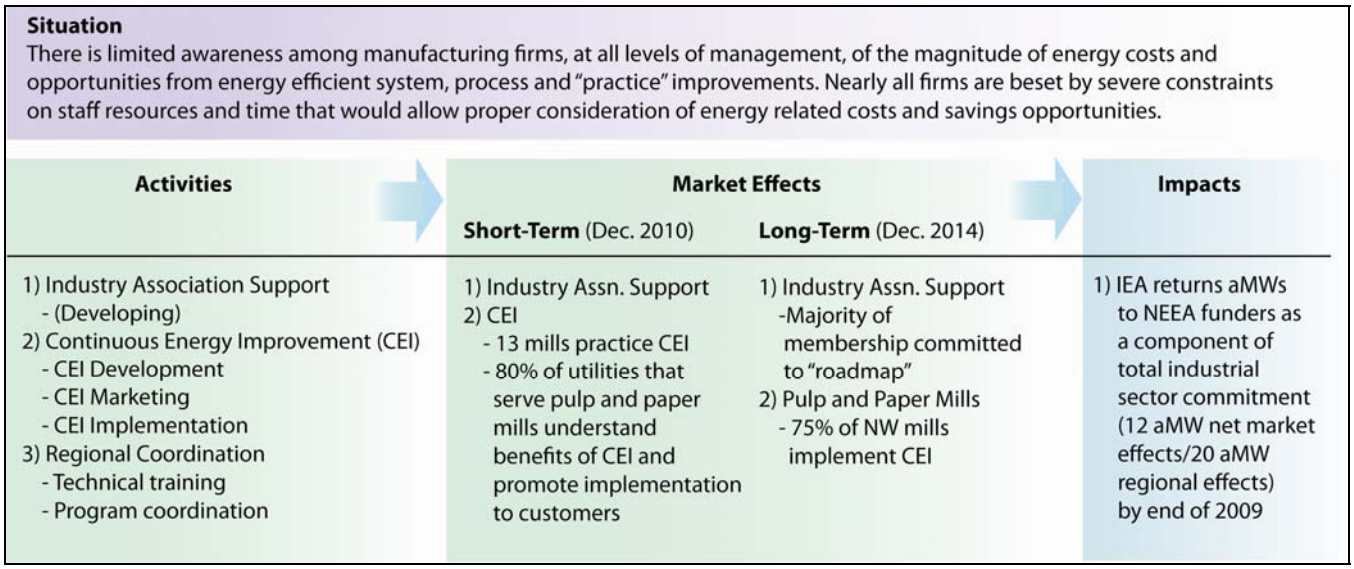


**Figure 4: Logic Model for Pulp and Paper Market**

Lastly, due to insufficient and inconsistent tracking of facility data—including interventions, project information, and savings estimates—this limited the estimation of energy savings. Moreover, insufficient planning regarding how the energy savings estimates would be developed and by whom, NEEA charged its evaluation contractor, Cadmus (formerly Quantec LLC), with the task of deriving initial savings estimates following the completion of site visits. Using this approach for 21 site visits, Cadmus was able to validate a total of 1.1 aMW in electric savings resulting from IEA's training activities for the duration of the implementation phase.

**Implementing a Standardized Approach (2008).** In addition to continuing its ongoing implementation activities, NEEA spent the first part of the year defining and documenting the current

product of its Industrial Initiative: CEI (version 1.0).NEEA is also working on developing standardized versions of CEI that can be transferred to other industrial sectors (CEI 2.x) or taken up by smaller food processors (CEI version 3.0).

In support of its stated goal of transforming the market, the Initiative has been working closely with the NWFPA to set a foundation for market transformation in the regional food processing sector. Specifically, NEEA assisted the NWFPA in their process of setting long-term energy reduction goals both for the Association and on the facility level. As a result, on October 4, 2008 the Executive Leadership of the NWFPA signed an agreement for their industry to collectively achieve a 25% energy intensity reduction goal in 10 years and then go on to reduce an additional 25% ten by 2028. Current estimates place electrical energy consumption by food processors in the northwest at 400 aMW.[2] As NWFPA membership comprises approximately 80% of facilities in the region, this goal translates to as much as 200 aMW of energy savings over the next two decades. While the NWFPA agreement is bold, it is also "**SMART**:" **S**pecific, **M**easurable, **A**chievable and **T**imely. As such, the food processing industry can measure their progress – or lack thereof – against a baseline to determine if their collective action is succeeding. In addition, this agreement serves as the basis for a "roadmap" with which the industry coordinates efforts to identify tools, technologies, and techniques to meet their goals. This agreement represents a milestone in NEEA's effort to transform the industrial sector of Oregon, Idaho, Washington and Montana through a combination of behavior and business practice change.

As the implementation team was actively working on improving data tracking related to all its interventions, in June 2008, Cadmus validated 1.60 aMW of energy savings due to the Initiative's involvement as shown in Table 1.

**Table 1: Validated Energy Savings (2006, 2007)**

| Year of Validation | Incented Capital Projects | Un-Incented Capital Projects | Operations and Maintenance | Total |
|---|---|---|---|---|
| 2006 | 0.656 | 0.009 | 0.271 | 0.936 |
| 2007 | 0.126 | 0.285 | 0.254 | 0.665 |
| Total | 0.782 | 0.294 | 0.525 | 1.601 |

Note: Training in 2005 resulted in behavior change-oriented savings in 2006. NEEA and Cadmus are still in the process of validating 2008 savings.

The majority of these savings were in food processing, totaling 1.26 aMW. Site visits and phone interviews revealed an additional 6.11 aMW of expected savings from capital projects. Cadmus found evidence suggesting that this number might be even higher if sufficient data were available to systematically track and quantify operation and maintenance savings (O&M). Per Table 2, Cadmus observed the following sources of energy savings per year:

**Table 2: Evolution of Savings**

| | Source of Savings | Type of Savings |
|---|---|---|
| 2005 - 2006 | Simple Training | Initial O&M Adjustments |
| 2007 | Advanced Training | Systematic O&M Changes; Capital Projects |
| 2008 | Continuous Improvement | Systemic and Sustainable Energy Managment |

[2] Northwest Power and Conservation Council 2001 estimate.

Note that the progression of sources of savings in Table 2 is consistent with the program logic. General "awareness" training provided the foundation for later system/technology-specific training. These training efforts resulted in changes to operations and maintenance (O&M) – the proverbial "low-hanging fruit" of the energy efficiency industry. Later more advanced training, known as *Industrial Mentored Training*, resulted in capital projects and the establishment of more energy efficient O&M regimes. While facility workers developed greater awareness and technical competencies, the Initiative's contractors worked with facility management to develop energy savings goals and metrics.

In 2008, participating facilities began to exploit past experiences and implement continuous improvement of energy use through energy management. Where the first savings were "one off" exercises, later savings were part of a coordinated and persistent effort.

Lastly, starting in late 2008, the implementation team will take over responsibility for developing savings estimates, both capital and O&M related. In this capacity, implementation contractors will assist participating facilities in developing energy accounting processes that allow energy champions and plant superintendents to monitor energy intensity and allocate labor and capital to optimize operations.

## Taking Inventory of Lessons Learned

Looking at NEEA's Industrial Initiative in late 2008, it is easy to critique the early implementation with 20/20 hindsight. The planners did not foresee the need to develop a methodology to estimate energy savings. Implementers pursued "low-hanging fruit" as the first step in market transformation but did not document or track their impacts. The desire to create behavioral changes overcame NEEA's tradition of systematic market transformation. The valuable lesson to NEEA, however, is that staff and contractors were able to adapt their management and move from ad hoc creativity to orderly productivity.

The most significant example of this adaptation is the reorganization of the Initiative into a process with defined goals, tools, and measures that a single facility or a regional industry can adopt. While uncomfortable for the implementers at the time, NEEA staff managed this reorganization by establishing clear responsibilities and metrics of progress. Success ceased to be an accumulation of good works and intentions and became an ordered effort to change specific business practices and measurably improve energy efficiency. Without such reform, the Initiative would likely have devolved into an infrastructure program or service bureau for local utilities that offered *ad hoc* assistance to end-users rather than an effort to change the industrial market.

With the reorganization came other adaptations. Of these, the most sweeping was the standardization of CEI as a defined intervention. This standardization allowed implementers to assess their successes and failures and then document their best practices to date. The process also allowed implementers to discontinue program elements that did not deliver value to NEEA, local utilities, and industrial customers. The result was a CEI "product" that was refined for the needs of the market place.

Another benefit of standardization is that it leads to consistency of intervention. Consistent intervention makes it possible for an evaluator to estimate initial impact and forecast future effects. Well-defined impacts and effects improve cost-effectiveness for NEEA and local utilities and reduce the risk for industrial end-users that wish to adopt CEI.

Consistency has the ancillary benefit of streamlining the CEI revision process. NEEA's management of CEI as a "product" will allow program planners to evolve CEI in a predictable and productive manner that meets the needs of additional industrial market segments. This, in turn, will lead to more cost effective allocations of NEEA's resources in the future.

Finally, standardization also allows for commercialization. NEEA's role in Northwest energy efficiency is to be the pathfinder and pioneer but not the settler or homesteader. After proving that CEI as a predictable method of improving energy efficiency that is willingly bought and sold, NEEA's responsibility is to exit and seek new markets to transform.