Experience with Superior Energy Performance Implementation Projects

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ABSTRACT

In July 2008 the US Department of Energy began testing the Superior Energy Performance, a proposed national plant energy-efficiency certification program, with five manufacturing plants. In the Texas Pilot Project, energy experts worked with staff from five Texas manufacturing plants. The program included training of plant staff on how to implement an energy management system that conforms with ANSI/MSE 2000-2008, coaching by energy management system experts during plant energy management system implementation, and measurement and verification of energy savings.

The goal of the pilot project was to verify that the proposed processes, standards, and performance criteria for the certification program are practical and achievable, provide benefit to participating plants, and reliably identify plants that meet the proposed certification criteria. The five plants have now undergone certification audits, demonstrating verified energy performance improvements of 6 to 17 percent over a three year period.

After the successful start of the Texas Pilot Project, demonstrations of the Superior Energy Performance in other facilities were initiated. In total, 23 facilities are currently involved in the regional demonstrations of the Superior Energy Performance program. The purpose of the demonstrations is to provide benefit to the participating facilities as well as begin training regional experts on implementing successful energy management systems that meet the requirements of the international standard and assisting facilities in preparing for Superior Energy Performance certification.

The pilot and demonstration projects were funded by the United States Department of Energy Office of Energy Efficiency and Renewable Energy Industrial Technologies Program (ITP), with some additional funds provided by state agencies. The projects are coordinated by various state or university organizations. Other organizations working under contract to U.S. DOE include Oak Ridge National Lab, Lawrence Berkeley National Lab and Georgia Institute of Technology.

The purpose of this paper is to present an overview of the Superior Energy Performance pilot and demonstration projects; the barriers, benefits and key learnings of program participation; as well as the results from the plants recommended for Superior Energy Performance certification as of May 2011.

Introduction

The Superior Energy Performance (SEP) program has undergone testing in 14 states since 2008. The purpose of SEP is to promote greater energy efficiency in U.S. manufacturing plants by making energy management a part of typical industrial operating practices. SEP provides a mechanism to help plants maintain their focus on energy efficiency improvements, while providing visibility for their achievements and verification of results to public and private entities.

The Texas Pilot Project, the first of the state tests, began in July 2008 and concluded with the last audit in February 2011. Five plants completed the ANSI-accredited third party audit and have been certified. They are: Cook Composites and Polymers Co. Houston plant; Freescale Semiconductor, Inc. Oak Hill plant; Owens Corning Waxahachie plant; and two plants at the Union Carbide Corporation, a wholly owned subsidiary of The Dow Chemical Company, Texas City Operations (Dow TCO).

The pilot and demonstration projects were funded by the United States Department of Energy Office of Energy Efficiency and Renewable Energy Industrial Technologies Program (ITP), with additional funds provided by state agencies. The projects are coordinated by various state or university organizations: the Texas Industries of the Future, located at The University of Texas at Austin, Georgia Tech Enterprise Innovation Institute, Northwest Energy Efficiency Alliance, Penn State, West Virginia University, Focus on Energy, University of Illinois at Chicago, Energy Resource Center, Illinois MEC, Purdue University, and Indiana MEP. Other organizations working under contract to U.S. DOE include Oak Ridge National Lab, Lawrence Berkeley National Lab and Georgia Institute of Technology. The U.S. Council for Energy-Efficient Manufacturing (CEEM) is providing oversight, support and guidance to the effort.

Project Design

Because of their difference in purpose, the pilot and demonstration projects are described separately below.

Texas Pilot Project

The goal of the Texas Pilot Project was to verify the processes, standards, and performance criteria considered for application to a plant under the SEP Program 1) are practical and achievable, 2) provide benefit to participating plants, and 3) reliably identify plants that meet the proposed certification criteria.

In order to foster success of the plants in the program, Texas industrial plants were recruited for the pilot project that met the following criteria:

- Had management that was serious about reducing energy expenditures and was interested in implementing an energy management system, as well as conducting technical assessments to find cost-effective opportunities. Management commitment was required for participation;
- Had at least two energy systems (pumps, steam, compressed air, or process heat) that they were interested in evaluating for savings opportunity;
- Had sufficient metering in place (by May 2008) that a baseline on energy use could be developed by plant personnel and savings could be measured.

All plants are part of national companies, and the sites represent three different industrial sectors: insulation, semiconductors and chemicals. The number of employees at the plant sites ranges from 36 to 2,700. All plants have implemented other management systems, such as ISO 9001:2008 and/or ISO 14001:2004; some plants have developed their own internal management systems incorporating health, safety and environmental requirements. Most plants have been

engaged in energy management for some time, however one plant had only recently begun to focus on energy. Diverse facilities were specifically recruited to provide a more robust assessment of the proposed SEP Program.

State Energy Demonstration Projects

The purpose of the demonstrations is to provide benefit to the participating facilities as well as begin training regional experts on implementing successful energy management systems and assisting facilities in preparing for Superior Energy Performance certification.

In order to ensure plant success in the program, it was strongly recommended that the facilities participating in the demonstrations met the following criteria:

- Had an existing registered management system in place (such as ISO 9001:2008 or ISO 14001:2004);
- Had management that was serious about reducing energy expenditures and interested in implementing an energy management system;
- Were prepared to allocate resources to energy management (for training, webinars, and implementation);
- Had sufficient metering in place that a baseline on energy consumption could be developed by plant personnel and savings could be measured;
- Were committed to pursuing Superior Energy Performance certification at the end of the demonstration (and incurring the cost of doing so).

Facilities participating in the Superior Energy Performance demonstrations span a variety of industrial sectors, employment levels, and energy efficiency experience. Most facilities have implemented other management systems, such as ISO 9001:2008 or ISO 14001:2004.

Regional consultants were recruited to assist the demonstration facilities in implementing the energy management system. These consultants possessed one of two skills sets 1) management system implementation experience and/or 2) energy efficiency expertise. The demonstrations began with a training course specifically designed to familiarize these consultants, or coaches, with the design and expectations of the demonstration project. The coaches then attend each training course with their assigned plant personnel, as well as train-the-trainer webinars on each facet of project implementation. The coaches provide assistance and guidance as necessary to ensure the demonstration facilities are successfully progressing through the program deliverables. The coaches benefit from the experience of working directly with a facility in implementation, and therefore build a national body of individuals capable of assisting manufacturers in implementing an energy management system and preparing for SEP certification.

Plants in the pilot and demonstration projects represent a number of industrial sectors: chemical manufacturing (7), vehicle manufacturing (2), insulation and building products (5), metals (4) and other manufacturing. Table 1 shows the plant count by employee size and energy spend. As the data illustrate, the population of plants testing SEP are extremely diverse in terms of their sectors, size and energy use.

Table 1: Pilot and Demonstration Plant Demographics

No. employees		Energy Spend ($/year)	
0-100	3	Under $1 million	5
100-500	10	$1 MM to $5 MM	3
500-1,000	5	$5 MM to $10MM	5
Over 1,000	5	Over $ 10 MM	10

SEP Program Elements

Energy Management Standard

An energy management system represents a standardized approach to managing energy supply, demand, reliability, purchase, storage, use, and disposal (applies to both primary and secondary energy sources) and can be used to control and reduce an organization's energy consumption, costs and energy-related environmental impact.

Coincident with the initiation of the Texas Pilot Project, an ISO project committee (PC 242) was formed to develop an international energy management standard. The energy management standard is designated as ISO 50001. (Development of ISO 50001 energy management standard occurs through a consensus of representatives from participating countries and through this process has become generally less prescriptive than the American National Standard for Energy Management, ANSI/MSE 2000-2008.) Because of the timing of the Texas Pilot Project, ANSI/MSE 2000-2008 was used as the basis for the plant training and third party audits for the first five plants. However, for the other demonstrations, ISO 50001 is the basis for training and third party audits.

Under the SEP program, a plant demonstrates conformance with ISO 50001 (or ANSI/MSE 2000-2008) as well as energy performance improvement, either through self-verification or a third-party onsite review. Plants would re-certify themselves to the energy management standard and performance level every three years. All future plant certifications will be based on the ISO50001 standard.

Measurement and Verification Protocol

An essential element of certifying plants for energy efficiency is validating plant performance through measurement and verification (M&V). The Superior Energy Performance M&V protocol provides the methodology to verify the results and impact from energy-efficiency projects and activities of a facility over time. The protocol for the Superior Energy Performance program specifies the development of statistically significant facility-level models for each energy source entering the facility boundaries. At a minimum, the facility must consider production quantities, weather, and input quantities and characteristics (such as moisture content) for inclusion in the facility-level models. The M&V protocol also addresses the specific criteria that the models must meet in order to be considered valid and appropriate for use in determining

energy improvement. Energy performance improvement calculated based on the use of these facility-level models determines the certification performance level a facility will meet; however, a bottom-up sanity check is also a requirement of the protocol. In other words, the facility must also show, using estimates of savings achieved by projects and actions, that the facility has exceeded the SEP program savings threshold.

The EnPI Tool is a tool available to demonstration plants, to assist in meeting the requirements of the M&V protocol. The tool will allow the plants to easily develop facility-level linear regression equations for each energy source, once energy consumption and variable factor data has been collected. The tool also assists the facility in determining if the model meets the statistical validity requirements designated in the protocol. After appropriate and statistically valid models have been developed, the tool will also calculate the energy performance improvement for a designated period of time.

Program Structure and Criteria (as of May 2011)

The SEP Program offers two membership levels, based on the degree of verification. Table 2 details the program structure and criteria as of May 2011.

Table 2: Superior Energy Performance Tiers and Summary of Requirements (May 2011)

PARTNER	CERTIFIED PARTNER
Criteria • Conformance with energy management standard • Measure and audit energy performance improvement	Criteria • Conformance with energy management standard • Measure, verify, and certify energy performance improvement
Performance Levels • Energy performance improvement required	Performance Levels • Energy performance improvement required, minimum requirements set by program • Two Pathways Available: Energy Performance or Mature Energy
Method of Verifying Result • Self Declaration	Method of Verifying Result • Third party verification via on-site review

The current program structure as presented in Table 2 was developed with significant input from the Texas pilot plants. It reflects many changes from the original structure proposed in Spring 2008, yet retains the principle theme of the program: a focus on implementing and sustaining an energy management system that results in improvements in energy performance. The significant issues identified as a result of the Texas Pilot Project were:

1. The need to focus on results (energy performance improvements) versus the certification of a plant.
2. The cost versus benefit to the plant of self-verification, remote verification, or third-party certification.
3. The need for flexibility in program design so that plants with mature, successful energy management programs could participate.
4. The need to recognize the temporary impact of the recent severe economic downturn on energy intensity indicators of progress.

The structure and criteria addressed the issues raised by the plants in the following ways:

Levels of verification and certification of energy performance improvement. The current program structure allows a plant to self-verify or to certify via a third-party onsite visit. Plants will determine which level is suitable, based on the cost and value they perceive for the verification and certification. For example, sites that wish to monetize their reductions will likely find they need the third-party on-site measurement and verification in order to sell reduction credits. Sites which see value in implementing the framework, but will not seek to generate verifiable energy-efficiency credits, can stop at self-verification; they do not need to go to the expense of third party review. However, sites may choose to go for third-party certification due to the additional oversight it provides for a facility's claims of energy improvement. An intermediate level, verification by a third party using remote review of information submitted by the plant, was included in the program design in 2009 to potentially decrease the cost of certification. However, this option was eliminated after the audits of the Texas Pilot plants because it offered little cost savings, and based on feedback, it was not attractive to the plants. The offsite review raised concerns of confidentiality of information, as well as the increased difficulty of sharing information stored in company computer systems. The final program design now calls for two levels of participation: self-verification and third party verification. This flexibility addresses the first two concerns noted above.

Two pathways for performance at the certified partner level. In addition to the other SEP Program criteria, such as conformance to an energy management standard, plants have to demonstrate a history of achieving energy performance improvements. This demonstration can be over either the most recent three year period or over the last 10 years. These two paths, respectively, are called "Energy Performance Pathway" and "Mature Energy Pathway" in Table 2. Plants which have achieved an energy performance improvement of 15% over the last 10 years can become Certified Partners via the Mature

Energy Pathway option. This option addresses the third and fourth points in the list above. It provides an option for plants that have had ongoing energy management programs and have demonstrated results over the last decade, but due to the timing of investments in the earlier part of the previous decade, would not show energy performance improvements of at least 5% in the most recent three year period. For plants with longstanding energy management programs, their opportunities for improvement will be more "blocky" because they need to make significant capital investments in new technologies to see improvements of 5%.

Results

The 23 plants are at all stages of implementation, with only the first five plants completing their certification audits. Results from the audit of the five pilot plants are shown in Table 3. The plants had verified energy performance improvements of 6.5% to 17.1%. All plants used the Energy Performance Pathway.

Table 3: Results of Plant Certification Audits

Plant	Audit Results
Owens Corning, Waxahachie, Tx	9.6% Silver; Energy Performance Pathway
Freescale Semi-conductor, Oak Hill, Tx	6.5% Silver; Energy Performance Pathway
CCP, Houston, Tx	14.9% Gold; Energy Performance Pathway
Dow TCO, Texas City, Tx (2 separate plants participated at site) 1. Isopropanol 2. Energy Systems	Both plants used the Energy Performance Pathway. 1. Isopropanol 17.1 % Platinum 2. Energy Systems 8.1 % Silver

Learnings

The pilot and demonstration projects have been a rich opportunity to learn what worked and what didn't. There were six key strategies that are supportive of instituting a systems approach to energy management:

1. Leveraging Existing Management Systems. Most of the participating plants have ISO 9001 or 14001 management systems in place. These teams incorporated the requirements for the management system for energy into their existing ISO management system framework. The use of this existing framework allowed the participating teams to leverage processes and practices that were already in place.
2. Cross-Training on Energy and Management Systems. Another benefit to incorporating the energy management system into the existing management system

framework is the exposure of additional personnel to energy management. Management system experts assisting in implementation are able to leverage their knowledge of management systems to gain a better understanding of energy management. In addition, the energy experts, on these teams, are able to interact and gain experience with management systems.

3. Cross-Functional Teams. Large cross functional team involvement was a key strategy employed by several of the demonstration participants. A cross functional team helps to ensure program success and sustainability through support outside of a particular department, plant or site. Management system robustness appears to be strongly linked with the level of involvement from different personnel, with diverse experience.
4. Management Commitment. Management commitment and involvement in the process is another key to success. Several of the participating teams include members of top management. These personnel are able to show support for the program by committing time and resources necessary to ensure success. In addition, these high level personnel are able to effectively communicate the importance of an energy management system at the facility and leverage the program from one site to others in the organization.
5. Regular Meetings. With the accelerated time frame of the demonstrations and the limited resources available in most organizations, regular team meetings are necessary to aid facilities in accomplishing goals. Many teams meet weekly to allow for quick and efficient discussion of energy issues, decisions, and program deliverables. Based on the demonstrations so far, a constant, measured focus on the management system is essential to ensure the timely implementation of an effective energy management system.
6. Structured Look at Data Using Statistical Methods. As part of the demonstrations, the participants used statistical methods to develop appropriate energy performance indicators at the plant level. Some plants went further and utilized these same statistical methods to develop energy performance indicators at the system level. These statistical methods help the facilities to understand the factors that impact their energy consumption. For some of the facilities, this confirmed what they already believed. However, for some this was an eye opening process. One facility was able to quickly identify a problem in their steam system just by reviewing these newly-developed energy performance indicators. Because of this, the issue was resolved, which resulted in immediate energy and cost savings. This approach has now been implemented at other systems in the plant.

There are four main barriers that the participating teams faced while implementing the management system.

1. Team Members in Many Locations. Many of the teams have active members and coaches that are not located at the implementing facility's site. In fact, one team consists of individuals at four different locations. So, in most cases, these teams hold teleconferences instead of face-to-face meetings. It is more challenging to coordinate efforts and communicate with the distant members, but the teams

modify meeting and communication formats in order to accommodate this situation.

2. Resource and Time Constraints. Participating teams all face time and resource constraints. The amount of time needed to fully implement an effective energy management system is more than some teams had expected. Getting team members together for regular meetings is a struggle because end users in manufacturing are typically focused on equipment uptime and product yield rather than utility conservation. These priorities sometimes draw resources away from the project and reduce the time team members have available for project implementation. In many cases, resources initially made available for the project were decreased due to economic conditions. One way the participating plants deal with resource constrains is by adjusting their expectations to reflect this new reality. Each facility closely reviews the scope of the management system and the selection of significant energy uses to ensure the appropriate resources are available for implementation.
3. Unplanned Events. Many unplanned events, including weather events and key personnel changes, have plagued the pilot and demonstration projects. Hurricane Ike struck in early September 2008, three months after the first Texas Pilot Project training. Two facilities, near the most hard-hit areas, were shut down or operating only limited equipment for several weeks. Resources in these facilities were not able to focus on the Texas Pilot but instead were spending time and energy to properly shutdown, repair, and start-up the facility equipment. This not only pulled resources away from the project, but depending on how the facility measured energy efficiency and improvement, it also impacted the energy performance measures of the organization.

   Several organizations have lost key personnel during the pilot and demonstration projects. When plant leadership changes occur in the middle of the implementation, the focus is often taken away from the implementation efforts. Many times during the demonstration, changes in leadership have required the implementation team members to devote an immense amount of resources to resell the program and ensure new management buy-in.
4. Economic Conditions. The recent economic conditions have posed a challenge for many of the facilities in the demonstrations. Because of the erosion of market conditions, production lines have been curtailed and resources have been reduced. As previously mentioned, production decreases can affect measured energy performance, while resource reduction can affect project resources and timing. In addition, facilities are extremely strapped for capital. Most of the plants participating in the Texas Pilot had their capital projects placed on hold in Spring 2009. Because most of the plants are well established in energy efficiency and management, these facilities have already taken advantage of the "low hanging fruit". Therefore, many of the opportunities identified for energy efficiency improvement required capital expenditure. Lack of capital for these projects is impacting the ability of these facilities to act on energy efficiency opportunities and improve energy performance measures. To ameliorate this issue, most facilities are looking for creative projects that are no or low cost that have not been previously

identified. Some facilities are utilizing their Six Sigma and lean tools to identify such opportunities.

In summary, the Texas Pilot plants' experiences support these recommendations to other plants seeking to become Superior Energy Performance certified:

- Bring your organization's management system expert in early.
- Communicate, communicate, communicate…to plant personnel and management. And keep communicating!
- Raise the stakes for the energy program by obtaining upper level plant management support and keeping the program visible.
- Encourage creativity in identifying and developing non-capital energy savings.
- Ensure corporate support is available for SME plant.
- Treat every standard practice, process work instruction or plant work instruction as a valuable tool in the energy efficiency toolbox.
- Make sure the project staff understands and defines the role of the Energy Management Representative.

Conclusions

From a process perspective, the pilot and demonstration projects have already proven successful, although the demonstrations are still in process. As stated previously, the goal of the Texas Pilot Project was to verify that the processes, standards, and performance criteria considered for application to a plant under the SEP program 1) are practical and achievable, 2) provide benefit to participating plants, and 3) reliably identify plants that meet the proposed certification criteria.

The revisions to the initial criteria have resulted in program criteria that are more flexible, yet realistic. For example, there are two options at the Partner Level: "Energy Performance Pathway" and "Mature Energy Pathway". This acknowledges that for plants just starting to pay attention to energy management, improvements in energy performance are relatively easy and inexpensive—there is a lot of "low hanging fruit". But for plants that have been aggressively managing their energy for a decade, significant year-to-year improvements are much harder to achieve. It is more likely that plants with mature energy programs will see no significant change in performance until they can make capital investments in technology. The "Mature Energy Pathway" provides these plants with a mechanism for participating in the program.

Feedback from the initial pilot plants and U.S. CEEM was that the revised criteria were practical and achievable. In addition, the flexibility in the program allowed plants to weigh the costs and benefits of being a participant at different levels of verification (Partner or Certified Partner).

The goal of the demonstrations is to provide benefit to the participating facilities as well as begin training regional experts on implementing successful energy management systems and assisting facilities in preparing for Superior Energy Performance certification. Demonstration facilities are indicating improvements in energy awareness and decision making as well as improvements in energy performance. Approximately 50 consultants

have participated in the demonstration training and webinars to date. And, these coaches are assisting in the energy management implementation at the demonstration plants utilizing their experience in management systems and expertise in energy efficiency. Many of these coaches are using the information and skills developed through the demonstration efforts to engage new or existing customers in energy management activities. Based on feedback from the participating facilities and consultants as well as the propagation of energy management activities, the demonstrations are considered a success.

Additional demonstrations are currently planned for Colorado, Texas, and the Northeast. These demonstrations will involve industrial facilities in the respective regions with the intent of preparing additional local consultants to provide assistance in preparing clients for implementation of ISO 50001 and Superior Energy Performance certification.