Results from the Texas Pilot Project on Manufacturing Plant Energy Efficiency Certification

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ABSTRACT

The US Department of Energy is working with Texas Industries of the Future and US manufacturers to pilot an energy-efficiency certification program for manufacturing plants. From July 2008 through February 2010, energy experts will be working with staff from five manufacturing plants in Texas to test the components of a proposed national plant energy-efficiency certification program. This program includes assessments of significant plant energy systems in accordance with proposed ASME standards, training of plant staff on how to implement an energy management system that complies 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 is 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 Texas plants participating in the pilot project are: Cook Composites and Polymers Co., Houston plant; Union Carbide, Texas City Operations (a subsidiary of The Dow Chemical Company); Freescale Semiconductor, Inc., Oak Hill plant; Frito-Lay, San Antonio plant; and Owens Corning, Waxahachie plant. Other supporting organizations working under contract to the U.S. DOE include Oak Ridge National Lab, Lawrence Berkley National Lab and Georgia Tech.

The purpose of this paper is to present the goals of the pilot project; the barriers, benefits and key learnings of program participation; as well as the interim results from the assessments of energy systems.

Introduction

The Superior Energy Performance (SEP) Texas Pilot Project is testing the criteria and assessment methods for a voluntary energy-efficiency improvement program, under development by industry and governmental organizations. 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 and provide 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 began in July 2008 and will conclude early in 2010. Five sites were selected for participation in the pilot project. They are: Cook Composites and Polymers

Co. Houston plant; Freescale Semiconductor, Inc. Oak Hill plant; Frito-Lay San Antonio plant; Owens Corning Waxahachie plant; and Union Carbide's Texas City Operations (a subsidiary of The Dow Chemical Company).

The goal of the Texas Pilot Project is 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. This paper describes the progress toward these goals as of May 2009.

The project is funded by the United States Department of Energy Office of Energy Efficiency and Renewable Energy Industrial Technologies Program (ITP) and the Texas State Energy Conservation Office. The Texas Industries of the Future, located at The University of Texas at Austin, is coordinating the Texas Pilot Project. 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 project.

Pilot Project Design

From January-May 2008, five Texas industrial plants were recruited that met the following criteria:

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

These criteria were developed in conjunction with the U.S. CEEM.

All plants are part of national companies, and the sites represent four different industrial sectors: food, insulation, semiconductors and chemicals. The number of employees at the plant sites ranges from 50 to 2,700. Four out of five 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 has only recently begun to focus on energy. Two of the facilities are part of corporations that have won the ENERGY STAR Partner of the Year award. Diverse facilities were specifically recruited to provide a more robust assessment of the proposed SEP Program.

Timing and Schedule of Activities

The pilot project consisted of the following activities.

1. Management System for Energy training (July 2008-May 2009). The face-to-face training was conducted in three, 3-day sessions at different Texas locations. Topics covered by these trainings included: planning, developing a baseline, identifying key performance indicators, implementing policies, procedures, operational controls, monitoring and conducting audits.
2. Energy system assessments (September 2008-January 2009). Two energy system assessments were planned for each plant using the draft ASME energy system assessment standards. These standards are under development for pumping, steam, process heating and compressed air systems.
3. Coaching and Implementation of the Management System for Energy (July 2008-August 2009). Training session topics were reinforced in bi-weekly technical assistance calls and monthly webinars.
4. Implementation of savings opportunities (ongoing) and
5. Measurement and Verification of Energy Savings (October 2009-February 2010).

Program Elements

Key program elements are described below for background.

Energy Management Standard

A management system for energy represents a standardized approach to manage 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 management standard for energy. The energy management standard is designated as ISO 50001. Although the pilot project continues to use the ANSI /MSE 2000-2008 as the basis for the plant training, it is likely that the adoption of an ISO energy management standard would preempt a national voluntary standard in this area.

Under the SEP Program, a plant would have to demonstrate conformance with the ANSI/MSE 2000-2008 (or ISO 50001) as well as energy performance improvement, either through self-verification, a third-party offsite review or a third-party onsite review. It is expected that plants would re-certify themselves to the energy management standard every three years. Because we anticipate the first plants will be certified in mid-2010, it is expected that the initial U.S. plants certified for energy efficiency will necessarily use the ANSI/MSE 2000-2008 standard.

System Assessment Standards

A large body of expert knowledge exists on the most effective way to conduct assessments of industrial systems such as compressed air, fan, pump, motor/drive, process

heating, and steam systems. These assessment techniques have been further refined in recent years by DOE's Save Energy Now and Industrial Assessment Center Programs, the Compressed Air Challenge™, and state/regional energy efficiency initiatives. The purpose of the System Assessment Standards is to provide a framework for conducting assessments that will help define the market for system assessment services and provide guidance on how to conduct an energy-efficiency assessment at a facility for a specific system type (initially pumps, compressed air systems, steam, and process heating). Use of the System Assessment Standards is not required for certification, but the standards clearly define a pathway for quickly achieving energy savings.

Measurement and Verification Protocol

An essential element of certifying plants for energy efficiency is validating plant performance through measurement and verification (M&V). The M&V protocol will offer a best practice methodology to verify the results and impact from energy-efficiency projects and specify parameters required to quantify the energy efficiency of a facility over time. At this time, this element is still being developed.

Proposed Program Structure and Criteria (as of May 2009)

The SEP Program proposes three membership levels, based on the degree of verification/certification demonstrated. Table 1 details the program structure and criteria of the proposed program.

The current proposal presented in Table 1 was developed after 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/sustaining an energy management system that results in improvements in energy intensity. The significant issues identified as a result of the Texas Pilot Project were:

1. The need to focus on results (energy intensity 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.

Table 1: Superior Energy Performance Membership Levels and Summary of Requirements

PARTICIPANT*	PARTNER	CERTIFIED PARTNER
Criteria ▪ Conformance with energy management standard ▪ Measure and audit energy performance improvement Performance Levels ▪ Energy intensity improvement required Method of Verifying Results ▪ Self Declaration	Criteria ▪ Conformance with energy management standard ▪ Measure and verify energy performance improvement Performance Levels ▪ Energy intensity improvement required, minimum requirements set by program ▪ Two Pathways Available: Energy Intensity or Mature Energy Method of Verifying Results ▪ Third party verification via remote review	Criteria ▪ Conformance with energy management standard ▪ Measure, verify, and certify energy performance improvement Performance Levels ▪ Energy intensity improvement required, minimum requirements set by program ▪ Two Pathways Available: Energy Intensity or Mature Energy Method of Verifying Results ▪ ANSI-accredited certification with onsite visit

*This tier includes candidate plants which set but have not yet met energy intensity improvement targets.

The structure and criteria as currently envisioned would address the issues raised by the plants in the following ways:

- Levels of verification and certification of energy performance improvement. The program allows a plant to self-verify, to verify via a third-party remote review, 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/certification. Sites which 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 (either remote or onsite). An intermediate level, verification by a third party using remote review of information submitted by the plant, provides increased scrutiny, compared to plants which self-verify. This will be a more appropriate route for sites seeking to communicate their actions and make them transparent to stakeholders. This flexibility addresses the first two concerns noted above.
- Two Pathways for Performance at the Partner Levels. 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 intensity 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 Intensity Improvement" and "Mature Energy Pathway" in Table 1. Plants which have achieved an energy intensity improvement of 15% over the last 10 years can become 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 good energy management programs, have demonstrated results over the last decade, and due to the recent economic downturn, will not show energy intensity improvements for 2008-2009.

Results from Implementation

Each facility has a different organizational structure, philosophy, and varying levels of management system experience. Based on these and other factors, the plants have developed five fairly different implementation strategies, all of which appear to be equally successful at this time. These are described below.

CCP

CCP Houston is a synthetic resin (polymer) manufacturing facility which supplies the composites and coatings industry. Unsaturated polyester resin production is the primary process. The major energy consuming processes include process heaters (three hot oil boilers), a steam boiler, a thermal oxidizer, a compressed air generator, a chiller, and two cooling water pumps.

The CCP Houston plant energy management program is in its infancy. The other management systems are robust and audited. The plant actively involves its employees in continual improvement activities and has experienced significant improvement in injury rates

and property loss through management systems. However, the plant has experienced a dramatic increase in its energy expenditures, with escalation from $600,000 to $1.8 million annual cost between 1998 and 2005. In 2008 energy was the second largest cost center for the Houston plant at approximately 20% of the manufacturing budget.

CCP tested the proposed ASME standards for steam system and process heating system assessments in September 2008. Opportunities identified through the two assessments totaled 30 percent of system natural gas use. Short term actions and low cost investments have been implemented resulting in savings of $40,000.

CCP has been successful in incorporating its energy management system into its already integrated health, safety, environmental and quality system. Use of the existing management system structure for energy management system implementation has exposed other CCP sites, not participating in the pilot project, to energy management system concepts. More employees, beyond those participating in the pilot, have become aware of energy management processes. And implementing energy management with a cross functional team has helped to ensure more likely success through support which extends beyond the plant boundaries.

Texas City Operations of Union Carbide Corporation

The Texas City Operations of Union Carbide Corporation, a wholly owned subsidiary of The Dow Chemical Company (UCC-TCO), is a large integrated chemical production site employing approximately 450 people in 2008. The 440 acre site is located in Texas City, Texas and is comprised of 10 production plants or units, including an Energy Systems plant. The 10 plants are aligned with 4 Dow global business units. The site typically produces approximately 2.5 billion pounds of alcohols, carboxylic acids, esters, aldehydes, vinyl acetate, and vinyl resins per year. In doing so, the site consumes approximately 7,250 trillion BTU annually in the form of steam, fuel and electricity.

Dow utilizes many different tools to accomplish its energy efficiency and conservation goals. These tools include six sigma methodologies, energy auditing techniques, leveraging internal best practices and many others. However, Dow also "reaches beyond the fence" for tools and methodologies. Dow is an active participant in the DOE's Save Energy Now program, the Energy Star - Industrial Energy Star program and Texas Industries of the Future's Texas Showcase. Dow viewed the pilot certification program as another tool to leverage from "beyond the fence".

The UCC-TCO site has a business aligned management structure characteristic of large facilities in the chemical industry. The structure presents unique challenges to implementation of the pilot program because the plants have separate management structure which reports up through the global business units. Programs are not rolled out “horizontally” through a plant, but rather “vertically” through the business units. It was recognized immediately that for the program to be successful, it needed to work within the established framework at the facility. As a result, the boundaries for the pilot project were defined to be the Energy Systems plant and the Isopropanol plant, which represents an energy user/energy conversion process and a manufacturing unit/energy consumer. The KPIs developed during implementation of the ANSI/MSE 2000-2008 are based on the plants within the boundaries of the pilot project.

The site tested the proposed ASME steam system assessment standard in Fall 2008. The steam system assessment identified opportunities to recover heat from condensate and to

potentially purchase steam at a higher temperature. The assessment was also useful in validating the current energy efficiency project list. In all, over $6,000,000 in energy saving opportunities were identified.

Freescale Semiconductor

Freescale Oak Hill plant is located in Austin, Texas. In addition to semiconductor manufacturing, site operations include test, design, research and development as well as corporate functions. In 2008 there were 2,700 full time employees and 500 contractors working on this site. The annual energy consumption includes 210 million KWH of electricity and 0.22 trillion BTU of natural gas.

The plant is currently ISO 9001 and 14001 certified. Freescale has chosen to implement their energy management system via incorporation of the requirements of the ANSI/MSE2000-2008 into their ISO 14001 program. The plant energy coordinator has worked closely with the ISO 14001 coordinator for the corporation throughout the pilot project. In addition to leveraging this resource and existing system, Freescale is also implementing the energy management system at a sister facility also located in Austin. Thus, although the SEP program is plant focused, this demonstrates how a company can leverage these plant-level activities into a corporate program.

The site had assessments of its compressed air and pumping/chilled water system in Fall 2008 under this project. Although the site has had an energy efficiency program since 2001, opportunities were identified with less than a year payback. Total savings opportunities were 1.1 million KWH for the pumping/chilled water assessment and 0.4 million KWH for compressed air. In addition to energy savings, the assessment identified opportunities for improvement in reliability of the compressed air system that supports manufacturing equipment and processes. In early 2010, the site's progress will be evaluated by a measurement and verification expert to determine savings realized as a result of projects and management system implementation.

Frito Lay

The Frito Lay plant participating in the Texas Pilot Project is located in San Antonio, Texas. The site produces over 50 million pounds of snack food annually. In 2008 there were 250 full time employees working at this site.

Frito Lay has chosen to augment its existing management program by implementing the requirements of ANSI/MSE 2000-2008. Frito Lay's San Antonio Technology Manager has been leading the implementation with assistance from Frito Lay's Director of Environmental Sustainability and personnel from the Corporate Energy Team. Per Frito Lay's typical practice, any best practices identified during this implementation are shared among its other North American manufacturing facilities.

The San Antonio Plant goals are on track with the long term corporate energy goals of reducing fuel consumption per pound of product by 30% (versus 1999) and reducing electric consumption per pound of product by 25% (versus 1999). The site had assessments of its compressed air and process heating systems in the fall of 2008 to identify opportunities that would aid them in meeting these goals. The site has had an energy efficiency program since 1999, and the assessments helped quantify potential energy and savings opportunities on systems that are currently monitored and measured. Total savings opportunities were 51% of operating

costs for the compressed air system and 5% for process heating. In the fall of 2009, the site's progress will be evaluated by a measurement and verification expert to determine savings realized as a result of projects and management system implementation.

Owens Corning

The participating Owens Corning plant is located on 236 acres in Waxahachie, Texas. The facility operates three manufacturing lines for the production of building insulation and loosefill insulation. In 2008 there were 440 full time employees at the plant. The annual energy expenditure for the facility is approximately $20 million.

The plant is currently ISO 9000 certified and also maintains an environmental management system as a part of the Waxahachie Plant Operating Management System. Owens Corning has chosen to implement their energy management system by incorporating the requirements of ANSI/MSE2000-2008 into their existing Waxahachie Plant Operating Management System. The site Energy Leader has been co-leading the program with support from the Building Materials Group Energy Leader. In addition, the implementation team has involved a variety of site departments such as Finance, Quality, and Corporate Sourcing. Following successful program implementation at the Waxahachie plant, it is expected that the program will be rolled out to other facilities within the division, and eventually further divisions within the company.

The Waxahachie Plant goals align with the corporate sustainability goal, in accordance with the Sustainability Report published in 2007, to reduce energy intensity by 25% over a ten year period from 2002 to 2012. Owens Corning Waxahachie Plant developed an extensive list of opportunities in order to meet these goals. The site then had assessments of its compressed air and process heating systems which helped to confirm the identified opportunities and validate the course of action previously determined appropriate by Owens Corning personnel. In addition, Owens Corning utilized the assessments as a training opportunity for energy engineers throughout the company. In the fall of 2009, the site's energy improvement progress will be evaluated by a measurement and verification expert to determine savings realized as a result of projects and management system implementation.

Learnings

Throughout the pilot process, the five participating teams determined there were key learnings that should be shared with plants participating in the SEP Program in the future. During the implementation effort, each team determined which strategies worked well and which strategies and events hindered their efforts.

There were six key strategies that were supportive of instituting a systems approach to energy management:

1. Leveraging Existing Management Systems. Four out of the five participating plants had 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 management system for energy into the existing management system framework is the exposure of additional personnel to energy management. Management system experts assisting in implementation were able to leverage their knowledge of management systems to gain a better understanding of energy management. In addition, the energy experts on these teams were 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 Texas Pilot participants. A cross functional team helped to ensure program success and sustainability through support outside of a particular department, plant or site. Management system health was strongly linked with the level of involvement from different personnel, with different experiences.
4. Management Commitment. Management commitment and involvement in the process was another key to success. Several of the participating teams included members of top management. These personnel were able to show support for the program by committing time and resources necessary to ensure success. In addition, these high level personnel were able to effectively communicate the importance of a management system for energy 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 project, regular team meetings were necessary to aid facilities in accomplishing goals. Many teams met weekly to allow for quick and efficient discussion of energy issues, decisions, and program deliverables. Based on the pilot 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 pilot project, the participants used statistical methods to develop appropriate key performance indicators at the plant level. Some plants went further and utilized these same statistical methods to develop key performance indicators at the system level. These statistical methods helped the facilities to understand the factors that impact their energy usage. 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 key performance indicators. Because of this, the issue was resolved, which resulted in immediate energy and cost savings.

There were four main barriers that the participating teams faced while implementing the Pilot Project requirements.

1. Team Members in Many Locations. Many of the teams had active members that were not located at the implementing facility's site. In fact, one team consisted of individuals at four different locations. So, in most cases, these teams held teleconferences instead of face-to-face meetings. It was more challenging to coordinate efforts and communicate with the distant members, but the teams modified meeting and communication formats in order to accommodate this situation.
2. Resource and Time Constraints. Participating teams all faced time and resource constraints. The amount of time needed to fully implement an effective energy management system was more than some teams had expected. Getting team members

together for regular meetings was a struggle because end users in manufacturing were typically focused on equipment uptime and product yield rather than utility conservation. These priorities sometimes drew resources away from the project and reduced the time team members had available for project implementation. In many cases, resources initially made available for the pilot project were decreased due to the recent economic downturn. One way the participating plants dealt with resource constrains is by adjusting their expectations to reflect this new reality. Each facility closely reviewed the scope of the management system and the selection of significant energy uses to ensure the appropriate resources were available for implementation.

3. Unplanned Weather Events. Hurricane Ike struck in early September 2008, three months after the first 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.
4. Economic Downturn. The recent economic downturn has posed a challenge for all of the facilities in the pilot project. 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 participating plants 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.

Conclusions

From a process perspective, the project has already proven successful, although the implementation of projects and the measurement of results 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 Intensity Pathway" and "Mature Energy Pathway". This acknowledges that for plants just starting to pay attention to energy management, improvements in energy intensity 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 intensity until they can make capital investments in technology. The "Mature Energy Pathway" provides these plants with a mechanism for participating in the program.

Inclusion of two levels of verification, as an alternative to the on-site certification by a third party, greatly enhances its usability to all industry participants. This was specifically incorporated as a result of comments by the pilot plants as well as USCEEM industry representatives. Many plants seeking to control energy costs will see value in implementing the SEP framework; yet not all plants would find enough additional value to pay for measurement and verification by a third party.

Feedback from the pilot plants and USCEEM 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 member at the different levels (Participant, Partner, or Certified Partner).

The next phase of the project will focus on the development and testing of a measurement and verification protocol. After development and pilot of the measurement and verification protocol, the improvements in energy intensity will be quantifiable. In addition, the ability of the SEP Program to identify plants that meet the proposed criteria will become more evident.