CEE Industrial Strategic Energy Management Initiative

For information, contact:
Jess Burgess
Industrial Program Manager
Industrial Program Planning Committee
jburgess@cee1.org
617-819-5943
Consortium for Energy Efficiency
98 North Washington Street, Suite 101
Boston, MA 02114

January 17, 2014
Terms of Use

This document may not be reproduced, disseminated, published, or transferred in any form or by any means, except with the prior written permission of CEE or as specifically provided below. CEE grants its Members and Participants permission to use the material for their own use in implementing or administering the specific CEE Initiative to which the material relates on the understanding that: (a) CEE copyright notice will appear on all copies; (b) no modifications to the material will be made; (c) you will not claim ownership or rights in the material; (d) the material will not be published, reproduced, transmitted, stored, sold, or distributed for profit, including in any advertisement or commercial publication; (e) the materials will not be copied or posted on any Internet site, server or computer network without express consent by CEE; and (f) the foregoing limitations have been communicated to all persons who obtain access to or use of the materials as the result of your access and use thereof.

CEE does not make, sell, or distribute any products or services, other than CEE membership services, and CEE does not play any implementation role in the programs offered and operated by or on behalf of its members. The accuracy of member program information and of manufacturer product information discussed or compiled in this site is the sole responsibility of the organization furnishing such information to CEE, and CEE is not responsible for any inaccuracies or misrepresentations that may appear therein.

CEE does not itself test or cause to be tested any equipment or technology for merchantability, fitness for purpose, product safety, or energy efficiency and makes no claim with respect thereto. The references and descriptions of products or services within the site are provided "As Is" without any warranty of any kind, express or implied. CEE is not liable for any damages, including consequential damages, of any kind that may result to the user from the use of the site, or any of the product or services described therein.
Contents

1 Initiative Summary
   1.1 Initiative Goal ................................................................. 5
   1.2 Supporting Objectives ...................................................... 6
   1.3 Initiative Organization ................................................... 7

2 Market Characterization .................................................. 8
   2.1 Industrial SEM Uptake ..................................................... 9
   2.2 Load Management Opportunity ......................................... 10
   2.3 Market Actors ............................................................... 10
   2.4 ISO 50001 Energy Management Systems Standard ............. 13

3 Strategic Energy Management Programs .......................... 13
   3.1 Emerging SEM Program Approaches ................................ 14
   3.2 SEM Program Results .................................................... 15
   3.3 Measurement and Verification of SEM Energy Savings ...... 18

4 Initiative Products and Participation Strategy .................. 20
   4.1 Initiative Products and Functions .................................... 21
   4.2 Proposed Future Year Activities ..................................... 22
   4.3 Participation Strategy .................................................. 23
1 Initiative Summary

Strategic energy management (SEM) is a continuous improvement approach to reducing energy intensity over time, characterized by demonstrated customer commitment, planning and implementation, and systematic measurement. SEM focuses on business practice change, affecting organizational culture, and improving capacity to successfully reduce energy waste and improve energy intensity. SEM emerged from continuous improvement management systems—such as for product quality—developed and used in the manufacturing sector. Many SEM approaches follow the familiar “Plan-Do-Check-Act” scheme to improve performance over time, with systematic performance measurement and regular reassessment of metrics and goals.

SEM programs offered by demand side management (DSM) program administrators seek to build customer capacity to support sustainable and effective strategic energy management practices at industrial facilities. Unlike other resource acquisition program designs that address equipment performance, SEM programs are fundamentally about investing in end user capacity and organizational change, in order to achieve holistic improvements in the ways that energy is used.

Based on early results from CEE member organizations, SEM implementation at industrial end user facilities can transform business practices, operations, procurement, and individual behavior, resulting in a significant reduction in overall energy intensity. SEM implementation often has additional benefits for end users, including enhanced process reliability, product quality, or visibility and reporting. From the DSM program administrator perspective SEM offerings show potential to reduce project transaction costs and lead times, increase capital project volume, and yield persistent, measurable savings from operations and maintenance changes (behavioral savings). SEM also has the potential to support program administrator objectives beyond energy efficiency, including customer engagement satisfaction, and load management.

SEM offers great potential as an opportunity for improved business competitiveness and cost-effective energy savings, because it may be applied effectively across a range of subsectors and business sizes. A growing number of DSM program administrators are offering support for SEM to their industrial business customers, and achieving cost-effective energy savings.

Research reports and member experience indicate that, while certain leading global firms have achieved meaningful energy savings through energy management, as a sector industrial firms rank energy as a low priority and take an ad hoc approach to savings opportunities, resulting in long project lead times and significant program-
side investment and risk. CEE is positioned to advance member industrial program objectives by developing a robust and well understood SEM platform. This platform includes consistent definitions and a program framework, to enable standardized SEM approaches that member programs can leverage to shift customer attitudes and practices at a binational scale.

This Initiative serves an important role to bring SEM to scale across the industrial sector by:

- Defining strategic energy management from an energy efficiency program industry perspective
- Collecting program approaches and developing a framework of effective SEM program strategies, including approaches to the measurement and verification of SEM energy savings, to inform program design and regulation
- Helping to position the program industry to leverage federal and international efforts, such as ENERGY STAR® for Industry, Superior Energy Performance, and ISO 50001

Another important role for the CEE Industrial Strategic Energy Management Initiative is to support SEM program experimentation and knowledge building within the DSM program industry. CEE is positioned to facilitate a learning process about this important emerging energy savings strategy at the program industry level. Knowledge building is a key first step on the path to broader DSM program adoption of SEM, and the development of enhanced SEM program approaches. Ultimately CEE seeks to identify effective and standardizable SEM program approaches that achieve recognition and credibility with program stakeholders and business decision makers. However the identification of standard approaches will only be justified and appropriate once sufficient program experience with SEM has been collected to demonstrate program efficacy across a broad range of business, regulatory, and geographic contexts.

1.1 Initiative Goal

The goal of the CEE Industrial Strategic Energy Management Initiative is to accelerate adoption of SEM as a standard business practice across the industrial sector in the US and Canada. The Initiative strategy to achieve that goal is to align DSM program industry support behind a set of SEM Minimum Elements, to influence the providers of SEM-enabling technologies and services, and increase end user demand for SEM.

The Initiative supports the expansion and enhancement of SEM offerings from DSM program administrators. The Initiative offers consistent definitions, program design support, collected program industry data, and the credibility of CEE and Initiative participant organizations, to assist DSM program administrators to obtain internal and regulatory support to develop new or enhanced SEM programs for their industrial customers.
The CEE Industrial SEM Initiative provides a consistent platform for participating program administrators to leverage direct outreach to end users and interactions with SEM market providers. Participating programs impact end users directly, by marketing and implementing SEM programs with their industrial customers. Initiative participants also inform the market by providing a consistent signal and a basis of sustained program resources to SEM service and technology providers that support key Initiative aspects, such as the CEE SEM Minimum Elements, with their product offerings.

1.2 Supporting Objectives
CEE has identified a set of supporting objectives, to advance the Initiative strategy and create value for member program administrators.

1. Identify the necessary Minimum Elements for industrial strategic energy management to yield energy savings that are measurable, persistent, and cost-effective.
2. Identify consistent practices for SEM energy measurement and performance reporting, to support program access to SEM energy savings, and to encourage the vendors of industrial business services and technology to incorporate SEM capabilities as a core part of their value proposition.
3. Enable member programs to leverage the market impacts of ISO 50001 and federal SEM programs, by establishing a credible and recognized SEM platform as an on-ramp to ISO 50001 for industrial end users, and by engaging federal programs to develop greater alignment between local and federal programs. ISO certification may become a key differentiating factor in supply chains, and federal programs provide valuable recognition opportunities, both of which may attract industrial companies to consider energy management. There is a role for DSM programs to assist industrials that may be compelled by these opportunities but lack the capacity or expertise to successfully implement SEM.
4. Support member programs to achieve greater load management results from industrial end users, by exploring and documenting member approaches to integrate energy efficiency and load management objectives, and by encouraging technology and service providers to develop packaged systems to enable load management as a part of SEM implementation.
5. Develop shared messaging opportunities to enhance market awareness of the SEM opportunity.

Initiative products and activities are described in detail in Section 5.

1.3 Initiative Organization
This Initiative description is organized to

- Educate program administrators regarding the definition or application of industrial SEM, current market conditions, and program approaches to support SEM in industry
• Describe CEE’s strategic direction to impact the market and achieve Initiative objectives, including the activities CEE will undertake to support member SEM programs, and a strategy and expectations for Initiative participants.

Section 3 describes current market conditions for industrial SEM, including the intended market for industrial SEM, current levels of SEM uptake, market actors, and market energy savings potential. Section 4 describes key program terms for SEM, program approaches to advance industrial SEM, SEM program results to date, and discusses measurement and verification of SEM energy savings. Section 4 discusses the Initiative scope, products, and Initiative activities, and describes the member participation strategy to achieve those objectives.

Two products of the Initiative are included as appendices. The SEM Minimum Elements define key industrial SEM terms, and describe the minimum conditions that an industrial business should have in place in order to continuously improve their energy performance in a manner that is measurable, persistent, and cost-effective. The SEM Program Case Studies, updated annually, provide both binational and individual program information about SEM program designs and results.

2 Market Characterization

Strategic energy management is used in the commercial, industrial, and institutional sectors to improve energy performance over time and achieve related goals. The CEE Industrial Strategic Energy Management Initiative specifically addresses SEM as it applies to and is practiced at industrial facilities in which the production process is the principal driver of energy consumption.

Because SEM is a set of practices making up a management system and is not bound to any piece of equipment or process, it is scalable and applicable to a broad range of manufacturing facilities regardless of size or industry. In 2010 the manufacturing sector comprised 299,982 facilities, and 258,662 firms in the US.¹ These facilities accounted for consumption of more than 713 billion kWh of electricity and 5,211 trillion Btu of natural gas.² In Canada in 2011 there were 79,915 manufacturing firms,³ accounting for 172 billion kWh, and 560 trillion Btu of natural gas.⁴

Based on first-year energy intensity reductions achieved by SEM programs at Energy Trust of Oregon and Bonneville Power Administration, and on the results of the Superior Energy Performance pilots, we may estimate that a given industrial end user will reduce their overall electric energy intensity by 5.4 percent during a one-

year SEM implementation period.\textsuperscript{5} Applied to the entire American and Canadian manufacturing sector, a 5.4 percent intensity reduction from SEM would yield approximately 47.8 billion kWh of annual electric savings, and 311.6 trillion Btu of natural gas savings.\textsuperscript{6}

2.1 Industrial SEM Uptake

Limitations in the available data make it challenging to estimate overall uptake of strategic energy management practices by industrial end users in 2013. A small number of indicators are available at a national market level that align with the characterization by many CEE members that, absent program support, industrial end users are generally not investing in strategic energy management.

Table 1 below shows the percentage of industrial end users, in 1998 and 2002, that reported participating in capital equipment rebate programs or including a full-time energy manager on staff. Overall these data indicate that a very small percentage of industrial end users demonstrate a focus on improving their energy consumption, from a low-resource level (equipment rebate programs) to a more significant commitment (energy manager on staff).

<table>
<thead>
<tr>
<th>Table 1. Market Level Indicators of SEM Uptake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemicals Manufacturing</td>
</tr>
<tr>
<td>Energy Manager</td>
</tr>
<tr>
<td>1998</td>
</tr>
<tr>
<td>2002</td>
</tr>
</tbody>
</table>

Another indicator of SEM adoption is participation in the ENERGY STAR Challenge for Industry, which integrates core SEM concepts such as achieving senior management commitment, dedicating staff resource, setting goals, and establishing an energy performance tracking system. Of approximately 300,000 qualifying industrial facilities in the US and Canada, as of November 2013 just over 600 had participated in the Challenge.\textsuperscript{7} The small percentage of end user uptake for the Challenge suggests there is significant opportunity for DSM program administrators to support broader adoption of SEM among their industrial customers.

Going forward, CEE will track the impact of this Initiative and member SEM programs, using data collected from the SEM Program Case Studies survey, including the number of industrial end users participating in member SEM offerings, and the total energy savings achieved annually by those customers. CEE will also work with federal programs to track end user participation in energy management programs from ENERGY STAR, US Department of Energy (DOE), and the Canadian Industry Program for Energy Conservation (CIPEC).

\textsuperscript{5} See Section 3.1 for a detailed discussion of these results
\textsuperscript{6} Assuming no change in overall production.
\textsuperscript{7} ENERGY STAR Industrial Program staff, personal communication
2.2 Load Management Opportunity
Beyond energy efficiency, SEM has the potential to support customer and program administrator load management objectives. Many industrial end users are currently targeted for participation in SEM offerings because of their size, savings potential, or management system sophistication, and for the same reasons are often good candidates for load management offerings. As a holistic approach to educating industrial end users and improving both their human and technological capabilities, SEM can provide a platform to raise end user awareness about load management opportunities, develop operator capabilities to act on those opportunities, and to implement technologies to provide greater visibility on specific process or equipment loads to support end user decision making. As part of future Initiative efforts to highlight key information and metrics to support SEM implementation in specific industries, CEE will identify metrics to quantify load management potential in industry.

The technologies that support improved data acquisition, analysis, and presentation to enable SEM may also enable or enhance end user value from load management opportunities. Improved customer capabilities resulting from SEM implementation may include real time energy performance monitoring, and the organizational capacity to react to performance signals in a timely and effective manner. Industrial controls and automation technologies also offer industrial end users the capability to access and act upon load management signals from their utility, independent system operator, or third-party provider. Signals could include demand response event calls, pricing signals, or others, and could be integrated into operator energy dashboards, load forecasting models, standard operating procedures, and management practices.

2.3 Market Actors
The industrial SEM market is dynamic and growing, with new providers entering the space during the writing of this Initiative description. This section outlines types of SEM support offered by the energy management provider industry. This document distinguishes between providers of SEM services and SEM-supporting technologies, though some providers offer both service and technology support.

2.3.1 SEM Service Providers
SEM service providers work with industrial companies to help them to implement strategic energy management at their facilities. These companies provide any of a range of support services, including:

- **Customer recruiting** Recruiting, screening, and business case development
- **Energy assessment** Opportunity assessment, energy use mapping, energy planning
- **Management system assessment** Assessment, organizational planning, assignment of roles and responsibilities (account centers)
• **Energy performance analysis** Baseline development, key performance indicators, savings analysis and reporting

• **Energy Management Information System (EMIS) planning and implementation** System design, specification, technology integration, information flow, training

• **Project implementation** Architecture and engineering, installation, monitoring, and verification

• **Process and impacts evaluation**

2.3.2 Technology Providers

Technologies that enable and support SEM generally fit into one of the following categories. Technology providers may offer one of these technology types or a holistic, packaged solution:

• **Distributed control system (DCS)** networked input points and process controllers, typically programmable logic controllers, on the shop floor. DCS may include limited data management and reporting capabilities
  
  o **Related** Advanced process controls, process automation
  
  o **SEM role** DCS may provide direct feedback (reports, alarms) to process technicians in real time

• **Data management** technology to collect and store data from the DCS and other input points, often including some analysis and reporting capabilities (e.g. data historian)
  
  o **SEM role** Collects and integrates energy, production, and other key input data into identified performance indicators, generates reports

• **Energy management software** typically a software or packaged hardware-software solution with advanced energy management analysis and reporting capabilities. Effective technologies may compile relevant information in dashboards that are readily understood by the broader organization, including top management and shop staff. Software only solutions may require integration with an existing data management system.
  
  o **SEM role** Analyses energy and other input data, generates reports, and facilitates an organization’s management systems.

2.3.3 Federal SEM Programs

Both the US and Canadian federal governments sponsor programs to enhance the adoption of industrial strategic energy management practices. CEE members have indicated that CEE can add value for their programs by enabling them to leverage the branding, resources, and national recognition opportunities federal programs offer. The Initiative will support member programs by working with federal partners to develop alignment, where appropriate, between federal SEM programs and the CEE SEM Minimum Elements. For more detailed information about any of
these programs, or to access federal program resources, visit the CEE Forum or use the links included below.

**US Department of Energy Better Buildings Program** The Better Buildings, Better Plants Challenge, part of the Better Buildings Program, is a voluntary recognition program for commercial property owners and industrial end users. Participants pledge an organizational energy savings goal, implement at least one showcase project, and share their results with DOE. DOE provides Challenge partners with technical assistance, tools and resources, connections to Ally companies, and national recognition for the Partner company’s efforts.


**Superior Energy Performance (SEP)** Superior Energy Performance™ is a certification program administrated by the US Department of Energy’s (DOE) Technical Assistance division of the Advanced Manufacturing Office, to assist US industry in the implementation of the ISO50001 Energy Management Systems Standard, and to enhance the benefits achieved through ISO implementation by layering on energy reduction targets. SEP is supported by DOE technical resources including the eGuide for ISO 50001, the Energy Performance Indicator Tool, and SEP Measurement and Verification Protocol.

Web site: [superiorenergypowerformance.energy.gov/index.html](http://superiorenergypowerformance.energy.gov/index.html)

**US Environmental Protection Agency ENERGY STAR for Industry** The ENERGY STAR program has been a pioneer in promoting strategic energy management practices since the mid-1990s, and has developed guidance and a wide range of tools to support strategic energy management, including the ENERGY STAR Guidelines for Energy Management, energy program assessment matrices, sector-specific energy performance benchmarking tools, energy treasure hunt guidance, communication resources, and recognition programs.

For specific industrial sectors, ENERGY STAR coordinates Industrial Focuses to identify best practices and develop plant energy performance benchmarking tools. To encourage and reward continuous improvement in energy performance, ENERGY STAR offers three forms of recognition to industrial companies and plants: ENERGY STAR Plant Certification for best-in-class performance; ENERGY STAR Challenge for Industry Achiever for sites reducing energy intensity by 10 percent or more within five years; and the ENERGY STAR Partner of Year Award for Excellence in Energy Management that recognizes world class corporate energy programs. The EPA’s ENERGY STAR Commercial and Industrial Program partners with utility programs seeking to advance SEM and leverage existing ENERGY STAR tools.

[www.energystar.gov/industry](http://www.energystar.gov/industry)
[www.energystar.gov/guidelines](http://www.energystar.gov/guidelines)
Canadian Industry Program for Energy Conservation (CIPEC) supports the implementation of energy management systems in many industrial sectors across Canada. The program offers industrial end users access to technical assistance and resources, cost-sharing opportunities for assessments or ISO 50001 implementation studies, and access to a network of CIPEC leader companies.

Web site: oee.nrcan.gc.ca/industrial/cipec/13673

2.4 ISO 50001 Energy Management Systems Standard

In 2012, the International Organization for Standardization (ISO) released an international standard for energy management systems. ISO 50001 provides a framework and certification opportunity for industrial end users that desire to put a management system for energy in place.

Previous ISO management system standards have had broad impacts on standards of practice for quality, safety, and environmental management in the North American industrial sector, and some analysts in the industrial and energy sectors anticipate that the 50001 standard will have a similar impact on energy. DOE and Natural Resources Canada both offer or are developing programs to support the implementation of the ISO 50001 standard in the US and Canada.

The ISO 50001 standard may provide a template for industrial SEM implementation that helps industrial end users to achieve measurable, persistent, cost-effective energy savings. However it is not yet known whether the ISO 50001 approach to SEM will prove more effective than current efficiency program SEM approaches. In general, the 50001 standard imposes specific requirements for certification on end users, especially in the areas of reporting and data management. These requirements entail a higher implementation cost than is usually required by most efficiency program SEM offerings. Currently several CEE member program administrators are investigating whether and in what situations the higher cost of ISO 50001 certification is justified by the marginal benefit, compared against the efficiency program standard SEM offering.

CEE intends to track these efforts to evaluate the marginal costs and benefits of ISO 50001 implementation, and to share these results with members.

3 Strategic Energy Management Programs

Unlike other resource acquisition designs that address equipment performance, SEM programs are fundamentally about investing in systems of practice that enable holistic improvements in the ways that energy is used across industrial facilities and processes. A paper co-authored by CEE staff and representatives from three SEM program leaders describes SEM programs this way:

“Working hand-in-hand with efforts historically focused on technology upgrades, SEM programs are designed as a whole-system strategy for improving energy efficiency. As

---

8 The standard is available at http://www.iso.org/iso/home/standards/management-standards/iso50001.htm
such, they complement traditional industrial retrofit programs providing financial incentives for verifiable energy savings projects, by opening up a significant new efficiency resource of persistent savings from operational and other behavior-based changes.9

SEM programs provide resources and support to increase end user capacity to manage energy. Two approaches to achieve this that have been replicated across service territories include supporting on-site energy managers on staff at customer facilities, and training customer management teams and plant staff in key energy management practices.

Section 3.1 shows how various program activities and approaches are currently supported across CEE member SEM program offerings. Section 3.2 provides energy savings and cost results from some early leader SEM programs. Section 3.3 discusses approaches to the measurement and verification of energy savings resulting from SEM activities.

### 3.1 Emerging SEM Program Approaches

CEE collected detailed information about member SEM program offerings in 2012, and updated and expanded this survey in 2013. The CEE SEM Program Case Studies provide a landscape view of program support for SEM along with detailed information about specific programs.

The SEM Program Case Studies reveal the emergence of particular program approaches and strategies to support SEM adoption by industrial businesses. Three areas tracked in the Case Studies include program activities, delivery channel, and target customer. Together these three areas present an outline of program support for industrial SEM at the binational level. CEE will continue to collect SEM program information from Initiative participants, and will use that information to identify convergent practices, regional characteristics, and emerging strategies such as SEM for small and medium businesses. Trends and convergent practices will be specifically highlighted and discussed in a proposed analysis of SEM program design.

**Program Activities** The CEE SEM Program Case Studies indicate that, as of 2012, certain program activities—development of an energy plan, plant staff training—are common across nearly all of the twelve CEE member programs for which data was available. Certain other activities, such as support for energy audits or management system assessments, are supported by the majority of the programs surveyed. Finally, other program activities, including some of the most recognizable SEM approaches such as support for an on-site energy manager, or for EMIS, are supported by fewer than half of the programs surveyed.

---

**Delivery Channel** The primary delivery channels CEE observed across member SEM programs involved efficiency program staff, customer account representatives or utility sales representatives, and third party vendors. Program delivery to a cohort of customers, rather than to customers individually, was less common, supported by four of the twelve offerings surveyed. Only one program in the survey used an on-site energy manager for program delivery.

**Target Customer** The survey also indicates that most program administrators with SEM offerings target their largest industrial end users for those offerings. The most common threshold level for surveyed programs was 10 GWh of electric consumption per year—others required 20 GWh/year, or $1 million in annual energy spend. Union Gas, the only gas program in the survey, uses a threshold level of one million cubic feet of natural gas consumption for its SEM offering. The most cited reasons for targeting large customers include the concentration of energy savings opportunity, as well as staffing availability, and management system experience.

Summary tables and detailed information about specific member program offerings can be found in the CEE SEM Program Case Studies, a resource of the CEE Strategic Energy Management Initiative.

### 3.2 SEM Program Results

SEM has demonstrated potential to accelerate energy savings from capital measures and to support persistent, measurable savings from operations and maintenance changes. The scale of this opportunity appears to be significant: The US DOE Superior Energy Performance program (SEP) pilot, which layers performance goals and measurement criteria onto the ISO 50001 energy management system framework, has so far certified 14 facilities,\(^{10}\) with an average energy intensity improvement of 4 percent per year. Savings achieved through the SEP program appear to be cumulative over a number of years: of the 14 certified facilities, eight have reduced their overall energy intensity by 10 percent or greater over the program period. Another two saw reductions of 9.6 percent and 9.8 percent. No facility reported an overall reduction of less than 6.2 percent. DOE reports that 77 percent of the savings achieved by certified facilities are attributable to operations and maintenance changes, the remaining 23 percent to capital projects.

#### 3.2.1 Bonneville Power Administration: Energy Smart Industrial

Bonneville Power Administration (BPA) has offered SEM programs since 2009. An impacts evaluation released in February 2013 determined that, in its first program year of SEM, BPA achieved more than 13 million kWh saved—8.3 million kWh attributable to operations and maintenance activities, 4.8 million to capital projects—and an average one year energy intensity reduction of 4.4 percent per site across 16 sites. The pilot had a total resource cost of $5.04 million, and a benefit/cost

---

\(^{10}\) The 14 facilities are located in Texas (5), Arkansas, California, Illinois, Iowa, North Carolina, Ontario, Pennsylvania, Tennessee, and Virginia.
ratio of 1.00, assuming three-year operations and maintenance measure persistence, or a benefit/cost ratio of 1.11, assuming five-year operations and maintenance measure persistence. Subsequent savings verification showed that operational energy savings increased by 67 percent between year one and year three, further improving the program benefit/cost ratio. See Table 5.

Table 2 provides a breakdown of energy savings achieved by BPA’s energy management pilot offering, by capital and O&M savings types.

Table 2. BPA Energy Management Pilot O&M and Capital Electricity Savings, 2009

<table>
<thead>
<tr>
<th>Capital Measure Savings</th>
<th>Electric Savings (kWh)</th>
<th>Savings as percent of Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>O&amp;M Savings</td>
<td>8,277,665</td>
<td>2.70%</td>
</tr>
<tr>
<td>Total Savings</td>
<td>13,084,135</td>
<td>4.40%</td>
</tr>
</tbody>
</table>


The BPA program also provides an indication of SEM’s potential to accelerate energy savings achieved through capital measures. Table 3 presents the number of projects and energy savings achieved by participants in BPA’s High Performance Energy Management (HPEM) offering, in the one year prior to and following the kickoff of their HPEM participation. These participants increased their number of capital projects by 130 percent and their capital project savings by more than 200 percent, compared against the 12-month period prior to their participation in the BPA SEM offering. The application of an overarching monitoring, targeting and reporting strategy helps ensure that utility and end user investments in capital upgrades produce durable savings results over the long term.

---

### Table 3. New Capital Projects Among HPEM Program Participants

<table>
<thead>
<tr>
<th>Industry SIC Code</th>
<th>Pre-HPEM Project Completion kWh/yr saved</th>
<th>Projects</th>
<th>Projects Submitted After HPEM Kickoff kWh/yr saved</th>
<th>Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>39-Misc. Manufacturing</td>
<td>1,123,328</td>
<td>1</td>
<td>1,049,021</td>
<td>4</td>
</tr>
<tr>
<td>49-Water-Wastewater</td>
<td>234,843</td>
<td>2</td>
<td>1,131,731</td>
<td>2</td>
</tr>
<tr>
<td>49: Water-Wastewater</td>
<td>151,428</td>
<td>1</td>
<td>238,287</td>
<td>1</td>
</tr>
<tr>
<td>39-Misc. Manufacturing</td>
<td>-</td>
<td>-</td>
<td>1,106,649</td>
<td>1</td>
</tr>
<tr>
<td>20: Food Processing</td>
<td>1,942,892</td>
<td>4</td>
<td>746,975</td>
<td>3</td>
</tr>
<tr>
<td>24: Wood Products</td>
<td>-</td>
<td>-</td>
<td>1,030,647</td>
<td>3</td>
</tr>
<tr>
<td>26: Pulp and Paper</td>
<td>1,230,064</td>
<td>2</td>
<td>2,443,945</td>
<td>1</td>
</tr>
<tr>
<td>14: Mining</td>
<td>-</td>
<td>-</td>
<td>2,552,995</td>
<td>3</td>
</tr>
<tr>
<td>49: Water-Wastewater</td>
<td>-</td>
<td>-</td>
<td>1,287,716</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>4,682,555</td>
<td>10</td>
<td>14,221,925</td>
<td>23</td>
</tr>
</tbody>
</table>


### 3.2.2 Energy Trust of Oregon: Industrial Energy Improvement (IEI)

Energy Trust of Oregon launched two SEM offerings in 2008. In 2011 its IEI offering achieved an average intensity reduction of 7.9 percent across ten customer facilities (Cohort 1 energy savings detailed in Table 4, below). Altogether Energy Trust’s SEM offerings in 2011 achieved just over 24 million kWh and 163,000 therms saved, from operations and maintenance measures only, at a program cost of $1.5 million. Capital measure savings are netted out from the IEI savings total, and attributed to other capital measure offerings. Though the IEI offering does not emphasize capital measures, Energy Trust staff report that industrial customers that participate in an SEM offering on average double their capital project volume vs. the period prior to implementing SEM. Capital project savings increased significantly, but not as sharply as project volume.\(^{12}\)

### Table 4. IEI Cohort 1 Participants, Baseline and First Year Energy Savings

<table>
<thead>
<tr>
<th>Participant</th>
<th>Baseline kWh Consumption</th>
<th>kWh Savings (Operational measures only)</th>
<th>Percent Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printer Manufacturer</td>
<td>24,700,000</td>
<td>855,000</td>
<td>3.5%</td>
</tr>
<tr>
<td>Container Company</td>
<td>1,279,000</td>
<td>26,000</td>
<td>2.0%</td>
</tr>
<tr>
<td>Forest Products</td>
<td>30,500,000</td>
<td>5,573,000</td>
<td>18.3%</td>
</tr>
<tr>
<td>Metals Manufacturer</td>
<td>32,621,300</td>
<td>572,000</td>
<td>1.8%</td>
</tr>
<tr>
<td>Specialty Plastics</td>
<td>10,515,000</td>
<td>1,075,000</td>
<td>10.2%</td>
</tr>
<tr>
<td>Computer Manufacturer</td>
<td>33,279,000</td>
<td>3,385,000</td>
<td>10.2%</td>
</tr>
<tr>
<td>Cement Transfer</td>
<td>3,402,000</td>
<td>503,000</td>
<td>14.8%</td>
</tr>
</tbody>
</table>

\(^{12}\) Energy Trust Senior Manager Kim Crossman, during Committee discussion of SEM approaches and results, March 2013.
### 3.3 Measurement and Verification of SEM Energy Savings

Implementation of strategic energy management may result in energy savings from capital projects and from operational improvements. This Initiative description assumes familiarity with capital project measurement and verification, and will focus on approaches to capture capital and operational energy savings attributable to SEM activities.

Measurement and verification of energy savings from SEM programs involves two key challenges, discussed in more detail below: developing the energy performance baseline, and the measurement and attribution of operational energy savings.

#### 3.3.1 The Energy Baseline

One key challenge for administrators of SEM programs, which seek to drive energy performance improvement over time, is how to measure and understand energy performance over time in a dynamic industrial facility environment, and specifically how to construct a robust business-as-usual baseline. Use of a static baseline—for example measured prior to SEM implementation—is insufficient because the conditions and energy performance drivers may undergo changes that have nothing to do with energy management priorities, with significant impacts on energy performance (for example changes to products, production lines, or schedules). The dynamic environment requires a performance baseline that is capable of adapting to reflect the current performance drivers and conditions.

SEM program administrators have generally addressed this challenge by using statistical methods to develop energy performance models capable of projecting business-as-usual performance. Use of a robust energy baseline gives SEM program administrators a business-as-usual case against which to measure actual energy performance during and following the SEM implementation period, in order to understand SEM’s energy performance impact at a given facility.\(^{13}\)

CEE intends to address key aspects of SEM energy performance baseline development as part of future work under this Initiative.

#### 3.3.2 Inputs for Measurement and Verification of SEM Energy Savings

In order to successfully model business-as-usual energy performance, SEM programs require data inputs to develop, test, and maintain the model over time.

---

\(^{13}\) Specific statistical methods currently used by some program administrators are discussed in detail in Section 4.4.3.
The specific data inputs needed to model business-as-usual performance over time will vary from customer to customer, according to their industry, product, process, and other factors. Across customers and industries, these models must all incorporate the key drivers of energy performance at a given facility—often these include indicators of production, but they may also include weather, feedstock characteristics, and more. Model development typically requires in-depth understanding of a customer’s process, in order to identify and incorporate these drivers. Submetering of key processes or systems may be required to understand an end user’s energy consumption patterns and support model development. In addition, rigorous statistical tests are often conducted to refine and prove model validity; testing may reveal additional drivers, or problematic statistical correlations between drivers that model developers must address.

3.3.3 Approaches to Capture Savings from Operational Changes

Discrete, measure-level analysis may fail to capture energy savings from operational changes, if changes occurred in a system not undergoing performance monitoring, or as commonly happens, changes do not appear consequential to the implementer, and are not reported. To address this challenge and capture savings from operational changes, many administrators of SEM programs integrate a whole-facility or “top-down” energy performance measurement approach, alongside a measure-level “bottom-up” approach.

- **Top-down approach** The top-down approach involves measuring energy performance at the scope level of the SEM implementation (typically the enterprise-, facility-, or system-level) to understand overall energy performance over time. Utility meter data is a common source of facility energy data to support a top-down approach.

- **Bottom-up approach** Bottom-up energy savings measurement for SEM programs involves collecting a list of implemented savings measures and the metered savings attributable to each measure.

Several administrators of SEM programs use the top-down measurement approach to capture a customer’s overall energy performance, and rely on the bottom-up approach to help ensure that energy performance measured using the top-down approach are attributable to SEM activities, rather than to weather, production shifts, or other factors. Because the bottom-up approach generally does a poor job of capturing operational energy savings, the bottom-up measurement is not expected to equal the top-down measurement, however any significant anomalies in the difference between the top-down and bottom-up measurements should be understood and attributed to their cause.

CEE intends to collect and share measurement and verification approaches used by member SEM programs, to facilitate better understanding of these emerging approaches across the efficiency program industry.

---

14 For more information, see the CEE SEM Minimum Elements, section 3: System for Measuring and Reporting Energy Performance.
3.3.4 Persistence of Operational Energy Savings

The DSM program industry is still gaining experience and understanding about operational and maintenance measures. There is scant empirical basis outside of SEM program results over the past four to five years to justify persistence claims for energy savings achieved through operational changes. Among the most robust results available to date, from the BPA ESI program, show that operational savings achieved in an SEM context persisted and increased by 67 percent over a three year study period. These data are presented in Table 5.

<table>
<thead>
<tr>
<th>Performance Period</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1 HPEM Savings (kWh)</td>
<td>5,773,976</td>
<td>5,773,976</td>
<td>5,773,976</td>
</tr>
<tr>
<td>Year 2 Incremental Savings</td>
<td>-</td>
<td>2,277,028</td>
<td>2,277,028</td>
</tr>
<tr>
<td>Year 3 Incremental Savings</td>
<td>-</td>
<td>-</td>
<td>1,604,030</td>
</tr>
<tr>
<td>Total Verified O&amp;M Savings15</td>
<td>5,773,976</td>
<td>8,051,004</td>
<td>9,655,034</td>
</tr>
</tbody>
</table>

Source: Bonneville Power Administration, personal communication

CEE intends to support administrators of SEM programs by collecting more detailed information on approaches to measure and verify energy savings attributable to SEM activities. CEE will collect, where appropriate, impact and process evaluations of member SEM offerings, and will make these available to CEE members via the CEE Forum. CEE will additionally participate as appropriate in national and regional efforts to resolve issues related to SEM energy savings measurement and verification, and make the outputs of these efforts available for members via the CEE Forum. CEE will also consider on an ongoing basis the need and opportunity to address specific measurement and verification challenges on behalf of member programs.

4 Initiative Products and Participation Strategy

As stated in the Section 1, the objective of the CEE Industrial Strategic Energy Management Initiative is to enhance awareness and accelerate uptake of certain CEE-defined SEM practices by industrial end users, to improve DSM program administrator access to accelerated capital project savings and untapped behavioural (operational) savings streams. The products, functions, and future activities described below support that objective and the Initiative strategy detailed in Section 1 above.

The scope of this Initiative includes SEM for all industrial end users, regardless of size, energy spend, or subsector. In its first year the Initiative will focus on SEM for large industrial end users, including developing a detailed comparison of SEM

15 Verified energy savings presented in Table 6 do not match savings totals in Table 2, because following year 1, a participating utility opted not to be directly served by BPA, and customers of that utility participating in the HPEM offering, along with their year 1 energy savings, were removed from the cohort and no longer tracked. Energy savings totals in Table 2, drawn from a published impact evaluation and including only year 1, include energy savings from this group of customers. Energy savings totals in Table 6 do not include year 1 savings from these customers.
program design components and approaches for measurement and verification of SEM energy savings.

4.1 Initiative Products and Functions
CEE will support the objectives of the Industrial Strategic Energy Management Initiative with the following:

1. **CEE SEM Minimum Elements** A consistent program industry definition of the minimum sufficient conditions of SEM, attached as Appendix A.

   **Strategic Purpose**
   
i. Enhance program consistency around the necessary components of effective SEM, to inform program design and to send a clear signal to end users and providers.

   ii. Enhance the credibility of SEM programs and energy savings with program regulators, by the establishment of credible, industry-vetted criteria for effective SEM.

   iii. Influence the providers of SEM technologies and services, by providing a platform for broad-based member support and resource collection.

2. **CEE SEM Program Case Studies** An annual member data collection effort, to provide a landscape of program support for SEM and detailed information regarding SEM program approaches and results. (2012 SEM Program Case Studies attached as Appendix B).

   **Strategic Purpose**
   
i. Enhance SEM program credibility by providing program regulators with annually-updated information regarding the number, key activities, and results of SEM programs across the US and Canada.

   ii. Demonstrate to SEM technology and service providers the collective resource of programs supporting the CEE SEM Minimum Elements.

   iii. Inform SEM program design by providing members with detailed descriptions of SEM program goals, activities, considerations, and results, and where applicable, highlighting integrated load management goals and activities.

   iv. Collect member SEM program data to track the market impact of the CEE Initiative over time.

3. **Analysis of SEM Program Designs** Building on information in the SEM Program Case Studies, the SEM Program Framework will document components of SEM program designs, and the way in which these program components address aspects of the SEM Minimum Elements. The Framework will present member program administrators with a set of program design options currently being used to support industrial SEM implementation. The Framework will also collect and compare current practices for the measurement and verification of SEM energy savings.
Strategic Purpose: To meet the program administrator need for assistance identifying effective SEM program designs, to support the increased availability of SEM to industrial end users from a broad set of program administrators. Additionally, the comparative presentation of measurement and verification approaches will support member savings claims achieved by SEM programs.

i. Library of SEM evaluation reports, study or pilot results, and program guides developed by or on behalf of member programs and shared with CEE.

Strategic Purpose To improve member access to SEM program evaluation data, to support member programs building a case for new or expanded SEM offerings.

ii. Coordination with federal SEM programs and related activities, including ENERGY STAR for Industry, Superior Energy Performance and the DOE Industrial SEP Accelerator, as well as the SEE Action Industrial working group, supported through Committee meetings and via the CEE Forum. Activities to include regular Committee updates from federal program staff, CEE Committee consideration of federal program pilots or resources in development where appropriate, and clear demonstration in initiative materials of points of alignment between the proposed CEE Initiative and federal SEM program resources to enable a clear understanding of how member SEM programs can use federal program resources to support their local SEM offerings.

Strategic Purpose To support alignment, where appropriate, between local and federal programs, to enable members to leverage the branding, resources, and national recognition opportunities federal programs offer.

4.2 Proposed Future Year Activities
In future years CEE may choose to focus the Initiative on particular industrial subsectors, for example, municipal water and wastewater or food processing, where CEE members observe the opportunity to achieve greater market impact through the development of sector-specific SEM modules. Such modules could include consistent metering strategies, key performance indicators, and standard reporting criteria. Sector-specific SEM efforts would also involve an engagement component with national or binational strategic partners such as industry trade associations.

Other future year Initiative activities may include:

1. Development of a “specification” for an SEM end user energy baseline model, including consistent parameters for statistical criteria and tests, and data intervals and collection periods.
2. Development of consistent customer-facing messages to increase end user familiarity with and demand for SEM.
3. Exploration of SEM’s potential to enhance end user and program administrator value from load management opportunities.
4.3 Participation Strategy

Member participation is both a goal and a strategic element of the CEE Industrial SEM Initiative. Support for this Initiative from member program administrators will enhance the credibility of this Initiative and of SEM as CEE has defined it. Further, broadening program support for the Industrial SEM Initiative will build end user awareness of SEM, and DSM program offerings to support SEM implementation in industry. Initiative credibility will likewise support SEM adoption by interested program administrators. Program results, design, and experience shared by Initiative participants will accelerate SEM learning by program administrators new to this approach. CEE will make this information available to help members build a case for new or expanded SEM offerings, for program regulators or other stakeholders.

4.3.1 Participation Requirements

Members participating in the CEE SEM Initiative are required to support through their programs the CEE Strategic Energy Management Minimum Elements. Support for the Minimum Elements is self-identified by participating members, and confirmed by CEE staff using program information collected through the CEE SEM Program Case Studies.

To achieve the program and market benefits described above, participating member programs are asked to do the following:

1. Incorporate the CEE SEM Minimum Elements into their industrial program portfolio.
2. Report SEM program offerings and results to CEE via the SEM Program Case Studies survey on an annual basis.
3. Identify SEM offerings as being in alignment with the CEE SEM Minimum Elements, ISO 50001, DOE SEP, or EPA ENERGY STAR® program.

4.3.2 The CEE SEM Minimum Elements

The CEE Strategic Energy Management (SEM) Minimum Elements introduce and define key industrial SEM terms. The elements describe, from the energy efficiency program industry perspective, the minimum conditions that an industrial company or facility should have in place in order to effectively and continuously improve their energy performance. They do not describe efficiency program strategies or delivery approaches; these are detailed in the CEE SEM Program Case Studies.

The Minimum Elements call out the basic infrastructure on which effective energy management practices may be built and that the efficiency program industry has come to support. By establishing a simple, clear description of what it means for an industrial site to be practicing SEM, the CEE SEM Minimum Elements provide a basis for consistent communication about SEM with industrial end users, improve market awareness and acceptance of SEM, and help bring SEM to scale across the US and Canada.
The CEE SEM Minimum Elements highlight customer commitment, energy management planning and implementation, and a system for monitoring, tracking and reporting performance as the threshold requirements for strategic energy management. Any management system that fails to include all three Minimum Elements, as specified in the CEE SEM Minimum Elements document, does not meet the CEE criteria, and shall not be considered to be SEM as CEE defines it. By extension, any member program that supports energy management and does not include all three Minimum Elements, shall not be considered an SEM program.

Also by extension, energy management technology and service providers can expect program administrators and industrial customers to request that their products and services meet CEE SEM requirements per the CEE SEM Minimum Elements.

The complete CEE SEM Minimum Elements is a resource of the CEE Strategic Energy Management Initiative.