ISO 50001 and SEP Faster and Cheaper - Exploring the Enterprise-Wide Approach

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ABSTRACT

ISO 50001 and other management systems (e.g., ISO 9001 and ISO 14001) allow for implementation and certification at the enterprise level. The "Central Office" concept, which allows a small group of employees to manage and facilitate the organization's energy management system (EnMS) at the enterprise level, was introduced within the ISO 50003 standard to provide guidance to ISO 50001 certification bodies.

Four industrial companies have partnered with the United States Department of Energy to pilot the enterprise-wide ISO 50001/SEP concept under the Better Buildings Superior Energy Performance (SEP) Enterprise-wide Accelerator. Each organization developed a Central Office to host their EnMS while implementing ISO 50001/SEP at multiple physically separated sites. The four corporate partners tailored their Central Office implementation model to meet their own specific circumstances and needs. This paper reviews the commonalities, differences, and benefits of each of these enterprise-wide implementation models, including organizational structures, Central Office staff responsibilities, and key strategies.

The cost savings and benefits of using the enterprise-wide approach were assessed, including the cost per site compared with that of a conventional, single-site ISO 50001/SEP implementation approach. This paper also discusses the drivers for the cost reductions realized through these enterprise-wide approaches.

The four partner companies worked with 30 total sites. On average, these 30 sites improved energy performance by 5% annually over their SEP achievement periods, saved more than $600,000 annually in energy costs and reduced implementation cost for ISO 50001 and SEP by $19,000 and 0.8 Full Time Equivalent × years (FTE-yr) of staff time per site. The results can inform other organizations seeking to implement enterprise-wide ISO 50001/SEP, as well as energy efficiency organizations seeking to promote wider adoption of ISO 50001 implementation.

1. Introduction

1.1 ISO 50001 and SEP

The U.S. Department of Energy (DOE) reports that the US industrial sector consumed nearly 25 quads of energy in 2014, over a third of total US end use energy consumption (LLNL 2015). Widely available and proven energy performance improvement practices have been estimated to potentially reduce industrial energy consumption by 7% with simple paybacks of less than two years (McKane, Scheihing, and Williams 2007). While economically feasible, these energy savings have not been fully realized (Eichhammer 2004, Enkvist, Naucler, and Rosander 2007, IEA 2008, IEA 2009). Experience has shown that energy performance gains from project based energy efficiency improvements do not deliver sustained energy performance improvements over time. This is due to a lack of monitoring and ongoing adjustments in response to operational changes that occur after implementation (Jeli et al. 2010, Ates and Durakbasa 2012, Galitsky and Worrell 2003, Therkelsen and McKane 2013). In order to ensure continual energy performance improvement, energy should not be considered a fixed operational expense but managed just as carefully as production, quality, and safety (Vikhorev, Greenough, and Brown 2013).

Published in June 2011, *ISO 50001: 2011 Energy Management Systems – Requirements and Guidance for Use*, is an international standard that provides a flexible framework for the implementation of a continual improvement-based energy management system (EnMS). DOE's Superior Energy Performance (SEP) program drives systematic improvements in energy performance across the industrial and commercial buildings sectors beyond ISO 50001. Facilities certified to SEP have an ISO 50001-certified EnMS in place, and must also demonstrate third-party verified energy performance improvement per the SEP Measure and Verification (M&V) Protocol. With its emphasis on metrics and energy performance improvement outcomes, SEP increases the benefits from implementation of ISO 50001 business processes and has presented clear business values to the industry (McKane et al. 2015).

1.2 Enterprise-wide ISO 50001-EnMS and SEP

Traditionally, ISO 50001 and SEP has been implemented on a single-site basis among industry. As of April 2017, 25 plants have been certified to SEP taking this approach. However, similar to ISO 9001 and ISO 14001, ISO 50001 can be certified at the enterprise level. This can be achieved by taking an "enterprise-wide" approach where multiple sites share a common ISO 50001 EnMS managed by a "Central Office". This approach promotes consistency, leverages resources, promotes best practice sharing, facilitates realization of economies of scale, and accelerates EnMS adoption. Though each site must comply with the EnMS procedures put in place at the Central Office, the program is flexible enough to accommodate site-specific circumstances. Under SEP enterprise-wide, compliance to ISO 50001 is audited by a third-party at the Central Office level, and allows for a subset of all prospective ISO 50001 sites to be audited, a process known as "sampling" (like enterprise-wide certification to ISO 50001). SEP requires improvement of energy performance, and each individual site must be able to demonstrate energy performance improvement and obtain third-party certification of this improvement in energy performance. In the future, SEP will be modified to also allow for audit sampling of energy performance under the enterprise-wide certification. The enterprise-wide approach streamlines ISO 50001 EnMS implementation, making the process more cost-effective per site.

1.3 DOE's SEP Enterprise-Wide Accelerator

The DOE's Better Buildings SEP Enterprise-wide Accelerator (EWA) was launched in December, 2013 to test the hypothesis that ISO 50001 and SEP could be implemented using the Central Office approach as outlined above, and reduce the overall implementation costs and labor expenditure per site as compared to the conventional, single-site implementation approach.

Four partners, 3M, Cummins, Nissan and Schneider Electric, joined the EWA pilot with multiple participating industrial sites[1]. Collectively, the partners successfully certified 30 sites to ISO 50001/SEP and achieved substantial energy savings and implementation cost reductions. Across the four companies and 30 sites, they improved energy performance by 5% annually over their SEP achievement periods, saved more than $600,000 annually in energy costs and reduced implementation cost for ISO 50001 and SEP by $19,000 and 0.8 FTE-yr of staff time per site on average. Each partner tailored the Central Office approach to their needs, which helped to reduce their implementation costs and labor requirements. This paper examines the implementation models and strategies of the four partners, and the resulting energy savings and implementation costs. The results of this paper inform organizations that are interested in evaluating the different approaches of enterprise-wide ISO 50001/SEP, or are seeking to reduce costs associated with implementing ISO 50001/SEP. Additional information about each partner's implementation approach and results are found in DOE's SEP Enterprise-wide case studies[2].

2. Methodology

DOE, the Lawrence Berkeley National Laboratory and Energetics, Inc. worked with the EWA partners to better understand energy savings, implementation costs, and labor expenditures associated with implementing enterprise-wide ISO 50001/SEP. Information was collected at both the Central Offices and the sites using surveys. Details regarding each partner's implementation approach was collected by a combination of reviewing existing publications (3M 2016, Cummins 2016, Schneider Electric 2016), telephone interviewing and exchanging emails.

Key information collected by individual site surveys included:

1. Site energy team members (titles and roles);
2. Estimated total full-time equivalent (FTE) of staff resource and duration of ISO 50001/SEP implementation (excluding time spent on implementing energy saving actions);
3. Estimated total FTE that the site invested in energy management under a business-as-usual (BAU) prior to implementing ISO 50001/SEP;
4. Estimated external costs for consultants (including EnMS training, energy assessments, certification preparation), third-party audit and certification, and metering equipment;
5. Estimated additional external costs (all cost categories in item #4) and labor and duration that would have been required if the site had to pursue ISO 50001/SEP as a standalone site instead of as part of an enterprise-wide approach;
6. Description of energy savings projects implemented during the achievement period, including project description, completion date, and energy savings for each fuel type;
7. Benefits of the enterprise-wide approach, opportunities for process improvement, and how ISO 50001/SEP identified new energy-saving opportunities.

In addition, a statement of energy performance improvement calculated using the SEP measurement and verification (M&V) Protocol was collected for each site and used to calculate annual energy and associated cost savings. The energy savings were broken down into capital and operational savings using data from each site.

[1] A 5th partner joined initially, but was significantly delayed due to staffing allocation priorities. This partner is not included in analysis for this paper.
[2] https://www.energy.gov/eere/amo/business-case-iso-50001-and-sep#Enterprise Wide

The Central Office survey focused on understanding implementation cost and labor effort at the Central Office level. It also sought to understand program benefits and asked questions similar to #1-3, #5, and #7 from the site surveys (see above). Some of the other key information collected defines the partner specific implementation approach and strategies. These included:

1. Existing energy management program;
2. Central office location and staffing;
3. Roles and responsibilities of the Central Office and the sites;
4. Organization of EnMS trainings and internal audit process, and method(s) for sharing best practices.

3. Results

As part of EWA and under the enterprise-wide approach, the four partners achieved ISO 50001/SEP certification at 30 sites, including seven re-certifications. An additional site achieved ISO 50001 certification, but not SEP certification. Based on their verified energy performance improvement, the 30 ISO 50001/SEP certified sites realized a total of 2.8 TBtu of annual primary energy savings, resulting in $18.9 million[3] in annual energy cost reductions[4].

On average, external implementation costs were $23,000 per site. In addition, internal labor averaged 0.9 FTE-yr at each site. Internal labor is reported as FTE-yr rather than a dollar value due to the wide variation in compensation rate by region and job classifications. Detailed results on the partners' energy saving and implementation costs at the site-level are summarized in Table 1. Further details on the implementation cost and labor expenditures are provided in section "7. Implementation Cost and Labor Reduction".

Table 1. SEP Enterprise-Wide Accelerator Partners Results Summary

	Number of Sites	Average Percent Performance Improvement per year (per site)	Average Percent of Energy Cost Savings from Operational Changes	Annual Energy Cost Savings (per site)	SEP External Cost excluding Metering (per site)	SEP Internal Labor (per site, FTE-yr)
3M	6	2.4%	77%	$0.6M	$21K	1.7
Cummins	3*****	3.9%	N/A	$2.1M	$33K	1.2
Nissan	3	6.2%	66%	$3.1M	$34K	0.4
Schneider	19******	5.8%	N/A	$92K	$18K	0.3
Total	**31**	**-**	**-**	**$18.9M**	**-**	**-**
Average	**-**	**5.0%**	**74%**	**$0.6M**	**$23K****	**0.9****
Min (site)	-	1.7%	41%	$13K	$14K	0.2
Max (site)	-	19.5%	89%	$4.8M	$42K	2.3

*****One site is ISO 50001 certified and seeking SEP certification. Energy performance improvement and annual energy cost savings are not reported.
******ISO 50001/SEP implementation cost and labor data is only available for seven of the 19 Schneider Electric sites.

[3] 2015 U.S. average rates for electricity (6.89 cents per kWh), natural gas ($3.91 per Mcf), diesel ($2.71 per gallon) and coal ($65.4 per short ton) are used. Source: U.S. Energy Information Administration (EIA).
[4] The SEP performance improvement achievement period is typically 3 years, which means the site's energy performance during the certified reporting period was compared against the performance during a baseline period from 3 years earlier. However, some of the partners' sites used achievement period shorter or longer than 3 years per SEP program administrator's approval.

Energy costs associated with operational energy savings actions accounted for 74% of the total energy cost savings for nine sites, for which information was available (see Figure 1). Three of the partners for which the information was available reported implementing 20-40 energy-saving actions per site. This confirms the results of Therkelsen et al (2015), that ISO 50001/SEP drives deeper energy savings compared to those realized from existing energy management programs.

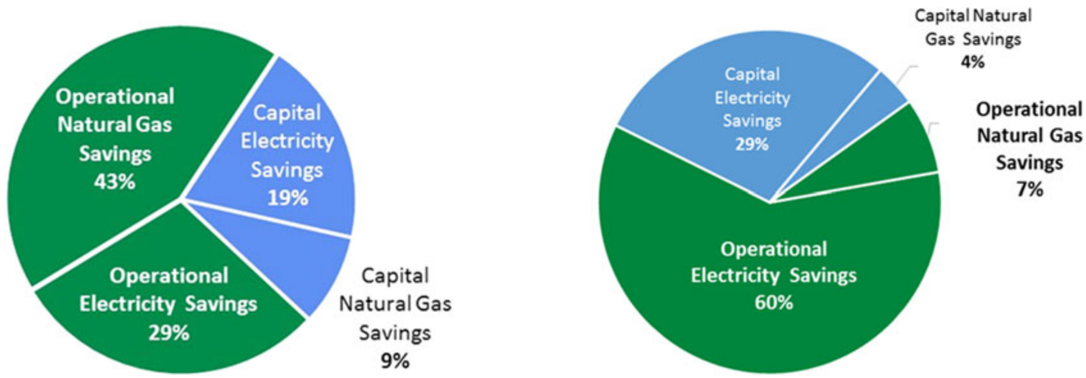

Figure 1. SEP Enterprise-wide Energy Savings Breakdown for 3M (Left) and Nissan (Right).

4. Two Implementation Models

Variation in the expenditure associated with ISO 50001/SEP implementation was observed. 3M and Cummins invested more than one FTE-yr of internal staff resources at each site on average, whereas Nissan and Schneider Electric spent about one-third FTE-yr (see Table 1). It was observed that the implementation labor generally increased with the number of staff members on the site energy teams. This trend can be attributed to two different implementation models used by the partners –a “site-centric” model (3M and Cummins) and a “core-team” model (Nissan and Schneider Electric). While the two models have distinguishable characteristics, they are not mutually exclusive and hybrid models are possible.

4.1 Site-centric Model

The site-centric model relies on site staff to implement ISO 50001 and SEP with guidance and assistance from their Central Office staff. 3M and Cummins adopted this model.

The selection of this model resulted in larger site energy teams, typically 5-10 people or more, representing several key departments within their local organization. Maintenance, plant or process engineering, utilities, facilities, quality, production, and health, safety, and environment departments were frequently represented on the site energy teams. Energy reviews, energy regression modelling, and analysis of energy saving projects were among the EnMS responsibilities handled by the site staff under this model.

The benefits of this model include input from a wide range of personnel, continued buy-in from the included departments, and enriched EnMS knowledge and expertise at the site. This model encourages the site to own the EnMS and tailor it to their needs.

4.2 Core-team Model

The core-team model relies on a small, centralized team of staff to perform certain key ISO 50001/SEP tasks and help stand up the sites' EnMS. Assistance from outside of the facility (excluding external consultants) came from the Central Office or other parts of the organization to which the sites report. Nissan and Schneider Electric adopted the core-team model.

Nissan and Schneider Electric chose this model because it required smaller site energy teams (typically 3-5 staff) compared to the site-centric model. The site energy teams focused on integrating the EnMS with existing management systems, training, and internal and third-party audits. Some consistency was observed in the job functions selected for the site energy teams, especially the team leaders. Nissan selected an energy engineer and an ISO 14001 system coordinator as the leads at each site, and Schneider Electric selected the regional or site facility manager as well as a representative from the site Environment, Health and Safety (EHS) department. In the case of Schneider Electric, energy reviews, energy modeling and analysis, and customizing operating procedures were largely completed by internal consultants as part of a core team (see section "5.1 Leveraging Internal and External Expertise" for more details). For Nissan, the sites attempted the above tasks to their best ability and then subject matter experts from the Central Office finalized them for the sites. This facilitated reduced site training and leveraged gained experience to implement these aspects of the EnMS. The result was lower labor requirements under this model.

In addition to the lower implementation labor, other benefits of this model include consistent adoption of best practices and the ability to more readily leverage the experiences from previous sites. As a result, the sites are likely to have consistent EnMS and practices.

5. Implementation Strategies

The four partners deployed various strategies to streamline their ISO 50001/SEP implementation. Some are unique to the implementation model; others are crosscutting and applicable to both models.

5.1 Leveraging Internal and External Expertise

Implementation of ISO 50001/SEP is aided by internal expertise on both energy management systems and energy engineering. The partners evaluated their own internal expertise and created strategies that best suit their internal abilities.

One common strategy used by three of the partners was leveraging the gap analyses and EnMS trainings provided by EnMS consultants. These trainings were typically delivered in three sessions at different implementation phases. During each session, representatives from all the participating sites within the partner's organization gathered at one location. They rotated the training locations across different sites from one session to another. This approach allowed the EnMS consultants to become familiar with multiple sites and enabled the energy team members from different sites to collaborate face-to-face.

Other approaches that the partners used to acquire the necessary expertise included using existing internal expertise on the team (Central Office or site) to train additional staff (3M), sending existing employees through certification trainings (Nissan), leveraging internal consultants with appropriate expertise (Schneider Electric), and hiring personnel with appropriate credentials and experience (Cummins and Nissan). For example, Schneider Electric leveraged internal consultants from their Energy and Sustainability Services (ESS) division to provide ISO 50001/SEP expertise. ESS is an independent division within the company and provides energy management consulting services to both internal and external clients. Each site typically used three consultants who spent a small portion of their time with the site for 3-6 months during implementation. Their services varied based on the needs of each individual site. Typical services included:

- Setting energy baselines;
- Creating energy performance metrics;
- Completing energy reviews; and
- Tracking energy projects.

Cummins and Nissan hired new employees with the Certified Practitioner in the Energy Management Systems (CP EnMS) credential and energy engineering expertise at the Central Office level. Nissan added staff with prior experience implementing ISO 50001/SEP using the enterprise-wide approach. This helped reduce the staff effort for implementation.

5.2 Integrating with Existing Management Systems

The partners all had corporate energy goals and existing energy management programs before joining EWA. In addition, they all had experience with ISO 14001 and/or other management systems at the corporate level. These experiences were valuable when implementing the enterprise-wide ISO 50001 EnMS. The partners utilized existing processes, procedures, and related infrastructure (such as databases and software) as much as possible.

For example, Cummins manages its Health, Safety and Environmental Management System (HSEMS) at the corporate level. When they adopted enterprise-wide ISO 50001, the corporate EnMS was fully integrated into the existing HSEMS, making energy efficiency a routine part of all the employees’ work. The corporate HSEMS manager’s role was expanded to encompass the EnMS. Processes and associated infrastructure in the existing management system, such as communications and documentation, were leveraged for the EnMS. At the site level, energy action plans were integrated into the Objectives and Targets for the site’s HSEMS, and progress toward targets is automatically reported to top management at the site and business unit levels.

Schneider Electric and Nissan used a similar approach to integrate ISO 50001 with their existing management systems such as ISO 14001 and OHSAS 18001 (Schneider Electric only). EnMS procedures developed during their first ISO 50001/SEP certifications were enhanced by the Central Office staff and integrated with the ISO 14001 system as part of corporate standard operating procedures (SOPs). The sites used the corporate procedure to develop customized SOPs. Sharing teams (e.g. management, internal audit) and processes/procedures across management systems was also found to be effective. Some examples included sharing policy, legal requirements, competence and training, communication, document and record controls, management review, internal audits, and corrective/preventive actions.

5.3 Developing Internal Tools

The identification of tool development to facilitate the enterprise-wide ISO 50001/SEP implementation was driven by the different implementation models. While the site-centric model was greatly aided by the development and use of tools, the core team model did not need to leverage as many tools. This was in part due to the core teams' proficiency using EnMS tools, such as DOE's Energy Performance Indicator (EnPI) tool, thereby relieving site staff from having to learn to use the tool.

The two partners that used the site-centric model (3M and Cummins) developed a suite of corporate tools for the sites to use and provided trainings on the tools. Table 2 compares the elements of each of the partners' toolbox. The tools were developed at the Central Office. The labor investment to develop these tools was justified by the resulting labor reductions at the sites. Further, these companies plan to implement ISO 50001/SEP at many more sites and these tools will be used for those implementations as well. These tools significantly streamlined the ISO 50001/SEP implementation process at these two partners' organizations.

The *Energy Review Tool*[5] developed by Cummins is a Microsoft Excel-based tool that provides step-by-step approaches for meeting the requirements in ISO 50001 for Energy Review, Energy Baseline, and Energy Performance Indicators (ISO 50001: 2011, § 4.4.3 - § 4.5.5). It helps the sites to determine their significant energy uses (SEUs) and to uncover opportunities for energy performance improvement. These opportunities are documented and prioritized within the tool; the resulting action plans are integrated into the Cummins site's HSEMS to track progress. This tool was shared with and further expanded by 3M to be a proprietary *Energy Review and Planning Tool*, containing additional steps related to ISO 50001 requirements for Energy Planning (ISO 50001: 2011, § 4.4). Both partners provided trainings to their users on these tools. 3M also hosted internal certification classes to ensure proper use of the tool. Both partners found these tools to be instrumental to effectively guiding their sites through the related implementation activities.

Table 2. 3M and Cummins Corporate ISO 50001 Implementation Toolbox

	3M	Cummins
General Conformance	Corporate Energy Manual	ISO 50001 requirements analysis; ISO 50001 & ISO 14001 comparison; Practical steps to ISO 50001 compliance
Operating Procedures	Corporate standard operating procedures	Corporate procedures and best practices; Example procedures from pilots
Energy Review	Energy Review and Planning Tool	Energy Review Tool
Tracking Systems	Energy use and cost; Energy projects; Corrective and preventive actions	Existing HSEMS tools tracks energy action plans
Other	Template for management reviews	-

On the other hand, the two partners that used the core-team model (Nissan and Schneider Electric) were able to complete their implementations using very few tools. In addition to leveraging existing databases or tracking systems they already had in place, corporate procedures and the DOE EnPI tool were the only significant tools used by these two partners. They were

[5] The Energy Review Tool developed by Cummins is available at https://www.energy.gov/eere/amo/downloads/cummins-energy-review-tool

able to do so because many key tasks were handled by central experts, who did not need tools to communicate detailed guidance. As introduced in section "5.2 Integrating with Existing Management Systems", customizing corporate procedures was completed by the core teams, i.e. the ESS consultants at Schneider Electric or Central Office subject matter experts at Nissan.

6. Central Office and Site EnMS Functions

6.1 Organizational Structures

Although the EnMS encompasses all affected employees and personnel in the organization, a smaller subset of staff is responsible for its key functions. This staff should be organized around a clear management and reporting structure. Regardless of the implementation model selected, the four partners' EnMS organizations all had three tiers – corporate leadership level, Central Office at the corporate level, and the site level. There can be sub-levels within each tier. For example, at the site level, there is typically site top management, an energy champion (management representative) as the lead, and a cross-functional energy team reporting to the lead. Similarly, there is usually a lead at the Central Office level with or without a direct line of reporting with the other Central Office staff. Figure 2 and Figure 3 show the organizational structure and key positions under the site-centric and core-team models respectively.

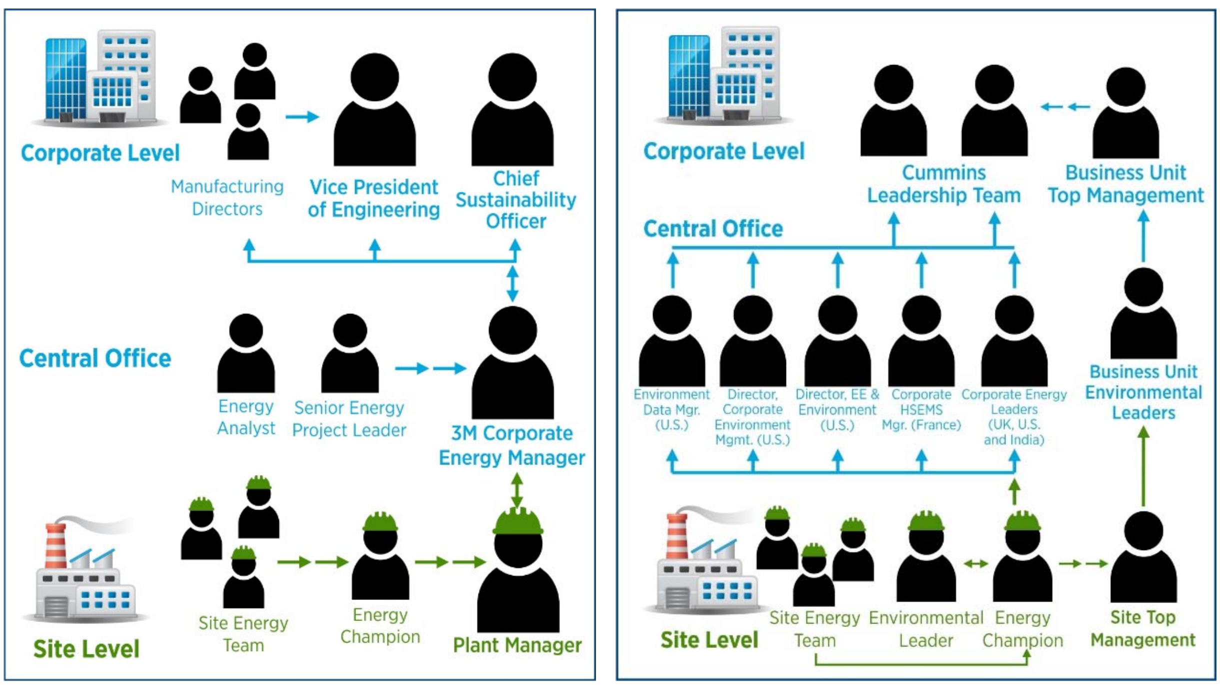

Figure 2. 3M (Left) and Cummins (Right) Enterprise-Wide ISO 50001 Organizational Structures using the site-centric implementation model.

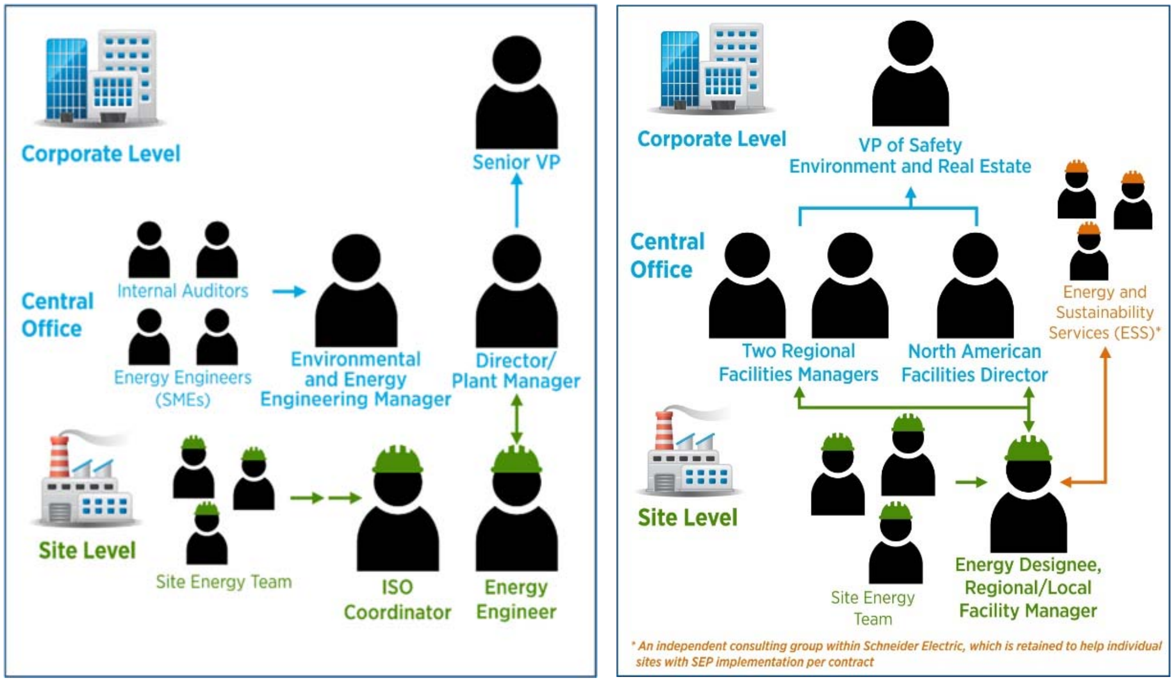

Figure 3. Nissan (Left) and Schneider Electric (Right) Enterprise-wide ISO 50001 Organizational Structures using the core-team model.

6.2 Central Office EnMS Functions

ISO 50003 defines the Central Office as the "location that is not necessarily the headquarters at which EnMS activities are planned, controlled or managed and a network of local offices or branches (sites) at which such activities are fully or partially carried out" (ISO 50003). The results from EWA can provide guidance to organizations on implementing a common EnMS across multiple sites using a Central Office.

There were several Central Office functions common to the partners, regardless of the implementation model chosen (shown in Table 3). However, among these common functions, each partner had different emphases for their own Central Office depending on their implementation model and other company-specific strategies and circumstances. In Table 3, the three top functions of a partner's Central Office are marked with a "P" to indicate where their primary resources were focused. Program planning, corporate energy policy and setting targets for each site was a common top function for all the partners' Central Offices. The other two top functions varied by implementation model and other partner-specific strategies. The two companies followed the site-centric model, 3M and Cummins, spent Central Office resources on developing tools as previously discussed. Both Cummins and Nissan hired EnMS experts on their Central Office teams to assist each individual site with key implementation tasks. Schneider Electric's Central Office spent minimal time administering enterprise-wide ISO 50001/SEP because of the readily available resources from their own ESS division. Their Central Office focus was on coordinating resources to make sure the sites get the assistance they needed and providing oversight.

Table 3. Central Office Functions during ISO 50001/SEP Implementation

Central Office Functions	3M	Cummins	Nissan	Schneider
Planning, policy and targets	P	P	P	P
Disseminating best practices	S	S	S	S
Coordinating resources	S	S	S	P
Developing tools and trainings	P	P	S	S
Guidance and technical support	S	P	P	S
Oversight: conformance/performance	S	S	S	P
Coordinating internal & 3rd-party audits	P	S	P	S
Identifying energy improvement actions	S	S	S	ESS
Creating measurement plans	S	S	S	ESS
Conducting site energy reviews	N/A	N/A	S	ESS

Note: "P" indicates a primary function of a partner's Central Office, "S" indicates secondary functions exercised by a partner's Central Office, and "N/A" indicates the function was not undertaken by the Central Office. "ESS" is specific to Schneider Electric and indicates that the function were delivered by its own Energy and Sustainability Services (ESS) division.

6.3 Site EnMS Functions

Due to the contributions from the Central Office, the partners' sites had less responsibilities under the enterprise-wide approach compared to the single-site implementation approach. The sites' ISO 50001/SEP implementation responsibilities varied by the model chosen. However, a minimum set of common EnMS functions included:

- Identifying and requesting assistance needed
- Implementing trainings (e.g. awareness, audit)
- Customizing and implementing corporate energy procedures
- Integrating with other site-level management systems
- Conducting energy reviews
- Implementing energy action plans
- Meeting performance improvement targets
- Conducting site-level management reviews, and
- Cooperating with site-level internal and third-party audits.

7. Implementation Cost and Labor Reduction

Table 4 breaks down the EWA partners' external costs and internal labor expenditures to implement ISO 50001/SEP under the enterprise-wide approach. External costs were subdivided into three cost components: metering equipment, external consultant, and third-party certification. In addition, there are two components to internal labor – Central Office labor and site labor. Complete data of all the above components were available for nine newly certified sites from three partners: 3M (five sites), Cummins (two sites) and Nissan (two sites). In addition, labor data was obtained for seven of the 15 newly certified Schneider Electric sites.

Table 4. SEP Enterprise-Wide Accelerator Partners Implementation Cost and Labor Breakdown (averaged per site)

	Metering	External Consultants	3rd Party Certification	Central Office Labor (FTE-yr)	Site Labor (FTE-yr)
3M	$41K	$9K	$12K	0.3	1.4
Cummins	$75K	$13K	$20K	0.3	0.9
Nissan	$15K	$20K	$14K	0.2	0.2
Schneider	n/a	n/a	n/a	0.1	0.2
Average*	**$43K**	**$13K**	**$14K**	**0.3**	**1.0**
Min (site)	$0	$0	$5K	0.2	0.2
Max (site)	$162K	$20K	$22K	0.3	2.0

*the average of three partners: 3M, Cummins and Nissan. Schneider Electric was not included in calculating the average because data was incomplete.

The reductions in external cost and internal labor expenditures as a result of the enterprise-wide approach are reported in Table 5. Here, the external consultant costs are further broken down into EnMS training and other external consultant costs to provide greater transparency into the source of savings.

Table 5. Reduced ISO 50001/SEP Implementation Costs and Labor (per site) under the Enterprise-wide Approach as Compared to Single-site Approach

	External Consultants – EnMS Training	External Consultants – Other	3rd Party Certification	Implementation Labor (FTE-yr)
3M	$16K	$4K	$4K	1.3
Cummins	$11K	$0	$0	0.5
Nissan	$4K	$5K	$10K	0.0
Average	**$12K**	**$3K**	**$4K**	**0.8**

Overall, Table 4 and Table 5 show that the three partners have saved, on average, $19,000 per site of external consultant and certification costs. These are very substantial savings when compared to the $27,000 of actual average consultant and certification costs under the enterprise-wide approach. Similarly, the three partners have saved an average 0.8 FTE-yr of internal labor per site while the actual average labor was 1.3 FTE-yr under SEP Enterprise-wide.

7.1 External Costs and Reduction

The external cost components were examined individually for the nine sites of the three EWA partners.

First, third-party certification for both ISO 50001 and SEP is a mandatory cost component. The average cost for a single site certification is reported as $17,000 (Therkelsen et al. 2015). However, organizations can reduce the cost for ISO 50001 certification by employing "sampling", as provided in ISO 50003. Sampling allows a third-party auditor to verify the ISO 50001 EnMS at a subset of sites that share a common EnMS. Both 3M and Nissan were able to take advantage of sampling and reduce their ISO 50001 certification costs by an average of $4,000 and $10,000 per site, respectively.

Second, in lieu of internal expertise, external consultants may be used to train Central Office and site teams. Organizations may also use external consultants for conducting energy assessments, providing other technical assistance (e.g. documentation support, energy engineering related), and preparing for internal or third-party audits. The partners' sites were requested to report their external consultant costs considering all of these components. As stated earlier, three partners used consultants for EnMS trainings. Through economies of scale, the average training cost per site was reduced from $24,000 (Therkelsen et al. 2015) under a single site implementation approach to $8,000 for 3M and $13,000 for Cummins under the enterprise-wide approach. The 3M sites also used consultants for energy assessments, but this cost was negligible. In addition, both 3M and Nissan reported that they would have had to secure additional external consultants if the sites had to use the single-site approach instead of the enterprise-wide implementation approach.

Third, ISO 50001 and SEP promotes data-driven approaches to finding energy performance improvement opportunities and tracking progress. To this end, some partners' sites decided to add metering equipment (can be hardware or software). Adding metering equipment is not typically a requirement of ISO 50001 or SEP. However, organizations often find that the investment returned significant value, including non-energy benefits. Four of the three partners' sites added metering equipment at average cost of $43,000 per site.

7.2 Internal Labor and Reduction

Similarly, internal labor was examined for the nine sites of the three partners as well as seven Schneider Electric sites. The implementation labor was broken down into site and Central Office labor.

The site labor was 1.4 FTE-yr (3M) and 0.9 FTE-yr (Cummins) per site for the two partners that chose the site-centric model. They reported that the enterprise-wide approach saved them 1.3 FTE-yr (3M) and 0.5 FTE-yr (Cummins) of implementation labor per site. These values of saved labor have been discounted to account for any Central Office labor for each site that offset site labor. The two partners (Nissan and Schneider Electric) that used the core-team model only needed 0.2 FTE-yr per site. The site labor in both models have been discounted by BAU-labor representing the level of effort that the site staff spent on energy management prior to implementing ISO 50001/SEP. The site labor was higher for 3M and Cummins when compared to that for Nissan and Schneider Electric. This difference was explained by their different implementation models (section "4. Two Implementation Models").

The Central Office labor ranged from 0.1 to 0.3 FTE-yr, with a typical implementation period of 12 months. In the case of Schneider Electric, ESS consultant's labor was included under the "Central Office labor" category because they are considered a "central" resource. The ESS labor represented most of the 0.1 FTE-yr for Schneider Electric's Central Office. The Central Office labor for each partner was not discounted by a BAU because some of the partners created new responsibilities in order to implement ISO 50001/SEP.

The implementation labor per each new site under both implementation models is expected to decrease after the first batch of sites. This can be attributed to an organization accumulating and applying ISO 50001/SEP experience and expertise. This is supported by Schneider Electric's experience – they have successfully reduced the internal labor across three phases of implementation (see Figure 4). The internal labor for their first phase (at their pilot site in Smyrna, TN) was 1.2 FTE-yr. This was reduced by almost 50% to an average of 0.6 FTE-yr during their 2nd phase when four sites implemented SEP using the single-site approach. It was further reduced by another 50% to 0.3 FTE-yr in their third phase when 15 additional sites certified and 4 others re-certified under the enterprise-wide approach.

Figure 4. Schneider Electric's Three SEP Implementation Phases and Labor Breakdown.

8. Conclusions

Results from the four partners of DOE's Better Buildings Challenge ISO 50001/SEP Enterprise-wide Accelerator showed that the enterprise-wide approach with a Central Office reduces the cost (including internal labor) of ISO 50001 and SEP implementation per site—compared to the conventional, single-site approach. All four partners had at least one SEP pilot site prior to launching the enterprise-wide ISO 50001/SEP program and found that having the pilot experience was a key to their success.

The partners' approaches to implementing enterprise-wide ISO 50001/SEP can be categorized by two models—"site-centric" and "core-team". While both models utilize a Central Office with 3-6 staff members who typically work part-time on ISO 50001 and SEP, the Central Office and site staff split implementation functions differently under these two models. The site-centric model engages a larger site energy team and relies on them to complete key implementation tasks such as energy reviews and modeling/analysis with guidance from the Central Office. In the core-team model, subject matter experts from either the Central Office or other central resources help the sites to complete the aforementioned tasks, leading to smaller site energy teams. The latter model requires less implementation labor because it avoids training a significant number of site staff and developing the necessary tools associated with this approach. It also promotes program consistency. The site-centric model retains more EnMS knowledge at the sites with potentially wider and longer lasting buy-in. We should note that there might be additional models possible to implementing the "Central Office" and ISO 50001/SEP Enterprise-wide. Furthermore, the above two models identified from the EWA pilot are not mutually exclusive, and hybrid models are possible to bring merits of the two models together to better serve the unique circumstances of other organizations looking to adopt ISO 50001/SEP at the enterprise level.

Both models expect resources to be frontloaded when implementing an enterprise-wide program due to necessary planning, training, and development of corporate tools and procedures, although this is more prominent with the site-centric model. Sharing ISO 50001/SEP expertise across the sites (typically at or through Central Office) can expedite implementation and reduce resource requirements at the sites and overall. Leveraging an organization's existing management systems for processes, procedures and platforms/tools is another common strategy to streamline implementation and reduce costs.

Acknowledgements

This work was supported by the Assistant Secretary for Energy Efficiency and Renewable Energy, Advanced Manufacturing Office, of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

The authors would like to thank the following people from the SEP Enterprise-wide Accelerator partners' organizations for contributing information critical for this paper: Steve Schultz, Chrissie Walsh and Brian Guggisberg of 3M, Sylvie Doré and Mark Dhennin of Cummins, Chris Goddard and Wade Willatt of Nissan, and Dennis Edwards and Edwin Willhite of Schneider Electric.

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