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ISO 50001 for Commercial Buildings: Lessons Learned From U.S. DOE Pilot Project

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ABSTRACT

The ISO 50001 Standard establishes the requirements for energy management systems (EnMSs) and has shown strong uptake in the U.S. industrial sector. The U.S. Department of Energy (DOE) undertook a pilot project to explore ISO 50001 implementation in commercial buildings. Eight organizations participated in the pilot project; technical assistance was provided by DOE, the National Renewable Energy Laboratory, Lawrence Berkeley National Laboratory, and the Georgia Institute of Technology. This paper shares lessons learned from the pilot project.

Staff time was the most critical resource for establishing effective EnMSs in commercial buildings. Technical support and template/example materials were also essential. Important activities included evaluating performance, establishing goals, making internal organizational connections, communicating operational controls, and tracking/reviewing progress.

Benefits included enhanced intra-organizational connections, greater energy awareness, increased process efficiencies, and improved ability to make energy efficiency business cases. The added benefits for ISO 50001 certification included greater accountability, assurance of best practices, public relations opportunities, and potential to unlock verified savings credits or incentive money. Incremental certification costs included more staff/consultant time, money for certification, and a tendency to limit EnMS scope to ensure favorable audit results.

Five best practices were identified – utilizing expert technical assistance, training, and other resources; focusing on implementation over documentation; keeping top management involved; considering organizational structure when selecting EnMS scope; and matching the implementation level to an EnMS's scope and scale. The paper also discusses appropriate organizational profiles for different levels of EnMSs.

Introduction

The U.S. Department of Energy (DOE) launched a pilot project in late 2010 for ISO 50001/Superior Energy Performance in Commercial Buildings following the success of a similar project for the industrial sector. The purpose of the pilot project was to explore the challenges and opportunities for establishing an ISO 50001 energy management system (EnMS) in commercial buildings. The pilot project focused on benefits and costs for establishing an effective EnMS; however, it did not run long enough to look at the long-term benefits and costs of maintaining an EnMS. Seven organizations agreed to participate using 12 sites: Cleveland Clinic (Euclid Hospital); General Services Administration (Denver Federal Center and Ronald Reagan Building in Washington, D.C.); Marriott (JW Marriott in Washington, D.C.); Massachusetts Institute of Technology (entire campus); Newmark Grubb Knight Frank/Aetna (Blue Bell, Pennsylvania); Target (three stores in Minneapolis, Minnesota); and Walmart (three stores in the Houston, Texas, metropolitan area).

This pilot project sought to answer several important questions:

- What resources and activities are essential to establish an effective EnMS in commercial buildings?
- What are the benefits and costs of implementing an EnMS? What are the incremental benefits and costs of attaining ISO 50001 certification?
- Therefore, what are the success factors and best practices for EnMS implementation?

This paper details the findings of the ISO 50001 pilot project and shows the experiences from the participants that help answer these questions.

What is an EnMS?

An EnMS is a "set of interrelated or interacting elements to establish an energy policy and energy objectives, and processes and procedures to achieve those objectives" (ISO 2011). The ISO 50001 Standard encourages EnMSs as a means to continually improve building energy performance. In the absence of EnMSs, most commercial buildings show degradation in energy performance over time, even after advanced design, commissioning, or deep retrofits.

The ISO 50001 approach to energy management is based on a Plan-Do-Check-Act (PDCA) continual improvement process. Figure 1 shows how the key components of ISO 50001 map to the PDCA process. Important components of an ISO 50001-conformant EnMS include:

- Top management commitment and responsibility,
- An energy policy focused on continual improvement,
- An energy management team led by an energy management representative who reports directly to top management,
- An energy review process with an energy baseline and energy performance indicators,
- Energy objectives and targets with action plans to achieve the objectives and targets,
- Operational and maintenance controls,
- Monitoring and measurement,
- Regular communications and training to promote a greater staff awareness of energy efficiency,
- EnMS documentation,
- Internal EnMS audits, and
- Top management review.

Some valuable resources are available to aid in understanding and implementing EnMSs. Of note are the DOE eGuide for ISO 50001 (DOE undated a), the DOE eGuide Lite (DOE undated b), and the ENERGY STAR® Guidelines for Energy Management (EPA undated a).

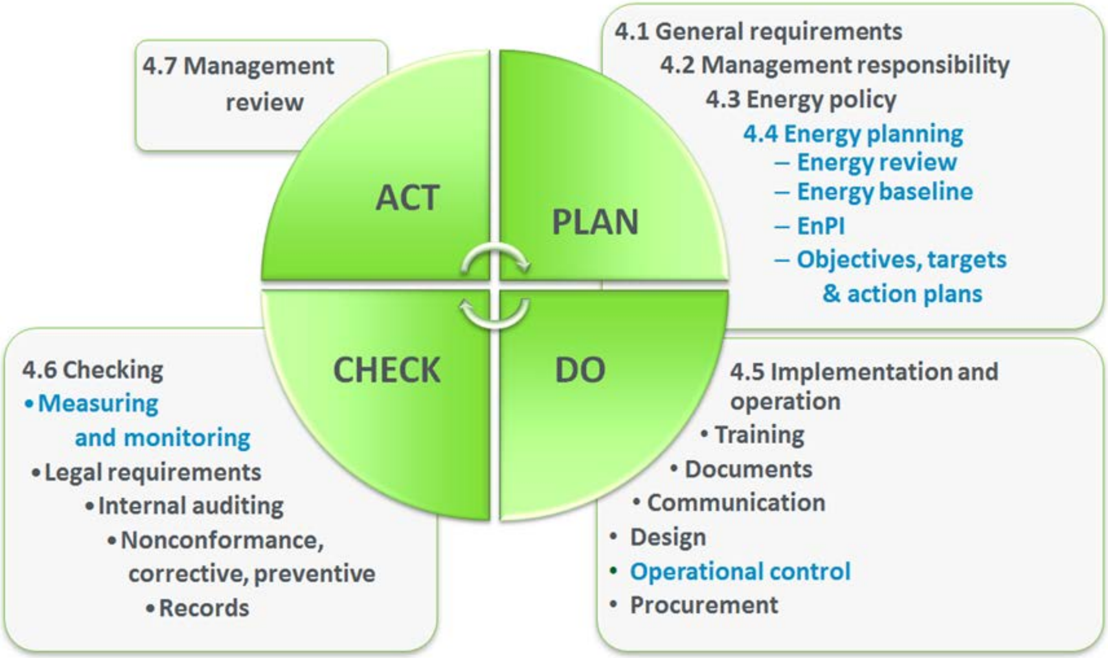

Figure 1. Mapping ISO 50001 elements to PDCA continual improvement (used with permission from the Georgia Institute of Technology [Georgia Tech]).

Commercial Pilot: How Do We Apply EnMSs to the Commercial Sector?

This section presents some relevant background on the history of the pilot project and how it evolved. The program was initiated within the Global Superior Energy Performance effort and endeavored to adopt a model similar to that of the industrial superior energy performance program – a certified ISO 50001 EnMS combined with verified performance toward energy performance improvement targets. DOE, Lawrence Berkeley National Laboratory (LBNL), and the National Renewable Energy Laboratory (NREL) iterated with the pilot participants to draft a set of performance targets for the commercial sector related to a building's ENERGY STAR score (EPA undated b). Performance targets, verified energy performance, and ISO 50001 certification are the essential components of the industrial superior energy performance program.

Choosing appropriate performance targets for the Superior Energy Performance in Commercial Buildings program presented several challenges, including the justification for different targets by building type. For example, what target is appropriate for a hospital, as opposed to a retail store or an office building, and is there a similar certainty in all three numbers? ENERGY STAR Portfolio Manager uses Commercial Building Energy Consumption Survey 2003 and other data to normalize performance levels across several, but not all, building types. Therefore, if ENERGY STAR Portfolio Manager and/or its technical methodology were used to choose performance targets, a sizable portion of the commercial building stock would be ineligible to have its performance rated in this program. Moreover, matching appropriate targets (most of which are calculated at the building level) with the goals of the ISO 50001 framework (which would occur at the organizational level) presented significant challenges for some pilot participants.

Thus, DOE decided to shift the program's focus to helping the pilot participants establish ISO 50001 EnMSs. Not all pilot participants were able to justify the cost and resources required to actively pursue ISO 50001 third-party certification, but they all expressed that the pilot project, including coaching assistance provided by DOE, LBNL, NREL, and Georgia Tech, added value to their organizations. Based on each organization's ability to allocate resources for the pilot project, DOE divided its technical support into three tracks – ISO 50001 certification, ISO 50001-inspired EnMS, and targeted technical assistance.

Showing the EnMS Process with a Logic Model

The process of developing and implementing an EnMS involves a series of steps, each of which, in turn, includes a series of specific actions. Breaking the process down into manageable parts helps anyone reviewing the EnMS to understand the important components without becoming overwhelmed.

For the purpose of this paper, a logic model is presented that breaks down the parts of each specific process into three main components: inputs, activities, and results. The results component is subdivided into two parts: outputs (things produced) and outcomes (organizational changes made). Figure 2 shows the logic model for the overall EnMS process. Some items may be necessary for ISO 50001 certification and considered optional in more general EnMS programs.

Inputs	Activities	Results	
		Outputs	Outcomes
Time Internal staff Contractors Suppliers Organizational buy-in Metering equipment (extent depends on choice of significant energy uses) Building energy data Equipment inventories Analysis software Access to standard operating procedures and/or control sequences Records of competency credentials Access to ISO 50001 Standard DOE resources: ○ Technical support ○ DOE eGuide for ISO 50001	Get started (Step 1) Conduct energy review (Step 2) Plan for energy management (Step 3) Implement energy management (Step 4) Measure projects and check results (Step 5) Review for continual improvement (Step 6)	Documentation to support energy management Cross-departmental teams, connecting various parts of the organization that affect energy performance Thorough planning for energy management Improved energy management processes Records of energy management activities and energy performance results	Increased organizational awareness of energy use, drivers, and performance Clearer vision of energy performance goals Organizational commitment to energy management Organization has enhanced confidence in its ability to demonstrate real energy savings Staff are able to present more solid business cases for energy efficiency measures to top management Building performance doesn't drift unnoticed over time

Figure 2. Logic model for overall EnMS process

Lessons Learned about the EnMS Process

The pilot project resulted in a variety of lessons learned by all participants. This section captures the highlights and is organized according to the components of the logic model in Figure 2 – inputs, activities, and results (subdivided into outputs and outcomes).

Inputs

Several key inputs were necessary to effectively create and implement the EnMSs in the pilot project. The level of staff effort required was considered the most significant input required of pilot participants. Table 1 shows the pilot participants' self-reported estimates of the number of hours (shown in bins of 500) spent through the end of 2013 in conjunction with EnMS development and ISO 50001 certification. Commitment by top management was also crucial to the success of EnMS development. Effective use of organizational resources, such as internal data analysis tools, performance data, training resources, communication mechanisms, and institutional knowledge of ISO standards were found to be very beneficial in EnMS implementation. External inputs that were found to be useful included expert technical assistance if available and example documents and templates, such as those included in the DOE eGuide for ISO 50001 (DOE undated b). Several of the pilot participants recommended that organizations take advantage of audit training early in their implementation processes to help staff work effectively toward EnMS implementation.

Table 1. Level of Effort Self-Reported by ISO 50001 CB Pilot Participants

Participant No.	Program Completion Track	Scope	Bin of Total Person-Hours Estimated
1	Targeted technical assistance	Three buildings	0-500
2	ISO 50001-inspired EnMS	One large building	500-1,000
3	ISO 50001-inspired EnMS	Three buildings	500-1,000
4	ISO 50001 certification	One large building	500-1,000
5	Targeted technical assistance	One large building	1,000-1,500
6	ISO 50001 certification	One large building	1,000-1,500
7	ISO 50001 certification	Entire campus	1,000-1,500
8	ISO 50001 certification	Entire campus	1,500-2,000

Activities

The six major activities that pilot participants performed during EnMS implementation are presented in Figure 2. The following list enumerates sub-activities involved in completing each activity. As with the items listed in Figure 2, some may be essential for ISO 50001 certification and considered optional in more general EnMS programs.

- Step 1: Get started.
    - Make the business case.
    - Secure top management commitment.
    - Understand EnMS documentation.
    - Identify and evaluate energy-related legal and other requirements.
- Step 2: Conduct an energy review.
    - Identify, collect, and analyze energy data.
    - Determine significant energy uses.
    - Identify opportunities to improve energy performance.
    - Prioritize opportunities to improve energy performance.
- Step 3: Plan for energy management.
    - Determine energy performance indicators and establish baselines.
    - Establish energy objectives and targets.
    - Formulate energy management action plans.
    - Reality check: Stop! Look! Can I go?

- Step 4: Implement energy management.
    - Manage and control information (documentation/record controls).
    - Determine operational controls.
    - Ensure staff are competent.
    - Ensure staff are trained and aware.
    - Define purchasing specifications for energy supply.
    - Incorporate energy considerations in procurement.
    - Manage energy considerations in design.
    - Communicate internally.
    - Decide on external communications.
- Step 5: Measure projects and check results.
    - Monitor, measure, and analyze key characteristics.
    - Calibrate monitoring and measuring equipment.
    - Evaluate legal and other compliance plans and conduct internal audits.
    - Take action to correct and prevent nonconformities.
    - Check and use the evidence.
- Step 6: Review for continual improvement.
    - Collect information for management reviews.
    - Conduct management reviews.
    - Ensure continual improvement.

Results

In general, making new connections (or reviving old ones) between people in various parts of an organization was a frequently employed mechanism for getting information to flow along the paths needed to create an effective EnMS. Analysis and review of energy data were also important means of accomplishing the tasks required in EnMS, and the pilot participants generally felt most comfortable with these activities. Although ISO 50001 was designed to have fewer documentation requirements than other ISO management systems, the most concrete initial effort of this pilot project was the completion of an energy manual (document), rather than implementation activities. As a result, documentation represented a greater portion of the effort than was necessary during the pilot. The lesson learned was to emphasize implementation sooner rather than later in any future efforts.

Pilot participants generated several items that can be referenced as outputs. Most fit into one of five categories: energy policy, energy manual, energy review tools, documented objectives and targets, and documented action plans. As opposed to the outputs of the EnMS effort, the outcomes involved transformed behaviors and added organizational knowledge. Pilot participants noted several distinct outcomes: intra-organizational connections, top management buy-in for energy management and continuous improvement, tenant buy-in (where applicable), standardization of energy management processes, greater awareness of energy impacts, identification of gaps in current practices, consideration of energy in procurement decisions, greater enforceability of practices, and energy/cost savings.

An important success story from the pilot project involved one pilot participant, JW Marriott, achieving official, third-party ISO 50001 certification at the end of the program. The JW Marriott was the first commercial (non-industrial) building in the U.S. to receive certification. At the conclusion of the pilot, two other pilot participants were also pursuing certification.

Primary Benefits and Costs to Pilot Participants

Examining the primary benefits realized and costs incurred by pilot participants helps determine the business case for EnMS implementation in the commercial sector.

All pilot participants expressed that the program benefited their organizations in various ways. Even pilots that did not seek ISO 50001 certification or that did not fully implement all the processes of an EnMS still gained value from these efforts. Benefits that applied to all pilot participants included enhanced intra-organizational connections, increased process efficiency, greater awareness of energy impacts, and improved ability to quantify impacts and make business cases for efficiency improvements.

The ISO 50001 certification track pilots saw additional benefits from their choices to develop EnMSs in conformance with the ISO 50001 standard. They developed a greater ability to enforce energy management practices, expected to benefit from the recognition that third-party certification could bring, and felt more confident that the energy management practices they worked so hard to establish would continue into the future, regardless of any personnel or department changes.

Some costs were incurred by all pilot participants, regardless of whether they chose to pursue ISO 50001 certification or simply sought to implement the elements of an EnMS. Those costs consisted primarily of staff time – the ISO 50001 certification track generally required the most staff time. To characterize the amount of time and effort needed to develop and implement an EnMS, DOE gathered data from pilot participants on how many person-hours they spent from spring of 2012 through the end of 2013 (see Table 1). The project scopes ranged from including employees at one building to entire campuses with more than 50 buildings, and the estimates ranged from a few hundred to almost 2,000. In general, during a period spanning approximately two years, pilot participants pursuing certification spent 750-1,750 person-hours; others spent fewer than 750 person-hours. Combining these large ranges with a small number of data points does not produce robust statistical results, but the data at least provide a starting point for understanding the level of effort required. In addition, these numbers are somewhat high because of the developmental nature of a pilot project and the additional work in helping DOE document the process.

Conclusions

At the conclusion of the pilot project, the lessons learned provided responses to the three main questions discussed in the Introduction:

- What resources and activities are essential to establish effective EnMSs in commercial buildings?
- What are the benefits and costs of implementing an EnMS? What are the incremental benefits and costs of attaining ISO 50001 certification?
- Therefore, what are the success factors and best practices for EnMS implementation?

Answering these questions helps clarify which organization types are best suited to simpler EnMSs and which would benefit from more sophisticated, possibly ISO 50001 conformant, EnMSs.

Regarding the first question, certain resources and activities proved to be the most critical to successful EnMS establishment in commercial buildings:

- Resources
    - Staff time: by far the most important resource required.
    - Internal information: about the organization and current management system(s).
    - Templates/examples: to help lighten the initial lift.
    - Technical support: critical resource to the success of the pilot participants.
- Activities
    - Evaluate current performance: collect and analyze energy consumption data.
    - Identify goals: identify energy objectives, energy targets, and action plans to achieve them.
    - Make connections: build organizational connections.
    - Communicate operational controls: formalize and disseminate standard procedures.
    - Track and review progress: continual improvement requires progress be tracked and reviewed toward an organization's energy goals.

To answer the second question, the benefits and costs of implementing an EnMS are summarized in Table 2 and the incremental costs and benefits of ISO 50001 certification are listed in Table 3.

Table 2. Benefits and Costs of Implementing an EnMS

Benefits	**Costs**
• Enhanced intra-organizational connections • Greater awareness of energy impacts • Increased process efficiency • Improved ability to quantify impacts and make business cases for efficiency improvements	• Staff time (however, EnMS may lead to reduced staff loading over time) • Consultant time/money, if applicable • Capital expenditure money for metering equipment or efficiency projects, if applicable

Table 3. Incremental Benefits and Costs for ISO 50001 Certification

Benefits	**Costs**
• Public relations tool • Greater assurance of continuity of best practices and continual improvement • Potential to unlock credits or incentive money tied to verified savings • Greater accountability of roles and responsibilities	• More staff time • More money for consultants and/or equipment if required • Money for certification body (cost of audits) • Possible incentive to lessen reach of EnMS to avoid poor audit results

Taking into account the resources, activities, benefits, and costs described in this paper, the commercial buildings pilot project was able to answer the third question by identifying five success factors and best practices that were associated with successful EnMS implementation:

1. Effectively utilizing expert technical assistance, training, and other energy management resources
2. Focusing on implementation and getting early wins before getting all the EnMS documentation in place (i.e., documenting a process or procedure after doing it)
3. Carefully considering organizational structure when selecting an EnMS scope (this is especially important in the commercial buildings sector)
4. Choosing an appropriate implementation level for the scope and scale of the application (this is also especially important for commercial buildings)
5. Keeping top management regularly involved and informed with progress and quantification or explication of specific benefits

Based on the lessons learned in this pilot project, the expected profiles of organizations that would likely benefit from low-level EnMSs and those that would benefit from more comprehensive EnMSs are described briefly, as follows. Of course, in some cases, it might be appropriate for an organization to begin by starting with a low-level EnMS and then advance to a more comprehensive version as its experience matured.

- Factors that might make a low-level EnMS more appropriate:
    - Chains of authority over personnel that impact energy consumption are complicated, unclear, or not well documented
    - Members of the energy team have difficulty influencing tenants and/or contractors, who have a significant impact on energy consumption
    - The public-facing entity (i.e., the entity that would receive recognition for certification) is not the entity responsible for implementing the EnMS
    - Little access to corporate resources
    - Less familiarity with documenting planning and operational processes and procedures
    - Few or no energy management practices already in place
    - Smaller building(s) – annual savings potential is small compared to initial investment required
- Factors that might make a comprehensive EnMS more appropriate:
    - Chains of authority over personnel that impact energy consumption are clear – the energy management representative and top management are positioned to effectively lead implementation
    - More access to corporate resources
    - Greater familiarity with documenting processes and procedures
    - Some energy management practices already in place
    - Larger building, campus, or portfolio

These lessons learned and best practices should help inform future efforts to encourage energy management and continual improvement in the commercial buildings sector.

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