Lawrence Berkeley National Laboratory

# Eccelerating the Uptake of ISO 50001 in Commercial Buildings: Two Early Adopters Utilizing an "Enterprise-wide" Approach to Save Energy and Beyond

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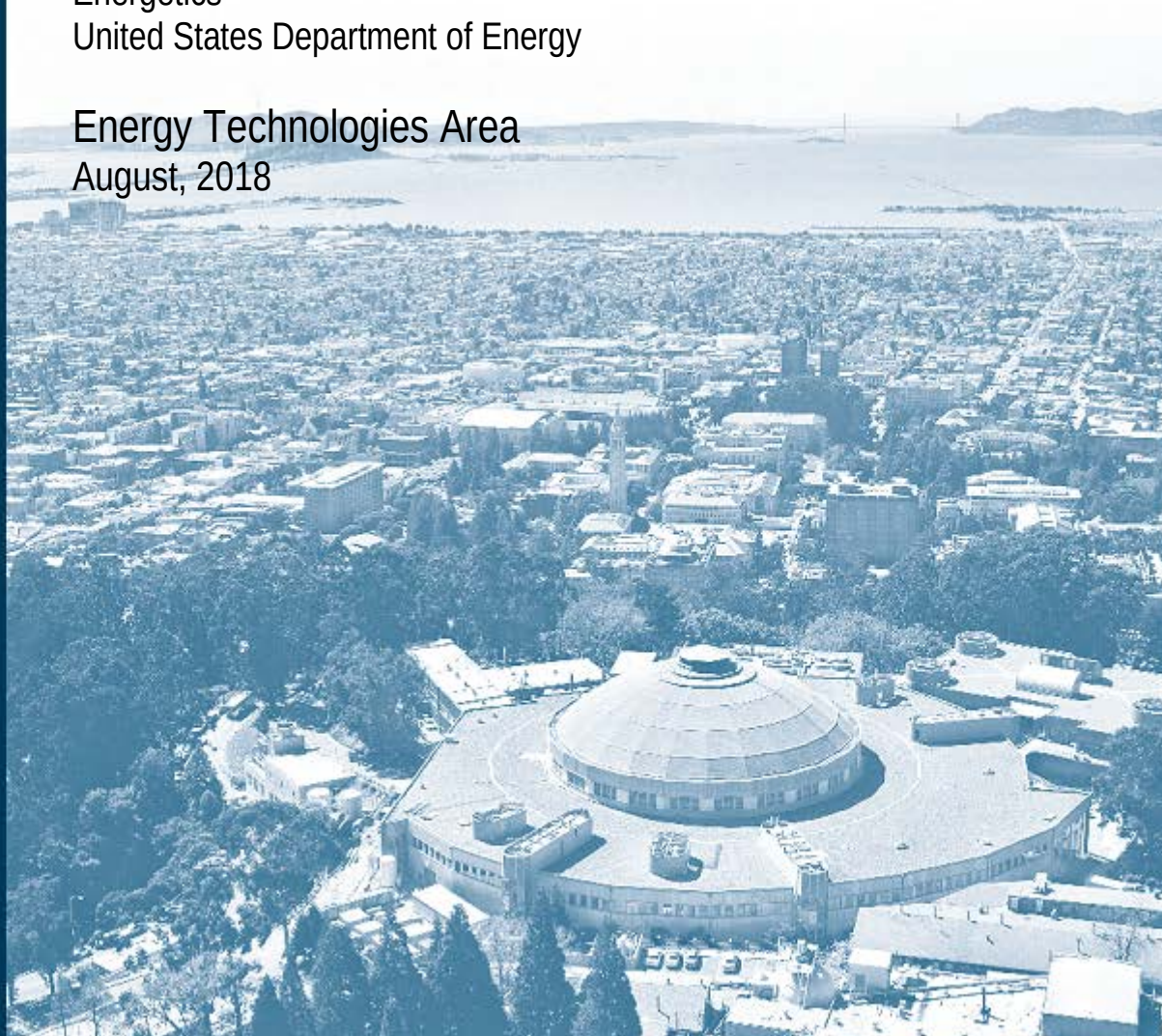

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# Accelerating the Uptake of ISO 50001 in Commercial Buildings: Two Early Adopters Utilizing an "Enterprise-wide" Approach to Save Energy and Beyond

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## ABSTRACT

ISO 50001:2011 is a voluntary international standard that provides a flexible framework for implementing a continual improvement-based system to manage energy. Experience shows that institutionalizing ISO 50001's proven best practices can lead to deep total energy savings of 5–20 percent annually. Based on an internationally developed methodology for predicting future impacts of ISO 50001 uptake within a region from McKane et al. (2017), we estimate that adopting ISO 50001 within the U.S. commercial buildings sector can generate annual energy savings of approximately 65 billion Btu in 2030. Commercial properties also could leverage ISO 50001 to unlock benefits through increased property values, rental premiums, company valuations, and access to new capital markets. Currently, within the United States, ISO 50001 has been primarily adopted in the industrial sector, with limited uptake in the commercial sector.

This paper discusses the motivation, implementation approach, and achieved benefits of two ISO 50001-certified companies with commercial building portfolios in the United States. Anecdotal results from these companies show that the commercial buildings sector has an opportunity to implement ISO 50001 cost-effectively at the enterprise level and scale energy savings quickly—especially among organizations with campuses and/or chains of geographically scattered buildings with similar building energy systems. These early results, coupled with estimated impacts from ISO 50001 uptake within the U.S. commercial buildings sector, suggest that direct uptake and incorporation of the standard in utility and government programs will generate significant energy and greenhouse gas reductions.

## Introduction – Current ISO 50001 Adoption

### Global and U.S. Adoption of ISO 50001

*ISO 50001: 2011 Energy Management Systems – Requirements and Guidance for Use* is an international standard that provides a proven framework for organizations to manage energy and continuously improve their energy performance. Since its publication in 2011, more than 20,000 certifications have been issued worldwide according to 2016 ISO Survey data (ISO 2018). The ISO Survey reports 47 certifications encompassing at least 180 U.S. sites, though evidence from national ISO 50001-based programs suggests this number is dramatically underreported. The U.S. Department of Energy (DOE) promotes ISO 50001 as a framework for standardizing the practice of managing energy (ISO 2011). It promotes voluntary uptake of the practices within ISO 50001 through its "50001 Ready" and Better Buildings Superior Energy Performance (SEP) programs.

### Useful Experiences and Resources from the U.S. Industrial Sector

Though open to organizations from all sectors, participants in the DOE voluntary 50001 Ready and SEP programs have been predominantly industrial. This is not surprising given that the industrial sector tends to be more energy intensive and has a longer history with energy management. In addition, DOE provides tools and resources to support ISO 50001 implementation, and many are useful to any organization looking to implement ISO 50001, regardless of economic sector (industrial, commercial, or institutional).

DOE has case studies of ISO 50001 and SEP implementation at both individual sites and the enterprise level. An earlier ACEEE paper (Liu et al. 2017) and DOE's Enterprise-wide Accelerator case studies (DOE EERE 2018) discuss the successful experience of four industrial organizations implementing ISO 50001 across multiple locations, including implementation models and strategies.

### Adoption among U.S. Commercial Buildings

ISO 50001 is designed for organizations in any economic sector, including those with commercial buildings. The 2016 ISO Survey data identifies nearly 8,700 certificates held by the industrial sector globally; about 43 percent of the total 20,200 certificates. The remaining 57 percent of certifications are held by non-industrial organizations, and commercial buildings are presumably a large component of that. According to public information, at least five global companies have achieved ISO 50001 certifications at more than 21 U.S. sites with commercial buildings. This is not an exhaustive capture of all existing U.S. ISO 50001 commercial building certifications, since certification tracking mechanisms are lacking. Those five companies represent three business segments within the commercial buildings sector: hospitality, information technology (IT), and insurance. We can draw hypotheses for why each of these sectors seeks ISO 50001 certification.

The hospitality sector is especially sensitive to operating costs and increasingly interested in meeting in corporate sustainability goals; both of which would drive the pursuit of ISO 50001. In 2013, the JW Marriott Washington D.C. hotel was the first U.S. hotel to achieve this certification (Georgia Tech 2013). In 2014, Hilton Worldwide certified at the corporate level, covering more than 5,100 properties globally, including all U.S. properties (Hilton 2014).

Another sector with high energy costs is IT. Google certified 12 of its data centers globally in 2013, including seven in the United States (Walker 2013). In 2012, IBM achieved its corporate-level certification (Bureau Veritas Certification 2012), which covers a number of global sites including seven U.S.-based research and development (R&D) sites.

The insurance companies with an emphasis on corporate social responsibility (CSR) were also early adopters of ISO 50001. Aflac was the first U.S. insurance company to achieve this certification, which covers 13 buildings at their headquarters.

## Potential Energy Impacts of ISO 50001 in the Commercial Sector

To inform government, utility and other energy efficiency (EE) programs, Lawrence Berkeley National Laboratory (LBNL) estimated the potential energy savings that may be achieved by promoting ISO 50001 among the U.S. commercial sector. The transparent and flexible modeling tool developed by LBNL, the "ISO 50001 Impact Estimator Tool" (or "IET

50001") is used for this purpose. IET 50001 is based upon an internationally accepted methodology developed by the ISO 50001 Global Impacts Research Network (McKane et al. 2017) using the 2016 ISO 14001 Environmental Management System (EMS) and ISO 50001 uptake survey data (Therkelsen, Fuchs, and Aghajanzadeh, Forthcoming). It is applied to the U.S. commercial sector to estimate reductions in energy consumption, energy costs, and associated carbon dioxide ($CO_2$) emissions stemming from ISO 50001 implementation. Table 1 summarizes, for five forecast scenarios, annual results for the year 2030, as well as cumulative results encompassing the years 2011 (when the ISO 50001 standard was first published) through 2030. The final two columns put these findings into perspective.

Table 1. Estimated annual and cumulative savings of energy consumption, cost and $CO_2$ emissions from adoption of ISO 50001 in the U.S. commercial sector

| Scenario | Uptake in 2030 | Annual savings in 2030 | | | Cumulative savings during 2011–2030 | | | 2030 Annual savings in context | |
|---|---|---|---|---|---|---|---|---|---|
| | Sector uptake | Primary energy[1] | Energy cost | Emissions | Primary energy[1] | Energy cost | Emissions | % of Total sector energy | Passenger vehicles[4] |
| | % | [billion Btu] | [2017 $US B][2] | [$MtCO_2$][3] | [billion Btu] | [2017 $US B][2] | [$MtCO_2$][3] | | [Million] |
| (a) Autonomous potential | 3 | 65 | 0.5 | 3.8 | 398 | 3.3 | 22.8 | 0.7 | 0.8 |
| (b) Low policy impact | 7 | 151 | 1.2 | 8.8 | 927 | 7.7 | 53.1 | 1.6 | 2.0 |
| (c) Medium policy impact | 14 | 302 | 2.4 | 17.6 | 1,851 | 15.5 | 106.0 | 3.2 | 4.0 |
| (d) High policy impact | 20 | 430 | 3.4 | 25.1 | 2,641 | 22.1 | 151.2 | 4.5 | 5.7 |
| (e) Economic potential | 27 | 580 | 4.6 | 33.8 | 3,560 | 29.8 | 203.8 | 6.1 | 7.2 |

1. Offsite electricity and steam generation multipliers are grounded on U.S. Energy Information Administration (EIA) values. *Source:* DOE EIA 2010; 2011.
2. "$US B" stands for "billion U.S. dollars." The annual interest rate used for discounting future annual cost reductions is based on the U.S. Treasury bond 10-year yield in 2016. *Source:* U.S. Department of Treasury 2016.
3. "Mt $CO_2$" stands for "metric tons of carbon dioxide."
4. Passenger vehicle equivalent $CO_2$ emissions are the weighted average of combined fuel economy and vehicle miles traveled of U.S. cars and light trucks in 2011. *Source:* EPA 2015.

The "(a) Autonomous Potential" scenario estimates that 3.0 percent of commercial sector energy use will be managed under ISO 50001 in year 2030 ("sector uptake") assuming adoption is voluntary with no new policy incentives. The "(e) Economic Potential" scenario assumes that all commercial buildings that can cost-effectively implement ISO 50001 will do so by 2030 and estimates 27 percent of sector uptake. Between these two "pinpoint" scenarios, we present three policy impact scenarios, and supply chain motivators, enterprise implementation, regulation, and sustainability standards are expected to drive adoption in those. We defined the sector uptake in each of the three scenarios somewhat arbitrarily because there is little evidence of how policies affect ISO 50001 adoption thus far. These policy impact scenarios intend to show possible

outcomes from different scales of policy interventions by government, utilities, and others. For example, at the "(c) Medium Policy Impact" level, 14 percent of the sector's energy use is expected to be managed under ISO 50001 in 2030. This may result in more than 1,800 billion Btu of primary energy savings, $15 billion in cost savings, and 100 Mt of $CO_2$ reduction.

In all five scenarios, we set energy savings from the first year of implementation to 5 percent, which equals the minimum level necessary to qualify for Silver certification under the current DOE SEP program. It is considered to be an achievable average goal for the first year after ISO 50001 Energy Management System (EnMS) implementation. The continual energy savings in the following years is set to 1 percent, since the cost of additional energy savings tend to increase as the EnMS matures.

## Benefits and Opportunities in the Commercial Sector

To promote ISO 50001 in the commercial building sector, it will be important to help building owners understand its difference from other U.S. energy efficiency and "green" building certifications, such as Leadership in Energy and Environmental Design (LEED), Green Globes, and Green Seal. ISO 50001 requires the implementation of a robust energy management system and focus on continual energy performance improvement. The requirements for ongoing system improvements under ISO 50001 produce particularly effective, additional benefits, as reported by ISO 50001 certified organizations:

- Visible demonstration of social responsibility and strong support of sustainability goals
- Sustained commitment (participation and follow through) of top management
- Documented processes and procedures that standardize energy management practices and help them persist throughout personnel turnovers
- Continual energy cost savings that improve business bottom line and competiveness
- Compliance with or ahead of energy and environmental regulations
- Increased awareness of energy consumption and greater focus of improvements by taking a system perspective rather than a project-level view
- Increased monitoring that leads to data-informed operational and capital decision-making
- Third-party verification that adds credibility and transparency

ISO 50001 presents unique opportunities for commercial buildings energy savings because: (1) the collective energy consumption of a campus or portfolio of distributed buildings can be substantial, (2) the standard allows wide flexibility (e.g., in defining the EnMS scope) while accommodating different building ownership and operation types and energy bill payment options, while engaging parties who affect energy use, and (3) the types of energy systems and equipment in commercial buildings are limited, so it is feasible to reduce implementation effort by sharing a standard set of procedures that constitute an ISO 50001 EnMS with little required customization.

## Suitable Commercial Building Market for ISO 50001

ISO 50001 can be of value to any organization with an energy footprint and is designed with great flexibility to accommodate various circumstances. However, certain segments within

the commercial building sector may receive a bigger "bang for the buck." This paper recommends several rules-of-thumb for this purpose. First, organizations with a total energy bill greater than $1 million per year are more likely to recoup the implementation (and certification) cost in a short period with energy cost savings.

Second, the following eight segments may have greater market potential among commercial buildings. This is because organizations in these segments tend to have a building portfolio large enough (e.g., > 50,000 square feet) with centralized building systems, and their collective energy cost offers large potential for reduction. Although office buildings may be an exception, these segments are also responsible for their energy bills, which motivates them to save energy.

1. Education – college campuses
2. Food sales
3. Retail – excluding malls
4. Inpatient health care
5. Hospitality
6. Office buildings
7. Laboratories
8. Data centers

In addition, organizations with a corporate energy or sustainability goal tend to find ISO 50001 more valuable, because it provides a structured approach to meet those goals. In particular, organizations with an energy program that has already harvested "low-hanging fruit" will benefit by implementing ISO 50001; the two early-adopter companies discussed in this paper are such examples. ISO 50001 is also particularly suitable for organizations with multiple sites, including multinationals. The standard can also be an effective way for corporations to push energy management to their managed and franchised properties, or through the supply chain.

The lessons learned from an earlier DOE commercial building ISO 50001 pilot (Deru, Field, and Punjabi 2014) suggest that organizations with experience implementing other ISO standards, greater access to corporate resources, and clear chains of authority over personnel who affect energy use are more likely to successfully implement ISO 50001.

## Leveraging "Enterprise-wide" ISO 50001 for Commercial Buildings

ISO 50001 can be implemented and certified either at a local organization (also known as "site") or for an entire corporation (enterprise-wide). Under an enterprise-wide ISO 50001, multiple sites share a common EnMS managed by a "Central Office". Central Office staff do not need to be in the same physical location and can be part-time. Figure 1 (Left) shows a "generic" organizational structure for this scheme. The Central Office is directed by the corporate top management and oversees the ISO 50001 enterprise program across sites. Each site has an energy champion leading the local program with support from a cross-functional team. Figure 1 (Right) shows a structure typically used for the traditional, single-site ISO 50001 approach. It is clear that the enterprise-wide approach requires less staff resources per site.

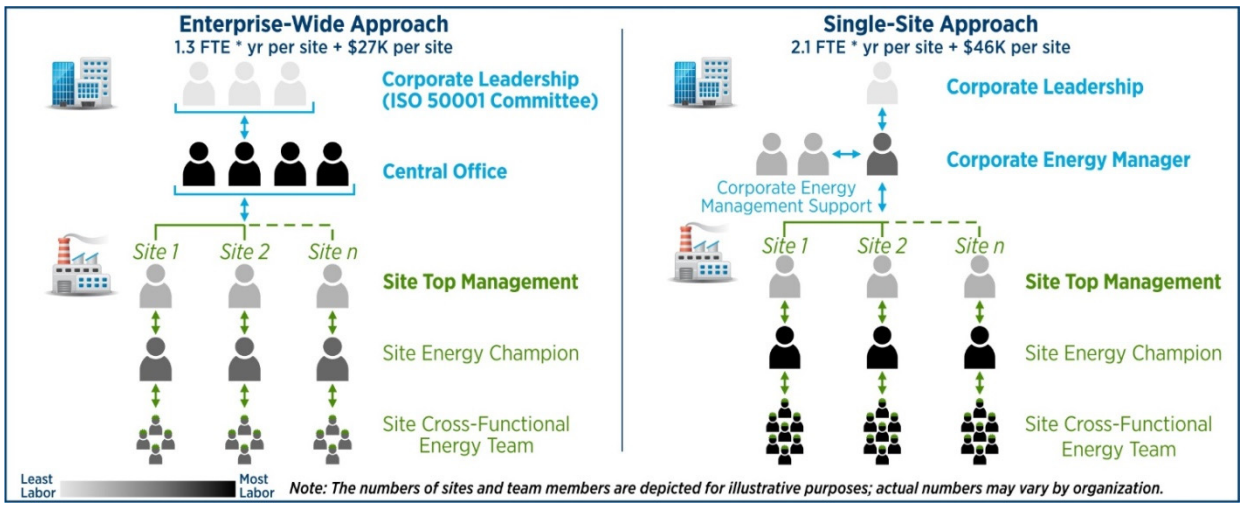


Figure 1. ISO 50001 organization structure requires less staff resources per site under enterprise-wide approach (left) vs. single-site approach (right). *Source:* DOE EERE 2017.

The enterprise-wide approach promotes consistency, leverages resources, promotes best practice sharing, facilitates economies of scale, and accelerates system adoption. Though each site must comply with the corporate EnMS procedures, the program is flexible enough to accommodate site-specific circumstances. An ISO 50001 third-party audit takes place at the Central Office level and allows for a subset of all perspective ISO 50001 sites to be audited, a process known as "sampling." The enterprise-wide approach streamlines EnMS implementation, making the process more cost-effective per site, as proven with four industrial companies: 3M, Cummins, Nissan, and Schneider Electric (Liu et al. 2017). Hilton's global ISO 50001 certification also proves the feasibility for commercial building organizations to impose a consistent EnMS across franchised properties through brand standards.

The enterprise-wide approach is very important for the commercial building sector because many organizations have multiple or even a large number of distributed locations. Each site's energy footprint may not be significant enough to justify dedicating staff to energy management. However, the organization's total energy footprint may be very large, and the corporation may be willing to dedicate central resources with support from across a campus. Examples of this arrangement could include university/college systems, government agencies, retail chains, restaurants, hotels, and hospitals. Real estate companies owning a portfolio of different types of buildings also are potential candidate for implementing enterprise-wide ISO 50001. The organization implementing the EnMS can be the building owner's, occupant's, or operator's organization, and does not have to be responsible for paying the energy bills, although it would be a plus. In addition, energy-consuming systems in commercial buildings tend to share many similar features across buildings. Therefore, it may make sense for many commercial building organizations to develop a corporate energy manual and a set of standard operating procedures supported by the central office, with flexibility for customization.

## Two Early Adopters of "Enterprise-wide" ISO 50001

Lawrence Berkeley National Laboratory and DOE interviewed two early adopters in the commercial sector—Hilton Worldwide and Aflac—both of whom have certified to ISO 50001 at


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the corporate level but with nuances in their certification scope. The interview notes are in a white paper (Liu and Sheaffer 2018) that reviews their motivation, achieved benefits, and implementation approach to inform other commercial organizations' business decisions. All the data given in the profiles below comes from those interviews.

**Hilton Worldwide – Full "Enterprise-wide" ISO 50001 with Central Office**

**Profile.** In 2014, Hilton became the first global hospitality company to achieve ISO 50001:2011 certification across its entire portfolio of owned, managed, and franchised properties. Hilton's certified portfolio of more than 5,100 properties had a combined energy footprint of nearly 45 million MBtu in 2016.

**Drivers.** In 2008, the company set five-year sustainability goals, one of which was to reduce energy consumption and carbon emissions by 20 percent. As a result, the company searched for a suitable company-wide energy management program. Considered options included ISO 50001, LEED, Green Seal, and others. ISO 50001 turned out to be the best fit because it is international and process-based, with a strong focus on continuous improvement. It was flexible and easy enough to implement across a varied global real estate portfolio through brand standards.

The 2012 promulgation of the Energy Efficiency Directive (EED) by the European Commission strengthened the business case to certify because, under the EED, Hilton's properties are required to either perform an energy audit every five years or be ISO 50001 certified. ISO 50001 offered a stronger return on investment and the opportunity to drive global improvement. The company officially started implementing ISO 50001 in 2013.

**Benefits.** By 2016, Hilton had reduced its energy use intensity by nearly 19 percent against a 2008 baseline. This is significant, given that the company has been working on energy management since the 1970s and has largely harvested the "low-hanging fruit." Being able to prove energy savings to comply with the EED added to the return on investment. Hilton believes that the ISO 50001 certification has strengthened its leadership position, which in turn motivates the company to invest more to further drive ISO 50001 compliance and energy performance.

In addition, from a risk management perspective, Hilton leverages ISO 50001 as a recognized program to mitigate risks in light of fluctuating energy costs and to stay ahead of any applicable legislation. The company values shifting away from a project-by-project approach to managing energy with a system perspective and discipline of documenting "how we do things," which are all enabled by implementing ISO 50001.

In 2017, Hilton was listed by the Dow Jones Sustainability Index (DJSI) for the first time and it believes that ISO 50001 has contributed to it. This achievement strengthens its corporate social responsibility platform, responding to consumers' and investors' needs as a publicly traded company, and improving employee-engagement with its Millennial-majority workforce. The third-party ISO 50001 certification and DJSI listing enhanced Hilton's brand attraction to consumers as well as hotel developers, which is critical to the company.

**Implementation Approach.** With over 85 percent of its global footprint operated by third-party management companies, the franchised company relies heavily on its Brand Standards to ensure quality and guest satisfaction. Hilton implemented ISO 50001 with goals and actions through its proprietary corporate responsibility measurement platform "LightStay," use of which is required

in the Brand Standards. ISO 50001 is fully integrated with ISO 9001 Quality Management System and ISO 14001 EMS at Hilton, which are together monitored for compliance by their quality assurance team.

Hilton has a six-person "Central Office" team within the existing management structure. Central team members consist of the Vice President of Corporate Responsibility & ADA Compliance, one person from Environment & Sustainability, and leaders of the Regional Property Management teams (Americas, Middle East & Africa, Europe, Asia Pacific). Other internal functions that were involved in ISO 50001 implementation are Quality, Guest Satisfaction, Property Operations, Engineering, Brand, Legal, and Supply Chain, which are all centralized functions at the corporate headquarters. The certification body (DEKRA) was also an important stakeholder. The local team at each site typically consists of 3–5 existing team members, including the General Manager and managers of major functions (e.g., Housekeeping, Engineering/Maintenance, Food Services).

**Keys to Success.** The company recommends using a robust and centralized energy consumption tracking system and clearly communicating its importance to staff, outlining expectations for using this information appropriately for daily operations.

### Corporate-level ISO 50001 at Headquarter Campuses

**Profile.** Aflac, the leading provider of voluntary insurance sales at the worksite, certified 13 buildings totaling 1.1 million square feet to the ISO 50001:2011 standard in 2013 at their Columbus, Georgia, headquarters. These buildings, owned by Aflac, on two adjacent campuses, have a combined annual energy consumption of 30 million kilowatt-hours at a cost of approximately $2.5 million. The company did not include any leased properties at satellite locations in the ISO 50001 scope because other parties influence the energy consumption at those locations.

**Drivers.** Aflac has a strong culture of prioritizing corporate sustainability and citizenship. In addition, energy costs are the second largest in the facilities' operating budgets, after personnel costs. Before embarking on the ISO 50001 journey, Aflac had completed a number of quick-win projects and had previously reduced its energy intensity by 40 percent in 2012 compared to its 2007 baseline. As the company began to rely more on capital projects for energy savings, the ISO 50001 standard provided an excellent framework for systematically evaluating such opportunities.

**Benefits.** By implementing ISO 50001, the company was able to better structure its energy program and gain greater focus with transparent objectives and targets that stimulated the discovery of new opportunities. Most early improvements were operational changes rather than capital projects; however, when energy savings began to flatten, the company started investing in capital projects, seeking for payback of four years or less. By 2016, the company was able to reduce its onsite energy intensity (annual Btu consumption per square foot) by a significant 16.7 percent compared to when they started implementing ISO 50001 in 2012. The company has saved approximately $15 million on energy cost over 10 years (2007–2017).

In addition to energy savings, the company's facility help desk received fewer comfort complaint calls from building occupants, since they improved energy management by optimizing

their HVAC system operating schedules, sequences, and set points. The much-reduced occupant complaints enabled facility staff to focus on other priorities, including further harvesting energy opportunities.

The third-party ISO 50001 certification provides additional credibility and is also a significant factor in corporate social responsibility reporting. For at least six years, DJSI has listed Aflac as one of the few U.S.-based insurers in its indices. The company expects that its ISO 50001 certification will help to maintain its place on the DJSI listing. The company also is excited about achieving ISO 14001 certification and implementing ISO 26000 Social Responsibility Guidance Standard as the next step.

**Implementation Approach.** Aflac's top management in ISO 50001 (and ISO 14001) is represented by the Vice President of Facility Support, who serves as the company's Sustainability Officer and reports to the board of directors biennially. The ISO 50001 team includes nine members. The company's Quality Assurance Consultant serves as the Management Representative in both ISO 50001 and ISO 14001 management systems. Director of Facilities Maintenance coordinates the implementation of both ISO systems. Under this role, two campus managers champion the ISO 50001 implementation at each campus, with an engineer and a building automation system (BAS) vendor's onsite representative supporting them. Other roles on the team include Administrative Assistant, Financial Analyst (manage energy data), LEED Specialist (non-conformity actions, liaison to business units), and Corporate Security Manager (internal lead auditor). Aflac did not use the "Central Office" model because the two campuses in the scope are close by.

Aflac leveraged its previous experience implementing ISO 9001 in a different functional area of the company—there were transferrable lessons in internal audit, documentation, and corrective actions. The company also maximized its utilization of other existing processes for ISO 50001 use, such as using the facilities work order system to manage corrective actions and centralizing all ISO systems documents in the existing SharePoint site. The team has developed an Energy Management System Manual, which is also hosted on the SharePoint. The manual describes how they meet the ISO 50001requirements in detail. Users manage energy consumption analysis in a spreadsheet tool that tracks energy performance and targets, among other sustainability metrics (for ISO 14001), from month to month. The energy team meets monthly with top management on issues that include the energy consumption progress. Implementing ISO 50001 has enabled the team to review energy consumption with more sophistication and to deeply understand the influence of weather and other variables.

**Keys to Success.** Aflac found its prior experience with ISO 9001 certification to be a key factor to its success with ISO 50001. By setting objectives and targets, and measuring progress with appropriate weather normalization techniques, the Aflac team was able to better understand building energy performance and gain greater focus. Their efforts also are made much more visible to the leadership on a regular basis.

## Multi-Site Approach for Market Transformation Programs

The value of an ISO 50001 EnMS and the foundational "Plan-Do-Check-Act" management framework is recognized by industry, government, and utility programs (Batmale et al. 2013). Besides the aforementioned DOE programs (inclusive to commercial and industrial

organizations), there are also a growing number of utility Strategic Energy Management (SEM) programs in the United States, stemming from the same fundamental principles as those used in the ISO 50001 standard (Burgess et al. 2015; Collins and Birch 2015). Despite the historical focus on industrial customers, many SEM programs are open to commercial customer participation and have gained more awareness among this customer base (Leritz et al. 2014).

A key challenge with commercial customers, though, is recouping the EnMS implementation cost through savings within a short period, because their energy intensity is generally lower than that of industrial customers. Therefore, a multi-site (including enterprise-wide) approach is an important part of solving this challenge because the energy savings achievable, and staff resource allocable, at each commercial building site are typically difficult to justify a full EnMS on its own. Although the enterprise-wide approach discussed earlier is most desirable, some organizations may be more comfortable implementing pilot projects among multiple sites at a local or regional level before expanding to the corporate level. In addition, utility programs often have limited influence over customers' corporate decisions beyond their sites within the utility service territory. Therefore, it would be practical to start implementing ISO 50001 or ISO 50001-inspired energy management programs among multiple sites, with the intention of further scaling them to the corporate level upon initial success.

The above proposition is based on what we have learned with real-world data collected in the industrial sector. When implemented across the enterprise or multiple sites with higher-level coordination, staff resources and overall implementation costs will be significantly lower (Liu et al. 2017). Compared to the industrial sector, the EnMS implementation effort in the commercial sector is expected to be less, since the types of energy systems and equipment are much more similar across buildings. This makes sharing a set of similar processes and procedures practical and, hence, reduces resource requirements per site. Therefore, when an organization implements ISO 50001 at a portfolio of commercial buildings, once the EnMS is established at one site, the expected effort to expand it to additional buildings will be incremental. In other words, the commercial building sector holds much greater opportunity to achieve economies-of-scale in adopting ISO 50001 EnMS using the multi-site approach. Several publications discuss the cost to implement ISO 50001 at industrial and commercial organizations (Therkelsen et al. 2015; Liu and Sheaffer 2018), and they can serve as references in designing market transformation programs. The existing tools and resources developed primarily in the industrial sector will leverage implementation among commercial buildings. The DOE's 50001 Navigator[1] is a good example of such tools. Customizing tools and resources that are uniquely designed for commercial organizations in the near future will accelerate transforming this sector's market.

It is important to note that non-energy benefits associated with implementing ISO 50001 at commercial organizations has been an under-recognized area. When energy benefits are combined with additional benefits such as operations and maintenance savings, rental premiums, increased property values, positive impact on stock prices, and access to additional capital for publicly traded companies, organizations can make stronger business cases (Liu and Sheaffer 2018).

[1] 50001 Ready Navigator is an online resource that provides step-by-step guidance for implementing an energy management system according to the principles of ISO 50001.

## Conclusions

The ISO 50001 standard has been successfully adopted in the industrial sector since its publication, with lots of well-established examples and available implementation resources. These serve as a great foundation for expanding ISO 50001 adoption in the U.S. commercial buildings sector, where it holds tremendous potential. It is estimated that adoption of ISO 50001 in this sector can yield at least 65 billion Btu of primary energy savings, equivalent to $0.5 billion in the year 2030. Currently, tracking of individual certifications is lacking, so its true uptake in the commercial buildings sector is unknown. However, there are some published examples of ISO 50001 certifications at the individual building level, multiple buildings level, and corporate level among U.S. commercial buildings and in the world.

The commercial buildings sector has some unique opportunities to benefit from ISO 50001 EnMS. Many organizations own multiple buildings, and the total aggregate energy consumption of those buildings is significant, with great opportunities to save. The similarities among energy-consuming systems in commercial buildings also make it easier to standardize and scale EnMS across buildings. Considering implementation resources and complexity of ownership and operation and maintenance responsibilities, we recommend a "suitable market" of eight segments within the commercial buildings sector for pursuing ISO 50001 EnMS. Using the enterprise-wide or campus-wide approach can reduce implementation resources and costs per site or building significantly. This approach can help leverage and transform the commercial buildings ISO 50001 EnMS market substantially. A number of resources are available to assist with implementation, including the DOE 50001 Ready Program with self-guided tools. It should be noted that implementing a self-declared ISO 50001-conforming EnMS, without bearing the cost of third-party certification, could be a beneficial goal for some small- to medium-sized commercial building organizations.

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