Moving the masses to ISO 50001 with 50001 Ready

Christine Wu, Dr. Peter Therkelsen,
Dr. Prakash Rao & Paul Sheaffer
Lawrence Berkeley National Laboratory
One Cyclotron Road 90R3111
Berkeley, CA 94720
USA
CJW@lbl.gov
PTherkelsen@lbl.gov
PRao@lbl.gov
PSheaffer@lbl.gov

Jay Wrobel, Pete Langlois & Paul Scheihing
U.S. Department of Energy
1000 Independence Ave. SW
Washington, DC 20585
USA
Jay.Wrobel@ee.doe.gov
Pete.Langlois@ee.doe.gov
Paul.Scheihing@ee.doe.gov

Keywords

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Abstract

For over a decade, the U.S. Department of Energy (DOE) has engaged in the development, uptake, and study of the ISO 50001 Energy Management standard, to advance the energy performance and competitiveness of U.S. manufacturing. While U.S. industry has responded with general support for establishing a standard practice for managing energy, the process and cost of certification have frequently been cited as obstacles to widespread uptake.

This paper explores the approach taken by DOE and Lawrence Berkeley National Laboratory (LBNL) to break down this barrier. 50001 Ready is a self-guided recognition program developed by DOE and LBNL to support facility-level adoption of the business practices of ISO 50001, by providing national recognition for self-driven uptake of energy management principles without the need for any third-party audits or verification.

Also developed by DOE and LBNL, the 50001 Ready Navigator is a self-guided online tool and resource database for step-by-step implementation of an ISO 50001-based energy management system, designed to build capacity at all organizational levels. Facilities seeking 50001 Ready recognition complete 25 tasks in the Navigator, self-report their energy performance, and provide executive-level attestation of implementation. The Navigator facilitates collaboration; users can track their progress, share notes with team members, receive expert assistance, and request DOE recognition directly through the Navigator.

Since the launch of 50001 Ready in early 2017 there has been widespread interest from both the industrial and commercial sectors, and the number of facilities using the Navigator is growing rapidly. This paper includes reflections from a diverse range of early adopters on the value of open knowledge-building resources and federal recognition, outlines how 50001 Ready can be leveraged and adapted to proliferate energy management best practices around the globe, and offers recommendations for future program strategies based on new research on barriers to ISO 50001 adoption.

Introduction

The ISO 50001 – Energy Management system (EnMS) standard is the international framework for the structured practice of managing energy, first published by the International Organization for Standardization (ISO) in 2011. ISO 50001 establishes the structure and discipline for organizations and facilities to manage their energy consumption, use, and procurement based on a rigorous continual improvement-based approach. Like ISO 140001 – Environmental Management and ISO 9001 – Quality Management system standards, ISO 50001 utilizes a Plan-Do-Check-Act cycle to deepen and sustain energy savings over time.

Since 2007, the U.S. Department of Energy (DOE) has been heavily engaged in the research, development and promotion of ISO 50001 – in absence of strong national policy – in order to bolster the global competitiveness of U.S. manufacturing and commercial businesses. In response to industry feedback on the cost- and knowledge-based obstacles to ISO 50001 certification, DOE's Advanced Manufacturing Office introduced the *50001 Ready* program in 2016 to provide a no-cost, self-

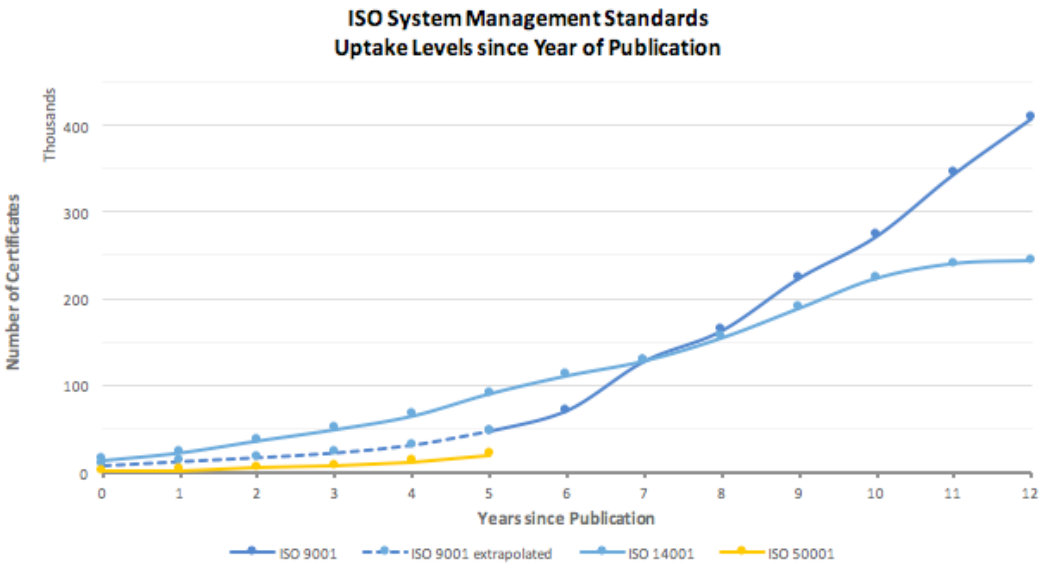


Figure 1. Uptake levels of ISO Management System standards since publication.

attested method to attain U.S. federal recognition for adoption of ISO 50001-based energy management practices.

Development of the 50001 Ready program and overall DOE support for ISO 50001 have been backed by research that demonstrates potential energy savings of 64 exajoules attributable to broad global implementation of ISO 50001 by 2030, saving over $700 billion in energy costs and resulting in emissions reductions equivalent to removing 212 million passenger vehicles from the road (Aghajanzadeh 2016). These outcomes are dependent on key growth parameters related to industry uptake of ISO 50001-based energy management practices, in order to achieve 50 % market saturation by the year 2030.

According to the most recent ISO Survey, over 20,000 sites worldwide have been certified to ISO 50001 at the end of 2016 (ISO 2016). Based on historical adoption rates from ISO 9001 and ISO 14001, ISO 50001 is approaching an inflection point critical to determining its long-term rate of adoption (Figure 1. Uptake levels of ISO Management System standards since publication[1]). Though initial adoption figures for ISO 50001 were lower than for ISO 14001, ISO 50001 has experienced a notably higher rate of growth in its first five years of publication (Figure 2). This suggests that significant potential market capture exists for energy management as a burgeoning field of business improvement.

As the growth rate for ISO 50001 certifications has yet to stabilize, effective tools, resources, and programs to support ISO 50001 adoption are increasingly critical to achieving the energy savings and emissions reductions forecasted to be attributable to energy management practices. The 50001 Ready has been designed to provide support in response to anecdotal feedback from industry that costs and effort related to certification are too great, but has the potential to further evolve as the barriers to implementation become increasingly well understood.

While some studies exist, relatively little empirical research has been conducted to formally evaluate the specific barriers to adoption for ISO 50001, resulting in limited ability to fine-tune strategies aimed at supporting uptake. Preliminary research by Lawrence Berkeley National Laboratory (LBNL) has contributed to unraveling this issue by quantifying common challenges faced by organizations seeking ISO 50001 certification. Referencing data from case studies authored by ISO 50001-certified organizations, Fuchs (2017) employed content analysis research methods to distill the most frequently cited keys to success and challenges related to ISO 50001 adoption. Table 1 shows Fuchs' analysis of linkages between five of the most commonly cited challenges and keys to success.

This burgeoning research provides an opportune moment to evaluate approaches taken by DOE and LBNL to bring ISO 50001 to the masses. This paper will first explore the approach taken by DOE and LBNL to address barriers to ISO 50001 implementation through the 50001 Ready program and related resources, referencing feedback from early adopters of 50001 Ready on the value of no-cost tools in building energy management business practices. This paper will further point to Fuchs' research to analyze alignment between 50001 Ready and identified industry needs, and explore potential program development strategies that may be employed to accelerate widespread adoption of ISO 50001 in the U.S. and globally.

The U.S. Department of Energy's Approach to ISO 50001 Adoption

The U.S. Department of Energy (DOE) has been a pioneer in the development of energy management as a standardized business practice since 2007, engaging early on with industry, foreign governments, and international organizations to identify a systematic, data-driven, and business-friendly approach to en-

1. The earliest data available for ISO 9001 certifications is at the end of 1992, when the ISO Survey project started. The ISO 9000 series of standards were first published in 1987 and were adopted in the U.S. as ANSI/ASQC Q90-1987 at the same time. As such, the number of ISO 9001 certifications is not available for the first five years of publication. Rather than assume a linear growth rate, a growth rate equivalent to ISO 14001 growth in its first five years is assumed.

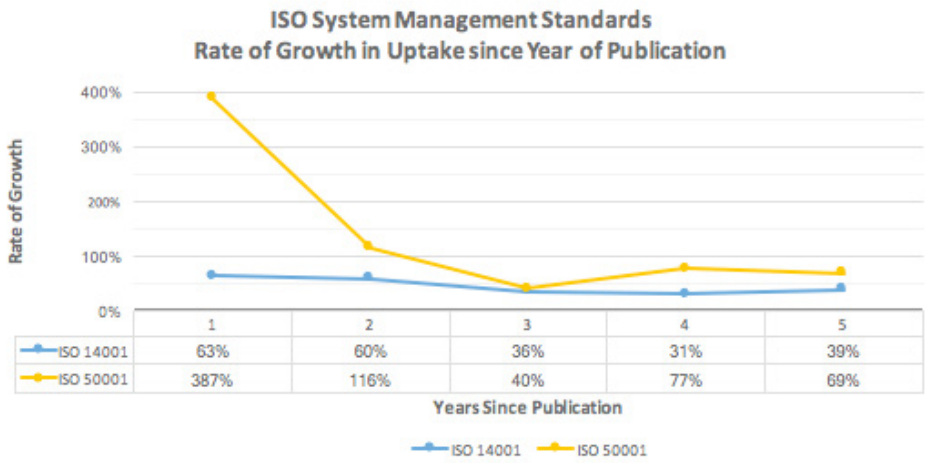


Figure 2. Rate of growth in uptake for ISO Management System standards since publication.

Table 1. Analysis of overlap between top five "Keys to Success" and "Challenges." Percentage values indicate the proportion of analyzed case studies that cite each challenge or key to success. (Fuchs 2017.)

1. Engagement and support of upper-level management	
Keys to Success	Support from management; corporate-level program leadership (72 %)
Challenges	Lack of ongoing top management support (17 %)
2. An energy-aware company culture	
Keys to Success	Existing culture of energy awareness; recognition that energy conservation is a responsibility and part of everybody's work (42 %)
Challenges	Energy management not integrated/rewarded within company culture, nor is it part of daily employee behavior (22 %)
3. Reliable and accurate energy metering	
Keys to Success	Reliable and accurate energy metering; understanding SEUs and identifying facilities with largest impact (35 %)
Challenges	Imperfect information; lack of disaggregated and transparent energy consumption data (24 %)
4. Overcoming organizational silos	
Keys to Success	Reduce departmental silos; create cross-functional energy teams; share required tools, frameworks and information (34 %)
Challenges	Departmental silos; misaligned responsibilities and budgets; knowledge gap between departments (12 %)
5. Employee awareness through communication and transparency	
Keys to Success	Specifically take measures to increase employee awareness and improve transparency and reporting (27 %)
Challenges	Lack of awareness or failure to recognize benefits of systematic EnMS or non-energy benefits (17 %)

ergy productivity. DOE's activities have included chairing the International Standards Organization's (ISO's) Technical Committee responsible for standardization of energy management practices, and serving as a member government in the Clean Energy Ministerial's Energy Management Working Group to support global adoption of ISO 50001.

Due to the heterogeneity of the market and the extreme variability in familiarity with energy management practices, DOE recognized early on a need to approach ISO 50001 adoption from multiple perspectives. In other words, organizations at different stages of establishing an EnMS would require different business case justifications and incentives, because they face different barriers to implementation. As a result, DOE instituted a continuum to structure its recognition programs to accelerate adoption, spanning from a data-driven approach for established performers, to a self-attested approach for mass uptake (Figure 3).

At the top, DOE's first EnMS recognition program, the Superior Energy Performance (SEP) program, was initiated in the early stages of ISO 50001 development as a voluntary program for facilities to be recognized for both meeting the ISO 50001 certification standard and having accredited third-party verified energy performance improvement. SEP encourages adoption of EnMS through rigorous, data-driven evidence of the energy and cost savings benefits of ISO 50001, and targets facilities and organizations at the more established end of the EnMS implementation spectrum. SEP-certified energy savings are verified according to guidelines set by the *SEP Measurement and Verification Protocol*, and supports the position that a rigorous data-driven approach to energy performance improvement will compel industry to achieve deeper, sustained savings. As of the end of 2017, nearly 60 facilities have been certified to SEP, with a verified 12.9 % average reduction in normalized energy consumption over a

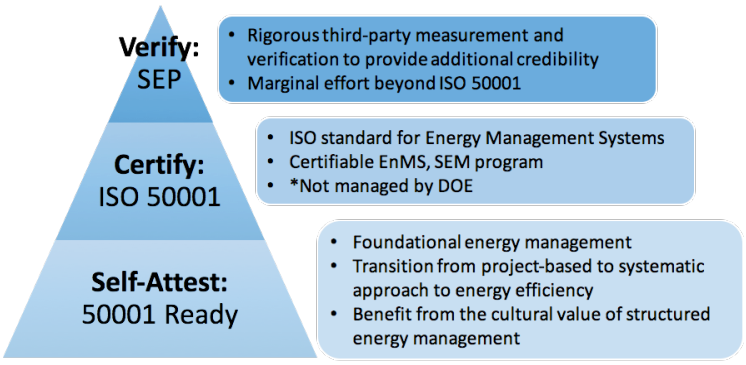


Figure 3. DOE continuum for ISO 50001 adoption.

3-year period, equivalent to 3.9 quadrillion Joules (3.71 trillion BTU) source energy.

In 2017, DOE's Advanced Manufacturing Office introduced the 50001 Ready program as a self-paced, no-cost recognition program to accelerate mass uptake of ISO 50001-based energy management business principles among facilities and organizations at the foundational or earlier stages of EnMS implementation. In contrast to SEP, 50001 Ready is built on the perspective that the environmental and cost benefits of energy management stem primarily from structured business practices, and not from certification per se; the program responds directly to frequently cited obstacles of process and cost of certification to a voluntary standard.

The following subsections will describe the 50001 Ready program and its related toolkits, in the context of the barriers to adoption they respectively challenge.

THE 50001 READY PROGRAM

Bypassing barriers of cost, risk, and workload

The 50001 Ready program is a no-cost, self-attested program developed and managed by DOE to offer federal recognition for voluntary uptake of the business principles of ISO 50001. 50001 Ready is designed to capture facilities at the foundational level of energy management implementation, by incentivizing a self-driven approach to adopting continual improvement-based energy practices. The program focuses on the adoption of the organizational structure and foundational business practices that comprise ISO 50001, and completely removes the cost barrier associated with certification by eschewing requirements for any third-party audits or verifications.

Obtaining 50001 Ready recognition consists of three steps:

1. Completing 25 tasks in the 50001 Ready Navigator
2. Self-reporting energy performance
3. Providing top management attestation of implementation

The program is supported by technical expertise provided by Lawrence Berkeley National Laboratory (LBNL), via a Help Desk accessible through the 50001 Ready Navigator. LBNL also provides quality control for recognition requests by confirming the veracity of basic information, including the type and location of the facility, and the identities of top management representatives. LBNL also conducts "gut-check" verification of reported energy data, and spot-checks for data entry and calculation errors. Recognition is then issued by LBNL on behalf of DOE.

As a self-attested program, 50001Ready by definition cedes some level of rigor in its implementation of a comprehensive EnMS, and is not intended as an equivalent or substitute for ISO 50001 certification. Nor does obtaining 50001 Ready recognition guarantee that a facility would be able to successfully pass an ISO 50001 certification audit, though it reduces the risk of failing an audit by minimizing any uncertainty associated with interpreting the standard. 50001 Ready is designed to help facilities institute the fundamental business culture needed to pass an audit, thus lessening the lift required to meet the "shall" statements of ISO 50001 should they choose to get certified. One facility that achieved 50001 Ready when it was already deep in the process of preparing for ISO 50001 certification reflected that going through 50001 Ready earlier on likely would have eased the certification process, due to the clarity of the guidance and the resultant confidence it gave them in their energy program.

The 50001 Ready program challenges the notion that the practice of energy management requires audit-level rigor that in turn necessitates costly consultants and additional staff workload. The program upholds that the practice of energy management can achieve notable savings and emissions reductions through self-management and fundamental culture change throughout the organization, particularly through no-cost practices like the early establishment of sustainability goals and securing leadership commitment.

As of early 2018, over 400 users from commercial, institutional, and industrial companies representing over 200 organizations around the globe have created accounts in the 50001 Ready Navigator and are in various stages of implementing ISO 50001-conformant energy management systems. Three facilities have achieved 50001 Ready recognition, representing produce warehousing, steel manufacturing, and automotive parts manufacturing. Data from the first three facilities recognized by 50001 Ready indicate potential for substantial annual energy performance improvement, with one facility achieving over 8 % using regression-based modeling.

Working with existing partners

DOE's promotion of 50001 Ready and energy management is embedded in broader agency efforts to advance U.S. competitiveness through improved energy efficiency, smart manufacturing and next-generation energy analytics. DOE promotes

50001 Ready through the agency's Better Buildings, Better Plants Initiative, which includes partners representing 13 % of total U.S. commercial building space, about 12 % of the U.S. manufacturing energy footprint, and 125 state and local governments.

Anecdotal data (since supported by Fuchs' research) has indicated that two of the prime indicators of ISO 50001 candidates are: 1) evidence of top leadership support, and 2) established energy goals or policies. Through cross-promotion of the 50001 Ready program with related federal energy efficiency programs including Better Buildings, Better Plants program, and the U.S. Environmental Protection Agency's ENERGY STAR program, DOE is maximizing its marketing strategies by targeting organizations that have a documented and observed dedication to sustainability initiatives. The 50001 Ready program does not prescribe a minimum energy improvement goal – other than performance must improve – in order to avoid any conflicts with other energy efficiency programs that might specify particular goals or measurement methodologies. "Energy performance" for the 50001 Ready program may be self-defined as any normalized measure of energy consumption, including weather, production, or facility size.

Program replicability and expansion

In addition to supporting direct adoption of 50001 Ready energy management systems within the U.S., the 50001 Ready program is designed for expansion, in order to encourage mass adoption of ISO 50001 even outside of the DOE's direct purview. Reasons for this include reducing the risk of energy-related uncertainty for U.S.-based manufacturers that rely on supply chains with facilities abroad. Within national borders, DOE recognizes and relies on the power of local jurisdictions and organizations to provide tactical and financial support at multiple levels closer than the federal government is typically able. Ultimately, DOE intends for 50001 Ready to serve as both a springboard and a common framework for building future programs and products that support next generation management practices.

The 50001 Ready program is built upon a defined kit-of-parts in support of replicability for utilities, governments, and other organizations that wish to run their own programs. Notably, the program is designed to be adaptable by strategic energy management (SEM) and continuous energy improvement (CEI) programs run by utilities and public benefits administrators. By offering an established recognition protocol, structured guidance aligned with the best practices of ISO 50001, and the technical architecture of the 50001 Ready Navigator (described in the next section), the 50001 Ready program provides SEM and CEI programs with the structural backbone to benchmark and develop their own offerings, without competing for clients or markets. Adopting the structure of 50001 Ready is intended to equip trade associations, utilities, and energy efficiency organizations with a proven strategy to build long-term relationships with customers, quantify operations and maintenance savings, and develop a pipeline of future improvement opportunities.

On the global frontier, DOE is pioneering the effectiveness of providing recognition for ISO 50001 conformance without certification or verification. While 50001 Ready recognition is currently only available to U.S.-based facilities, the program and the 50001 Ready Navigator have received international interest from other countries. DOE is presently executing partnerships with Canada and Mexico to establish versions of the 50001 Ready program for facilities within their respective boarders.

THE 50001 READY NAVIGATOR

Bringing best-in-class information to the masses

The 50001 Ready Navigator is a free, publicly available web-based tool and resource developed by DOE, LBNL, and the Georgia Institute of Technology (Georgia Tech) in support of the 50001 Ready program. As a publicly provided, open-source software platform, the 50001 Ready Navigator is the first of its kind to democratize first-class energy management principles. Until now, actionable ISO 50001-based guidance has mostly been available through paid consultants and implementation experts, and especially out of reach for organizations not seeking formal certification. The Navigator is the first resource to remove this financial barrier to accessing information, while ensuring that the information is consistent, legible, and complete.

The Navigator is a replacement and comprehensive overhaul of the eGuide, DOE's first edition of an online handbook for ISO 50001 implementation. Similar to the eGuide, guidance in the Navigator has been repurposed from ISO 50001 into "tasks" defined largely by the activities and business lines involved in accomplishing them. The Navigator lays out the concepts, requirements, and best practices of ISO 50001 in plain language – translating them into actionable steps that are intended to be comprehensible by all levels of technical and decision-making staff. In other words, rather than expressing ISO 50001 as a series of audit-level requirements, the Navigator communicates the culture of energy management as a framework of beneficial practices that can be achieved by organizations at any level of energy maturity and literacy.

A total of over 100 downloadable resources, including templates, calculators, and business cases largely developed by Georgia Tech are associated with the Navigator guidance. These resources have frequently been cited by 50001 Ready facilities and users of the Navigator as one of the most valuable offerings of the Navigator, because they provide a concrete starting point to guide and motivate action. (For reasons of privacy and security, the Navigator does not include the capability to upload or share files. All file management is expected to take place within each organization's own systems.)

Guidance in the Navigator has been authored and continues to be maintained by LBNL and Georgia Tech to ensure alignment with the intent and purpose of ISO 50001. Pending future revisions of the ISO 50001 standard, guidance within the Navigator will be updated to reflect all changes. All guidance and resource documents in the Navigator are fully available to anyone even if they do not intend to achieve 50001 Ready recognition, and can be accessed without creating a user account or requiring any information be supplied to DOE.

Currently, there are no other free, U.S.-based, open sources of information that provide the same value as the 50001 Ready Navigator. Guidance for ISO 50001 implementation can be found in products including training software offered by consultants, but these products are often costly and heavily catered to audit-level compliance for certification. Meanwhile, some

Table 2. 50001 Ready Navigator Sections and Tasks.

Section	Tasks
Planning	Task 1: Scope and Boundaries Task 2: Energy Policy Task 3: Management Commitment Task 4: Energy Team Task 5: Legal Requirements
Energy Review	Task 6: Data Collection Task 7: Data Analysis Task 8: Significant Energy Uses Task 9: Relevant Variables Task 10: Performance Indicators Task 11: Baselines, Objectives and Targets Task 12: Improvement Opportunities Task 13: Improvement Projects
Continual Improvement	Task 14: Monitoring Task 15: Measurement Task 16: Operational Controls Task 17: Corrective Actions Task 18: Energy Consideration in Design
System Management	Task 19: Documentation and Records Task 20: Communications Task 21: Training Task 22: Procurement Task 23: Internal Audit Task 24: Calculate Energy Savings Task 25: Management Review

utilities and regional energy efficiency groups offer action plans through SEM and CEI programs, but these programs currently have little standardization or alignment with each other or the best practices of ISO 50001.

The Navigator serves as DOE's primary tool to break down the barriers of complexity and lack of information regarding ISO 50001, and focuses on energy management as an achievable practice that results in significant benefits from low- and no-cost improvements. This has the widespread effect of increasing awareness throughout the market, and gradually building capacity and baseline literacy for structured, continual improvement-based approaches to energy efficiency.

Facilitating team collaboration and breaking down silos

In order to achieve 50001 Ready recognition, users must create a Navigator account to track their progress through the 25 tasks, using an intuitive dashboard to monitor the status of each task (Figure 4). Users may invite their energy team members to join their Navigator project and assign them to contribute or approve specific tasks, depending on their area of expertise. Project team members can communicate with each other directly within the Navigator platform through a 'notes' feature associated with each task. All roles and assignments appear in the main dashboard, giving transparency to the cross-functional effort required to establish an ISO 50001-based EnMS.

The Navigator plays a unique role in that it offers training, action plans, and team management capabilities all rolled into a single platform. Numerous energy dashboards exist, and an even greater number of project management software platforms exist, but the Navigator is the first to combine these capabilities into a single tool. While the team collaboration capabilities in the Navigator are still in their relatively nascent stages, they nonetheless communicate the critical importance of approaching energy management from a cross-functional and synergistic perspective.

Future iterations of the Navigator are expected to not only expand its team collaboration features, but also to offer enterprise-wide collaboration for organizations with large portfolios. LBNL and DOE research has demonstrated that an enterprise-wide approach to adopting EnMS, as opposed to site-by-site, can significantly reduce the cost and staff time associated with implementation (Liu 2017). The Navigator is currently undergoing product development to actualize these findings into tools to support cost-effective adoption of energy saving business practices.

Overcoming IT barriers and encouraging industry-government dialogue

In support of the replicability of the 50001 Ready program, the Navigator is provided through partnership with DOE as a tool that can be adapted by other organizations and governments that wish to run their own recognition programs. In addition to the guidance, the Navigator has been designed to fully contain the technical architecture for receiving technical assistance and requesting program recognition. In agreement with DOE, organizations and governments have the ability to host a customized version of the Navigator on their own servers, that incorporates their own logos, design schemes, resources and tooltips, program requirements, and language translations. The Navigator may also be repurposed to provide guidance only, for organizations that wish to be able to provide their own specific tooltips and resources without running their own recognition program.

Provision of the Navigator in this method not only advances awareness and reach of ISO 50001 cultural practices, but expedites the process by reducing time, effort, and cost associated with developing IT tools and infrastructure for each proprietary instance of Navigator-like software. While this approach

places some limits on customizability of the tool, it encourages continued dialogue between industry and DOE on how the Navigator and other DOE-provided resources can be improved to better address industry needs.

ENPI LITE

Mitigating the complexity accurately determining energy performance improvement

In support of data-driven energy performance improvement and to build capacity for energy analysis, 50001 Ready requires demonstration of energy performance improvement by the second year of recognition. In the first year, the program primes facilities to begin analyzing their energy performance by requiring energy consumption data to establish a baseline for future comparison. While several reporting structures are accepted for 50001 Ready recognition in order to minimize redundancy in reporting with other energy efficiency programs, the Energy Performance Indicator tool (EnPI) Lite tool is the preferred and encouraged method for the 50001 Ready program.

As its name suggests, EnPI Lite is a lightweight web-based calculator developed by DOE and LBNL specifically for the 50001 Ready program to make regression-based modeling accessible for facilities in the foundational stages of energy performance analysis. EnPI Lite's modeling approach is based on guidance for calculating facility-level energy savings as documented in the *50001 Ready M&V Protocol*. EnPI Lite builds off of the more robust capabilities of the original EnPI Tool, a Microsoft Excel-based calculator that follows the *SEP M&V Protocol* to produce the rigorous energy performance improvement metrics required for SEP certification. The major difference between M&V Protocols for 50001 Ready and SEP is the exclusion of a bottom-up approach to determining energy savings from the 50001 Ready Protocol. Both Protocols require top-down energy performance calculations to demonstrate improvement.

EnPI Lite uses user-provided energy consumption, cost, and independent variable data (such as cooling and heating degree days or production numbers) to establish baseline energy performance and perform regression analysis against a given reporting year (Figure 5). The tool is designed to simplify and minimize required user inputs, in order to help overcome perceived and actual knowledge barriers commonly associated with the complexity of robust regression modeling. Note that EnPI is not intended as an ongoing tracker or monitor of energy performance, but as an easy-to-use calculator that may be used with other tracking mechanisms like EPA's Portfolio Manager or DOE's Energy Footprint Tool. Ultimately, DOE anticipates that use of EnPI Lite will have the effect of improving overall literacy in energy data analysis, without prescribing a particular tracking protocol. Users including one 50001 Ready facility have reported uncovering significant opportunities to improve operational performance through use of EnPI Lite, either by being able to visualize trends in performance vis-à-vis relevant variables that indicate room for improvement, or by spotting performance outliers that signal operational errors or oversights.

Aligning 50001 Ready with Results from New Research

The 50001 Ready program was developed by the U.S. Department of Energy (DOE) in response to repeated but anecdotal industry feedback that the cost and complexity associated with formal audits and ISO 50001 certification were prohibitive to broad uptake. Since the program's introduction in 2017, new

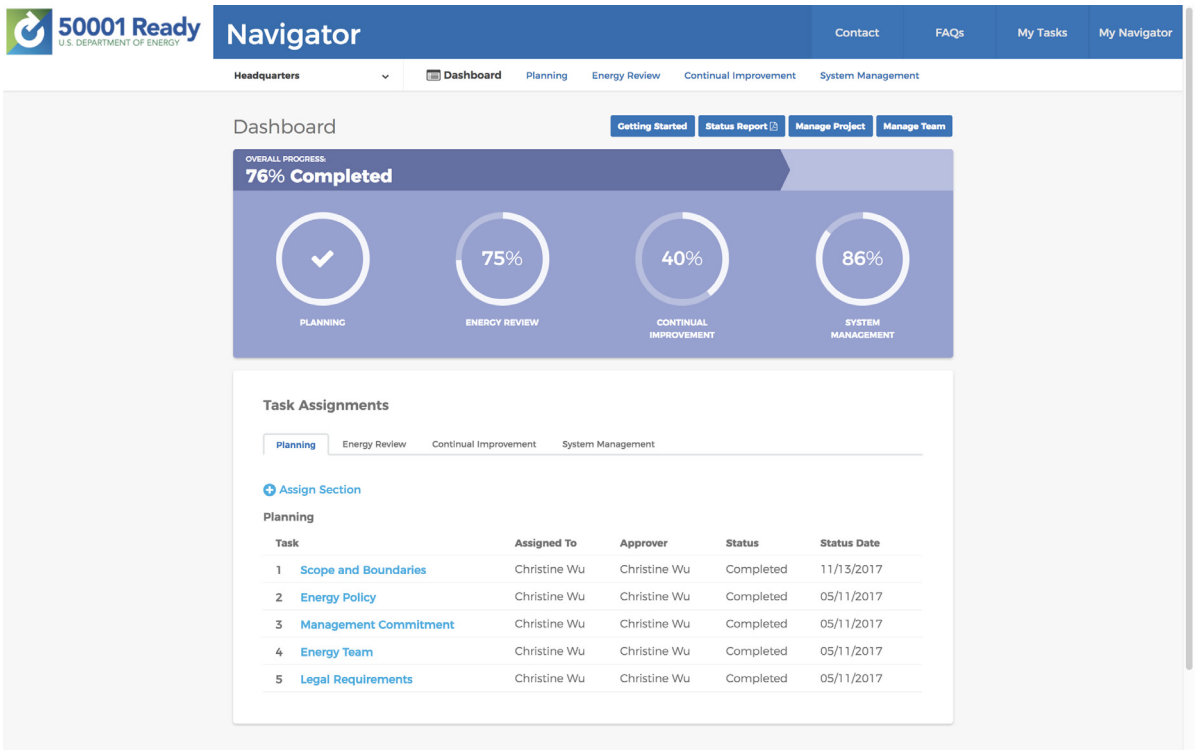


Figure 4. Screenshot of 50001 Ready Navigator Dashboard.

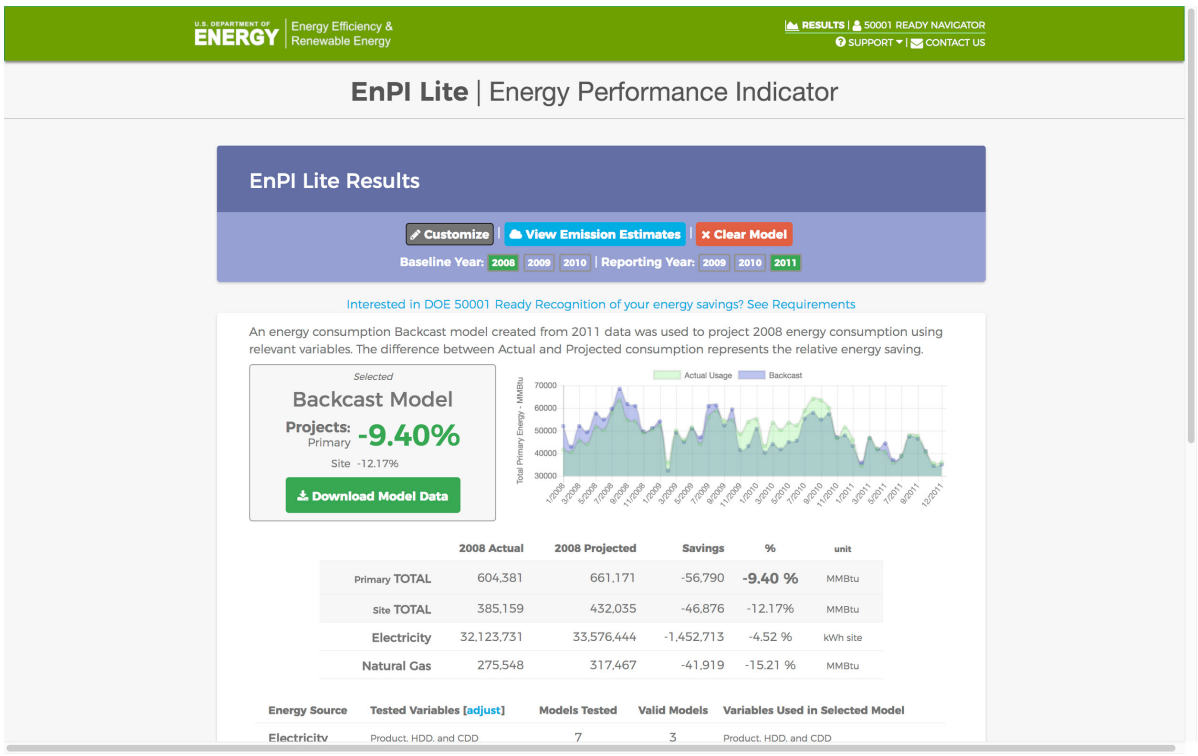


Figure 5. Screenshot of EnPI Lite sample model results.

research has emerged to empirically quantify the challenges and keys to success to ISO 50001 implementation (Fuchs 2017). At this critical point in the growth of ISO 50001 adoption rates, it is paramount to continually assess the alignment of program strategies and activities with the expressed needs of industry. The remainder of this paper will outline the existing alignment of 50001 Ready-related strategies with the top opportunities identified in Fuchs' work (Table 1), and suggest areas of future program development to increase impact on accelerating adoption.

ENGAGEMENT AND SUPPORT OF UPPER-LEVEL MANAGEMENT

Ongoing support from top management was the top cited key to success in case studies reviewed in Fuchs' analysis, and was found to be a notable but not foremost barrier to implementation. Securing leadership support has been one of the core challenges addressed by 50001 Ready, first by requiring top management representative engagement in Navigator projects, and second by cross-promoting between other federal recognition programs that require corporate partnership agreements.

Research results suggest that convincing leadership of the benefits of implementing continual improvement-based EnMS may not be the primary challenge that can be addressed by DOE, but instead, formally documenting their support and ensuring that it is widely and regularly communicated across the organization.[2] In line with this finding, formal partnership agreements are available but have not been required for 50001 Ready, partly due to the hurdles and overhead associated with documenting corporate-level commitment to future actions and outcomes. Research suggests that partnership agreements and formally declaring corporate commitments early in the process may result in greater outcomes, and should be emphasized in future program development for 50001 Ready.

Aside from requiring partnership agreements, tactical strategies to achieve this may include expanding the role of leadership in Navigator projects, for example, by requiring top management to accept project invitations early in the process rather than at the end when the project is being submitted for recognition. The program may also prioritize the development and provision of templates and other resources to communicate leadership support to the broader organization.

AN ENERGY-AWARE COMPANY CULTURE

Fostering an energy-aware company culture was the second-most cited key to success for ISO 50001 adoption, and also the second-most cited challenge for implementation. As a whole, this is the primary and fundamental aim of the 50001 Ready program; the implementation of a 50001 Ready EnMS should by definition indicate that cultural awareness and continual improvement-based practices are ingrained throughout an organization.

The self-attested nature of 50001 Ready, however, places limits on how diligently these practices can be assumed to have been implemented. To address this, the program may consider requiring easy-to-obtain evidence of cultural behaviors, for instance through photographs of informational energy-related postings in common areas, or a list of methods through which corporate energy policy is conveyed to general staff.

2. It should be noted that the sources of this research (self-authored case studies from award recipients of the EMWG Energy Management Leadership Awards) may exhibit biases to avoid emphasizing the challenge of securing leadership buy-in. Recommendations in this paper do not address this potential conflict, but acknowledges that future studies may result in different outcomes.

RELIABLE AND ACCURATE ENERGY METERING

Lack of energy data availability and monitoring was cited as the top challenge for facilities seeking ISO 50001 certification. Currently, the 50001 Ready program provides guidance and tools to help facilities understand how to collect and analyze their energy data, but provision of actual data acquisition or analytical services (for example, submeters and energy management information systems) have generally been considered out of scope for the program. While it is unlikely that this service will be offered directly from 50001 Ready in the future due to issues of budget and expertise, developing partnerships with providers may be an important focal point to bolster 50001 Ready's reach and impact. Potential partners may include DOE's Smart Energy Analytics campaign managed out of their Building Technologies Office, or local and regional programs that have the capacity to offer rebates for adoption of advanced technologies for energy analytics.

OVERCOME ORGANIZATIONAL SILOS

Overcoming organizational silos was frequently cited as a key to success in implementing ISO 50001-based EnMS, and to a lesser extent as a challenge to implementation. Specifically, the research suggests that the existence or creation of tools, frameworks, and information that can be shared between departments and business lines can have far-reaching impacts on the ease at which continual improvement-based practices can be implemented throughout an organization. The 50001 Ready Navigator is designed to inherently address this challenge by serving as a common platform for team communication and information sharing, without requiring any software development or IT approvals at the corporate level.

Currently, while the Navigator strongly emphasizes the inclusion of cross-divisional team members in projects, team members are ultimately only identified by name and title. Potential improvements to the Navigator to highlight the cross-functional practices required by effective energy management practices include, at the simplest level, provision of an interactive checklist of commonly found business lines from which to draw team members. As a more advanced solution, future software development of the Navigator may include visual mapping of roles and team members vis-à-vis user-provided business lines and departmental priorities specific to their organization.

EMPLOYEE AWARENESS THROUGH COMMUNICATION AND TRANSPARENCY

Related to fostering an energy-aware company culture, taking measures to structure staff communication has been cited as both a challenge and key to success for ISO 50001 implementation. Task 20 of the 50001 Ready Navigator is dedicated to means and methods of creating a communication plan in support of EnMS implementation, and provides the greatest number of downloadable resources out of all Navigator tasks (fourteen).

One challenge of Navigator guidance is the appearance of linearity when all tasks are in fact intended to be tackled concurrently and non-consecutively. Compounding this issue is that all 25 tasks are given equal weight when calculating the level of completion shown in the main dashboard, when in fact some tasks represent a more significant level of impact than others. As a result, though the Communication task is comprehensive and accordingly requires a higher level of time and effort to implement, it can get lost simply by nature of being located at the tail end of the 25 listed tasks. A/B testing may be valuable to assess the effectiveness of reordering tasks, to maximize the number of user clicks on ones that are more critical or complex. This can also potentially be resolved through software development to emphasize the concurrent nature of Navigator tasks, for example through redesigning the dashboard to accommodate varying weights between tasks, or including a more advanced time-based tracking element to emphasize the ongoing nature of effective communication strategies.

Discussion and Conclusion

As the culmination of over a decade of research and collaboration with industry, the U.S. Department of Energy's (DOE's) 50001 Ready program represents a groundbreaking strategy to promote continual improvement-based approaches to energy management, and to realize the environmental and economic benefits of ISO 50001 without depending on third-party certification and performance verification. The program offers the tools and information needed to build literacy and capacity for a mass audience, and constructs the pathways for program replicability around the globe.

In its first year of operation, the 50001 Ready program has focused on:

- Overcoming barriers of cost, risk and workload associated with third-party audits and certification
- Making available comprehensive and actionable guidance to drive EnMS implementation, particularly at foundational levels
- Challenging organizational silos and enabling cross-functional team building and communication
- Providing a replicable technical infrastructure for offering recognition for self-attested EnMS adoption
- Building capacity and mitigating aversions to robust energy data modeling

Based on early research, this paper offers several opportunities for development priorities that have the potential to significantly expand program reach and effectiveness:

- Enforce early documentation of leadership commitment to establishing a 50001 Ready EnMS
- Self-validate attested activities with easy-to-obtain evidence of cultural practices
- Partner with programs focused on enabling reliable and accurate energy metering and analysis
- Enhance and emphasize cross-functional team building capabilities within the Navigator
- Develop the Navigator dashboard to address variation in time, effort, and impact of tasks

In order for the 50001 Ready program to continue to have impact on adoption levels of ISO 50001-based practices, it must regularly assess its strategies against the dynamic needs of industry, and challenge barriers beyond the cost and complexity of certification. While formal research in the area of barriers and enablers to adoption is still in its nascent stages, the 50001

Ready program provides the platform upon which DOE can proactively anticipate and plan for the technical and structural resources that will be most effective in bringing structured energy management practices to the masses.

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