



# NREL Lessons Learned in the Pursuit of ISO 50001

Michelle Slovensky and Suzanne Belmont

*National Renewable Energy Laboratory*

**NREL is a national laboratory of the U.S. Department of Energy  
Office of Energy Efficiency & Renewable Energy  
Operated by the Alliance for Sustainable Energy, LLC**

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## List of Acronyms

DOE	U.S. Department of Energy
EnMS	energy management system
ISO	International Organization for Standardization
LLP	laboratory level program
PDCA	Plan-Do-Check-Act
NWTC	National Wind Technology Center
STM	South Table Mountain
NREL	National Renewable Energy Laboratory
NZE	net zero energy
SSP	Site Sustainability Plan

## Executive Summary

In 2015 the National Renewable Energy Laboratory (NREL) embarked on a path to obtain International Organization for Standardization (ISO) 50001:2011 certification in energy management systems. This paper documents considerations for NREL's peer community intending to either pursue certification outright or use its process as guidance to improve operational performance.

Previously, NREL conducted pilot projects to investigate the practicality of new initiatives to enhance energy performance. The U.S. Department of Energy's Federal Energy Management Program engaged NREL as a test site for acquiring certification and to help demonstrate the feasibility of deploying energy performance enhancements at other federal sites.

Determining the value of ISO certification started by identifying NREL's organizational objectives. NREL has long been committed to operating as a living laboratory by demonstrating, through campus design and operations, which energy achievements can be implemented in a cost-effective manner. Prior to ISO certification, NREL used the net-zero energy Research Support Facility on the South Table Mountain campus in Golden, CO as a subset of the laboratory's energy ecosystem to evaluate NREL's continuous commissioning strategy and ability to meet performance goals. As a U.S. Department of Energy national laboratory, NREL also submits an annual Site Sustainability Plan documenting performance metrics. This and other data collection practices were considered in determining NREL's readiness to pursue energy management certification. An action plan was developed to define the scope and identify areas of the organization that would be governed by the certification. NREL sought to utilize ISO 50001 to benchmark the laboratory's current processes and capture additional cost efficiencies even though the laboratory was meeting all operational compliance requirements. NREL was awarded ISO 50001:2011 certification by the accredited registrar in May 2017.

Since the costs and benefits are unique to each organization pursuing certification, the value of acquiring ISO 50001 certification is maximized if the benefits, magnitude of staff and monetary resources, site preparedness, and governance align with the organization's objectives.

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## Introduction

In the spring of 2015, the National Renewable Energy Laboratory (NREL) embarked on a path to obtain International Organization for Standardization (ISO) 50001:2011 certification in energy management systems (EnMS). Subsequent to that, NREL was asked by the Federal Energy Management Program to document its process to pursue ISO 50001 and to share the experience, lessons learned, and key findings for other federal sites. This report is not a comprehensive assessment of ISO 50001 adoption across the federal laboratory system.

The purpose of the ISO standard is to enable an organization to follow a systematic approach in achieving continual improvement of energy performance, including energy efficiency, energy security, energy use, and consumption<sup>1</sup>. This standard specifies the requirements for establishing, implementing, maintaining, and improving an EnMS. NREL has long been committed to operating as a living laboratory by demonstrating, through its campus design and operations, which energy achievements can be implemented in a cost-effective manner.

NREL sought to utilize ISO 50001 specifications to benchmark the laboratory's current processes and capture additional cost efficiencies even though the laboratory was meeting all compliance requirements for its operations. Since NREL has a robust EnMS to meet compliance requirements, the laboratory was well positioned to meet the requirements of ISO certification. What remained unknown at the decision point to certify was the quantification of cost savings and energy efficiencies that could be gained. NREL successfully completed stage 1 and 2 audits in April 2017 and certification was awarded by the accredited registrar on May 22, 2017. It should be noted that a more recent edition of the ISO 50001 standard is now available, ISO 50001: 2018, which was published in August 2018.

Organizations seek certifications to communicate proficiency in a specific area of expertise for internal and external audiences. Certification can be used to support reputation, increase recognition, intensify an energy program, and perform more rigorous assessments to identify additional energy and cost efficiencies. Substantiation of these claims can be attained through a rigorous third-party audit.

Preparation for any certification program can seem formidable so it is critical organizations identify expectations and the perceived value they anticipate receiving. Maintenance costs and efforts to uphold ISO 50001 certification are substantial, as it requires a dedicated team of full-time employees. Different types of facilities may benefit more from ISO 50001, such as manufacturing facilities. There may be economies of scale for larger organizations.

The purpose of this paper is to share key findings discovered along NREL's ISO 50001:2011 certification journey including considerations for federal audiences intending to either pursue certification outright or utilize its processes as guidance to heighten operational performance. Outlined below are key issues that will be used to frame this discussion:

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<sup>1</sup> Eccleston, Charles, Frederic March, Timothy Cohen. 2011. *Inside Energy: Developing and Managing an ISO 50001 Energy Management System*. CRC Press Inc.



1. The perceived value to attain ISO 50001 certification.
2. What is an EnMS?
3. How to benchmark the readiness of your organization.
4. Steps in the certification process.
5. Documentation needed in preparation for the audit.
6. Identifying the milestones and deliverables to demonstrate proficiency in the ISO 50001 standard.
7. How to ensure the EnMS includes all necessary individuals.
8. Developing the organization's communications plan to implement the standard.
9. Preparation needed for participation in the audit process.
10. Understanding potential costs from the organization's labor efforts and third-party certification.
11. Identifying expectations and benefits to be derived from ISO 50001 certification.
12. Potential value in undertaking an ISO 50001 process versus acquiring certification.

## **The Perceived Value to Attain ISO 50001 Certification**

Many certification programs similar to the ISO standard assert there are beneficial outcomes to be gained if certification is achieved. Since there is a significant allocation of staff and monetary resources necessary to pursue such an undertaking, it is important for an organization to assess if this challenging effort supports its objectives. Aligning ISO 50001 certification to organizational objectives is an important first step in determining the value of this pursuit, including whether to pursue certification or to comply with the ISO 50001 requirements without certification.

As a U.S. Department of Energy (DOE) national laboratory, NREL has utilized statutes and mandates required by DOE to develop its energy management program and associated goals. NREL is committed and actively manages its operational assets to meet these demanding performance metrics. Even though these goals are identified, the path to capturing results is not straightforward. Upgrading energy intensive equipment and systems is only one component to achieving results. Implementing and streamlining processes is instrumental for greater targeted and sustained results. To ensure energy conservation efforts are in alignment with organizational goals and part of a broader strategy for energy and cost savings, an overarching framework such as ISO 50001 can provide the necessary structure for an energy management program.

NREL has utilized its net-zero energy (NZE) Research Support Facility located on the South Table Mountain campus in Golden, CO as a subset of the laboratory's energy ecosystem to implement and evaluate the continuous commissioning strategy and to ensure fulfillment of performance goals. This effort has required NREL's support of its:

- Zero-energy objective
- Monitoring and analysis of energy usage and generation
- Alteration of building systems and occupant behaviors
- Collection of field verification to validate performance results.

While this effort is limited to a singular building condition, it is an indication of NREL's commitment and effectiveness of NREL's organizational objectives for robust and integrated energy management practices. This NZE process established a firm foundation for pursuing ISO certification.

When developing NREL's Strategic Energy Management Plan, NREL recognized the need for a broader energy management structure that could be replicated over the entire laboratory campus footprint. Since NREL already held ISO 14001, 18001, and 9001 certifications to manage the laboratory's environmental and quality programs, NREL examined the potential usage of the ISO 50001 standard as a process to broaden the scope of the EnMS.

Early reviews in the underlying foundation of the Plan-Do-Check-Act (PDCA) continual improvement structure for an EnMS revealed potential for:

- Filling gaps in NREL's internal processes
- Gaining commitment from executive management
- Enhancing communication to delineate expectations to varying audiences
- Establishing guidance to reinforce roles, responsibilities, and authority for NREL staff to increase energy performance.

It was critical to identify these benefits upfront to justify the work to become ISO 50001:2011 certified.

## What Is an EnMS?

The ISO 50001 standard's approach to energy management is based on a PDCA continual improvement process as shown in Figure 1. This is tracked through the establishment of an EnMS defined as a "set of interrelated or interacting elements to establish an energy policy and energy objectives and processes and procedures to achieve those objectives."<sup>2</sup> The ISO 50001 standard encourages an EnMS to serve as an agent by continually revealing and documenting all activities necessary to improve building energy performance.

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<sup>2</sup> International Organization for Standardization (ISO). 2019. "3.9 Energy Management System definition." <https://www.iso.org/obp/ui/#iso:std:iso:50001:ed-1:v1:en>.

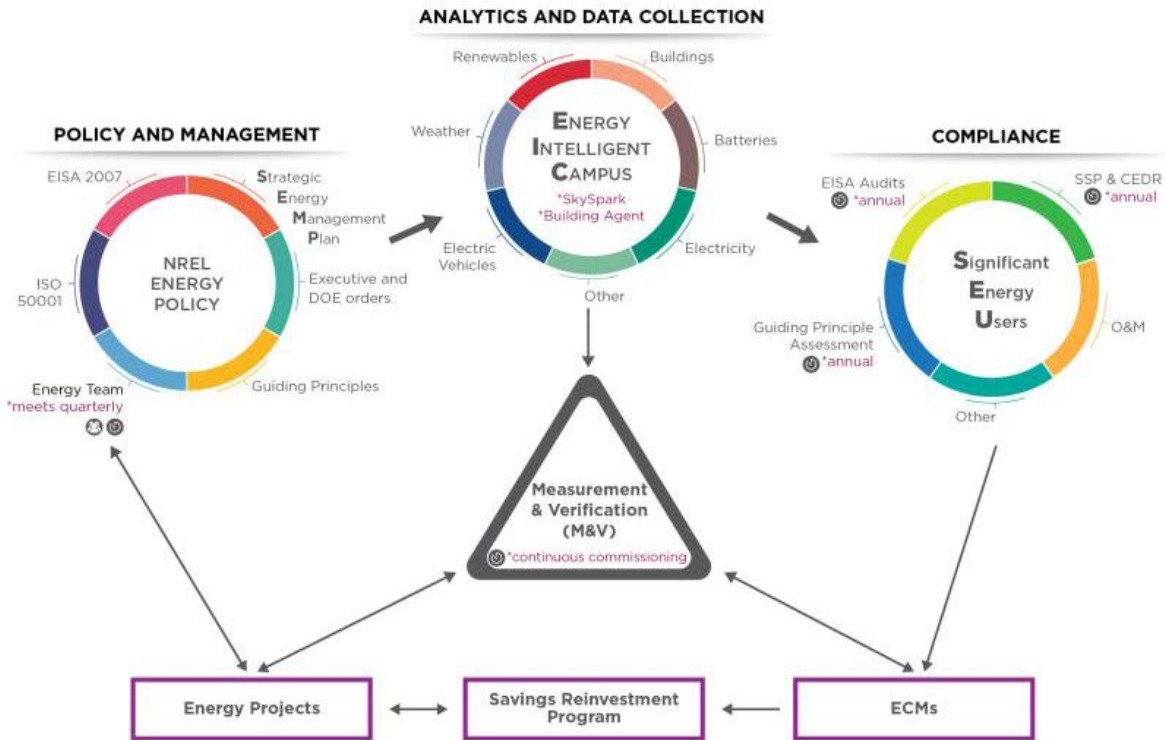


**Figure 1. Mapping ISO 50001:2018 elements to PDCA continuous improvement.**

Source: Georgia Institute of Technology. Note: EnPI = Energy performance indicator tool.

The ISO 50001:2018 standard requires the establishment of an EnMS, but it allows the organization to define what its configuration can be. While the standard allows for some creativity in how its requirements are adapted to a particular context, there are prescriptive elements necessary to attain successful certification. Figure 2 presents an illustrative mapping of how NREL’s energy management practices aligned with the ISO 50001 standard.

## Energy Management System (EnMS)



**Figure 2. Illustrative mapping of NREL's EnMS.**

Note: EISA = Energy Independence and Security Act, SSP = Site Sustainability Plan, CEDR = Consolidated Energy Data Report, O&M = operations and management, ECM = energy conservation measure.

NREL's experience with establishing an ISO 50001 EnMS identified several important factors critical to its success, including:

- Executive management commitment, responsibility, and review
- An energy policy focused on continual improvement
- An energy management team led by an energy management representative who reports directly to executive 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.

NREL utilized several helpful resources to assist in understanding and implementing its EnMS. These include:

- 50001 Ready Navigator (Lawrence Berkley National Laboratory, <https://navigator.lbl.gov/> / undated c)
- DOE eGuide Lite (DOE, <https://www.energy.gov/eere/amo/articles/doe-eguide-lite/> / undated b)
- ENERGY STAR® Guidelines for Energy Management ([https://www.energystar.gov/buildings/reference/guidelines EPA/](https://www.energystar.gov/buildings/reference/guidelines_EPA/) / undated a).

## How to Benchmark an Organization's Readiness

To facilitate the ISO 50001 certification process, an organization should begin by assessing its level of readiness. The assessment of the existing energy management practices will illuminate whether the organization is prepared to pursue the rigor of the ISO 50001 certification process. In NREL's example, the laboratory reviewed internal policies, Site Sustainability Plan (SSP) performance achievements, Energy Independence and Security Act (EISA) audits, staff resources, documentation process and products, and functionality of existing EnMS to assess readiness.

NREL operates two campuses: the 327-acre South Table Mountain campus in Golden, CO and the 305-acre Flatirons Campus near Boulder, CO. NREL manages these two campuses, which include approximately 1.2 million square feet of facilities that support research for optimizing energy technologies and systems. NREL's operational asset portfolio incorporates energy production from wind, solar, and biomass to offset grid electricity and thermal consumption from campus facilities. NREL also manages its utility budget for grid electricity and natural gas delivered by Xcel Energy. NREL manages performance simultaneously from an enterprise-wide perspective and at the building level to attain a comprehensive understanding of the energy footprint of each operational asset. NREL enables this approach by capturing, monitoring, analyzing, and storing historical energy data within an open standard modular building analytics platform. The collection of this data provides the insight to continuously improve energy performance and creates the foundation of the laboratory's EnMS.

NREL's experience in generating strategic and tactical assessments was supported by a library of performance metrics that mark a solid foundation to demonstrate proficiency in energy management. NREL's experience in acquiring Leadership in Energy and Environmental Design (LEED) certification for seven buildings and maintaining the laboratory's ISO 140001, 90001, and 18001 certifications provides a robust capability in governance, compliance documentation, and management oversight. Additionally, as a DOE national laboratory, NREL develops an annual SSP that documents performance metrics achieved for DOE designated goals. At the time of NREL's pursuit of ISO 50001:2011 certification, there were 32 goals required by DOE for operational efficiency and sustainability purposes. Over the past decade, dedicated staff have been integrated and continuously collaborate to meet the needs of these objectives. These practices formed the basis from which NREL considered its measure of readiness to pursue energy management certification.

The abbreviated list below presents considerations NREL used to determine its level of readiness for ISO 50001 certification:

- Does the organization monitor its consumption on a regular basis?
- Does the organization have an energy policy?
- Does the organization have a framework for energy objectives and targets?
- What activities, records, and submittal requirements does the organization engage in to meet organizational mandates or legislative compliance?
- Does the organization have an organization-level procedure for energy management?
- Does the organization have a dedicated staff for energy management and buildings operations?
- Does the organization have an informatics platform to collect, store, and assess energy data?
- Is the organization’s management regularly kept apprised of energy performance?

Positive responses to these questions are fundamental to meeting the primary requirements within the ISO 50001 standard. Additionally, the questions help to identify an organization’s level of readiness and effort to achieve ISO 50001 certification.

## Steps in the ISO 50001:2018 Certification Process

The ISO 50001 certification process involves a two-step audit by a third-party accredited auditor. If successful, certification is valid for three years (Figure 3). During this period, adherence to the ISO 50001 standard must be maintained by conducting annual third-party surveillance audits. After the three-year cycle a recertification audit by a third-party accredited auditor occurs for renewal. In preparation for the audit process it is important to note that the organization’s EnMS should be documented and active by the start of the Stage 1 audit.

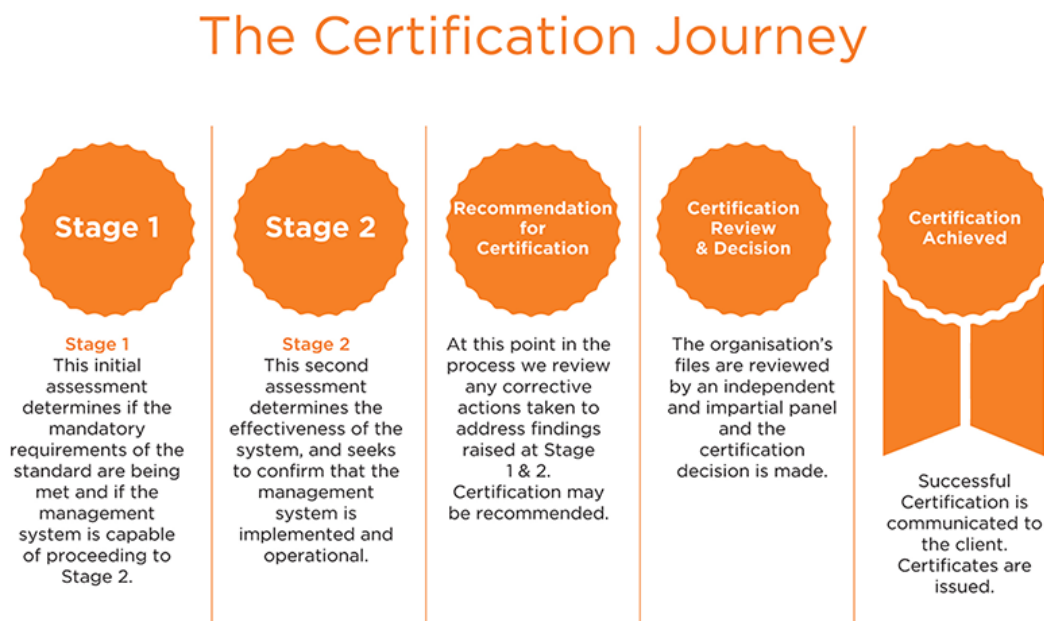


Figure 3. ISO 50001:2011 and 2018 certification processes

Source: Certificationeurope.com.

Stage 1 of the audit is an in-depth review of processes and documentation to determine if the organization meets the mandatory requirements and is ready for a full assessment. The auditor confirms the accuracy of the information submitted, checks legislative compliance, records the determination of the boundary scope for certification, verifies that the management system conforms to the requirements of the standard, and evaluates the status of implementation of the management system. The results are documented by the auditor in a report that identifies any non-compliance issues or opportunities for improvement that need to occur before the organization can move forward with Stage 2 of the audit. This triggers a mutually agreeable action plan; if required. If elements of Stage 1 are met successfully the auditor will review an assessment plan and date for the Stage 2 audit.

Stage 2 of the audit is an extensive examination into the operations of the organization's energy management program to ascertain the effectiveness and deployment of the management system. During this evaluation, the auditor documents how the system complies with the standard by using objective evidence, reviewing sample audits conducted for processes and activities defined in the scope of certification, visiting and conducting interviews with personnel at locations identified in the boundary scope, reporting any non-conformities or opportunities for improvement, and producing a surveillance plan that will be reviewed the following year. If any non-conformities or opportunities for improvement are identified a corrective action plan is recommended. The organization has up to six months to execute and ensure compliance is verified by the third-party accredited auditor. When all requirements are met certification is awarded by the registrar.

## Documenting NREL's Preparation for the Audit

In April 2015, NREL began preparing for ISO 50001 certification. As part of the preparation for both the Stage 1 and Stage 2 portions of the audit, the following list of steps proved useful to guide and structure the NREL team initiatives:

1. **Prepare the Organization** – NREL initiated the first step by understanding the requirements of an ISO 50001:2011 certified EnMS and identifying implementation processes to institutionalize the requirements within the organization.
2. **Conduct a Gap Analysis** – A crosswalk between NREL's current energy policies and procedures; ISO 140001, 9001, 18001 certifications; and the 50001:2011 standard was conducted. NREL examined and utilized the DOE eGuide<sup>3</sup> to determine what gaps remained for the EnMS to fulfill requirements of ISO 50001:2011. The DOE eGuide is now the 50001 Ready Navigator and can assist in identifying organizational gaps.
3. **Create a Project Plan** – NREL generated a project plan that illustrated a timeline of tasks, training, stakeholder interviews, internal audits, top management reviews, and the third-party Stage 1 and 2 audits. Additionally, this plan allocated hours for staff to complete tasks, select an accredited registrar, and establish the cost for the third-party audit.

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<sup>3</sup> U.S. Department of Energy. 2014. "DOE eGuide." <https://www.energy.gov/eere/amo/articles/doe-eguide>.

4. **Build Internal Capacity** – Both NREL energy team members and internal auditors completed education courses to develop understanding and proficiency in the ISO 50001:2011 standards and requirements.
5. **Document NREL’s EnMS** – During the Stage 1 audit the auditor concurred NREL had a strong energy policy and organizational energy management plan, but the laboratory lacked an overarching procedural document. In order to proceed to Stage 2, the team developed a laboratory level program (LLP) to implement the laboratory’s EnMS emphasizing processes, procedures, manuals, plans, and other resources that acted as the mechanism to implement EnMS activities. NREL’s Energy Management Program established organizational structure and requirements that clearly demonstrated compliance with ISO 50001:2011.
6. **Put NREL’s ISO 50001 EnMS into Action** – NREL deployed the LLP, amended activities to align and comply with agreed upon standards, prepared for internal audits, prepared internal corrective action plans, held key stakeholder and executive management meetings, and established a hierarchy for records control and archiving. Throughout this process, alignment with key energy objectives ensured continuity between all areas of EnMS execution.
7. **Perform Internal Audits** – NREL’s internal audit team was comprised of subject matter experts from NREL’s quality group. The expertise and experience contributed to help modify NREL’s documentation processes, assisted in the interpretation of the ISO 50001:2011 standard, and provided effective tips to participate in the third-party audit.
8. **Prepare for Registration Audit** – NREL selected an accredited registrar, educated employees involved in implementing the EnMS on how to participate in the upcoming audit, managed the facility in accordance to ISO 50001:2011 requirements, and organized documentation for the auditor.

## Identifying the Milestones and Deliverables

Before an action plan is created an organization must determine the boundary scope for certification. This includes identifying facilities, energy types, and other considerations that will be captured within the boundary. An organization that has no prior experience with extensive compliance, certifications, and enforcing rigorous processes for external audits might embark on a smaller scope, such as a singular facility. The effort to become certified is not completely scalable, so a similar level of effort is needed for either a singular facility or for an entire campus. This should be taken into consideration when determining the scope and boundaries of the EnMS. Once the organization’s EnMS and associated processes and procedures have successfully met the ISO 50001:2018 standard for certification the boundary scope can be expanded during the following renewal cycle of certification.

After establishing the scale and specificity of scope for the organization’s asset portfolio it is essential to create a project plan. This plan will chart the course for creating or documenting an EnMS and the method in which the organization’s operations already meet the ISO 50001:2018 standard as well as continuous improvement processes so that the ISO 50001 standards and requirements are integrated into all operations. Identifying specific milestones can delineate significant stages in progress towards preparing and attaining certification. Additionally, the project plan will function as a tool for communicating expectations to the team and management. The project plan will also include deliverables that represent tasks and collectively mark the



completion of a specific milestone. Creating this tactical assessment is significant because it is the guiding force to maintain focus, organization, development, and schedule.

## Creating a Roadmap to Demonstrate Proficiency in the ISO 50001 Standard

Each roadmap to ISO 50001 certification will be unique because every organization’s EnMS is unique. One organization may need to implement new policies and procedures while another may simply need to document processes already in place. NREL’s first step of cross-walking and identifying gaps in the current EnMS was a critical to planning and roadmap development for its ISO 50001:2011 certification. The project team identified capacities with strong compliance, gaps in current processes and procedures, as well as areas where other ISO standards and initiatives overlapped with the ISO 50001:2011 standard.

NREL’s most fruitful lesson learned was the creation of an overarching program or procedural document that outlined all aspects of the laboratory’s EnMS. In order to improve energy management across an organization a broad perspective is required, encompassing all aspects of energy policies, procedures, and use within the organization’s boundaries. EnMS implementation must integrate the energy objectives and targets, demonstrate management support, and reach across all levels of an organization’s operations. NREL’s development of the EnMS roadmap to ISO 50001:2011 certification would have been less arduous if the team had begun with the establishment of this overarching document. Below in Table 1 is a brief outline of NREL’s process to demonstrate proficiency with the ISO 50001:2011 standard.

**Table 1. NREL Roadmap for ISO 50001:2011 Certification**

<b>April 2015</b>	Decision to pursue ISO 50001:2011 certification
<b>April 2015–January 2016</b>	<ul style="list-style-type: none"> <li>• Gap analysis, documentation collection, training in ISO 50001:2011</li> <li>• Update of documentation</li> </ul>
<b>February 2016–March 2016</b>	Internal audit
<b>March 2016–April 2016</b>	Preparation for Stage 1 audit
<b>April 2016</b>	Stage 1 audit
<b>April 2016–April 2017</b>	<ul style="list-style-type: none"> <li>• Revision to EnMS to address opportunities for improvement</li> <li>• Creation of the EnMS program at the LLP level</li> <li>• Documentation updates</li> <li>• Creation of documentation to highlight processes in place</li> <li>• Updates to desk procedures</li> </ul>
<b>April 2017</b>	Stage 2 audit
<b>May 2017</b>	ISO 50001:2011 certification

## Ensuring the EnMS Includes All Necessary Individuals

A notable takeaway from NREL's exchange with the auditor is the need to define who comprises the team for implementing the ISO 50001 standard. It is much broader than just the designated group assigned to energy management. It is essential to understand anyone who connects to any of the components for implementation of the EnMS is part of the organizational structure. The expectations of the ISO 50001 standard is that personnel—from technicians to executive management—are individually and collectively contributing to the progress of EnMS objectives and targets that adhere to the organization's energy policy. This reinforces the criticality of an overarching program to implement an EnMS system. For example, if the organization's energy policy identifies a commitment to energy efficiency, the objectives and targets should reflect that commitment. At the highest level of executive management, a commitment to energy efficiency is demonstrated by an allocation of resources. An energy manager—who reports on the energy performance of facilities—should communicate energy efficiencies achieved, demonstrate progress for ongoing targets that match management determinations, and identify areas for improvement to meet those goals. At the day-to-day level, engineers and operators should meet the requirements outlined in the organization's guidelines.

Developing a culture of inclusion and a flow of information around the subject, intentions, and resources of energy management are foundational to an effective and compliant EnMS.

## An Organization's Communication Plan

Achieving ISO 50001 certification requires a substantial amount of communication across all groups within an entire organization. This approach socializes the implementation of the ISO 50001 standards, results in sponsorship and participation, and celebrates the success of certification achievement. Messaging from executive management is imperative for success. All communication initiatives need to be direct, easily understood, provide context to the overall goals of the program, and provide a diversity of delivery methods since audiences can vary.

Training is also an important extension of communication. Different levels of training will address specific needs for both the energy team and for general staff. All staff must understand their roles in connection to the organization's energy policy.

Specific to the EnMS, progress should be communicated on a regular basis with all levels of the organization. Developing reports, infographics, dashboards, and other methods of communicating energy data is a notable consideration. Utilizing reporting processes already in place to facilitate information sharing can also be an effective way of communicating EnMS results. For example, NREL utilizes its annual SSP reporting process as a means to inform all levels of the organization.

## Assessing Preparation and Lessons Learned from the Audit Process

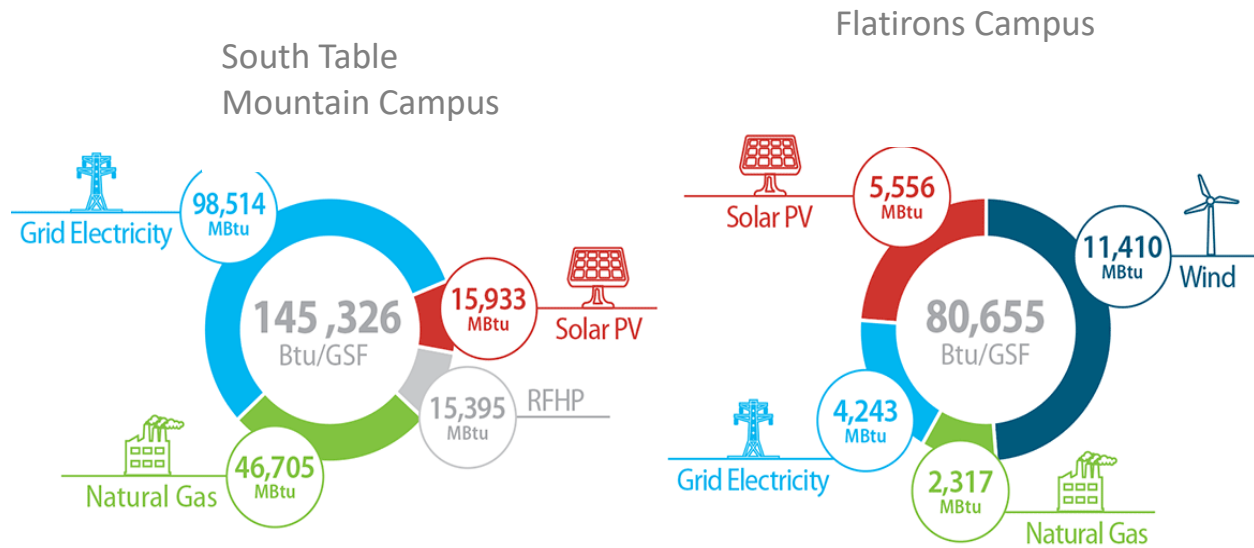
In preparing for a Stage 1 audit, NREL found the creation and collection of documentation to be an intensive process. Even though an organization may be actively implementing principles of

the energy management certification it may not have the necessary documented processes, activities, and performance results for the audit review.

Another key qualifier is conducting executive management reviews prior to the Stage 1 audit. The records for these meetings are vital to demonstrate executive management’s awareness of energy management activities and verification that dedicated resources are committed from senior leadership for the pursuit of continuous EnMS improvement. Other elements central to preparation are a well-defined organizational scope (Figure 4), the clear identification of objectives and targets, and one overarching program (Table 2) to define and implement an EnMS. Figure 5 illustrates NREL’s energy intensity performance for the organizational scope identified in Figure 4.

*The scope of NREL’s EnMS includes the laboratory operations at the South Table Mountain Campus and the Flatirons Campus including buildings, onsite renewable systems, and fleet fuel usage within the boundaries defined below. Fuel use for motor vehicle equipment and subcontracted vehicles is not included. There are a number of significant energy users (SEUs) at each campus that the Energy Management Team monitors on an ongoing basis. Due to the dynamic nature of SEUs, the Energy Management Team also continually reevaluates the SEUs at both campuses as well as determines whether additional SEUs should be identified and monitored.*

**Figure 4. Example of NREL’s organizational scope**



**Figure 5. NREL campus energy intensity performance FY2018.**

Note: MBtu = one million British thermal units, Btu/GSF = British thermal units per gross square foot, RFHP = Renewable Fuels Heating Plant.

**Table 2. NREL’s Laboratory Level Procedure Framework to Implement the EnMS Purpose**

<b>Applicability and Scope</b>	Applies to research, maintenance, and administrative activities and operations across the Laboratory Activities and Operations at both the South Table Mountain and Flatirons campuses. This includes buildings, onsite renewable systems and fleet fuel usage.
<b>Management System Structure</b>	Level 1 – Energy and Water Efficiency Policy Level 2 – Laboratory level policies, procedures, and forms, include implementing the EnMS program Level 3 – Desk procedures, such as guidance, planning documents, checklists, and manuals Level 4 – Records
<b>Organizational Structure</b>	Parties relevant to implementing EnMS
<b>Leadership</b>	Commitments and resources
<b>Planning</b>	Defining implementation of targets through procedures and action plans
<b>Support</b>	Staff expertise, training/awareness and communication
<b>Operation</b>	Planning and control through related policies, procedures, programs, plans, and manuals

The Stage 2 audit commences with a close out of any issues raised in Stage 1 audit. Then review in the Stage 2 audit emphasizes in-depth observation of activities and interviews by the auditor to examine the rigor and command conducted by personnel involved in the implementation of the EnMS. Areas of concentration included interviews with members implementing scope, observation of tools and methods in action, and validating linkages between documentation and operations. Preparing for Stage 2 of the audit was less cumbersome for NREL. This part of the audit permitted NREL to showcase its interactive informatic tools with the auditor. These visualizations included creative energy dashboards and user interfaces (Figure 6 and Figure 7).

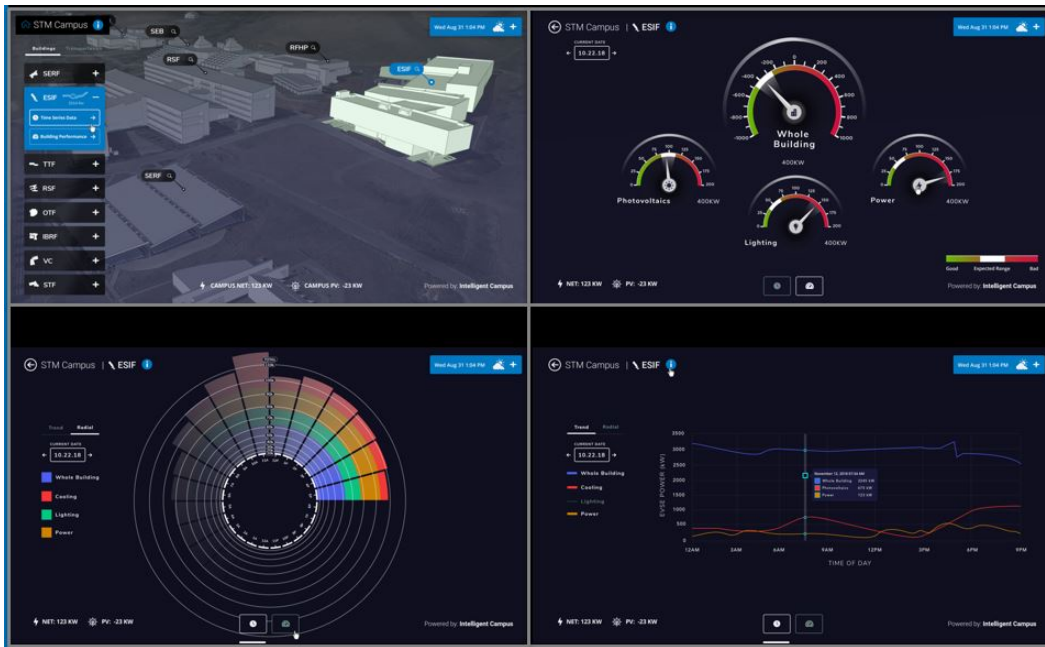


Figure 6. NREL's facility dashboards



Figure 7. NREL's immersive visualization capabilities for campus planning

## Identifying Costs for the Organization's Labor Efforts and Third-Party Certification

Pinpointing a generalized cost for the implementation of the ISO 50001 standard can range extensively for organizations. Generating a reliable estimate depends on several specifics to an organization such as the size of operational assets, scope of objectives and targets, and capacity of staff resources. Because energy conservation is already part of NREL's regular cost of operations associated with adopting these measures, it is difficult to innumerate and monetize over time. NREL has dedicated staff resources to support on-going maintenance of building and equipment systems with the intent to sustain energy efficiencies. In development of the EnMS, NREL required additional staff resources equal to two full-time equivalent personnel for two years to prepare the documentation, processes, reviews, and readiness of its facilities for the ISO 50001:2011 certification. NREL's cost for the third-party audit was a few thousand dollars.

## Identifying Expectations and Capturing Benefits

Regardless of the size of an organization's site assets, it is fundamental that those managing the physical footprint correspond their activities to the objectives and execution of an organization's energy policy and mission. For the organization to flourish, executive management must enable and demonstrate commitment to the energy management program and team by setting clear expectations.

NREL discovered opportunities to increase cost effectiveness, identify initiatives for improvement, benchmark processes, and capture energy savings. NREL used these activities as a motivator to pursue ISO 50001 certification. Substantial cost savings to NREL has not been realized since the certification in 2017. The benefits of improving energy policies, procedures, and systems are beneficial to the operations of the organization, however they are difficult to quantify.

Benefits are dependent upon the goals of the organization. Grouped by key themes below are beneficial qualitative outcomes NREL found through pursuit of the EnMS:

1. Managing the portfolio from a holistic approach to sustain organizational health and longevity:
  - A. Applying an enterprise-wide perspective across multiple facilities simultaneously enables both broad and granular views
  - B. The ISO 50001 standard supports the development of an energy policy and contributes to the structure of an energy plan to achieve targets across an entire portfolio
  - C. These targets and objectives are self-assigned
  - D. The process integrates a review cycle for the effectiveness of the policy and addresses administrative controls.
2. Implementing an ISO 50001-based EnMS demonstrates credible external visibility of energy saving actions:

- A. The EnMS is process driven but can integrate creative, organization-specific content
  - B. The underlying structure necessitates robust and reliable data for monitoring, assessment, and decision-making for energy use and consumption
  - C. The system benchmarks and measures the results of energy efficiency improvements and investments
  - D. It is a communications tool to socialize and recognize the organization's reputation for energy and fiscal accountability.
3. Capturing energy and cost savings with minimal or no capital investment:
- A. Integrating fault detection and diagnostic analytics can further expose and refine opportunities for efficiency through non-structural modifications such as rule programming, dispatching work orders for repairs, reduction of staff labor for assessment, proactive responses to operational and preventative maintenance issues, and reduced equipment system downtime
  - B. The ISO 50001 standard deploys a method to continually improve energy management, but the percentage of cost reductions or identifying a mitigation plan for rising costs (i.e., utilities, equipment, labor, etc.) is specific to each organization's portfolio
  - C. The ISO 50001 process fosters a change in culture that engages and empowers employees to identify and respond to energy-saving opportunities as they occur.
4. Prepares organizations to act more dynamically to the emerging need for resiliency:
- A. The comprehensive structure and information revealed in applying the ISO 50001 standard improves the ability of organizations to manage energy risks concerning possible impacts
  - B. The ISO 50001 standard strengthens the governance and fiscal competitiveness of organizations
  - C. The ISO 50001 configuration assists in management of an organization's vulnerability with respect to energy price fluctuation and availability of energy.

## Value in Implementing an ISO 50001 Process Versus Acquiring Certification

Acquiring ISO 50001 certification can derive value if the benefits, magnitude of staff and monetary resources, site preparedness, and governance align with the organization's objectives. Developing an EnMS that meets the ISO 50001 standard without certification can also have significant organizational value. One possibility is to use the DOE 50001 Ready Navigator<sup>4</sup> which NREL has found to be quick and easy to use. This program guides an organization through the necessary requirements and steps of an ISO 50001 certifiable EnMS. The tool provides simple implementable tasks, examples, and tracks the checklist entries so all necessary elements are met to deploy an effective EnMS. Once the process is complete, an organization

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<sup>4</sup> U.S. Department of Energy. "50001 Ready Program." <https://www.energy.gov/eere/amo/50001-ready-program>.

can assess the value of moving forward with certification or continue to internally administer the maintenance of an EnMS system. In either case, only a committed and continuous implementation will deliver sustained and meaningful value.

Prior to certification, NREL's notable performance capabilities in conducting energy management were achieving high value and already embodied multiple aspects of the ISO 50001 process. Since receiving the certification, the laboratory has not seen an increased benefit relative to the additional efforts required to warrant recertification. For other organizations where energy management has not been a primary objective this certification could provide a path for significant enhancements. NREL will continue to implement and comply with ISO 50001 core principles through its established processes, achieve the laboratory's performance goals for energy management, and maintain DOE's recognition as a 50001 Ready site.

The need for future assessments is warranted since this study only examined results at NREL sites. There is an opportunity to investigate the adoption of ISO 50001 at additional federal sites to better understand costs and benefits.