

Strategic Energy Management and Metrics for Market Transformation

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ABSTRACT

Strategic Energy Management (SEM) programs are a proven approach for achieving energy savings and hence addressing climate change. SEM typically includes participants' commitments to continually improve energy use, and provides them methods and tools to do so. Accordingly, SEM transforms participants, which furthers voluntary market transformation (MT). In-depth interviews in 2020 were conducted with 24 SEM program administrators in the U.S. and Canada, confirming programs' general effectiveness and revealing potential improvements. Analysis of the interviews was hindered by the lack of a systematic program design and objectives assessment framework, demonstrating the need for metrics to more accurately assess MT efforts and improvement opportunities. Interviews provided a basis for suggesting improvements to SEM programs, but affirmed the challenge of making suggestions without an assessment framework, especially for MT programs. Interviews revealed opportunities for improving SEM performance in the commercial sector (typically at campuses), as well as other sectors. These include changes to increase improvements in energy-using equipment and clarify how savings from upgrades are tracked and credited.

Importantly, two recent efforts, one international, to develop standard approaches for making such assessments are pertinent to the permanence of SEM's MT effects. These could be applied to current SEM programs and illustrate specific areas for improving the MT effects of SEM programs. These might also provide a basis for constructing formal approaches to analyzing the effectiveness of other MT efforts.

Introduction

This paper examines the first question among the themes of this panel: "Which lever(s) will move us toward our climate change mitigation goals the fastest?" The question presumes that there are metrics whose use will identify such levers. This paper proposes that there may be alternative approaches to metrics to add to the "tool kit" for MT programs. With better tools to assess MT programs—particularly identification of more effective market interventions—the speed at which the U.S. and other countries can address climate change will increase.

This current effort began with work the authors and others did on behalf of the North American Strategic Energy Management Collaborative (NASEMC) in 2020 to survey the landscape of North American SEM programs (SEM Report, Therkelsen et al. 2021). That study involved interviewing 24 commercial and industrial SEM programs active at that time to assess their persistence and cost-effectiveness. However, it was difficult to reach definitive conclusions because the terms "persistence" and "cost-effectiveness" lacked consistent definition—leading to the authors' interest in further work on program metrics in a well-designed assessment framework.

This current work examines an approach to SEM implementation from the International Standards Organization (ISO) published in 2021, ISO 50005:2021, Energy Management Systems – Guidelines for a phased implementation. This standard works alongside ISO 50001 – Energy

Management Systems, ISO's management system model of continual improvement that is meant to be integrated into an organization's business practices.

Using standardized assessment approaches enables comparisons of end user SEM activities at different points of time and can be extended to define the energy management system (EnMS) objectives of an SEM program. It also allows for comparison of different SEM programs. Conceptually, these standardized assessments follow similar approaches: divide SEM activities into specific critical elements, for each element define different levels based on the maturity or accomplishment of that level, and assess a score for each. Scoring based upon these assessments might be implicit by describing capabilities or attributes, or explicit by being linked to a numeric score. In the latter case, a summary score might also be computed.

This paper assesses the general approach of ISO 50005 and proposes that an ISO 50001-based EnMS maturity model scoring metric could be applied to SEM programs. It also discusses extending this approach to more traditional MT programs. This paper presents how the ISO 50001 based maturity model concept developed in ISO 50005 is being leveraged by the U.S. Department of Energy to create a free of charge, publicly available, online ISO 50001-based energy management assessment (EMA) tool.

SEM as Defined in the U.S. and Canada and in the Rest of the World

To understand these assessment approaches, it is useful to note how SEM programs in the U.S. and Canada differ from SEM activities in the rest of the world. In the U.S. and Canada, SEM (whether aimed at the commercial or industrial sector) is usually deployed as a program offered by an energy efficiency program administrator. At present the North American SEM Collaborative (NASEMC) lists 38 program administrators offering 57 SEM programs¹. The program administrator markets the program and offers to program participants a mix of technical information, financial analysis, and organizational and financial support for designated activities. Each of the 24 programs surveyed in the SEM Report (Therkelsen et al. 2021) followed this pattern, but the mix of offerings to participants differed even though almost all asserted their program was consistent with the Consortium for Energy Efficiency (CEE)'s Strategic Energy Management Minimum Elements².

In the U.S. and Canada, various SEM frameworks, descriptions of energy management systems in practice, have been developed over time. The U.S. Environmental Protection Agency published as early as 2013³ the ENERGY STAR Guidelines for Energy Management with the latest update made in September 2021. The seven topics detailed in the ENERGY STAR Guidelines are: make commitment, assess performance, set goals, create action plan, implement action plan, evaluate progress, and recognize achievements. In 2014 CEE published the CEE Strategic Energy Management Minimum Elements. The CEE Minimum Elements provides 13 elements essential to a functional energy management system organized into three sections:

¹ Count from NASEMC website accessed May 30, 2022: <https://www.aceee.org/sem-program-directory>. Number of sites that are or have participated in SEM programs in the U.S. or Canada seems not to be tracked.

² CEE Strategic Energy Management Minimum Elements, accessed June 9, 2022 at https://library.cee1.org/system/files/library/11283/SEM_Minimum_Elements.pdf

³ The publication date of the ENERGY STAR Guidelines for Energy Management is not included on the publication itself and an original publication date could not be found online. A U.S. Department of Energy website links to a 2013 version of the ENERGY STAR Guidelines for Energy Management but the provided URL indicates this might be a version 6 of the Guidelines. <https://betterbuildingssolutioncenter.energy.gov/resources/epas-energy-star-guidelines-energy-management>

customer commitment, planning and implementation, and system for measuring and reporting energy performance. Launched in April 2017, the U.S. Department of Energy (U.S. DOE)’s 50001 Ready Navigator “is an online application that provides step-by-step guidance for implementing and maintaining an energy management system in conformance with the ISO 50001 Energy Management System Standard (LBNL 2022a).” Though the 50001 Ready Navigator does not purport to prepare organizations for an ISO 50001 audit, the guidance of the Navigator encompasses the vast majority of ISO 50001 requirements. In this way the 50001 Ready Navigator is an SEM framework dependent on ISO 50001 and is currently used by more than 4,300 users at 3,300 sites. This dependency is reflected by the fact that the 50001 Ready Navigator was updated to be aligned with the 2018 revision of ISO 50001.⁴

In the rest of the world, the institution of energy efficiency program administrators is generally missing, and a different approach—arising in a different context and meeting somewhat different needs—is used to spread SEM practices, especially among large energy users. An international process following the procedural requirements of the International Standards Organization (ISO) developed a standardized form of SEM, ISO 50001 in 2011. In some countries, governments choose to encourage or mandate its use. Organizations implementing ISO 50001 expected to realize the value to the organization, for example energy cost reductions, beneficial product branding or quality recognition. They also anticipated meeting the generally higher level of regulatory requirements that often occur outside the U.S., such as those issued by the European Union (Kelly 2016). For example, in Germany, a company receives substantial tax relief [Spitzenausgleich-Effizienzsystemverordnung - SpaEfV] if it is certified ISO 50001 compliant. These tax exemptions totaled nearly €10 billion in 2012 (Rohde 2015).

The number of ISO 50001 certifications achieved in the United States is lower than in many other countries. From 2011 (the first year ISO 50001 was available) to 2020, just over 124,000 ISO 50001 certificates were awarded globally, with the top five countries (in terms of certificates) making up 68% of the global total ISO Survey 2021. See Figure 1. Over this same time period, 411 U.S.-based organizations were certified (only 0.3% of the total), as well as 82 Canadian organizations (0.1% of the total), even as program administrator-offered SEM programs spread in the U.S. Looking only at the Group of Seven (G7), which are comparable in terms of being the world’s wealthier democracies and advanced economies, G7 countries received nearly three quarters of ISO 50001 certificates over this same time span. Yet the share of U.S. and Canadian certifications from 2011 to 2020 compared to all G7 countries was less than 1%, while in 2020 the U.S. and Canada made up 48%⁵ of the G7 by population (World Bank 2021). As a way of making an approach to ISO 50001 more accessible, in 2017 the U.S. Department of Energy created the voluntary “50001 Ready” recognition program based on the aforementioned 50001 Ready Navigator.

⁴ Not addressed in the paper is the issue of scalability: whether the programmatic approach of utility-associated SEM programs or the essentially self-motivated approach of 50001 Ready/ISO 50001, or both, can scale fast enough to successfully address climate challenges. Early observations indicate that to reach a scale that can meaningfully affect climate change requires an SEM framework that is standardized so it can be applied by companies within and across utility service territories, has value in a global marketplace, and is holistic but can be uniquely approached by individual organizations.

⁵ The U.S. represents 43% of the G7 population, while Canada makes up 5%.

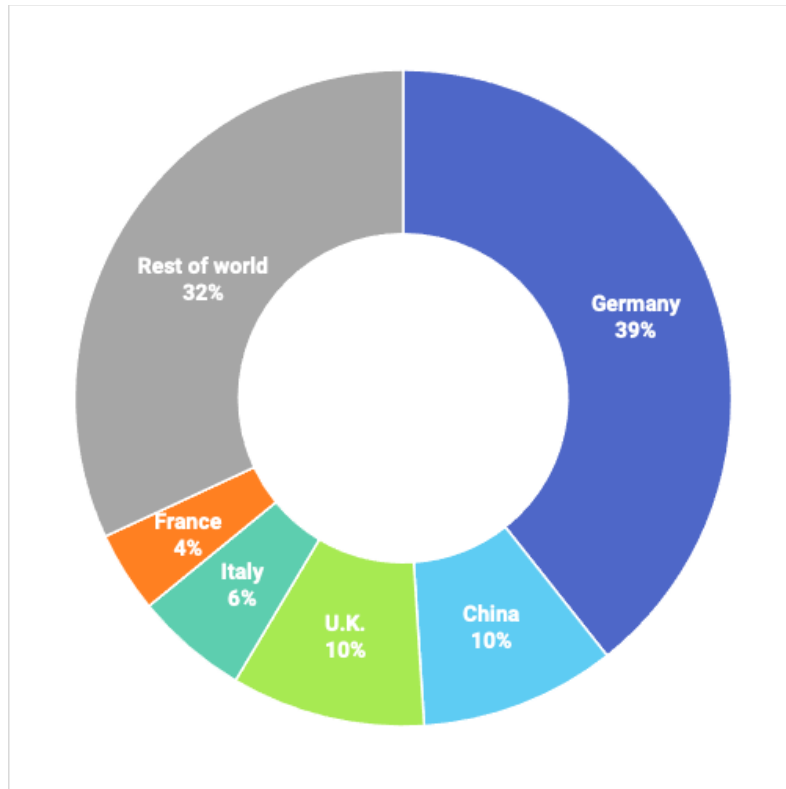


Figure 1. ISO 50001 certificates awarded 2011 to 2020 by country.
Source: ISO Survey 2021.

Energy Management Assessments and Emerging Metrics for SEM/ISO 50001

While the implementation of strategic energy management has proceeded differently between the U.S. and Canada compared with the rest of the world, there has been at least a partial convergence in how to assess the maturity of an SEM implementation. The spread of SEM in the U.S. and wide adoption of ISO 50001 in the rest of the world has sparked international interest in how an organization can measure progress toward a full SEM or ISO 50001 implementation and how to assess the quality of that implementation.

Describing a phased approach to the implementation of SEM or the quality of an SEM implementation has long standing precedents. As noted in the CEE Minimum Elements footnote number 1,” examples of energy management assessment practice score cards and energy management assessments are available from ENERGY STAR for Industry, The Carbon Trust, and EnVinta.” The ENERGY STAR Guidelines for Energy Management contains a set of energy management matrixes that can be used to “help organizations and energy managers compare their energy management practices to those outlined in the [ENERGY STAR] Guidelines for Energy Management (U.S. EPA 2021).” Created in 2011, the Excel based Carbon Trust energy management self-assessment tool consists of an energy management matrix and energy management assessment that encompasses 12 key areas.⁶ As reported in the SEM Report and from personal conversations with SEM leaders, most experienced SEM implementation

⁶ The Carbon Trust Energy Management Self-assessment Tool, accessed June 2022:
<https://www.carbontrust.com/resources/energy-management-self-assessment-tool>

consulting companies have developed and use their own EMA resource or tool. These proprietary resources are not publicly available and the basis on which they are created is not generally known.

Also, as least as far back as 2013, the Northwest Energy Efficiency Alliance sponsored work that became the basis for its EMA tool.⁷ This tool is commonly used in conjunction with SEM programs in the Pacific Northwest. As documented in the SEM Report, this EMA tool is used by 11 of 20 responding SEM program administrators⁸. The NEEA EMA tool is publicly available and gives organizations (or their program administrator and implementer) a way to assess SEM implementation progress, identifying which parts of its EnMS need further development or whether goals for the EnMS's functionality have been achieved.⁹ It identifies the critical aspects of an SEM implementation into a number of elements¹⁰ and describes how each could be attained at up to five levels. This provides a convenient way to score the major elements, as well as provide an overall score. The NEEA EMA is not self-described as an SEM framework but was developed “referenc[ing] two significant efforts to established definitions of SEM components: the ISO 50001 Standard... which describes a fully functioning organizational energy management system, [and] the Minimum Elements of Strategic Energy Management for the industrial sector, laid out by the Consortium for Energy Efficiency” (Leritz et al. 2014).

The value of a phased approach to implementing an energy management system is well recognized, and it has been incorporated into ISO 50005:2021 “Energy management systems – Guidelines for a phased implementation” (ISO 50005). Unlike the NEEA EMA, ISO 50005 draws exclusively from the SEM framework of ISO 50001, though as stated in the standard's introduction, “this document is consistent with ISO 50001:2018 but does not cover all of its requirements.” Similar to the NEEA EMA, ISO 50005 is not patterned on the structure of ISO 50001 but created twelve elements, each divided into a number of sub-elements or “topics” with four achievement levels. As an ISO standard, ISO 50005 will remain fixed for at least a five-year period.¹¹ The NEEA's EMA tool does not have a documented revision schedule, though the current version may remain stable. ISO 50005 provides no scoring system, unlike NEEA's EMA tool. The ISO Standard does describe how energy management system implementation can be guided by a schedule of achieving specific levels for some or all of the topics by specific time frames established by the implementing organization. Unlike the NEEA EMA, ISO 50005 is not freely available but must be purchased from ISO or ANSI. Finally, while expressed from the point of view of qualitative progress, ISO 50005 is easily transformed into a scoring system as illustrated below. Appendix 1 of this paper details characteristics of SEM frameworks and EMAs including the NEEA EMA and ISO 50005.

The basic structure of ISO 50005, like the EMA tool before it, is a “maturity model” approach dividing energy management implementation into twelve defined elements¹² that, in

⁷ See Gilles et al. (2013) and Leritz et al. (2014).

⁸ In the SEM Report there was some indication other forms of an EMA were used, but this was not a focus of that study.

⁹ Surprising to the authors, who also authored the 2021 SEM Report, was how infrequently any energy management assessment tool was used at the of an SEM program to assess the permanence of SEM practice. Seventeen of twenty-three did not use such a tool.

¹⁰ Leritz et al. (2014) uses twelve.

¹¹ ISO policy is that standards remain in place for five years, and are automatically reviewed and changes (if any) incorporated at the five-year review point.

¹² The NEEA EMA tool and ISO 50005 define their respective elements differently.

turn, are further divided into sub-elements or “topics” (51 in total). Taken together these compose select elements of ISO 50001. The maturity model approach defines up to (but not always) four levels representative of progressive improvement in that element. Level 1 represents the first steps in enabling an EnMS, while Level 4 indicates the topic meets the “core elements of ISO 50001” and that the EnMS would be ready for gap analysis versus ISO 50001 with positive results. The elements in the standard are shown in Table 1.

Table 1. Elements in ISO 50005:2021

Elements of ISO 50005:2021 ¹³	Description
Element 1: Context of the organization.	The organization should understand internal and external issues including available resources, personnel and drivers for implementing an EnMS.
Element 2: Leadership.	Describes top management's levels of leadership and commitment with respect to continual improvement of energy performance and effectiveness of the EnMS.
Element 3: Resources	Management ensures resources (financial, human, etc.) required for energy management and the EnMS are available.
Element 4: Energy review	Energy use is determined so the organization learns how it uses energy and how that use affects its facilities.
Element 5: Energy performance indicators and energy baselines	Covers establishing energy performance indicators (EnPS - the measure or unit of energy performance) and Energy baselines (EnBs - the quantitative reference(s) for comparison of energy performance and calculating energy savings).
Element 6: Objectives, energy targets and action plans	Covers setting objectives and targets and developing an action plan for energy performance improvements.
Element 7: Competence and awareness	Presents progressive levels pertaining to the competence, awareness and motivation of staff.
Element 8: Operations and maintenance	Discusses progressive levels for the planning, implementation and monitoring of operations and maintenance (O&M) processes related to major energy uses.
Element 9: Procurement and design	Describes progressively steps for energy performance (savings) in the choices in procurement and the design of facilities, equipment or energy-using processes.
Element 10: Process for communication and control of documented information	Specifies levels in the process for obtaining, analyzing, communicating and distributing information included in the EnMS.
Element 11: Monitoring, measurement, analysis and	Describes progressively introducing monitoring and measurement to provide information to determine the effectiveness of the energy management activities, if action

¹³ The elements as listed in this column are ©ISO. This material is reproduced from ISO 50005:2021 permission of the American National Standards Institute (ANSI) on behalf of the International Organization for Standardization. All rights reserved.

evaluation of energy performance	plans are being effectively implemented and when corrective action is necessary.
Element 12: Management review and improvement	Presents progressive levels for management to regularly review past energy performance and refresh plans for energy performance improvements.

In the standard itself, each element has one or more sub-elements. Each sub-element has criteria for meeting each of the four levels. For example, Element 3: Resources has three sub-elements – see Appendix 2. With the identification of the four levels, this provides a 51 by 4 matrix of criteria against which an SEM implementation can be planned and assessed.

The standard describes using this matrix as a tool to set goals for the progressive implementation of a strategic energy management system. That is, for each element and topic, a date can be chosen by which each level would be accomplished. This allows the implementing organization to set the pace of accomplishment and the level of the final system based on its needs and resources. Organizations needing a rigorous system could target level 4 for all elements; organizations needing a less comprehensive approach could target lower levels or even not seek to address all elements at first. Regardless of the number of elements and depth targeted, this structure provides organizations the basic structure of the project plan to implement their strategic energy management system with the possibility of continual improvement over time. It also gives the organization a framework with which to gauge implementation progress and to identify areas where implementation is delayed or where progress is achieved and resources can be shifted elsewhere.

While constructed as a diagnostic tool, the basic structure of the ISO 50005 standard could easily be converted to an accomplishment metric by assigning numerical values to each cell in the matrix. The simplest approach would be a numerical value equal to the level satisfied. That is, if on a particular sub-element, the criteria for level 2 had been satisfied, then the organization would score 2 on that sub-element. Summary statistics could be produced by summing the scores for the sub-elements within an element, and an overall score produced.

While the ISO 50005 standard contains the structure and content to be a viable ISO 50001 based EMA tool it is hindered in that it does not have explicit scoring and by nature of being a copyrighted document cannot be made into a free of charge tool without license agreement with ISO. Building upon the concept of an ISO 50001 based EMA presented by ISO 50005 but seeking to address these limitations, the 50001 Ready EMA was released in draft form early 2022. This resource is based upon the 50001 Ready Navigator, which derives its own structure and content from ISO 50001 (LBNL 2022b). The 50001 Ready EMA was developed at the request of 50001 Ready users as a way to assess both organizational knowledge and actions being taken related to the content of the 50001 Ready Navigator.

The 50001 Ready EMA draws upon features of other EMAs including those from ENERGY STAR, NEEA, and ISO. The 50001 Ready EMA conforms to the overall structure of ISO 50001 as well as the 50001 Ready Navigator with 25 “tasks” divided into 114 sub-tasks. Each sub-task includes five descriptions, with associated scores 0-4, that users can select based upon their knowledge and action related to that component of an ISO 50001-based EnMS. The 50001 Ready EMA suggests that a score of 3 indicates an organization has met the concept of the associated 50001 Ready sub-task. The score of 4 is provided for organizations to emphasize the concept of continual improvement beyond what might generally be considered as being “50001 Ready.” The 50001 Ready EMA is being incorporated into the 50001 Ready Navigator

with input from SEM program administrators, implementers, and end users. This will result in an online, free, publicly available EMA with its structure and content based on ISO 50001, and scoring that will be updated as the ISO 50001 standard is revised.

Application of SEM EMAs to Market Transformation Programs

The approach of using an EMA to assess SEM programs in general and specifically an ISO 50001-based EMA such as that of ISO 50005 or the 50001 Ready EMA, suggests an approach to strengthen the implementation of MT programs in the U.S. To show this, it is first useful to review some aspects of MT program design and development.

Currently, MT programs are based on a theory of a particular market for more efficient equipment or the actions which would make the use of energy more efficient.¹⁴ If aspects of the market aren't understood, a market study is undertaken to identify the barriers to the adoption, or quicker adoption, of efficiency-improving equipment or actions. These are the market barriers the MT program addresses. Based on a well-understood market, a program theory is developed, often presented as a logic model, which specifies the specific intervention strategies designed to reduce the market barriers. The effects of these intervention strategies are apparent through market effects indicators, and observable changes in the uptake or use of more efficient measures (equipment or actions). When the program interventions sufficiently change these indicators and the planned increase in efficiency is obtained, the market is considered transformed. Inherent to this transformation is that the efficiency improvement will persist after the market intervention is changed, reduced, or eliminated (CPUC 2006; Colby 2016; Davis et al. 2019). In some cases, energy savings (as a result of the transformed market) can be ensured through an energy usage standard (e.g., an appliance standard), a voluntary specification (buildings), product labeling, or even competitiveness (i.e., the more efficient products can out-compete less efficient products—in terms of price, shelf space, etc.). To summarize:

Market model:

- Who produces, distributes, retails the product or product category, e.g., stocking patterns,
- Who is buying the product, and what motivates consumer purchases,
- How goods, components, or even credit or finance flow in the market,
- Clear barriers to the spread or increased use of energy efficient equipment, measures or practices

Program Theory:

- Actions to affect the market barriers
- Specific market indicators or metrics that can be used to identify changes in the market (particularly the identified barriers), such as:
 - Awareness of energy-efficient products,
 - Market shares energy-efficient products,
 - Stocking of energy-efficient products,
 - Indicators of market effects indicating permanent reduction in market barriers

¹⁴ One of the first challenges in designing an MT program is a useful definition of the market to be transformed. An MT program has addressed a wide range of markets ranging from specific products (e.g. high performance windows or motors) to the generic practices associated with energy use (e.g. implementing strategic energy management). The process of developing an MT program often serves to precisely define the market to be transformed.

One area in which the methodology of ISO 50005 or 50001 Ready EMA might enhance MT programs is the use of a specific scheme of progressive milestones to track implementation success and potentially provide a way to uncover approaches that accelerate the success of MT programs¹⁵. First, specific targets for the intervention strategies regarded as most impactful could be developed, particularly for those strategies expected to lead to a transformed market. For example, if an intervention strategy is to increase the awareness of consumers of the advantages of energy efficiency appliances, targets could be set as to how much of an increase is to be obtained at specific time intervals after implementation begins. If awareness was found to be 10% in the initial market study, interim targets might be set to raise this to 20% after 6 months, 40% after a year and 75% after two years. This is analogous to choosing levels to reach for an element in ISO 50005 or the 50001 Ready EMA. In this example, targets might be set based on the results of the market study that underlies the program theory, as well as previous experience with alternative forms of outreach to the targeted consumers.

In developing the interim and final targets that are expected to represent a transformed market, the resource cost of each target can be deliberately set and actual resource costs tracked. This provides additional tools for assessing if the path to a transformed market is being followed or needs modification. For example, if raising the level of awareness to 20% was achieved in six months, but cost more than budgeted, a modification of the approach may be warranted.

There is another benefit to setting target values when there is more than one intervention strategy which is to identify and correct potential conflicts between them. An example would be that for the overall MT program to be effective, the levels of awareness of, and the availability of more efficient products should move in tandem. This could help avoid having aware customers frustrated by unavailable efficient products, or efficient products being available but not finding interested buyers. By having target values for several of the intervention strategies, potential conflicts or gaps can be identified and implementation plans adjusted to prevent their occurrence.

Second, while the MT program is being implemented and is in place, measuring those metrics can be undertaken and be compared to the target values. This would provide indications whether implementation is proceeding as planned, or which strategies are falling short or exceeding plans, enabling adjustments to be made. The essence of ISO 50005 and the 50001 Ready EMA is a set of well-defined targets, which are pre-specified and common to all applications to enable comparison and assess progress in reaching those targets. The advantage of this approach—when combined with completion dates—is that it yields a metric for under- or over-performing market interventions and an opportunity for timely interventions to improve MT program performance.

Another opportunity to develop analytic tools to identify the characteristics of high-performing MT programs would be to develop a tool, analogous to NEEA's EMA, the element-level framework of ISO 50005, or the no cost, publicly available, ISO 50001-based 50001 Ready EMA, to apply to MT programs (MT assessment tool). This tool, in addition to energy savings

¹⁵ Maturity models originated in the mid-1980s as a way for purchasers of software to assess the formality and optimality of software developers' development processes. The first model of a process maturity framework was the Capability Maturity Model (CMM), which was followed by the Capability Maturity Model Integration (CMMI) approach starting in 2002 (SEI 2002). CMMI describes process performance levels as follows: initial, managed, defined, quantitatively managed, and optimizing. The conceptual approach has been applied elsewhere; Wikipedia gives examples at https://en.wikipedia.org/wiki/Maturity_model. Note that not all software companies aim for the highest maturity levels of CMMI. Similarly, organizations seeking to manage energy may aim for the level most appropriate for their objectives based on existing commitments and targets, current capacities, and energy-using characteristics, among other factors.

performance, could be used to compare different MT programs.¹⁶ When considering how this approach could be applied to MT, a reasonable starting point could be to group markets that are similar but deployed in different locations (e.g. MT programs for consumer products or high-performance windows), or are similar in structure (e.g. MT programs for multiple home appliances) in a given location. The grouping might take into account any similarities in the barriers in the different marketplaces (e.g. low awareness, low availability of efficient products), as well as basic characteristics (e.g. energy costs). This might require a concerted effort to develop a basic framework of generic common elements and levels of accomplishment/performance for at least one group of MT programs.

An MT assessment tool could have several advantages. If successfully applied, it could reduce the difficulties inherent to inconsistent or incompatible data when attempting to compare MT programs.¹⁷ More uniform data could potentially allow identification of preferred intervention strategies, or implementation of particular strategies. Further, such an approach might help as a template in designing intervention strategies or market metrics. Also, for programs that relied on an MT assessment tool in their development and implementation, those programs' evaluation might be facilitated. Ideally, the use of an MT tool would be a logical starting point for examining differences in performance between two markets and accurately identifying more effective interventions.

An example of a starting point might be that because there have been several decades of experience with MT programs that address consumer products, it would be possible to define the generic elements of such a program and develop generic levels of accomplishment. The elements might fall into such categories as:

- Customer awareness and interest
 - Defined forms of outreach
 - Specific inducements to try the efficient product
- Availability at the retail level
 - Efforts to affect stocking
 - Inducing retailers to advertise
- Inducements for manufacturers to produce, or be able to increase production of, efficient the efficient product.
- End state guarantee of improved efficiency
 - How use an efficiency standard
 - How to use reduced production cost to be at or below the cost of inefficient products

This could be refined by an examination of logic models and evaluations of consumer-oriented market transformation programs.

Conclusion

This paper shows the ISO 50001-based framework of ISO 50005 and the 50001 Ready EMA may provide an important starting point for developing a MT assessment tool that could help to identify which levers would improve MT program performance and move toward climate change goals faster. It could provide a foundation to compare one “lever” to another. The

¹⁶ A significant effort using the NEEA EMA tool for SEM programs in Oregon is presented in Leritz et al. (2018).

¹⁷ Leritz et al. (2018) mentions that evolution in the NEEA EMA tool, and potentially variations in application may have resulted in issues in their data.

suggested MT assessment tool would have a framework analogous to that of ISO 50005 or the 50001 Ready EMA. This framework would make it possible to establish meaningful comparisons (and useful performance assessments of levers as they are implemented). The adaptation described includes a qualitative and quantitative aspect, facilitating the achievement of improvement of the effectiveness of a particular lever, as well as comparison between levers. One challenge to achieving widespread adoption of this framework is that many existing programs may prefer the status quo. However, existing approaches do not enable definitive comparisons between various levers to understand which achieve better MT program outcomes. It may be difficult to convince potential adopters to use such an ISO 50001-based framework until they see the benefits of making these comparisons—which may not occur until they are using said framework. Continued conversation and presentation of the values of an ISO-50001 based framework continue in forums such as the North American and Northwest Strategic Energy Management Collaboratives, which are resulting in more utilities adopting the 50001 Ready framework as their program framework. Presenting empirical data and case studies from these and other 50001 implementations may help lower barriers to adoption.

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Appendix 1: Matrix of SEM Frameworks and EMA Characteristics

Table 2. Characteristics of SEM resources that are or can be used as energy management assessments

	Program/ Implementer Proprietary	CEE Minimum Elements	ENERGY STAR Guidelines for Energy Management	NEEA EMA	ISO 50005	50001 Ready EMA
Content based on	???	CEE Minimum Elements	Successful practices of ENERGY STAR partners	Generally ISO 50001:2011 and CEE Minimum Elements ¹⁸	ISO 50001: 2018	ISO 50001: 2018
Structure based on	???	CEE Minimum Elements (13 elements)	ENERGY STAR Guidelines (7 steps)	12 elements	12 elements	ISO 50001: 2018, ISO High Level Structure
Availability	Proprietary	Public	Public	Public	Public	Public
Cost	???	No cost	No cost	No cost	Cost	No cost
Revision planning	???	Not changed	Unknown	Not changed	5-year revision cycle	ISO 50001's 5- year revision cycle
Scoring	???	Implicit binary scoring	Implicit 3-level scoring	Explicit 5-level scoring	Implicit 4-level scoring	Explicit 5-level scoring
Online tool	???	No	No	Yes	No	Yes

¹⁸ See Gilles et al. (2013) and Leritz et al. (2014).

Appendix 2: Example of ISO 50005

ISO 50005:2021 presents much of its material on Elements and Levels in the form of twelve tables. This appendix reproduces the table pertaining to the Element: Resources in order to illustrate that documents content. In it, the abbreviation “EnMT” stands for energy management team, i.e. those responsible for implementing the energy management system.

Table 3. ISO 50005:2021 Element - Resources

Topics	Criteria			
	Level 1	Level 2	Level 3	Level 4
Energy Management Team (EnMT)	Establish an informal EnMT	Establish an EnMT. EnMT begins to collect information that can be used on energy performance and energy performance improvement.	EnMT ensures that the EnMS is established, implemented, maintained and continually improved. EnMT implements action plans to continually improve EnMT monitors the energy performance of the organization. EnMT regularly communicates energy performance and achievements within the organization.	EnMT monitors the status of the action plans. EnMT reports to top management on the performance of the EnMS and the improvement of energy performance at determined intervals.
Budget	Allocate some budget for energy management activities.	Allocate the budget necessary for initial training and implementation.	Absorb costs for the EnMS into existing capital and/or operational expense budget(s).	Determine and allocate the budget needed for continual improvement of energy performance and the EnMS.

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