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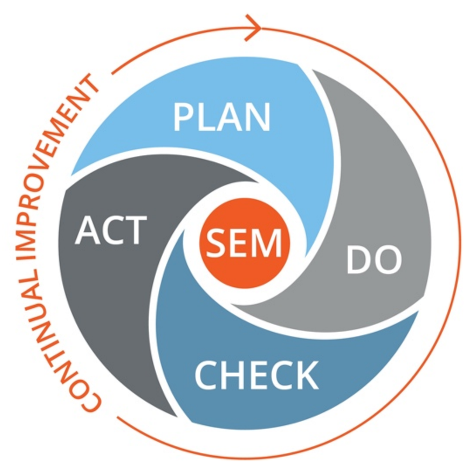
Strategic Energy Management Program Persistence and Cost Effectiveness

An Analysis of the SEM Program Landscape



North American SEM Collaborative

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Disclaimers

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Foreword

Strategic energy management (SEM) is an energy-efficiency program model that began over ten years ago largely in the Northwest with industrial customers and has since spread across North America to include commercial and institutional customers. The North American Strategic Energy Management Collaborative (NASEMC) seeks to accelerate adoption of SEM by energy efficiency programs and energy end users and enhance the effectiveness of SEM. The NASEMC seeks to build on the experiences of existing organizations promoting SEM and work collaboratively to develop solutions for its expansion.

NASEMC has its origins from an SEM Summit held by ACEEE at their Industrial Summer Study in 2017. At this summit it was proposed that a North American (United States and Canada) collaborative could be beneficial to advancing SEM. Since that time, NASEMC was formed with the support of ACEEE and is looking to sustain its efforts through membership enrollment. As a member-driven organization, we benefit greatly from member input and guidance on where to focus our efforts. One example of this member input was received during our annual SEM Summits at which many issues and challenges with current SEM delivery were discussed, but had no clear answers. These unanswered questions laid the foundation for this research.

For this research effort, the NASEMC was fortunate to be granted the generous gift of in-kind support by the DOE Lawrence Berkeley National Laboratory (LBNL) and additional funding through ACEEE from specific research funders: ComEd, ConEd, CenterPoint Energy, Eversource, NYSERDA, and the Tennessee Valley Authority. This research is meant to be the first step in understanding the existing landscape around energy savings persistence, program cost effectiveness, and customer energy management system (organizational change) persistence. We are very grateful to the combined efforts of authors from both LBNL and ACEEE for this research report.

The NASEMC views the results of this research as a significant step toward furthering our mission to promote and improve the implementation of SEM across North America. Thank you for your review of this research report and please do let us know if you have feedback. We encourage you to become a member of NASEMC and help us continue to advance the impact of SEM.

NASEMC Leadership Team

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The Structure of This Report

This study examines the relationship between strategic energy management (SEM) programs and their persistence and cost effectiveness, with analysis based on interview data from 24 SEM program administrators, SEM program evaluations, and other reports. The 80 interview questions focused on the topics of program design, energy savings, energy savings persistence, cost effectiveness, and customer SEM persistence. The generosity of interview respondents provided a wealth of data, resulting in a report of sufficient length to warrant inclusion of this brief guide of the report structure. The major sections are listed below with brief descriptions. Individual sections of this report are mainly stand-alone and do not require reading of other sections. As a result, there is some duplication between sections, but with differing levels of detail.

Executive Summary: Presents three key conclusions of this work with a short description of potential actions to advance the understanding of each key finding.

Brief Observations: Lists a large number of bulleted observations resulting from this research, arranged by the five major topic areas included in the interviews. Analysis details are provided in the Analysis of Interview Results section.

Foundations for this Research: Provides an overview of SEM, SEM frameworks, SEM programs, the topics of persistence and cost effectiveness, and the focus of this research.

Methodology: Details the approach and strategy of this research, providing background information relevant to the formulation of interview questions and the identification of which SEM programs to interview.

Observations from Compiled Evaluations and Other Reports: Reports observations from the collection and analysis of program evaluations, annual reports, utility planning documents, and SEM-related white papers. This section, presented in bullet form, highlights challenges in data collection and ultimately a comparison of program practices as they pertain to persistence and cost effectiveness.

Analysis of Interview Results: Presents detailed analysis of responses from SEM program administrators, arranged by the five major categories examined: program design, energy savings, energy savings persistence, cost effectiveness, and customer SEM persistence. Interview questions are generally grouped together into subsections when it makes sense to examine them together.

SEM Programs Challenge Traditional Cost-Effectiveness Metrics: Details an analysis based on five key factors showing that applying traditional cost-effectiveness metrics to SEM programs is not straightforward. This invites the opportunity to consider whether traditional cost-effectiveness metrics are applicable to SEM programs, either individually or at large.

Resolution of Research Hypotheses: Tabulates a set of hypotheses that were developed to address the fundamental nature of the research at hand. Analysis of responses to multiple questions informs an understanding of each hypothesis and can be used to better understand the SEM program environment at large.

Executive Summary

Strategic energy management (SEM) is a systematic organizational process of holistically managing energy that facilitates more efficient use of energy resources while fostering a culture of continual improvement. Advancing the adoption of strategic energy management is imperative, considering the urgent need for carbon emissions reduction.

In late 2019, against a diverse backdrop of current SEM program offerings, the North American SEM Collaborative (NASEMC) requested that this research project investigate the persistence of energy savings from SEM programs, the cost effectiveness of SEM as measured by these programs, and how the cost effectiveness of these programs should be evaluated.

The objective of this research was to collect and synthesize performance-based information on prospective savings persistence and its influence on the forecast cost effectiveness of SEM programs for SEM practitioners, program administrators, regulators, and planners. Findings were also intended to supply a better understanding of common practices across North American SEM programs in order to document benefits of SEM programs and strengthen the effectiveness of their offerings.

This research was conducted in two main phases. The first involved a review of publicly available SEM evaluation, measurement, and verification (EM&V) reports of SEM programs in North America published in the last decade; this effort focused on findings related to persistence and cost effectiveness. The research team analyzed more than 80 documents via a systematic review to collect information on program design, methodologies, data, and other factors that may affect energy savings, persistence, or cost effectiveness. Findings from this review were very broad and consequently insufficient to resolve the key research questions for this project. Instead, this phase enabled the research team to understand wide-ranging practices influencing SEM persistence and cost effectiveness, and it also informed the second research phase.

This second phase entailed conducting in-depth, semi-structured interviews of SEM program administrators to gain more insight into SEM as it is currently practiced, especially with regard to persistence and cost effectiveness. Interviews focused on five main areas: program design and implementation, energy savings and reporting, energy savings persistence, cost effectiveness, and energy management system persistence. Completed interviews, each around 90 minutes in duration, of program administrators from 24 of 42 identified potential North American SEM programs enabled the research team to create and analyze a rich data set. The findings are presented in this report.

Three key conclusions from these interviews are summarized below, along with recommendations for future opportunities for the NASEMC to advance these findings.

Savings Persistence

Effective useful life (EUL) values used in SEM programs vary widely among programs, and most are not based on primary research.

Respondents were asked for a typical range of expected annual energy savings for their SEM program; Figure 16 on page 42 shows the diversity of expected impact. The EULs of these savings have significant influence on program cost effectiveness, but prior to this project, no study had explored how EUL values are determined across the landscape of SEM programs. Difficulties in determining EULs exist for other demand-side management (DSM) programs, but SEM programs face the complexities of estimating the measure life of behavioral and operational actions or business practices—or that of the SEM program itself. In theory and likely in practice, gathering robust field measurements over time with no confounding factors poses many challenges, especially for resource-constrained programs.

Interviews revealed that SEM programs employ varying methodologies to establish program-specific EULs, as exhibited in Table 14 (page 47) and Figure ES-1 below. While the average value is 4.2 years and the median is only 3 years, it is the dispersion that is most striking.

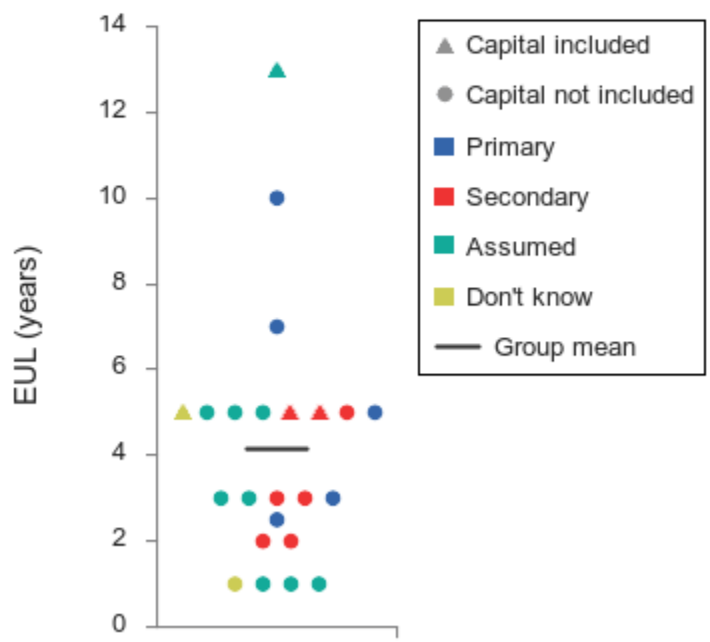

Figure ES-1: EUL values for interviewed SEM programs, color coded by determination method and with shapes denoting whether capital projects were included in determining EUL

Less than one-quarter of interviewed programs establish EUL values through primary research or original assessments, with the majority instead employing secondary sources (such EULs from hypothetically similar energy efficiency measures) or reasonable assumptions to justify this analytical choice. In addition, notable scatter exists in terms of EUL values, ranging from 1 to 13 years, with clusters of at least 4 programs at one year, three years, and five years—and there is no strict relationship between EUL value and determination method. However, taken together, the EUL values established via primary research exhibit higher mean and median values than those determined through secondary, assumed, or unknown methods. In addition, programs with higher EULs report program savings including capital savings from projects installed because of SEM more often than is the case with programs with lower EULs. However, only 4, or 18% of, respondents to a short follow-up survey of interviewees stated that the determination of EUL was based on the program including capital project activity: these were the program with an EUL of 13 years and 3 of the programs with an EUL of 5 years. This apparent inconsistency may be because EULs were developed based on a forecast of program activity, while reported savings are derived from actual activity.

To better understand SEM savings persistence, more research is needed (see Figure 24 on page 54). Aiming for more rigorous methodologies to ascertain EUL values for SEM programs with primary assessments of field data as a basis would increase confidence in the persistence and cost-effectiveness estimates achieved by SEM.

Recommendations for Future Work

- Conduct a sensitivity analysis with NASEMC members or other willing SEM programs to understand how current SEM cost-effectiveness values would change if they employed various EUL inputs, either from a fixed set of EULs (e.g., 1, 2, 3, 5, and 7 years) or using percentages of the current value (e.g., 25%, 50%, 200%, and 300%). This analysis could illuminate to what extent cost effectiveness depends on EUL choice. Of course, problems with comparing cost effectiveness values among programs remain.
- Undertake an investigation and assessment of the methodologies used in primary and secondary reports cited by respondents as the sources they currently rely on for EUL determination. This may reveal commonalities, important distinctions, and a path toward a more standardized methodology. A more standardized methodology may help increase acceptance and confidence by utilities and regulators of the operational energy savings produced by SEM programs.
- Convene a working group centered on determining a robust, field-based—yet practical—methodology to establish EULs, with the aim of disseminating this methodology among NASEMC members and other SEM practitioners.
- Further explore the treatment of capital projects arising from SEM programs. This issue has two aspects.
    - First, some SEM programs count capital projects' energy savings arising from SEM program participation not in the SEM program but in rebate programs offered by the implementer. This may lead to undervaluing the SEM program. A study and survey could determine the rationale for this and the impact of this approach on the EUL of both the SEM and the rebate programs.
    - Second, further exploration could more accurately identify, and even quantify, the degree to which SEM programs stimulate capital projects that would not have occurred otherwise. This effect of SEM programs in

accelerating more efficient capital improvements may be an unquantified benefit of SEM programs.

Program Cost-Effectiveness Evaluation and Results

Only some of the SEM program administrators reported recent cost-effectiveness values during their interviews, but all reported that their SEM programs are cost effective. The total resource cost (TRC) test, alone or with other tests, is by far the most common approach to analyzing cost effectiveness. However, tests, inputs, and assumptions differ from utility to utility, generally making cost-effectiveness values noncomparable.

The 11 of 24 respondents that reported recent SEM or portfolio cost-effectiveness values during interviews confirmed these SEM programs pass cost-effectiveness requirements. The cost-effectiveness values range from 1.1 to 2.4, with an outlier at 8.5 (see Figure ES-2). Generally, the SEM and the portfolio containing the SEM program are similar.

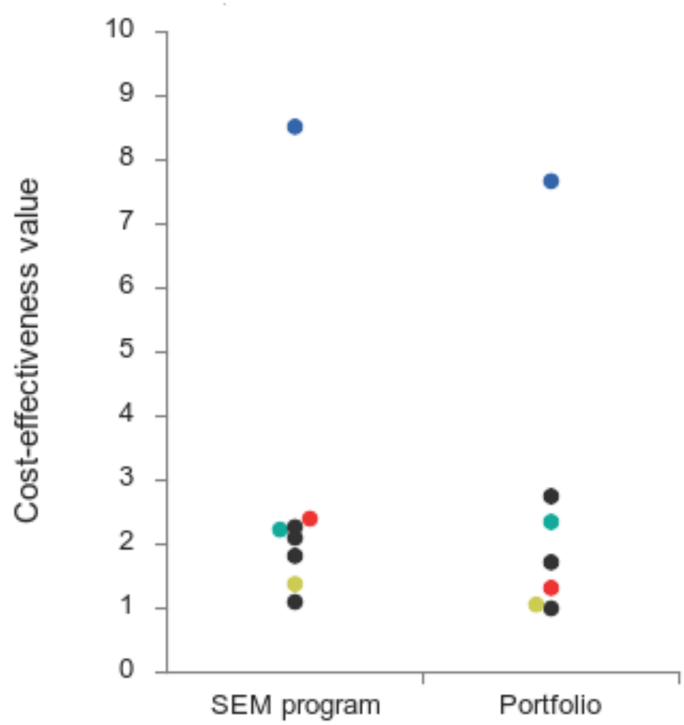

Figure ES-2: Reported SEM program and portfolio cost-effectiveness values; colored dots represent programs reporting both SEM and portfolio values. Note that the black portfolio value at 2.75 was reported as "between 2.5 and 3.0," so it is plotted at the midpoint. The black portfolio value at 1 was reported as "1 or above."

Respondents provided information indicating that cost-effectiveness tests generally have not recently changed and have most often been chosen by regulators. Twelve respondents employed the TRC alone, 4 used the societal cost (SC) test, 4 used the TRC and program administrator cost (PAC) tests, and 4 used some other test or combination of tests (see Figure 25 on page 56). Most program providers stated that the approach to the SEM program's cost effectiveness conformed to the cost-effectiveness analysis of other programs in that same portfolio.

The research team concluded that comparing SEM program cost-effectiveness results would most likely be meaningful only within a given portfolio of energy efficiency programs in which each program's benefits and costs could be clearly and completely identified and separated. Given the variation in responses about program design, somewhat different treatment of costs, and linkages between programs (such as in cases where SEM acts as a "feeder" for other programs), it is unclear whether the calculated cost-effectiveness ratios accurately reflect the benefits and costs of SEM programs. More extensive data gathering and analysis are necessary before meaningful underlying cost-effectiveness comparisons can be made. And in advance of this work, the use and benefits of the comparisons would need to be clearly identified.

Recommendations for Future Work

- Collect more data about the inputs used in cost-effectiveness tests in order to pursue the topic of cost-effectiveness comparison. Inputs covered should include:
    - the source of values used to compute the benefits of energy saved by a given SEM program (e.g., from avoided gas-fired plants or forgone renewable energy purchases),
    - the rate used for discounting future costs or benefits,
    - duration of the SEM program savings (i.e., the time horizon used for the cost-effectiveness analysis) (note connection to issues associated with EUL values),
    - which specific costs (e.g., marketing, administration, rebates and their processing) were included in the cost-effectiveness computation,
    - which specific benefits (e.g., program attribution impacts, savings from operational changes, improved maintenance, capital projects) were included in the cost-effectiveness computation, and
    - whether any benefits or costs not already included (e.g., enhanced participant relationships and future program participation) could be quantified and included.
- Collect more data about the relationship between SEM programs and other programs in the energy efficiency portfolios to which they belong, in order to assess whether a particular cost-effectiveness ratio accurately reflects the full benefits and costs of a given SEM program. Such analysis should clarify whether the SEM program:
    - was used to achieve savings in cooperation with other programs,
    - was targeted to specific market sectors or used to achieve savings in competition with other programs in the same portfolio,
    - was aimed at energy savings potential that it could capture more effectively than other programs in the portfolio,
    - had its cost effectiveness calculated using the benefits and costs associated with it alone, including the effects that might otherwise be attributed to other programs. (For instance, were the benefits and costs of capital

projects that occurred because of the SEM program included in the SEM program cost-effectiveness calculation?).

- Explore the implications for cost-effectiveness results of more accurately identifying savings persistence of actions taken on account of the SEM program. This could include comparing forecasted cost effectiveness to measured actual cost effectiveness.

These points bring up the challenges of overall energy efficiency portfolio design and how SEM programs can best be integrated with other programs to maximize portfolio objectives.

Customer Energy Management System Persistence

The implementation approach of SEM programs varies greatly across programs, and the foundational concept of continual improvement as part of SEM challenges traditional cost-effectiveness metrics.

Seventy-five percent of SEM programs self-identify as using some form of SEM framework such as the CEE minimum elements, 50001 Ready, or ISO 50001 as part of their program. The use of a SEM framework provides the SEM program and participants a documented structure on which to develop energy management business practices.

A lower 63% of SEM programs consider the ability of customers to self-manage their SEM practices after the program ends as part of the program design. However, only 17% of respondents assess customer energy management activities at the conclusion of the SEM program and only 1 out of 21 respondents assesses the energy management activities of customers beyond their participation in the SEM program. Even so, more than half of respondents identified one or more stakeholders, such as regulators or utility management, as being interested in knowing if customer energy management activities persist beyond the SEM program.

The concept of SEM includes an organization developing a long-term, facility-wide, continual improvement process that results in ongoing capital as well as operational, maintenance, and behavior actions that improve energy performance and deliver energy savings. SEM programs may determine energy savings over the period of intervention or through an annualization process. However, persistence, EUL, and cost-effectiveness tests were designed for use with traditional energy efficiency programs as operated by regulated electric or natural gas utilities. These traditional utility programs and their regulators developed metrics suited for programs intended to induce discrete actions by participants to improve energy efficiency. Typically, these programs claim energy savings from these actions that are annualized and assign an EUL to the actions to determine the duration of the savings. They do not typically assume or expect that program participants will pursue continual energy performance improvement. Even if the metrics used by utilities or their regulators do not fit well with rigorous SEM programs, they still provide the framework by which SEM programs are assessed.

Analysis of interview results uncovered that SEM programs are diverse in relationship to five key factors: program duration, program objectives, customer ability to self-manage SEM practices, evaluation of SEM practices, and energy savings treatment, as seen in Figure 33 on page 64 (with a more detailed discussion starting on page 63). The variation of programs across these key factors demonstrate that SEM programs challenge traditional cost-effectiveness metrics.

Recommendations for Future Work

- Consider how best to use an SEM framework to design SEM programs and teach to customers energy management practices.
- Measure and monitor the ability of customers to self-manage SEM practices before, during, and after the SEM program engagement.
- Consider the construct of EUL in relation to the concept of SEM frameworks intended to promote the continual improvement of energy performance.
- Review the structure, inputs, and assumptions of cost-effectiveness tests, and develop an SEM-specific test developed for use regardless of applicability to specific regulatory requirements.
- Initiate conversations with utility and regulatory staff to understand how best to quantify and communicate the continual improvement objectives of SEM and the relationship of these objectives to traditional cost-effectiveness metrics.

Brief Observations

The bullet points listed below are a set of observations made on the basis of analysis conducted during this research. These points are arranged by the five major topic areas included in the utility interviews. Analysis details for each bullet point are provided in the corresponding subsection of the Analysis of Interview Results section. The Table of Contents indicates where to find each subsection.

Program Design and Implementation

Experience with SEM and Age of Current Programs

- Utility experience with SEM programs is as long as 17 years and as brief as less than 1 year.
- On average, the 24 utilities interviewed have 6.8 years of experience with SEM programs (the median is 6 years).
- A small group of 6 utilities have had more than 10 years of experience with SEM programs.

SEM Program Objectives

- All SEM programs aim to produce energy savings, but they do not all share the same focus on the transfer of knowledge of SEM practices to customers so that customers will be able to self-manage SEM outside of the utility program.

Customer Focus

- SEM programs together serve the industrial, commercial, educational, water/wastewater, municipal, hospital, and university sectors.
- Eighteen out of 24 SEM programs serve the industrial sector. The second most served sector is commercial, with 11 programs.
- Three SEM programs accept customers from any economic sector. Eleven of the 24 programs include multiple sectors but not all of those listed above. Ten programs serve a single sector; among these, 8 focus on industrial, 1 on commercial, and 1 on universities.
- SEM programs generally cater to medium and large customers. Seventeen percent of programs support any size customer, with the rest focusing on only large or large and medium customers.

Program Duration

- Approximately one-third of the interviewed programs offer a continuous engagement opportunity for customers. These continuous programs have longer average experience with SEM than all programs together: 9 years vs. 6.8 years.
- Programs that do not offer continuous engagement are between 1 and 6 years in duration, with an average of 3.1 years.
- Seven of the 8 SEM programs that accept only industrial customers are either continuous or of 6-year duration.

Program Delivery Structure

- Of the 24 interviewed programs, 13 organize customers into learning cohorts, 8 exclusively engage with customers on a one-on-one basis, and 3 offer both cohort and individual delivery of the SEM program to their customers.

Program Design Ownership and Delivery

- More than three-quarters (78%) of utilities hire contracted implementers to provide SEM coaching and technical assistance to customers. An additional 13% of utilities stated they jointly provide SEM coaching and technical assistance to customers.

Energy Managers

- While the interview asked about the role of energy managers, only one program encouraged a position with such a title. Ten SEM programs, however, encourage an "energy champion."
- Of 23 respondents, 15 SEM programs do not fund in any part an energy manager or champion.

SEM Framework

- Of the 75% of SEM programs that make use of an SEM framework, 14 use the Consortium for Energy Efficiency (CEE) minimum elements as a foundation, while 3 use 50001 Ready and 1 uses ISO 50001.
- The 50001 Ready and ISO 50001–based programs are relatively young, either one or five years old.
- Sixty-three percent of SEM programs consider the ability of customers to self-manage their SEM practices after the program ends as part of the program design.

Energy Management Assessments and Tools

- The study found that 17% of respondents did not understand questions related to the concept of an energy management assessment (EMA), generally confusing the idea of evaluating an energy management system with energy modeling or project tracking.
- Eleven programs (46%) reported using the EMA tool developed by the Northwest Energy Efficiency Alliance (NEEA). Four programs are currently switching from a proprietary EMA to the NEEA EMA.
- The majority of programs that do not use an SEM framework are offered by utilities with five or fewer years of experience with SEM.

Incentives and Rebates

- Nineteen utilities offer some form of financial incentive to customers for participation in the SEM program; the remainder do not.
- One program charges customers US$10,000 to participate, stating that the customer receives approximately US$50,000 worth of consulting support.
- Twenty-nine percent of reporting programs offer only performance-based incentives, 18% offer only milestone payments, and 47% offer both.
- Average electric incentives are 3.5 cents per full, first-year kilowatt-hour (kWh) savings when including the one notable outlier offering 18 cents per kWh. Removing the outlier, the average electric incentive rate drops to 2.3 cents per kWh.
- Average natural gas incentives are 25 cents per therm.

Customer Recruitment

- Human connection is critical to recruitment; account managers, implementers, and word of mouth were most mentioned by interviewed utilities (75% of mentions).

- When recruiting customers, SEM programs highlight energy cost savings and incentives and rebates first, followed by the potential for customers to meet their energy management goals and improve their workforce.
- Peer learning, energy cost savings, and the usefulness of having energy management goals were the most mentioned value propositions reported by customers to program administrators.
- All SEM programs for which customers valued energy management goals were ones that used some form of SEM framework (e.g., the CEE Minimum Elements).

Program Energy Savings

Energy Savings Methodology

- There is no single standardized methodology for calculating SEM energy savings.
- SEM programs typically rely on one or several energy savings methodology protocols, with the most common being the International Performance Measurement and Verification Protocol (IPMVP), followed by program-specific guidelines/protocols and Bonneville Power Administration (BPA) Energy Smart Industrial (ESI) Monitoring, Targeting, and Reporting (MT&R) Reference Guide.
- Most programs prefer top-down modeling to determine energy savings, while employing both top-down modeling and bottom-up project accounting approaches as appropriate.

Baselining Energy Savings

- Nineteen of 24 interviewed programs compare energy savings with a baseline, which can include using the prior year of energy use, 1 to 2 years prior, 2 years prior, and even 3 years prior.
- Fifteen interviewed programs consider establishing a new baseline period and energy model when necessary, such as when there are significant or sufficient changes in site conditions. Four programs re-baseline at regular intervals unless these changes occur first.

Facility Boundaries for Calculating Savings

- Almost all interviewed programs employ a whole-facility basis for calculating energy savings, except when it is more appropriate to model only certain parts of the facility (depending on site context or customer preference).

Energy Sources

- Ten programs sell only electricity and 7 sell electricity and natural gas to SEM participants, while 17 include both electricity and natural gas in energy savings calculations (i.e. natural gas from another provider), and 14 report electricity and natural gas savings to regulators.

Reporting Frequency and Annualization of Savings

- SEM program energy savings are most often reported to regulators on an annual basis.
- Nearly three-quarters of interviewed programs annualize reported energy savings.

Non-Utility Energy Supply

- Nine of 24 respondents do not consider non-utility supplied energy in reporting energy savings, while 8 do. Those that do typically account for on-site generation in their regression models. Exactly how this is implemented varies by site.

Types of Energy Savings

- Twenty-three programs include both behavioral and operational actions in SEM program savings. Eleven also include capital projects installed because of the SEM program, and among these, 6 noted that capital projects receiving incentives from other savings are netted out of SEM savings. Two programs also consider maintenance actions, and 1 includes retrocommissioning.
- Twenty-one of 24 programs report energy savings from SEM as a single value.
- Energy savings from SEM may be considerably understated if capital projects that otherwise would not have been implemented are instead attributed to other programs.

Typical SEM Energy Savings

- There is no single typical range of energy savings as a fraction of participant baseline energy consumption that is expected for SEM programs, because programs and their circumstances are heterogeneous.
- Five programs expect annual savings to range from 2% to 5%, while 11 others gave different ranges—but 10 of those had the midpoint of their range still falling in the 2% to 5% range.
- Fourteen programs see annual energy savings change over time, while 6 do not. Of the former, 6 expect savings to decrease over time, 5 to increase over time, and 3 to increase and then decrease over time.
- As programs persist and experience grows, program administrators typically speak with more precision and detail about their programs.
- Eighty percent of respondents affirm or suspect that savings at facilities participating in SEM are greater than savings at facilities that have not participated in SEM. However, only 3 interviewed programs have quantitative projections of this difference.

SEM Energy Savings Compared with Other Programs

- According to respondents, aspects of SEM that contribute to greater savings than non-SEM programs include: SEM as a holistic concept that empowers people to more deeply understand energy use, customer awareness and engagement, technical assistance resources, on-site energy managers, opportunity registers (i.e., lists of energy savings opportunities), and energy management assessments.

Program Energy Savings Persistence

Energy Savings Persistence and Effective Useful Life

- Most (88%) of the interviewed programs project that energy savings persist after SEM engagement ends, with nearly all applying an EUL-type value to reported energy savings.
- Interviewed programs described a wide range of methods for determining EUL values, which were categorized as primary, secondary, assumed, and unknown.

- EUL values range widely from 1 to 13 years, with all but 3 falling under 6 years. Two clusters of roughly equal size can be seen of EUL ≥ 5 years and EUL ≤ 3 years. Compared with the latter, the programs in the former group more often include capital projects installed because of SEM in reported savings. They also more often determine EUL via primary research rather than secondary research or assumptions. There is no meaningful relationship between program age and EUL.
- Fifteen of 24 respondents apply the same EUL to all aspects of the SEM program, while 7 apply separate EULs for business practices (operation and maintenance, O&M) and for capital/custom projects or other distinct actions.

EUL Application and Changes over Time

- Few programs claim that the number of years a participant has continued with the SEM program changes the EUL value.
- A majority of interviewed programs had not altered SEM values over time. Half of those that did so revised the EUL based on new information on persistence from evaluations, persistence studies, stakeholder advisory groups, and/or experience.

SEM Persistence Compared with Other Programs

- Six of 24 programs confirm that energy savings achieved through SEM persist longer than savings achieved by customers participating in other energy efficiency programs but not SEM. The same number state that these savings do not last longer than those for other programs. One asserts that savings persistence is comparable for SEM and non-SEM programs, while the rest do not know.
- Little evidence currently exists to support the hypothesis that SEM program savings persist longer than non-SEM savings. Just 3 interviewed programs reported that they have collected such evidence (and 1 of these contends that savings persistence of 10 years is comparable to the savings persistence of other programs).
- Aspects of SEM mentioned as supporting longer savings persistence include: the relationships built between the utility and the customer and the customer's energy use, SEM's holistic nature, its approved methodology, the streamlined process of SEM engagement, participants being able to see savings results and present those to management, successful approaches by contracted implementers, sustainment plans focusing on O&M, opportunity registers, mandatory reporting, and performance contracts.

Program Cost Effectiveness

Cost-Effectiveness Tests Used for SEM Programs

- The TRC test, alone or in conjunction with other tests, is the most common cost-effectiveness test framework applied to SEM programs.
- While the TRC test is most commonly used, the PAC and SC tests are also used.
- Cost-effectiveness testing does not seem to be a compelling concern among those interviewed.

Reported values for SEM Programs

- As offered, SEM programs are cost effective.

Comparison of Cost-Effectiveness Results

- After considering the issues of comparability in detail, the research team provisionally concludes that comparisons of cost effectiveness may be valid within a given implementer's energy efficiency program portfolio.
- Among the issues affecting comparability within a portfolio are whether the inputs used do or do not artificially generate differences, and whether the portfolio components are designed to complement each other or are implemented to serve separate types of customers or customer needs.
- A cost-effectiveness comparison alone may not reflect the other considerations (equity, need to serve all customers, restrictions on budget allocations) that are important in determining a particular energy efficiency portfolio.
- Cost effectiveness may be affected by the specific goal an SEM program is being used to achieve. For example, an SEM program could be limited to achieving only short-lived operational savings, used as a "feeder" activity for other (e.g., rebate) programs or used to pursue savings in specific customer segments (e.g., paper mills) where large and persistent energy savings can be realized.
- Comparisons of cost-effectiveness values between implementers' SEM programs or portfolios are not likely to be valid given the differences in tests, inputs, or aspects of program design.
- Further research on program practices, inter-portfolio relationships, and differences should be undertaken before additional analysis of SEM cost effectiveness is initiated.

Customer SEM Persistence

- Seventeen percent of respondents assess customer energy management activities at the conclusion of the SEM program.
- One out of 21 respondents assess the energy management activities of customers beyond their participation in the SEM program.
- More than half of respondents identified one or more stakeholders, such as regulators or utility management, as being interested in knowing if customer energy management activities persist beyond the SEM program.

Introduction: Origins of This Research

The basic concepts in Strategic Energy Management (SEM) emerged over 15 years ago as an approach for facilities to holistically improve energy performance (energy use, efficiency, and consumption) over the long term. These concepts have been used as a stand-alone approach by individual organizations, as part of national policies, and also in the U.S. in energy efficiency program designs in programs offered by regulated electric and natural gas utilities, including energy efficiency program administrators. The concepts in SEM build on *energy management systems* principles designed to promote continual improvement of energy performance that were being implemented at the time by some larger, private-sector organizations. Critical components are management commitment and a continual process of planning, implementing and monitoring the results of energy performance improvements done largely by the organization itself.

For individual organizations, these practices were documented in the Management System for Energy (MSE) published by Georgia Tech in 2000.[1] The U.S. Environmental Protection Agency built on these, releasing its “ENERGY STAR Guidelines for Energy Management” in 2003. Those documents—along with others—led to establishing an international standard, ISO 50001, Energy Management Systems, in 2011 (McKane et al., 2009). The ISO 50001 standard has since been used by several European and Asian countries as part of policies to promote greater energy efficiency. The U.S. Department of Energy has also promoted the use of the ISO 50001 standard through tools such as the ISO Ready Navigator.

In parallel, U.S. state utility commissions acting through regulated utilities or program administrators fostered energy efficiency programs based on SEM concepts. During the 2000s, programs were initiated in Wisconsin and in the Pacific Northwest. The concentration of SEM programs in the Pacific Northwest led to the establishment of the Northwest SEM Collaborative (NWSEMC) in 2011. The NWSEMC is a model of cooperation, with an organizational mission to enhance SEM program successes and accelerate SEM program deployment. Membership is largely comprised of utility SEM program administrators, implementers, and regulators from the United States and Canadian Northwest.

The Consortium for Energy Efficiency (CEE) convened a member’s process resulting in the publication of the SEM Minimum Elements in 2014, further encouraging SEM program deployment.[2] These programs focused on helping customers establish stronger energy management practices focused on continual improvement. The CEE Minimum Elements have since become influential in the design of most SEM programs in North American.

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[1] In 2013, ISO 50001 replaced MSE (https://energymanagementstandards.org/mse-standards/ansi-approved-mse-standards/).

[2] CEE members are investor-owned or municipal utilities, government agencies, state or provincial energy offices, and non-utility program administrators.

The success of the Northwest SEM Collaborative led to the formation of the North American SEM Collaborative (NASEMC) in 2019 to promote SEM in the United States and Canada, although annual SEM Summits had already begun in 2017. Among the early actions of the NASEMC was to identify that the use of program cost-effectiveness tests and the use of program savings' duration metrics (effective useful life, EUL) needed to be better understood in order to communicate the value of SEM in relation to other utility programs. To explore this issue further, the Lawrence Berkeley National Laboratory (LBNL) and the American Council for an Energy-Efficient Economy (ACEEE) agreed to work on behalf of the NASEMC to survey current and historical practices regarding these and other related aspects of SEM program deployment. By identifying current practices, this research aims to provide a foundation for assessing the various approaches to program deployment, and potentially to furnish guidance on the importance of particular aspects of program design or attributes of programs as they are assessed in regulatory approval proceedings.

As a focus of this research, particular attention is paid to the following questions:

- How are energy efficiency savings calculated and, importantly, how is the duration of those savings calculated?
- How is cost effectiveness determined?
- Are SEM program participants successful in adopting ongoing energy management systems to maintain and increase energy savings?

The persistence of savings in SEM programs is another fundamental question, as this may be the most important aspect in determining SEM programs' cost effectiveness and importance in generating long-lived energy savings.

A number of participants at recent North American SEM Summits identified the method by which cost-effectiveness tests are applied to SEM programs as an important issue. This arose because there was concern that SEM programs have been evaluated inconsistently. This study gathers basic information on which cost-effectiveness tests have been used, which cost-effectiveness values have been recorded, and how SEM cost-effectiveness values compare with others in the same portfolio. One aspect of this question entails whether SEM cost-effectiveness test inputs were developed using the same methods as other programs in the same portfolio.

The final question to be addressed arises from the defining characteristic of SEM programs: namely, whether current SEM programs, as deployed, meet the criteria of "focus[ing] on business practice change from senior management through shop floor staff, affecting organizational culture to reduce energy waste and improve energy intensity" (CEE 2014). It is this aspect of an SEM program, as embodied in the creation of a robust, effective energy management system, that holds promise for producing ongoing, lasting energy savings with minimal outside (i.e., programmatic) intervention—and providing participating customers with the motivation and means to continue to save energy, reduce costs, and improve productivity on their own.

Methodology

At the beginning of this project, the research team was not aware of any comprehensive overview of SEM programs in the United States and Canada that could provide a foundation for this project's specific goals. Accordingly, the research team undertook several activities to explore the main issues raised above, intentionally employing a broad definition of what constitutes an SEM program (e.g., programs did not necessarily need to align with CEE Minimum Elements) in order to cast a wide net. The first phase involved assembling and reviewing publicly available documentation on SEM programs, including evaluation, measurement, and verification (EM&V) reports, which are typically conducted rigorously. After analysis of these reports to determine what findings were available with respect to the cost effectiveness and persistence of SEM program savings, it became clear that additional research was necessary. While this initial work showed the rough landscape of SEM practice, it was best suited to provide a perspective that helped guide the design of questions that needed to be probed further. Accordingly, the research team initiated a second project phase, consisting of interviewing SEM practitioners to gather new data more directly relevant to the research questions.

Program Evaluation, EM&V, and Other SEM Reports

The first research phase consisted primarily of online investigation, with the research team collecting over 90 publicly available documents describing programs in North America. The Northwest Energy Efficiency Alliance (NEEA) Meta-Analysis, which contains information on regional SEM programs, served as a starting point (NEEA 2020). Collected program materials consisted of program evaluations, regulatory filings, annual reports, and demand-side management plans, among various other resources spanning the last 10 years. Zotero, a reference management software tool, was used to collect and sort the documents. A list of these documents can be found in Appendix A: Table of Reports (Evaluation and Other). This appendix only contains documents found during this initial collection phase; additional documents were discovered or shared with the research team after this analysis.

The research team engaged in a systematic review to capture information on program design, methodologies, data, and other factors that may influence energy savings, persistence, or cost effectiveness. Each of the documents found in the initial collection phase was assessed, which served to evaluate the source information and illustrate the broad landscape of program practices over the past decade. Because of the substantial differences in the data included in the various document types, documents were scanned for key information regarding energy savings, persistence, and cost-effectiveness keywords using the Find function, with data collected in an Excel spreadsheet.

The Observations from the Initial Research Phase section, beginning on page 12, reveals the wide range of SEM reporting practices and the challenges in answering the research questions from this activity alone. These observations helped the team identify gaps in available data, refine the research design, and inform the details to be acquired in the interviews.

Program Administrator Interviews

At this point, the second research phase began. Informed by the review of evaluation reports, the research team developed a set of eight hypotheses to sharpen the focus from broad research questions to those that should be asked of SEM program administrators during interviews. These hypotheses, formulated as paired null and alternative hypotheses, are presented and further discussed in the Resolution of Research Hypotheses section, beginning on page 67.

Because the field of SEM research is emergent, this research project was exploratory, lending itself well to a research design with semi-structured, in-depth qualitative interviews. Interviewing practitioners allows researchers to gain insight into the nature of the field(s) in which those practitioners work, as well as the practices and perspectives of the respondents. In-depth interviews are well suited to uncovering and understanding the diversity of individual SEM programs, even though these programs share a common orientation toward SEM. For researchers, interviews "provide a living interchange for present and future use; we can rummage through interviews as we do an old attic—probing, comparing, checking insights, finding new treasures the third time through, then arranging and carefully documenting our results" (Anderson and Jack 1998).

Semi-structured interviews strike a balance between the freedom and flexibility of entirely open-ended interviews and the ability of the structured interview—or survey—to gather information on topics strictly relevant to the research being conducted. The limited number of SEM programs in North America made it infeasible to construct a statistically representative sample that might be better served by a structured survey (see the Sampling Strategy section, below). Instead of being statistically representative, qualitative interviews of SEM program administrators using an in-depth questionnaire illuminated a range of current practices employed by SEM programs regarding program design and implementation, energy savings and reporting, energy savings and persistence, cost effectiveness, and EnMS persistence. This deep, qualitative approach elicited an array of variations on a broader story of how SEM is currently practiced in North America.

Identifying SEM Programs

To the research team's knowledge, no publicly available directory of current North American SEM programs exists.[3] Over a period of weeks, the research team developed a list of energy efficiency programs in North America that might be considered SEM programs, starting with the 21 organizations with reviewed evaluation reports. In May and June 2020, NASEMC Leadership Team members drew upon their experience and connections to expand the list and recommend the best contact at each SEM program for the research team to interview. During interviews, research team members also asked respondents whether they should speak with others regarding these topics, and

[3] E Source maintains a subscription-based repository of demand-side management (DSM) programs which includes SEM programs called DSM Insights, https://www.esource.com/about-dsminsights.

this netted a few additional programs and contacts. This list grew to encompass 42 separate SEM programs.

Sampling Strategy

Ideally, surveys are employed with a statistically significant, random sample of a larger population, such that characteristics identified in the sample can be inferred to the general population. Representative surveys of smaller populations require large sample sizes. For the population of 42 North American SEM programs ($N = 42$), a 95% confidence level and 5% margin of error would entail a sample size of $n = 38$, or an overall response rate of 90.5%, which is rarely achievable (Millar and Dillman 2011; Baruch and Holtom 2008). Because a statistical sample is unrealistic for this small population, the research team instead employed unstructured "sampling" for interview-based research that strove for representation that is more loosely defined than in survey research. In lieu of statistically representing the population, sampled units (SEM programs) can instead illustrate facets of North American SEM programs and help us understand more about them.

Starting in July 2020, the research team contacted each of the 42 identified SEM programs at least twice via email. The first contact contained an invitation to participate in interviews, and the second, sent at least two weeks later, encouraged recipients to take part. Each contained a scheduling link allowing invitees to book a 90-minute interview slot with the research team at their convenience, as well as the questionnaire, as an attachment, to enable prior review. If neither email received a response, in cases where members of the research team personally knew invitees, they followed up with a telephone call; in other cases, NASEMC Leadership Team members leveraged personal connections while reaching out via telephone or email to encourage participation.

Questionnaire Development

Because research about SEM and similar programs is a relatively new field, a longer, in-depth questionnaire would allow the research team to capture more information on SEM program practices. The review of existing evaluation reports and the associated screen (see the Observations from Compiled Evaluations and Other Reports section) led us to divide the interview into four focus areas: program components, energy savings, persistence, cost effectiveness and energy management system persistence. Throughout the questionnaire, inquiries focused wholly on the practices of the respondents' organizations and did not delve into the behavior, opinions, or subjective experiences of the respondents themselves. The research team took a highly iterative approach to improving the questionnaire throughout May and into June 2020, with nine revisions substantial enough to be differentiated as separate versions. In mid-June the research team field-tested the questionnaire to improve the clarity and acceptability of individual questions by conducting pilot interviews of the three NASEMC Leadership Team members, after which another iteration was finalized. Please refer to Appendix B: Interview Questions for the final version of the questionnaire.

Questionnaire Focus Areas

The interview questionnaire is split into five major sections, or focus areas, as detailed below.

Program Design and Implementation

The first and longest section focused on the question "What comprises an SEM program?" For example, does the term "SEM program" apply only to activities occurring under an energy ratepayer–funded, regulator-overseen program run by an energy efficiency program administrator, or does it also apply to self-managed activities (e.g., Hilton Hotels' implementation of ISO 50001)? Relative to traditional resource or market transformation programs, what is unique about SEM programs? In 2014, CEE provided a list of "threshold criteria" for energy management practices, not program characteristics (CEE 2014). Participants in CEE's Industrial SEM Initiative supported these elements as criteria to be met or exceeded in the implementation of management practices. However, even when applied to a program, these criteria are broad and define more of a "genus" than a "species."

A lack of consistency around what constitutes an SEM program in terms of its offerings and intended outcomes makes a comparative analysis of energy savings persistence and cost effectiveness difficult, if not misleading. Thus this section of the questionnaire contained 27 questions concerning program design elements. Questions focused on program history and longevity, purpose/objective, design ownership, design focus in terms of distinguishing activities or concepts, delivery structure, reliance on energy managers, implementing or improving an energy management system, role of program delivery staff, type of customer engagement, and the relationship to other programs offered by respondents' organizations. Analyzing SEM practitioners' responses to this uniform set of questions was meant to shed light on common elements of program design and implementation currently employed, as well as to help the broader SEM community understand to what extent these programs can be compared.

Energy Savings and Reporting

This section examined the methods used to calculate energy savings from the SEM program. Methods include "top down" versus "bottom up" approaches, and use of annual versus annualized savings. Some programs include all energy sources while others do not, and likewise, in some programs non-SEM savings are netted out, while in others they are not. All these methods focus on the energy savings (and their persistence) from specific actions caused by the program. For a specific action taken, some work has been done to determine how long savings last and whether the size of the savings changes over time.[4] The use of diverse methods complicates inter-program comparison.

The questionnaire included 21 questions (6 of them conditional on how respondents answered preceding questions) on the following topics: the measurement and verification (M&V) process, scope and boundaries, the reporting of savings, and savings

[4] For example, see the studies referenced in NWSEMC 2020.

levels. The questions were designed to lead to a better comprehension of the typical methodologies used, and potentially to an assessment of the suitability and comparability of methods employed to date for SEM programs.

Energy Savings Persistence

This section was motivated by one of the overarching questions from NASEMC that seeded this project: What is the persistence of energy savings from SEM programs? This research question prompts others. First, regarding persistence, what is the temporal meaning of this concept in practical terms? For example, does the term *persistence* imply just the persistence of energy savings that occur during the time of program participation, or does it include the persistence of those savings as well as any savings that occur after program participation has ended even though the participant continues to practice SEM? Next, one must question what persists: energy savings, and/or the site's energy management system (EnMS)? The former is likely the most typical use of the term *persistence*, but the latter is relevant for SEM programs that have a goal of participants initiating and permanently using an EnMS. Because the persistence of energy savings and the persistence of an EnMS are distinct topics, the questionnaire had two sections; for the second, refer to the Energy Management System Persistence section on page 9.

The section on program energy savings persistence evaluated current practice via 11 questions (5 of which were conditional on the preceding answers). They center on whether persistence is considered, EUL values and considerations, and whether energy savings achieved through SEM persist longer than savings achieved by customers participating in other energy efficiency programs but not SEM. Gathered data may help illuminate how robustly SEM programs assess the persistence of energy savings via findings regarding current assumptions about EULs, how energy savings persistence is determined, and whether certain SEM program elements or other factors contribute to energy savings persistence.

Cost Effectiveness

The other major research question motivating this project was "How is the cost effectiveness of SEM programs being evaluated?" To explore this question, the research team wanted to understand more about how cost effectiveness is determined where both traditional programs and SEM programs are offered. Cost-effectiveness evaluation compares energy efficiency's benefits and costs, helping to judge whether to implement, retain, revise, or eliminate efficiency programs or specific energy efficiency measures. Such evaluation also can provide feedback on how energy efficiency compares with other energy resource options.

Because the benefits and costs of energy efficiency programs do not fall uniformly on all involved, different benefit-cost tests have been devised to summarize the effects on different stakeholders or groups of stakeholders. Thus, each test gives a perspective specifying which benefits and costs affect a particular stakeholder or group of stakeholders. The cost-effectiveness tests used in this study are summarized in Table 1. Further and more comprehensive discussion and framework for cost-effectiveness analysis for all distributed energy resources can be found in the *National Standard*

Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources (Woolf et al. 2020).[5]

Table 1: Cost-effectiveness tests discussed during the interviews

Test	Acronym	Perspective: What it measures
Total Resource Cost Test	TRC	Costs incurred by and benefits accruing to the program administrator, utility system where the program takes place, and program participants, taken all together
Program Administrator Cost Test (formerly the Utility Cost Test)	PAC (UC)	Costs incurred by and benefits accruing to the program administrator and the utility system where the program takes place, taken together
Societal Cost Test	SC	Costs and benefits to society as a whole
Rate Impact Measure Test	RIM	Costs and benefits as they relate to electric or natural gas rates
Levelized Cost of Energy	LCE	The present value of the cost of a stream of energy saved over time by an energy efficiency program; useful comparison to the levelized cost of a stream of energy generated over time by a conventional power plant
Modified Total Resource Cost Test	MTRC	Same as TRC, but modified to fit the policy of a specific location. For example, energy savings might be valued using the avoided costs of conventionally generated energy or renewable energy, depending on the source of the energy displaced by the efficiency program.

The inquiry into cost effectiveness can analyze the way in which cost effectiveness for SEM relates to other aspects of an energy efficiency portfolio. For example, it is often supposed that cost-effectiveness results and the persistence of energy savings (i.e., the EUL used in the analysis) are related. In addition, the research team wished to examine current reported cost-effectiveness values for SEM programs and the larger portfolio to which they belong.

As a result, eight questions were included on cost effectiveness, covering

- its scope (i.e., on what basis it is addressed),
- the method used to calculate it (e.g., what specific test or tests are used, whether it has changed over time, and how SEM-specific inputs are determined relative to other efficiency programs),
- the choice process (who determines which cost-effectiveness test to employ),
- and the most recent evaluated numerical values for program and portfolio cost effectiveness.

[5] An excellent description of the historical tests can be found in Appendix E. Traditional Cost-Effectiveness Test.

Questions were tailored to elicit responses that would give a basic understanding of the current role of cost-effectiveness analysis as it pertains to SEM programs, as well as a foundation for developing further research activities.

Energy Management System Persistence

The final section of the questionnaire focused on the persistence of an EnMS at participating sites. EnMS persistence enables ongoing, sustained—or even increasing—energy savings whether or not the participant remains in an SEM program. One alternate hypothesis (see Resolution of Research Hypotheses) related to EnMS persistence posits that the persistence of energy savings from SEM is a function of the customer's energy management behaviors. Moreover, the SEM program likely influences the development of those energy management behaviors. If those behaviors are driven by a functioning EnMS, it is critical to investigate to what extent SEM programs assess or measure the persistence of EnMS activities.

This section contained six questions, two of which were conditional on preceding answers. They touched on whether any organization formally evaluates the persistence of participants' EnMS activities, whether any assessments of how participants' EnMS and/or business practices last beyond SEM program participation, how often the program assesses the persistence of EnMS activities of previous participants, which metrics or tools are used to monitor participants' energy management activities, whether any particular organization has an interest in the persistence of these activities, and whether persistence of these activities was considered in the design or implementation of the SEM program.

Completed Interviews

In July through October 2020, the research team conducted 25 separate interviews of SEM practitioners; this represents a good response rate (59.5%).[6] Because not every SEM practitioner contacted agreed to participate, this method was subject to unquantifiable response and self-selection biases, as respondents make up a nonrandom sample of the population. If there were some systematic difference between respondents and nonrespondents that would cause the two groups to respond differently to the questionnaire, it would not be valid to infer that findings from interviews apply to the larger population. It is impossible to know whether such systematic differences existed, so it is inadvisable to extrapolate findings from these interviews to remaining SEM programs in North America.[7] Figure 1 depicts the geographic range of the interviewed SEM programs.

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[6] In their analysis of 1,607 surveys, Baruch and Holtom (2008) find an average response rate for data collection from individuals to be 52.7%, with a standard deviation of 20.4%. Interviews generally have lower response rates than surveys (Galvin 2015).

[7] Galvin (2015) employs a statistical approach grounded in binomial logic to consider "how many interviews are enough" for building energy researchers to assess the transferability of their findings from interviewed samples to the larger population. Because the research team likely did not interview a truly random sample of North American SEM programs, it was challenging to ascertain the required sample size for reliability. Note that the extremely small size of the population of North American SEM programs to which one could potentially infer results is unusual.

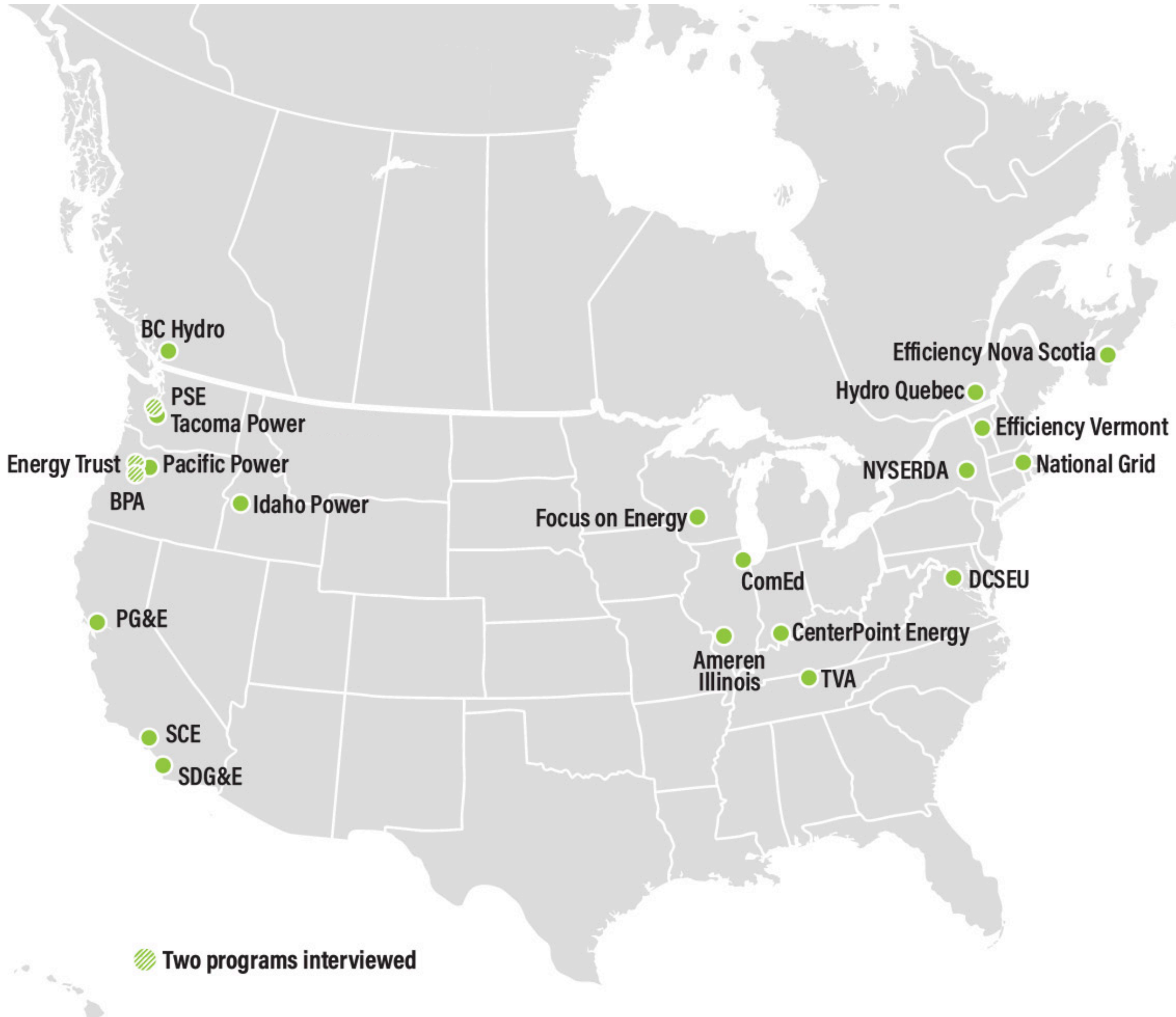


Figure 1: Interviewed North American SEM programs

Before each interview, participating LBNL and ACEEE staff reviewed program synopses synthesized by a member of the research team from publicly available material to briefly familiarize themselves with program objectives and results. With few exceptions, interviews were held on the Zoom video conferencing platform. Each interview was scheduled for 90 minutes; on average, they ran 85 minutes. The sum total of interviews spanned more than 35 hours. One of three interviewers on the research team led each interview, with at least one other member of the research team simultaneously recording notes via Google Forms. Lead and note-taking responsibilities rotated among the researchers, depending on individuals' availability; interviewers were instructed to ask questions as written in the questionnaire, with neutral prompting allowed to elicit more information about a specific question. With the verbal consent of respondents, interview audio was recorded and transcribed automatically via Zoom transcription. After each interview, the note taker reviewed his or her notes and the audio or transcript to ensure the notes were accurate and complete. One of the first interviews conducted was with a program evaluator. That interview led to the realization that the questionnaire was best suited for program administrators, so the recruitment for remaining interviews was refined accordingly.

Once all interviews were completed, it was necessary to structure the recorded data prior to analysis. The Google Form utilized by note takers automatically pushed responses to a spreadsheet, where each column is a unique question and each row a separate response. Where more than one note taker participated in one interview, which occurred more often early in the process, notes were synthesized/consolidated into a single record. When respondents elaborated on their answers, new columns were created to capture such discursive detail, labeled with the question number plus a letter (a, b, c) and a descriptive title. In addition, if respondents did not provide answers to questions that might be present in published materials, or if they were unable to recall a particular value during the interview, the research team made efforts to identify missing information by emailing respondents and searching program applications, reports, and marketing materials. Finally, one interview was removed from the set of completed interviews because responses for that program were also obtained from the SEM program administrators (consistent with other programs). Retaining the initial interview, which was from a non-implementer, would have over-weighted that program in the resulting data set. This meant that analysis results are based upon 24 completed interviews of SEM program administrators.

Observations from the Initial Research Phase

This section serves to illuminate high-level takeaways and limitations from the collected documentation from the initial research phase. These observations informed subsequent interview-based research efforts. The observations below highlight a variety of obstacles the research team faced and why additional research was needed.

- Although NEEA's meta-analysis served as a starting point for this research, there is no central location where SEM program documentation for all North American programs can be found. This documentation can be challenging to find across utility webpages, regulatory docket filing systems, conference proceedings, and elsewhere.
- Utility annual reports, DSM plans, and program evaluations do not capture or report data uniformly.
    - New energy efficiency programs are often initiated as pilots; this is the case for some newer SEM programs. As such, available information is limited. Depending on utility or regulatory requirements, pilot SEM program energy savings and/or cost-effectiveness values may not be publicly available.
    - In some cases, SEM programs are a component of larger energy efficiency offerings. Depending on utility or regulatory requirements, energy savings and/or cost-effectiveness values for the individual SEM program may not be publicly available.
    - SEM programs have been established serving multiple industry cohorts or completely different customer segments. Energy savings and cost effectiveness are not captured uniformly.
    - Program administrators are often required to report energy savings on a yearly basis, but often these savings have not been evaluated.
    - Program evaluations occur at the discretion of the utility or regulator and may assess one or multiple years.
- There is a wide distribution in program practices that likely impact the level and duration of energy savings, including:
    - Objectives
    - Duration
    - Implementation
    - Determination and value of SEM energy savings EUL
- There is a wide distribution in how cost effectiveness is determined
    - Various primary and secondary cost-effectiveness tests are used.
    - Even the same cost-effectiveness test can be applied differently from state to state.

These observations indicated a need for additional research in order to evaluate nuances that are critical to understanding how utilities apply the concepts of persistence and cost effectiveness to SEM programs.

Second Research Phase: Analysis of Interview Results

Analysis of responses from SEM program administrators is arranged by the five major categories examined: program design, program energy savings, program energy savings persistence, program cost effectiveness, and energy management system persistence. Within each major category, individual analyses that take up various topics are presented. The analyses do not focus on any one specific SEM program, but rather look across the portfolio of SEM programs for which data were obtained. To preserve the anonymity of respondents and their organizations, the interviewed programs are rarely mentioned individually. When they are mentioned, they are denoted with letters (*A* through *X*).

Individually and together, these analyses reveal the diversity of SEM program design, methods used to calculate energy savings, inputs and assumptions about persistence, and the extent to which programs focus on customer self-managed SEM practices.

Program Design and Implementation

Experience with SEM and Age of Current Programs

Number	Question
8	When did your organization first start offering SEM programs, including or other than the [PROGRAM NAME] program?
9	When did your organization start offering the [PROGRAM NAME] program specifically?
10	For which years is the current program approved, or expected to be deployed?

Utilities have varying historical experiences with SEM and SEM-type programs. In some territories, SEM was previously referred to as continual energy improvement (CEI). It was left to respondents to determine if their current or past programs would be considered SEM programs; no researcher-defined test was applied. Respondents were prompted with the following statement: “In this research, we’re taking SEM broadly—for example, SEM could include a ‘continual energy improvement’ program, so anything you would consider to be part of that type of program would be something we’re interested in hearing more about.”

A number of current SEM programs have evolved over time on the basis of experience with the current program as well as experience with previously offered programs. Respondents were asked when their most recent SEM program was developed. Regulators’ authorization to offer an SEM program can be a reflection of their confidence in the program’s ability to deliver results, as well as what is considered to be achievable within the authorized time period for the program to exist.

Analysis in this report is relevant only for current programs and should not be used to understand or document SEM programs that were offered earlier but have since been terminated.

Utility experience with SEM programs is as long as 17 years and as brief as less than 1 year. On average, the 24 utilities interviewed have 6.8 years of experience with SEM programs (the median is 6 years). A small grouping of 6 utilities have had 10 years' experience or more with SEM programs, as shown in Figure 2. The majority of utilities have between 1 and 10 years of experience with SEM programs.

Ten utilities indicated they have changed their SEM program such that the current program is definitively different from prior versions. The average age of current SEM programs for the 24 interviewed utilities is 4.4 years (the median is 5 years); the oldest has been running for 11 years and the newest for less than 1 year.

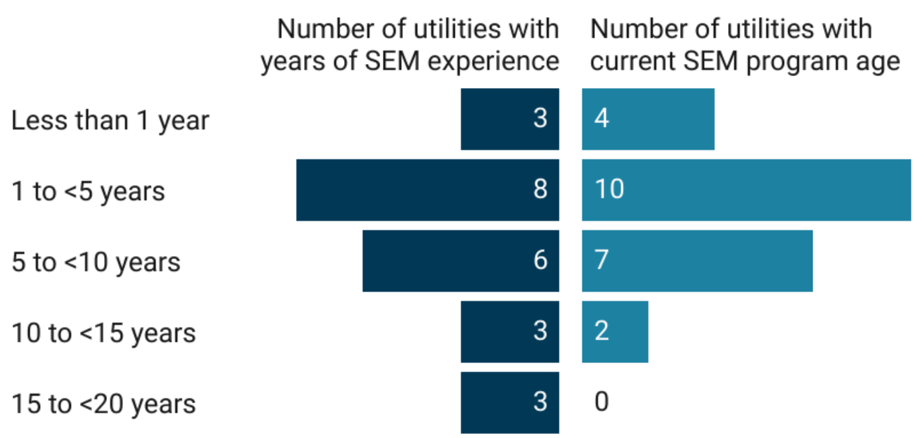


Figure 2: Respondents' years of experience with SEM programs and the age of the current SEM program

Figure 3 shows that most utilities with fewer than 8 years of SEM program experience either made no changes to their SEM programs or made changes early on during their SEM experience. Three out of four utilities with 8 to 14 years of SEM experience made changes to their programs three or four years after beginning their experience with SEM programs. The three utilities that had the longest experience with SEM (16–17 years) made changes to their SEM programs between 2 and 6 years ago. These utilities with the most SEM program experience, and thus the SEM pioneers in North America, have updated their programs, showing the ability to practice the hallmark continual improvement concept of SEM itself.

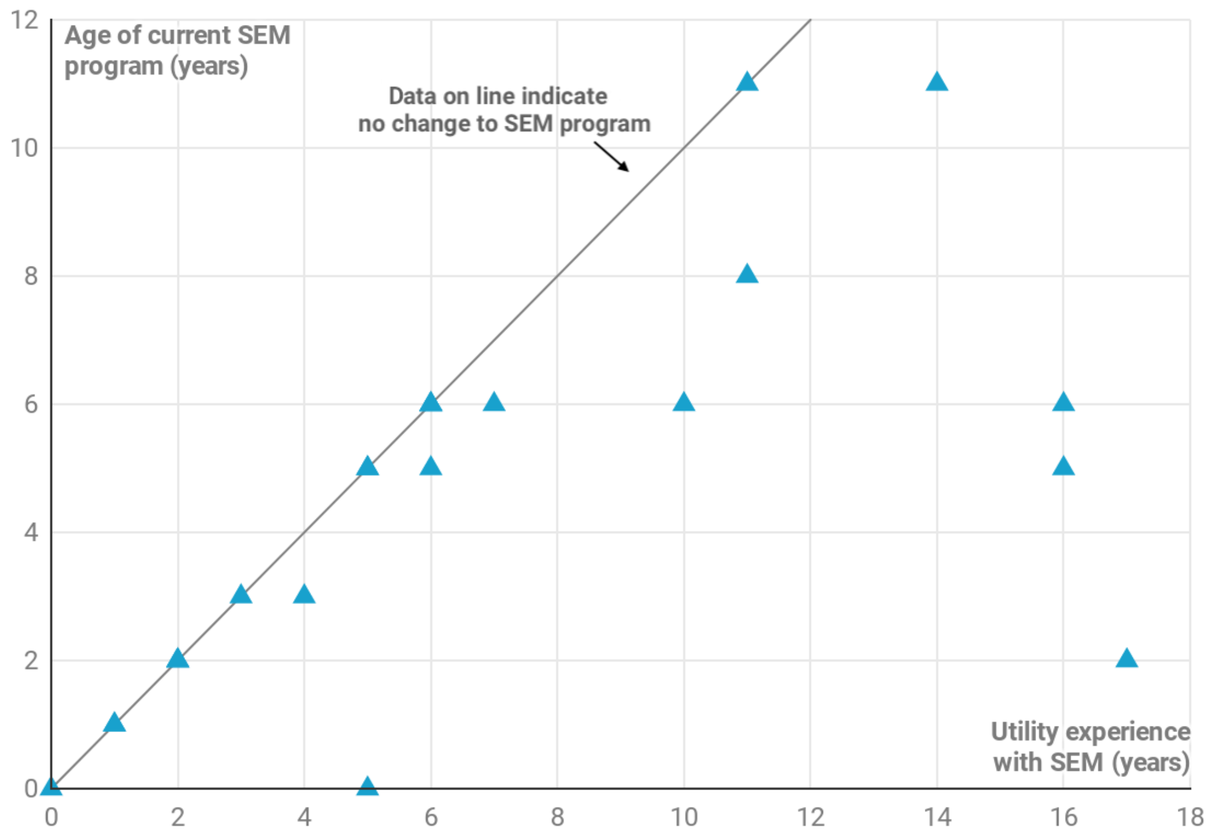


Figure 3: Utilities with less SEM experience have made fewer changes to their programs. Utilities with more SEM experience are more likely to change their SEM program. Utilities that have never made changes to their SEM programs follow the diagonal line (years of experience with SEM = age of current SEM program).

SEM programs are authorized to be offered on the basis of a mixture of regulatory and utility direction. Eighteen interviewed utilities provided an authorization duration for their SEM program. Of these, 6 utilities stated that their current SEM program is authorized indefinitely. These “indefinite” programs are associated with utilities that have between 5 and 17 years of experience with SEM. It is unknown whether long experience is what led to an open-ended authorization or if the indefinite authorization was provided earlier on, creating time and space for the origination of SEM programs.

Programs with defined authorization periods are associated with utilities that have no more than 7 years of experience with SEM. Authorizations are provided for 1 to 5 years. The average authorization for SEM programs (excluding indefinite authorizations) is 2.5 years. Figure 4 provides the distribution of authorization durations.

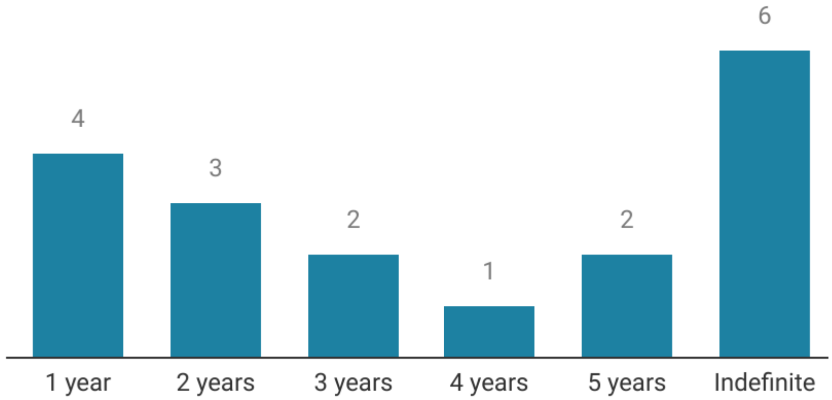


Figure 4: Frequency of years for which SEM programs are authorized to be offered

Utilities with short-term authorizations may be challenged to create or employ SEM program designs that embrace the CEE-defined and generally understood "long-term" holistic approach to managing energy embodied by SEM.

SEM Program Objectives

Number	Question
18	Does the program apply a specific energy management framework to participants (for example, CEE Minimum Elements, DOE's 50001 Ready, ISO 50001, or a proprietary structure)?
44	How often do you report energy savings to your regulator?
80	In designing or implementing the SEM program, was the persistence of the participants' energy management activities considered?

While CEE provides a definition of SEM for customers, the CEE SEM Minimum Elements, ISO 50001, and 50001 Ready provide differing frameworks on which customers can develop energy management practices.

While these SEM frameworks exist for customers, no definition exists for what constitutes an SEM program or what its objectives should be. An assessment of self-declared SEM program objectives was made by examining answers to three questions that focus on (1) regulatory claiming of energy savings, (2) whether an SEM framework (CEE, 50001 Ready, ISO 50001, or other) was used as part of the program design or implementation, and (3) if the program design considered the ability of customers to self-manage their SEM practice.

Producing energy savings is a common objective for all utility SEM programs. All 24 interviewed utilities responded that they claim energy savings to a regulator on a consistent basis.

Eighteen of the 24 interviewed utilities identified using some form of an SEM framework as part of their program. This question indicates only that select SEM programs made use of an SEM framework, not that the program addressed all components of that framework or that the customer will be able to self-manage an SEM practice at some point.

Twenty-two respondents were able to speak about the origins of the SEM program design and whether it considered the customer's ability to self-manage the SEM practice. Fourteen of these 22 respondents (64%) indicated that such a consideration was made. Six of the 8 respondents who reported that they did not consider the customer's ability to self-manage the SEM practice identified an SEM framework used by their program.

Two utilities indicated that they considered the ability of customers to self-manage their SEM practices but did not identify an SEM framework used as part of their program. While an SEM framework is not needed per se for customers to self-manage their SEM practices, it is assumed that a specific SEM framework would be immensely helpful to customers as a reference point when self-managing their SEM practice.

Twelve utility respondents indicated that they both considered the ability of customers to self-manage their SEM practice and identified an SEM framework used as part of their SEM program.

These findings indicate that while all SEM programs share an objective of claiming energy savings, they do not all share the same focus on the transfer of knowledge of SEM practices to customers in a way that enables the customer to self-manage SEM outside of the utility program.

Customer Focus

Number	Question
23	What types of customer segment does the program serve (e.g., commercial, industrial, agricultural or small, medium, large)?

Many times, utility energy efficiency programs are organized around customer economic sectors the programs serve. These delineations may create programs focused on industrial, commercial, residential, or other specific sectors. The definition of SEM and the SEM frameworks listed in this report do not limit the scope of SEM to any set of economic sectors.

All 24 interviewed utilities provided information about the target customer segment and size for their SEM programs. The researchers did not define small, medium, and large for the respondents.

Three of the 24 SEM programs indicated they will accept customers from any economic sector, and 11 indicated they include multiple but not all sectors. Table 2 details the sectors supported by the programs that serve multiple sectors but not all. Ten SEM programs serve a single sector, with 8 focusing on industrial customers, 1 on commercial customers, and 1 on universities.

Eighteen of 24 SEM programs serve the industrial sector. The second most served sector is the commercial, with 11 programs. The focus on the industrial sector was mentioned by many utilities because of the opportunity for large energy savings offered by this sector—savings that are difficult to access through deemed or other standardized approaches. Respondents highlighted the flexibility of SEM and its focus on improving both customer operations and energy savings.

Table 2: Sectors served by SEM programs that cater to more than one sector

Sector	Program letter										
	E	F	G	H	J	M	O	Q	U	V	W
Industrial		x			x	x	x	x	x		x
Commercial		x	x	x		x			x	x	x
Schools	x	x		x		x				x	
Water/wastewater	x				x		x				
Municipal		x	x								
Hospitals								x			

There is little difference in the ages of all programs compared with those for industry only, as shown in Table 3.

Table 3: Ages, in years, of all SEM programs compared with industry-only SEM programs

	Average age	Median age	Minimum age	Maximum age
All programs	6.8	6	< 1	17
Industry-exclusive programs	6.5	5.5	2	14

SEM programs cater to medium and large customers. Of the 17 programs that indicated an orientation toward a particular customer size preference, only 3 indicated they support any size customer, with the rest focusing on large or large and medium customers (Table 4). Programs that support only large customers tend to be younger than programs that serve any or large and medium customers (6 versus 9 years), but they include one of the youngest and one of the oldest SEM programs interviewed.

Table 4: Number and ages, in years, of programs serving different customer sizes

	Number of programs	Average age	Median age	Minimum age	Maximum age
Any size	3	9	11	5	11
Large	10	6	4.5	1	17
Large and medium	4	9	8	6	10

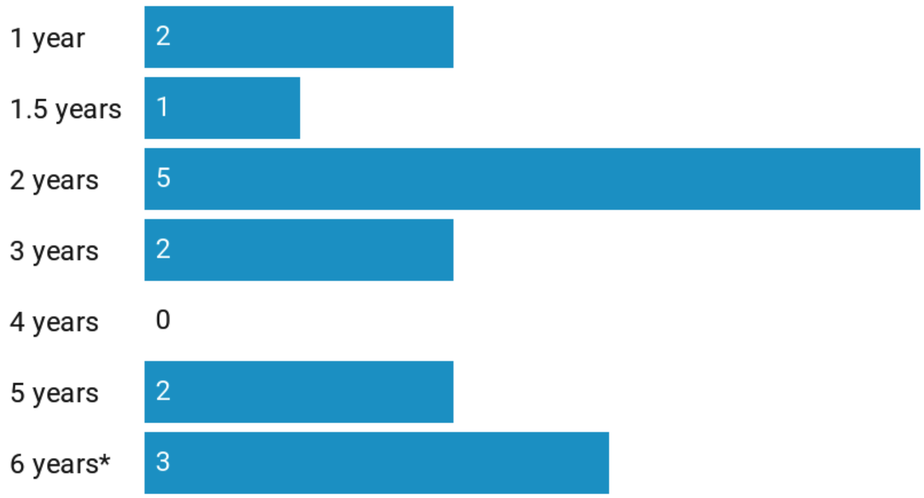
Program Duration

Number	Question
30	How long do participants typically participate in the program?

SEM programs are designed to engage with customers for different durations. They can be structured to have a single duration, multiple engagements of shorter durations, a defined engagement and then continuous engagement , or be structured as a continuous offering from the original engagement. Outside of intended engagement durations, customers may voluntarily leave programs early.

Of the 22 respondents who provided information on program duration, 7 programs included a continuous engagement strategy. Utilities with longer SEM experience tend to be the ones with continuous programs. For example, 3 of the 5 utilities with SEM experience greater than 7 years have continuous program offerings. Of the 17 utilities with 7 or fewer years of SEM experience, only 2 have continuous programs. None of the programs with 5 or fewer years of experience had continuous programs.

Respondents who do not offer continuous programs indicated typical customer participation lengths between 1 and 6 years, with an average of 3.1 years. The 3 programs with 6-year customer durations are all located in California and use a program design based on three 2-year engagement cycles. Figure 5 breaks out the typical duration of customer engagement for each program that reported such data.



** divided into three two-year engagements*

Figure 5: Typical duration of customer engagement

Seven of the 8 SEM programs that accept only industrial customers are either continuous or of 6-year duration, while the remaining industry-only SEM program typically has a 5-year customer engagement. The fact that continuous SEM programs are focused primarily on the industrial sector may indicate that utilities use the SEM program as a way to extend a continuous relationship with key customers.

The 3 non-industrial-only continuous or 6-year programs are open to either all sectors; commercial and municipal sectors; or industrial, commercial, school, and municipal sectors.

Program Delivery Structure

Number	Question
15	Are participants organized into cohorts, treated individually, or grouped in some other way?

Compared with traditional deemed and capital programs, SEM programs typically require an extensive amount of customer education and engagement. While training from utility staff or contracted implementers may constitute the majority of this education, peer learning is understood to be a powerful method of sharing knowledge and motivating customers.

Of the 24 interviewed programs, 13 organize customers into learning cohorts, 8 programs exclusively engage with customers one-on-one, and 3 programs offer both cohort and individual delivery of the SEM program to their customers. In many cases, individual delivery is made available to large energy consumers or key customers, while others are encouraged to join cohorts. While customers may be organized in a cohort to share training and peer learning experiences, in many cases they are treated individually with customized support.

Of the 8 SEM programs that cater only to industrial customers, 3 programs organize customers into cohorts, 3 provide individual delivery, and 2 are mixed.

Four programs that offer continuous delivery organize customers into cohorts, 3 offer individual delivery, and 2 are mixed.

Program Design Ownership and Delivery

Number	Question
13	Does your organization own the program design, that is, did your organization develop or pay for the development of the program design and hold it now? If not, what organization, if any, does own the design (e.g., the utility, contracted implementers, or other)?
22	Who delivers the program to participants (e.g., utility staff or contracted implementers)?

Three-quarters of utilities claimed ownership of their SEM program. While the interview question did ask about the organization that originally developed the program, this portion of the question was rarely answered. Ownership of the SEM program design could be an indicator of commitment by the utility to the SEM program concept and the ability to readily adapt the program as needed, including adjusting contracted SEM coaching staff and technical assistance to best serve customer needs.

More than three-quarters (78%) of utilities hire contracted implementers to provide SEM coaching and technical assistance to customers. An additional 13% of utilities stated they jointly provide SEM coaching and technical assistance to customers. Only 2 respondents (4%) of utilities indicated their staff provide all technical assistance for their SEM programs.

As a holistic strategy for managing energy, SEM takes a whole-facility approach to energy performance improvement in part by creating functional operations and communications within normal business practices. The dual focus of SEM on delivering energy savings and developing SEM business practices requires that individuals who teach SEM be experts in both energy engineering and business operations. This expertise is not common to utility staff, and one solution is to outsource SEM coaching to contracted third-party implementers. This gives utilities the flexibility to bring in the best subject matter experts to serve their customers.

All 5 of the utilities that indicated they do not own their SEM program design hire third-party contractors to implement the SEM program. Though not explicitly asked, it is assumed that the contracted implementation company owns the program design.

No relationship was found between utility SEM experience, age of SEM programs, and SEM program design ownership and implementation staff.

Energy Managers

Number	Question
16	Does the program encourage the participant to have an in-house energy manager?
17	Does the program in any part fund an energy manager for the participant?

Utilities were asked if their program encourages customers to have an in-house energy manager. While SEM is a whole-facility concept that theoretically creates business practices extending beyond an energy manager or energy champion, a person who has a core responsibility of managing energy can be beneficial to a customer's SEM practice.

Only 1 program encouraged participants to designate an "energy manager." Ten SEM programs, however, encourage designation of an "energy champion." Conversations with respondents indicate that the title of energy champion is more open to interpretation and can be a component role of a customer staff member with other responsibilities. Energy manager is seen as a more specific role, one that customers may not be interested in supporting.

Of the 11 programs that encourage the naming of an energy manager or champion, 8 programs suggest rather than encourage an energy champion, 2 mentioned focusing on an energy team, and 1 confirmed identifying a customer data manager. The variety of approaches may indicate that flexibility is required to induce customers to commit the resources to practice energy management.

No relationship was found between utility SEM experience, age of SEM programs, and encouraging customers to name an energy manager or champion.

Of 23 respondents, 15 SEM programs do not fund in any part an energy manager or champion. Five respondents noted that their utility offers other programs that would financially support in part or in full an energy manager or champion. Three SEM programs paid for part of an energy manager's time (or other customer staff time) as part of an incentive structure.

SEM Framework

Number	Question
18	Does the program apply a specific energy management framework to participants (for example, CEE Minimum Elements, DOE's 50001 Ready, ISO 50001, or a proprietary structure)?
80	In designing or implementing the SEM program, was the persistence of the participants' energy management activities considered?

The use of an SEM framework (e.g. CEE Minimum Elements, 50001 Ready, ISO 50001, or a proprietary structure) can provide a defined direction for customers to work toward while developing their SEM practices.

Eighteen (75%) of the 24 interviewed SEM programs make use of some form of SEM framework, while the remaining 6 explicitly said they do not. The majority of programs that do not use an SEM framework are offered by utilities with 5 or fewer years of experience with SEM. Two programs that do not use a framework have greater than 15 years of experience, but their current programs are 2 and 6 years old, respectively. These 2 utilities with longstanding SEM experience would have begun offering an SEM program before any of the listed SEM frameworks were developed.

Of the 18 programs that mentioned using an SEM framework, 14 use the CEE Minimum Elements as a foundation, 3 use 50001 Ready, and 1 employs ISO 50001 (Figure 6).

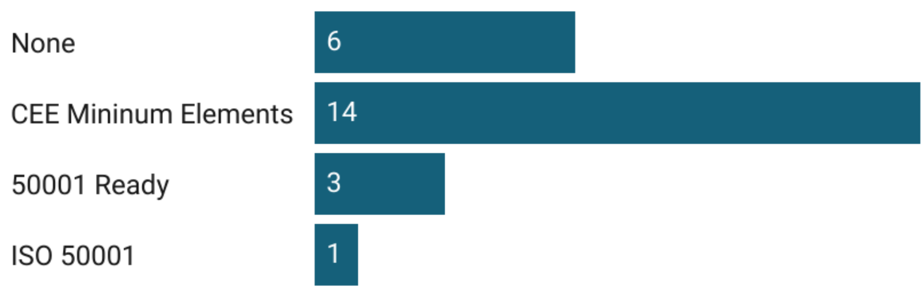


Figure 6: SEM framework foundation to SEM program

Nine programs indicated that they offer customers assistance developing SEM practices based on the CEE Minimum Elements or 50001 Ready (Table 5). One program offers customers assistance with either a 50001 Ready or ISO 50001 SEM practice, and another supports customers with any of the three SEM frameworks they are interested in pursuing.

Table 5: Span of SEM frameworks if more than one SEM framework was mentioned

<table>
<tr><th></th><th>CEE Minimum Elements</th><th>50001 Ready</th><th>ISO 50001</th></tr>
<tr><td>CEE Minimum Elements to 50001 Ready</td><td colspan="2">9</td><td></td></tr>
<tr><td>50001 Ready to ISO 50001</td><td></td><td colspan="2">1</td></tr>
<tr><td>CEE Minimum Elements to ISO 50001</td><td colspan="3">1</td></tr>
</table>

The programs based on either 50001 Ready or ISO 50001 are relatively young, either 5 years or 1 year old. One of these programs has had 16 years' experience with SEM, and the others had the same length of experience as their program age.

While 18 programs use an SEM framework, only 14 confirmed that the persistence of the customer's energy management activities is considered in program design. Eight programs do not consider customer self-management of SEM. Four programs that use an SEM framework said the self-management of SEM activities by the customer is not considered, and 2 programs that do consider the customer's ability to self-manage SEM practices stated they do not use an SEM framework.

Energy Management Assessments and Tools

Number	Question
19	Does the program use an energy management assessment tool or software (e.g., NW (NEEA) EMA or proprietary)? If so, which one?
20	Does the program monitor or track changes in the participant's energy management practices over time?
21	When a participant's engagement with the program ends, is there an assessment made of the maturity or self-sufficiency of its energy management practices? If so, how is this assessment conducted?

EMAs and associated tools have been developed by public and private organizations to create metrics assessing the maturity of customer SEM practices. Among these is an EMA tool developed by the Northwest Energy Efficiency Alliance (NEEA).[8]

While all 24 interviewed utilities provided responses to questions about the use of an EMA, responses from 4 of the utilities indicated that the interviewee did not understand either the question as presented or the concept of an EMA. Answers indicating a misunderstanding focused on energy modeling and tracking of individual energy savings projects. These 4 responses were thus excluded from the analysis on EMAs.

Eleven interviewed SEM programs reported using the NEEA EMA tool. Four utilities indicated they are currently using a proprietary EMA developed by their contracted program implementer but also said they were moving away from this approach and toward the NEEA EMA tool. Though not part of the original question set, when asked why this transition was being made, respondents expressed interest in using a tool that is publicly available to the utility and the customer, as well as aligned with other programs.

Two utilities stated that their contracted implementers use a proprietary EMA and did not indicate they were looking to shift away from the current tools. One utility said its customers use the DOE 50001 Ready Navigator as an EMA tool. Two utilities mentioned that they do not use an EMA tool as part of their program (Figure 7).

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[8] SEM hub Energy Management Assessment Tool. Complete Your Energy Management Assessment. https://ema.semhub.com/.

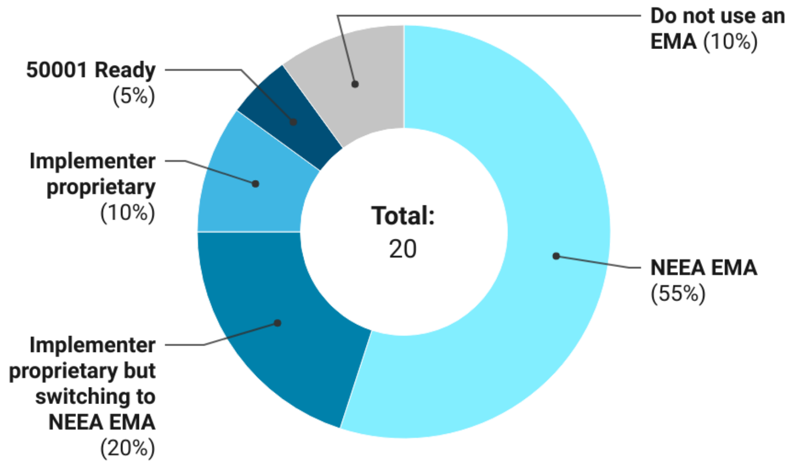


Figure 7: Use of energy management assessment tools

Of the 18 utilities that said they use an EMA, 12 use the tool to measure changes in customer SEM practices during the program or after it concludes. Half of the 12 that use the tool to measure changes do not do so regularly over time.

Seven utilities indicated there is some form of assessment made of the maturity of a customer's energy management practices at the conclusion of the customer's engagement with an SEM program. Fourteen utilities said no such assessment is made, and 3 stated it was too soon for them to know if they would do so in the future.

Incentives and Rebates

Number	Question
27	Does the program provide financial incentives or rebates to participants? If so, which activities are eligible, and what is the basis for the incentive?

Nineteen utilities offer some form of financial incentive to customers for participation in the SEM program, and 5 utilities do not. One of the 5 that does not provide an incentive charges customers US$10,000 to participate, stating the customer receives approximately US$50,000 worth of consulting support.

Seventeen programs provided details about their incentive and rebate offerings. Five programs offer only performance-based incentives, 3 offer only milestone rewards, and 9 offer both.

Thirteen programs provided information on their electric incentive, detailed in Table 6. The average electric incentive is 3.5 cents per kilowatt-hour (kWh) when including the one notable outlier of 18 cents/kWh saved. Removing the outlier, the average electric incentive rate dropped to 2.3 cents/kWh.

Table 6: Electric incentive rates

Incentive amount (cents per kWh)	Count
2	6
2.5	5
3	1
18	1

Five programs provided information on their natural gas incentive and rebate offerings, detailed in Table 7. The average of the natural gas incentives is 25 cents per therm.

Table 7: Natural gas incentive

Incentive amount (cents per therm)	Count
20	3
25	1
40	1

Respondents provided a list of customer actions that can result in a milestone payment, although values for these milestones were often not provided. Milestone incentive topics include:

Program participation
- Production data
- Creating an energy team with an executive sponsor
- Meetings with an energy adviser
- Providing data to develop a baseline energy model

Saving energy
- Completing quick strike projects
- Completing a certain percentage of identified projects

SEM practices
- Energy management practices
- Implementing an SEM framework
- $10,000 for achieving 50001 Ready recognition
- $20,000 for ISO 50001 certification

Hardware purchases
- Up to $20,000 for energy monitoring hardware (50% match)

- Up to $75,000 for an energy management information system (EMIS) (50% match)

Customer Recruitment

Number	Question
25	How do customers learn about the program, or how are they recruited?

Figure 8 lists the recruitment methods mentioned and the number of mentions for each; it also shows how many programs indicated a particular recruitment method was the sole one used. Responses regarding how customers learn about SEM programs highlight the importance of and reliance on human connections. Recruitment through account managers, implementers, and word of mouth were most frequently mentioned by respondents. Four utilities indicated they rely solely on account managers for recruitment, and 3 programs rely solely on implementers.

All but 2 programs that were interviewed use account managers, implementers, or both for recruitment. The 2 programs that did not report using these methods did say they coordinate with local utility companies, which in turn may use account managers for recruitment.

The 5 programs that rely in part on word of mouth have an average of 9 years' experience with SEM programs (10 years median, 2 years low, 17 years high), compared with the 6.8 years average experience for all programs.

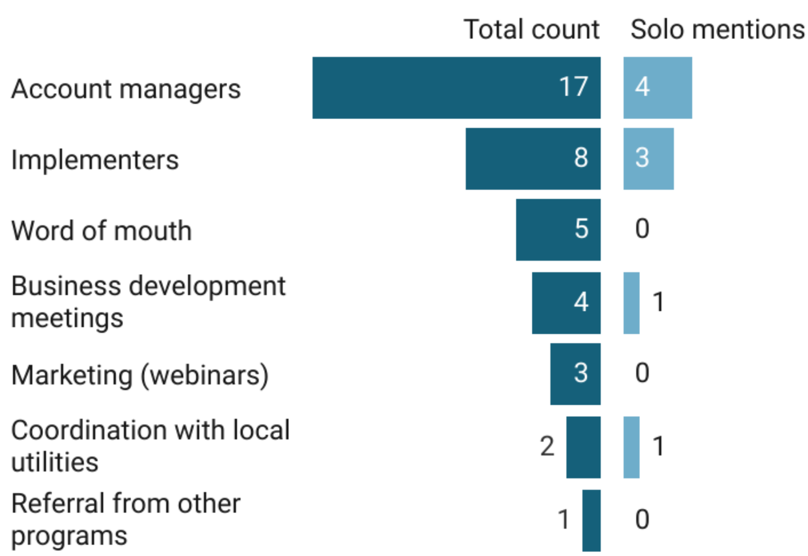


Figure 8: Methods of customer recruitment

Value of the SEM Program

Number	Question
26	What key value propositions does the program advertise to prospective participants?
28	What do customers report as key benefits of the program?
29	Do customers report benefits for the SEM program that they don't report for other non-SEM programs? If so, what are these benefits?

Respondents were asked about the value propositions for SEM that the program advertises to customers, as well as the benefits customers reported. Benefits mentioned by customers (as respondents see it) five or more times include peer learning, energy cost savings, setting energy management goals, and workforce development. A full list makes up the second column of Figure 9. The majority of benefits mentioned could be classified as "non-energy benefits." It seems clear that while customers value energy cost savings, other benefits of SEM program engagement are equally important.

The third column of Figure 9 lists the benefits customers experience from SEM program participation that they do not experience from traditional utility energy efficiency programs (as reported by interviewed program administrators). Responses to this question highlight the ability of SEM programs to offer peer learning and workforce development opportunities within an energy efficiency program construct. Of note is that this question also resulted in 2 mentions of improved utility relationship, indicating that some customers found the value of the SEM program to be more than just transactional.

The rightmost column of Figure 9 tabulates the value propositions used by utilities when recruiting customers to join an SEM program. Energy cost savings and incentives/rebates were most frequently mentioned, followed by energy management goals. Strikingly, the peer learning and other benefits reported by respondents to be the most widely valued among customers were not frequently mentioned as part of recruitment. This should not be interpreted as an evaluation of the effectiveness or appropriateness of recruitment approaches. Customers may very well resonate initially more with messages about energy cost savings and incentives/rebates but then, through program engagement, find peer learning, energy management goals, and workforce development to be more compelling. Though not asked, 2 utilities indicated that incentives were becoming a less emphasized value proposition as part of their recruitment efforts.

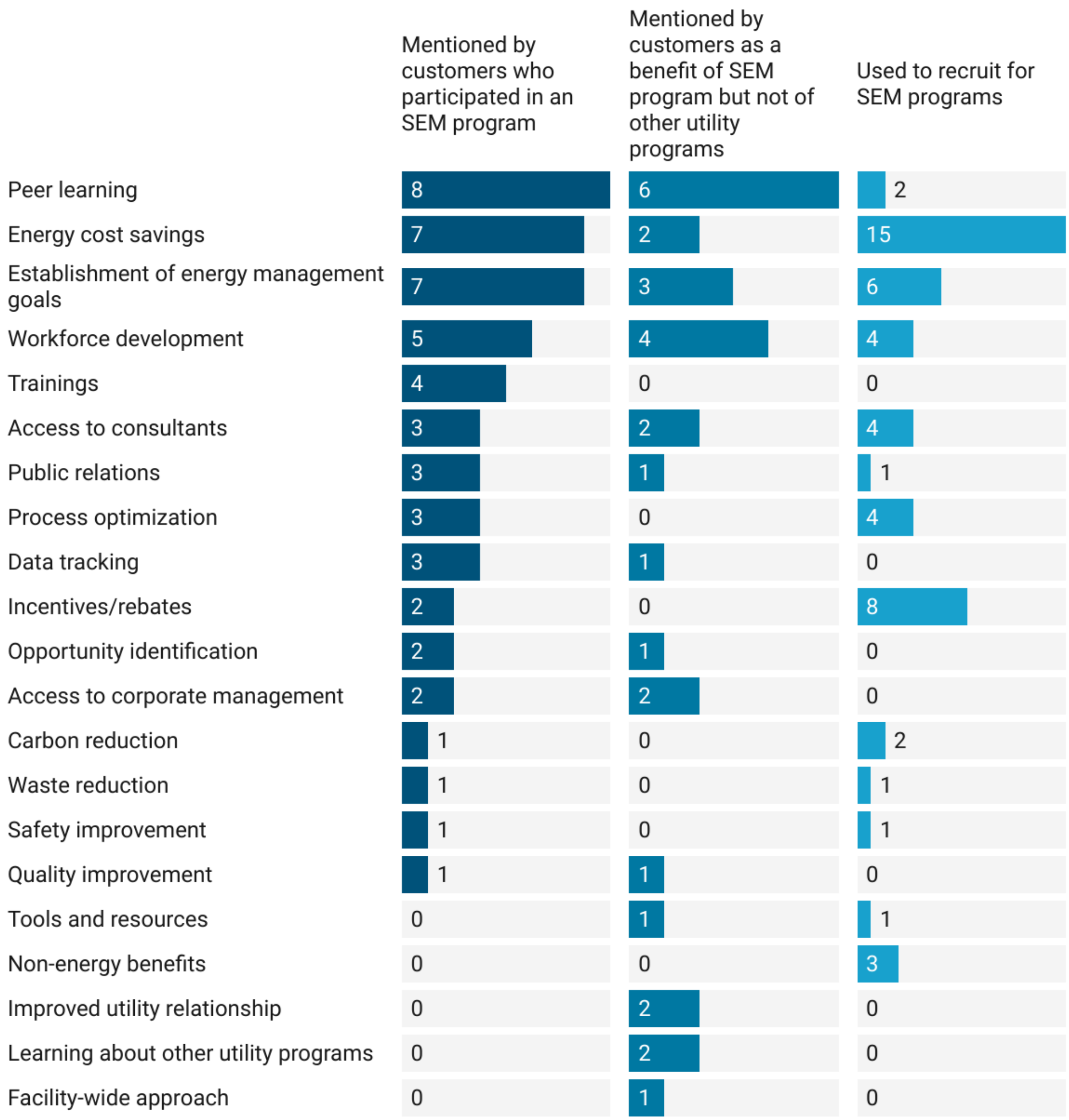


Figure 9: SEM program benefits/value propositions reported by customers to program administrators and used for customer recruitment; all numbers represent mentions by interview respondents.

All SEM programs for which customers mentioned that energy management goals are a value use some form of SEM framework. Figure 10 documents the specific SEM frameworks used as a foundation by these programs. Table 8 shows that four of the programs that use the CEE Minimum Elements as a foundation also will help customers to use 50001 Ready as an SEM framework.

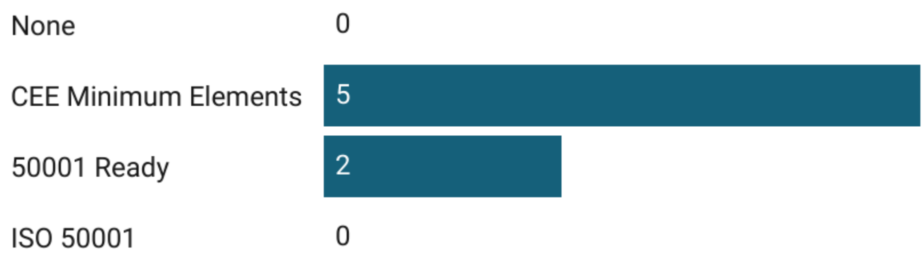


Figure 10: SEM framework of programs for which customers mentioned that energy management goals were a value

Table 8: Span of SEM frameworks if more than one SEM framework was mentioned

<table>
<tr><th></th><th>CEE Minimum Elements</th><th>50001 Ready</th><th>ISO 50001</th></tr>
<tr><td>CEE Minimum Elements to 50001 Ready</td><td colspan="2">4</td><td></td></tr>
<tr><td>50001 Ready to ISO 50001</td><td></td><td colspan="2">0</td></tr>
<tr><td>CEE Minimum Elements to ISO 50001</td><td colspan="3">0</td></tr>
</table>

Engagement after Conclusion of the SEM Program

Number	Question
32	What sort of engagement with the customer occurs after they stop formally participating in the program?

Many utilities continue to maintain a relationship with customers after the customers voluntarily disengage from an SEM program or the program comes to its natural conclusion. Figure 11 details the answers provided by respondents when asked about the mechanisms they use to maintain engagement. Of the 24 respondents, 22 provided one answer, 1 interviewee gave two answers, and 1 gave three answers. When multiple responses were provided, responses of “account managers” and “thinking about it” were mentioned together and “alumni network,” “self-service,” and “re-engagement outreach” were also mentioned together.

A strategy of continued engagement after a program ends has not been considered by 7 utilities. These utilities have less experience with SEM programs overall, with an average value of 3.8 years (median 2 years, minimum less than 1 year, and maximum 11 years) compared with the overall average of 6.8 years’ experience.

The most cited mechanisms for connecting with customers following an SEM program were account managers and customers' continued engagement with other utility program offerings. Four utilities affirmed they had no engagement with customers after the program ended.

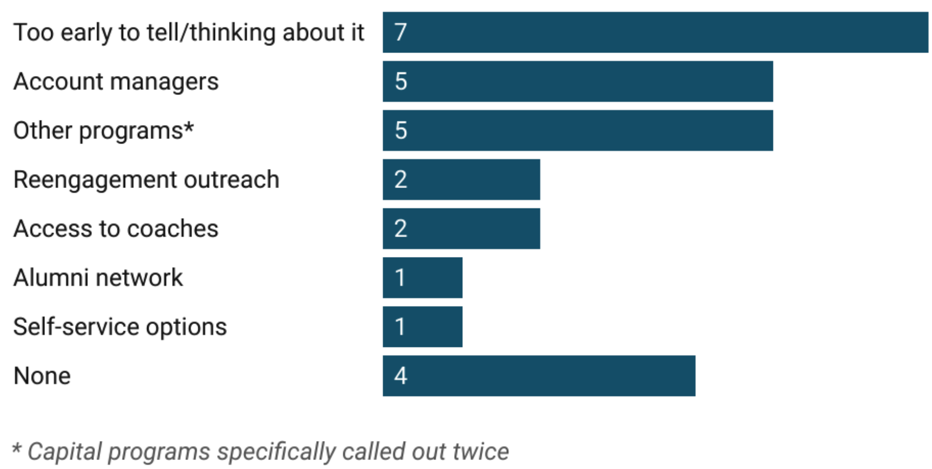


Figure 11: Methods of engaging customers after SEM program participation

Relationship to Other Utility Programs

Number	Question
33	Does the program have any relationship to other programs offered by your organization (e.g., other energy efficiency programs, demand response, on-site generation, time-of-use pricing, peak demand reduction, fuel-switching)?
34	Could you clarify the relationship to other energy efficiency programs, for example the relationship to programs using deemed or customized savings approaches?

As indicated in other questions, customers participated in other utility programs before, during, and after SEM program engagement. Of 23 respondents, 16 indicated that their SEM program has a relationship with other utility program offerings, while 7 stated there is no relationship, although their utility does offer other programs.

Multiple relationship formats exist between SEM and other utility programs (Figure 12). Nine respondents indicated that the SEM program promotes other programs but did not indicate any more formal relationships or connections among the various program types. In 3 cases SEM is part of a larger integrated offering, and in 1 case SEM is the larger program foundation under which other programs exist.

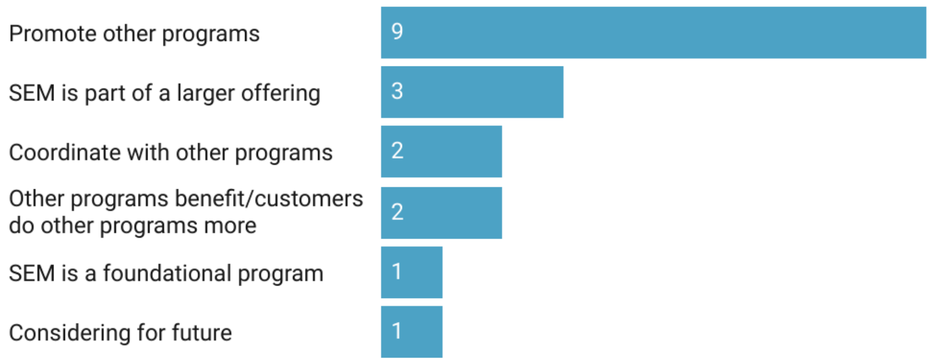


Figure 12: Relationship between SEM and other utility programs

Program Energy Savings

Energy Savings Methodology

Number	Question
35	Does your program make use of an energy savings methodology document to calculate energy savings? [List of common documents provided]
36	Does your program make use of a top-down modeling, a bottom-up project accounting, or both to determine energy savings?
37	Which approach (top-down or bottom-up) is preferred by the program?

Eight respondents indicated reliance on more than one energy savings methodology protocol, with several drawing from three separate documents. Several respondents reported using a methodology other than one of the nine listed for top-down modeling and the International Performance Measurement and Verification Protocol (IPMVP) for instances where bottom-up project accounting is more appropriate. For the 5 instances of using another program-specific guideline or protocol, as shown in Table 9, 3 respondents mentioned that energy savings are calculated via the standard approach of their third-party implementation contractor, while 2 cited territory-specific technical reference/resource manuals.

Table 9: Energy savings methodology document used to calculate energy savings

Energy savings methodology document	Count
International Performance Measurement and Verification Protocol (IPMVP)	9
Another program-specific guideline or protocol	5
Bonneville Power Administration Energy Smart Industrial Monitoring, Targeting, and Reporting (BPA ESI MT&R) Reference Guide[9]	5
ASHRAE Guideline 14: Measurement of Energy, Demand, and Water Savings	4
California Industrial SEM Measurement & Verification Guide	3
Energy Trust of Oregon Production Efficiency—Energy Intensity Modeling Guideline	3
Superior Energy Performance (SEP) Measurement & Verification Protocol	2
Commercial O&M Measurement and Verification Guideline—for Energy Trust of Oregon's Commercial Strategic Energy Management (SEM) and Pay for Performance (Pfp) offerings	1
Uniform Methods Project (UMP) SEM Evaluation Protocol	1

Most programs use both top-down and bottom-up approaches, while preferring top-down modeling, and IPMVP is utilized by more than one-third of interviewed programs (9 of 24). Still, there appears to be no single standardized methodology for calculating SEM energy savings, which complicates comparability (Table 10). In addition, as mentioned above, several respondents stated that third-party implementation contractors calculate these savings in accordance with their standardized approach. This may indicate that program administrators are unfamiliar with the specific methodologies underlying these approaches, perhaps because it is irrelevant to their work.

[9] The Bonneville Power Administration Energy Smart Industrial Monitoring, Targeting, and Reporting (BPA ESI MT&R) Reference Guide is updated on a near annual basis. No specific version was referenced when conducting interviews.

Table 10: Top-down modeling versus bottom-up project accounting

Type of approach	Uses (Q36)	Prefers (Q37)
Top-down	7	17
Bottom-up	1	3
Both	15	--
No preference/Depends	--	3
To be determined	--	1

Baselining Energy Savings

Number	Question
38	Are energy savings calculated compared to a particular base year or on a prescribed basis (for example, year-on-year, against a fixed baseline, compared to industry standard practice, or compared to business as usual for the participant)?
39	Is re-baselining of the energy savings model considered (i.e., establish a new baseline period and energy model)? What is or would be the governing motivation to change the baseline or model?
43	From what energy sources are energy savings reported to your regulator?

Traditional programs may use an industry standard practice, code, modeled, or existing baseline to determine energy savings. The basis of an energy baseline significantly alters the resulting energy savings value calculated, regardless of calculation method. The usefulness of an energy savings model typically erodes over time, and programs approach the mandatory or optional establishment of new baselines and models differently.

Of the 24 programs interviewed, 19 compare energy savings to a baseline, while 3 found the question not applicable because they prefer bottom-up project accounting. One program is still determining its plans, and another intends to employ a baseline but is experiencing challenges because its program started in 2020 and is targeting a sector that has been heavily affected by the COVID-19 pandemic. Six of the 19 programs with a baseline use the prior year of energy use as the baseline, and 2 programs each employ the following time periods: at least the year prior, one to two years prior, two years prior, and three years prior. One program compares energy savings to industry standard practice.

Regarding re-baselining energy savings models, 15 programs consider establishing a new baseline period and energy model, 2 do not, and 1 program does not re-baseline during the program's time frame but recommends it to exiting participants given significant product/scheduling shifts or fuel mix changes. The remaining 6 programs had "other" responses (e.g., confidential, not applicable). Most of the programs that consider re-baselining cited their governing motivation to be significant or sufficient changes in site conditions such that models no longer accurately predict energy savings (e.g., major changes in operations, new construction or equipment, the COVID-19 pandemic). Four programs re-baseline at regular intervals—between SEM program engagement periods for ongoing participants or every two, three, or five years—unless significant changes to customers' energy use occurs first. One program mentioned engaging in re-baselining at the utility's request.

Common practice among interviewed SEM programs using a top-down regression model for energy savings is to compare these savings with a particular base year or on a prescribed basis, and most of these programs re-baseline energy savings models given major changes in drivers of energy use. Such practice suggests that SEM programs seek to make energy savings models reflect what is occurring on the ground, and it appears that a shared consensus has emerged around what makes it necessary to incorporate significant changes into these models.

Facility Boundaries for Calculating Savings

Number	Question
40	What part of the facility is the basis for calculating energy savings (e.g., whole facility, part of the facility)?

In almost all cases, two similar bases for calculating energy savings were observed: (1) the whole facility, or (2) typically the whole facility, except in cases where part of the facility is more appropriate or where customers want to focus only on certain buildings or areas. Depending on the context, a whole-facility basis may be too large and/or too variable to accurately capture in an energy model. The measurement boundary is commonly seen as a flexible one that can contract or expand depending on site specifics. One program emphasized that in cases of a partial-facility basis, this assumption is discussed in advance with the customer to ensure that no load-shifting occurs. Several respondents mentioned that whole-facility boundaries are not always congruent with what is covered by the energy meter(s) in question (e.g., parking lights may be excluded). Two respondents mentioned a quantitative basis for determining the boundaries of what is encompassed in the SEM program: One program mentioned it may exclude a meter if the energy use captured by that meter is 1% or less of base load, while another mentioned that in order to focus on a specific system, that system must represent 20% of facility energy use.

In sum, interviewed SEM programs generally take a whole-facility approach to system boundaries, except when the energy savings model cannot accommodate an entire facility, which is highly dependent on the context of individual sites. A framework that considers some explicit quantitative rules to determine what is and is not included in SEM, if more broadly adopted, would foster greater transparency and rigor in the field of practice.

Energy Sources

Number	Question
41	What energy sources does your organization or utility sell to participants?
42	What energy sources are energy savings calculated for as part of the SEM program offering?
43	From what energy sources are energy savings reported to your regulator?

The questions on energy sources are interrelated. Ten interviewees' organizations sell only electricity to SEM program participants, 7 sell electricity and natural gas, and 7 do not sell energy of any kind to participants (Figure 13). Six of the interviewed programs calculated energy savings only for electricity; 17 programs calculate savings for both electricity and natural gas, and 1 calculates savings for electricity, natural gas, and other fuel types. When it comes to reporting energy savings to regulators, not all programs that calculate savings for electricity and natural gas are required to report savings for both fuel types, with some required to report only electricity savings. One interviewed program self-regulates, with no requirement to report to an external regulator.

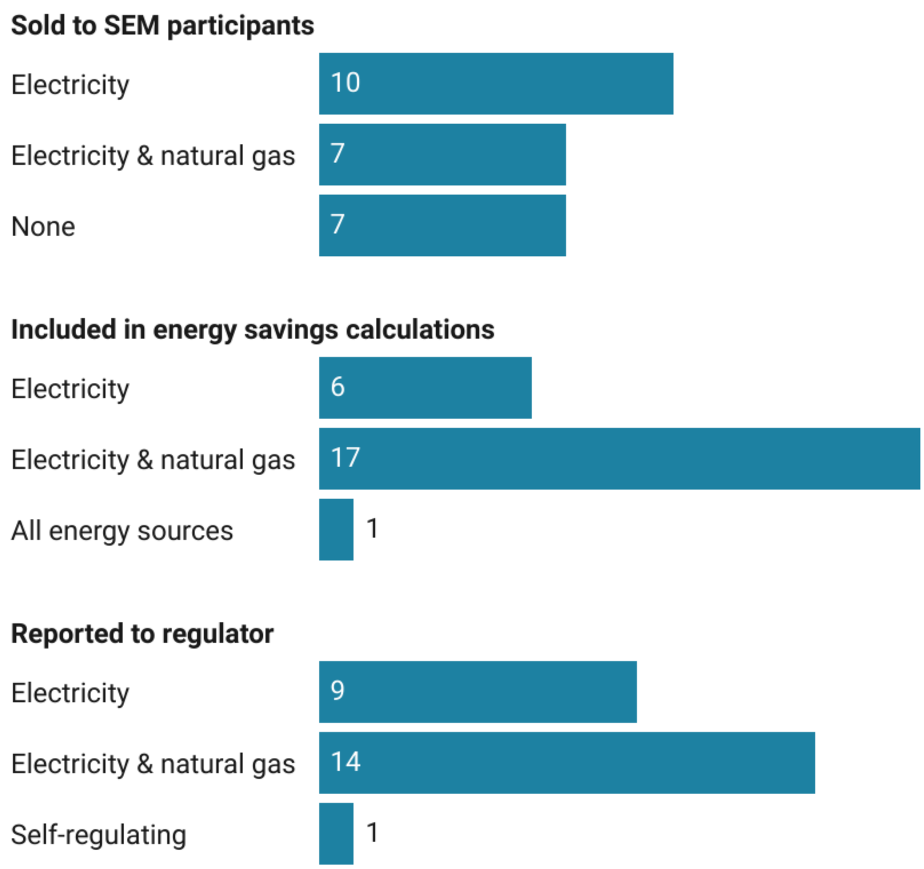


Figure 13: Energy sources sold to SEM participants, included in energy savings, and reported to regulators

Reporting Frequency and Annualization of Savings

Number	Question
44	How often do you report energy savings to your regulator?
46	Are reported energy savings annualized, as if the program's effects were in place for a calendar year?

Once per year is by far the most common frequency with which SEM program energy savings are reported to regulators. Two programs that report biennially to regulators mentioned that their internal reporting is annual (not indicated in Table 11), and 2 programs reported using more than one time interval (i.e., annually and semiannually; or monthly, quarterly, and annually). Others referred to a mismatch between the required reporting schedule and SEM program engagement length.

Table 11: Frequency at which energy savings are reported to regulators

Reporting frequency	Count
Monthly	2
Quarterly	4
Semiannually	1
Annually	17
Biennially	3

When asked whether reported savings are annualized, 14 of interviewed programs confirmed they are. Five do not report savings in this manner, and one program spanning multiple states responded that it depends upon the particular jurisdiction (Figure 14). Programs that do not annualize but do employ an EUL value may be incorrectly calculating the total energy savings over the life of the program.

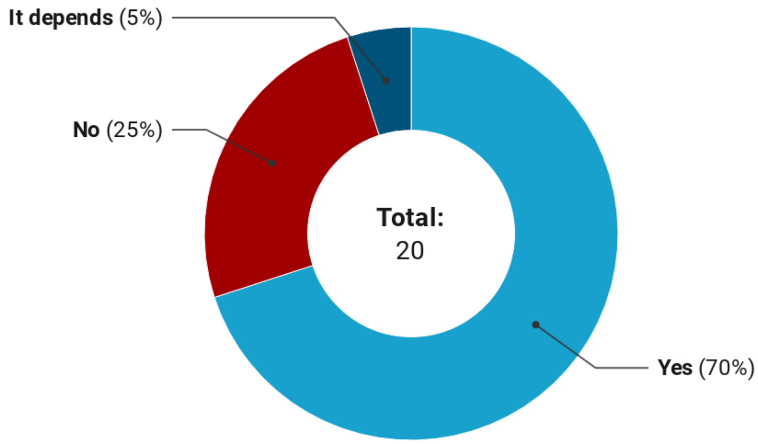


Figure 14: Are reported energy savings annualized?

Non-Utility Energy Supply

Number	Question
45	Are considerations for non-utility supplied energy sources made when reporting energy savings (i.e., is some form of reduction in energy savings made for on-site generation)?

The question about non-utility energy elicited a range of responses, which have been broadly categorized in Table 12. A plurality (9 of 24, or 37.5%) of respondents do not consider non-utility supplied energy sources in reporting energy savings. Four of these did not explain further, while 1 mentioned it is interested only in the energy its own organization supplies to customers, another stated that it assumes savings are all on the utility system, and yet another said that as far as the utility knows, its program does not track cogeneration activities or have credits for them. Those affirming that non-utility energy sources *are* considered typically account for on-site generation in the regression model, although how this is done varies by site. One program mentioned it has used total energy data with alternative meters along with billing data to derive adjustments for on-site CHP and solar. To appropriately account for non-utility supplied sources, Data availability (in terms of sub-metered data) is crucial, as alluded to by several of the "yes" and "it depends" respondents. Finally, 3 respondents have not yet encountered situations in which this question would apply.

Table 12: Consideration of non-utility supplied energy sources when reporting savings

Are non-utility supplied energy sources considered when reporting savings?	Count
No	9
Yes	8
Doesn’t apply yet	3
It depends	2
Unsure	2

Collectively, these responses suggest that within the SEM community, there is no commonly accepted practice for considerations related to non-utility supplied energy. This variation may be due to the nature of a program’s funding and the way in which program budgets were developed (e.g., if electric-only tariffs fund the program, only electric savings may be perceived as of value to the utility and ratepayers).

Types of Energy Savings

Number	Question
47	What energy savings are included in the SEM program’s reported savings?
48	Are reported energy savings disaggregated by the various types mentioned before, or are they reported all together as a single value (behavioral, operational, capital)?
49	Thinking about your response to the relation of the SEM program to other programs, could you clarify when savings are claimed for the SEM program as distinct from programs using savings determined via a deemed or customized approach?

Figure 15 displays the breakdown of individual action types included in reported savings for SEM programs across all respondents. Of the 11 respondents who mentioned capital projects that were installed because of SEM, 6 also noted, unprompted, that capital projects receiving incentives from other programs are netted out of SEM program savings (represented as the light blue portion of the bar). Several said this occurs if the capital project is large enough to be eligible for other incentives. Another respondent mentioned that its criterion for attributing capital project savings to SEM is whether the capital project is considered “direct” (with a one-year simple payback from low/no-cost measures) or “indirect” (with a greater than one-year simple payback), with indirect projects generally not claimed by the SEM program. Last, 1 respondent noted that its SEM program no longer reports savings after 2018, so it was not included in Figure 15.

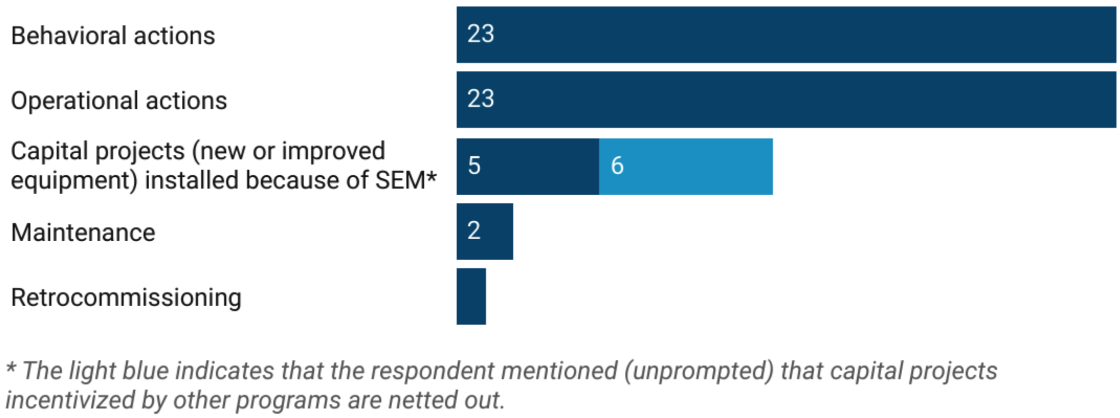


Figure 15: Actions included in an SEM program's reported savings

Some diversity emerged when respondents were asked to clarify the relationship between savings claimed for the SEM program and those claimed for programs using savings determined via a customized or deemed approach. Fourteen programs stated either that they claim energy savings from SEM and capital separately, or that if a measure gets other incentives, those energy savings are subtracted from SEM program savings accordingly. One program mentioned that project tracking software is helpful in this effort. On the other end of the spectrum, 1 program reports savings for all the activity occurring through the SEM program at a given site. For example, if deemed measures like lighting or capital projects occurred through SEM, they would be included as part of SEM savings, but if another site implemented a stand-alone lighting program unrelated to SEM, those savings would be reported in the appropriate (non-SEM) program. Several programs highlighted complexities in distinguishing deemed/customized savings from SEM savings, with 1 citing an "accounting nightmare" depending on the timing of SEM engagement and capital project installation. Another explained that SEM claims savings after they occur, while capital projects claim savings at installation, assuming they will accrue in the future.

An overwhelming majority of interviewed programs (21 of 24) report energy savings from SEM as a single value instead of disaggregating savings into the various actions listed in Figure 15. Many of these mentioned that they roll up or lump together these savings for reporting purposes. Several programs that report savings in aggregate emphasized again that capital project savings are excluded/counted elsewhere. Of the 3 programs that do not report savings as a single value, 1 reports SEM savings in two buckets of "direct" and "indirect" measures, as defined earlier. Another distinguishes capital savings from behavior, retrocommissioning, and operational (BRO) savings, and the last responded that the framing of the question was not congruent with the way the utility thinks about its offerings, which are marketed on the basis of customer needs instead of programs. Reporting SEM savings as a single value instead of disaggregated savings may preclude more nuanced analysis and greater insight into the North American SEM landscape.

Overall, all interviewed SEM programs reporting savings include behavioral and operational actions (with several respondents calling out retro-commissioning and maintenance separately), while fewer than half involve capital projects installed because of the SEM program. These interviews also confirm that SEM program administrators are highly conscientious about avoiding double-counting energy savings, although which types of programs (SEM versus deemed or customized) are credited with savings from projects initiated through SEM is variable in practice. Which savings fall in the SEM realm typically are determined in the plan that defines each program, but SEM programs that claim capital project savings are likely to have longer EULs, and thus to be assessed as more cost effective than they would be without capital savings (see Energy Savings Persistence and Effective Useful Life on page 46 for more). Also, energy savings from SEM may be substantially understated if capital projects that would not have been implemented without SEM are attributed to other programs, whether because no capital savings are included in SEM as a matter of practice, or because these projects are large enough to receive other incentives. However, a motivation to exclude capital savings may be to demonstrate the cost effectiveness of SEM on the basis of cost per unit of energy relative to other programs at the utility (e.g., if the all-in first-year cost of SEM were $0.08/kWh saved compared to a standard offer of $0.14/kWh).

Typical SEM Energy Savings

Number	Question
50	What is a typical range of energy savings, as a fraction of participant baseline energy consumption, that is expected for your program?
51	Does the expected range of annual energy savings change as the participant continues with the SEM program over time?

In response to the question about expected energy savings, some of those interviewed stated a range, others a single point value, and 3 gave us two ranges: a wider range along with a more typical central value or an inner range. In Figure 16 the latter is displayed as a single point, the average of the two endpoints of the inner range. Figure 16 is organized by these three types of responses; within each response type, it is organized in descending order in terms of high or stated central values. Note that the questionnaire did not specify the time frame of expected savings, and in cases where answers were unclear on this, a member of the research team contacted respondents via email for clarification. Several respondents confirmed they had answered this question considering the duration of SEM engagement. Subsequently, expected energy savings values occurring over more than one year were converted to annual savings. In addition, where interviewees mentioned separate values for electric or natural gas savings, these distinctions are preserved in the chart.

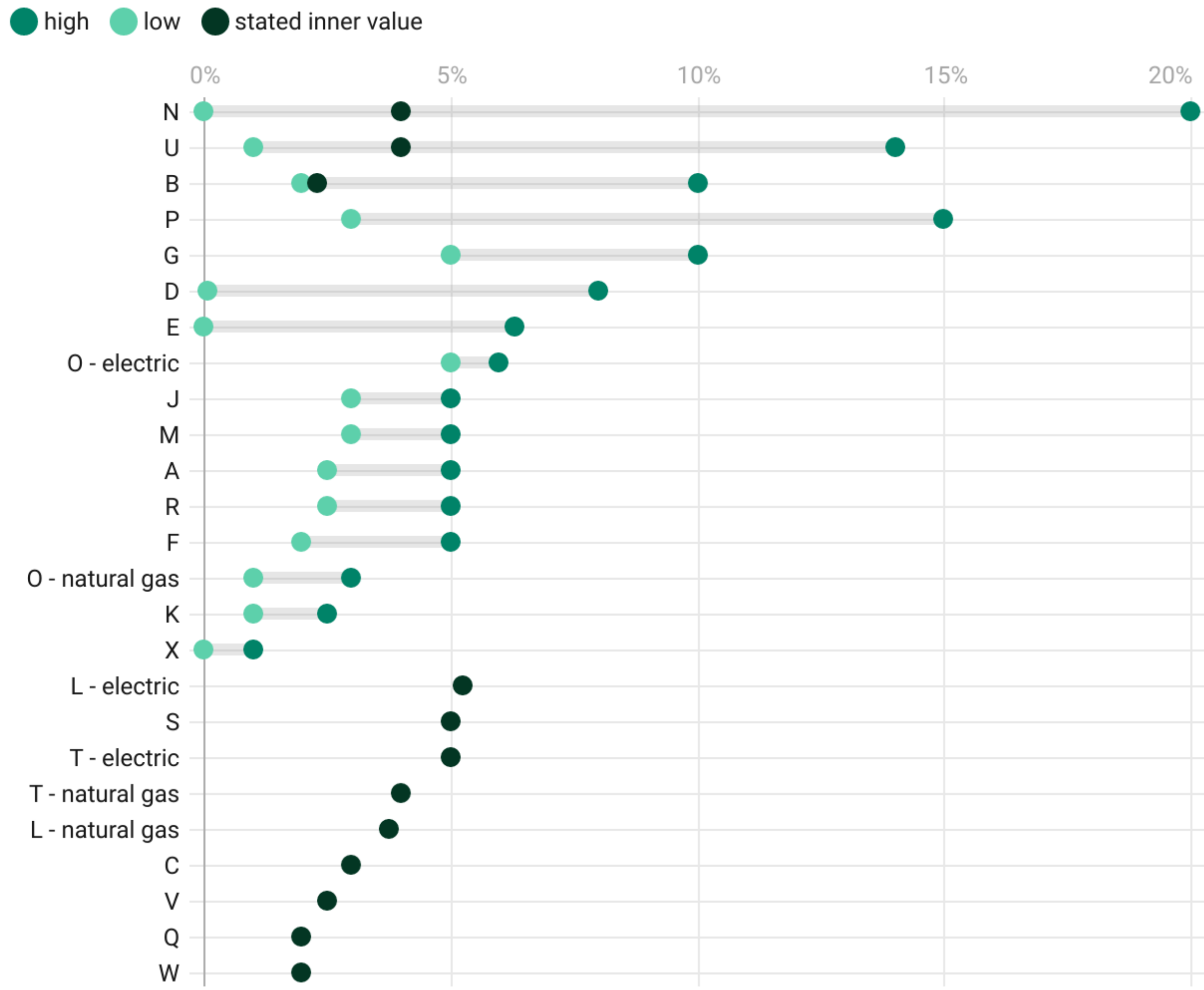


Figure 16: Typical range of expected annual energy savings as a fraction of participant baseline energy consumption

For the 3 interviewed programs that gave an inner range or point value within a wider range as the more usual expectation for energy savings, those savings are in the lower half or at the lower end of the wider range. This indicates that those participants achieving annual savings of 10–20% are atypical—but also not inconceivable. Taken together, stated central values (dark green) range from 2% to 5.25%; low ends of ranges from 0% to 5%, and high ends of ranges from 1% to 20%. Ultimately, 5 separate programs expect annual savings to range from 2% to 5%, and all but 1 of the 11 stated central values fall within this range as well. While programs and the contexts in which they exist are heterogeneous, these overlapping estimates may signify a reasonable expectation for annual SEM energy savings.

In addition, programs reporting a more defined distribution (i.e., an inner or point value within a wider range) have median and mean program ages of 11 and 9.3 years, those stating a range have median and mean program ages of 4 and 3.8 years, and those giving a single point value have median and mean program ages of 2 and 3.4 years. This finding suggests that—as one might expect—as programs persist and accrete knowledge and experience, program administrators speak with more precision and detail about their programs.

Regarding whether annual energy savings are anticipated to change over time, see Table 13. Many programs expect energy savings to change, but the nature of that change varies, with 6 programs anticipating a decrease over time as the low-hanging fruit is plucked, while 8 others anticipate more savings in year two after a ramp-up period. One interviewee stated, "By that point, the energy management teams that have been put in place are now accustomed to the opportunities from simple changes, so we can better sell the reasons for why more robust projects should be implemented." In fact, several of those 8 programs have noted a gradual decay in savings after that period of higher savings has been achieved.

Table 13: Change over time of annual energy savings

Do expected annual energy savings change over time?	Count	If energy savings change over time, what is the nature of that change?	Count
Yes	15	Decrease over time	6
No	6	Increase over time	5
Depends on sector	1	Increase, then decrease over time	3
Don't know	1	Not specified	1
Not applicable	1		

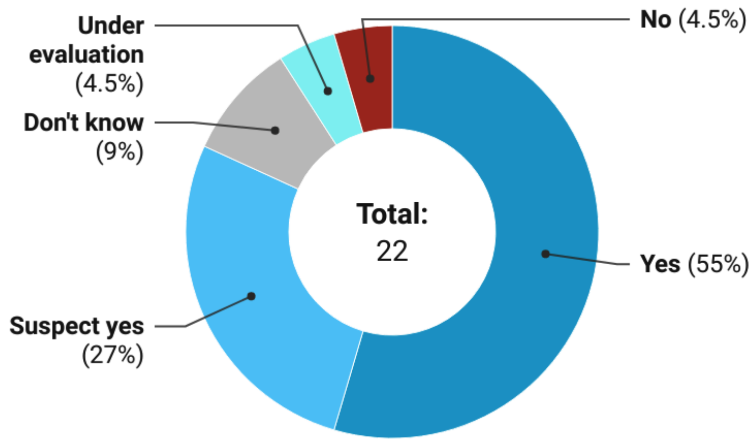
Generally, whether expected annual energy savings change over time varies, suggesting that program-specific contextual factors influence this phenomenon in addition to the magnitude of energy savings.

SEM Energy Savings Compared with Other Programs

Number	Question
52	This is an open-ended question, but would you speak to whether the savings at a facility participating in the SEM program are greater than the savings at facilities that have not participated in the SEM program?
53	Is there a quantitative or qualitative projection of that difference?
54	If the basis is quantitative, would it be possible for you to share that data or evidence after the interview?
55	Do aspects of the SEM program design contribute to this difference?

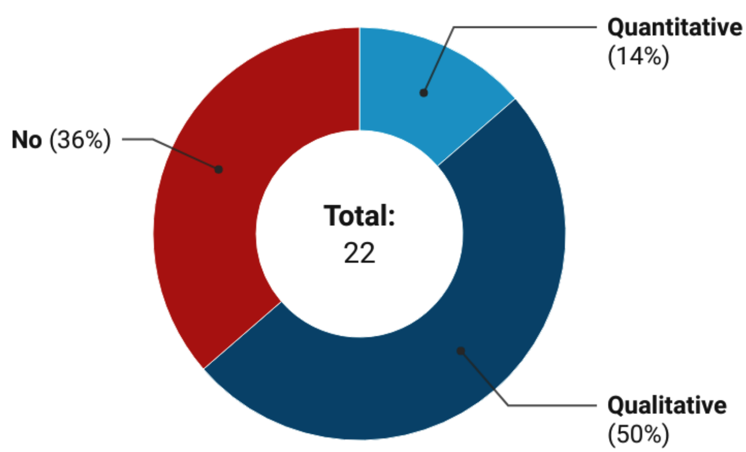
Taken together, 82% of respondents suspect or affirm that savings at facilities participating in SEM are greater than savings at facilities that have not participated in

SEM (as seen in Figure 17). However, an even greater share of programs either have not established a projection of that difference or consider it only qualitatively (Figure 18). It was common to hear from respondents that whether energy savings are greater for SEM than for non-SEM programs is a good—but challenging—question. Several programs mentioned they are currently investigating this matter. They and others cited a lack of data and resources necessary to provide a definitive answer for their program, or methodological challenges that are difficult to overcome. As a result, qualitative assessments of this difference typically are grounded in anecdotal evidence and/or observations.



Two of 24 interviewees found this question not applicable (one because the program was new, one because they calculate bottom-up savings).

Figure 17: Whether energy savings at facilities participating in SEM are greater than those at facilities that have not participated in SEM



Two of 24 interviewees found this question not applicable.

Figure 18: Whether there is a quantitative or qualitative projection of the difference in energy savings between SEM and non-SEM facilities

Only 3 interviewed programs make quantitative projections of this difference. One of them mentioned that SEM participants implement additional capital projects, with one additional project yielding 159,000 kWh in savings on average (within a fairly large range). Another referred to a pending report concluding that 80% of annual industrial SEM savings stem from its energy manager program serving large customers instead of its cohort program with medium-size customers. The third has compared SEM to non-SEM customers' implementation of capital projects and found a far higher rate of capital projects for SEM participant organizations; it is also planning to analyze operations and management–related activities for SEM versus non-SEM customers in the future.

In terms of aspects of SEM program design that contribute to this difference, respondents voiced a diversity of opinions. Several program administrators thought that specific program design elements are less relevant than the concept of SEM overall, with one stating, "It's powerful to [look] at things holistically, putting numbers to the things seen every day but ignored. Empowering people to understand what they are doing makes people grasp the concept of saving energy in the way that individual/one-off projects don't." Another echoed this idea: "The conventional wisdom/anecdotal evidence points at customers undertaking the sorts of activities that identify those opportunities as a function of participating in SEM, whereas before they have not done the deep-dive/energy Kaizen events—but I'm not going to say we've done a full scientific study to verify this . . . We do find that [SEM customers] are often looking at their processes in a more in-depth fashion than they would have otherwise, because they're literally finding things they hadn't thought to look for before . . . These are distinct improvements they would not have made absent the program." A third program administrator also voiced confidence in the nature of SEM: "Competitor [programs] are doing a more piecemeal, project-by-project approach, so I think they're getting less bang for their buck. In some ways, SEM is both horizontal (looking within the organization in that particular cohort year) and longitudinal (looking also at year-over-year improvements upon your improvements). So that's the basis of a continual energy improvement program: once you establish savings, you keep looking for more savings."

Other respondents identified customer awareness and engagement as key to energy savings realized through SEM. One noted that SEM raises awareness such that customers become conscious of energy-related decisions being made. Several other programs mentioned that through SEM, customers notably increase their engagement with the utility or entity offering SEM. One stated that customers become much better at using their services, and another affirmed, "Our relationship with these customers is very different, especially because they're participating on a longer-term basis. We have more contacts and insight into how it's working . . . You'll get bigger savings and longer persistence. They know the system, and take advantage of our system to build a better business case." Another claimed that "SEM is really good at delivering a consistent message with quantitative data to back it up."

Finally, another set of respondents specified particular program design elements as crucial for SEM energy savings. Several referred to technical assistance resources provided through the SEM program, variously mentioning "having someone take the time to analyze the benefit of a project," "bringing in subject matter experts from outside and bringing in internal people for specific trainings," and "general technical services being provided in the form of someone coming in and helping them collate issues all in one place and establishing a set of procedures to systematically work through them." One posited that having an energy manager at the customer site is crucial: "Having someone 100% focused on energy management—they're the conduit for all the projects and for how policies get in place." Yet another flagged opportunity registers as "the thing that seems to stand out in customers' minds," and another interviewee highlighted EMAs: "There's no particular magic in that, but it actually tells people, 'Oh, we don't do this.' Or 'You do it and no one else knew you were doing it.' [EMAs] are just wonderfully eye-opening for organizations to improve."

In sum, among respondents there is support for the hypothesis that facilities engaged in SEM achieve higher energy savings than facilities not engaged in SEM but participating in other utility energy efficiency programs. While exceptions exist, qualitative observations and a limited amount of quantitative data bolster this assertion. In terms of whether specific elements of SEM program design contribute to this differential, some programs referred instead to the overarching holistic concept of SEM, while others variously pointed to customer engagement/awareness, technical assistance, energy managers, EMAs, and opportunity registers. The range of responses suggests that SEM, as currently practiced, is largely perceived by utilities and program administrators as more effective at achieving energy savings than other energy efficiency programs. However, SEM is not rigorously defined; instead, a constellation of various programs and practices exists. It would be valuable to have further research employing empirical data in a robust study design that can isolate the effect of SEM versus non-SEM programs on energy savings.

Program Energy Savings Persistence

Energy Savings Persistence and Effective Useful Life

Number	Question
56	Does your program estimate or assume that energy savings from the SEM program persist after the participant's engagement ends?
57	Is an effective useful life (EUL)-type value applied to the energy savings values reported by your program?
58	What EUL coefficient value is applied?
61	How was the numerical value(s) of the effective useful life (EUL) selected or determined? (Estimated based on past savings trends [econometrically], estimated based on the types of measures installed [i.e., using the EUL of those installed measures], taken from another territory, or other)

The effective useful life (EUL) is a critical input into cost-effectiveness calculations, with a very significant impact on cost effectiveness, but it is difficult to accurately discern how long SEM energy savings persist. As seen in Figure 19, a great majority of interviewed programs estimate or assume that energy savings persist after the SEM engagement ends, and nearly all apply an EUL-type value to reported energy savings. The single program estimating that energy savings do not persist post-engagement assumes a one-year measure life.

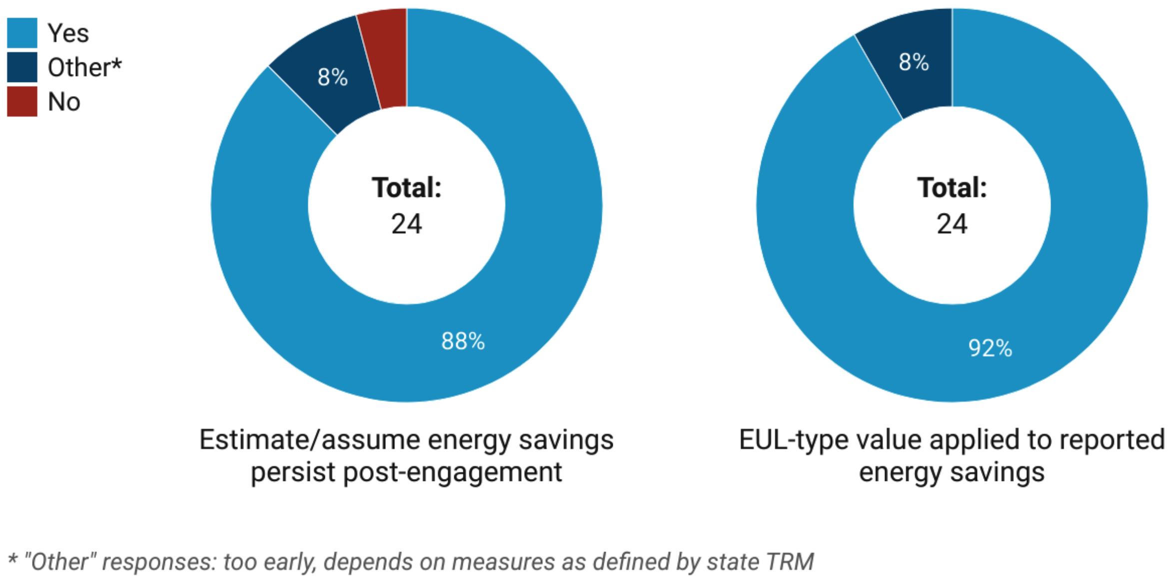


Figure 19: Savings persistence and EULs

Responses to the question of how EUL values are determined or selected ranged widely but can be grouped into the categories listed in Table 14. Note that several programs employed several methods to determine EUL, so the number of responses exceeds 24.

Table 14: Method of EUL determination, and categorization by research team

Method of EUL determination	Categorization	Count
Taken from a study	Secondary	5
Made reasonable assumption	Assumed	5
Estimated based on types of measures installed	Assumed	4
Evaluated	Primary	3
Conducted primary research	Primary	2

Blend of previous custom and prescriptive projects	Assumed	1
Developed internally based on attrition rate	Secondary	1
Estimated based on past savings trends (econometrically)	Primary	1
Negotiated with consultants	Assumed	1
Regulatory decision	Secondary	1
Don’t know	Unknown	2
Too early to say	Unknown	1

To analyze this wide range of determination methods, the research team defined four categories that collectively encompass these methods, as detailed below. Because these categories were developed only after the interviews had been conducted, these assignments were subject to the research team’s interpretation.

- **Primary:** Assigned if a program has conducted original research of some kind into SEM savings persistence to arrive at an EUL value
- **Secondary:** Assigned if an interviewee relied specifically on a secondary source of information
- **Assumed:** Assigned if an interviewee referred to experience or institutional knowledge, reasonable/conservative/tractable assumptions, and/or estimates based on types of measure installed
- **Unknown:** Assigned when the interviewee was not familiar with the rationale behind the EUL value, or it was too early to say

Figure 20 shows 23 EULs from 22 programs (1 program starting in 2020 had not yet determined an EUL value, 1 has no particular EUL since the basis is the types of measures installed, and 1 program routinely applies two different EUL values depending on whether customers develop a sustainment plan). Dots for EULs are color-coded by primary categorization; where programs relied on one more than one method, the research team assumed the most rigorous one applied (primary > secondary > assumed). This plot also displays a horizontal line at the mean EUL, 4.2 years (the median is 3 years).

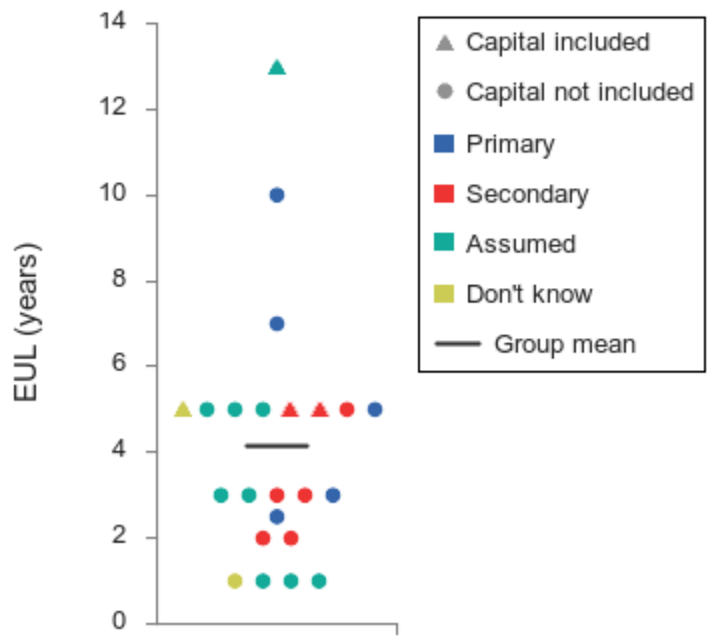


Figure 20: EUL values for interviewed SEM programs, color coded by determination method and with shapes denoting whether capital projects were included in determining EUL

Only five EUL values were determined via primary research and the mean (5.5 years) and median (5 years) for those 5 are higher than those of any other subgroup.

Table 15: Determination method and actions included in SEM savings for two EUL groupings

Determination method	**EUL ≥ 5 years**	**EUL ≤ 3 years**
Primary	27%	17%
Secondary	27%	33%
Assumed	36%	42%
Unknown	9%	8%
Treatment of capital projects in SEM program savings	**EUL ≥ 5 years**	**EUL ≤ 3 years**
Capital projects (installed because of SEM) included	55%	33%
Capital projects excluded	45%	67%

Next, as seen in Table 15, EUL values and their determination method were investigated in relation to other potentially relevant aspects of the SEM program, broken out into groupings arising from the dot plot: EULs of at least 5 years, and EULs of no more than 3 years.

Interview data indicate that primary research determined a greater proportion of EUL values of 5 years or longer than it did EUL values of 3 years or shorter.

In addition, a majority of interviewed programs (55%) with EULs of 5 years or longer included savings from capital projects installed because of SEM, while only one-third of programs with EUL values of 3 years or less included capital project savings. To assess further whether capital projects were a consideration in establishing EUL values, the research team conducted a short follow-up survey of interviewees in March 2021. Data was obtained on all 22 programs surveyed. Only 4, or 18% of, respondents reported that the determination of EUL was based on the program including capital project activity: these were the program with an EUL of 13 years and 3 of the programs with an EUL of 5 years. This apparent inconsistency may be because EULs were developed based on a forecast of program activity, while reported savings are derived from actual activity. Further research may be required to resolve this matter.

Similarly, as Table 16 details, the mean EUL of programs including capital project savings is more than 1 year longer than programs excluding these savings.

Table 16: Mean EUL and program age for different SEM program groupings

Metric (EUL or program age), condition dependent	Mean (years)
EUL, capital projects (installed because of SEM) included in program savings	4.8
EUL, capital projects excluded from program savings	3.7
Program age since earliest SEM, where EUL ≥ 5 years	6.6
Program age since earliest SEM, where EUL ≤ 3 years	7.6

One might also imagine that the chosen EUL could be related to program age; indeed, several respondents indicated they had revised the EUL value over the course of their program. Revisions based on new evidence or information coming to light were typically upward, while those based on some change in the program that prompted a different determination or assumption could be either upward ("we changed to a fixed baseline") or downward ("for simplicity's sake"). However, while the mean program age for EULs of three years or less exceeds that of those programs with EULs of at least five years, a scatter plot (Figure 21) shows no meaningful correlation between these two variables.

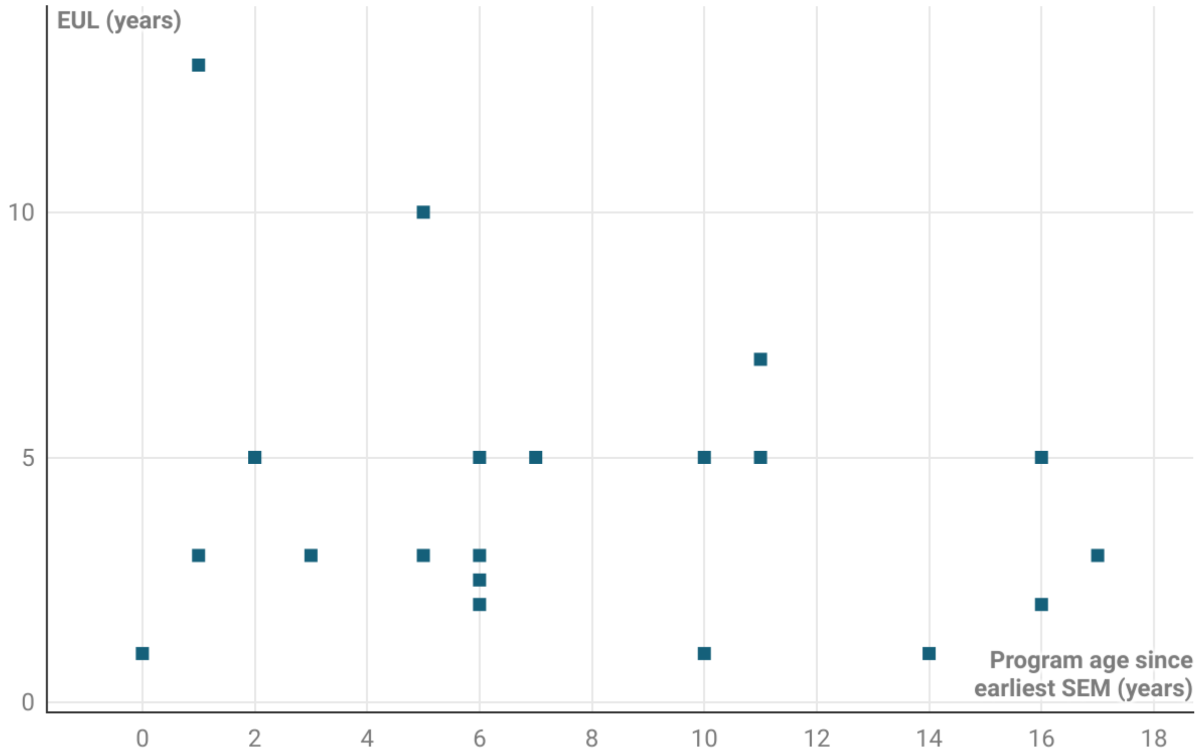


Figure 21: EUL compared with program age since the earliest SEM

In determining EUL values, it is generally very challenging to obtain data-based information given myriad difficulties associated with collecting robust field measurements over time. The findings illustrate that, indeed, less than one-quarter of programs determine EULs via primary research, with the majority instead relying on secondary sources or reasonable assumptions. They also show that programs with higher EULs include capital savings from projects installed because of the SEM program more often than do programs with lower EULs. One important factor for persistence is the sector or subsector to which companies practicing SEM belong; for example, a manufacturing plant that reconfigures its production lines at regular intervals is likely to exhibit a shorter EUL than a wastewater treatment plant that relies on stable technologies and practices over decades. An SEM program with a cohort made up of companies from different sectors or subsectors may find it more challenging to establish an EUL that is adequately representative. Future work in this area might involve investigating the methodologies employed in primary and secondary reports cited by respondents. Ultimately, refining EUL values would ideally be more grounded in field data.

EUL Application and Changes over Time

Number	Question
59	Does the number of years a participant has continued with the SEM program alter the EUL value(s)?
60	For some SEM programs, one EUL is applied to the program's savings as a whole, and in other SEM programs, separate EULs are applied to business practices and to capital projects, i.e., new or upgraded equipment. In your SEM program(s) is the same EUL applied for all actions in the program, or is a different EUL used for different aspects of the SEM program?
62	Has this value (for any of the EULs) changed over time and if so, why?

Most respondents stated that the number of years a participant has continued with the SEM program does not alter the EUL value; only 2 said that it does (Figure 22). One of the latter noted that its evaluators analyze how often participants are continuing SEM engagement and determine an appropriate EUL value from this analysis.

A majority of respondents (15 of 24) apply the same EUL to all aspects of the SEM program, while 7 apply separate EULs for business practices (O&M) and for capital/custom projects or other distinct actions (e.g., stand-alone O&M outside the SEM program). For the latter group, custom/capital projects are given EULs specific to each measure.

A majority of interviewed programs had not changed SEM EUL values over time (Figure 22). Among those that did, half did so on the basis of new information on persistence generated via evaluations, persistence studies, stakeholder advisory groups, and/or experience. One program switched from a multiyear EUL to a one-year EUL for simplicity's sake, while another shifted to an EUL of three years from one year when the program switched from a rolling baseline to a fixed baseline. Finally, another program employs a different EUL (five years instead of one year) if customers establish a sustainment plan focusing on operations and maintenance.

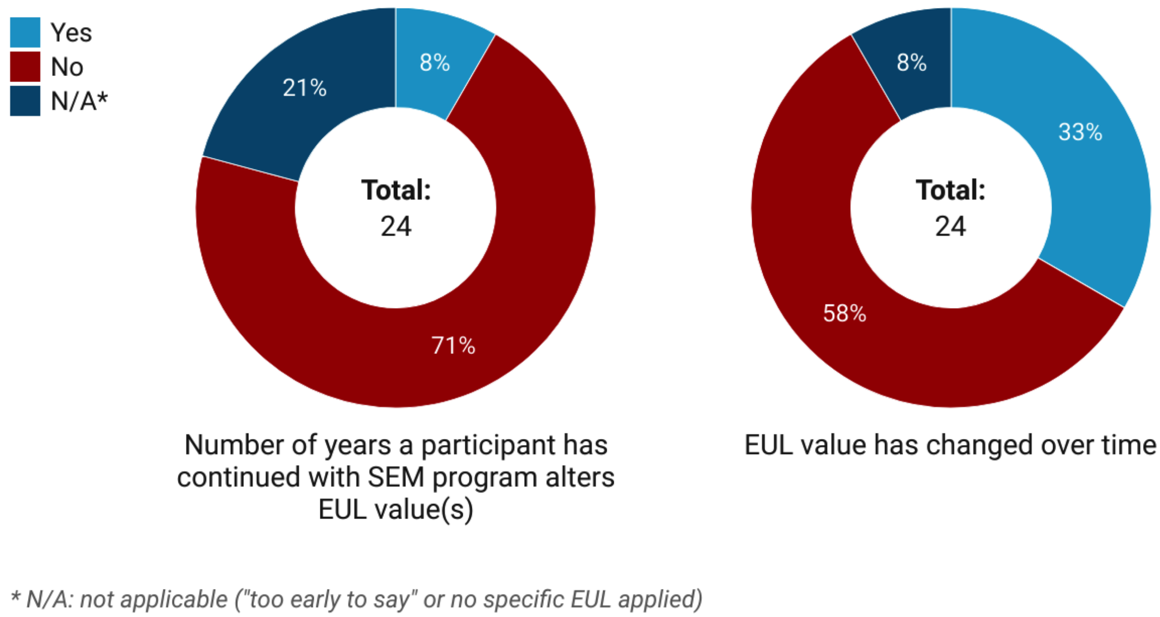


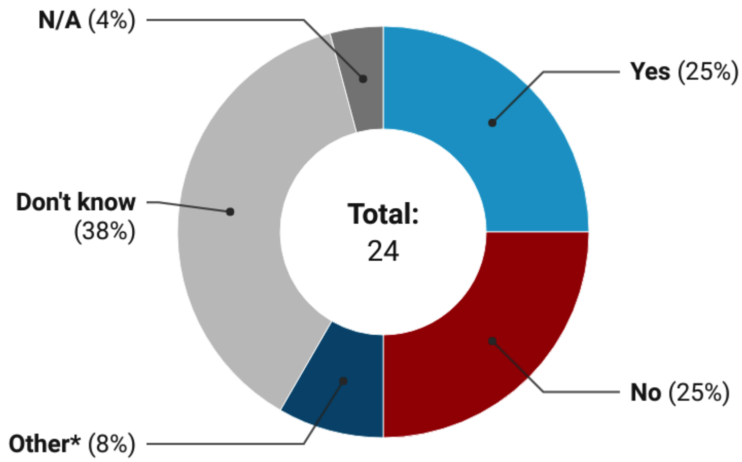
Figure 22: Changes in EUL values over time

Few programs alter EUL values based on the length of time a participant has continued with the SEM program, perhaps in part because doing so defensibly would require a thorough, careful analysis. Because the research team interviewed as many current SEM programs as possible, which vary in terms of program age, it is unsurprising to see mixed results in terms of changes to EUL values over time. Some SEM programs update EUL values in order to integrate new data when they are available; such a practice should be encouraged so that SEM cost effectiveness—of which EUL is a significant driver—reflects realities on the ground as closely as possible over time.

SEM Persistence Compared with Other Programs

Number	Question
63	Do the energy savings achieved through the SEM program at the facility level (i.e., the practices and equipment upgrades taken together) persist longer than the savings achieved by other customers that participate in other energy efficiency programs but not SEM?
64	Is there evidence supporting this, and can you provide it to us?
65	Is there a quantitative or qualitative projection of that difference?
66	Do aspects of the SEM program design contribute to this difference?

One-quarter of respondents indicated that energy savings achieved through the SEM program at the facility level persist longer than the savings achieved by other customers that participate in other energy efficiency programs (Figure 23). The same share responded in the negative, while a plurality of respondents stated they did not know. In addition, few interviewed programs had amassed evidence behind these assertions, as shown in Figure 24. Two of the 3 respondents with evidence confirmed that energy savings achieved through SEM persist longer, and their evidence was qualitative in nature. The third program with supporting evidence asserted that SEM savings persistence (an EUL of 10 years) is comparable to that of other programs, but did not share more about this evidence.



** "Other" responses: "comparable to other programs" and "it depends on which other programs customers participate in"*

Figure 23: Whether energy savings achieved through SEM at the facility level persist longer than those achieved by customers participating in other energy efficiency programs but not SEM

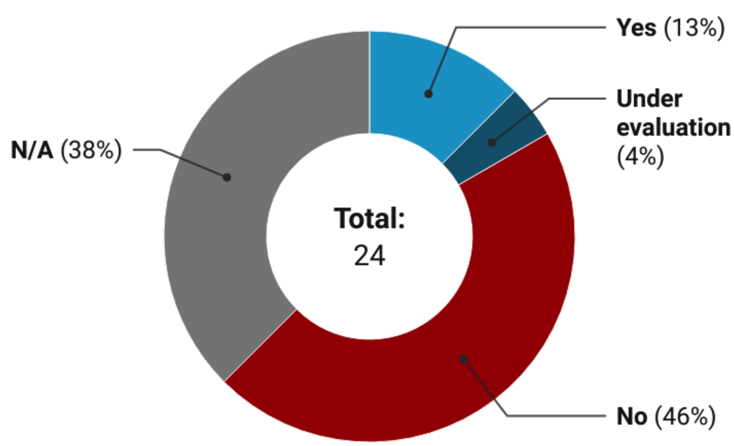


Figure 24: Whether evidence exists to support SEM energy savings persisting longer

Six interviewed programs mentioned elements of program design contributing to the relative persistence of SEM versus non-SEM savings. One of these, who said savings at facilities engaging in SEM do not last as long as those at other facilities, stated that operational and management savings are counted under the SEM program, while longer-lived capital savings are not. Another respondent, who said SEM persistence is comparable to that of other programs, cited culture changes as the driver. The remaining 4 asserted that SEM savings persist longer than non-SEM savings, and collectively mentioned the following contributing factors, some of which are specific elements of program design:

- The relationships built through SEM engagement create persistence.
  - SEM builds a positive relationship between customers and the energy they are using.
  - SEM helps customers perceive the utility as an entity that wants to partner with them to help reduce their bills.
- SEM is holistic.
- SEM has an approved methodology with backing from the state energy regulator.
- The process of SEM engagement is "as streamlined as I can imagine it being."
- Participants can see savings results, which they bring back to their management.
- Contracted implementers have been successful.
- Sustainment plans focusing on O&M, including:
  - Opportunity registers,
  - Mandatory reporting, and
  - Performance contracts

Programs working to achieve longer persistence of SEM savings may wish to consider incorporating some of these elements into their program design.

Interviewed programs demonstrated markedly more consensus and confidence that they get *greater* energy savings from SEM programs than that they get *more persistent* savings (relative to savings from other energy efficiency programs that are not SEM). At the same time, these interviews suggest that energy savings are more rigorously determined than is the persistence of those savings. Thus, it is likely premature to conclude that SEM programs result in higher savings that do not last as long in comparison with those from other, non-SEM efficiency programs.

Program Cost Effectiveness

Cost-Effectiveness Tests Used for SEM Programs

To begin to examine the role of cost-effectiveness analysis in SEM programs, the survey included several basic questions about how this analysis was applied, including:

Number	Question
68	Which cost-effectiveness test or tests are used for your SEM program?
70	Has the test used for approving your SEM program changed over time?
71	Are the inputs for the cost-effectiveness test for SEM developed in the same way as the inputs for other programs?
72	What organization decided the cost-effectiveness test that is in use?

The first, most basic question was what cost-effectiveness test was in use for SEM programs (Figure 25).

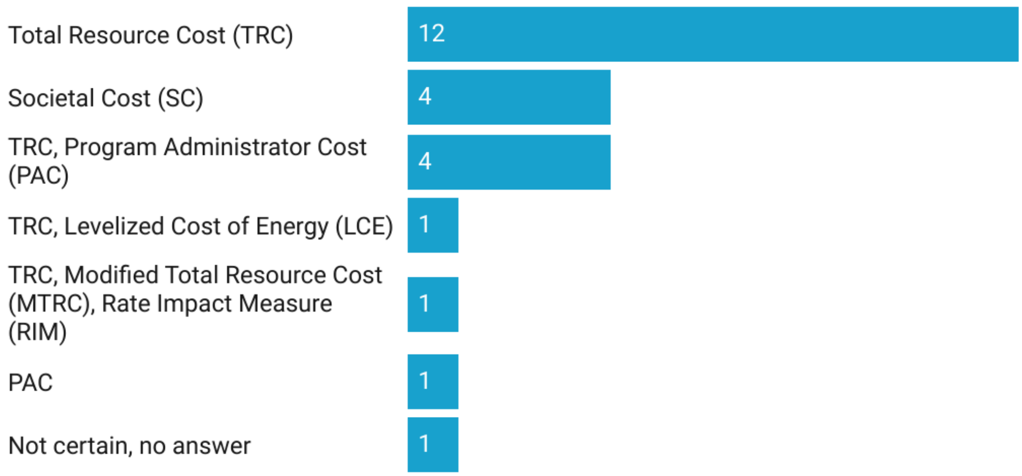


Figure 25: Cost-effectiveness tests used by the interviewed SEM programs

In response, half of the respondents (12 of 24) reported that they used the TRC test. Another 6 reported using the TRC along with other tests. Four respondents used the SC test and did not mention the TRC. These responses indicate that the framework provided by the TRC—that is, the benefits and costs included in the test—is the most common approach in use. Note that other tests are often also used to provide additional perspectives on the effects of SEM programs. The geographic distribution of tests (for territories in which programs were interviewed) is shown in Figure 26.

Interviewees also were asked whether they'd changed their choice of test over time (Figure 27). The responses indicated that the use of a particular test tends to be relatively unchanged; once a test has been established, it remains in place. Only 2 said they were in the process of changing, and another 2 reported that they were considering doing so in the future.

A further question tried to explore more deeply the actual cost-effectiveness test value. Because SEM programs as a group have some unique characteristics, this question aimed to determine if these characteristics had led programs to develop inputs for the cost-effectiveness calculation differently from how they developed inputs for the cost effectiveness of other energy efficiency programs. While the respondents were not always intimately involved in the actual calculations, there were some interesting results (Figure 28).

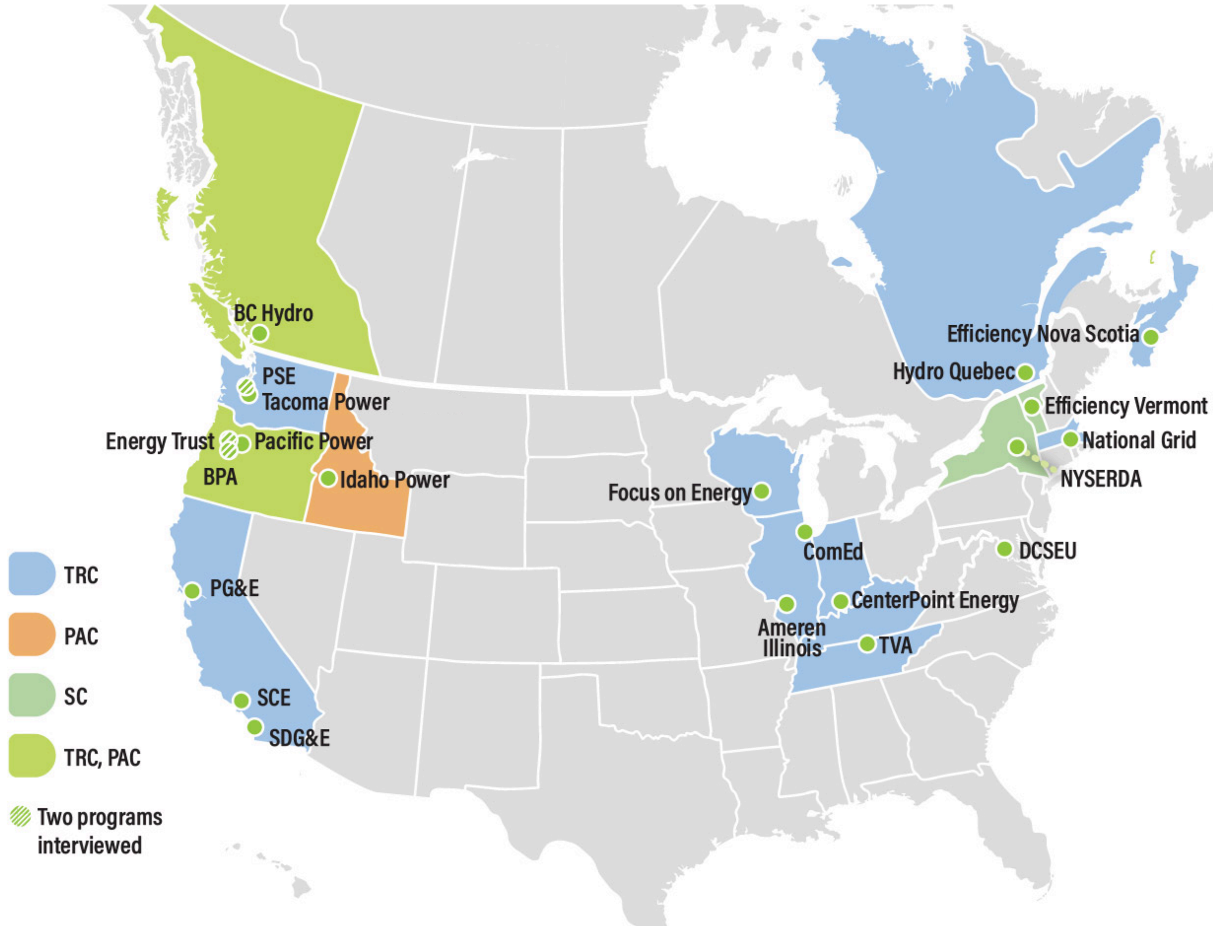


Figure 26: Cost-effectiveness tests in territories in which interviews were conducted

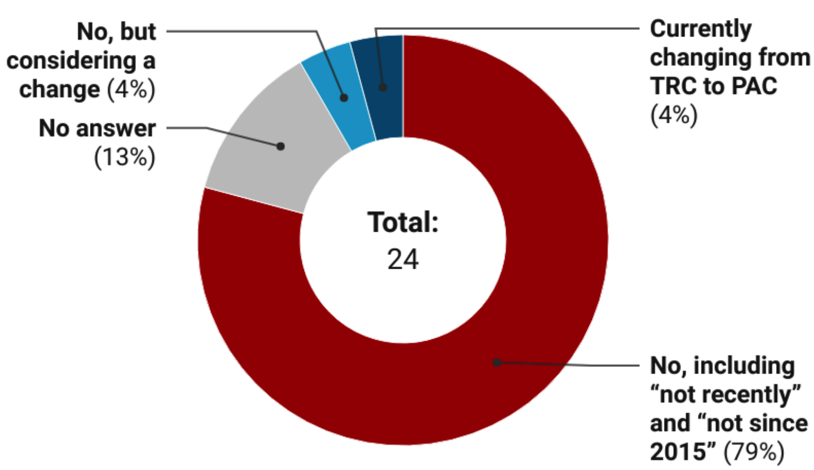


Figure 27: Whether the cost-effectiveness test applied to the SEM program has changed over time

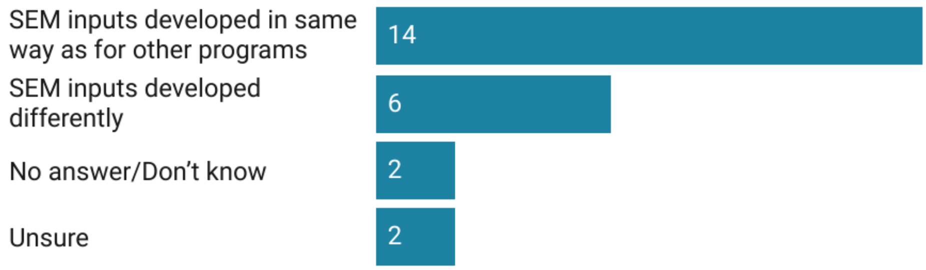


Figure 28: Whether inputs for the cost-effectiveness test for SEM are developed in the same way as inputs for other energy efficiency programs

While most felt the inputs were developed in the same way, 6 reported differences. These fell into no particular pattern but seemed to reflect the specific circumstances of program delivery in each individual situation. For example, one interviewee reported that marketing and outreach costs were only included for the cost-effectiveness value at the sector level, as it was felt that this was a joint activity, with all programs in the sector benefiting. Another respondent said the SEM program had a pre-specified proportion of the benefits (and costs) attributable to the SEM program, while for other programs in the portfolio, this proportion was determined by evaluation and measurement activities. Yet another indicated that SEM program costs did not include some staffing costs, while similar costs were included in other programs. Note that these differences do not capture the fact that some SEM programs include capital project savings and costs and some did not.

The final question in this set of questions concerned the cost-effectiveness test decision maker; that is, what organization approved or authorized the cost-effectiveness test in use. Answers from respondents are shown in Figure 29.

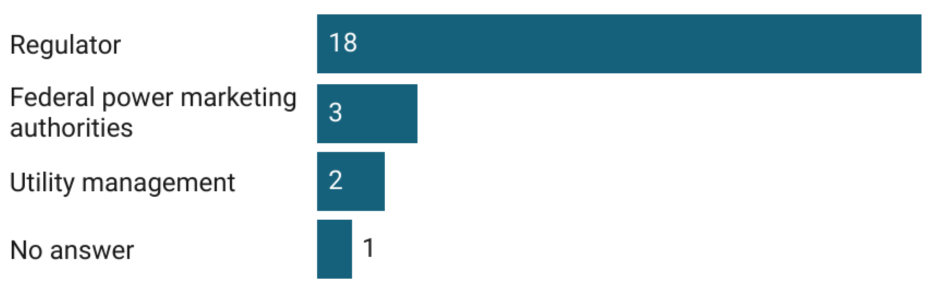


Figure 29: Decision maker for cost-effectiveness test(s)

Three-quarters of responses (18 out of 24) indicated that choice of the cost-effectiveness test came from a regulator specifically charged with representing the public interest. Three respondents stated the test was chosen by their power wholesaler, a federal power marketing authority (also an organization with an eye on the public interest). This generally aligns with the prevalence of the use of the TRC, which is designed to represent a program's total resource effects (representing the program implementer's and customers' collective use of resources). One takeaway is that any proposed change to the test used would have to be approved through a public or regulatory process.

Reported Values for SEM Programs

Respondents were asked to provide a cost-effectiveness value for their SEM program and another value for the portfolio of programs that contained the SEM program. Figure 30 shows the types of results provided.

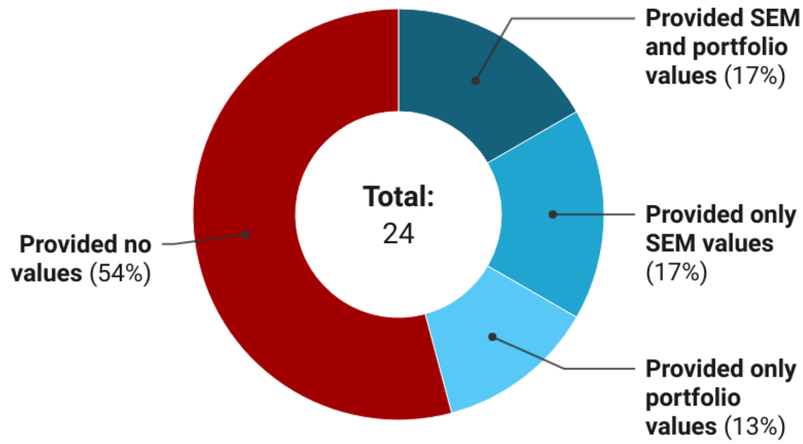


Figure 30: Types of responses to cost-effectiveness question

It is striking that such a large share of this group of program administrators did not provide answers to this question. This lack of response may be an indication that cost effectiveness is not of value or concern to program administrators who participated in this study. When cost-effectiveness values were provided during interviews, they were reported as shown in Figure 31.

Several observations can be made about these values. First, the SEM values range from just over 1.0 to 2.4 (with an outlier at 8.5 paired with a comparable portfolio value of 7.7). All SEM programs were cost effective, so from the point of view of those involved with approving and implementing programs at a particular location, the SEM programs were positive activities. Given that SEM programs are being offered to various customer segments and under various approval methods (e.g., TRC, PAC, and SC tests), there is evidence that the SEM approach has wide applicability. Finally, note that the term *portfolio* was used in the sense of a larger group of programs, including the SEM program, consistent with the respondent's usage.

As discussed in the section on savings persistence, further research would be useful on the effects of SEM programs on participants' implementation of capital improvements. First, if the costs and benefits of those improvements are not counted as effects of the SEM program, the SEM program's effects might not be accurately accounted for. Further, some respondents expressed the opinion that SEM program participants had a greater tendency to implement capital projects.

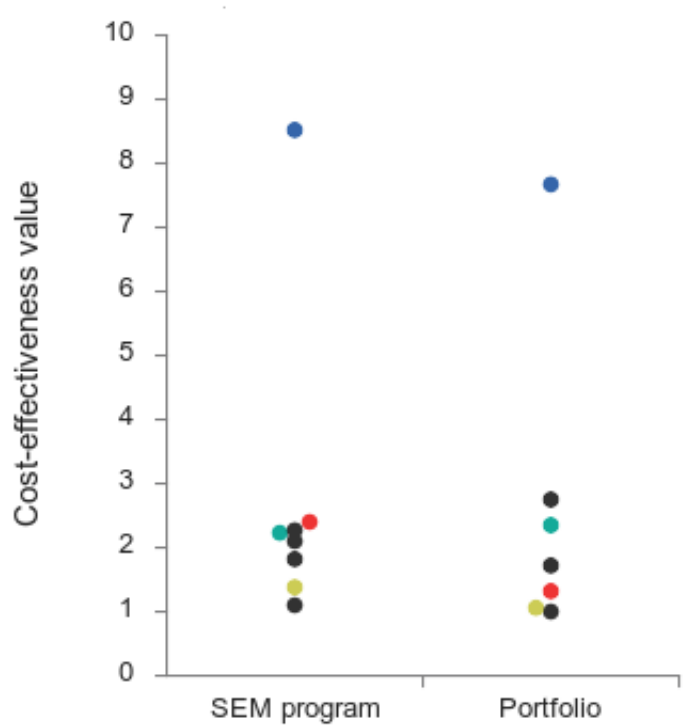


Figure 31: Reported SEM program and portfolio cost-effectiveness values[10]

Comparison of Cost-Effectiveness Results

Besides affirming that each SEM program included in the survey was cost effective, the research team wanted to see whether cost-effectiveness test results could be compared. The first kind of comparison would be between the SEM program and other programs offered currently in the same location. As a general approach, interviews revealed several difficulties in making such a comparison. For example, the SEM program is sometimes targeted to a particular market sector or is used as a feeder activity to increase uptake in other programs in the portfolio, such as those that support capital upgrades. In these cases, the SEM program is part of a broader strategy, and inter-program comparisons would not be meaningful. The surveyed group's responses to these questions did not indicate that such circumstances were commonplace.

The second form of comparison of cost-effectiveness results would be between SEM programs offered by different providers. Unfortunately, in addition to the situations just mentioned, comparisons between different SEM programs are hampered by additional considerations. These include:

- The duration of savings—EUL—included in the cost-effectiveness calculation for the various SEM programs vary from provider to provider.
- No information was gathered on how energy savings were valued for inclusion in the cost-effectiveness tests. This commonly is the cost of an alternative source of

[10] Colored dots represent programs reporting both SEM and portfolio values. Note that the black portfolio value at 2.75 was reported as "between 2.5 and 3.0," so is plotted at the midpoint. The black portfolio value at 1 was reported as "1 or above."

energy, which could be a natural gas–fueled power plant or a source of renewable energy. The actual costs of such resources vary by location and by the means of transporting the energy to the point of consumption.

- Whether capital projects were included as part of SEM benefits and costs varied. About half the respondents said that capital projects were reported as part of the SEM program. Since capital projects often have significant costs and benefits, their inclusion or exclusion could make a substantial difference between two otherwise similar SEM programs.
- Differences exist between the sectors to which the SEM programs are targeted/marketed. Some implementers offer their SEM programs to a customer class (e.g., to all customers defined as "industrial" in that utility service area), while others focus their SEM efforts on a particular category of customer (e.g., pulp and paper mills). These differences are likely to affect the cost of the program as well as the energy savings opportunities, leading to differences in the energy savings benefits over time.

The research conducted for this study does highlight some of the aspects of cost-effectiveness calculations. It also begins an exploration of considerations that will need to be addressed should there be a continued interest in using cost-effectiveness analysis to compare SEM programs.

Customer SEM Persistence

Persistence of SEM Practices after Program Engagement

Number	Question
75	Does any organization formally evaluate the persistence of participants' energy management system activities during or at the conclusion of the SEM program?
76	Are there any assessments of how participants' energy management systems and/or business practices last beyond their participation in the SEM program?
79	Does any organization, for example a public regulator or utility management, have an interest in the persistence of participants' energy management activities? If yes, which organizations?

In addition to inquiring about the persistence of energy savings, the research team asked a set of questions focusing on the persistence of customer energy management practices. Taken together, responses highlighted that while understanding the persistence of energy management practices is an area of interest, there is less focus on that than on the persistence of energy savings overall.

Of 23 respondents, 6 indicated that they or another organization evaluates the persistence of customers' energy management practices at the conclusion of the SEM program, and 17 said this type of evaluation does not take place. Respondents listed a variety of methods by which such assessments are made, including EMAs, third-party evaluation, and internal appraisals.

Extending beyond the immediate conclusion of the SEM program, only 1 of 21 respondents said they currently assess the persistence of customer energy management practices. This one positive respondent stated that an evaluation report queries customer about different SEM activities as part of a larger evaluation of the SEM program. This respondent uses the CEE Minimum Elements as its program's SEM foundation, and its experience with SEM programs is among the longest of interviewed programs. Three of the negative responses to this question specified that it was too early in their program's life to consider such a post-program assessment.

Twelve of 23 respondents confirmed that some organization, such as public utility regulator or utility manager, had an interest in the persistence of customers' energy management activities. The interested organizations are listed in Figure 32, with some respondents identifying more than one organization.

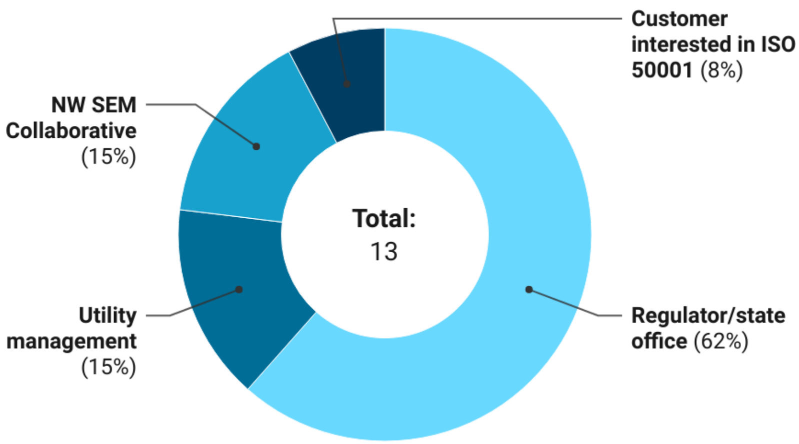


Figure 32: Organizations reportedly interested in persistence of customer energy management practices

More than half of respondents stated that an organization has an interest in understanding customer energy management practice persistence, but only one-quarter actually assessed the persistence of customer SEM practices at the conclusion of the SEM program, and just 1 program makes such an assessment beyond that. This gap highlights an opportunity for programs to capture such data for interested parties.

SEM Programs Challenge Traditional Utility Cost-Effectiveness Metrics

This research focused on the persistence and cost effectiveness of SEM programs. Responses from 24 interviewed programs confirmed that assessing the persistence and cost effectiveness of SEM programs is important to utilities and their regulators, and that the metrics used to assess traditional utility programs (deemed and capital) are applied to SEM programs and the portfolios in which SEM programs are included.

The traditional metric of energy savings persistence is effective useful life (EUL), which is the number of years the annualized energy savings of an energy efficiency program are expected to continue. This is used to estimate energy savings expected to be realized over the average full life of a given energy efficiency measure or project. This multiyear energy savings value, along with other cost and benefit metrics, is typically used as an input to a number of cost-effectiveness tests. A cost-effectiveness test can be applied to a specific program or to a portfolio of programs. Specific inputs and assumptions used in cost-effectiveness tests are variable from one utility to another. Results of this research highlight that EUL and, typically, the total resource cost (TRC) test are commonly used by utilities that offer SEM programs.

The concepts of EUL and cost-effectiveness tests were designed for use with traditional utility efficiency programs. Traditional utility programs, even those implemented over a year or more, can be described as repeated events, each consisting of a single intervention to improve energy efficiency. There is no assumption of subsequent efficiency improvement; the energy savings of each intervention are annualized and last for a specific period of time. Because the concept of SEM is based on a different perspective, the traditional approaches to cost effectiveness and savings persistence may not allow an accurate assessment of SEM program benefits.

The perspective for an ideal or rigorous SEM program would be to establish, at the facility level, a long-term, facility-wide, continual improvement process that results in multiple and ongoing capital as well as operational, maintenance, and behavioral actions that improve energy performance and deliver energy savings. In the most rigorous form, an SEM program includes a commitment by the implementing facility to maintain and increase energy savings over time, even if the effects of earlier energy savings activities decay over time. In this rigorous form, SEM savings for the facility would never end and could continue to increase. This would make the concept of EUL for the facility moot, and also would mean that the application of traditional energy efficiency metrics could understate the longevity of savings (at the facility level) and cost-effectiveness test results.[11]

[11] Because SEM programs are relatively new compared with traditional energy efficiency programs and still exhibit significant variety in terms of their design, use of metrics that may have a conservative bias may be advisable in the near term.

In this study, this potential misalignment was investigated by examining the structure of all 24 interviewed SEM programs to see how many and which programs are structured in ways that make traditional persistence and cost-effectiveness metrics likely or unlikely to provide appropriate assessment. All interviewed SEM programs were assessed for five key factors and placed into one of two or three segments based on their responses. Each segment can be linked to a lower or greater applicability of traditional cost-effectiveness metrics to SEM programs. Table 17 presents the five key factors, along with questions used to place interviewed SEM programs into these segments. This exercise analysis gives insight into which SEM programs are more like traditional programs and which may function more like ideal SEM programs. SEM program objectives, use of an SEM framework, and use of an SEM assessment tool all contribute to understanding the notion of continual improvement, which is core to the SEM concept.

Figure 33 shows the letter identifiers used in this report for each interviewed program, grouped by segment for each of the five identified factors. For each factor, placement of a program to the left of the graphic indicates that the application of traditional cost-effectiveness metrics is more likely to be meaningful than if the program is listed in the central or right-hand segment.

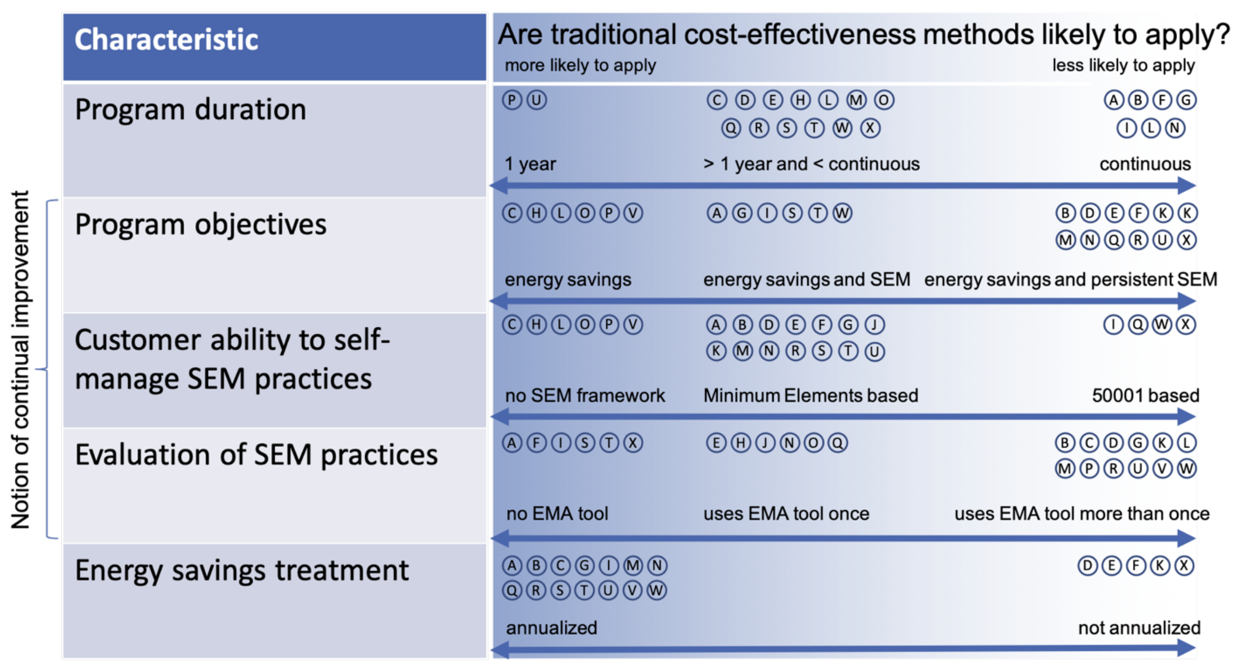


Figure 33: Distribution of utility SEM programs across five key factors, showing differing levels of applicability of traditional cost-effectiveness tests

Programs are distributed within the different segments across the five key factors. There are no major trends in terms of program placement within segments across the key factors, once again highlighting the diversity of SEM programs across the continent. This indicates that the usefulness of the traditional cost-effectiveness metrics could be misleading unless further information, based on the five key factors, has been determined.

This analysis shows that the application of traditional cost-effectiveness metrics are challenged by the objectives and structure of SEM programs, inviting the opportunity to consider whether traditional cost-effectiveness metrics are applicable to individual SEM programs or at large. If traditional cost-effectiveness metrics are not meaningful in application to SEM, then SEM programs should consider different metrics and assess their comparability to results of traditional cost-effectiveness metrics that will still be used for deemed and capital programs. If alternative cost-effectiveness metrics are to be considered for SEM programs, an opportunity exists to develop metrics that are comparable when used by multiple utilities, enabling comparative understanding of the impact that different SEM programs have.

Table 17: Five key factors and input used for segmentation

Key factor	Segments	Relevance to traditional cost-effectiveness metric applicability	Questions used to determine SEM program segmentation
Program duration	• 1 year • 1 year and < continuous • Continuous	Traditional utility programs last for less than one year. This short duration allows immediate claiming of energy savings and does not afford an opportunity for continual improvement of the energy savings.	30: How long do participants typically participate in the program?
Program objectives	• Energy savings • Energy savings & SEM • Energy savings & persistent SEM	Customers participating in SEM programs with a focus on energy savings may have less chance of developing continual improvement practices. SEM programs with an SEM framework and programs stating an intent to impart self-maintained SEM practices to customers will probably have a greater chance of creating customer-driven continual improvement processes.	18: Does the program apply a specific energy management framework to participants (e.g., CEE Minimum Elements, DOE's 50001 Ready, ISO 50001, or a proprietary structure)? 44: How often do you report energy savings to your regulator? 80: In designing or implementing the SEM program, was the persistence of participants' energy management activities considered?
Customer ability to self-manage SEM practice	• No SEM framework • Minimum Elements based • 50001 based	Use of an SEM framework provides customers a basis on which to improve their SEM practices. The SEM Minimum Elements from CEE provides a general framework. ISO 50001 and 50001 Ready provide more detail within that SEM framework.	18: Does the program apply a specific energy management framework to participants (e.g., CEE Minimum Elements, DOE's 50001 Ready, ISO 50001, or a proprietary structure)?
Evaluation of SEM practices	• No EMA tool • Uses EMA once • Uses EMA more than once	EMA tools provide a potential feedback mechanism for customers to assess and improve their SEM practices, potentially creating stronger continual improvement feedback.	19: Does the program use an energy management assessment tool or software? If so, which one? (e.g., Northwest Energy Management Assessment Tool) 20. Does the program monitor or track changes in the participant's energy management practices over time?
Energy savings treatment	• Annualized • Not annualized	Proper use of EUL requires annualized energy savings. Using non-annualized energy sayings with an EUL value will give a misleading result.	46: Are reported energy savings annualized, as if the program's effects were in place for a calendar year?

Notion of continual improvement

Resolution of Research Hypotheses

In preparation for this study, the research team developed a set of hypotheses that tries to address the fundamental nature of the research at hand. Each hypothesis is expressed as the statement to be disproved (i.e., the research team sought to reject the "null" hypothesis, labeled H0) and is paired with an alternative hypothesis (HA). These hypotheses were instructive but were not the only input or framework considered in the development of the interview questions. As such, no individual question or set of questions perfectly addresses each hypothesis. Analysis of responses to multiple questions informs the research team's understanding of the hypotheses and can be used to better understand the SEM program environment at large.

Focus area	Null hypothesis (H0)	Alternative hypothesis (HA)
Program design components	The term "SEM program" is precise enough to allow useful comparisons of cost effectiveness and persistence between SEM programs.	The term "SEM program" is insufficiently precise for useful analysis of cost effectiveness and persistence between programs termed SEM.
Observations	Data analysis indicates that the presented alternative hypothesis is valid. This study showed that cost-effectiveness values from different utilities cannot be meaningfully compared and that each SEM program is unique when assessed by its objectives, design, implementation, and energy savings calculation approach.	
Energy savings	Any SEM program, as named by its implementers, produces energy savings that are comparable to those from any other SEM program.	SEM energy savings are not comparable between programs.
Observations	Data analysis does not allow a definitive selection of either the null or alternative hypothesis as valid. The vast majority of interviewed SEM programs report average typical energy savings of 2% to 6% of facility baseline energy consumption, with individual cases exceeding 25% (see Figure 16 on page 42). The process by which energy savings are calculated, and the inclusion or removal of savings attributed to projects not influenced or incentivized by SEM (such as capital projects), are inconsistent across SEM programs, limiting the value of comparing expected energy savings values between utilities.	
Persistence (energy savings and EnMS)	The effective useful life (EUL) of energy savings is the same for each category of SEM intervention (e.g., one year for changed practices pertaining to energy use, or a fixed number of years for capital or equipment projects).	EUL for SEM ranges widely even within categories of similar actions.
Observations	Data analysis indicates that the presented alternative hypothesis is valid. EUL values for SEM programs vary between 1 and 13 years, with the majority of values below 6 years. Stated	

	rationales for EUL value selection raise questions about the appropriateness of EUL values to specific program design and results.	
Persistence (energy savings and EnMS)	SEM program administrators robustly assess (measure and analyze) the persistence of energy savings from their SEM program either directly (using their own previous SEM program experience) or indirectly (using data from very similar SEM programs elsewhere).	SEM programs do not robustly assess the persistence of energy savings.
Observations	Data analysis indicates that the presented alternative hypothesis is valid. Stated methods used to select EUL values (energy savings persistence) are largely not based on specific evidence related to individual programs. A number of programs' evaluations include energy savings assessment, but rarely do these reports include energy savings persistence studies.	
Persistence (energy savings and EnMS)	The persistence of energy savings is unrelated to whether a customer uses a fully functioning energy management system (EnMS).	The persistence of energy savings from SEM is a function of the customer's energy management behaviors.
Observations	Data analysis does not allow a definitive selection of either the null or alternative hypothesis as valid. While discrete cost-effectiveness values cannot be compared between utilities, the majority of cost-effectiveness values are more or less clustered together, showing that SEM programs are cost effective regardless of design or use of an SEM framework. The selection rationale for EUL value used by SEM programs is highly variable and, in many cases, explicitly not founded on a relationship to the program being offered. Hence it is challenging to say if the persistence of energy savings is or is not related to whether a customer uses a "fully functioning energy management system," as EUL values are not derived with such consideration in mind.	
Persistence (energy savings and EnMS)	SEM programs do not assess—much less measure—the persistence of energy management activities.	SEM programs do assess the persistence of EnMS activities.
Observations	Data analysis indicates that the presented alternative hypothesis is more valid than the null hypothesis. While 75% of respondents use an SEM framework and 63% consider the ability of customers to self-manage their SEM practices after the program ends as part of the program design, only a scant 16% of respondents assess customer energy management activities at the conclusion of the SEM program engagement. Only 1 in 21 respondents assess the energy management activities of customers beyond their participation in the SEM program, though more than half identified one or more organizations—such as regulators and utility management—that are interested in knowing whether customer energy management activities persist beyond the SEM program.	
Cost effectiveness	The predicted and historical cost effectiveness of SEM programs is consistently	SEM programs use a variety of cost-effectiveness tests and various approaches to developing inputs.

	calculated, using the same test components and methods of providing inputs.	
Observations	Data analysis indicates that the presented alternative hypothesis is valid. Across multiple SEM programs, cost effectiveness is not consistently calculated, though the framework of the TRC test is most commonly used. The underlying assumptions (especially programmatic ones) and inputs used by providers are different, making the resulting cost-effectiveness values noncomparable. These differences can include whether the benefits and costs of capital projects are included, as well as a number of differences in the inclusion of costs (e.g., marketing costs). While inter-utility comparisons may not be valid, for a given utility consistent use of cost-effectiveness analysis among its programs and portfolios seems to be the case, so comparisons may be valid. Over time, such comparisons could result in interesting trends or relative cost-effectiveness values.	
Cost effectiveness	No metric other than a cost-effectiveness test is needed to assess whether an SEM program should be implemented or has been successful.	Use of other metrics instead of, or along with, cost effectiveness may be necessary to demonstrate the value or usefulness of an SEM program (e.g., portfolio cost effectiveness, carbon dioxide savings, number of projects identified and implemented, and reduction in business closures or exits from territory).
Observations	Data analysis does not allow a definitive selection of either the null or alternative hypothesis as valid. While the research shows that the inputs and assumptions applied to cost effectiveness by different utilities result in values that are noncomparable, the collective values do show SEM is cost effective. In the course of the interviews, the respondents mentioned a number of other aspects of SEM programs providing value from the perspective of the implementer and also for the participant. Aspects mentioned by implementers include their improved relationships with customers and greater participation in other implementer-offered programs. The values of SEM as reported by customers include peer learning, having set energy management goals, and workforce development (employee training and productivity). These are not considered in most utility cost-effectiveness tests. Additionally, multiple organizations including regulators and utility management are reportedly interested in the persistence of customer SEM practices, but very little assessment is conducted on this topic or included in cost-effectiveness analysis.	

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Appendix A: Table of Reports (Evaluation and Other)

Report name	Sponsor	Report date	Evaluator or implementer	Program years covered
2018 Portfolio Status Report of the Energy Efficiency and Peak Demand Response Programs	AEP Ohio	2019 May	Navigant	2018
Strategic Energy Management Literature Review Findings	Ameren Illinois	2018 October	Opinion Dynamics	N/A
Strategic Energy Management Evaluability Assessment	Ameren Illinois	2019 February	Opinion Dynamics	N/A
Ameren Illinois Company 2019 Business Program Impact Evaluation Report	Ameren Illinois	2020 April	Opinion Dynamics	2019
Growing Pains: Lessons from the Edge of SEM Program Evaluation	Apex Analytics, BPA, Cadmus, SBW	2017 August	N/A	N/A
Demand Side Management Milestone Evaluation Summary Report F2017	BC Hydro	2017 December	Not Specified	Various
Demand Side Management Milestone Evaluation Summary Report F2018	BC Hydro	2018 July	Not Specified	Various
Leaders in Energy Management – Commercial Program Evaluation: F2013 to F2017	BC Hydro	2019 March	Conservation and Energy Management Evaluation	2013–2017
Report on Demand-Side Management Activities for Fiscal 2019	BC Hydro	2019 July	Not Specified	2019
Report on Demand-Side Management Activities for Fiscal	BC Hydro	2020	Not Specified	2020

2020		July		
Industrial Strategic Energy Management (SEM) Impact Evaluation Report	BPA	2017 February	SBW Consulting, Cadmus	2010–2014
Evaluability Assessment for the BPA Commercial SEM Pilot Program	BPA	2017 August	SBW Consulting	N/A
Improvements in SEM Program Impact Evaluation Methods: Lessons Learned from Several Recent Projects	Cadmus, BPA, ETO	2015 August	N/A	N/A
Does SEM Achieve Verifiable Savings? A Summary of Evaluation Results	Cadmus, ETO, NEEA	2015 August	N/A	N/A
Estimating Energy Savings Resulting from Strategic Energy Management Programs: Methodology Comparison	Cadmus	2017 August	N/A	N/A
2014 CEE SEM Program Case Studies Report	CEE	2015 February	N/A	2014
The Second Generation of Strategic Energy Management Programs	CEE, AEP Ohio, Efficiency VT, National Grid	2015 August	N/A	Various
CEE 2016 SEM Program Summary	CEE	2016 November	N/A	2016
CEE 2017 SEM Program Summary	CEE	2018 May	N/A	2017
CEE 2018 Behavior Program Summary	CEE	2018 June	N/A	2018
ComEd and Nicor Gas Strategic Energy Management (SEM) Evaluation Report	ComEd/Nicor Gas	2016 December	Navigant	2015–2016

Joint ComEd and Nicor Gas Company Strategic Energy Management Impact Evaluation Report	ComEd/Nicor Gas	2019 April	Navigant	2018
ComEd Company Strategic Energy Management Impact Evaluation Report	ComEd	2020 April	Guidehouse	2019
Consumers Energy: 2018-2021 Energy Waste Reduction Plan	Consumers Energy	2017 March	N/A	2018–2021
Energy Waste Reduction 2019 Annual Report	DTE Energy	n.d.	N/A	2019
2016 DSM Evaluation Reports	Efficiency Nova Scotia	2017 March	Econoler	2016
Custom Incentives Program 2018 DSM Evaluation	Efficiency Nova Scotia	2019 March	Econoler	2018
Energy Trust of Oregon and Commercial Strategic Energy Management: A Catalyst for Accelerating Customer Energy Savings	Energy Trust of Oregon	2014 August	N/A	2013
2014 Energy Trust Workshops on Strategic Energy Management Impact Evaluation: Report on Key Outcomes	Energy Trust of Oregon	2014 August	Cadmus	N/A
Energy Trust Commercial Strategic Energy Management Pilot: Evaluation Report 2	Energy Trust of Oregon	2014 September	PWP/Michaels Energy	2011–2013
Review of Commercial SEM Savings Methods	Energy Trust of Oregon	2015 June	PWP/Michaels Energy	N/A
Impact Evaluation of Commercial Strategic Energy Management	Energy Trust of Oregon	2016 October	DNV GL	2013–2015
Strategic Energy Management Modeling: What’s good	Energy Trust of Oregon,	2017	N/A	N/A

enough?	Cadmus	August		
Energy Trust Production Efficiency Strategic Energy Management Evaluation	Energy Trust of Oregon	2019 February	Cadmus	2010–2013
Looking Beyond Operational Savings: Quantifying Strategic Energy Management's Influence on Capital Efficiency Projects	Energy Trust of Oregon	2019 August	N/A	N/A
2020 Plan Update to the 2019-2021 Conservation & Load Management	Eversource Energy	2019 November	N/A	2019–2020
Focus on Energy Calendar Year 2018 Evaluation Report VOLUME I	Focus on Energy	2019 May	Cadmus	2018
Focus on Energy Calendar Year 2018 Evaluation Report VOLUME II	Focus on Energy	2019 May	Cadmus	2018
Focus on Energy Calendar Year 2019 Evaluation Report VOLUME I	Focus on Energy	2020 June	Cadmus	2019
Focus on Energy Calendar Year 2019 Evaluation Report VOLUME III APPENDICES	Focus on Energy	2020 June	Cadmus	2019
Triennial Plan Program Year 2019-2021	Hawai'i Energy	n.d.	N/A	2019–2021
Accelerating the Adoption of Strategic Energy Management through Stakeholder Engagement	Idaho Power, Cascade Energy	2015 August	N/A	2013
Demand-side Management Supplement 1: Cost Effectiveness	Idaho Power	2020 March	Various	2019
Demand-side Management Supplement 2: Evaluation	Idaho Power	2020 March	Various	2019

Annual Report for 2019 Energy Efficiency Plan of Interstate Power and Light Company	Interstate Power and Light Co.	2020 May	N/A	2019
Midwest Industrial Energy Efficiency's Future: Using Strategic Energy Management Strategies to Overcome Policy Barriers	MEEA	2019 August	N/A	N/A
Applying Strategic Energy Management to Multifamily: You're Kidding Right? Nope.	Milepost Consulting, O'Brien and Company, PSE	2018 August	N/A	2017
Strategic Energy Management Market Assessment Study: Food Processors and Beverage Manufacturers	NEEA	2012 January	Market Strategies International	N/A
Strategic Energy Management Market Assessment Study: Small, Medium, and Metals Manufacturers	NEEA	2012 January	Market Strategies International	N/A
Strategic Energy Management Market Assessment Study: Dairies, Irrigators, and Nurseries	NEEA	2012 January	Market Strategies International	N/A
NEEA Market Progress Evaluation Report #7: Evaluation of NEEA's Industrial Initiative	NEEA	2012 August	ERS	2010–2011
Commercial Real Estate Program 2012 Impact Analysis: Add On Analysis	NEEA	2014 March	Itron	2012
2013 Energy Savings for the Commercial Real Estate Strategic Energy Management Cohorts	NEEA	2014 April	Cadmus	2013
NEEA Industrial Initiatives- Market Progress Evaluation Report #8	NEEA	2014 April	DNV/Kema	2012
Small to Medium Industrial SEM Energy Savings Validation	NEEA	2014 April	Energy 350	2011–2013
Commercial Real Estate (CRE) Market Test Assessment:	NEEA	2015	New Buildings Institute	N/A

Understanding Delivery, Partnership Strategies and Program Channels		March		
Commercial Real Estate Participant Cohorts Market Progress Report	NEEA	2015 March	Cadmus	N/A
2014 Energy Savings for the Commercial Real Estate Strategic Energy Management Cohorts	NEEA	2015 October	Cadmus	2014
Commercial Real Estate Market Partners Program Savings Persistence Analysis	NEEA	2016 March	Cadmus	2011–2013
Commercial Real Estate (CRE) Infrastructure Market Progress Evaluation Report #1	NEEA	2017 March	Navigant	N/A
Chapter 24: Strategic Energy Management (SEM) Evaluation Protocol	NREL	2017 May	N/A	N/A
Continuous Energy Improvement Market Evaluation YEAR 2	NYSERDA	2018 September	Cadmus	N/A
Continuous Energy Improvement Market Evaluation 2019 Final Report	NYSERDA	2020 April	Cadmus	2017–2019
Idaho Wattsmart Business Program Evaluation	PacifiCorp	2017 February	Cadmus	2014–2015
Washington Wattsmart Business Program Evaluation	PacifiCorp	2017 May	Cadmus	2014–2015
Washington Wattsmart Business Program Evaluation	PacifiCorp	2018 November	Cadmus	2016–2017
Idaho Wattsmart Business Program Evaluation	PacifiCorp	2018 November	Cadmus	2016–2017

Washington Annual Report on Conservation Acquisition	Pacific Power	2020 June	N/A	2019
Strategic Energy Management Impact Evaluation Report	Peoples Gas & North Shore Co	2020 June	Guidehouse	2019
Resource Conservation Manager Program Evaluation	PSE	2013 November	SBW Consulting, DNV KEMA	2011–2012
Industrial Systems Optimization Program	PSE	2017 July	DNV GL	2012–2015
Resource Conservation Manager Program Evaluation	PSE	2018 June	Cadmus	2015–2016
Idaho Energy Efficiency and Peak Reduction Annual Report	Rocky Mountain Power	2020 April	N/A	2019
Strategic Energy Management Cohorts: Wastewater Treatment and Manufacturing Customer Engagement and Collaboration	Snohomish PUD	2019 August	N/A	N/A
Strategic Energy Management Maturity and Its Impact on Savings and Savings Persistence	Strategic Energy Group	2015 August	N/A	N/A
Challenges and Opportunities of Multi-Utility Strategic Energy Management Programs	US DOE	2019 August	N/A	N/A
Evaluation of Continuous Energy Improvement Pilot	Vermont Public Service Department	2016 August	Cadmus	2014–2015
2019/2020 Demand-Side Management Plan Electric and Natural Gas.	Xcel Energy	2019 April	N/A	2019–2020

Appendix B: Interview Questions

Below is in full the exact script used to conduct interviews as part of this research. Limited deviations from scripted questions were permitted; interviewers agreed to employ only neutral prompts to elicit more detailed replies when appropriate.

Introduction

My name is [INTERVIEWER NAME] and I am a researcher at Berkeley Lab studying the cost-effectiveness and persistence of strategic energy management (SEM) programs on behalf of the North American Strategic Energy Management Collaborative. We're aiming to have interviews representing as many as thirty or more SEM programs in Canada and the U.S. The interview will follow a set of standard questions, not all of which may be applicable, but complete responses will facilitate analysis. There will be an opportunity at the end of the interview to catch any additional comments

To begin, I'd like to ask some questions about [ORGANIZATION's] SEM program, [PROGRAM NAME].

1. The goal of our research is to understand how the concepts of cost-effectiveness and persistence are being applied to SEM programs across North America. Are you willing to be interviewed as part of this research project?
    a. Yes/No
2. [NAME] is also on the line with me to take notes as we go. Would it also be OK to record this conversation in case we miss something and would like to fill in the blanks? This recording will not be shared outside the research team.
    a. Yes/No

Some of this conversation is about the information that is already publicly available, while the rest is expected to be kept confidential. Still, if there are any particularly sensitive areas that are discussed, please let me know. You will be given an opportunity to read and comment on the final research report prior to public release.

In this research, we're taking SEM broadly – for example, SEM could include a "continual energy improvement" program, so anything you would consider to be part of that type of program would be something we're interested in hearing more about.

3. In preparing for this call, our team has been looking at evaluation reports, conference papers, case studies, and other published materials on SEM programs. We have identified and called you about the [PROGRAM NAME] program. Is this a program you can speak to?
    a. Yes/No
4. Are there other SEM-type programs offered by your organization? If so, what are they?
5. [OPTIONAL BASED UPON PREVIOUS ANSWER] Who would be an appropriate person to speak to about that program, and how might we get in touch with them?
6. Do you mind explaining your current role at [ORGANIZATION], and specifically with regards to the [PROGRAM NAME] program?

7. We have found the following regarding the [PROGRAM NAME] program: [LIST MATERIALS]. Other than the documents we have already reviewed, are there other materials you recommend we review which provide description of your SEM program? If so, could you send them to me, or provide me with links?

Program Design Questions

First, we would like to learn more about your program.

Program history and longevity

8. When did your organization first start offering SEM programs, including or other than the [PROGRAM NAME] program?
9. When did your organization start offering the [PROGRAM NAME] program specifically?
10. For which years is the current program approved, or expected to be deployed?

Program purpose

11. Does the program have a stated objective? Is there a document with that statement that we can access? If so, could you provide access (a link or reference will do)?

Program history

12. Has the [PROGRAM NAME] program significantly changed over time? If yes, why and how?

Program design ownership

13. Does your organization own the program design, that is, did your organization develop or pay for the development of the program design and hold it now? If not, what organization, if any, does own the design (e.g., the utility, contracted implementers, or other)?

Program design focus

14. What are key or distinguishing activities or concepts of the current SEM program?

Delivery structure

15. Are participants organized into cohorts, treated individually, or grouped in some other way?

Reliance on energy managers

16. Does the program encourage the participant to have an in-house energy manager?
17. Does the program in any part fund an energy manager for the participant?

Energy management system (EnMS)

18. Does the program apply a specific energy management framework to participants (for example, CEE minimum elements, DOE's 50001 Ready, ISO 50001, or a proprietary structure)?
19. Does the program use an energy management assessment tool or software (e.g., NW (NEEA) EMA or proprietary)? If so, which one?
20. Does the program monitor or track changes in the participant's energy management practices over time?

21. When a participant's engagement with the program ends, is there an assessment made of the maturity or self-sufficiency of its energy management practices? If so, how is this assessment conducted?

Program delivery staff

22. Who delivers the program to participants (e.g., utility staff or contracted implementers)?

Engaging customers

23. What types of customer segment does the program serve (e.g., commercial, industrial, agricultural or small, medium, large)?
24. What are the criteria for eligibility to participate?
25. How do customers learn about the program, or how are they recruited?
26. What key value propositions does the program advertise to prospective participants?
27. Does the program provide financial incentives or rebates to participants? If so, which activities are eligible, and what is the basis for the incentive?
28. What do customers report as key benefits of the program? [If only one answer, add "Anything else"?]
29. Do customers report benefits for the SEM program that they don't report for other non-SEM programs? If so, what are these benefits?

Customer engagement

30. How long do participants typically participate in the program?
31. What keeps customers engaged in the program?
32. What sort of engagement with the customer occurs after they stop formally participating in the program?

Relation to other programs

33. Does the program have any relationship to other programs offered by your organization (e.g., other energy efficiency programs, demand response, on-site generation, time-of-use pricing, peak demand reduction, fuel-switching)?

[If the answer above includes other energy efficiency programs]

34. Could you clarify the relationship to other energy efficiency programs, for example the relationship to programs using deemed or customized savings approaches?

<u>Program Energy Savings Questions</u>

Next, we're interested, at a high level, in what methods are used to calculate energy savings from the program.

M&V process

35. Does your program make use of an energy savings methodology document to calculate energy savings? Some common documents include:
    a. ASHRAE Guideline 14
    b. BPA MT&R Guideline
    c. Energy Trust of Oregon Industrial
    d. Energy Trust of Oregon Commercial
    e. California Industrial SEM M&V Guide

f. California NMEC Guide 2.0
g. UMP SEM Evaluation Protocol
h. SEP M&V Protocol
i. IPMVP
j. Or another program specific guideline or protocol: ______________________________

36. Does your program make use of a top-down modeling, a bottom-up project accounting, or both to determine energy savings?
37. Which approach (top-down or bottom-up) is preferred by the program?

[If the answer to the above indicates a top-down approach]

38. Are energy savings calculated compared to a particular base year or on a prescribed basis (for example, year-on-year, against a fixed baseline, compared to industry standard practice, or compared to business as usual for the participant)?

[If the answer to the above indicates a top-down approach]

39. Is re-baselining of the energy savings model considered (i.e., establish a new baseline period and energy model)? What is or would be the governing motivation to change the baseline or model?

Scope and boundaries

40. What part of the facility is the basis for calculating energy savings (e.g., whole facility, part of the facility)?
41. What energy sources does your organization or utility sell to participants?
    a. Natural gas
    b. Electricity
    c. None
    d. Other

42. What energy sources are energy savings calculated for as part of the SEM program offering?
    a. Natural gas
    b. Electricity
    c. Other

Reporting savings

43. From what energy sources are energy savings reported to your regulator?
    a. Natural gas
    b. Electricity
    c. Other
44. How often do you report energy savings to your regulator?
45. Are considerations for non-utility supplied energy sources made when reporting energy savings (i.e., is some form of reduction in energy savings made for on-site generation)?
46. Are reported energy savings annualized, as if the program's effects were in place for a calendar year?
47. What energy savings are included in the SEM program's reported savings? For example, are savings included from:
    a. Behavioral actions

b. Operational actions
c. Capital projects (new or improved equipment) installed because of the SEM program
d. Other

48. Are reported energy savings disaggregated by the various types mentioned before, or are they reported all together as a single value (behavioral, operational, capital)?

[If necessary]

49. Thinking about your response to the relation of the SEM program to other programs, could you clarify when savings are claimed for the SEM program as distinct from programs using savings determined via a deemed or customized approach?

Savings level

[If savings are calculated on a top-down basis]

50. What is a typical range of energy savings, as a fraction of participant baseline energy consumption, that is expected for your program?
51. Does the expected range of annual energy savings change as the participant continues with the SEM program over time?
52. This is an open-ended question, but would you speak to whether the savings at a facility participating in the SEM program are greater than the savings at facilities that have not participated in the SEM program?

[If the answer to the above is YES]

53. Is there a quantitative or qualitative projection of that difference?

[If the answer to the above is YES]

54. If the basis is quantitative, would it be possible for you to share that data or evidence after the interview?

[If the answer to the above is YES]

55. Do aspects of the SEM program design contribute to this difference?

Program Energy Savings Persistence Questions

One of the two main goals of this research project is to evaluate current practice concerning the persistence of energy savings.

Is persistence considered?

56. Does your program estimate or assume that energy savings from the SEM program persist after the participant's engagement ends?

Effective useful life (EUL)

57. Is an effective useful life (EUL)-type value applied to the energy savings values reported by your program?

[If the answer to above is YES]

58. What EUL coefficient value is applied?
59. Does the number of years a participant has continued with the SEM program alter the EUL value(s)?

60. For some SEM programs, one EUL is applied to the program's savings as a whole, and in other SEM programs, separate EULs are applied to business practices and to capital projects, i.e., new or upgraded equipment. In your SEM program(s) is the same EUL applied for all actions in the program, or is a different EUL used for different aspects of the SEM program?

[If the answer to above is YES]

61. How was the numerical value(s) of the effective useful life (EUL) selected or determined?
    a. Estimated based on past savings trends (econometrically)
    b. Estimated based on the types of measures installed (i.e., using the EUL of those installed measures)
    c. Taken from another territory
    d. Other: ____

62. Has this value (for any of the EULs) changed over time and if so, why?

Persistence of SEM vs. non-SEM

63. Do the energy savings achieved through the SEM program at the facility level (i.e., the practices and equipment upgrades taken together) persist longer than the savings achieved by other customers that participate in other energy efficiency programs but not SEM?
    a. Yes/No

[If the answer to the above is YES]

64. Is there evidence supporting this, and can you provide it to us?

[If the answer to above is YES]

65. Is there a quantitative or qualitative projection of that difference?

[If the answer to above is YES]

66. Do aspects of the SEM program design contribute to this difference?

<u>Program Cost-Effectiveness Questions</u>

Scope of cost effectiveness

67. How is the cost-effectiveness of energy efficiency programs for your organization addressed? Is it:
    a. On a portfolio basis
    b. On a resource programs vs. non-resource programs basis
    c. On a sector (i.e., industrial-commercial-residential-others) basis
    d. On a program-specific basis
    e. Other (some basis or not addressed):____ _____

Method

68. Which cost-effectiveness test or tests are used for your SEM program?

   a. Total Resource Cost Test
   b. Societal Cost Test
   c. Utility (or Program Administrator) cost test
   d. Other: ______________________________

69. Is there anything else you would like to add regarding this topic? [Ask this after Q74]
70. Has the test used for approving your SEM program changed over time?
71. For the SEM program to have its cost-effectiveness determined, were the SEM-specific inputs determined…?
   a. In the same way as for other energy efficiency programs
   b. In a different manner from other efficiency programs; please briefly explain this difference [Note-taker checks both this box and fills out the "other" box here if they explain the difference]

Choice process

72. What is the organization that decides which cost-effectiveness test should be used?
   a. Regulator
   b. Utility management
   c. Other: ______________________________

Cost-effectiveness value

73. Most recently, what evaluated numerical value for cost-effectiveness was given to your SEM program?
74. Most recently, what evaluated numerical value for cost-effectiveness was given to the portfolio to which your SEM program belongs?

<u>Program EnMS Persistence Questions</u>

Is this assessed?

75. Does any organization formally evaluate the persistence of participants' energy management system activities during or at the conclusion of the SEM program?
76. Are there any assessments of how participants' energy management systems and/or business practices last beyond their participation in the SEM program?

[If YES to either of the above two questions]

77. How often does your program check on the persistence of energy management activities of previous participants?

Method

[If YES to above questions]

78. Which metrics or tools are used to monitor or check in on participants' energy management activities?

Of value

79. Does any organization, for example a public regulator or utility management, have an interest in the persistence of participants' energy management activities? If yes, which organizations?

80. In designing or implementing the SEM program, was the persistence of the participants' energy management activities considered?

Conclusion

81. Are there other aspects of SEM cost-effectiveness and persistence we didn't ask about that your organization finds important and uses to make decisions? If so, can you speak a little more about them?
82. Who else should we talk to about the topics of SEM cost-effectiveness and persistence, and how might we get in touch with them?
83. As our research proceeds, we may wish to contact you again. Would you be OK with that?
    a. Yes/no

Thank you for your time. We really appreciate your talking to us about these issues. We are conducting interviews over the summer. We expect to be analyzing the data and issuing one or more reports in the fall. As we said, if we use any data or information specific to this interview in a non-aggregated form, we'll check with you first.