GROUP D

Strategic Energy Management Expansion Study

California Public Utilities Commission

CALMAC ID: CPU0376.01

Date: May 23, 2024

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Glossary of key terms and acronyms

California Public Utilities Commission (CPUC) – A state agency created by constitutional amendment in 1911 to regulate the rates and services of privately owned utilities and transportation companies. The CPUC is an administrative agency that exercises both legislative and judicial powers; its decisions and orders may be appealed only to the California Supreme Court. The major duties of the CPUC are to regulate privately owned utilities, securing adequate service to the public at rates that are just and reasonable both to customers and shareholders of the utilities; including rates, electricity transmission lines and natural gas pipelines. The CPUC also provides electricity and natural gas forecasting and analysis and planning of energy supply and resources. Its headquarters are in San Francisco.[1]

Effective Useful Life – An estimate of the median number of years that a measure installed within a program will still be in place and operable.

Free ridership – A measure of the extent to which free riders – project participants who would have installed the same energy efficiency measures if there had been no program – are represented within a population of participants[2].

In-depth Interviews (IDIs) – For this study, a roughly one-hour long interview conducted remotely with either a SEM program manager, a SEM subject matter expert, or a SEM implementer to collect data and test hypotheses.

Industrial SEM Program – An SEM program delivered to industrial customers.

Net-to-gross Ratio (NTGR) – A factor representing net program load impacts divided by gross program load impacts that is applied to gross program load impacts to convert them into net program load impacts. This factor is also sometimes used to convert gross measure costs to net measure costs.[3] The NTGR encompasses free ridership considerations.

Non-industrial sector – Encompasses commercial operations but also includes facilities such as schools, hospitals, and municipal/public sector customers.

Non-Industrial SEM Program – An SEM program delivered to non-industrial customers.

Program Administrator (PA) – An entity tasked with the functions of portfolio management of energy efficiency programs and program choice.

Program manager – One of the 12 SEM program representatives DNV spoke with for the purposes of this study.

Sector or market sector – A group of customers in the same general industry.

Strategic Energy Management (SEM) – A method of managing energy that uses techniques for continual improvement and takes a systematic approach to energy performance. SEM involves, at a minimum, the following three elements: commitment, energy management planning and implementation, and a system for measuring and reporting performance.[4]

[1] CPUC. "California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals." April, 2006.

[2] Phil Degens, et al. "Energy Trust Free Ridership Methodology." Energytrust.org, 8/7/13. https://www.energytrust.org/wp-content/uploads/2016/12/Energy_Trust_Free_Ridership_Methods.pdf

[3] Ibid.

[4] Ethan Rogers, et al. "Features and Performance of Energy Management Programs." January 2019.

1 EXECUTIVE SUMMARY

DNV conducted a California Strategic Energy Management (SEM)[5] Expansion Study on behalf of the California Public Utilities Commission (CPUC). This Executive Summary provides a high-level overview of the study's background, objectives, and approach, as well as our key findings and recommendations for the CPUC staff, their program administrators (PAs),[6] and interested stakeholders.

1.1 Study background

The California PAs and other stakeholders are interested in expanding initial California SEM programs beyond the industrial sector to include non-industrial market sectors, such as commercial, agricultural, education, and the public sector. The original statewide industrial SEM program allows a net-to-gross ratio (NTGR)[7] of 1.0 and an effective useful life (EUL)[8] of five years for all projects adhering to the California SEM Design and M&V Guides (SEM guidebooks), [9] which were initially developed for the Statewide Industrial SEM Program.

As per recent CPUC decision guidance,[10] DNV conducted this study to investigate whether the above NTGR of 1.0 and 5-year EUL assumptions would be appropriate for non-industrial SEM and to develop recommendations for successful non-industrial SEM programs based on our findings. We also examined and developed findings on the suitability of different market sectors for non-industrial SEM and the cost-effectiveness considerations of implementing SEM for non-industrial customers.

1.2 Study objectives & key research questions

The objectives of this SEM Expansion study were to:

1. Identify the sector and program design characteristics that achieve high NTGR values in a California SEM program.
2. Identify the sector and program design characteristics that achieve high EUL values in a CA SEM program.
3. Identify general market sector characteristics of successful SEM participants, including resource availability, knowledge, and cost-effectiveness.
4. Develop recommendations for successful non-industrial SEM programs that justify continued use of the current program NTGR, EUL values, and SEM guidebooks (or the use of these guidebooks with minimal adjustments while maintaining current NTGR and EUL values and cost-effectiveness thresholds).

This study included the following key research questions:

- Are the current industrial SEM program attributes, including the NTGR of 1.0 and EUL of 5 years, justified for non-industrial SEM participation?
- What are the minimum requirements for non-industrial SEM participation and program tracking to justify application of the NTGR of 1.0 and EUL of 5 years?

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[5] Strategic Energy Management (SEM) is a method of managing energy that uses techniques for continual improvement and takes a systematic approach to energy performance. SEM involves, at a minimum, the following three elements: commitment, energy management planning and implementation, and a system for measuring and reporting performance. California SEM programs have been running in the industrial sector since 2018.

6 In this case a program administrator is an entity tasked with the functions of portfolio management of the California ratepayer-funded energy efficiency programs and program choice.

[7] The ratio of net program impacts to gross program impacts. Net program impacts subtract the estimated amount of program impact that would have happened if there had been no program (free ridership). The NTGR estimates the portion of gross energy savings attributable to the financial incentives or activities of an energy efficiency program

[8] Effective useful life or EUL is generally an estimate of the median number of years that the measures installed under a given program are still in place and operable. The upcoming potential and goals study will be looking at refining the EUL estimates for SEM.

[9] SERGIODIAS Consulting. "California SEM Design Guide For: Cycle 1, 2, and 3-Version 1.01." pda.energydataweb.com, 7/5/2022. https://pda.energydataweb.com/api/view/2647/CA_3_CYCLE_SEM_Design_Guide_V1.01.pdf

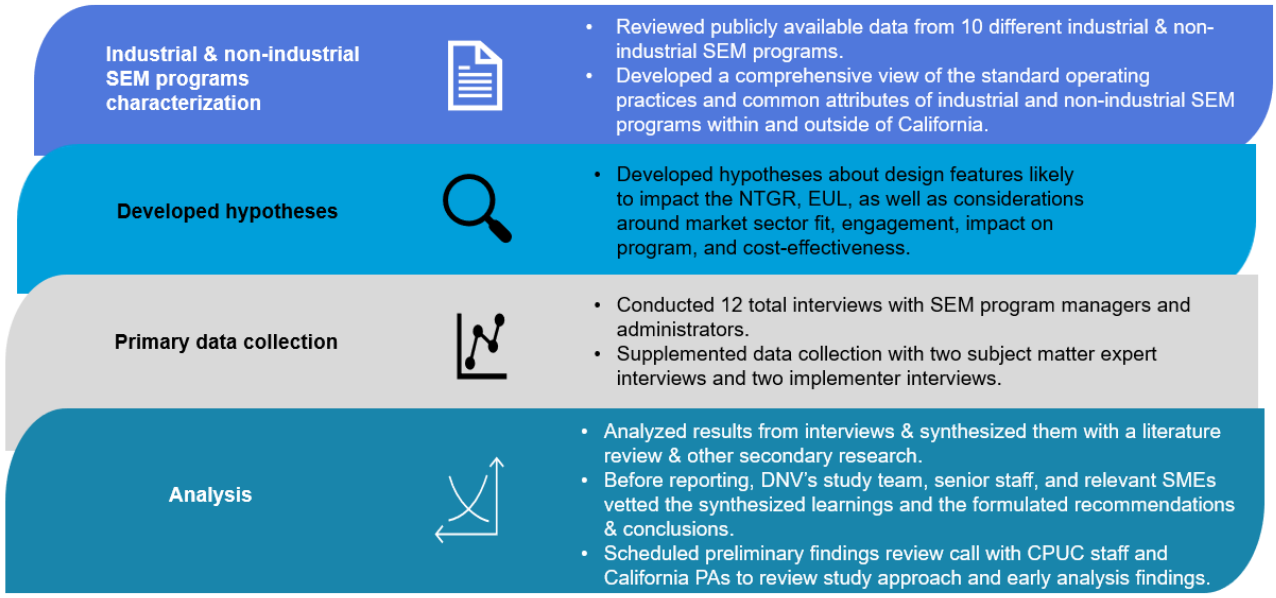
[10] CPUC. Rulemaking 13-11-005-*Decision Addressing Energy Efficiency Third-Party Processes and Other Issues*. 2/2/2023. Decision number 23-02-002. https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M501/K931/501931085.PDF

- Are there any current industrial SEM design elements that may not be required for non-industrial SEM participation, and how are those elements related to the current NTGR and EUL assumptions?
- What are the program design elements of successful non-industrial SEM programs?
- What are the characteristics that make a "good" SEM customer?

1.3 Study approach

Figure 1-1, below, summarizes DNV's approach for this SEM Expansion Study. Section 3 of the full report provides more detailed information about the approach and methodology. Programs targeted for research were drawn from a pool of about 30 programs in operation across the country. They were selected to represent different regions and sectors and to include mature and successful programs. The final targeted list of interviewees was reviewed by stakeholders.

Figure 1-1. Summary of DNV's approach for SEM Expansion Study



1.4 Study results

The following section summarizes the results of the study, grouped by key objective.

1.4.1 NTGR and EUL assumptions

A core objective of this study was to investigate whether a NTGR of 1.0 and a 5-year EUL assumption would be appropriate for non-industrial SEM. Rulemaking 13-11-005 (Conclusion of Law No. 22) states, "Commission staff should complete a study to determine if the NTGR and EUL assumptions for SEM remain appropriate for all sectors and applications."[11]

The 12 non-California SEM program managers we interviewed served diverse sectors, as highlighted in the table below. The average EUL was 7.5 years for the pure industrial programs compared to 4.6 years for the pure commercial programs.

11 Ibid

Table 1-1. EUL and program duration (by sector served)

Program type	Number of programs	Range of EUL claimed (years)	Average EUL	Average duration of participant enrollment (years)
Industrial	4	7-8 (n=2)	7.5	3.7
Commercial & Industrial	3	4-5 (n=2)	4.5	2.3
Commercial	5	1 – 7.3 (n=5)	4.6	3.8

There was also a correlation between the average length of time a customer remained in the program (duration) and the claimed program EUL, which showed that programs that kept participants in the program longer were claiming higher EULs. However, these numeric relationships are not necessarily meaningful since the EULs are stipulated and rarely based on primary research. A review of SEM EUL and NTGR research by DNV, by the SBW team as part of the previous evaluation cycle,[12] and by Grounded Research[13] found limited rigorous independent research into either EUL or NTGR. This analysis included data from seven programs and thus does not represent a rigorous statistical analysis. As discussed further below, respondents saw a much stronger correlation between customer engagement activities and persistence than they did between customer sector and persistence.

There is also a noteworthy lack of primary research into NTGR for SEM programs. The rationale is that SEM identifies low-cost/no cost "things [customers] haven't thought about before, otherwise they would have done them," contributing to the opinion among interviewees that free ridership (which impacts NTGR) is rare in SEM programs. However, only one program we studied claims capital measures. For the other programs, the savings from capital measures were sent to separate, dedicated programs and any capital measure savings were backed out from the SEM program. The California SEM programs allow capital measures to be claimed. NTGR research in California indicates that capital measures, which constitute the majority of custom measures, do exhibit some free ridership.

DNV formulated several hypotheses based on the factors affecting persistence and free ridership, which were posed to the program managers during the interviews. Respondents slightly disagreed[14] with the idea that industrial customers experienced lower free ridership and higher persistence than non-industrial customers, suggesting that program managers do not see a clear difference in how non-industrial vs. industrial programs perform. The consensus view across the 12 completed program manager interviews was that SEM – regardless of the customer sector in question – is designed to discover energy savings opportunities and instill new behaviors that participating customers otherwise would not have known about or adopted, resulting in little to no free ridership. This means that a program delivered to non-industrial customers that adheres to the existing SEM design guidebook should receive the NTGR of 1.0 and EUL of 5 years so long as the core customer engagement activities (described in Section 1.4.2) remain a part of the program (though certain flexibility adjustments can be made, as described in Section 1.4.5).

[12] SBW Consulting, Inc. "2018-19 Industrial Strategic Energy Management (SEM) Impact Evaluation." pda.energydataweb.com, 1/31/22. https://pda.energydataweb.com/api/view/2582/GroupD-SEM%202018-19%20Impact%20Evaluation%20PDF%20Final.pdf

[13] Memo 3: Strategic Energy Management Programs Outside of the Industrial Sector, Grounded Research and Consulting

[14] 4.2, on a 0-10 scale between strongly disagree and strongly agree

1.4.2 Engagement is what makes SEM, SEM

Our review of programs (n=10) and our interviews with program staff and industry practitioners (n=18) paint a picture of SEM programs that are designed and delivered along lines consistent with the California SEM guides, regardless of the location or segments served. With some minor variation, most programs, regardless of sector served, maintain core elements of the SEM engagement template, such as Energy Team check-ins and Treasure Hunts. As an exception, most programs do not require an Energy Management Assessment (though the EMA is an optional task per the CA SEM guidebooks).

Interviewees were consistent in their view that SEM programs take a high level of customer commitment, as noted in their estimates of the annual hours expected of customers when participating in SEM and the average number of staff with a role on the SEM Energy Team (Table 1-2). Interviewees recommended that the Energy Team include at least two staff members.

Table 1-2. SEM program engagement activity overview

Customer engagement activity	Number of programs requiring (out of 12)	Percent of programs requiring	Most highly rated	Least important
Workshops	11	92%	0	4
Treasure Hunt	12	100%	4	0
Opportunity Register	12	100%	0	0
Energy Team Check-ins	11	92%	3	2
Energy Management Assessment	4	33%	0	3

DNV asked program managers which of the SEM engagement activities was most and least impactful on program outcomes. Respondents were hesitant to suggest that any activities were less valuable than others, and, when pressed, usually included a caveat in their answer. They were more likely to note activities they felt were strong components of the package, notably Treasure Hunts and Energy Team check-ins. Respondents strongly agreed (9.2 of 10) that if the most highly rated feature was removed from the program, program savings would be less persistent, suggesting a strong link between customer-facing engagement activities and the persistence of the resulting energy savings.

Interviewees (n=7) with programs serving different customer segments noted differences between the segments (for example, commercial sector focus is HVAC and lighting versus industrial, which focuses on process) but only modest changes in the delivery of the program. For example, for the education sector, one program concentrates activities during the summer months. Other program design elements, like the incentives and the engagement structure, remain the same.

To ensure committed customers, three of the interviewed program managers noted that they conduct customer screening calls to ensure that participating customers have a clear understanding of the expected commitment, the program's objectives, and the benefits of participation. Other program managers had requirements to improve and/or sustain program persistence, like requiring the customer staff to identify back-ups for key positions so that staff turnover would not stall progress at the site.

1.4.3 Energy modeling as both an engagement and measurement tool

The interview structure of this study did not address energy models as a tool for customer engagement; however, interviewees reported that it serves an engagement function as well as a measurement function. According to the

Consortium for Energy Efficiency (CEE) Strategic Energy Management Minimum Elements guide[15], one pillar of a SEM program is using metered data to estimate savings and to reliably report it to stakeholders. Top-down energy models fulfill this function while bottom-up models only do so indirectly and incompletely.

Of the 10 interviewees that responded to the question of whether their programs primarily rely on top-down models, nine stated that top-down was their highly preferred method. Bottom-up methods were allowed as exceptions when models did not produce reliable results. One program manager said, “we don’t ever do bottom-up, it’s just too complicated.” (This program has about 500 sites enrolled at any one time and concluded it was too much volume to allow bottom-up.) Bottom-up estimates can be costly, especially if provided at the same rigor as the top-down models.

In addition to providing critical feedback, the top-down model is the only measurement technique that can reliably and systematically capture behavioral measures, which is the core focus of SEM. Thus, the intended impact of SEM on behavior remains unmeasured, uncelebrated, and unreinforced with bottom-up estimates, whereas a top-down model allows customers to make the connection between their efforts and the resulting energy and cost savings.

Industrial models typically entail multiple independent variables representing production output and schedules that can be challenging to acquire. Non-industrial buildings, however, can often be modeled more easily, using weather conditions and the business schedule as the primary independent variables. There are also open-source and commercial billing analysis tools that could be productively leveraged for some sectors.

1.4.4 Cost-effectiveness and its supporting structures

Another core objective of this study was to gain an understanding of cost-effectiveness considerations in non-industrial SEM programs. The program managers we interviewed widely agree that larger customers are, on average, more cost-effective because they result in greater savings per unit of implementation effort invested. Most of the programs we studied have a minimum energy consumption threshold of about 1,000,000 kWh for SEM program participation.

Most interviewees (9) noted that their largest spending category was labor, in the form of outreach, coaching, site visits, and model development. Based on the program savings and costs provided by the interviewed program managers, there is a trend that programs with higher average savings per participant have the lowest program cost per unit savings, showing that the costs of program delivery do not necessarily scale with the savings potential of participants.

One noted strategy to improve cost-effectiveness was to deliver services through a peer framework, in which a group of participants move through the program in a peer group (like a “freshman class”) and receive certain engagement activities, like training workshops, together. This approach spreads program delivery costs across a large pool of savings, keeping the program cost-effective, and offers an opportunity for members of the peer group to share experiences with, learn from, and encourage each other. Interviewees also noted that smaller customers could perform well and could help motivate larger customers in a peer structure.

Interviewees did not suggest that any customer segment is categorically ill-suited to SEM participation.

1.4.5 SEM design considerations

The California SEM Guidebooks, even through multiple revisions, have provided a consistent framework, or blueprint, for SEM program delivery in California. The findings outlined in this report support the continued use of the California SEM Guidebook framework with targeted changes to add flexibility for all sectors. This flexibility must be bounded to ensure that

[15] “EE Strategic Energy Management Minimum Elements.” cee1.mysite.com, 2/11/2014. https://cee1.my.site.com/s/resources?id=a0V2R00000sUQcE

critical engagement activities are not dropped or diluted to the point that they would deviate from core SEM objectives and jeopardize the continued use of the existing NTGR and EUL values.

Table 1-3 provides recommendations regarding where additional flexibility in the SEM Guidebook will allow program designers to develop diverse programs tailored to the needs of specific sectors or featuring different approaches to delivering the SEM components.

Table 1-3. Summary of activity-level flexibility opportunities and limitations, linked to existing activities

Required SEM components	Potential for flexibility	Potential for peer-style delivery	Notes on limits to flexibility and/or peer-style delivery
Kick-off meeting	No	No	The kick-off meeting should remain a required and individual activity.
Energy Team check-in calls	Yes	No	• Moving from monthly to less frequent (bimonthly or quarterly) meetings can reduce SEM Coach spending depending on the customer and their state of progress. • Implementers may encourage Energy Teams to continue meeting monthly without requiring SEM Coaches to be present; in this case, meeting minutes could be shared to document discussions. • Energy Team check-ins should still occur on a regular basis.
Energy Management Assessment (EMA)	Yes	No	• Interviewees found the EMA to be a helpful but not critical activity. As such, it may be possible to do this less frequently without harming outcomes. This is currently an optional activity in the CA SEM guide.
Energy mapping exercise	No	No	Energy mapping should remain a required and individual activity.
Treasure Hunt and Action Plan	No	Yes	• Treasure Hunts are a critical activity that should not be dropped. • Flexibility-wise, while in-person Treasure Hunts are preferable, interviewees noted that virtual Treasure Hunts can be an option. • In cases where one customer owns or operates multiple similar buildings, staff might attend one Treasure Hunt at a representative building. • SEM Program Managers noted that some participants were comfortable allowing peers in the same cohort to attend their Treasure Hunt as a way to extend learning opportunities. This should be considered an option, though it may be challenging for reasons of geography, competitiveness, etc.
Opportunity register	No	No	Opportunity tracking via the opportunity register should remain a required and individual activity.

Required SEM components	Potential for flexibility	Potential for peer-style delivery	Notes on limits to flexibility and/or peer-style delivery
Site-specific planning exercises (Action Plans, annual planning, transition planning)	No	Yes	• While site-level planning sessions are not compatible with peer group delivery, implementers may consider convening joint discussions to provide common guidance to streamline participants' individual planning activities.
Education, training, and workshops	Yes	Yes	• Program Managers introduced flexibility by allowing participants to skip specific workshops that did not apply to their facilities. • Training and workshops can be delivered via a one-to-many format to reduce delivery costs.

1.5 Key findings

Table 1-4 summarizes DNV's key findings for this SEM Expansion Study. Section 4 of the full report presents our findings in more detail.

Table 1-4. DNV's key findings for SEM Expansion Study

Key finding	Explanation
Nationally, numerous successful SEM programs exist for both industrial and commercial sectors.	The reviewed programs served numerous building and use types within the industrial and commercial sectors.
Little primary research has been conducted into the NTGR for commercial and industrial SEM programs, and program managers see little potential for free ridership in SEM programs.	In general, SEM program managers did not believe free ridership was a factor in their programs due to the rigorous design. They believe that SEM is designed to discover energy savings opportunities and instill new behaviors that customers otherwise would not have known about or adopted. There is also a noteworthy lack of primary research into NTGR for SEM programs. This contributes to the general opinion among SEM program managers and administrators that free ridership (which impacts NTGR) is rare in SEM programs. However, all but one of the programs exclude capital measures, unlike the California programs which allow capital measures to be claimed by SEM.
A wide range of EUL values exist across various SEM programs in the U.S.	Of the 12 programs interviewed, the lowest EUL was 1 year and the highest was 8.5 years; many of these values are stipulated. The average EUL was 7.5 years for the pure industrial programs compared to 4.8 years for the pure commercial programs.

Key finding	Explanation
Programs leverage a common set of simple requirements for SEM participation.	The two types of program eligibility requirements mentioned by program managers included: • Minimum energy spending ($) or consumption (kWh) • A dedicated Energy Team Energy Champions and Executive Sponsors were the roles most commonly required; the Data Lead, which is a requirement for California's industrial SEM programs, was a required role for 2 out of 12 programs.
Program time commitments and duration of participation are key elements of most programs across the country.	The average annual time commitment cited by program managers was approximately 200 hours of staff time per year for SEM participation (or roughly 10% of a full-time employee). This time commitment is significant and is aligned with interviewee perspectives regarding low or non-existent free ridership as a result of the program's high expectations. Program participants remain committed for at least two years across all programs. No other program requires a 6-year cycle for full participation.
Program implementation costs are driven by customer engagement, including coaching, outreach, and site visits.	Program costs are driven by customer engagement, therefore achieving higher savings per customer (because they are larger energy users or higher savings are achieved per customer) will amortize engagement costs across a larger volume of energy savings.
SEM programs share a common framework of customer engagement activities.	This framework includes workshops, a Treasure Hunt, opportunity register, Energy Team check-ins, and energy modeling; these activities were consistent across program sector and customer size. Treasure Hunts and Energy Team check-ins were most frequently mentioned by project managers as the most important engagement activities.

1.6 Conclusions and recommendations

This section summarizes the study's conclusions and recommendations.

Conclusion 1. The research and interviews found no evidence that the NTGR and EUL values should be different for the same program design delivered to the industrial sector versus the non-industrial sector.

Recommendation 1. We recommend maintaining the existing Industrial SEM NTGR value (currently 1.0) and EUL value (currently five years) for non-industrial SEM programs that adhere to the current SEM Design and M&V Guidebooks.

Conclusion 2. The driver of a successful SEM engagement – where success is defined as persistent and meaningful energy savings – is a comprehensive program of customer engagement with a committed customer. The current Industrial SEM Guidebook provides a blueprint for successful engagement that can be applied to non-industrial SEM with minimal changes.

Recommendation 2. We recommend that non-industrial SEM in California continue to employ the industrial SEM engagement elements, such as the Treasure Hunt, Opportunity Register, training/workshops, Energy Team check-ins, and

defined staff roles, among others. The minimum engagement recommendations were discussed in Section 1.4.5. Further, no findings indicate a need to produce a separate SEM guide specifically for commercial participants, though we do recommend that allowances for flexible delivery approaches be introduced to facilitate design and delivery of successful SEM programs to diverse non-industrial customer sectors while maintaining a high level of rigor (see Conclusion 7). This does not preclude stakeholders from making future adjustments when needed.[16]

Conclusion 3. Despite sharing a number of common program design features and customer engagement elements, many of the SEM programs we studied featured a two- to four-year participation cycle, compared to the six-year California program participation cycle. Interviewees indicated that a two-year minimum participation period was critical to allow customers to get familiar with the program and start to see results, though many of them indicated that they expected participants to have "graduated" from the SEM program within about four years.

Recommendation 3. The CPUC may want to consider allowing a shorter program cycle (less than six years) for non-industrial SEM. Because a shorter design could have an impact on persistence, this change could be paired with the introduction of new design elements, like "Succession Plans"[17] and "Persistence Strategies"[18] for individual measures/projects, to help buttress persistence. Guidance for these new design elements can be provided through targeted updates to the existing SEM guidebook.

Conclusion 4. Energy modeling is a core element of a SEM program, providing important feedback on all activities, including BRO and capital measures; the preferred approach is top-down modeling using historical energy consumption. Just as SEM works best with motivated customers, it also works best with sites amenable to modeling. Sites that are unable to secure representative billing or production data, or sites with erratic operations, may not be good SEM candidates because they will have a harder time getting critical feedback on the impact of their actions.

Recommendation 4. Top-down energy modeling should remain the primary method for determining program savings, with individual site exceptions allowed for bottom-up estimates as specified in the SEM Guide. Program designers should be able to propose simpler modeling methods, potentially using open-source or commercial tools to estimate aggregate savings. Programs might also consider screening sites before recruiting for the availability of key data, like production and billing data. The cost of having to utilize bottom-up energy savings methods should also be considered as part of the cost-effectiveness of the program.

Conclusion 5. Program managers broadly agreed that larger customers were more cost-effective for both the vendors and the program, and several noted that smaller customers could be less cost-effective. However, the desire to serve customers of diverse sizes and sectors overrode concerns about site-specific cost-effectiveness. Additionally, program managers assess cost-effectiveness at a program level and count on a mix of large and small savers to balance out a cost-effective program overall. Program cost-effectiveness can be monitored by tracking total program costs and savings rather than by screening individual sites.

Recommendation 5. CPUC staff recommends the SEM Program Implementation Plans (PIPs) specify the metrics for monitoring cost-effectiveness while allowing a broad spectrum of customers to participate to foster program innovation. Metrics could include, but are not limited to: number of targeted annual enrollees, total targeted number of enrollees,

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[16] DNV reviewed the current SEM guidebooks as part of this study.

[17] SEM participants could develop "succession plans" to identify back-up Energy Team members to mitigate the negative impacts of staff turnover. These documents would identify back-ups and outline the role and responsibilities, and would likely be an internal organizational document (potentially based on a common program template).

[18] A "persistence strategy" document would outline a participating customer's plans for ensuring that a behavioral, retrocommissioning, or operations and maintenance (BRO) measure would be maintained after implementation (rather than reverting to the original state). This document could be based on a common template and could be incorporated into the organization's standard operating procedures (e.g., turning lights off at the end of each day, or resetting HVAC setpoints).

standard participant characteristics, anticipated annual usage, anticipated energy savings per participant, average and minimum eligible participant consumption, and project delivery costs.

Conclusion 6. Program delivery to a peer group (like a “freshman class”) offered numerous benefits to the programs we studied, including cost reductions, improved cost-effectiveness, and potentially greater participant engagement.

Recommendation 6. Program delivery via a peer framework – in which participants co-participate in engagement activities and have opportunities to interact with each other – should be an option for California PAs and implementers. Care should be taken not to place direct competitors in the same peer group to mitigate concerns about competitiveness. The size of a peer group must be small enough to still permit high levels of engagement.

Conclusion 7. The current SEM Guide presents a blueprint for SEM programs that can be adapted to address all sectors. A single guide has the advantage of providing consistency and clarity across all SEM programs and will better facilitate program designs that address both industrial and non-industrial sectors.

The value of flexibility was a common refrain across multiple interviewees, who noted that it allowed them to “meet customers where they are,” address individual and sector-specific nuances, and in some cases streamline program delivery without significantly impacting savings or other key metrics (including NTGR and EUL). Notably, the California PAs also described the value of flexibility to “meet customers where they are.”

Recommendation 7. As PAs and program implementers design non-industrial SEM offerings and develop implementation plans, they should do so with an eye toward allowing flexibility in the targeted areas identified in Table 1-3. These flexibility adjustments can be included as modifications to the existing SEM Design Guide without requiring new guides; efforts to introduce flexibility should balance the need to maintain core elements of successful SEM programs with allowing programs to tailor the guide to their specific targeted sectors and use cases.

2 INTRODUCTION

This section provides an overview of the background and purpose of the SEM Expansion Study.

2.1 Background

Strategic Energy Management (SEM) programs have been running in the California industrial sector since 2018 and adhere to the California Industrial SEM Design Guide (Industrial SEM guidebook). This guide outlines the structure and content of program delivery including the type, number, and sequencing of program activities and customer engagement methods; strategies for establishing and/or updating business management practices to foster engagement and continuous improvement; and methods for quantifying and reporting on performance improvements. Per Rulemaking 13-11-005, "the SEM approach leads to capture of additional savings from behavioral, retro-commissioning, and operational (BRO) activities, as well as identification of bigger opportunities and tracking of projects planned by the customer."

The California Program Administrators (PAs) and other stakeholders have recently demonstrated an interest in expanding SEM beyond the industrial sector to include non-industrial market sectors, such as commercial, agricultural, education, and the public sector. As a result, on February 2, 2023, the California Public Utilities Commission (CPUC) was directed to initiate a study to understand whether the guidance from the industrial SEM guidebook could be emulated for non-industrial SEM programs.

Currently, the statewide industrial SEM program allows a net-to-gross ratio (NTGR) of 1.0 and an effective useful life (EUL) of five years for all projects adhering to the industrial SEM guidebook. In Rulemaking 13-11-005, the CPUC directed this study to investigate whether the above NTGR of 1.0 and 5-year EUL assumptions would be appropriate for non-industrial SEM and to develop recommendations for successful non-industrial SEM programs based on lessons learned through the study. The study objectives were expanded further to collect insights on and develop findings regarding the suitability of different market sectors for non-industrial SEM as well as cost-effectiveness considerations for deploying SEM to non-industrial customers. The results of this study may be used to inform updates to the existing SEM guidebooks and/or develop new materials to guide the delivery of SEM to non-industrial sectors that have characteristics conducive to successful SEM participation.

2.2 Study objectives

The objectives of this study are defined as follows:

1. Identify the sector and program design characteristics that achieve high NTGR values in a CA SEM program.
2. Identify the sector and program design characteristics that achieve high EUL values in a CA SEM program.
3. Identify other market sector characteristics of successful SEM participants, including resource availability, knowledge, and cost-effectiveness.
4. Develop recommendations for successful non-industrial SEM programs that warrant continued use of the current program NTGR, EUL values, and SEM guidebooks (or the use of these guidebooks with minimal adjustments while maintaining current NTGR and EUL values and cost-effectiveness thresholds).

2.3 Key research questions

This study included the following key research questions:

- Are the current industrial SEM program attributes, including the NTGR of 1.0 and EUL of 5 years, appropriate for non-industrial SEM participation?
- What are the minimum requirements for non-industrial SEM participation and program tracking to justify application of the NTGR of 1.0 and EUL of 5 years?

- Are there any current industrial SEM design elements that may not be required for non-industrial SEM participation, and how are those elements related to the current NTGR and EUL assumptions?
- What are the program design elements of successful non-industrial SEM programs?
- What makes a “good” SEM customer?

3 METHODOLOGY

This section outlines DNV's methodology for the SEM Expansion Study.

3.1 Approach overview

We understand that after this study, the CPUC will leverage the findings to identify those SEM program design attributes that are *necessary* for a non-industrial SEM program to maintain the current industrial SEM program NTGR and EUL assumptions and may direct changes to the existing SEM guidebook to expand its applicability to non-industrial sectors. Further, the CPUC will leverage these results to guide a cost-effective delivery of SEM programs to the non-industrial space, where there is a wide range of business and facility types; customers both large and small in terms of overall energy consumption; and diverse energy end-uses that may or may not be strong candidates for BRO-type interventions. In order to collect a robust set of evidence for informing the potential next steps outlined above, the study approach was designed to develop a better understanding of both the design of non-industrial SEM programs throughout North America and the experience and thought process of people closely involved with those "peer" programs.

To collect data and reach conclusions objectively, our team followed the steps outlined below:

1. **Characterize** the CA industrial SEM programs and a group of other SEM programs (both industrial and non-industrial) outside of California that have been operating long enough to have a performance track record. This review of publicly available secondary data focused on program design features as well as program-specific NTGR and EUL values, where available.
2. Before collecting primary data (via interviews), **formulate hypotheses** about the design features that are likely to impact the NTGR and EUL; this exercise was informed by the program research conducted above as well as DNV's deep experience with SEM programs throughout North America.
3. Develop **interview guides** to inform interviews of program administrators, SEM subject matter experts, and program implementers (primary research) to gather additional information about the investigated "peer" programs. These interview guides provided a structured and consistent dataset across the diverse SEM programs that were studied and designed to address the study objectives and research questions.
4. **Analyze** the collected data to identify themes, correlations between program attributes and outcomes, and other learnings that will help the CPUC guide the future of non-industrial SEM programs in California.

3.2 SEM program characterization

To characterize industrial and non-industrial SEM programs both within and outside of CA, DNV reviewed the publicly available documentation of various SEM (or similar) programs across the country to develop a stronger working knowledge of the SEM program landscape and to begin identifying common program design features. This review included both industrial and non-industrial SEM programs. DNV reviewed data from 10 different programs with varying levels of publicly available information.

To select programs for review, DNV referred to the American Council for an Energy-Efficient Economy's (ACEEE's) "Features and Performance of Energy Management Programs" report from January 2019, which contained a directory of SEM programs in the US and Canada. We focused on programs that appeared to remain active as of 2023 and further augmented the list based on past experience with SEM programs and industry knowledge. This informed the list of programs DNV then began to research, which included programs in the Pacific Northwest, Midwest, East Coast, and Canada, as well as the California programs.

DNV's review leveraged the following sources:

- Utility websites
- Customer applications and/or program handbooks
- Jurisdiction websites (e.g., energy efficiency committees, regulators, or energy offices)
- Relevant studies and evaluations
- Company annual reports

DNV reviewed the various sources to develop a comprehensive view of the standard operating practices and common attributes of industrial and non-industrial SEM programs within and outside of California, including common attributes across programs as well as key differences between industrial and non-industrial programs. Further, we sought to understand the magnitude of savings and size of the programs in relation to the program attributes (Table 3-1).

Table 3-1. Keywords and attributes searched for in literature review

Attributes	
Size of service territory	Key SEM activities (Treasure Hunts, modeling, etc)
Delivery mechanism	Resource & staff requirements and commitments
Eligibility criteria	Participation requirements
Number of participants	Savings (kWh, therms)
Measures allowed in SEM (e.g., BRO, capital)	Total program budget
Savings calculation approach (e.g., top-down model)	Evaluation process
NTG assumptions	EUL assumptions

After reviewing the 10 identified programs, DNV identified several issues with the literature review process, which are outlined below:

- Publicly available information was scarce for many programs.
- When available, information tended to focus on a limited set of data, such as eligibility criteria and basic SEM activities, without providing additional detail to help differentiate programs.
- Information on participant counts, energy savings, and program budgets was extremely limited.

As a result of these issues, DNV recognized that the study's planned in-depth interviews (IDIs) would be a more fruitful source of specific program design and performance information. Another study (Gaps and Emerging Issues), completed in October 2022, found similar gaps in publicly available information for SEM programs. DNV also interviewed one of the authors of that study in October 2023, who further confirmed that data discovery was a challenge.

As such, beginning in October 2023, the team concentrated its efforts on expediting interview guide development to ensure there would be sufficient time to interview between 14 and 18 subjects, as outlined in the workplan. While there were challenges in collecting program comparison research data through this literature review, the exercise did provide DNV with a good overview of the SEM program landscape, which helped to inform the development of hypotheses and other questions that were included in the interview guide for program staff and implementers.

3.3 Hypothesis development

Through the literature review described in Section 3.2, DNV discovered many consistencies across programs and many questions to consider. We also scheduled a series of three "brainstorming session" webinars (October 12, 13, and 17, 2024) with the California PAs, the CPUC, and several implementers to collect additional insights and feedback that we incorporated into the final workplan and interview guide. We then applied this knowledge to the development of talking points for group conversations and interview questions for in-depth interviews (IDIs).

Table 3-2 below illustrates the hypotheses that DNV designed, through this process, to be tested through IDIs and other conversations and that were informed, in part, from the literature review activity. We pulled the hypotheses directly from the interview guide. DNV designed these questions to test respondents' agreement or disagreement with them, which provided valuable data pertaining to how SEM program managers (PMs) view the relationships between program attributes and metrics such as NTGR, EUL, and cost-effectiveness.

Table 3-2. Hypothesis questions (from interview guide)

Hypothesis #	Program Design Attribute	Hypothesis
1	Measure types	If a SEM program includes capital measures, the free ridership will increase.
2	Customer engagement activities	If the [most highly rated engagement element defined in Q9] was dropped from my program, savings would be less persistent.
3	Customer engagement activities	If the [lowest rated engagement element defined in Q10] was dropped from my program, savings would be less persistent.
4	Customer engagement activities	You reported the average number of engagement hours required from the customer is [Q12 response]. If the average number of engagement hours required by the customers in the program were reduced by 20%, the free ridership will increase (or persistence will decrease).
5	Technical staff	In my program, sites with less technical staff, for example, administrators versus trained HVAC or equipment technicians, will have less persistent savings.
6	Customer segment/facility type	In my program, commercial sites typically require less customer engagement than industrial sites.
7	Top-down savings modeling	If savings estimates are predominantly calculated using top-down pre/post billing savings models, the free-ridership will decrease (or persistence will increase).
8	Customer segment/facility type	Industrial SEM participants typically have lower free ridership and longer-term persistence of savings than non-industrial SEM participants.
9	Customer engagement activities	Utilizing a cohort strategy versus one-on-one engagement with SEM participants decreases customer engagement. (A cohort strategy involves engaging a group of customers, often but not necessarily from the same industry, to jointly participate in SEM in order to share best practices, learn from each other, and set targets.)

3.4 Data collection

The primary source of data for this study was IDIs with SEM professionals; the interview count by interviewee type is summarized in Table 3-3 below.

Table 3-3. Interview counts by interviewee type

Interviewee type	Interview count
SEM program managers and/or administrators	12
SEM subject matter experts	4
SEM implementers	2
Total	**18**

DNV primarily interviewed SEM program managers and administrators (12 total interviews) and supplemented data collection with two subject matter expert interviews and two implementer interviews to capture broader perspectives. We anticipated that this population would have the best and most current insight into SEM program design and attributes, program theory, program delivery, and program outcomes, including considerations of cost-effectiveness and the suitability of SEM for participating customers from different market sectors.

Each interview was approximately one hour long and was conducted by an experienced technical interviewer. We found that the SEM community was excited to participate in the study by answering our questions and providing their perspectives. As an expression of our gratitude for their time, we offered each interviewee a $100 honorarium.

3.5 Analysis

Upon the completion of primary data collection, DNV compiled, applied quality control (QC) to, and analyzed the results of the interviews, synthesizing them with a literature review and other secondary research. The interview data was transformed into a centralized Excel workbook to facilitate analysis. Before reporting, the synthesized learnings and formulated conclusions and recommendations were vetted by DNV, including senior staff and relevant SMEs. DNV then scheduled a preliminary findings review call (February 13, 2024) with the CPUC and the California PAs to provide an opportunity for review and comment before report finalization. In this meeting, we reviewed the study approach and early analysis findings.

Note that there were not enough SEM programs or SEM program variations to be able to compare all characteristics in a statistically robust manner. Our intent, instead, was to conduct robust outreach and thorough interviews to gather well-rounded perspectives from industry experts and across jurisdictions; this, in turn, provided a clear understanding of the attributes of successful non-industrial SEM programs and how they related to NTGR, EUL, cost-effectiveness, and sector-based considerations.

4 RESULTS

The following subsections outline the results of our analysis.

4.1 Interviewee and program overview

DNV conducted interviews with representatives from 12 SEM programs in North America; these respondents are referred to as interviewees and project managers throughout this report. The majority of interviewees were the Project Manager of their respective program; several people we spoke with also indicated that they support program design, provide technical and/or engineering expertise, or serve as a sector lead in addition to project management responsibilities. Interviewees had an average of six years of experience working in their role with their SEM programs, and the studied programs had an average of almost nine years in operation, with some programs having been established in the last several years and others dating back to as early as 2010.

Several participants described their programs using language that is common among SEM professionals, including the following quotes:

- "Our program aims to achieve holistic, cultural, organizational change [with regards to energy usage and behavior.] We focus on low/no-cost efforts, identify a quick win early, and then work with the site's established Energy Team to create successful strategies for the long-term."
- "We help large commercial customers save energy in facilities through no- or low-cost improvements and behavior changes. We also provide educational workshops, Treasure Hunts, opportunity registers, and technical support."
- "We focus on the entire business or a specific campus with multiple buildings. We deliver workshops, trainings, Treasure Hunts, energy models, and teach the fundamentals of energy management to save energy."

Others have developed more unique program designs, with one interviewee describing how their program, launched in 2016, pivoted from an in-person, cohort-based design during the COVID-19 pandemic to an "entirely virtual and one-on-one" design (DNVSEM06). Their current design leverages aspects of both previous designs to incorporate flexibility in participation while still giving participants the opportunity to engage with peers. Another program positioned itself as an "industrial audit" program that served as a feeder to other existing energy efficiency programs.

Interviewees also cited several common objectives of their SEM programs, including:

- Energy savings
- Participant engagement (through enrolling more participants)
- Training and educating customers
- Non-energy benefits, including reliability

The program descriptions and objectives provided by participants closely align with the language in the California Industrial SEM Design Guidebook. The guidebook says that SEM "is delivered to a customer through a progression of educational modules and site-specific activities" and is designed to "continually develop the customers' understanding, skills, and capabilities relative to energy while consistently delivering energy savings."[19]

4.1.1 Market and customer sectors

Table 4-1 summarizes the breakdown of the market sector orientation of the programs we studied. Note that these counts are drawn from the 12 program manager interviews we conducted.

[19] SERGIODIAS Consulting. "California SEM Design Guide For: Cycle 1, 2, and 3-Version 1.01." pda.energydataweb.com, July 5, 2022. https://pda.energydataweb.com/api/view/2647/CA_3_CYCLE_SEM_Design_Guide_V1.01.pdf

Four of the 12 programs had a purely Industrial focus (green), five had a purely Commercial focus (blue), and three had a Commercial and Industrial focus (light blue). One program was focused solely on K-12 schools. It appears that narrowly focused programs are less common than those that accept customers from a broad set of market sectors and business or organization types.

The SEM program managers we spoke to also indicated that their programs are offered to numerous diverse types of customers within the commercial and industrial sectors, which is further highlighted in the table below.

Table 4-1. Market Sectors Served by SEM Programs

Program number	Industrial	Manufacturing	Agriculture	Wastewater	Commercial	Small Commercial	Hospital/ Healthcare	Municipal/ Government	Higher Education	K-12
Program 1	x	x		x	x		x	x	x	
Program 2	x	x	x	x						
Program 3	x				x				x	
Program 4	x			x						
Program 5							x	x	x	x
Program 6		x	x		x		x		x	
Program 7	x	x								
Program 8					x	x	x	x	x	x
Program 9							x	x	x	x
Program 10	x									
Program 11					x		x	x	x	x
Program 12					x			x	x	x

The distribution of customer and building types and sectors served illustrates an ability for SEM to succeed beyond the industrial space. The finding that successful SEM is less dependent on customer/building type and more on engagement – as we will discuss further in Section 4.2 – is corroborated by our conversation with one of the subject matter experts we interviewed, who noted that the primary goal of SEM is engagement. They went on to note that, due to engagement being the primary goal, "you can definitely have smaller customers who succeed with SEM." Further, they noted that a cohort strategy can benefit smaller customers who are motivated, since having small customers mixed in with large customers can aid the cost-effectiveness of the program.

In the report, SEM Markets Expansion Study: Assessing Potential New Markets for the Expansion of California's Strategic Energy Management Program, the authors noted that "there are no 'bad' segments – candidate characteristics are the key".[20] This further confirms the findings that customer willingness to participate and engagement with the program are a greater determinant than the building or sector type in the potential for SEM participant success. This study went on to distinguish potential commercial building types into three segments: best-fit, good-fit, and other segments. They say, "Although, as indicated above [in the three segments], there are some segments that as a whole seem to be best suited for

[20] Jay Luboff Consulting, LLC. "SEM Markets Expansion Study: Assessing Potential New Markets for the Expansion of California's Strategic Energy Management Program." pda.energydataweb.com, December 1, 2023. https://pda.energydataweb.com/api/view/3894/SEM%20Market%20Expansion%20Study_Final%20Draft_Post%20to%20PDA_.pdf

expansion, information gathered throughout the Study indicates that there is not a 'bad' segment from the perspective of SEM participation."[21]

The best-fit, good-fit, and other segments from the SEM Markets Expansion Study are provided in Table 4-2, below.

Table 4-2. Commercial segments and their fit for SEM, from SEM Markets Expansion Study[22]

Best-fit segments	Good-fit segments	Other segments
Higher Education	Lodging	Other Commercial
k-12 Schools	Office	Retail
Government	Grocery	Restaurant
Hospital	Residential Multifamily	
	Warehouse	
	Other Health	

We went on to ask interviewees whether their programs had a specific goal of serving any "prioritized" customer or building types; the results are presented in Table 4-3.

Table 4-3. Prioritized sectors and building types

Prioritized Sector	Frequency
Low Income & Multifamily	3
MUSH (Municipal, university, schools, hospitals)	2
Gas Consumers	1
High Energy Users	1
Big Buildings	1

Note that not all interviewees responded to this question.

The interviewees interpreted the question on prioritized customer segments in two ways. Several respondents identified prioritized segments as those that would deliver high savings through SEM participation – including the broad category of "high energy users" as well as both large buildings and large portfolios of small- to medium-sized buildings.

In the same vein, several interviewees indicated that their programs targeted the Municipal/Government, Universities, Schools, and Hospitals (MUSH) set of customers for the following reasons:

- They felt that these customers were more likely to have sustainability goals which would motivate high engagement and management buy-in and thus result in persistent energy savings.
- They felt that the MUSH group tended to have a public-facing orientation and long-term outlook that would align well with the traditional SEM focus on continuous improvement, organizational behavior change, and low- or no-cost BRO-type interventions.
- These customers tended to have high energy consumption and met their program's minimum eligibility criteria, which focused on annual energy consumption.

Other respondents identified "aspirational" sectors where there were drivers to engage other than savings. For example, the interviewee who mentioned "gas consumers" noted that this was the result of regulatory guidance, whereas the respondents who mentioned low-income customers indicated that they have non-binding goals for reaching more low-income customers through their SEM program.

It is worth noting that none of the interviewees indicated that there are segments they avoid. These results suggest that while many SEM programs do aim to reach large energy users, who can offer greater opportunity for energy savings through

[21] Ibid
[22] Ibid

SEM, there may be instances where additional factors – such as, say, policy guidance around reaching underserved communities or low-income customers – need to be considered.

4.1.2 Program design and metrics

Table 4-4, below, summarizes key features and metrics for the program described by the program managers. While the interviewees were extremely generous with their time, they were not always able to respond to every question; these cases are indicated by a "No data" entry in the table.

Table 4-4. Summary of program metrics

Program ID	Location	Capital Measures?	Sectors	Established	Total unique 2022 enrollees	Ave Duration (yrs)	Total Enrolled	2022 Program Spend	2022 gross program savings claimed (MWh - ,000 kWh)	2022 gross program savings claimed (therms)	Million Btu/ Calculated
SEM-01	Northeast	Not usually	C&I	2020	10	3	30	No data	No data	No data	
SEM-02	PNW	Not usually	I	2009	50	4	200	$12,017,944*	23,722*	85,464*	89,510
SEM-03*	Mid-Atl	No Response	K-12	2020	64	3	192	$3,746,000	5,522	63,876	25,234
SEM-04	PNW	No Response	I	2009	20	2	46	No data	16,731	0	57,103
SEM-05	PNW	Not usually	C	2018	8	2	16	$57,000	860	0	2,935
SEM-06	Northeast	Yes	n/a	No data	No data	2	No data	No data	No data	No data	
SEM-07	Midwest	No Response	I	No data	34	2	68	$300,000	14,000	43,000	52,082
SEM-08	PNW	No	C	No data	No data	4	No data	No data	No data	No data	
SEM-09	PNW	No	C	2011	80	2	160	$4,000,000	14,000	5,000	48,282
SEM-10	Midwest	No	C&I	2014	33	4	312	$5,900,000	36,865	0	125,820
SEM-11	PNW	No	C	2010	49	4	196	$2,160,000	13,000	400,000	84,369
SEM-12	PNW	Not usually	C&I	I:'16 / C:'23	20	4	80	$918,000	9,640	0	32,901

*2021 data

4.1.3 Participation Requirements

DNV asked Program Managers if their programs had any requirements for participation. Throughout this section, we take a closer look at the customer attributes required by customers as well as the ways programs have remained flexible in those requirements. Table 4-5 outlines two requirements mentioned by Program Managers – minimum energy spend/consumption and Energy Team roles.

Table 4-5. Program requirements

	Minimum Energy Consumption Requirement (n=7)	Energy Champion (n=11)	Executive Sponsor (n=11)	Data Lead (n=11)	Average Staff on Energy Management Team (n=7)
SEM-01	3,000,000 kWh	x	Not Required	x	3
SEM-02	$50,000/year energy spend	x	x	x	
SEM-03	3,500 kWh	x	x	Not Required	
SEM-04	40 MW avg demand 3,500,000 kWh	x	x	Not Required	
SEM-05	1,000,000 kWh	x	x	Not Required	4
SEM-06	No data	x	x	Not Required	2.5
SEM-07	Electric – 1,000,000 kWh Gas – 30 MCF	Not Required	Not Required	Not Required	3.5
SEM-08	No data	x	Not Required	Not Required	3.5
SEM-09	No data	x	x	Not Required	6
SEM-10	No data	x	x	Not Required	2
SEM-11	Industrial – 4,000,000 kWh Commercial – 1,000,000 kWh	x	x	Not Required	

The majority of program managers reported having minimum energy consumption thresholds, noting this threshold as one way to ensure a site has sufficient energy savings potential to warrant the required investment of program resources. Some program managers mentioned that the minimum energy consumption threshold was flexible, with two respondents noting that they sometimes aggregate smaller sites from the same customer to allow them to increase their total energy consumption and meet the participation requirements. One interviewee noted that the ability to relax the eligibility threshold "has helped us to enroll other sites that may not be large, but they have the drive and executive support" to succeed.

Table 4-5 also highlights which program roles are required by each program. The California SEM guidebook requires that several roles be filled by staff members of participating customers; the people in these roles collectively comprise the Energy Team. The majority of the SEM programs we studied define similar roles – often with identical naming – to provide structure to the SEM engagement. These roles are defined as follows:

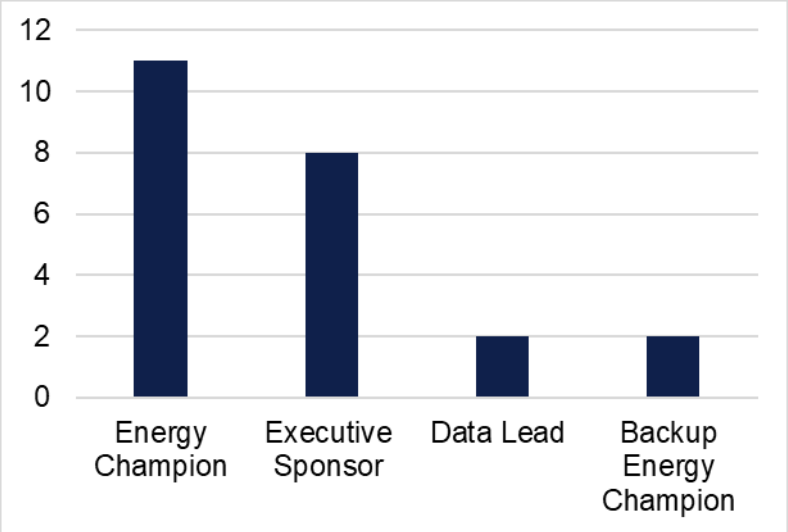
- **Energy Team** – typically a cross-functional team that "meets regularly to manage and develop any energy management-related business practices and activities" as part of SEM program participation.
- **Energy Champion** – coordinates internally within the Energy Team and other customer site staff as well as the SEM Coach to direct the customer's SEM program participation.
- **Executive Sponsor** – a high-level manager, typically with the ability to approve budgets and dedicate resources, who ensures the Energy Team has the necessary resources to successfully participate in a SEM program.

- **Data Lead** – responsible for developing a data collection plan that will provide visibility into site-wide energy usage and facilitate the development of an energy model to support the Energy Team's engagement in the SEM program, track progress, and support program evaluation.
- **Backup Energy Champion** – a person who is proactively identified to support and, as necessary, take over for the Energy Champion (e.g., in the event that the Energy Champion leaves the organization).
    - This role is not defined in the California SEM guidebook but was mentioned by multiple interviewees as an effective strategy for mitigating the impacts of staff turnover at participating customer sites.

As shown below in Figure 4-1Figure 4-1, the key Energy Team roles of Energy Champion and Executive Sponsor are found across the majority of the programs we studied. The Data Lead role is much less common as a standalone role, though many interviewees indicated that their programs allow the Energy Champion to also serve as Data Lead. Interviewees suggested that allowing the same person to fill both roles allows customers with limited staff and/or time availability to take part in the program. Two programs also mentioned having Backup Energy Champions to help with position turnover.

Other than the required Energy Team roles, programs have no minimum Energy Team size threshold, with teams ranging from 2 to 14 members depending on the site. Interviewees agreed that an Energy Team of one member would not be successful. One utility that offers both industrial and commercial SEM programs mentioned commercial teams tend to be smaller, though DNV found no notable differences between industrial and commercial programs' Energy Team sizes.

Figure 4-1. Count of interviewed programs requiring selected roles on Energy Teams



When asked if any specific titles or technical capacities were required of the various program roles (e.g., if an Energy Champion should have a "manager" title or if a Data Lead should have any technical certifications), all interviewees reported that these requirements did not exist in their program. Interviewees spoke about their program's ability to teach Energy Team members how to perform successfully, noting that success is less about technical capacity and more about overall buy-in to the program.

> *"[Non-technical Energy Team members] can learn the tools to manage energy just as well as technicians, especially if the program provides technical resources to get them up to speed."*

In addition to firm participation requirements, three participants mentioned using a checklist or scoping activity to ensure customers exhibit desirable customer attributes. Several other participants also noted preferring customers to exhibit similar attributes. These attributes included the following:

- Strong existing relationships with customers from previous successful implementations.
- Supportive management and/or executives that understand the connection between energy and strategic business objectives.
- Corporate mandates – sustainability/decarb goals.
- No recent or expected major changes (organizational, process, or structural).

By meeting these attributes, customers are likely to have the existing framework to be a committed program participant who can successfully engage in program activities and implement program improvements.

4.2 Customer engagement

DNV took a closer look at the ways that customers are engaged through the various SEM programs. SEM programs across the country exhibited similarities in the types of engagement activities but showed variability in the requirements or the level of the customer interaction.

4.2.1 Participant experience

Time commitment is a key aspect of SEM programs. As SEM programs are inherently designed differently than mass market programs, like upstream or midstream, the interaction and touch points influence the change in energy use. As such, time commitments and duration of participation are core to most programs across the country. Table 4-6 below, illustrates the various minimum/maximum and average time commitments or program participation durations.

Table 4-6. Minimum/maximum and average time commitments by program

	Minimum Team Annual Engagement (hrs)	Maximum Team Annual Engagement (hrs)	Required Commitment (yrs)	Average Duration of commitment (yrs)
Program 1	150	200	-	3
Program 2	-	-	1.2	4
Program 3	130	130	-	2
Program 4	200*	500*	5	-
Program 5	100	100	2	2
Program 6	144	144	-	2
Program 7	-	-	None	2
Program 8	20	20+	-	4+
Program 9	520**	1040**	1.2	2
Program 10	30	30	None	4+
Program 11	-	-	-	4+
Program 12	48	72	2	4+

*High hours denote year 1 whereas the lower amount denotes years 2 and beyond

** Interviewee answered as a fraction of a full-time employee (FTE). Noted ¼ to ½ FTE. FTE=2080 hrs/yr

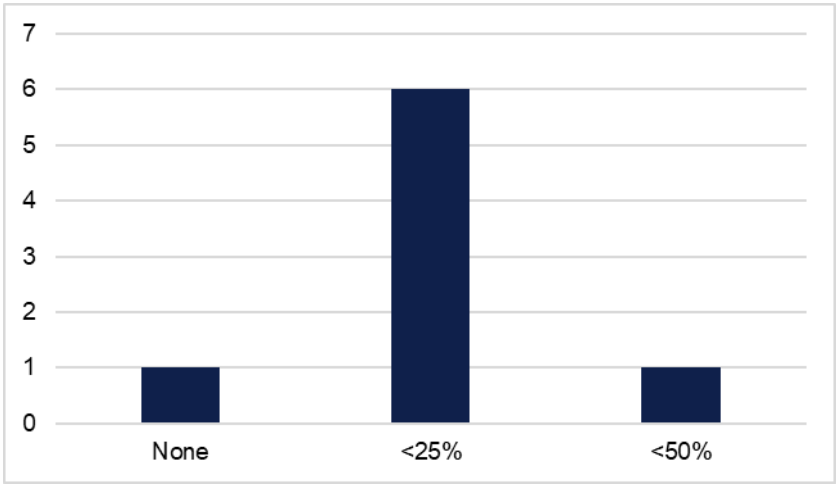
As the table shows, the hourly commitments by year vary from program manager responses. Yearly engagement times range from a minimum of 20 hours to 1,040, or about half of a full-time employee (FTE).

Further, not all program staff denoted a minimum required time commitment in years, with two highlighting that they do not have any requirement. Others noted 14 months and up to 5 years. With this said, almost all respondents highlighted that their program participants have remained committed for at least 2 years, and four programs noted relationships beyond four years were quite common. When asked what the average duration of participation was, one program manager noted, “I don’t know yet, people haven’t really dropped out. Most have been engaged since the program started 5 years ago.”

When asked what the average duration of participation was, one program manager noted, “I don’t know yet, people haven’t really dropped out. Most have been engaged since the program started 5 years ago.”

When further probed about participant dropout, program managers noted minimal dropout, with the majority highlighting less than 25% drop-out rates since launching their SEM programs. Figure 4-2 highlights the responses below. In the few instances where the program managers elaborated on why participants dropped out, staff capacity or the departure of the Energy Champion were highlighted. Further, two respondents noted that the lack of internal company energy efficiency prioritization is a barrier to continuance with participants.

Figure 4-2. Drop-out rate



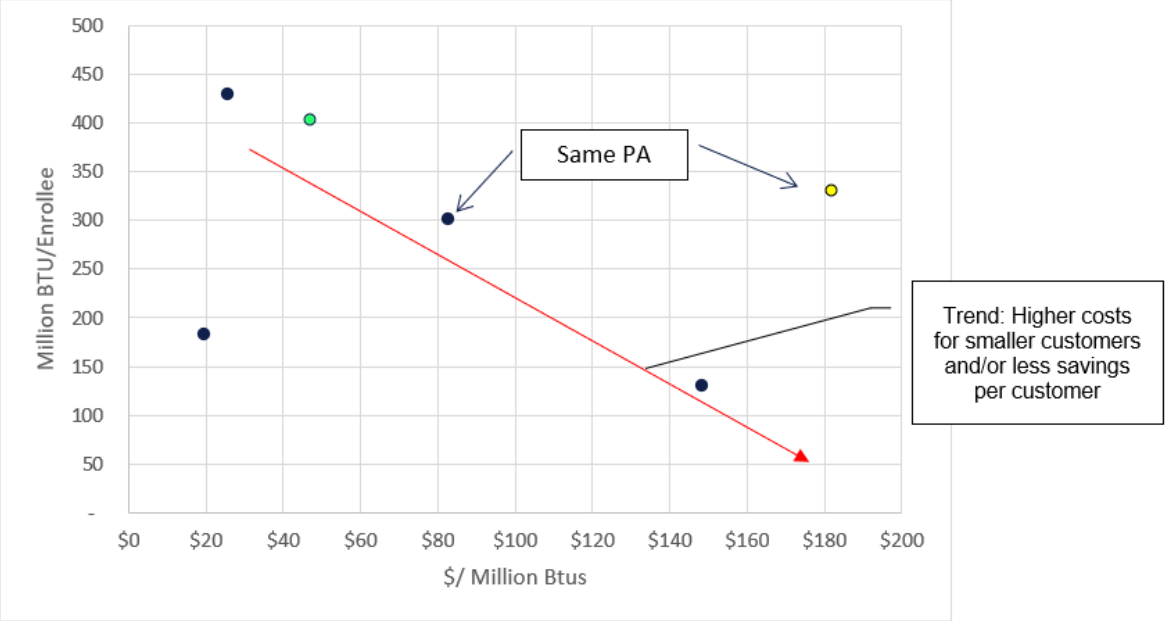
Metrics Comparisons

The interview responses can be combined to begin to see relationships between costs, savings, and different design elements. This analysis includes a relatively small number of data points because some customers did not provide, for example, complete program budgets or program savings, and responses are required for all values from a participant before they can be integrated into these comparisons. Nonetheless, trends are apparent with the sample points available.

Figure 4-3 compares the savings rate per participant compared to the program cost to acquire the savings for six programs. The BTU savings is the sum of program claimed in therms and electricity.[23] The figure shows a trend that the higher the savings per customer, the lower the cost per savings acquired.

[23] Site BTU conversion of 3,412 BTU/kWh and 100,000 BTU/therm.

Figure 4-3. Average energy savings per customer compared to average program costs per BTU saved.



One of the programs is an industrial program (yellow dot), one program is both C&I (green dot), and the rest of the programs (dark blue) are commercial. Two of the programs are operated by the same program administrator and while the savings per enrollee is similar, the costs are different. While one must be careful to draw conclusions from these few data points, the outcome makes sense. Program costs are driven by customer engagement, therefore achieving higher savings per customer (because they are larger energy users or higher savings are achieved per customer) will amortize engagement costs across a larger volume of energy savings.

4.2.2 Program SEM activities

Quality customer engagement is at the core of SEM and is fostered by a series of engagement activities common throughout all SEM programs. Table 4-7 displays which engagement activities are included in each program. As the table shows, there is a common framework across all SEM participants to include workshops, a Treasure Hunt, opportunity register, Energy Team check-ins, and energy modeling, regardless of program sector or size. Almost all programs we interviewed included the first four elements, and most programs required top-down energy modeling.

Table 4-7. Engagement activities by program

Program ID	Workshops	Treasure Hunt	Opportunity Register	Energy Team Check-ins	Energy Management Assessment	Top-down Energy Modeling
SEM-01	x	x	x	x	Not required	Preferred, 60% top-down

Program ID	Workshops	Treasure Hunt	Opportunity Register	Energy Team Check-ins	Energy Management Assessment	Top-down Energy Modeling
SEM-02	x	x	x	x	x	Top-down, some exceptions
SEM-03	x	x	x	x	Not required	No Data
SEM-04	x	x	x	x	Not required	No data
SEM-05	x	x	x	x	Not required	Was 100% top-down. COVID had an impact (50%)
SEM-06	x	x	x	x	Not required	50/50 top-down. May not save enough for a good fit.
SEM-07	Not required	x	x	Not required	Not required	Not required. An audit program.
SEM-08	x	x	x	x	x	Top-down, some exceptions
SEM-09	x	x	x	x	x	Only top-down, to manage cost.
SEM-10	x	x	x	x	Not required	Top-down, some exceptions.
SEM-11	x	x	x	x	Not required	Top-down only. Allows them to manage the volume.
SEM-12	x	x	x	x	x	Top-down, some exceptions,

The programs showed a strong preference for top-down modeling. Bottom-up estimates are accepted by exception when, for example, the models fail or when savings are too small to be expected to register in billing. Two program managers noted top-down is more cost-effective than a bottom-up approach.

Overall, Program Managers noted that each engagement activity included in their program design has value in executing a successful SEM program. DNV asked respondents a series of questions to determine which engagement activities were most and least influential in ensuring persistent energy savings and lower free ridership. DNV first asked which three program engagement activities included in their program design are most influential, and out of those three elements, which is the most important. DNV then asked Project Managers which engagement activity is the least impactful. During this series of questions, Program Managers found it difficult to parse out the most and least important activities, noting it is the combination of program activities and their strong dynamic that produce a successful SEM program.

Table 4-8 shows how Program Managers responded to the series of questions pertaining to the most and least important engagement activities in their programs. Treasure Hunts and Energy Team check-ins were most frequently mentioned by

project managers as the most important engagement activities. Of the 10 responses, four reported Treasure Hunts and three noted Energy Team check-ins as the most important engagement activity.

Program managers found it most difficult pin-pointing the least impactful engagement activities, again noting all engagement activities had value to their program. When pressed, four of eight project managers thought workshops were the least impactful engagement activity, noting the difficulties of keeping participants engaged throughout the entirety of the workshop, especially with virtual workshops.

In addition to program managers emphasizing how important the combination of all program engagement elements are to SEM program success, they also noted the importance of remaining flexible when conducting each engagement element. Program managers noted their program design including flexibility in program engagement activities as well as altering the engagement activities for specific participants depending on their resources and needs (e.g., "If there's less staff at smaller sites, we might relax the curriculum/networking requirements"). For example, we heard from programs that offered both optional and required workshops as well as both in-person and virtual workshops and Treasure Hunts. One program mentioned that offering Treasure Hunts virtually allows them to break the activity into sessions by system, process, or building as opposed to the customer needing to commit to an all-day onsite activity. Energy Team check-in meetings were also an area Project Managers mentioned keeping flexible by offering a standard cadence of check-ins with the program but altering that cadence to individual customers' bandwidth and needs.

Table 4-8. Most and least important engagement activities to ensure persistent energy savings and lower free ridership

	Most Impactful (n=11)	Top three* (n=8)	Least Impactful (n=9)
Treasure Hunt/energy scan	4	1	
Energy Team Check-ins	3	1	2
Energy model development and maintenance of model	1		
Development of energy mgmt. strategy (goals/policy)	1	2	
Workshops		3	4
Annual participant recognition event		1	
Development of a robust energy team	1		
Activities to ensure cultural/organizational change	1	2	
Energy Management Assessment			3

* Note that the "top three" column does not include the most impactful cited activity.

4.3 Hypothesis testing

DNV developed a series of hypothesis-based questions around SEM sector and design features likely to impact the NTGR and EU, as discussed in section 3.3. We posed this series of hypothesis-based questions to Program Managers and asked them to rate their agreement or disagreement on a scale of 0 to 10, where 0 signifies strong disagreement, and 10 signifies strong agreement. The results are summarized in Table 4-9, below.

Table 4-9. Hypothesis based-questions and average scores across respondents

Questions (by SEM sector and design feature)	**Score**
Customer Engagement	
If the [most highly rated engagement element] was dropped from my program, savings would be **less persistent.** (n = 11)	9.1
If the [lowest rated engagement element] was dropped from my program, savings would be **less persistent.** (n = 8)	3.5
Utilizing a cohort strategy vs. one-on-one engagement with SEM participants **decreases customer engagement**. (n = 11)	3.1
If the average number of engagement hours required by the customers in the program were reduced by 20%, the **free ridership will increase.** (n = 8)	1.5
Customer segment	
In my program, **commercial sites** typically require **less customer engagement** than industrial sites. (n = 8)	2.3
Industrial SEM participants typically have **lower free ridership** and **longer-term persistence of savings** than non-industrial/commercial SEM participants. (n = 6)	4.2
Measure Type	
If a SEM program includes capital measures, the **free ridership will increase.** (n = 5)	2.3
Technical staff	
In my program, sites with less technical staff, (for example administrators versus trained HVAC or equipment technicians) will have **less persistent savings**. (n = 11)	5.2
Top-down savings modeling	
If savings estimates are predominantly calculated using top-down pre/post billing savings models, the **free-ridership will decrease.** (n = 6)	3.9

Top-down savings modeling

Program managers struggled to see the correlation between free ridership and top-down modeling. It is worth noting program managers generally thought that free ridership does not exist in SEM programs, due to the holistic nature of these programs (further discussed in Section 5.1), which impacted the ability of program managers to respond to hypothesis-based questions related to free ridership.

Customer Engagement

DNV asked four hypothesis-based questions concerning customer engagement. Program manager responses to these questions further support the findings discussed in Section 4.2.2 that customer engagement activities, with a flexible approach, are core to a strong SEM program. Program managers agreed that customer engagement is a critical component of SEM with a strong link to persistence of savings. The hypothesis-based question concerning dropping the “lowest-rated” engagement activity received a more neutral rating, with program managers noting that while customer engagement is key,

not all activities are created equal. As mentioned in Section 4.2.2, programs are willing to be flexible when it comes to program activities dependant on customer needs and resources. When asked if their programs were to reduce the number of hours required by SEM participants by 20%, and if free ridership would increase, interviewees strongly disagreed and did not see a causal effect between engagement hours and free ridership.

The last hypothesis-based question related to customer engagement pertained to programs utilizing a cohort strategy. DNV asked if utilizing a cohort strategy would decrease customer engagement. Interviewees disagreed and have found success with a combination of cohorts and one-on-one engagement. The cohort approach creates opportunities for participants to come together and learn from peers about challenges and solutions, though care should be taken to avoid placing direct competitors in a cohort together.

Customer Segment

Two hypothesis-based questions aimed to capture whether there were any differences between commercial and industrial SEM customers. Program managers' responses noted slight differences between commercial and industrial customers as they pertain to customer engagement, free ridership, and persistence of savings but ultimately concluded they are similar. The amount of customer engagement across commercial and industrial customers is similar, but customer engagement with commercial sites can be more challenging, in part because the opportunities for savings may not be clear or obvious. That being said, "the biggest factor is the people, the organization, and their engagement/interest," per one interviewee. For the persistence of savings, some program managers noted there is potential for backsliding across both commercial and industrial programs, given the nature of SEM savings, but can be more common in commercial programs due to commercial programs implementing behavioral changes and less O&M.

Measure Type

Program managers do not see a direct linkage between capital measures and free ridership. The programs we studied generally did not offer capital measures, but those that did reported little concern with free ridership.

Technical staff

When asked if less technical staff will result in less persistent savings, responses yielded an average rating of 5.2. Most program managers disagreed or had neutral feelings, having seen energy teams with limited technical capacity be successful with additional training and support. One program manager mentioned commercial sites, which typically have less technical capacity, are able to be successful if there is strong engagement and change management skills: "In commercial, if you have strong change management skills, then you can have a big impact even if you're missing the technical know-how."

4.4 Associated net-to-gross factors and EUL

The effective useful life, or EUL, is an estimate of the median number of years that a measure installed within a program will still be in place and operable.[24] NTG is a measure of free-ridership comparing the gross savings (changes in energy consumption that result directly from program-related actions) to the net savings. These net savings effectively measure what changes in energy use are attributable to the energy efficiency program's activities as opposed to those changes that the customer would have done anyway (free ridership).[25]

[24] CPUC Definition: https://docs.cpuc.ca.gov/published/Final_decision/11474-13.htm#:~:text=Effective%20Useful%20Lives%20of%20Energy%20Efficiency%20Measures&text=The%20EUL%20is%20generally%20an,still%20in%20place%20and%20operable.

[25] ACEEE. "Evaluation, Measurement & Verification." aceee.org. Accessed 3/1/2024. https://www.aceee.org/toolkit/2017/06/evaluation-measurement-verification

DNV reviewed a number of national SEM programs and interviewed program managers to understand what EUL and NTGR metrics were being applied to the programs, but also to better understand what was informing those metrics. Of the 12 program managers interviewed, only 2 gave NTG values for their SEM programs. Those values are 1 and 0.85. Since these interviews targeted the program managers, it can be deduced that they would be less familiar with the details around NTGR evaluation results than if we interviewed evaluators. Despite this, most respondents indicated skepticism that NTGR would be anything other than 1. One interviewee noted "[The program] hasn't seen a lot of free ridership. The Treasure Hunt produces things these sites haven't thought about before, otherwise they would have done them. Past program involvement is also reviewed to minimize free-ridership and double-counting."

One interviewee noted "[The program] hasn't seen a lot of free-ridership. The Treasure Hunt produces things these sites haven't thought about before, otherwise they would have done them. Past program involvement is also reviewed to minimize free-ridership and double-counting."

The general narrative was that SEM is designed to discover energy savings opportunities and instill new behaviors that these customers otherwise would not have known about or adopted. Therefore, if they were not aware of the opportunities, how could they free-ride the program? Further, many of these values are not derived from primary research; for example, one program's NTG of 1 is a deemed value adopted through their state's stakeholder advisory group.

DNV further took a look at the inclusion of capital measures, as the measure lives for capital measures, say an HVAC system with a long measure life, could alter the EUL for an SEM project/program if included in the calculations. As shown in Table 4-4, of the 12 programs interviewed, only one consistently included capital measures. This individual noted a desire to "include everything", as it can streamline modeling and also benefits cost-effectiveness. Four respondents noted that they never claim savings and will direct those capital measures to another program and "strip capital savings out of SEM savings." Three respondents did not comment and the final three indicated that "it depends" whether they include capital measures. One interviewee described it as, "If participants qualify for incentives under another program (standard measures) then [we do not] claim those savings through SEM. That said, if something shows up in the Treasure Hunt and isn't already covered by another program, [we] will claim it."

The programs have more robust data to inform their EUL metrics, though many still rely on other studies across the country and the range of EULs adopted is quite large (1.0 to 8.0), as can be seen in Table 4-10, below. In a 2023 study of persistence for the Bonneville Power Administration[26], the study found an EUL of 8.5 years and in a 2022 study for ComEd[27], the EUL was found to be 7 years for electric SEM measures. In California, the industrial SEM program launched with a 5-year EUL, and this was reviewed and confirmed in a 2018-2019 SEM impact evaluation.[28] This study supported the 5-year EUL and noted that "…findings suggest that industrial SEM programs operating in the Pacific Northwest, which are

[26] Bonneville Power Administration. "Strategic Energy Management Persistence Evaluation-Final report." bpa.gov, 11/30/22. https://www.bpa.gov/-/media/Aep/energy-efficiency/evaluation-projects-studies/bpa-sem-persistence-study-report.pdf

[27] Guidehouse. "ComEd Strategic Energy Management Impact Evaluation Report." ilsag.info, April 20, 2022. https://www.ilsag.info/wp-content/uploads/ComEd-SEM-CY2021-Impact-Evaluation-Report-2022-04-20-Final.pdf

[28] SBW Consulting, Inc. "2018-19 Industrial Strategic Energy Management (SEM) Impact Evaluation." pda.energydataweb.com, 12/17/21. https://pda.energydataweb.com/api/view/2572/GroupD-D11.03-SEM%202018-19%20Impact%20Evaluation.pdf

similar to industrial SEM programs in California, experience savings that persist over a longer period of time than initially estimated. However, further evaluation targeting California industrial SEM programs could help bolster confidence in EUL estimates, especially if the types of measures being pursued in California facilities are significantly different compared to the programs operating in the Pacific Northwest."[29]

Table 4-10. Program Manager Reported EULs

Interviewee	EUL
SEM-01	4
SEM-02	7
SEM-03	5
SEM-04	8
SEM-05	1
SEM-06	-
SEM-07	-
SEM-08	5
SEM-09	5
SEM-10	-
SEM-11	7.3
SEM-12	-

[29] Ibid

5 SYNTHESIS AND CONCLUSIONS

This section summarizes the study's conclusions and recommendations, segmented by category.

5.1 NTGR and EUL assumptions

A core objective of this study was to investigate whether a NTGR of 1.0 and a 5-year EUL assumption would be appropriate for non-industrial SEM. Rulemaking 13-11-005 (Conclusion of Law No. 22) states, "Commission staff should complete a study to determine if the NTGR and EUL assumptions for SEM remain appropriate for all sectors and applications."[30]

Through the interviews conducted with SEM programs across the country, we found that both commercial and industrial sectors are successfully served by SEM programs. The values used for NTGR and EUL, though, are often stipulated and based on other jurisdictions; few of the programs have recently gone through independent evaluations, especially for NTG. Accordingly, there has been little to no independent research conducted to date that clarifies whether the commercial programs should have the same or differing NTGR and EUL as the industrial programs. However, our research provides insights into this matter.

We went on to review a number of studies that are available and performed primary research. This review was not comprehensive, but informative.

- A BPA SEM Persistence report suggested an 8.5-year EUL; this study was looking at manufacturing, wastewater, and refrigeration storage, three building types found in the industrial sector.[31] This program has a 5-year participation requirement.
- A CY2021 study done for ComEd found an EUL of 7.0 for the whole building SEM measures; this program does not require a set period of enrollment. This program does include capital measures that otherwise would not have been moved through the broader EE programs and includes both commercial and industrial participants[32].
- In a 2020 report, the Energy Trust of Oregon was recommended to use a 7-year EUL for their industrial SEM programs while requiring a 14-month enrollment period.[33]
- The 2018-2019 Industrial SEM impact evaluation for the CPUC recommended using a 5-year EUL for their industrial program with a 6 year commitment[34]. This EUL was similar to a BC Hydro study that it reviewed, among others[35].

This brief review contributed to the narrative that industrial programs may have stronger persistence than commercial, as many of the longest EULs are for industrial programs, but did not provide conclusive direction as one of the studies that recommended 7 years also served the commercial sector. It further highlights that the required duration of enrollment in the program does not necessarily correlate to persistence, as the EULs did not track with commitment duration.

DNV formulated several hypotheses based on the idea that persistence and free ridership could be influenced by program duration, program design differences (including the type and amount of customer engagement activities), and/or the inclusion of capital measures. As Table 4-1 shows, both industrial and commercial sectors are thoroughly served by SEM

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[30] CPUC. Rulemaking 13-11-005-*Decision Addressing Energy Efficiency Third-Party Processes and Other Issues.* 2/2/2023.

[31] Bonneville Power Administration. "Strategic Energy Management Persistence Evaluation-Final report." bpa.gov, 11/30/22. https://www.bpa.gov/-/media/Aep/energy-efficiency/evaluation-projects-studies/bpa-sem-persistence-study-report.pdf

[32] Guidehouse. "ComEd Strategic Energy Management Impact Evaluation Report." ilsag.info, 4/20/22.. https://www.ilsag.info/wp-content/uploads/ComEd-SEM-CY2021-Impact-Evaluation-Report-2022-04-20-Final.pdf

[33] Energy Trust of Oregon. "Industrial O&M Persistence Study-Program Years 2010-17." energytrust.org, 4/28/2020. https://www.energytrust.org/wp-content/uploads/2020/04/DNVGL_2019_Persistence_Study_Report_FINAL-w-SR.pdf

[34] SBW Consulting, Inc. "2018-19 Industrial Strategic Energy Management (SEM) Impact Evaluation." pda.energydataweb.com, 12/17/21. https://pda.energydataweb.com/api/view/2572/GroupD-D11.03-SEM%202018-19%20Impact%20Evaluation.pdf

[35] Ibid.

programs, which is further confirmed by the SEM Markets Expansion Study.[36] The programs, whether they serve industrial or commercial customers, did not show any significant delivery mechanism differences to suggest that NTGR and EUL values differ due to the sectors. Table 4-7 shows similar program elements across all respondents, encompassing both industrial and commercial offerings.

The programs we studied generally did not offer capital measures, but those that did reported little concern with free ridership. Of the 12 interviewed, one program incentivized capital measure consistently, citing a desire to "include everything" as it can streamline modeling and benefit cost-effectiveness (see Table 4-4). The remaining respondents prohibited capital measures outright (often directing them to other programs) or allowed them on an exception basis. The following quote summarizes a common approach regarding capital measures: "If participants qualify for incentives under another program (standard measures) then [we do not] claim those savings through SEM. That said, if something shows up in the Treasure Hunt and isn't already covered by another program, [we] will claim it."

When responding to the hypothesis questions, respondents struggled to identify any connection between program activities and free ridership. SEM program managers did not find the inclusion of capital measures to increase free ridership, scoring 2.3 on a 0-10 scale (with 10 indicating "strong agreement" that there was a connection between the two). They also did not agree that reducing engagement hours would lead to more free ridership, scoring a 1.5 out of 10 on the same scale. Additionally, respondents slightly disagreed with the idea that industrial customers experienced lower free ridership and higher persistence, suggesting that program managers do not see a difference in how non-industrial vs. industrial programs perform. For example, one interviewee stated, "[The program] hasn't seen a lot of free ridership. The Treasure Hunt produces things these sites haven't thought about before, otherwise they would have done them. Past program involvement is also reviewed to minimize free ridership and double counting." Although this does not highlight the distinction between commercial and industrial SEM programs, practitioners do not see free ridership as an issue in SEM generally.

Conclusion: The research and interviews found no evidence that the NTGR and EUL values should be different for the same program design delivered to the industrial sector versus the non-industrial sector.

> **Recommendation:** We recommend maintaining the existing Industrial SEM NTGR value (currently 1.0) and EUL value (currently five years) for non-industrial SEM programs that adhere to the current SEM Design and M&V Guidebooks.

5.2 Engagement is what makes SEM, SEM

The SEM programs we studied tended to follow a similar engagement template, as seen in Table 4-7. Our review of programs and interviews with program staff and industry practitioners paints a picture of programs that are designed and delivered along consistent lines, regardless of the location or segments served. With some minor variance, most programs, regardless of sector, maintain core elements of the SEM engagement template, such as Energy Team check-ins, Treasure Hunts, and energy modeling as a tool for engagement and feedback. This structure is quite similar to how the current CA SEM design guide lays out the programs for Industrial SEM, illustrating that this core set of activities can be successfully deployed in a similar framework with commercial participants.

The most notable difference across programs was found in the expected level of time and staff resources committed by participating customers. This can be seen in Table 4-6, which shows a wide range in anticipated annual hours of engagement (from 20 to 1,040). Despite the wide range of hourly commitment, opinions were consistent in that SEM

[36] Jay Luboff Consulting, LLC. "SEM Markets Expansion Study: Assessing Potential New Markets for the Expansion of California's Strategic Energy Management Program." pda.energydataweb.com, December 1, 2023. https://pda.energydataweb.com/api/view/3894/SEM%20Market%20Expansion%20Study_Final%20Draft_Post%20to%20PDA_.pdf

programs take a high level of customer commitment. Six of the 12 interviewed programs noted at least 100 hours of site staff commitment per year, and there appears to be a modest correlation between annual customer staff hours and higher savings.

The interviews also collected data on the number of staff typically involved in participating Energy Teams. Across seven respondents, the average Energy Team size ranged from two to six members, with three of seven responses indicating that Energy Teams of three or fewer people were not uncommon, as seen in Table 4-5. The range of typical time and resource commitments highlights the variability observed across various industrial and commercial programs and shows that while a site team of two can succeed, additional team members provide more support. This minimum of two team members also aligns with the sentiment that was expressed by some program managers that "small customers can be successful."

DNV asked program managers about various aspects of the SEM engagement package, looking to see whether any particular activity was more or less impactful than others in terms of influence on program outcomes. Respondents were hesitant to suggest that any activities were less valuable than others, and, when pressed, usually included a caveat in their answer. They were more likely to note activities they felt were very strong components of the package, notably Treasure Hunts and Energy Team check-ins. The main takeaway from the conversations about the SEM engagement package is that program managers view engagement holistically. Although the program would still run if certain pieces were taken out, it would not run as well; trying to rank elements was perplexing to the respondents.

Conclusion: The driver of a successful SEM engagement – where success is defined as persistent and meaningful energy savings – is a comprehensive program of customer engagement with a committed customer. The current Industrial SEM Guidebook provides a blueprint for successful engagement that can be applied to non-industrial SEM with minimal changes.

> **Recommendation:** We recommend that non-industrial SEM in California continue to employ the industrial SEM engagement elements, such as the Treasure Hunt, Opportunity Register, training/workshops, Energy Team check-ins, and defined staff roles, among others. Further, no findings indicate a need to produce a separate SEM guide specifically for commercial participants, though we do recommend that allowances for flexible delivery approaches be introduced to facilitate design and delivery of successful SEM programs to diverse non-industrial customer sectors while maintaining a high level of rigor (see Conclusion 7). This does not preclude stakeholders from making future adjustments when needed.

Conclusion: Despite sharing a number of common program design features and customer engagement elements, many of the SEM programs we studied featured a two- to four-year participation cycle, compared to the six-year California program participation cycle. Interviewees indicated that a two-year minimum participation period was critical to allow customers to get familiar with the program and start to see results, though many of them indicated that they expected participants to have "graduated" from the SEM program within about four years.

> **Recommendation:** The CPUC may want to consider allowing a shorter program cycle (less than six years) for non-industrial SEM. Because a shorter design could have an impact on persistence, this change could be paired with the introduction of new design elements, like "Succession Plans" and "Persistence Strategies" for individual measures/projects, to help buttress persistence. Guidance for these new design elements can be provided through targeted updates to the existing SEM guidebook.

Note that we explore the potential for and bounds of flexibility in further detail in Section 6.

5.3 Energy modeling as both engagement and measurement tool

The IDI interview structure did not address energy models as a tool for customer engagement; however, interviewees reported that it serves an engagement function as well as a measurement function. According to the CEE Strategic Energy

Management Minimum Elements guide, one pillar of a SEM program is a "System for Measuring and Reporting Energy Performance," which entails the cycle of acquiring usage data, analyzing it, and reporting it to stakeholders. Top-down energy models fulfill this function while bottom-up models only do so indirectly and incompletely.

Of the 10 interviewees that responded to the question of whether their programs primarily rely on top-down models, nine stated that top-down was their highly preferred method. Bottom-up methods were allowed as exceptions when models did not produce reliable results.[37] One program manager said, "we don't ever do bottom-up, it's just too complicated." This program has about 500 sites enrolled at any one time and concluded it was too much volume to allow bottom-up.

In addition to providing critical feedback, the top-down model is the only measurement technique that can reliably and systematically capture behavioral measures, which is the core focus of SEM. As a practical matter, most BRO measures cannot be estimated reliably using bottom-up methods. As such, bottom-up estimates often do not attempt to estimate BRO impact. Thus, the intended impact of SEM on behavior remains unmeasured, uncelebrated, and unreinforced. As one PA noted, "it is powerful to use billing data to show year-to-year performance".

Developing and maintaining energy models is a program expense requiring skilled individuals with data manipulation skills, statistics, and an engineering sense of the building. Industrial models typically entail multiple independent variables representing production output and schedules that can be challenging to acquire. Commercial buildings, however, can often be modelled with weather conditions and the business schedule as the primary independent variables. As noted above, at least one PA finds it less expensive to implement top-down models. There are also open-source and commercial billing analysis tools that could be productively leveraged for some sectors.

Conclusion. Energy modeling is a core element of a SEM program, providing important feedback on all activities, including BRO and capital measures; the preferred approach is top-down modeling using historical energy consumption. Just as SEM works best with motivated customers, it also works best with sites amenable to modeling. Sites that are unable to secure representative billing or production data, or sites with erratic operations, may not be good SEM candidates because they will have a harder time getting critical feedback on the impact of their actions.

> **Recommendation**. Top-down energy modeling should remain the primary method for determining program savings, with individual site exceptions allowed for bottom-up estimates as specified in the SEM Guide. Program designers should be able to propose simpler modeling methods, potentially using open-source or commercial tools to estimate aggregate savings. Programs might also consider screening sites before recruiting for the availability of key data, like production and billing data. The cost of having to utilize bottom-up energy savings methods should also be considered as part of the cost-effectiveness of the program.

5.4 Cost effectiveness and its supporting structures

Another core objective of this study was to gain an understanding of cost-effectiveness considerations in non-industrial SEM programs and to understand the way SEM PMs and PAs view and measure cost-effectiveness. The cost-effectiveness of program delivery is determined by two key factors:

- The program's spending on activities – like outreach, customer engagement and coaching, and energy modeling – as well as incentives for participation, milestone completion, and energy savings
- The resultant savings, which are a function of customer attributes, customer resources, energy consumption, energy end uses, and the quality and structure of the coaching/engagement

[37] The tenth responder represented an industrial audit program designed as a feeder to the custom program, so this question did not apply.

Because there are many different ways to measure the costs and benefits of a program that differ across jurisdictions, we asked interviewees to think of cost-effectiveness in terms of total program costs and program energy savings only.

The programs we studied widely agree that larger customers are, on average, more cost-effective, and several programs noted that smaller customers could cost more to serve without resulting in corresponding savings. One program manager noted that "retail is more costly due to the number of touch points required – they need a bit more attention." However, site-specific cost-effectiveness considerations did not appear to overrule other program design or delivery considerations, such as the desire to serve more and varied customers (including those in underserved or low-income segments) and to identify those "small-but-mighty" customers who are motivated to participate in the program. Many PMs also noted that small customers, if engaged in the program, often performed well and could help motivate larger customers in a cohort structure. Relatedly, interviewees did not suggest that any particular customer segment would be ill-suited to SEM participation.

> *"Cohorts increase engagement…dramatically by allowing customers to come together and speak with peers about challenges and solutions."*

Several interviewees noted that they addressed the issue of variable cost-effectiveness for different customers by leveraging a cohort framework in which diverse customers move through the program in a peer group and receive certain engagement activities, like training workshops, together. This cohort approach offered peer-to-peer engagement opportunities; chances for customers to share challenges, success stories, and lessons learned; and created a "healthy sense of competition" that furthered the goals of the program. These factors combined to, per one interviewee, "dramatically" increase engagement. The cohort approach also supported cost-effective program delivery by allowing certain activities to be conducted in a one-to-many format and by pulling together a mix of large and small customers, potentially from different sectors, whose relative costs and energy savings balanced out to cohort- or program-level cost-effectiveness. One evaluation study we reviewed also noted that the cohort approach "appears to be much more cost-effective than the one-on-one approach in helping organizations improve the efficiency of their energy management." It is also worth noting that program managers do not measure the cost-effectiveness of their SEM programs by industry or sector; rather, they assess cost-effectiveness at a program level and count on a mix of large and small savers to balance out a cost-effective program overall.

Most interviewees (9) noted that their largest spending category was labor, in the form of outreach, coaching, site visits, and model development. Respondents noted that program delivery was often overseen by implementers and that the costs of program delivery could be significant. One interviewee noted that "having the ability to visit the site multiple times or to engage" in other ways was critical but costly; however, the investment of implementation time and labor paid dividends since "the team can be more successful when there is a holistic approach that allows program staff to get into the details with the customer."

To influence overall program cost-effectiveness, program managers mentioned multiple potential strategies for managing program delivery costs. In addition to the use of cohorts, these PMs introduced flexibility in certain engagement activities. For example, one interviewee noted that they allow participants to shift to bimonthly Energy Team meetings instead of monthly, thus reducing coaching/implementation costs. This flexibility can be introduced to individual customers or whole segments to manage seasonal business patterns or other unique aspects of customer operations. We explore the potential for and bounds of flexibility in further detail in Section 6.

Most of the programs we studied have a minimum energy consumption threshold of about 1,000,000 kWh for SEM program participation. “Small” is a relative term – small customers are not equivalent to the small business sector, as one industrial program identified small customers as those using less than 2,000,000 kWh per year. However, several interviewees indicated that this threshold can be relaxed for individual customers on a case-by-case basis if customers demonstrate significant interest or organizational capacity and/or if they can aggregate multiple smaller sites in the program. In addition to energy-driven eligibility criteria, three of the 11 program managers indicated that they employ qualitative screening calls and/or checklists as part of the recruitment/onboarding process. They use these tools to better understand the prospective participant’s organizational structure, resource and staff availability, and recent experiences executing similar cross-functional, continuous improvement-style projects and to more holistically assess whether the prospective participant seems like a good fit for SEM.

Conclusion: Program managers broadly agreed that larger customers were more cost-effective for both the vendors and the program, and several noted that smaller customers could be less cost-effective. However, the desire to serve customers of diverse sizes and sectors overrode concerns about site-specific cost-effectiveness. Additionally, program managers assess cost-effectiveness at a program level and count on a mix of large and small savers to balance out a cost-effective program overall. Program cost-effectiveness can be monitored by tracking total program costs and savings rather than by screening individual sites.

> **Recommendation:** CPUC staff recommends the SEM Program Implementation Plans (PIPs) specify the metrics for monitoring cost-effectiveness while allowing a broad spectrum of customers to participate to foster program innovation. Metrics could include, but are not limited to: number of targeted annual enrollees, total targeted number of enrollees, standard participant characteristics, anticipated annual usage, anticipated energy savings per participant, average and minimum eligible participant consumption, and project delivery costs.

Conclusion: Program delivery to a peer group (like a “freshman class”) offered numerous benefits to the programs we studied, including cost reductions, improved cost-effectiveness, and potentially greater participant engagement.

> **Recommendation:** Program delivery via a peer framework – in which participants co-participate in engagement activities and have opportunities to interact with each other – should be an option for California PAs and implementers. Care should be taken not to place direct competitors in the same peer group to mitigate concerns about competitiveness. The size of a peer group must be small enough to still permit high levels of engagement.

6 NON-INDUSTRIAL SEM DESIGN CONSIDERATIONS

The findings outlined in this report support the continued use of the existing Industrial SEM Guidebook with targeted changes designed to address common implementation barriers related to non-industrial customers. An overarching design principle we recommend is to allow greater flexibility for PAs and their implementers to adapt the required program design elements and participation requirements in response to "meet customers where they are." We acknowledge that the existing industrial guide currently allows flexibility in how educational modules are turned into educational activities, which allows these activities to be "tailored to different sectors and customer cohorts."[38]

This study found that additional areas of flexibility in program implementation may be explored to serve different sectors and customers without negatively impacting participant outcomes, NTGR, or EUL. We stress that the flexibility we recommend must be bounded to ensure that critical engagement activities are not dropped or diluted to the point that they would deviate from core SEM objectives and jeopardize the continued use of the existing NTGR and EUL values. It is difficult to comprehensively prescribe a proper balance between flexibility and structure that will allow PAs and their implementers to be creative and responsive to the needs and challenges of future non-industrial SEM participants while hewing to the core tenets of SEM theory. As such, in Table 6-1, below, we summarize the current SEM activities outlined in the industrial guidebook and highlight examples of flexibility that were incorporated successfully by the program managers we interviewed. Note that flexibility needs may evolve over time or as SEM is introduced to new market sectors; we encourage the CPUC, PAs, and implementers to discuss challenges, successes, and lessons learned in testing more flexible delivery approaches.

Table 6-1. Summary of activity-level flexibility opportunities and limitations, linked to existing activities

Required SEM components	Potential for flexibility	Potential for peer-style delivery	Notes on limits to flexibility and/or peer-style delivery
Kick-off meeting	No	No	The kick-off meeting should remain a required and individual activity.
Energy Team check-in calls	Yes	No	• Moving from monthly to less frequent (bimonthly or quarterly) meetings can reduce SEM Coach spending depending on the customer and their state of progress. • Implementers may encourage Energy Teams to continue meeting monthly without requiring SEM Coaches to be present; in this case, meeting minutes could be shared to document discussions. • Energy Team check-ins should still occur on a regular basis.
Energy Management Assessment (EMA)	Yes	No	• Interviewees found the EMA to be a helpful but not critical activity. As such, it may be possible to do this less frequently without harming outcomes. This is currently an optional activity in the CA SEM guide.
Energy mapping exercise	No	No	Energy mapping should remain a required and individual activity.

[38] P. 13 in the PDF of the Guidebook: https://pda.energydataweb.com/api/view/2647/CA_3_CYCLE_SEM_Design_Guide_V1.01.pdf. Flexibility is allowed in "the format (i.e., on-line or face-to-face), the delivery (e.g., pre-recorded, live, interactive, mix), the participants (i.e., one-on-one or cohort or mix), the number of activities (e.g., one session or multiple sessions), and the length of each educational activity.

Required SEM components	Potential for flexibility	Potential for peer-style delivery	Notes on limits to flexibility and/or peer-style delivery
Treasure Hunt and Action Plan	No	Yes	• Treasure Hunts are a critical activity that should not be dropped. • Flexibility-wise, while in-person Treasure Hunts are preferable, interviewees noted that virtual Treasure Hunts can be an option. • In cases where one customer owns or operates multiple similar buildings, staff might attend one Treasure Hunt at a representative building. • SEM Program Managers noted that some participants were comfortable allowing peers in the same cohort to attend their Treasure Hunt as a way to extend learning opportunities. This should be considered an option, though it may be challenging for reasons of geography, competitiveness, etc.
Opportunity register	No	No	Opportunity tracking via the opportunity register should remain a required and individual activity.
Site-specific planning exercises (Action Plans, annual planning, transition planning)	No	Yes	• While site-level planning sessions are not compatible with peer group delivery, implementers may consider convening joint discussions to provide common guidance to streamline participants' individual planning activities.
Education, training, and workshops	Yes	Yes	• Program Managers introduced flexibility by allowing participants to skip specific workshops that did not apply to their facilities. • Training and workshops can be delivered via a one-to-many format to reduce delivery costs.

Additional sources of flexibility not tied to a specific existing SEM activity include:

- **Eligibility criteria.** Allowing flexible relaxation of minimum energy consumption participation thresholds while requiring programs to meet program administrator-approved average consumption can expand access to smaller customers and diverse sectors. Additional screening efforts, including qualitative screening calls and checklists, can help to assess non-energy factors, like billing and production data availability and to create a clear understanding of time commitments, that may impact the success of a prospective customer's SEM participation.
- **Duration of engagement:** The CPUC may want to consider allowing fewer program cycles (two cycles) for non-industrial SEM. Allowing a successful conclusion after fewer cycles may work well for individual sectors.
- **Staff roles:** Allowing flexibility in Energy Team formation may work better for participants with limited resources or high turnover. Allowing the Energy Champion to take on the dual role of Data Lead can mitigate resource constraints, while proactively identifying a Backup Energy Champion can mitigate the negative impacts of turnover. However, a single individual is less likely to be successful and subjects the project to turnover risk.

Conclusion: The current SEM Guide presents a blueprint for SEM programs that can be adapted to address all sectors. A single guide has the advantage of providing consistency and clarity across all SEM programs and will better facilitate program designs that address both industrial and non-industrial sectors.

The value of flexibility was a common refrain across multiple interviewees, who noted that it allowed them to "meet customers where they are," address individual and sector-specific nuances, and in some cases streamline program delivery without significantly impacting savings or other key metrics (including NTGR and EUL). Notably, the California PAs also described the value of flexibility to "meet customers where they are."

> **Recommendation**: As PAs and program implementers design non-industrial SEM offerings and develop implementation plans, they should do so with an eye toward allowing flexibility in the targeted areas identified in Table 1 4. These flexibility adjustments can be included as modifications to the existing SEM Design Guide without requiring new guides; efforts to introduce flexibility should balance the need to maintain core elements of successful SEM programs with allowing programs to tailor the guide to their specific targeted sectors and use cases.

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