Report **Group D – D11.03**

2018-19 Industrial Strategic Energy Management (SEM) Impact Evaluation

Submitted to
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ENERGY + WATER + EFFICIENCY

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List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
BRO	Behavioral, retrocommissioning and operational based energy savings
CPUC	California Public Utilities Commission
CUSUM Graph	Cumulative sum of differences graph – This is a graph that plots the cumulative difference between model-predicted energy use and actual energy use.
EUL	Effective useful life – The average time over which an energy efficiency measure results in energy savings, including the effects of equipment failure, removal, and cessation of use.
IOUs	Investor owned utilities
kW	Kilowatts
kWh	Kilowatt-hours
M&V	Measurement and verification
MMBtu	Millions of British thermal units
MW	Megawatt
MWh	Megawatt-hours
NMEC	Normalized metered energy consumption – This is a means by which savings are quantified at the meter level through a regression approach that normalizes energy use by independent variables such as weather, production, etc.
NTGR	Net-to-gross ratio
Opportunity Register	A document of identified energy saving opportunities intended to be a living document that assigns actions to responsible parties and includes due dates for activities, notes, etc.
PA	Program administrators – For industrial SEM programs, all program administrators are investor owned utilities.
PI	Program implementers – In California SEM these are third party entities that deliver the SEM curriculum and work directly with sites.
POE	Preponderance of evidence
PG&E	Pacific Gas and Electric
RFP	Request for proposals
RUL	Remaining useful life – The number of remaining years that an item, component, or system is estimated to be able to function
SCE	Southern California Edison
SCG	Southern California Gas
SDG&E	San Diego Gas and Electric

Acronym/ Abbreviation	Definition
SEM	Strategic energy management — A strategy for generating energy savings from large energy users by incorporating energy management into their internal management systems
SOP	Standard operating procedure
Treasure Hunt	A one-day facility scan conducted by a team of facility staff and SEM implementers who search for energy efficiency opportunities— Opportunities found are populated in the Opportunity Register. See opportunity register.
Workshops	Training sessions that gather SEM participants to deliver curriculum defined in the SEM statewide design guide— The guide calls for eight workshops; each covering different topics.

* See Glossary of Terms on page 205 for a detailed explanation.

Executive Summary

In this report, the SBW team describes how we evaluated the Cycle 1 accomplishments of industrial Strategic Energy Management (SEM) programs in California. We independently determined SEM energy and demand savings for the four California investor-owned utility (IOU) program administrators (PA).[1]

Industrial SEM launched in California mid-year in 2018. The projects included in this evaluation pertain to the first and second-year achievements for the initial 35 participants (industrial business customers of the IOUs). They are referred to as Cohort One by the PAs. PAs reported savings for the first two years of these participants in 2019 and 2020, with additional reported savings for year three in 2021. We did not evaluate any third-year reported savings in this evaluation. Future evaluations should include year three and beyond for these participants and any new cohorts launched after 2018.

Objectives

The objectives of our evaluation were:

- **Evaluate Gross Savings**. Gross savings are site-level energy savings that result directly from program-related actions taken by energy consumers exposed to the program, regardless of the extent or nature of program influence on these actions. We evaluated the gross first-year and life-cycle electric (kilowatt-hour, or kWh), electric demand (kilowatt, or kW), natural gas (therm), and combined (MMBtu) savings achieved by the SEM-project portfolio. Then we explained why our evaluated gross savings differ from those reported.
- **Evaluate Net Savings**. Evaluate the portion of the gross savings caused by the programs' actions—that is, the net savings. Explain what factors drove the results.
- **Reproducible Results**. Document our data-collection, modeling, and data-processing procedures to ensure that our results are transparent and reproducible.
- **Recommendations**. Provide actionable recommendations to improve the programs, PA savings reports for future SEM projects, and future evaluation methods.

Methodology

We evaluated gross savings for all 30 sampled participants regardless of whether there was a savings claim and regardless of if that claim was positive or negative. We first gathered a complete record of what the programs did from project files and supplemental information requests. We carefully reviewed this record of the methodology, data, and analysis

[1] The four PAs are Pacific Gas & Electric, Southern California Edison, Southern California Gas, and San Diego Gas & Electric.

underpinning the savings reported for each participant. Next, we developed and implemented a measurement-and-verification (M&V) plan for each participant that detailed the appropriate approach for collecting data, including interviews, virtual site visits[2], measurements of affected equipment, and other sources.

Carrying out the M&V plan for each participant required multiple virtual site visits, data requests, independent discovery of energy-system and project implementation details, and development of energy models. It was not uncommon to develop multiple energy models for participants when they use both gas and electric energy. An energy model applies to multiple reporting periods. Cycle one of SEM includes two reporting periods, each one year in length. Once we established energy models for both reporting periods, we calculated energy savings for each reporting period. We then quantified incremental energy savings for subsequent reporting periods. In addition to gross energy savings, we evaluated net energy savings. Net savings are those energy savings that are estimated to be caused by the SEM program.

We estimated program influence using a theory-driven approach that relied on the preponderance of the evidence[3] approach (Davidson 2000; Forss, Marra, and Schwartz 2011). We then translated these results into a net-to-gross ratio (NTGR) for sampled projects to determine the net savings attributable to the Program. This ratio is a percentage value between zero and one hundred that represents the portion of the gross savings likely caused by the Program.

Our approach drew upon CPUC-approved methods for nonresidential programs in use since 2006 in California and at least four other states. These methods rely on multiple sources of information to help us understand the extent to which the Program influenced a customer's decision to implement energy savings opportunities. Sources included carefully structured telephone interviews with key decision-makers and documentation (e.g., scoping reports, energy maps, energy models, completion reports, participant tracking reports, etc.) submitted by the PAs.

Once we completed work on the gross and net samples, we extrapolated the results to estimate gross savings, NTGR, and other factors for the population. Ultimately, we used the sample to estimate gross and net savings for each PA and statewide.

[2] Virtual site visits replaced physical site visits due to the COVID-19 pandemic. These site visits included interviews with customer staff, media sharing (photos and videos), virtual walkthroughs with customer processes and document sharing through virtual meeting platform. All agendas were developed in advance to seek to discover necessary data for validation of energy savings.

[3] The preponderance of evidence approach asks whether, after examining all of the evidence, an evaluator can conclude that the provability that the program played a substantial role in causing the observed outcomes is greater than 50% (i.e., more likely than not).

Findings

Gross Electric Savings

Higher life-cycle savings, first-year savings confirmed. Our evaluation of Industrial SEM electric gross energy savings found:

- Higher evaluated savings than reported for life-cycle electric savings, and
- Similar first-year electric savings

Error! Reference source not found. and **Error! Reference source not found.** show the electric savings. These tables show an unusually high life-cycle gross realization rate for SDG&E. We found this PA entered the wrong EUL of one year in all SEM savings reports when they should have entered the correct value of five years. When we correct the reported EUL to the correct value of five years, the life-cycle gross realization rate (GRR) is in line with other PAs (see explanation below).

IOUs report energy savings achieved by energy efficiency programs. Periodically the CPUC conducts energy savings evaluations to evaluate results independently. One of the reported metrics of evaluation is the savings gross realization rate. GRR is a ratio of the reported energy savings validated by third-party evaluators. We calculate GRR by dividing the gross evaluated energy savings by the reported energy savings.

A GRR of 1.0 would indicate that the evaluated savings are equal to the reported savings. A GRR of 6.0 indicates that the evaluated energy savings are six times greater than the reported energy savings. In an ideal program, the GRR is 1.0, indicating the program administrators are not over-or under-reporting energy savings.

Table 1: Life-Cycle Gross and Net Electric Savings, by PA and Statewide

PA	Life-Cycle Electric Savings				
	Reported (MWh)	Gross Evaluated (MWh)	GRR	Net Evaluated (MWh)	NTGR
PG&E	162,852	164,630	1.01	164,630	1.00
SCE	59,837	61,023	1.02	60,481	0.99
SDG&E	5,030	30,246	6.01	30,246	1.00
Statewide	227,719	255,899	1.12	255,357	1.00

Table 2: First-Year Gross and Net Electric Savings, by PA and Statewide

PA	First-Year Electric Savings				
	Reported (MWh)	Gross Evaluated (MWh)	GRR	Net Evaluated (MWh)	NTGR
PG&E	32,570	30,945	0.95	30,945	1.00
SCE	11,967	12,647	1.06	12,535	0.99

PA	First-Year Electric Savings				
	Reported (MWh)	Gross Evaluated (MWh)	GRR	Net Evaluated (MWh)	NTGR
SDG&E	5,030	5,781	1.15	5,781	1.00
Statewide	49,568	49,373	1.00	49,261	1.00

Gross Gas Savings

Lower first-year savings, higher life-cycle savings. Our evaluation of Industrial SEM gas gross energy savings found:

- Higher evaluated savings than reported for life-cycle gas savings, and
- Lower evaluated savings than reported for first-year gas savings statewide.

Implementing large capital measures with long effective useful lives[4] (EULs) caused the evaluated life-cycle gas savings to exceed those estimated by the PAs. **Error! Reference source not found.** and **Error! Reference source not found.** show the gas savings.

Table 3: Life-Cycle Gross and Net Gas Savings, by PA and Statewide

PA	Life-Cycle Gas Savings				
	Reported (Therm)	Gross Evaluated (Therm)	GRR	Net Evaluated (Therm)	NTGR
PG&E	10,220,077	13,390,036	1.31	13,390,036	1.00
SCG	1,937,845	1,326,655	0.68	1,314,872	0.99
SDG&E	88,555	376,183	4.25	376,183	1.00
Statewide	12,246,477	15,092,875	1.23	15,081,092	1.00

Table 4: First-Year Gross and Net Gas Savings, by PA and Statewide

PA	First-Year Gas Savings				
	Reported (Therm)	Gross Evaluated (Therm)	GRR	Net Evaluated (Therm)	NTGR
PG&E	2,044,015	1,439,623	0.70	1,439,623	1.00
SCG	387,569	287,087	0.74	284,537	0.99
SDG&E	88,555	75,237	0.85	75,237	1.00
Statewide	2,520,139	1,801,946	0.72	1,799,396	1.00

Reasons our first-year savings differed. SEM projects quantify savings in one of two ways—either by a top-down regression model normalized to production and other independent

[4] A measures life is referred to as the effective useful life. More specifically this is the life in years that a measure is anticipated to provide energy savings benefits to the grid.

variables, or bottom-up calculations, estimating each measure[5] independently. PAs adhere to the guidance of the *California Industrial SEM M&V Guide*[6] to quantify savings. However, given the complexity of industrial sites and significant variety in the solutions implemented to save energy, evaluators reached a different conclusion on many projects. Gas realization rates were sensitive to adjustments as a small count of large projects accounted for most savings for SCG and PG&E. The most considerable gas savings adjustments came from an SCG project where an energy model error over-estimated savings. For PG&E, we found inaccurate sub-meter data applied to a project and an invalid energy model due to exceptional growth in production output[7], thus over-estimating energy savings by extrapolation beyond the allowable thresholds in the M&V guide. Aside from these, the most prevalent reasons our savings estimates differed from PA reports were:

- **Calculation methods.** Some of the most significant adjustments, representing 38% of the instances, to estimated savings, resulted from more accurate energy models and improved quality and rigor of bottom-up calculations.
- **Operating Conditions.** We identified that the operating conditions of the equipment were different from those stated in the reports. For example, variable speed pumps that operated at different speeds for different hours per year than assumed in the reports.

Net Savings

NTGR was determined to be near 1.0. We found strong support, via a preponderance of the evidence, that customers' decisions to implement energy-efficiency improvements in Industrial SEM aligned with the motivations designed within the logic models[8] for each PA. When the PAs launched SEM, NTGR was debated but ultimately set to 1.0 statewide. Our evaluation confirmed the validity of this assumption. While we identified multiple sites that were not influenced significantly by the SEM programs, we found these sites less engaged and, ultimately, achieved little or no energy savings during the first two years within SEM. Therefore, the evaluation found little savings not attributable to SEM.

Effective Useful Life (EUL)

SEM influences more capital-equipment upgrades than anticipated, resulting in a longer EUL than reported. SEM launched with an established EUL of 5 years. This evaluation analyzed EUL at the completed-measure[9] level. We evaluated behavioral, retro-commissioning,

[5] A measure in SEM is any unique action that a participant implements to save energy. Measures can be behavioral, (turning off the lights when you leave a room), operational (programming conveyors to idle when no product is present) or can involve upgrading equipment.

[6] Sergio Dias Consulting. 2020. *California Industrial SEM M&V Guide v2.02.*

[7] The Industrial SEM M&V Guide requires implementers to consider the valid model range for energy model coverage by invalidating energy models when the independent variables significantly change over time. In this isolated case the second reporting period production outputs were substantially greater than the baseline observations yielding an invalid energy model and the necessity to turn to bottom-up calculations.

[8] The SEM program implementers developed logic models for implementation. These logic models are shared in each of their respective implementation plans. A sample logic model is available in Section 3.4.2.

[9] In SEM measures are completed actions to save energy.

and operational (BRO) measures with an EUL between one and five years and equipment measures consistent with custom projects[10].

All PAs offered industrial participants in SEM an option to either implement equipment upgrades through SEM with SEM incentives or apply for a custom-project incentive (if applicable). No custom projects were completed in the first two years of SEM.[11] The evaluation found that roughly 16% of the first-year savings and 35% of the life-cycle savings within Industrial SEM resulted from equipment upgrades. Participants confirmed their preference for ease of implementation over incentive value.

However, not all equipment upgrades increased the EUL of each site. Particularly, lighting upgrades result in a lower EUL than five years.

Recommendations

We base our recommendations on observations made during this evaluation. Implementing these recommendations will improve the accuracy of program-reported savings and enhance future evaluators' ability to verify those reports expeditiously. In summary, our most important recommendations are:

Table 5: Recommendations

Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
Adopt improved guidance for the level of rigor required for bottom-up calculations	Evaluators found a varying level of detail for bottom-up calculations. In general, the higher the savings, the more rigor is expected.	We recommend leveraging the statewide SEM Energy Savings Best Practices Workgroup for PA collaboration on solutions. All bottom-up calculations should define the baseline and proposed energy consumption and annual hours of operation. Additionally, we recommend adding an amendment to the statewide M&V Guidelines for documenting and determining each term within the energy calculations	Savings Calculations - Bottom-Up
Use accurate and reliable energy meters	Implementors should only use accurate and reliable energy meters for M&V. One sizeable natural gas project had a low gross realization rate due to inaccurate meter data in the M&V calculations. The customer confirmed the meter is erroneous, exceeds the	If participant-owned sub-meters are deemed inaccurate, PIs should not rely on the data for energy models or bottom-up calculations. Refer to the Industrial SEM M&V Guide Section 5.3.3 for guidance on meter calibration.	Savings Calculations

[10] Custom projects are defined by IOUs to be unique. They are energy efficiency projects that require a study, said study be reviewed and approved and a custom project incentive agreement authorized before a participant elects to move forward with implementation.

[11] The development timeline for a custom project is long. It can take over two years between identification, study, authorization and implementation to occur. Some custom projects are in development and will complete in out years.

Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
	range of data collected, and was adjusted many times.		
Lack of documentation for non-routine events adjustment methodology	Evaluators often had to interpret the various methodology for non-routine adjustments by reviewing model inputs rather than the supplied documentation.	Provide clear documentation of non-routine adjustment methodology in M&V reports and make notes or comments in modeling tools where applicable. All calculations and data processing must be transparent and retained within the model files for review and evaluation. Additionally, non-routine events include a start and end date, hence why they are "non-routine." If an open-ended non-routine event is specified, the modeler must state clear conditions for how and when to re-evaluate ending the adjustment. For example, if an air compressor fails and a backup unit is in place, the condition would be the repair of the air compressor, and shutdown of the backup unit would end the non-routine event.	Non-Routine Events
Missed non-routine events	Review of energy consumption, regression models, and production data, followed by discussions with the site, often identified non-routine events the energy model did not account for in PA/PI savings calculations.	Standardized methodologies greatly aid in the identification and documentation of non-routine events. We recommend the PIs create tools and templates based on the criteria in the California Industrial SEM M&V Guide and best practices for non-routine events identification, such as the "IPMVP Application Guide on Non-Routine Events & Adjustments" (e.g., heat maps, residual analysis, CUSUM inflection analysis, etc.). When examining data for non-routine events, consider filtering data into significant day-types or operating modes where appropriate to ensure that users can compare potential changes in static factors to relevant base conditions and aid in identifying substantial shifts.	Non-Routine Events
SEM participants missing in claims dataset	Many claims for SEM participants were missing in a given program year dataset. PAs presented various reasons for why claims were not in CEDARs. The following reasons summarize all instances of a missing claim: 1. M&V was not completed within the deadline for program year entry. 2. Energy savings result were zero. The PA decided not to enter a claim.	To aid in impact evaluation and thoroughly document participant results, PAs should be required to enter a claim for all SEM participants each program year. Evaluators expect to see a claim for each participant even if the result is no savings.	Evaluation

Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
	3. The M&V method failed. The energy savings result was unknown and assumed zero for the reporting period. In a subsequent year, the implementor changed the M&V method to quantify savings. The PA decided not to enter a claim. 4. Energy savings result were negative, and the PA decided not to enter a claim. Missing claims affects an evaluator's ability to sample claims properly.		
Evaluators might be underestimating the benefits of the SEM program since they cannot consider the longer-term impacts.	A significant belief or hypothesis underlying the SEM program is that changing the organizational culture for energy management will increase the likelihood that the behaviors and evaluated savings will persist and additional savings identified. We could not thoroughly test this in Cycle 1, given the longer-term nature of cultural change. However, that 82% of the participants in Cycle 1 have decided to participate in Cycle 2 presents an excellent opportunity to assess any additional changes in the organizational culture, the persistence of savings verified in Cycle 1, and the identification of additional opportunities to reduce energy use.	We recommend assessing the cumulative effect of the SEM program over several years since it is a rare opportunity to evaluate the Program's longer-term impacts. A primary goal of this research should be to better understand persistence and EUL of SEM.	Evaluation
While the implementers submitted logic models, they were inconsistent, in some cases, and incomplete. The logic models also lacked an accompanying narrative that explains how specific actions lead to certain outcomes.	Developing a logic model and an accompanying narrative explaining why specific actions lead to certain outcomes is critical for such a complex program as SEM. The underlying theories can be based on social science and engineering principles or simply on past evaluations of what works and for which populations (i.e., "practical" program theories). In a statewide program involving multiple implementers, a collaboration between implementors to develop a single logic model and underlying narrative is essential. In addition, it is also critical that the evaluators and implementers agree on the key performance indicators early in the life of the Program and map them into the various links of the logic model	Implementers should develop a statewide SEM program logic model and an underlying narrative based on social science theories and engineering principles or past evaluations of what works and for which populations (i.e., "practical" program theories). In addition, evaluators and implementers should agree on the key performance indicators early in the Program's life and map them into the various links of the logic model.	Evaluation
Quantify and claim demand	PAs inconsistently claimed demand savings across program years. All SEM project claims with electric energy	We recommend that demand savings are quantified and claimed for all SEM projects. Demand savings calculation	Reporting

Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
savings for all SEM projects	savings should include demand savings.	help provide a savings metric for facility-level projects that incorporate different savings types from different resources (ex: gas & electric, energy efficiency, demand response, and distributed generation). A demand savings calculator was developed and proposed by the evaluation team during the Group D contract. We recommend that the IOUs take ownership of that tool, continue improving it, and support claiming demand savings.	
Use correct EULs for SEM projects	Some claims entered by PAs had an EUL of 1 year for SEM projects.	PAs should ensure that EULs are assigned appropriately at 5 years.	Reporting
Standardize claim entries statewide	We observed variation in claims data entry from one PA to another and within PA claims. We found gross savings for SEM claims to be the product of two fields in CEDARS claims. For example, the first baseline kWh savings are "NumUnits" and "UnitkWh1stBaseline.x". Similar fields are available for therms, kW, and 2nd baseline.	We recommend that CPUC provide more specific guidance to the PAs to standardize claim entries. The preferred method would be to use a value of "1" in "NumUnits" and the unit value of savings in each savings-specific field. However, some PAs include multiple claim entries (one for each fuel) and use the "NumUnits" field to enter the unit value of savings, then putting a 1 in "UnitkWh1stBaseline.x".	Reporting

1 Introduction

In this report, we—the SBW team—describe how we completed the *2018-2019 Industrial Strategic Energy Management Impact Evaluation* and the resulting findings. Our goal was to conduct an independent evaluation of the gross and net savings—kilowatt-hour (kWh), kilowatt (kW), and therm—associated with the projects reported by program administrators (PA) during 2019, 2020, and 2021[12] for the first cycle of the first cohorts of industrial SEM. This study continues the history of similar CPUC-mandated evaluations of custom projects that began with the 2006-08 program cycle.

1.1 Background

California Public Utilities Commission (CPUC) Decision 16-08-019[13] directed the investor-owned utilities (IOUs) to implement strategic-energy-management programs. The decision defines SEM as a holistic, whole-facility approach that uses normalized metered energy consumption (NMEC) and a dynamic baseline model to determine savings from all program activities at the facility, including behavioral, retrocommissioning, and operational (BRO) and custom projects. The decision calls for IOUs to administer their programs based on a consistent, statewide program design.

The California IOUs contracted with Sergio Dias Consulting to develop the *Statewide Industrial SEM Design Guide and the Measurement and Verification (M&V) Guide*. The PAs, with input from Sergio Dias Consulting, developed a three-cycle SEM program. Design guides have been developed for Cycles 1 and 2, and a guide for Cycle 3 is pending. These documents serve as the framework by which each PA is directed to design and implement their SEM programs. Each cycle involves a two-year engagement, with M&V periods at the end of each year.

Since the completion of the SEM design and M&V guides, the PAs have issued requests for proposals (RFPs), selected implementers, and written implementation plans for their industrial SEM programs. The PAs recruited a total of 37 participants for the first cohorts. Of the 37 participants originally recruited, two did not complete and dropped out of SEM leaving a total of 35 participants completing cycle one. While each PA's program has subtle differences, all generally follow the statewide design and M&V guides.

[12] Savings claims for Cycle 1 of the first cohorts spanned three program years. The program by design was a two-year engagement for the first cycle.

[13] Public Utilities Commission of the State of California. 2016. Order Instituting Rulemaking Concerning Energy Efficiency Rolling Portfolios, Policies, Programs, Evaluation and Related Issues. http://ccag.ca.gov/wp-content/uploads/2016/10/6.5-Attachment-ALJ-Decision-16-08-019-081816.pdf

1.2 CPUC Policies and Guidance

When designing and implementing our evaluation, we considered the following CPUC policies and guidance:

- *CPUC Energy Efficiency Policy and Procedures Manual* (v. 5) [14]
- *Statewide Custom Project Guidance Document v. 1.0*[15]
- *Utility Statewide Custom Policy and Procedures* manual[16]
- CPUC resolution E-4818[17] affecting assignment of project baselines
- Tables supporting NTGR and EUL/RUL downloaded from READI v.2.5.1[18]
- California Industrial SEM M&V Guide v 2.02[19]
- California Industrial SEM Design Guide v1.0[20]
- Energy Efficiency Savings Eligibility at Sites with non-IOU Supplied Energy Sources – Guidance Document v1.1[21]

1.3 Structure of this Report

The balance of our report consists of the following sections:

- **Methodology.** This section summarizes substantive changes to the workplan regarding methods we used to estimate gross and net savings.
- **Findings.** This section provides our estimates of gross and net savings for each PA and statewide. It also describes the reasons our savings differ from the PA's claims and explores the determinants of the NTGR.
- **Recommendations.** This section provides our recommendations to improve claim reporting, review of reported claims, and evaluation of SEM projects.

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[14] CPUC. 2013. *Energy Efficiency Policy Manual Version 5.0 For Post-2012 Programs.* San Francisco, CA: CPUC. https://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy_-_Electricity_and_Natural_Gas/EEPolicyManualV5forPDF.pdf

[15] PG&E, SCE, SoCalGas, SDGE 2019. Statewide Custom Program Guidance Document ver. 1.0. https://www.cpuc.ca.gov/General.aspx?id=4133

[16] PG&E, SCE, SoCalGas, SDG&E. 2018. *2018 Statewide Customized Offering Procedures Manual for Business.* San Francisco, CA: CPUC. https://www.pge.com/pge_global/common/pdfs/save-energy-money/facility-improvements/custom-retrofit/Customized-Policy-Procedure-Manual_2018.pdf

[17] CPUC. 2017. *Resolution E-4818.* San Francisco, CA: CPUC. http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M171/K557/171557623.PDF

[18] http://www.deeresources.com/index.php/deer-versions/readi

[19] Sergio Dias Consulting. 2020. *California Industrial SEM M&V Guide v2.02.*

[20] Sergio Dias Consulting LLC. 2017. *California Industrial SEM Design Guide v1.0.*

[21] CPUC. 2015. *Energy Efficiency Savings Eligibility at Site with non-IOU Supplied Energy Sources – Guidance Document.* San Francisco, CA: CPUC. https://pda.energydataweb.com/api/downloads/2118/EnergyEfficiency_Savings_at_Sites_with_non-IOU_Fuel_Sources_2015-11-06.pdf

- **Integrated Demand Side Management Observations.** This section provides insights collected during our evaluation pertaining to IDSM.
- **Data Products.** This section describes the data products that we prepared to help the PAs and other stakeholders review this report.
- **Appendices.** In these appendices we provide detailed tabulations of our findings and additional information describing our methods, including NTGR questionnaires and our project-specific data-collection procedures.
- **Glossary.** This section provide definition for phrases and abbreviation used throughout this report.

2 Methodology

For a review of the SEM impact-evaluation methods, please refer to the *Group D Industrial SEM Evaluation Workplan*.[22]

2.1 SEM Evaluation Methods that Differed from Custom

This section documents changes in the methodology that were required to address the unique aspects of SEM. These methods differed from similar approaches taken in the custom-project, CIAC evaluation.

1. **Sampling.** The SEM sample frame was drawn on a combined fuel and Btu basis. Sampling was not fuel dependent and not all sites participated in SEM with both fuels.
2. **COVID Observed Conditions.** Due to the timing of SEM (reporting periods during the pandemic), quantifying COVID impacts for SEM was slightly different than for CIAC. The first reporting period was before the pandemic, so was not impacted by COVID. The second reporting period included a portion of time before and within the pandemic. Therefore, the energy savings during the pandemic was captured by the energy models during the second reporting period. As with CIAC, SEM uses the as-observed COVID conditions to quantify the estimated life-cycle savings.
3. **Demand Savings.** Predicated on input Group D received from the IOUs during the workplan development and an early opinion request through custom project review, a methodology for quantifying demand savings in SEM was jointly developed between the evaluators and the PAs. Quantifying demand savings for SEM projects improves the program evaluation and accuracy for cost-effectiveness assessment.

   Evaluating demand savings for SEM presented unique challenges. Namely, demand savings were not included in the original program M&V guide. Therefore, IOUs did not claim demand savings during the first reporting period for most sites. Late in the process of reporting, the IOUs and the CPUC agreed on a method to quantify demand savings. Specifically, that method involved an IOU-specific energy-to-demand factor to estimate demand savings based on energy savings. Claims late in the first reporting period and for the entire second reporting period did include demand savings. To avoid an unreasonable gross realization rate (GRR) for demand, we applied the GRR from energy savings (MWh) to the demand (MW) results.

[22] https://pda.energydataweb.com/api/downloads/2466/Group D - Workplan Update for SEM Evaluation Final Revised January 2021.docx

2.2 Evaluating Effective Useful Life

SEM involves implementing a variety of energy-improvement actions identified by consultants and energy-team members. Actions are a mix of BRO (behavioral, retrocommissioning, and operational) and equipment upgrades. In the energy-efficiency industry, it is common to refer to equipment upgrade projects as capital projects, and BRO projects as operations and maintenance (O&M). It is long understood that the measure life of equipment upgrades is different than BRO. For SEM this necessitates quantifying a participant savings-weighted effective useful-life (EUL) from the life-cycle savings of each action.

Our gross-savings evaluation determined the most appropriate values for EUL for each significant implemented action. To do so, we first reviewed the evaluator's measure description and measure type (BRO or Capital). Since PAs and PIs did not identify a specific measure-application type (BRO, add-on equipment [AOE)], accelerated-replacement [AR], normal replacement [NR], replace on burn-out [ROB], etc.) we had to determine the most relevant application type. Next, whenever possible, for equipment measures we used the values we found using the EUL descriptions from the Remote Ex Ante Database Interface (READI) database and entered those values in our evaluation database. When matching was difficult, a pair of evaluators would consult and then agree on the most appropriate values for EUL and remaining useful life (RUL).

For add-on equipment, we needed a different approach to assign the EUL. We weighted the respective EULs of the add-on component and modified the system in a manner consistent with Resolution E-4818, which states:

> "The EUL of AOE measures is capped at the RUL of the equipment being retrofitted. This means that AOE measures utilize the RUL of the preexisting equipment up to and not to exceed the EUL for the AOE measure."

All BRO measures used a five-year EUL. Given that SEM is still relatively new to California, primary research on SEM EUL in California is absent. We reviewed the SEM EUL literature and summarized findings in a memo included in Appendix D. Until primary research has been conducted, we recommend using a five-year EUL.

3 Findings

In this section, we present our findings related to gross and net savings and address related topics including the reasons for differences in gross savings, discuss attribution in depth, summarize the effects of the COVID pandemic, and present cost effectiveness.

SEM savings results are presented for Cycle 1 as the sum of incremental savings resulting from reporting period one and reporting period two. Cycle 1 occurred over a course of 24 months. Each PA launched Cycle 1 on a slightly different schedule with the earliest launching July 2018 and the latest October 2018. The table below shows key engagement dates and summarizes the number of participants for each cohort.

Table 6: SEM Cohort Start Dates and Participant Count

Industrial SEM Cohort	Start Date	End Date	Number of Participants
SCE/SCG Industrial SEM – Cohort 1	Aug 1, 2018	Jul 31, 2020	8
SDG&E Industrial SEM – Cohort 1	Jul 1, 2018	Jun 30, 2020	7
PG&E SEM Manufacturing Program – Cohort 1	Jul 1, 2018	Jun 30, 2020	10
PG&E SEM Food Processing Program – Cohort 1	Oct 1, 2018	Sep 30, 2020	10

3.1 Gross Savings and Gross Realization Rates

In this section, we present our findings regarding gross savings. We present all savings in both first-year and life-cycle form, extrapolated to the population for each PA and statewide.

We evaluated gross savings for SEM at the site level by each reporting period. Sites that could not be modeled (as noted by the implementer and PA) used bottom-up calculations to quantify savings. Other sites used a top-down energy model. Energy models for SEM are often assembled with multiple independent variables including weather, production, indicator variables for holidays, shutdowns, and non-routine events. Energy models are fuel-specific and can be seasonal. We worked to recreate and evaluate all energy models. When a different outcome was reached, we noted reasons for the difference including detailed descriptions within the gross-savings workbooks, the primary data-collection instrument for evaluation.

We calculated life-cycle savings based on an evaluated EUL for each project. We evaluated EULs specific to the combination of measures installed and influenced by SEM at each site. We then weighted the EULs by savings to estimate EUL at the site and fuel level and again to represent EUL at the PA level.

3.1.1 Electric Savings

Table 7 and Table 8 show our findings for gross first-year and life-cycle, MWh and MW savings, by PA and cumulatively statewide. As noted in section 2.1, we calculated demand

savings with a factor unique to each PA. Demand-savings factors were a product of a demand-savings calculation made available to us by each PA. Because demand savings were not included in the SEM M&V Guide[23] or claimed for any SEM projects during the first reporting period, we did not calculate a demand GRR from the claimed demand savings. Instead, we applied the energy GRR to the demand savings, thus avoiding the errors created from the missing demand-savings claims early in the program year.

SEM includes a mix of equipment upgrades and operational, or BRO, measures. Industrial participants spoke highly of the flexibility the program provided to simply implement energy projects rather than perform a custom study, seek approvals, and authorize incentives. SEM enabled participants to act more quickly on the recommended projects from the PI coaching teams, and suggestions from internal energy-team members. For this reason, we observed a mix of completed measures. SEM by default claims a five-year EUL. Table 8 shows that the gross realization rate for life-cycle savings is higher than first-year savings in many fuel and PA domains. This is a result of several equipment upgrades implemented within SEM. Equipment upgrades tended to extend the EUL of savings beyond the default five years offered by BRO.

Table 7: First-Year Electric Gross Savings by PA (MWh and MW)

PA	First-Year Electric Gross Savings					
	MWh			MW		
	Forecast Claimed	Evaluated	GRR	Forecast Claimed *	Evaluated	GRR **
PG&E	32,570	30,945	0.95	2.09	3.94	0.95
SCE	11,967	12,647	1.06	0.52	1.68	1.06
SDG&E	5,030	5,781	1.15	0.26	0.74	1.15
Statewide	49,568	49,373	1.00	2.87	6.36	1.00

* Forecast Claimed MW does not consider reporting period one MW demand because it was not reported by the PAs

** MW GRR was established from MWh GRR

Table 8: Life-Cycle Electric Gross Savings by PA (MWh and MW)

PA	Life-Cycle Electric Gross Savings					
	MWh			MW		
	Forecast Claimed	Evaluated	GRR	Forecast Claimed *	Evaluated	GRR **
PG&E	162,852	164,630	1.01	10.43	20.95	1.01
SCE	59,837	61,023	1.02	2.62	2.62	1.02
SDG&E	5,030	30,246	6.01	0.26	3.89	6.01
Statewide	227,719	255,899	1.12	13.31	32.94	1.12

[23] Demand savings were added in the second release of the Industrial SEM M&V Guide.

* Forecast Claimed MW does not consider reporting period one MW demand because it was not reported by the PAs
** MW GRR was established from MWh GRR

Figure 1 and Figure 2 show the distribution of kWh GRR by PA. Each marker represents one of the sampled projects. The red horizontal line on each panel corresponds to the PA's GRR.

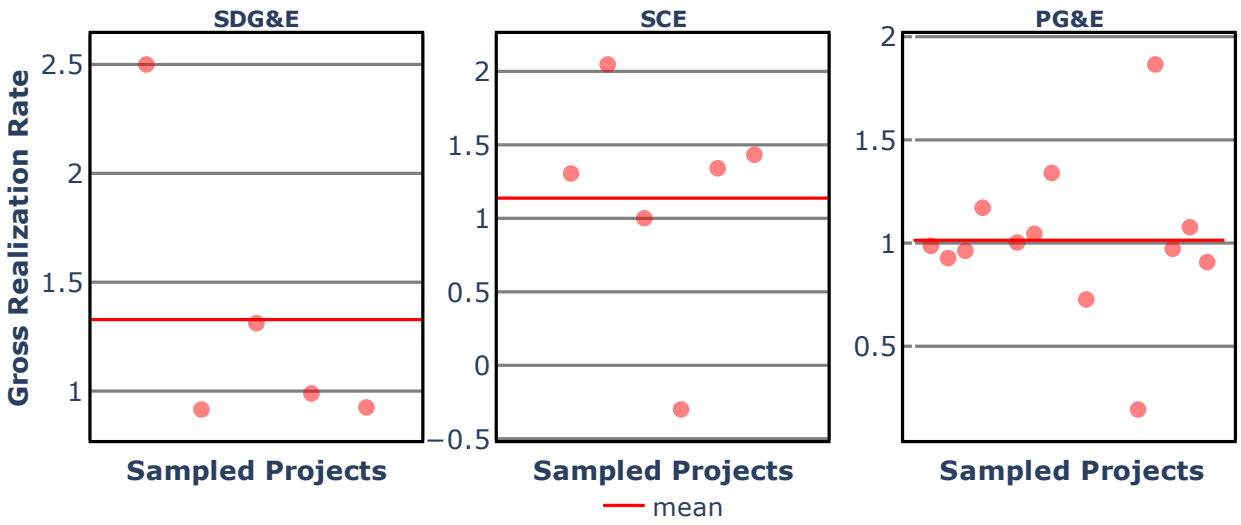


Figure 1: Distribution of kWh GRR by PA (First-Year Gross Savings)

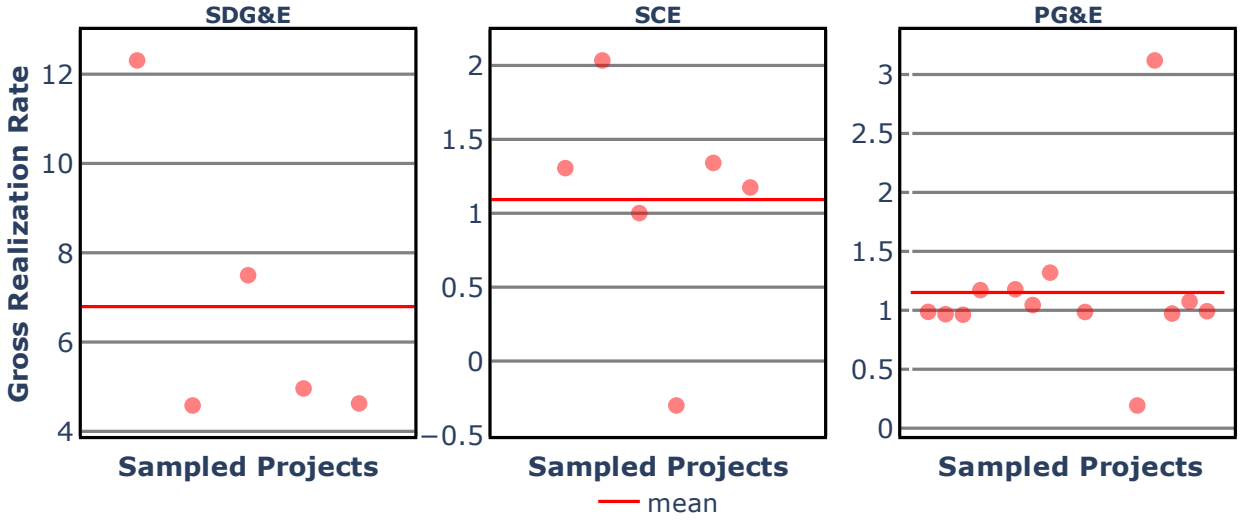


Figure 2: Distribution of kWh GRR by PA (Life-Cycle Gross Savings)

Figure 3 and Figure 4 show the relationship between evaluated and claimed gross electric savings for the sampled projects. The color of the markers on the plot indicates the PA that claimed the project. If a project's evaluated savings is equal to the claimed savings the marker falls on the diagonal line and it would have a GRR = 1. Markers below the diagonal line

represent projects for which we found less savings than claimed by the PA. For those above the line, we found more savings than the PA claimed. Multiple sites claimed no savings and evaluated at no savings. For this reason, there are fewer than 35 data points plotted in the figures.

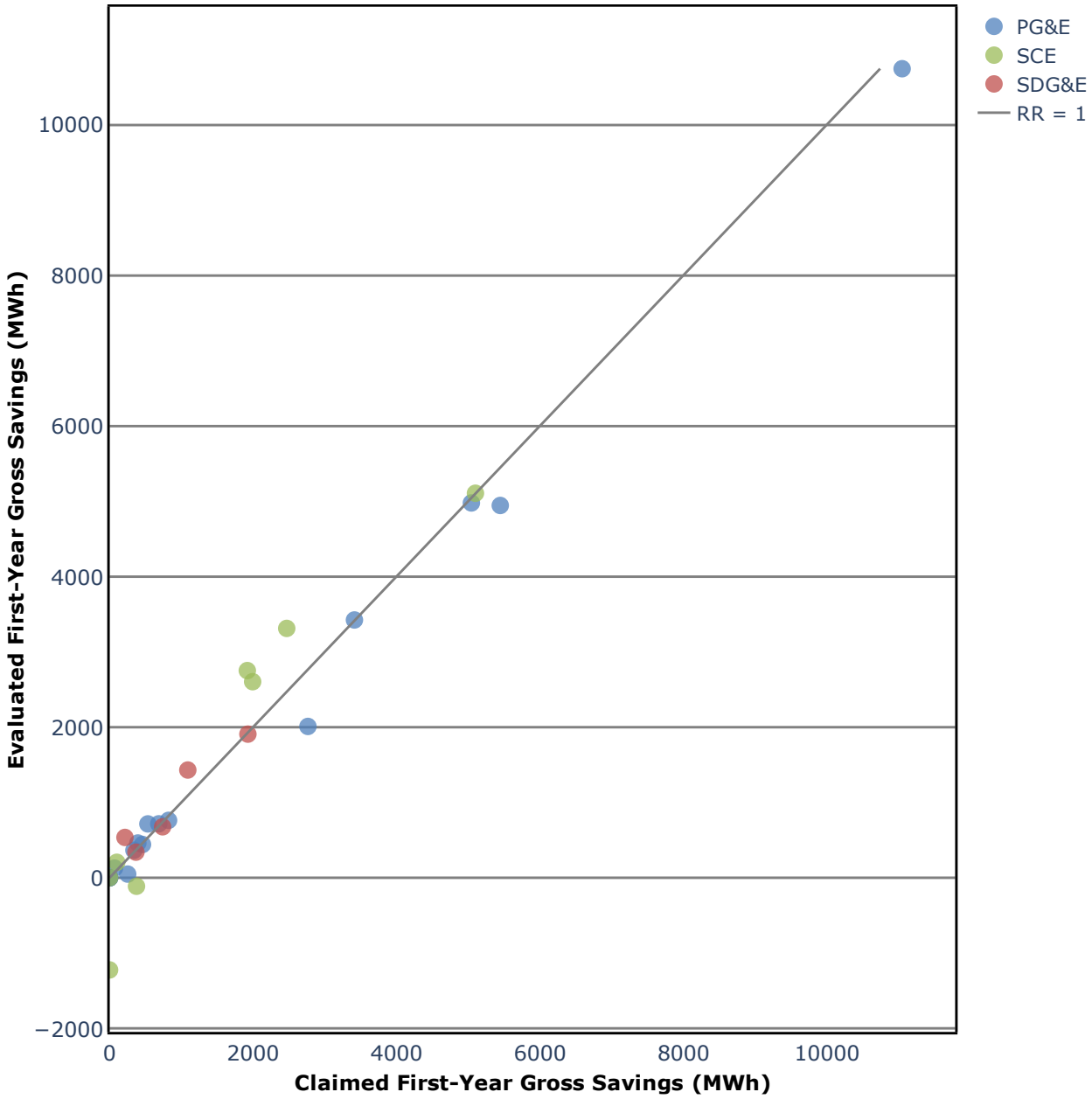


Figure 3: Evaluated vs. Claimed Gross First-Year Electric Savings

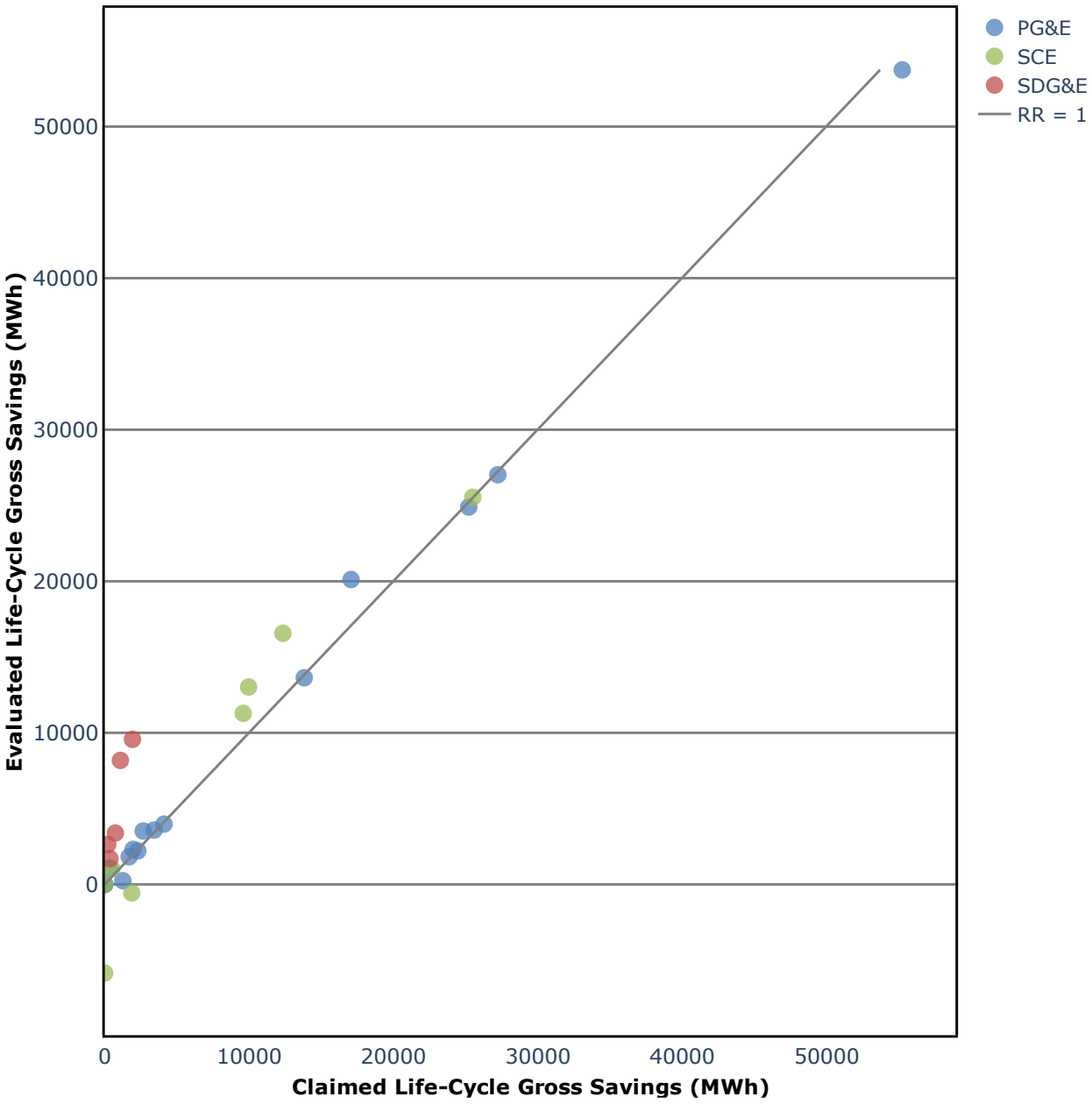


Figure 4: Evaluated vs. Claimed Gross Life-Cycle Electric Savings

3.1.2 Gas Savings

Table 9 and Table 10 show our findings for gross first-year and life-cycle therm savings by PA and cumulatively statewide. Gas GRRs for first year savings for all PAs evaluated lower than electric.

For PG&E, three large gas projects accounted for 80% of PG&E's gas savings that did not fully materialize in evaluation. The primary reasons for reduced savings included inaccurate sub meter data, energy model range validity (variable data exceeded the acceptable range during the

reporting period) and more accurate equipment specifications for bottom-up calculation of savings.

For SCG, one large gas project evaluated with lower first year savings than claimed. The primary reason for this difference included the use of an incorrect indicator variable for production capacity. The evaluating engineer confirmed with the participant instances of when the indicator was wrongly applied in the energy model affecting the energy savings calculations. In addition, one significant SCG gas saving project evaluated with a savings weighted EUL of 2.7 years, thus reducing the life-cycle GRR when compared to the first-year GRR.

Table 9: First-Year Gas Gross Savings by PA (therms)

PA	First-Year Gas Gross Savings		
	Forecast Claimed	Evaluated	GRR
PG&E	2,044,015	1,439,623	0.70
SCG	387,569	287,087	0.74
SDG&E	88,555	75,237	0.85
Statewide	2,520,139	1,801,946	0.72

Table 10: Life-Cycle Gas Gross Savings by PA (therms)

PA	Life-Cycle Gas Gross Savings		
	Forecast Claimed	Evaluated	GRR
PG&E	10,220,077	13,390,036	1.31
SCG	1,937,845	1,326,655	0.68
SDG&E	88,555	376,183	4.25
Statewide	12,246,477	15,092,875	1.23

Figure 5 and Figure 6 show the distribution of therm GRR at the site level by PA.

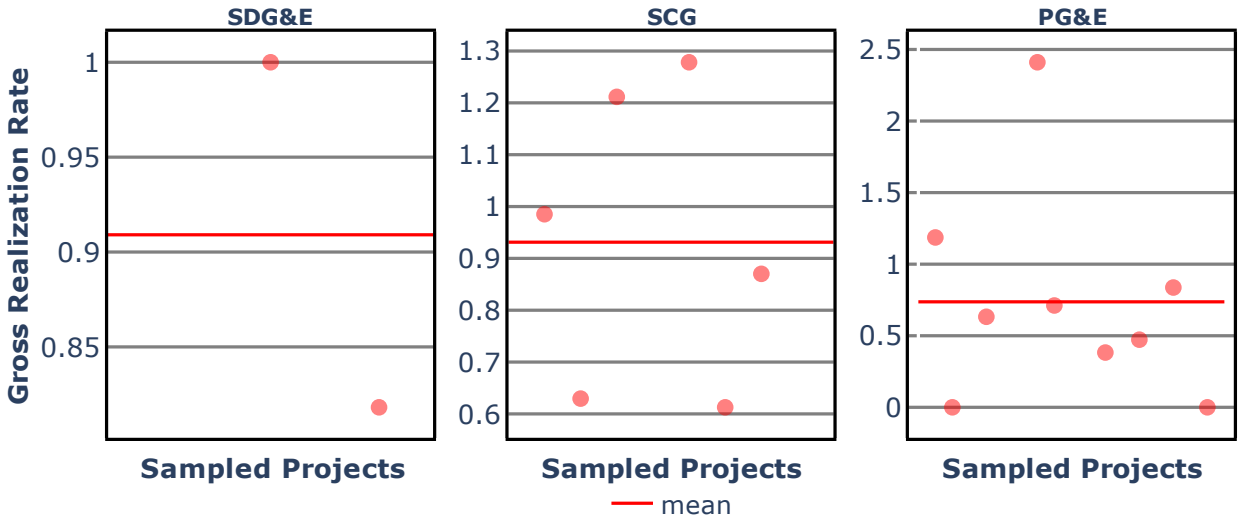


Figure 5: Distribution of Therm GRR by PA (First-Year Gross Savings)

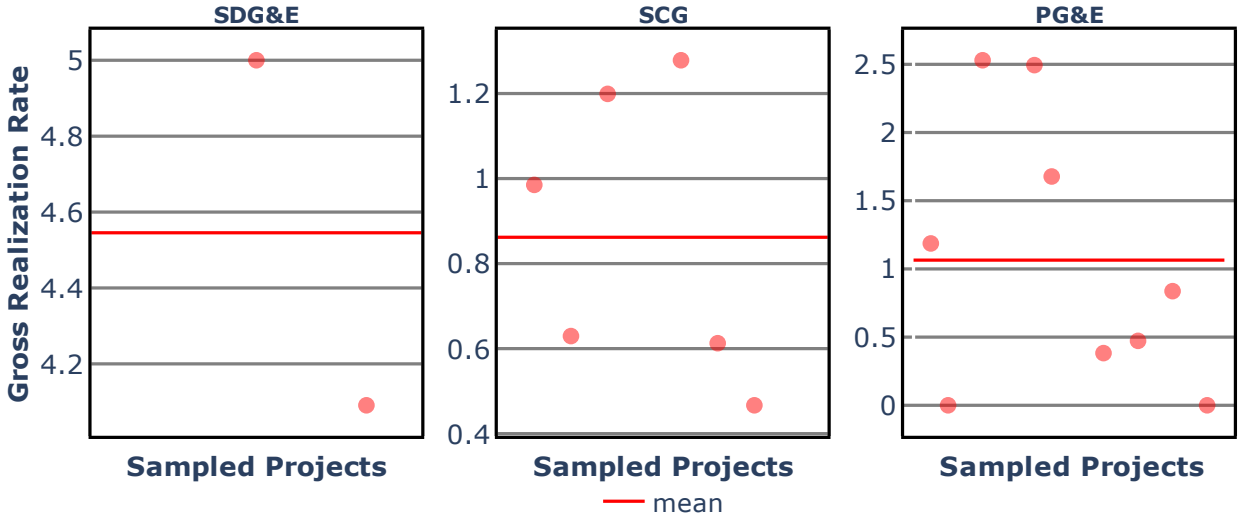


Figure 6: Distribution of Therm GRR by PA (Life-Cycle Gross Savings)

Figure 7 and Figure 8 shows the relationship between evaluated and claimed gross gas savings.

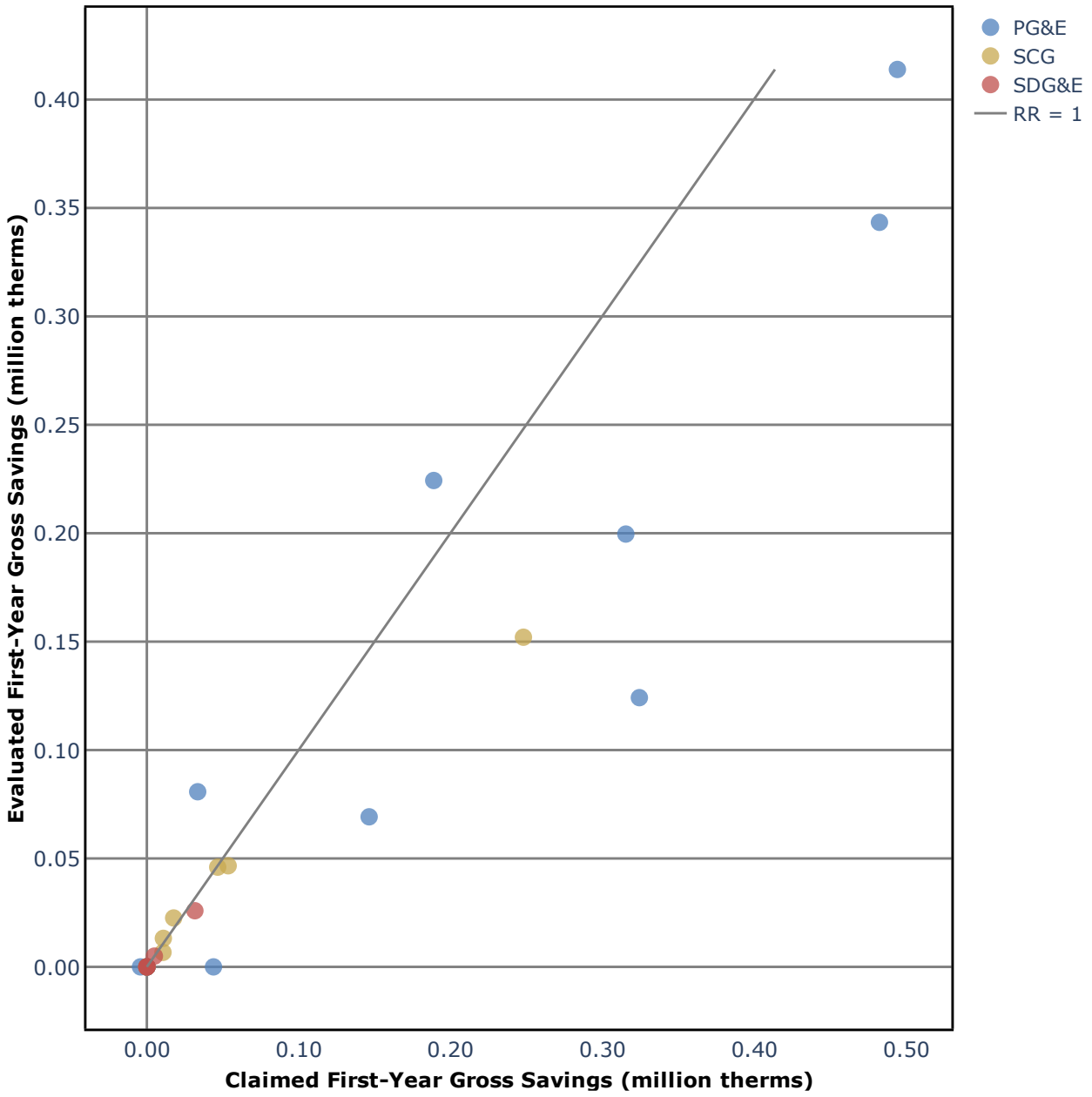


Figure 7: Evaluated vs. Claimed Gross First-Year Gas Savings

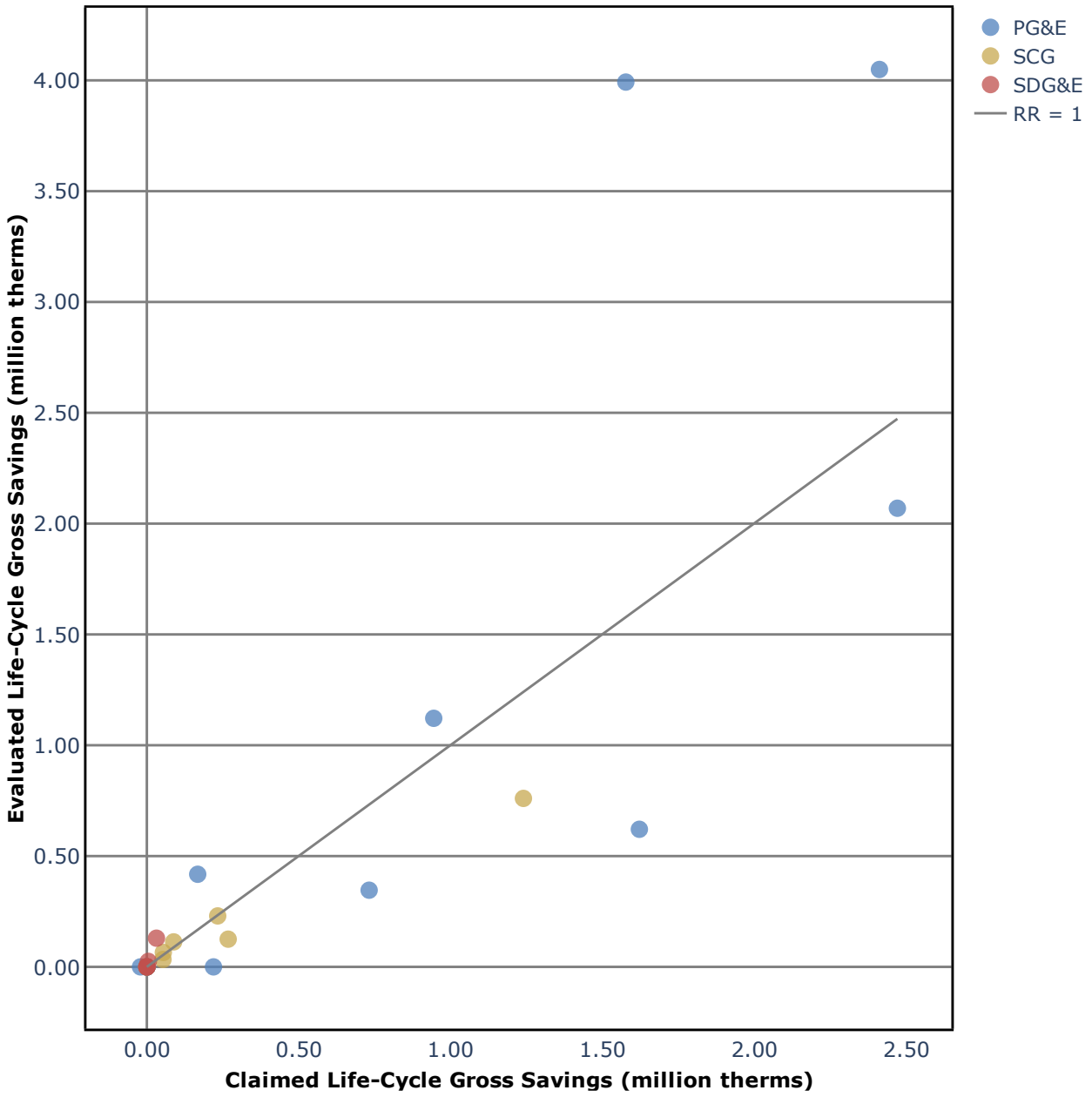


Figure 8: Evaluated vs. Claimed Gross Life-Cycle Gas Savings

3.1.3 MMBtu Savings

Table 11 and Table 12 show our findings for gross first-year and life-cycle MMBtu savings, by PA and cumulatively statewide. We defined sampling stratum based on estimated combined MMBtu savings (small, medium, and large). As SEM touches both fuels at a participant site, this is the most logical means for sampling. Because we sampled based on a combined (MMBtu) energy basis, this is also where we present the relative precision of population savings estimates. With a high number of sites sampled from each population, uncertainty is low. SCE and SCG samples represented the full population and therefore have no uncertainty.

Table 11: First-Year Energy Gross Savings by PA (MMBtu)

PA	First-Year Energy Gross Savings (MMBtu)			
	Forecast Claimed	Evaluated	GRR	RP (%) *
PG&E	315,564	249,579	0.79	0.17
SCE	40,845	43,165	1.06	0.00
SCG	38,757	28,709	0.74	0.00
SDG&E	26,022	27,254	1.05	0.52
Statewide	421,188	348,706	0.83	0.13

* Relative precision at the 90% confidence level.

Table 12: Life-Cycle Energy Gross Savings by PA (MMBtu)

PA	Life-Cycle Energy Gross Savings (MMBtu)			
	Forecast Claimed	Evaluated	GRR	RP (%) *
PG&E	1,577,821	1,900,885	1.20	0.91
SCE	204,225	208,270	1.02	0.00
SCG	193,785	132,666	0.68	0.00
SDG&E	26,022	140,849	5.41	3.95
Statewide	2,001,852	2,382,670	1.19	0.76

* Relative precision at the 90% confidence level.

Figure 9 and Figure 10 shows the distribution of MMBtu GRR by PA. Each marker corresponds to one of the sampled projects. The red horizontal line on each panel corresponds to the PA's GRR.

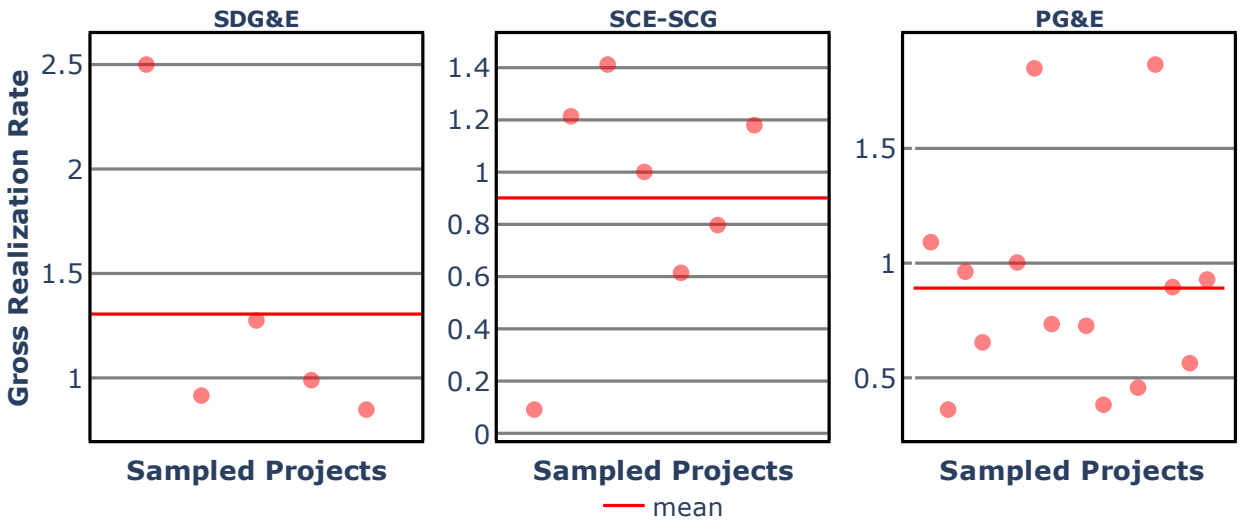


Figure 9: Distribution of MMBtu GRR by PA (First-Year Gross Savings)

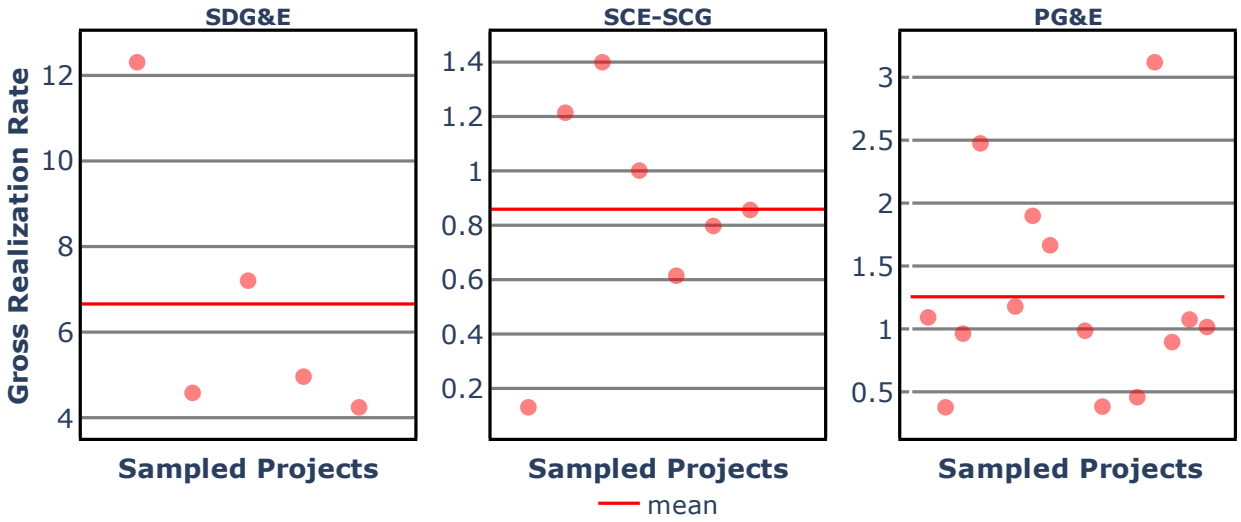


Figure 10: Distribution of MMBtu GRR by PA (Life-Cycle Gross Savings)

Figure 11 and Figure 12 show the relationship between evaluated and claimed gross electric savings for the sampled projects. The colors of the markers on the plot indicate the PA that claimed the project. If a project's evaluated savings is equal to the claimed savings, the marker falls on the diagonal line and it would have a GRR = 1. Markers below the diagonal line represent projects for which the evaluation found less savings than claimed by the PA. For those above the line, we found more savings than the PA claimed. Some PAs had more participants than others. Observing the relative number of data points below the mean line, is not directly indicative of performance. The magnitude of energy savings is also a key factor to PA-level results.

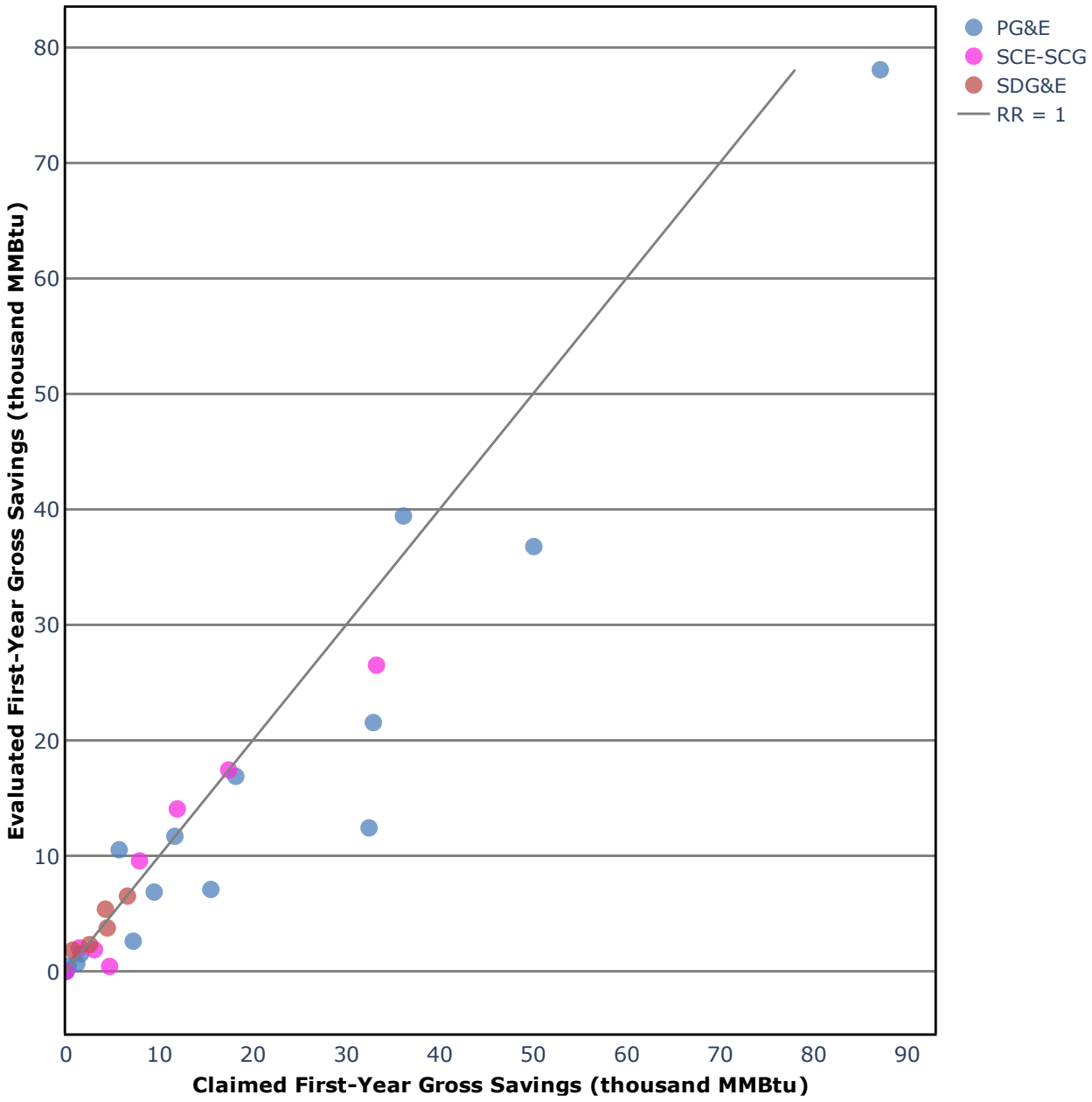


Figure 11: Evaluated vs. Claimed Gross First-Year MMBtu Savings

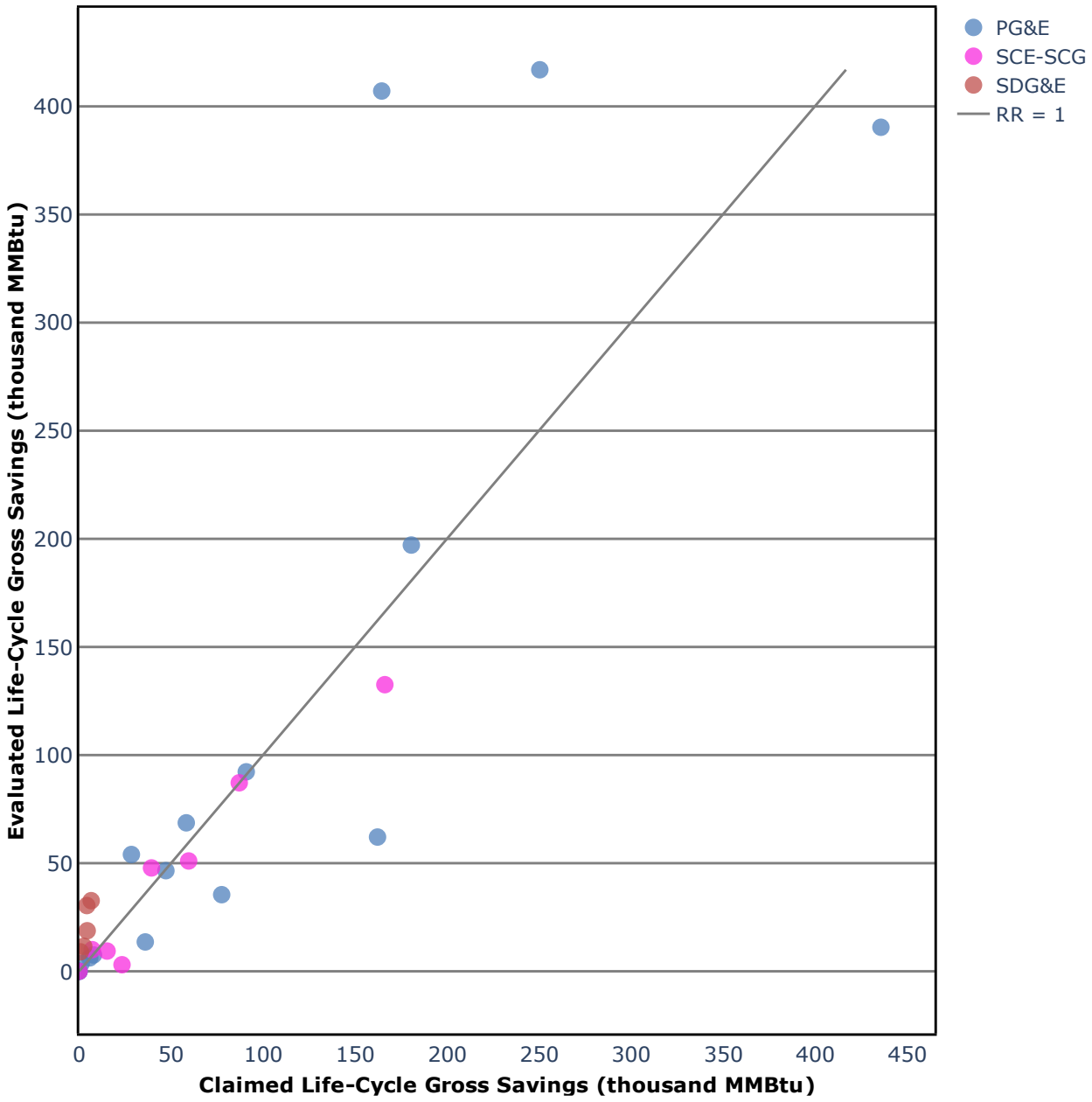


Figure 12: Evaluated vs. Claimed Gross Life-Cycle MMBtu Savings

3.1.4 Adjusting for SDG&Es EUL Claim Error

SDG&E claimed an EUL of one year for all SEM projects in both 2019 and 2020 claim entries. This error affects the reporting of SDG&Es life-cycle gross realization rate. When we adjust for this error and recalculate the GRR, the results are more in line with other PAs. Table 13 presents the GRRs as calculated and with the adjustment, overriding EUL from one year to five in the claim.

Table 13: SDG&E GRR Adjusted for Claims Data Error

	Fuel	GRR as Claimed	GRR Adjusted
Life-Cycle Gross	MWh	6.01	1.20
	MW	6.01	1.20
	Therms	4.25	0.85

3.2 Reasons for Differences in Gross Savings

We determined the primary reasons for differences between our evaluated gross savings and the PA's gross savings claims. We identified the following categories of reasons and then determined whether they applied. All cases are described in detail in the evaluation project files which will be provided to Energy Division and PAs for documentation.

- **Baseline Specification.** We identified an error in the baseline specification. This category mostly applied to projects quantifying savings with bottom-up calculations. One example is assuming the wrong lamp wattage for existing fixtures.
- **Calculation Method.** We concluded more accurate energy models and improved quality and rigor of bottom-up calculations improved accuracy of savings. An example is using a weekly model with lower uncertainty versus a monthly model.
- **Claim Data-Entry Error.** The approved savings results found in the project documentation were inconsistent with the savings in the CEDARS claim.
- **Operating Conditions.** We identified that the operating conditions of the equipment were different than those stated in the reports. For example, variable speed pumps that operated at different speeds for different hours per year than assumed in the reports.
- **Operating Hours.** We identified different operating hours for the affected equipment. For example, lighting operated at different hours than the assumption used in the calculations.
- **Other.** Some differences did not clearly fall into other categories, or there were situations where it was hard to identify the primary reason among multiple reasons for the savings difference.

3.2.1 Electric Savings

Figure 13 shows the percent of claims associated with each of the primary reasons for the difference between the electric savings claimed for each PA and the savings we evaluated.

Four of the reasons explain the largest percentage of claims with variant savings estimates:

- calculation method,
- operating conditions,

- operating hours, and
- other.

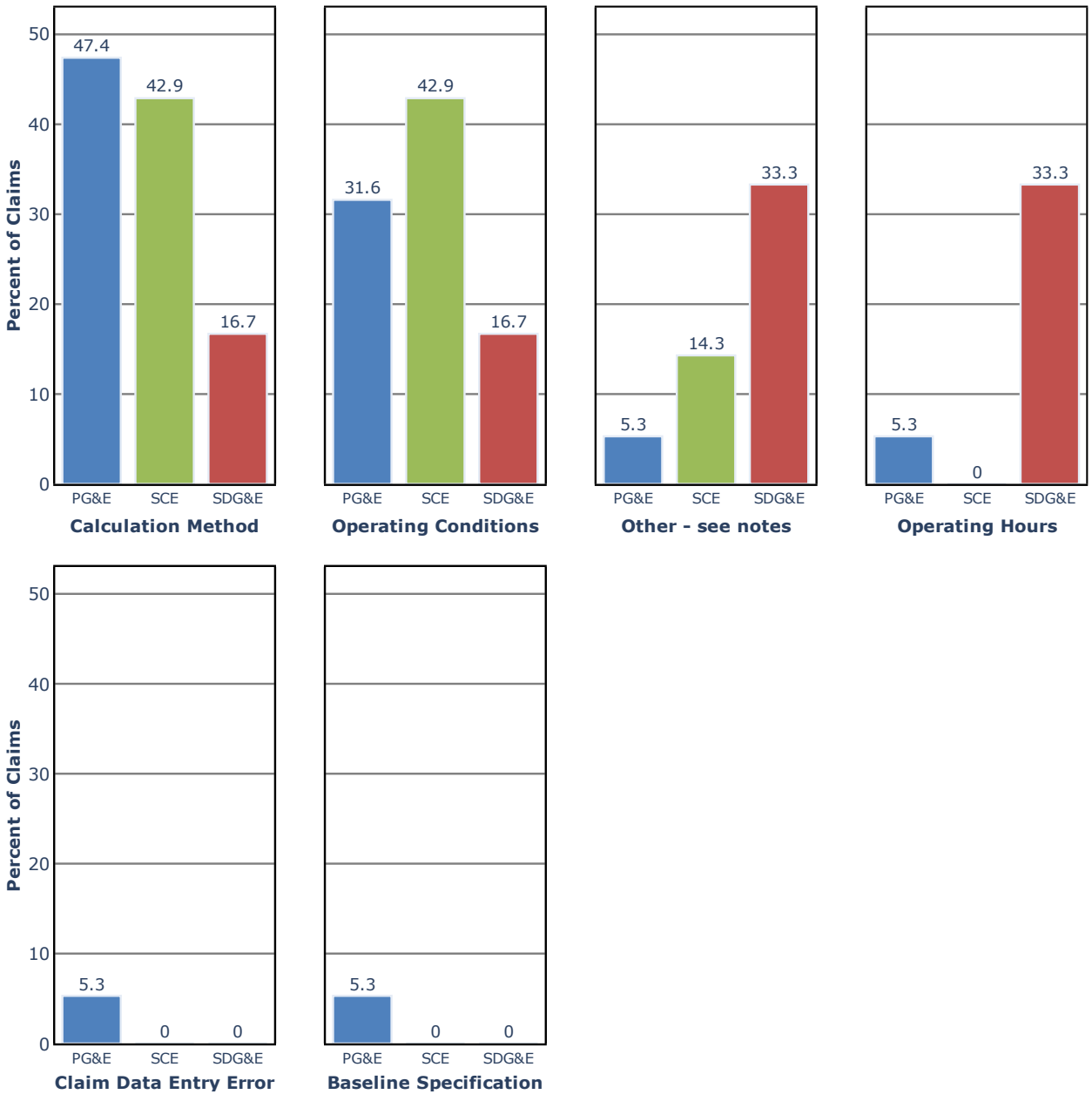


Figure 13: Primary Reasons for Differences in First Baseline (All Claims) Gross Savings (kWh)

3.2.2 Gas Savings

Figure 14 shows the percent of claims associated with each of the primary reasons for the difference between the claim and evaluated therm savings for each PA. Three of the reasons explain the largest percent of claims with variant savings estimates:

- other,

- calculation method, and
- operating conditions.

SDG&E had just two gas claims in the evaluation sample, and one was observed with a savings claim entry error.

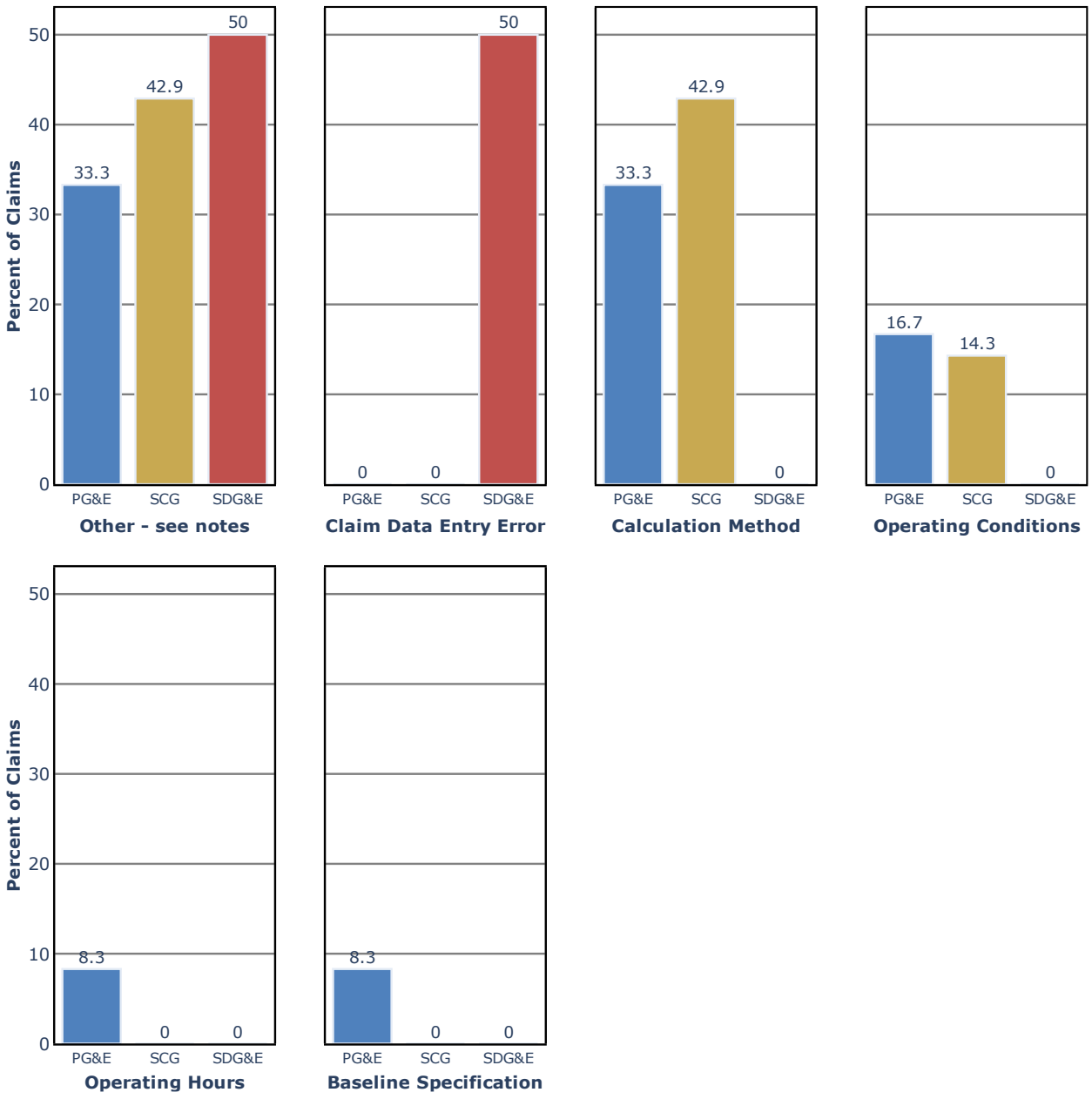


Figure 14: Primary Reasons for Differences in First Baseline (All Claims) Gross Savings (Therms)

3.3 Net Savings and Net-to-Gross Ratio (NTGR)

In this section, we present our findings regarding the net savings and the associated net-to-gross ratio (NTGR). All results are presented in both first-year and life-cycle form.

When the PAs launched SEM, the net-to-gross ratio (NTGR) was much debated but ultimately set to 1.0 statewide by the CPUC.

Our evaluation supported the validity of this assumption. While we identified multiple sites that were not influenced significantly by the SEM programs, these sites were also found to have been less engaged and, ultimately, achieved little or no energy savings during the first two years within SEM. Therefore, the evaluation found little savings not attributable to SEM.

For a more in-depth discussion of the results of the evaluation of net savings, see section 0.

3.3.1 Electric Savings

Table 14 and Table 15 show our findings for net first-year and life-cycle MWh and MW savings, for each PA and summarized statewide.

Table 14: First-Year Electric Net Savings by PA (MWh and MW)

PA	First-Year Electric Net Savings					
	Evaluated MWh			Evaluated MW		
	Gross	Net	NTGR	Gross	Net	NTGR
PG&E	30,945	30,945	1.00	3.94	3.94	1.00
SCE	12,647	12,535	0.99	1.68	1.66	0.99
SDG&E	5,781	5,781	1.00	0.74	0.74	1.00
Statewide	49,373	49,261	1.00	6.36	6.35	1.00

Table 15: Life-Cycle Electric Net Savings by PA (MWh and MW)

PA	Life-Cycle Electric Net Savings					
	Evaluated MWh			Evaluated MW		
	Gross	Net	NTGR	Gross	Net	NTGR
PG&E	164,630	164,630	1.00	20.95	20.95	1.00
SCE	61,023	60,481	0.99	8.10	8.03	0.99
SDG&E	30,246	30,246	1.00	3.89	3.89	1.00
Statewide	255,899	255,357	1.00	32.94	32.87	1.00

Figure 15 shows the distribution of NTGRs by PA. The red horizontal line on each panel corresponds to the PA's NTGR.

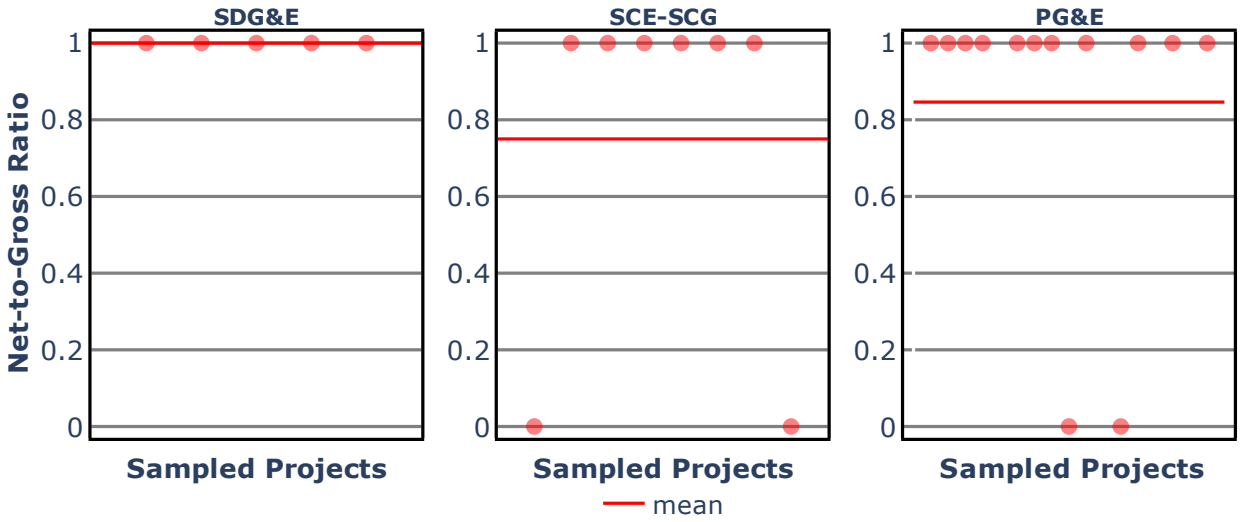


Figure 15: Distribution of NTGRs by PA

Figure 16 and Figure 17 shows the relationship between evaluated and claimed life-cycle net electric savings. This combines the effect of GRR and NTGR on the claimed saving value. Projects on the diagonal have a GRR of 1 and an NTGR of 1.

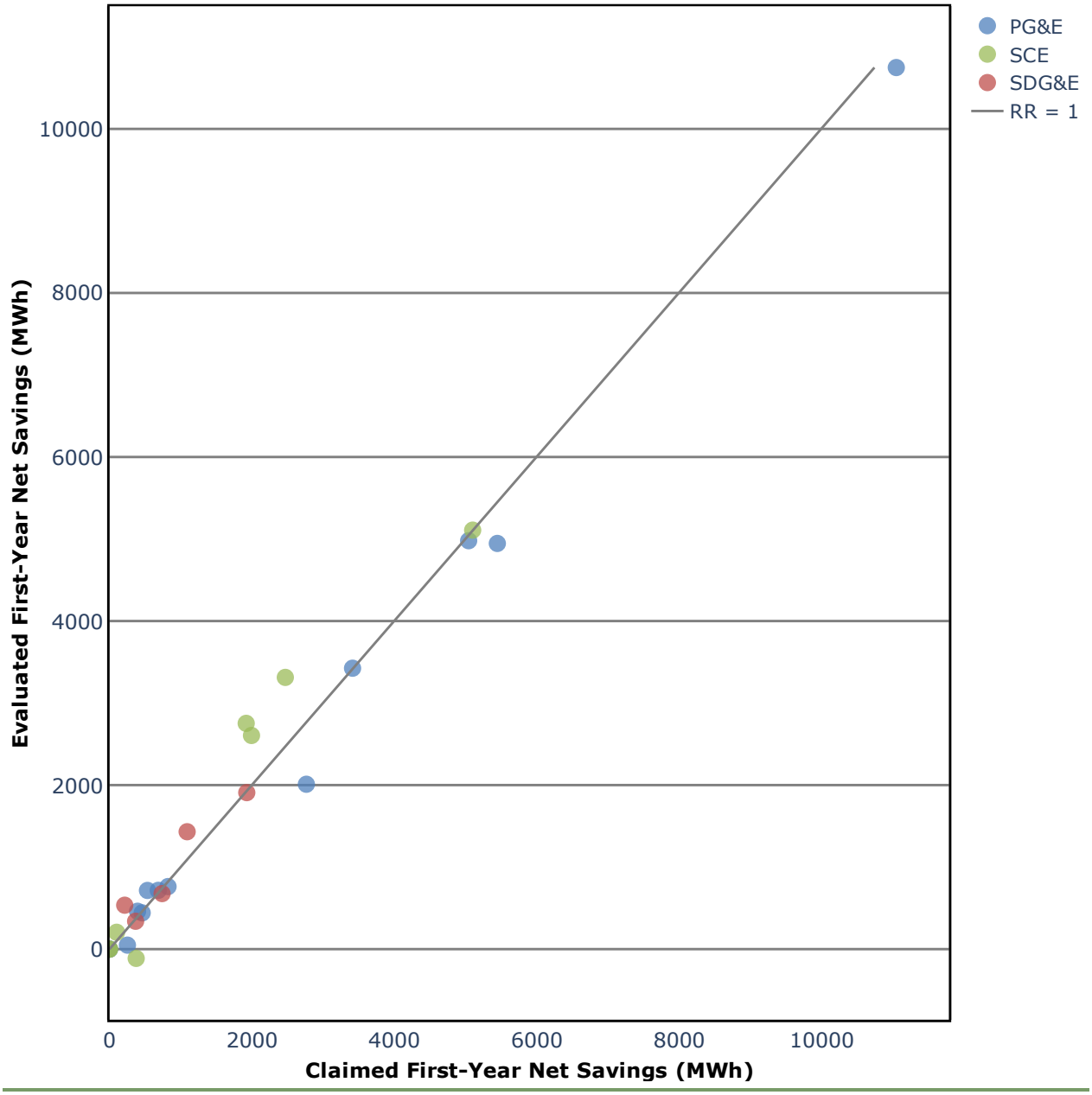


Figure 16: Evaluated vs. Claimed Net First-Year Electric Savings

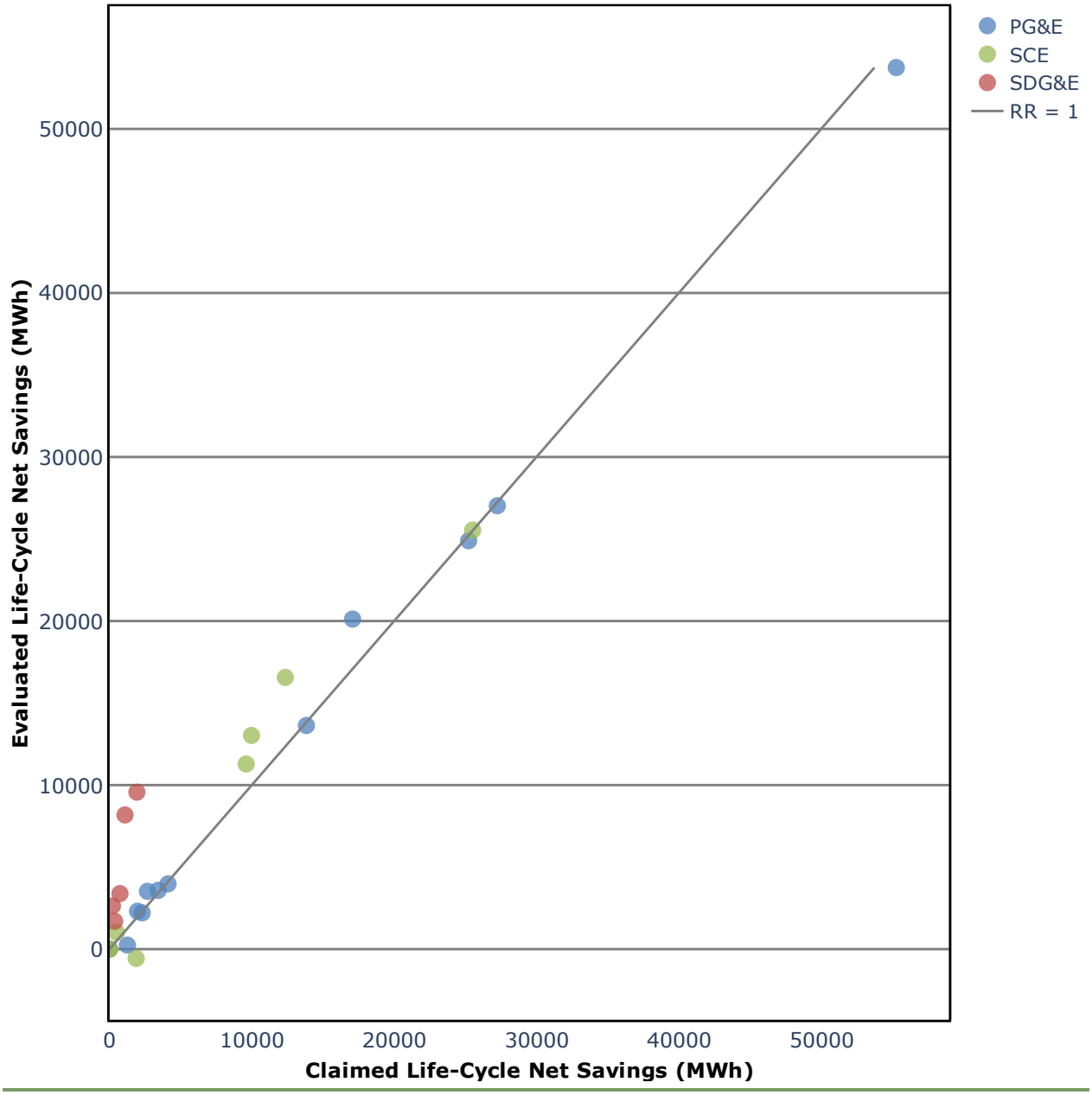


Figure 17: Evaluated vs. Claimed Net Life-Cycle Electric Savings

3.3.2 Gas Savings

Table 16 and Table 17 shows our findings for therm savings and NTGRs.

Table 16: First-Year Gas Net Savings by PA (therms)

PA	First-Year Gas Net Savings		
	Gross	Net	NTGR
PG&E	1,439,623	1,439,623	1.00
SCG	287,087	284,537	0.99
SDG&E	75,237	75,237	1.00
Statewide	1,801,946	1,799,396	1.00

Table 17: Life-Cycle Gas Net Savings by PA (therms)

PA	Life-Cycle Gas Net Savings		
	Gross	Net	NTGR
PG&E	13,390,036	13,390,036	1.00
SCG	1,326,655	1,314,872	0.99
SDG&E	376,183	376,183	1.00
Statewide	15,092,875	15,081,092	1.00

Figure 18 and Figure 19 show the relationship between evaluated and claimed net gas savings.

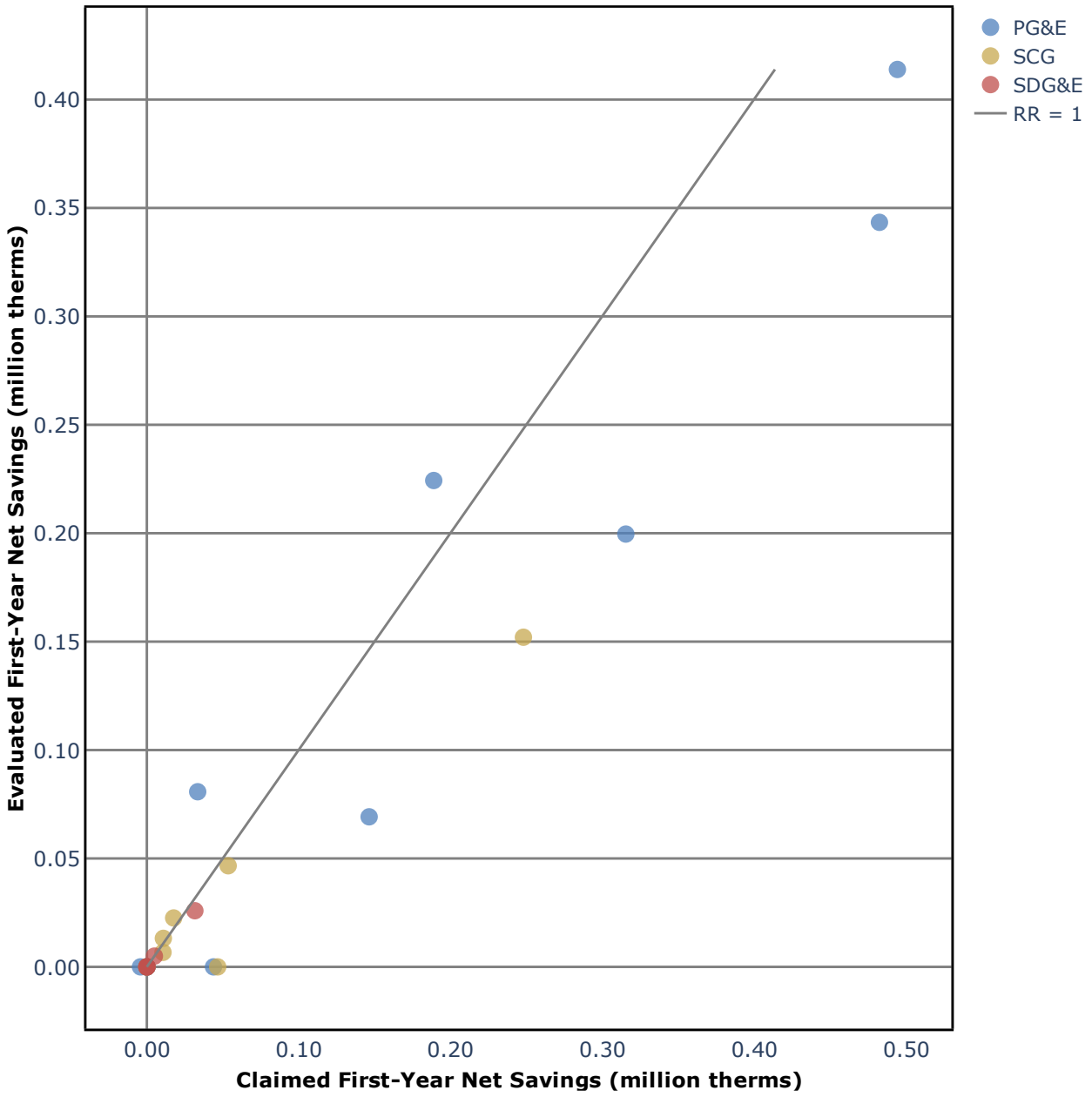


Figure 18: Evaluated vs. Claimed Net First-Year Gas Savings

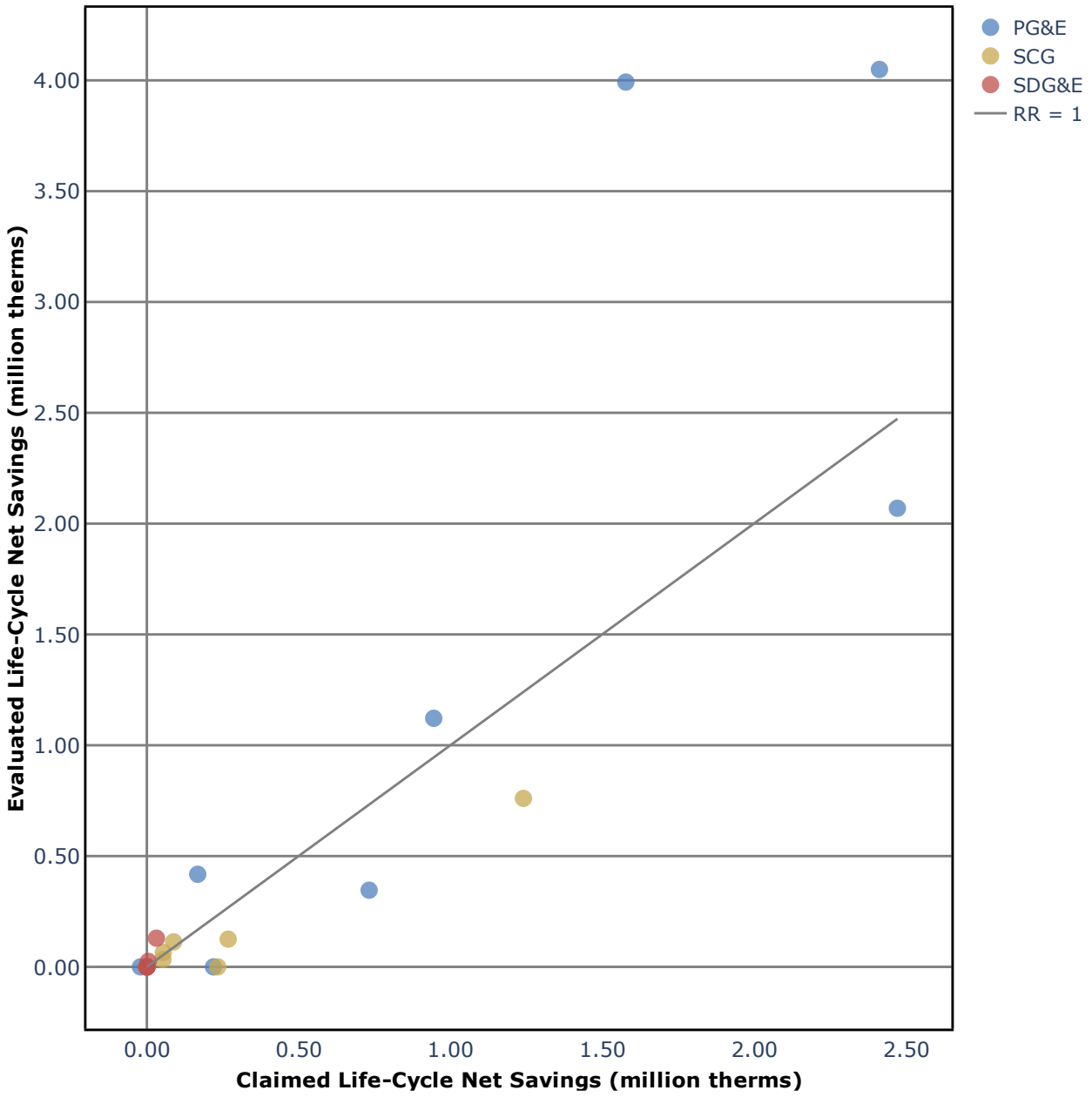


Figure 19: Evaluated vs. Claimed Net Life-Cycle Gas Savings

3.3.3 MMBtu Savings

Table 18 and Table 19 show our findings in terms of net MMBtu saved.

Table 18: First-Year Energy Net Savings by PA (MMBtu)

PA	First-Year Energy Net Savings (MMBtu)			
	Gross	Net	NTGR	RP (%) *
PG&E	249,579	249,579	1.00	0.00
SCE	43,165	42,782	0.99	0.00
SCG	28,709	28,454	0.99	0.00
SDG&E	27,254	27,254	1.00	0.00
Statewide	348,706	348,068	1.00	0.00

* Relative precision at the 90% confidence level.

Table 19: Life-Cycle Energy Net Savings by PA (MMBtu)

PA	Life-Cycle Energy Net Savings (MMBtu)			
	Gross	Net	NTGR	RP (%) *
PG&E	1,900,885	1,900,885	1.00	0.00
SCE	208,270	206,420	0.99	0.00
SCG	132,666	131,487	0.99	0.00
SDG&E	140,849	140,849	1.00	0.00
Statewide	2,382,670	2,379,642	1.00	0.00

* Relative precision at the 90% confidence level.

Figure 20 and Figure 21 show the relationship between evaluated and claimed combined MMBtu savings.

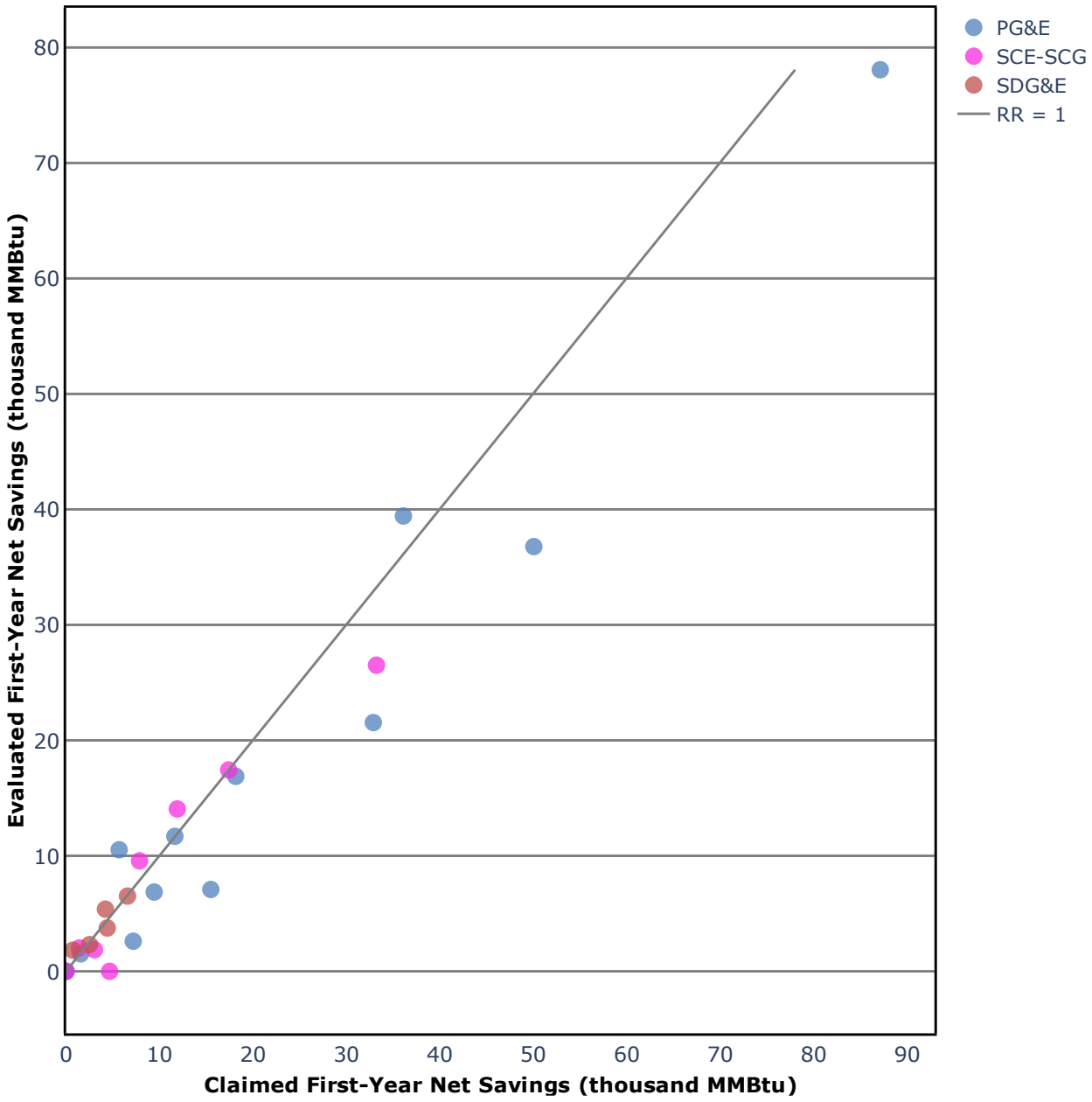


Figure 20: Evaluated vs. Claimed Net First-Year Combined Savings (MMBtu)

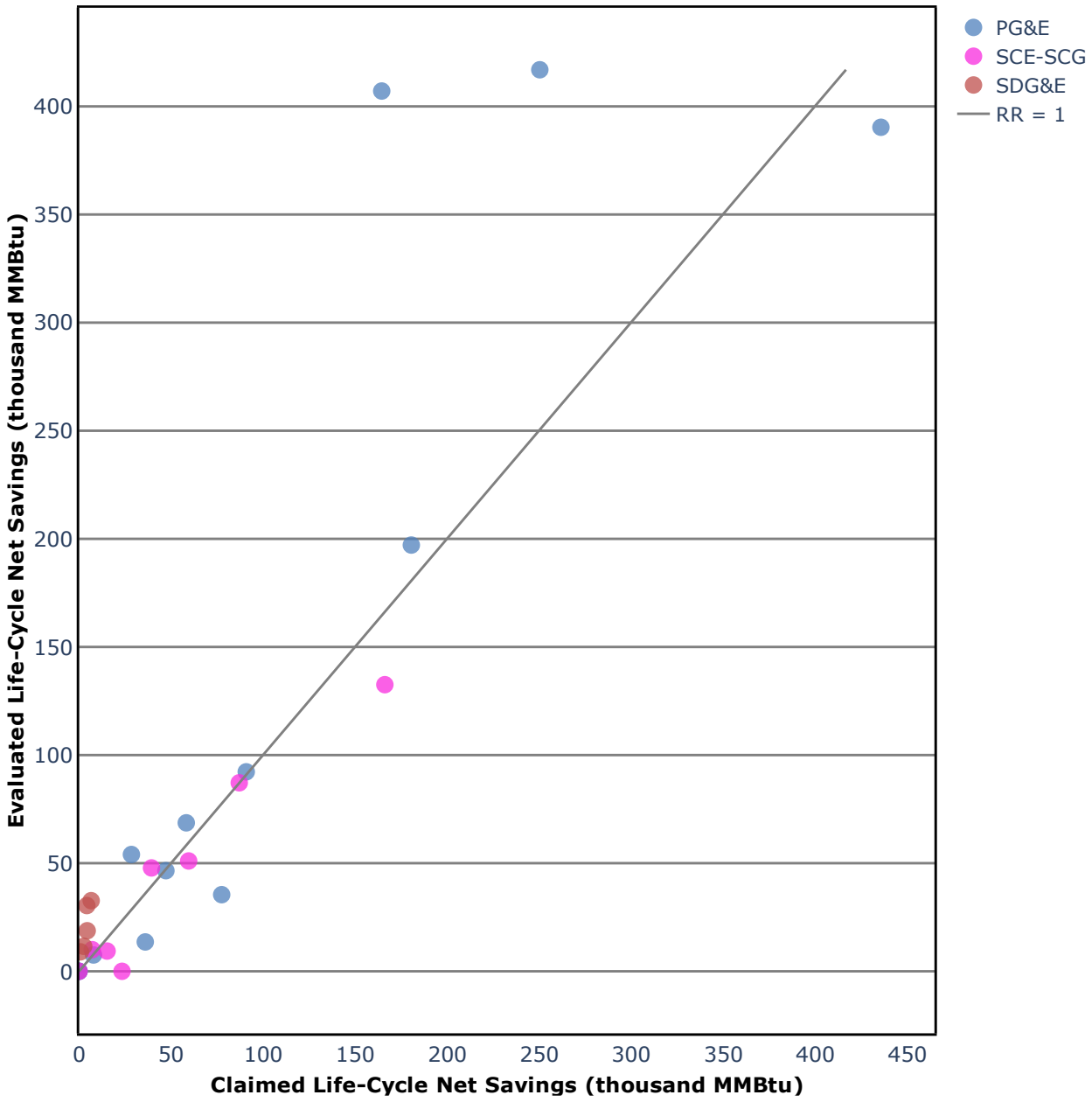


Figure 21: Evaluated vs. Claimed Net Life-Cycle Combined Savings (MMBtu)

3.4 Net Results

In this section, we describe the results of the self-report net-to-gross ratios (NTGRs) and the theory-driven analysis of program attribution.

3.4.1 Self-Report NTGR

We estimated NTGRs at the enhanced level of rigor for each participant for which the Energy Champion completed an NTGR interview. We present the evaluated self-report NTGRs for each PA in Table 20.

Table 20: Self-Report NTGRs, by PA

PA	Core NTGR	Unweighted-Adjusted NTGR	Life-Cycle-Savings-Weighted Core NTGR	Life-Cycle Savings-Weighted Adjusted NTGR
PG&E	0.57	0.60	0.60	0.64
SCE/SCG	0.55	0.60	0.43	0.59
SDG&E	0.59	0.63	0.54	0.58
Statewide	0.57	0.61	0.57	0.63

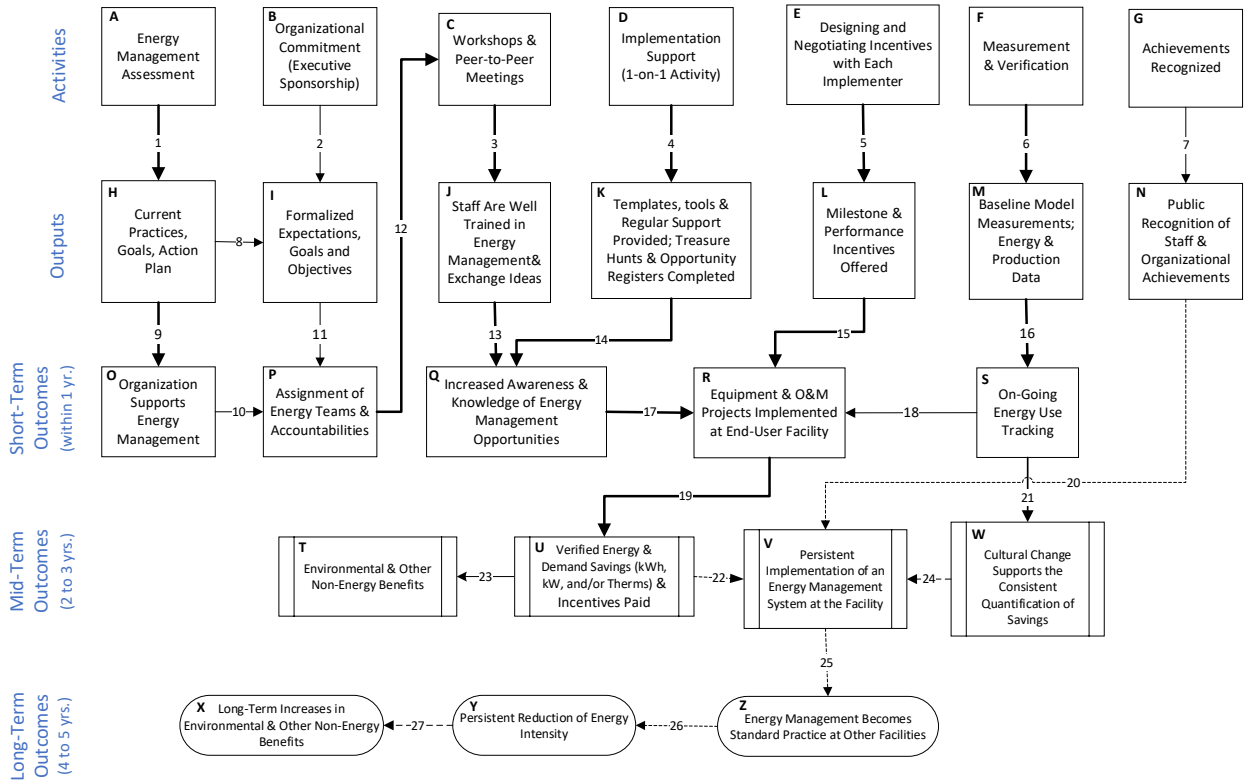
Note that for all sites, the self-report NTGR, which we also call the Core NTGR, was first calculated using survey responses from the energy champion, the person who was most consistently involved in the decision to install the efficient equipment and/or make O&M changes. We included the Energy Champion questionnaire in Appendix F. We then collected and analyzed additional quantitative and qualitative data, sometimes resulting in adjustments, either upward or downward, to the Core NTGR resulting in the Adjusted NTGR.

We did not rely on the self-report NTGRs as our final estimate of program influence. Instead, we incorporated these self-report NTGRs as one input into the more comprehensive theory-driven results discussed in the next section.

3.4.2 Theory-Driven Attribution

This section presents the results of our program-attribution analysis. This influence is based on our analysis of the linkages and hypotheses in the logic model in Figure 22. In Appendix G, we provide additional details about this logic model and how it provided a framework for this net impact evaluation. To better organize our results, we grouped the linkages into eight groups, each associated with a particular activity and a particular overarching hypothesis. For example, we grouped the results for Links 3 and 13 since they were both associated with the workshops and peer-to-peer meetings. Also, some of the groups share the same outcome. For example, the workshop activity and the implementation activity are both expected to lead to an increase in awareness and knowledge of energy-management opportunities. We did not investigate Links

25, 26, and 27 because they are long-term outcomes that require years to have passed before they can be assessed.



* Those linkages/hypotheses with the thickest lines received more attention than those with thin lines. Those with dashed lines received even less attention since they are associated with longer-term outcomes that could not be fully investigated.

Figure 22: Common SEM Logic Model

We assessed each link individually and then grouped them into 8 categories each associated with a particular activity and a particular overarching hypothesis. Table 21 presents these groupings

Table 21: Linkage Groups

Links	Program Elements
1, 2, 8, 9, 10, 11 & 12	Organizational Commitment
3 & 13	Workshops
4 & 14	Implementation Support
6, 16 & 21	Measurement & Verification
7	Achievement Recognition
5, 15, 17 & 18	Capital and O&M Projects Implemented
19 & 23	Energy & Environmental Impacts

Links	Program Elements
20, 22 & 24	Persistent Implementation of EMS
25, 26 & 27	Sustainability

Note that leading indicators of cultural change (the change in EMAs) are included in our analysis of Links 20, 22 & 24, persistent implementation of EMS. In effect, any cultural change is expected to be the result of activities, outputs, and outcomes prior to Link 24. Note also that we did not address Links 25, 26 and 27 in the logic model which are the expected long-term impacts (i.e., sustainability) since they were beyond the time period covered by this evaluation.

In sections 3.4.2.1 through 3.4.2.8 we present the results of Step 1 of our analysis (refer to Appendix E for the methodological details). For each site for each PA, using the three-point scale (Weak Support=1, Moderate Support=2 and Strong Support=3), we assessed the extent to which the various metrics supported each of the link groups in Table 21 based on the preponderance of evidence, which we called the *link-support score*[24]. These scores are averaged across the sites for each PA and represent the extent to which the link group is functioning as expected.

In section 3.4.2.9, we present the results of Steps 2, 3 and 4 of our theory-driven analysis.

3.4.2.1 Organizational Commitment: Links 1, 2, 8, 9, 10, 11, and 12

These activities begin with conducting the first energy management assessment (EMA-1) that provides a snapshot of the starting practices and establishes goals and an action plan[25]. Within the organization, a specific person is selected to be the Executive Sponsor who supports the formalization of the expectations, goals, and objectives and who, along with others, selects individuals whose technical and interpersonal skills match the skills needed to participate on the Energy Team.

3.4.2.1.1 Energy Management Assessment

In our review of program documentation, we found that for each of the participants, the EMA was conducted early in the first reporting period. EMAs are used to identify relative strengths and weaknesses of energy-management practices. The higher the score, the more robust the energy-management practices are for the organization. Table 22 presents the EMA-1 (the baseline EMA) for each PA[26].

[24] We allowed for a score of 1.5 or 2.5 when the whole-number score for a given Link Group seemed too high or too low.

[25] See Appendix J for a description of the general EMA framework and scoring.

[26] Scores represent the percent of the maximum score (depending on the EMA instrument), ranging from 0% to 100%.

Table 22: Mean EMA-1, by PA

PA	EMA-1 Score	Standard Deviation	CV[27]
PG&E	47%	25%	53%
SCE-SCG	72%	9%	13%
SDG&E	57%	5%	9%

The results of this analysis supported the establishment of general energy-management goals for the first two reporting periods (of Cycle 1) and the development of an action plan. In parallel with the EMA activity, the management within each organization decided to support the action plan and commit the necessary internal resources (e.g., formation of Energy Teams, attendance at seven workshops, participation in Treasure Hunts, etc.).

3.4.2.1.2 Organization Support and Accountabilities: Energy Management and Energy Team

A review of Participant Tracking Reports indicates that all implementers formed Energy Teams early in the first reporting period. This is important since, the sooner teams are formed, the sooner they can begin acquiring the knowledge and skills required for their new role. Based on the monthly participant/cohort tracking reports, we found that the vast majority of the Energy Teams were formed on the same day as the kick-off meetings. For the remaining projects, the Energy Teams were formed within four to six weeks of the kick-off meeting.

Burke (2018) suggests that cross-functional teams are important since, to change the behavior of employees and eventually the culture of an organization, enough key departments and workgroups need to be represented in order to spread the awareness and knowledge and ensure compliance and commitment. The Energy Champions reported during the NTGR interviews that over the two-year reporting period, on average, nearly five different departments or workgroups were represented on their respective Energy Teams. The Energy Champions also reported that they received support from their Energy Team, and all but one site reported receiving support from the Executive Sponsor. In the unique case of the one site with a lack of Executive Sponsor support, the evaluating engineers noted that the low executive support was due to a change in engineering management during the engagement period; it was the Energy Team that worked together to continue progress when possible.

Energy Champions also rated, on average, the influence of the Energy Team on the decisions to implement the O&M and equipment measures to be 8.1 on a 0–10 scale, while they rated the influence of the Executive Sponsor decisions to implement the O&M changes a 7.8 and the equipment measures a 7.9.

[27] The coefficient of variation (CV) is a statistical measure of the dispersion of data points in a data series around the mean. The coefficient of variation represents the ratio of the standard deviation to the mean, and it is a useful statistic for comparing the degree of variation from one data series to another.

The commitment of the participants was reflected not only in the formation of an Energy Team but also in sending Team members to a series of eight workshops, participating in energy Treasure Hunts, developing Opportunity Registers, and continuing to meet with their Energy Champions and Energy Coaches throughout the two reporting periods. These allowed them to apply and hone their newly acquired knowledge and skills in identifying new energy-reduction opportunities. This organizational commitment was also reflected in the fact that 28 of the 35 participants (80%) in the 2018-2019 SEM program chose to continue their participation for another two years.

3.4.2.1.3 Summary of Organizational Commitment Links

We found that the participants completed their Energy Management Assessments that formed the foundation of their goals and plans for improvement which were supported by their executive management. This support led to the formation and education of Energy Teams representing key departments and workgroups. Based on these analyses, we conclude that the organizational commitment links are functioning as expected. This conclusion is summarized in Table 23, which presents the link-support scores across all sites for each PA. These percentages are the averages of the individual site link-support scores for this group of links for each PA.

Table 23: Mean Link-Support Scores for Links 1, 2, 8, 9, 10, 11, and 12, by PA

PA	Mean	Standard Deviation	CV
PG&E	2.38	0.46	0.19
SCE-SCG	2.13	0.83	0.39
SDG&E	2.80	0.45	0.16

Recall that we used a three-point scale (Weak Support=1, Moderate Support=2 and Strong Support=3) to assess the extent to which the various metrics supported each of the link groups in Table 21 based on the preponderance of evidence, which we called the link-support score. These scores are averaged across the sites for each PA and represent the extent to which the link group is functioning as expected. All three scores are well above 2 for each PA, which, of course, is also true at the State level. This analysis also revealed that 2 (8%) of the 26 sites had link-support scores of 1 for organizational commitment.

3.4.2.2 Workshops: Links 3 and 13

Link 3 is concerned with the training of participants in a series of workshops designed and implemented according to adult education principles. Link 13 is concerned with the relationship of this training to any increases in awareness and knowledge of energy management opportunities associated with the training and development workshops and their associated outputs and outcomes. The general hypothesis is that workshops implemented in a manner

consistent with adult-education principles and containing enough contact hours of instruction will increase awareness and knowledge of energy-management strategies.

3.4.2.2.1 Basic Design and Delivery Framework

One of the first considerations is whether the level of effort, defined as the number of workshops, the number of attendees, and the contact hours of instruction for each workshop could reasonably be expected to produce the outputs and outcomes associated with Links 3 and 13. We first note that Leidos divided their ten participants into two cohorts of five and delivered the workshops to each independently.

In this section, we assess the level of effort as reflected in the number of workshops, number of attendees, and the hours of instruction per workshop. For this analysis, we relied on the workshop summaries and PowerPoint presentations supplied by the implementers. Our analysis focused on the first seven workshops since the eighth workshop basically celebrated the achievements of each site and lasted about two hours each. During the two reporting periods, the three implementers, covering the four PAs, conducted workshops for the 35 participating organizations that completed both reporting periods.

In all, there were 557 participants[28] across all five sets of workshops[29] with an average of 16 participants per workshop and little variation across the PAs[30]. Slightly more than 43% of the participating companies sent at least one person to all seven workshops, 8% sent at least one person to six of the workshops, nearly 38% sent at least one person to five of the workshops and nearly 6% sent at least one person to four of the workshops.

Not surprisingly, not everybody was able to attend all the workshops due to regular work responsibilities, made even more challenging by COVID-19. Some people may have attended only certain workshops that were directly relevant to their specific roles as members of their Energy Teams. Furthermore, some companies were already experienced in energy management and might have attended only those workshops that covered material that needed refreshing or was new to them. In addition, those who did attend may have shared the PowerPoint presentations, workshop handouts, software etc. and what they learned from their peers with those who were unable to attend.

While it is difficult to know for sure, it is plausible that a critical number of employees[31] were exposed to topics relevant to their roles in the Energy Team and that enough Energy Team members received enough exposure, either directly or indirectly, to topics relevant to them such that they could begin trying to apply this knowledge and these skills on the job.

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[28] There is some uncertainty regarding these numbers given that some participants recorded only their first names and other spelling irregularities.

[29] The five sets are: 1) PG&E: Leidos: Cohort 1, 2) PG&E: Leidos: Cohort 2, 3) PG&E: CLEAResult, 4) SCE-SCG Cascade and 5) SDG&E: Cascade

[30] Of these 557 participants, 214 were unique with an average of about 43 unique individuals per implementer, again with little variation across the PAs. On average, each unique individual was able to attend nearly 3 workshops.

[31] The critical number of employees is expected to vary depending on the size and complexity of the organization.

We were also able to reasonably estimate contact hours of instruction[32] across workshops one through seven for each of the five sets of workshops. For the most part, the time the instruction began, the length of any lunch breaks and the end time for each workshop were provided in the workshop summaries, which allowed for reasonably accurate estimates of the hours of instruction. When the data was not available, we used our best judgement. Across the five sets of workshops, each workshop averaged approximately 5.6 hours per day or a total of nearly 40 hours of instruction for each of the five sets of seven workshops and a grand total of 197 hours of instruction. An average of nearly 40 hours of instruction seems sufficient to transmit the SEM framework and specific skills regarding energy management. It is important to recognize that this training was expected to be reinforced and deepened by regular technical support from Energy Champions and Energy Coaches and participation in such activities as the Treasure Hunts and the creation of opportunity registers (Links 4 and 14).

In addition, the length of the intervals between workshops is very important. To space the workshops over time, rather than all within a six-month period, for example, likely provided the attendees enough time to apply these skills on the job and eventually master them. In between these workshops, any challenges that arose in applying these skills could be addressed in meetings with the Energy Coaches or Energy Champions.

Figure 23 shows the dates for each of the 8 workshops for each implementer. Clearly, each implementer spaced their workshops fairly evenly over the first two reporting periods in a manner that allowed participants many opportunities to apply and improve these skills.

[32] A contact hour is a measure that represents an hour of scheduled instruction given to students.

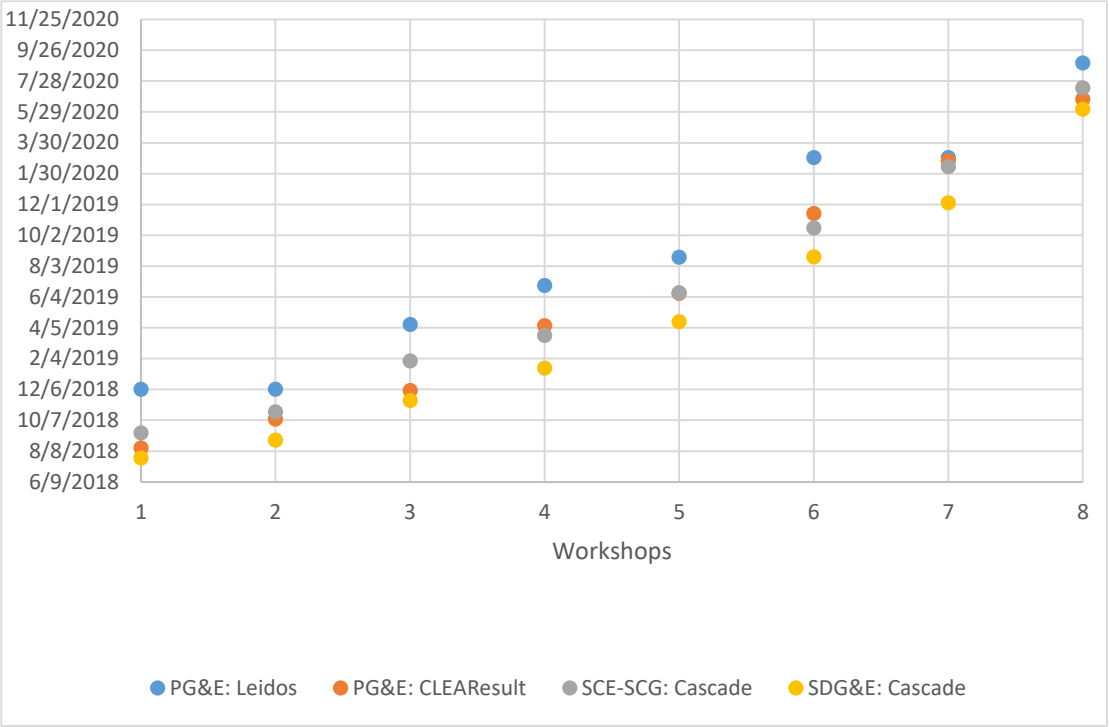

Figure 23: Workshop Dates, by Implementer

After each workshop, the implementers administered an end-of-workshop survey which focused on the reaction of participants to the training program. Details regarding the end-of-workshop surveys are provided in the following section.

3.4.2.2.2 Consistency with Adult Education Principles

To be effective, these workshops and peer-to-peer meetings would have to be designed and conducted according to adult-education principles and result in the participants gaining the necessary awareness, knowledge, and techniques of energy management that can be applied cost-effectively at their facility. If we cannot confirm either of these two causal mechanisms, using the preponderance-of-evidence criterion, we will be less confident that the workshops were effective and that the program caused the mid- and long-term outcomes.

Link 3 in the Program Logic Model diagram above is mechanical in nature and easily confirmed; implementers conducted workshops that resulted in a verified number of people being trained. The key area of uncertainty is the extent to which the curriculum materials and activities used in these SEM workshops conformed to best practices in adult education (Knowles, Holton and Swanson, 2015; Caffarella 2002; Galbraith 2004; Jarvis, 2010; Beich 2014). We reviewed workshop summaries, workshop materials, and the PowerPoint presentations provided by the implementers to assess consistency with adult-education principles. We focused on four areas, which are discussed in more detail in Appendix E:

- Development of learning objectives

- Selection of instructional techniques
- Assessment of results
- Devising transfer-of-learning plans

Development of Learning Objectives: We found that all implementers had learning objectives for each workshop and, although the objectives were stated somewhat differently, they were consistent with the adult-education principles.

Selection of Instructional Techniques: We also found that the instructional techniques used (e.g., lectures, group problem solving, sharing of ideas, hands-on experience, etc.) are consistent with adult-education principles. For example, we found that:

- Lectures were used to provide basic information about, for example, the day's learning objectives, the basics of energy management, energy-use-tracking software, the basics of regression modeling, or certain technologies such as air conditioning and compressed air.
- Small groups were frequently formed and asked to engage in various activities including practicing simple calculations around electricity and gas use, savings (kWh, therms, and dollars), and plotting a dataset.
- They used the demonstration-with-return-demonstration approach. As an example, each trainee was given a one-on-one training on how to update their respective tracker including how to obtain data, how to clean/organize data, and how to transfer new data into the tracker each month. Trainees were assured that the Energy Coaches would be available to support them during the next several model/tracker monthly updates when the trainee would be able to demonstrate the required skills.
- Each workshop provided numerous opportunities for trainees to share ideas among themselves.

Another basic question in selecting techniques is whether the instructors have the knowledge, skill, and confidence to handle a particular technique. Do they feel comfortable using it? If not, the instructor's discomfort may be distracting. Data collected from the Energy Coaches indicated that the design and delivery of these workshops were consistent with adult-education principles, which is at least partly explained by two facts: 1) that they had hired an adult-education specialist to assist in developing their workshops, and 2) that they had received instruction on how to train adults. Another indicator, discussed in more detail in the following section, is that scores in the end-of-workshop surveys were uniformly very high, indicating, among other things, that the participants thought the instructors possessed the necessary skills and confidence and were comfortable using these skills.

Assessment of Results: Another basic set of metrics of design and delivery is based on the framework of Kirkpatrick and Kirkpatrick (2014) who specified four levels of training evaluation, the first of which was *reaction,* which focuses on the reaction of participants to the training program. Although this is the lowest level of measurement, it remains an important gauge of participant satisfaction.

Participant reactions were gathered through short surveys administered by each implementer at the end of each workshop. Each end-of-workshop survey contains five or six questions that focused on common topics such as[33]:

- Whether the workshop met expectations
- Whether the facilitator encouraged participation
- Quality of presentations
- Quality of instruction/facilitation
- Whether the ideas to manage energy were useful
- Whether the amount of material covered was too much, not enough, or about right
- Pace of the workshop
- Whether the handouts were useful
- Whether the homework was useful
- Overall workshop experience

We obtained the end-of-workshop summaries provided by the implementers for each of the five sets of workshops and then averaged the scores across all five workshops. We then calculated the overall average score across all five sets. The uniformly high scores within and across the implementers shown in Table 24 indicate that the participants thought the workshops were well-designed and -implemented and provided useful tools and skills.

Table 24: Overall Post-Workshop Survey Scores, by PA and Implementer

PA: Implementer	Mean	Standard Deviation	CV
PG&E: Leidos: Cohort 1	93%	0.05	0.05
PG&E: Leidos: Cohort 2	94%	0.08	0.09
PG&E: CLEAResult	91%	0.04	0.04
SCE-SCG Cascade	94%	0.02	0.02
SDG&E: Cascade	94%	0.01	0.01
Overall	**93%**	**0.04**	**0.05**

None of these surveys attempted to measure the specifics of what was learned. Only one implementer administered an additional separate end-of-workshop competency exam which attempted to measure the extent to which key concepts were learned. We discuss this competency test in the following section.

Devising Transfer-of-Learning Plans: Appendix E notes that there are a variety of techniques that can increase the transfer of learning such as: mentoring, coaching, transfer teams, and

[33] The surveys also actively sought feedback about how to improve the subsequent workshops.

support groups. The presence of Energy Coaches, Energy Champions, Energy Teams, and peer-to-peer meetings, all of which extended over the two-year period, are all consistent with these elements. In this framework, the role of the Energy Coach matches the Mentoring role, the Coaching role matches the Energy Champion, the role of the Transfer Team matches the role of the Energy Team, and the Support Groups map to on-going communication between the Energy Coach and the Energy Champion. All these strategies were consistently implemented throughout the two reporting periods.

3.4.2.2.3 Increased Awareness and Knowledge

None of the end-of-workshop surveys attempted to measure the specifics of what was learned. Measuring such specifics is what Kirkpatrick and Kirkpatrick (2014) refer to as a Level 2 evaluation of training. Only Leidos administered a separate competency exam at the end of each workshop. The brief exam consisted of five to nine multiple-choice questions, which might be enough to assess the extent to which trainees have learned key concepts. Only three workshops across both cohorts had scores less than 90%, and the overall average for both cohorts was 92% with a little variation (CV=0.07) suggesting that participants learned key energy-management concepts.

Other indicators of how much was learned is based on self-reports by members of the Energy Team. They indicated that the workshops and peer-to-peer meetings were very useful in providing ideas to reduce energy use that they had not previously known about (an average score of 4.4 out of 5) and in raising their general levels of energy-efficiency awareness (an average score of 4.4 out of 5). While such self-reports are not a particularly accurate assessment of actual learning, they do provide a general sense that something positive was learned. It is also important to recognize that throughout both reporting periods: 1) the Energy Coach and Energy Champion provided technical support, and 2) the Energy Coach, Energy Champion and Energy Team members participated in Treasure Hunts and created Opportunity Registers. It is the combination of these activities and outputs that were expected to increase awareness and knowledge (see Links 4 and 14 in the Logic Model).

3.4.2.2.4 Summary of Workshop Links

We found that the level of effort was likely sufficient to achieve the desired learning objectives and the workshops were taught in a manner that was consistent with adult-education principles. Based on the preponderance of evidence, we have concluded that Link 3 is implemented as intended.

The evidence for Link 13 is more complex. First, recall that we found the evidence for any increases in awareness and knowledge of energy management based on data collected at the end of each workshop was relatively weak. Given this, we conclude that there is only moderate support for Link 13. However, because we confirmed that the level of effort and consistency with adult-education principles were likely sufficient to achieve the learning objectives, the trainees probably acquired a framework of basic information and skills regarding energy

management. Nevertheless, acquiring this framework might not have been sufficient to identify and implement all the energy-reduction O&M actions and equipment measures that produced the verified savings unless it was combined with many opportunities to apply the skills acquired in the workshops along with the support of the Energy Coaches and Energy Champions and, in the process, acquire a deeper understanding of the principles and mechanics of strategic energy management. In this context, we view the workshops as providing that framework of basic information and skills that were then honed over time through their on-the-job application.

Based these analyses, we conclude that Links 3 and 13 are functioning as expected. This conclusion is summarized in Table 25, which presents the link-support scores across all sites for each PA. These percentages are the averages of the individual site link-support scores for this group of links for each PA.

Table 25: Mean Link-Support Scores for Links 3 and 13, by PA

PA	Mean	Standard Deviation	CV
PG&E	2.42	0.29	0.12
SCE-SCG	2.00	0.53	0.27
SDG&E	2.50	0.50	0.20
Statewide	2.30	0.45	0.20

All three scores are 2 or greater for each PA, which, of course, is also true at the state level.

3.4.2.3 Implementation Support: Links 4 and 14

Link 4 is concerned with the provision of templates and tools, regular support from the Energy Coach, and various activities such as Treasure Hunts and the creation of Opportunity Registers. Link 14 is concerned with whether these tools, regular support, and activities led to an increase in awareness and knowledge of energy management opportunities.

3.4.2.3.1 Treasure Hunt Participation and Projects Identified

Treasure Hunts and opportunity registers were completed twice, once early in the first reporting period and again early in the second reporting period. Table 26 presents the total number of participants in the Treasure Hunt for each PA and the number of participants per company.

Table 26: Total Treasure Hunt Participation, by PA and Company

	PG&E	SCE-SCG	SDG&E
Total	133	87	87
Average by Company	6	11	12

Table 27 presents the total number of projects identified in the Treasure Hunt for each PA and the number of projects identified per company

Table 27: Total Treasure Hunt Projects Identified, by PA and Company

	PG&E	SCE-SCG	SDG&E
Total	624	293	308
Count by Company	28	37	44

Below we discuss how much awareness and knowledge these activities contributed to the implementation of equipment and O&M projects.

3.4.2.3.2 Increased Awareness and Knowledge

To assess how much awareness and knowledge regarding energy-reduction opportunities had increased as a function of the technical support from regular meetings with the Energy Champion and Energy Coach, we relied on interviews with the Energy Coaches and Energy Champions.

Nearly 35% of the 26 Energy Champions reported that they met with the Energy Coaches at least once a week, more than 48% reported meeting at least twice a month, and nearly 83% reported meeting at least once a month. Only 17% met only once a quarter. In general, the Energy Coaches appear to have been very engaged with each of their participants to provide the technical support as participants applied the skills they were learning during the workshops.

The four Energy Coaches[34] reported that the Energy Champions were very engaged when meeting with them providing a score of 4.6 on a 0 to 5 scale, but they found the members of the Energy Team to be somewhat less engaged, providing a score of 3.9. The Energy Coaches also reported encountering very little resistance among the Energy Champion and members of the Energy Teams to implementing the SEM strategies to manage their company's energy use, scoring it a 1 on a six-point scale ("0" = "No Resistance" and a "5" = "Significant Resistance"). When asked whether the number of sites they served through the SEM program was either too many to adequately serve, about the right number, or fewer than they could have served, two of the four said about right and the other two said they could have served more. This indicates that they had enough time to provide the desired level of technical support to each participant.

All respondents to the Energy Team survey reported that the frequency of meetings with the Energy Champion and meetings with the Energy Coach were about right. Finally, they reported that the Energy Coach was extremely helpful in identifying and implementing efficiency

[34] There were four Energy Coaches: PG&E-CLEAResult, PG&E-Leidos, SCE-SCG-Cascade and SDG&E-Cascade. However, each Energy Coach is comprised of more than one individual, each of whom provides specific skills to their participants. When Energy Coaches were interviewed, more than one person typically participated.

opportunities and offering strategies for the continuous improvement of energy management (a score of 5 on a 6-point scale).

Next is a summary of the Implementation Support Links.

3.4.2.3.3 Summary of Implementation Support Links

An adequate number of employees from each site participated in the Treasure Hunt and identified multiple opportunities for reducing energy use. While there was no survey or test of knowledge that specifically addressed increases in awareness and knowledge at the conclusion of each workshop, the Energy Coaches, Energy Champions, Energy Teams, program records, and the site-level analysis, as described above, all suggest that awareness and knowledge very likely increased through a combination of the workshops, technical support provided by the Energy Coaches and Energy Champions and the participants' on-the-job application of workshop skills.

Based these analyses, we conclude that Links 4 and 14 are functioning as expected. Table 28 summarizes this conclusion and presents the link-support scores across all sites for each PA. These percentages are the averages of the individual site link-support scores for this group of links for each PA.

Table 28: Mean Link-Support Scores for Links 4 and 14, by PA

PA	Mean	Standard Deviation	CV
PG&E	1.91	1.91	1.00
SCE-SCG	2.25	2.29	1.02
SDG&E	2.30	2.46	1.07
Statewide	2.11	2.12	1.01

Only PG&E had an average link-support score less than 2.0. The average of the PA scores at the statewide level is also larger than 2.0.

In the next section we address the measurement and verification links.

3.4.2.4 Measurement and Verification: Links 6, 16, and 21

3.4.2.4.1 Baseline Models, Energy Production Data Developed and On-Going Energy Use Tracking

Link 6 is concerned with the collection of energy and production data and the development of baseline regression models needed to develop an energy-use forecast against which actual energy use can be compared to estimate savings. Link 16 is concerned with whether these data and baseline models led to on-going energy use tracking. Link 21 is concerned with whether the

on-going tracking of energy use contributed to any cultural change that supported the consistent quantification of savings.

A review of the Participant-Tracking Reports showed that baseline models were developed in the first half of year 1. Measurement and verification occurred on an on-going basis with participants involved. The ways in which participants were involved with M&V included:

1. Providing production data for model development (Link 6) and model updates (Link 16).
2. Reviewing model outputs including cumulative sum of residuals (CUSUM) charts at energy team meetings (Links 16, 21).
3. Tracking energy performance by indicating when projects were installed versus when residuals were observed on the CUSUM (Links 16, 21).
4. Provided input for energy savings estimates when projects were identified on the opportunity register. Inputs included equipment specifications, run-time, and load assumptions (Link 6).

Next, we discuss efforts to measure changes in company culture that might predict maintaining savings over time.

3.4.2.4.2 Cultural Change

The primary metric for tracking changes in organizational culture with respect to energy management was the energy-management assessment (EMA) developed by each implementer and administered twice, once early in the first reporting period and again late in the second reporting period. The EMAs were facilitated by the Energy Coach at the customer site, required two to three hours to complete, and involved collecting a combination of quantitative and qualitative data at each site. While the three EMAs are organized differently and contain different levels of detail, they recognize that cultural transformation takes commitment from all levels of the organization and address most of the same topics such as:

- management support,
- energy policy,
- planning,
- employee engagement,
- implementation,
- measuring and reporting, and
- third-party certification.

While not formally recognized by the implementers as a measure of organizational culture, we treated the EMAs as such a measure since they address the obvious artifacts and espoused values related to energy use. However, as a measure of organizational culture with respect to energy use and sustainability, the EMA is limited since it is based on an input from a small

group rather than on a survey of all or a representative sample of employees. A more detailed review of each PIs EMA and scoring criteria are provided in Appendix J.

In addition, the validity and reliability of the EMAs have never, to our knowledge, been established. While the EMAs have no established measure of validity, we concluded that the EMAs have what is called "face validity." That is, they appear to be measuring what they are supposed to be measuring[35] and were designed to help organizations define and diagnose their organizational culture to determine if it is healthy and well-aligned with the organization's mission to integrate sustainability into their business. Reliability is harder to assess and would require an effort beyond the scope of this evaluation.

The surveys of the Energy Coaches, Energy Team members, and Executive Sponsors also touched on such topics as the sustainability of energy-management strategies, barriers to cultural change, and whether on-going energy management has been incorporated into the job descriptions of the Energy Team. We began by producing various descriptive statistics such as EMA-1 and EMA-2 scores and the percent change for those sites in the gross sample that submitted scores. We then calculated paired t-tests (one tail) to see if there was a statistically significant increase in EMA-2 scores over EMA-1.

The sample included 30 sites, but only 20 were available for analysis, for several reasons. First, while Leidos developed a custom Microsoft Excel-based EMA tool built around the requirements of ISO 50001,[36] they decided to drop the full ISO 50001 assessment update because it was not very practical for most participants. As a result, Leidos did not administer its EMA-2 so we were forced to eliminate these nine sites from our EMA-change analysis. One site dropped out of the program, leaving20 sites in our EMA-change analysis.

Focusing on these 20 sites, our first analysis compared the EMA-1 and EMA-2 scores for all 20 sites. Our research hypothesis was that EMA-2 score would be larger than EMA-1 score. Table 29 shows these results.

Table 29: EMA-1 Scores, EMA-2 Scores, and the Percent Change

Project	EMA-1	EMA-2	Percent Change
1	11%	28%	150%
2	11%	25%	125%
3	11%	42%	275%
4	19%	50%	157%
5	25%	58%	133%
6	28%	59%	111%
7	31%	56%	82%
8	39%	61%	57%

[35] Over time, a stronger type of validity such as predictive validity could be used to assess the EMAs.

[36] ISO 50001 Energy Management Standard. https://www.iso.org/iso-50001-energy-management.html

Project	EMA-1	EMA-2	Percent Change
9	51%	81%	58%
10	54%	72%	32%
11	55%	54%	-2%
12	57%	76%	33%
13	58%	71%	23%
14	66%	73%	12%
15	67%	69%	3%
16	72%	76%	5%
17	73%	77%	5%
18	74%	69%	-7%
19	75%	71%	-6%
20	84%	96%	13%
Mean	48%	63%	63%
Standard Dev.	0.24	0.17	0.75
CV	0.50	0.28	1.18

The mean EMA-1 score was 48% with a CV of 0.17 while the mean EMA-2 score was 63% with a CV of 0.28. Seventeen of the EMA changes are positive; six are greater than 100%, and three are negative (i.e., the score went down). The overall average change for the 20 sites is 63% with a CV of 1.18.

Clearly, even with some potential for measurement error, 60% of these 20 sites have made substantial (>20%) improvements in the various components addressed by the EMAs and moved their respective cultures in the right direction with respect to energy management.

Following is a summary of our assessment of the measurement and verification efforts in the participating sites.

3.4.2.4.3 Summary of Measurement and Verification Links

We confirmed that there was a large and statistically significant change in the culture as measured by the EMAs and survey responses from the Executive Sponsors, Energy Coaches, and Energy Team members. However, we recognize that it is uncertain whether this mid-term cultural change is sustainable and eventually becomes standard practice, even if narrowly focused on energy management, since so much of what happens after the SEM program concludes is subject to the unique, complex, and evolving culture of each organization. Of course, that 28 of the 35 participants (82%) have decided to participate in Cycle 2 of SEM program suggests that the cultural change that has occurred thus far will be maintained and likely increase over the next two years.

These cultural changes were expected to motivate participants to create an EMS, update their EMS, or become more diligent in their use of their EMS and then to persistently use them in managing their energy and increasing savings.

Based these analyses, we conclude that Links 6, 16, and 21 are functioning as expected. Table 30 summarizes this conclusion and presents the link-support scores across all sites for each PA. These percentages are the averages of the individual site link-support scores for this group of links for each PA.

Table 30: Mean Link-Support Scores for Links 6, 16, and 21, by PA

PA	Mean	Standard Deviation	CV
PG&E	1.97	1.99	1.01
SCE-SCG	2.00	2.14	1.07
SDG&E	2.70	2.70	1.00
Statewide	2.13	2.19	1.02

Only PG&E had an average link-support score that was (slightly) less than 2.0, and the statewide score was greater than 2.0.

Next, we discuss the link pertaining to the recognition of achievement experienced by participants.

3.4.2.5 Achievement Recognition: Link 7

This link was among those that received much less attention because of budget constraints and our judgement that it was less critical than other links in assessing the success of the program. For this Link, we relied entirely on an attempted census of the 73 Energy-Team members using an on-line survey. Unfortunately, only seven responded, creating the likelihood of non-response bias, which we were unable to investigate. Five of the seven said that their Energy Team had been recognized for their energy-management work. It is unclear how and how often they were recognized and by whom (e.g., senior management, middle management, immediate supervisor, etc.). Consequently, Link 7 is relatively weak due to the low levels of confidence and precision.

Following is a summary of our findings related to this link.

3.4.2.5.1 Summary of Achievement Recognition Link

While five of the seven respondents indicated that their Energy Team had been recognized for their energy-management work, there is the potential for non-response bias, and the small sample size means that our confidence that this was the norm is quite low. Consequently, our confidence that Link 7 is functioning as expected is low.

Based on this analysis, we conclude that there is relatively weak support for Link 7. Table 31 summarizes this conclusion and presents the link-support scores across all sites for each PA. These percentages are the averages of the individual site link-support scores for this group of links for each PA.

Table 31: Mean Link-Support Scores for Link 7, by PA

PA	Mean	Standard Deviation	CV
PG&E	1.23	0.44	0.36
SCE-SCG	1.25	0.46	0.37
SDG&E	1.00	0.00	0.00
Statewide	1.16	0.40	0.35

All Link-Support scores at the PA level and statewide level are less than 2 for Link 7.

The following sections address the equipment and O&M projects that were implemented by the participants.

3.4.2.6 Equipment & O&M Projects Implemented: Links 5, 15, 17, and 18

This critical group of links involves the expected increase in awareness and knowledge resulting from the workshops and implementation support. Kirkpatrick and Kirkpatrick (2014) refer to this as a Level 3 evaluation of training which focuses on the degree to which trained participants can transfer learning to their workplace behaviors. This group also involves the use of incentives and on-going energy-use tracking that, combined with increased awareness and knowledge, are expected to result in the implementation of equipment and O&M projects.

The following sections address the links associated with equipment and O&M projects implemented and their causes.

3.4.2.6.1 Incentives Designed and Offered: Links 5 & 15

Link 5 is concerned with designing and offering incentives to the implementers which was hypothesized to lead to O&M and equipment changes. The PAs and their respective implementers designed and proposed performance incentives and/or milestone incentives unique to their cohort. PAs established incentives in the respective implementation plan for each PA. Table 32 presents the incentive structures, by PA.

Table 32: SEM Incentive Structure, by PA

PA	Program Name	Engagement Start Date	Market Sector	Partici-pants	Milestone Incentives	Performance Incentives
SDG&E	Industrial SEM	1-Jul-18	Industrial	7	$5,000 paid as earned.	BRO: no incentive. Custom: traditional programs
PG&E	SEM-Food Processing	1-Jul-18	Food Processing	12	$6,000 paid as earned.	BRO: $0.025/kWh; $0.20/therm at months 9 & 26.
						Custom: traditional programs
	SEM for Manufacturing Facilities	1-Oct-18	Manufacturing	10	$25,000 paid as earned	BRO: $0.03/kWh (Y1), $0.02/kWh (Y2); $0.40/therm (Y1), $0.20/therm (Y2)
						Custom: traditional programs
SCE/SCG	Industrial SEM	1-Aug-18	Industrial	8	$5000 paid as earned	BRO: $0.02/kWh; $0.75/therm paid at months 12 and 24.
						Custom: traditional programs

Milestone incentives are paid for accomplishing SEM practices during the engagement, not directly tied to energy savings.

The question is whether the offer of these incentives led to the implementation of equipment and O&M changes at end-user facilities.

3.4.2.6.2 Increased Awareness and Knowledge: Link 17

Link 17 is concerned with the hypothesized relationship between an increase in awareness of energy management opportunities and the implementation of equipment and O&M projects at end-user facilities. Earlier in Section 3.4.2.4.1, we confirmed that there was such an increase. The question is whether this increase in awareness and knowledge led to the implementation of equipment and O&M changes at end-user facilities.

3.4.2.6.3 On-Going Energy-Use Tracking: Link 18

Link 18 is concerned with the hypothesized relationship between on-going energy use tracking the implementation of equipment and O&M projects at end-user facilities. Earlier in Section, 3.4.2.4.1, we confirmed that on-going energy use tracking was occurring. The question is whether on-going energy use tracking led to the implementation of equipment and O&M changes at end-user facilities.

3.4.2.6.4 Implementation of Equipment Upgrades and O&M Projects

The gross-savings team verified that sampled participants implemented 333 O&M changes and installed 84 equipment upgrades. Overall, the mean number of verified O&M changes is 11.1 while the mean number of verified equipment measures is much lower at 2.8. We additionally found that the mean number of verified O&M changes and equipment upgrades for the sites have standard deviations of 8.1 and 2.6, respectively, and coefficients of variation of 0.9 and 0.7, respectively. This indicates that the average number of verified O&M changes and equipment measures that sites pursued in the program are highly variable though still occurred across the population. Table 33 shows the verified O&M changes and equipment measures by PA.

Table 33: Verified O&M changes and Equipment Measures, by PA

	PA	Total Sites	Total Verified	Mean	SD	CV
Equipment Measures	PG&E	17	44	2.6	2.2	0.8
	SCE-SCG	8	20	2.5	2.5	1.0
	SDG&E	5	20	4.0	3.6	0.9
	Total	30	84	2.8	2.6	0.9
O&M Changes	PG&E	17	163	9.6	6.7	0.7
	SCE-SCG	8	94	11.8	9.5	0.8
	SDG&E	5	76	15.2	8.3	0.5
	Total	30	333	11.1	8.1	0.7

PG&E had the most verified O&M changes and equipment measures and the most sites. The variation in the number of verified O&M changes and equipment measures is high across all the PAs as is clear from the coefficient of variation (CV), which is the standard deviation divided by the mean. A CV close to or larger than 1 indicates a high level of variability.

Next, we summarize the findings of this section.

3.4.2.6.5 Summary of Equipment and O&M Projects Implemented Links

The preponderance-of-evidence (POE) analysis strongly supports these four links. The offer of incentives, the increase of awareness and knowledge of energy management opportunities, and the information gathered from on-going tracking of energy use have combined to influence participants to implement equipment measures and O&M projects at their sites.

Based these analyses, we conclude that Links 5, 15, 17, and 18 are functioning as expected. Table 34 summarizes this conclusion and presents the link-support scores across all sites for each PA. These percentages are the averages of the individual site link-support scores for this group of links for each PA.

Table 34: Mean Link-Support Scores for Link 5, 15, 17, and 18, by PA

PA	Mean	Standard Deviation	CV
PG&E	1.75	1.69	0.97
SCE-SCG	2.25	2.29	1.02
SDG&E	2.40	2.40	1.00
Statewide	2.04	2.04	1.00

Only PG&E had an average link-support score that is slightly less than 2.0 partly due to lower link-support scores for Leidos. The average of the PA scores statewide is greater than 2.0. This analysis also revealed that five of the 26 sites had a link-support score less than 2. That four of these sites were PG&E's explains its low average link-support score.

The following section addresses the energy and environmental impact links.

3.4.2.7 Energy and Environmental Impacts: Links 19 and 23

This group of links involves the implementation O&M changes and equipment measures that are expected to affect energy and demand. Kirkpatrick and Kirkpatrick (2014) refer to this as a Level 4 evaluation of training which moves beyond the training participant to assess the impact of training on organizational performance, i.e., verified energy and demand reductions and environmental and other non-energy benefits.

The following subsections describe the links associated with energy and environmental impacts.

3.4.2.7.1 Evaluated Energy and Demand Savings and Incentives Paid: Link 19

Link 19 represents the relationship between equipment and O&M changes and verified energy and demand savings (and incentives paid). Our gross analysis in Section 3.1 showed significant energy and demand savings, validating Link 19.. As a result of the evaluated savings, PAs paid implementers both performance and milestone incentives. Table 35 presents these verified incentives.

Table 35: Evaluated Incentives Paid, by PA

PA	Total
PG&E	$1,455,157.00
SCE-SCG	$561,817.50
SDG&E	$44,000.00
Grand Total	**$ 2,060,974.50**

We hypothesize that these energy and demand savings and incentives would motivate participants to persist in implementing their energy-management systems. This relationship is discussed in Section 3.4.2.8.

3.4.2.7.2 Environmental and Other Non-Energy Benefits

Link 23 is concerned with the relationship of energy and demand savings and environmental and other benefits. The SEM impact team did not estimate non-energy benefits (NEBs). as these effects are hypothesized to be a mid-term outcome, occurring two to three years after beginning program participation. Similar to the green-house-gas emissions that are already included in the avoided costs that are used as an input to the CPUC Cost-Effectiveness Tool (CET), it is reasonably expected that any additional NEBs would reinforce the persistent implementation of Energy Management Systems by increasing the program's benefits relative to the program's costs.

3.4.2.7.3 Summary of Energy and Environmental Impact Links

The evaluated gross savings and the over two million dollars of incentives almost certainly played a role in motivating implementers to train and provide technical assistance to participants throughout the two reporting periods. The environmental benefits will be formally captured by the CET as described above. Based on these analyses, we conclude that Links 19 and 23 are functioning as expected. Table 36 summarizes this conclusion and presents the link-support scores across all sites for each PA. These percentages are the averages of the individual site link-support scores for this group of links for each PA.

Table 36: Mean Link-Support Scores for Links 19 and 23, by PA

PA	Mean	Standard Deviation	CV
PG&E	1.89	1.87	0.99
SCE-SCG	2.00	2.14	1.07
SDG&E	2.40	2.60	1.08
Statewide	2.04	2.09	1.02

Only PG&E had an average link-support score that is slightly less than SCE-SCG's score of 2.0 partly due to lower link support scores for Leidos. The average of the PA scores statewide is greater than 2.0. This analysis also revealed that six of the 26 sites had a link-support score less than 2.0. That four of these sites were PG&E sites explains its relatively low average link-support score.

The next section addresses the issue of persistence in implementation of EMSs.

3.4.2.8 Persistent Implementation of Energy Management System (EMS): Links 20, 22 and 24

This group of links involves the recognition of the achievements of the Energy Champions and Energy Teams (Link 7), verified energy and demand impacts (Link 19), and the cultural change (Link 21) that supports the consistent quantification of savings that are expected via Links 20,22, and 24 to lead to the persistent implementation of an energy-management system.

Earlier, we found:

- **Recognition of Achievements:** There was relatively weak evidence that the members of the Energy Team were recognized for their organizational achievements (Link 7) since the results of the Energy Team interviews were potentially biased and the sample size was small. This also means that its relationship to the persistent implementation of an energy management system (Link 20) is also relatively weak.
- **Cultural Change**: The on-going energy-use tracking led to the consistent quantification of savings that was supported by cultural change with respect to energy management, i.e., changes at the PA level from EMA-1 to EMA-2[37] were statistically and practically significant (Link 21)[38]. However, in Section 3.4.2.4.2, we recognized that there is uncertainty as to whether this mid-term cultural change is sustainable and eventually becomes standard practice, even if narrowly focused on energy management. This is the case since so much of what happens after the SEM program concludes is subject to the unique, complex, and evolving culture of each organization. The question is whether these cultural changes led to the persistent implementation of an energy management system (Link 24).
- **Energy and Demand Savings**: Earlier, we confirmed that the equipment and O&M changes implemented resulted in the verified energy and demand savings and incentives being paid (Link 19). The question is whether this led to the persistent implementation of an energy management system (Link 22).

Following is a summary of our findings related to the links in this section

3.4.2.8.1 Summary of the Persistent Implementation of Energy Management Systems Links

Using the preponderance of evidence, we were able to confirm Links 19 and 21, but only found relatively weak support for Link 7. We hypothesize that the combination of the verified energy and demand savings (Link 19), the public recognition of staff and their organizational achievements (Link 7) and change in the organization's culture that supported the consistent quantification of savings (Link 21) would result in the persistent implementation of an energy-

[37] See Appendix J for a description of the general EMA framework and scoring.

[38] Although Leidos did not administer a second EMA, we expect that the results would have been similar given the consistent design and implementation of the SEM program across all the PAs, but also lower as an artifact of starting at a higher EMA score than other PA sites.

management system at each facility. Recognizing that we are forecasting based only on data collected over a two-year period, we have concluded that the prior program activities, outputs, and outcomes probably increased the likelihood of the persistent implementation of energy-management systems

Based on these analyses, we conclude that Links 20, 22, and 24 are mostly functioning as expected. Table 37 presents the link-support scores across all sites for each PA. These percentages are the averages of the individual site link-support scores for this group of links for each PA.

Table 37: Mean Link-Support Scores for Links 20, 22, and 24, by PA

PA	Mean	Standard Deviation	CV
PG&E	1.35	1.30	0.96
SCE-SCG	2.13	2.29	1.08
SDG&E	2.70	2.60	0.96
Statewide	1.85	1.86	1.01

Only PG&E had an average link-support score less than 2.0 partly due to lower link-support scores for Leidos[39]. Our prior uncertainty about these links, as indicated by their dashed lines in the logic model in Figure 22, is greater than all prior links. This uncertainty is driven primarily by the uncertainty in Links 20 (recognition of Energy Team) and 24 (cultural change supporting consistent quantification of savings). In other words, while it seems likely that the implementation of the participant energy management systems will persist, we cannot know for sure.

Following is our assessment of program influence, overall.

3.4.2.9 Overall Assessment of Program Influence

This section describes the results of Steps 2, 3, and 4 of our analysis (refer to section E.1.5.2 in Appendix E for the methodological details).

3.4.2.9.1 Threshold for Preponderance of Evidence, 0.50

The preponderance of evidence in assessing program attribution as a tool for evaluating complex programs is well established in the evaluation literature:

[39] The relatively poor performance of Leidos could have been due to a number of factors including the types of customers whose chose to participate in the program, the differential impact of COVID on manufacturing, their choice of using the relatively challenging ISO 50001 as their energy management framework and a small sample size in which two of the six performed poorly. One should also keep in mind that Leidos did not always have the lowest score for every link and even had the highest score on a few others. As discussed below in Section 3.4.2.9, the overall mean TD-A scores for CLEAResult and Leidos were well beyond the preponderance of evidence threshold of 50%.

- Coryn, C.L., L.A. Noakes, C.D. Westine, and D.C. Schröter. 2011. "A Systematic Review of Theory-Driven Evaluation Practice from 1990 to 2009," American Journal of Evaluation, 32(2)
- Forss, Kim, Mita Marra, and Robert Schwartz. (2011). Evaluating the Complex: Attribution, Contribution and Beyond. New Brunswick, New Jersey: Transaction Publishers
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- Chen, H.T. 1990. Theory-Driven Evaluations. Thousand Oaks, CA: Sage; Donaldson, Stewart I, Christina A. Christie and Melvin Mark (Eds.) 2009. What Counts as Credible Evidence in Applied Research and Evaluation Practice? Los Angeles, CA: SAGE
- Patton, M. Q. 2006. "The Debate about Randomized Controls in Evaluation: The Gold Standard Question." Paper presented at IPDET. June, Ottawa

In risk assessment, as in some legal contexts, the "standard of proof" may be a preponderance of evidence or "greater than 50% confidence" ((Krimsky S. 2005. The weight of scientific evidence in policy and law. Amer J Public Health. 95 (Supplement 1): S129-S136. doi: 10.2105/AJPH.2004.044727).

This is also the legal standard under which administrative agencies normally operate (Walker, Vern R. (1996). Risk Characterization and the Weight of Evidence: Adapting Gatekeeping Concepts from the Courts. Risk Analysis, Vol. 16, No. 6. [https://scholarlycommons.law.hofstra.edu/faculty_scholarship].

Decision 11-07-030 notes that it is necessary to establish, by a preponderance of evidence, that the program has induced the replacement rather than merely caused an increase in efficiency in a replacement that would have occurred without the program. The "Early Retirement Using the Preponderance of Evidence" (2014) notes that this preponderance is based on the more convincing evidence and its probable truth or accuracy, and not on the amount of evidence.

Resolution E-4818 adopted the Working Group's definition of preponderance of evidence: "Preponderance of evidence is a term borrowed from civil law. The preponderance of evidence standard requires that evidence for two opposing conditions be considered – in this case accelerated replacement and normal replacement baselines – and the condition more likely to be true (greater than 50% probability) be chosen." The preponderance of evidence has been used on the evaluation of the 2018 and 2018 Custom Program.

It is important to remember that we assessed the causal linkages for each of the 27 linkages for each participant site. For a site to receive a T-DA score greater than 50% meant that the entire pattern of link-support scores was consistence with the expectations of the program developer

and the various theories underlying the logic model, i.e., the entire network of causal mechanisms was confirmed. For a PA to receive an overall T-DA score greater than 50% meant that the average of the overall T-DA scores was greater than 50%.

3.4.2.9.2 Theory Driven Attribution Results

We calculated a theory-driven attribution (T-DA) score for each site as the sum of the eight link-support scores divided by 24 (the maximum score of 3 multiplied by 8). The average of the link-support scores (based on the preponderance of the evidence) for each site within each PA became its T-DA score. Figure 24 presents these T-DA scores for each site for each PA (each bar represents a different site).

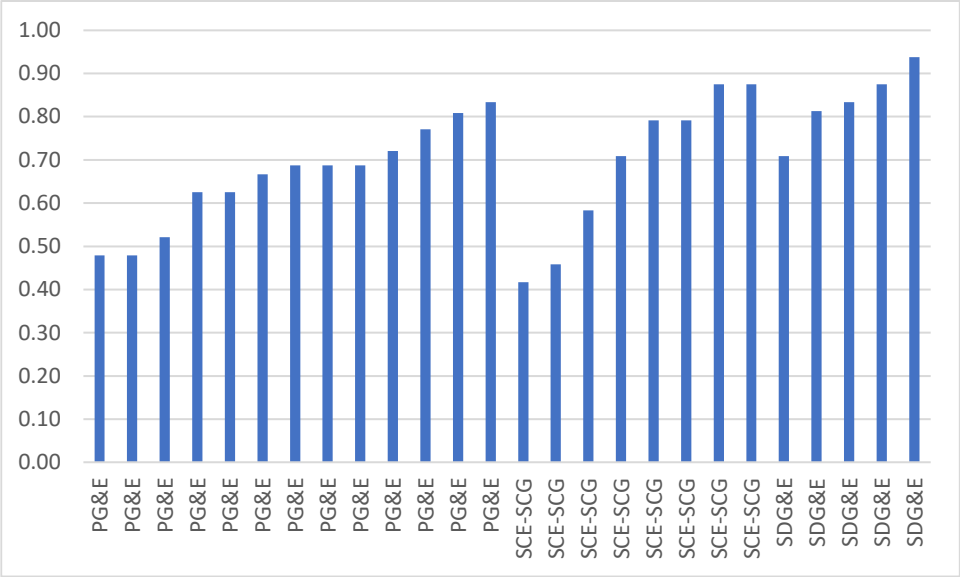

Figure 24: T-DA Scores, by PA

For PG&E, 85% of T-DA scores were greater than 0.50 For SCE--SCG and SDG&E it was 75% and 100%, respectively.

Because more than half of the T-DA scores for all three PAs were greater than 50%, we conclude that the probability that the program played a substantial role in causing the observed outcomes is greater than 50% (i.e., more likely than not). Our aim was to demonstrate a *reasonable attribution* or *credible association* between the SEM program activities and the observed impacts. Using the POE approach, we sought only to assess whether a convincing case could be made that the SEM program has made a substantial contribution to any reductions in energy use and changes in the organization's culture with respect to energy use. Reasonable attribution is sufficient evidence that the program is effective, which is the most that a theory-driven evaluation of any complex program can claim.

This is not to minimize the method, as a theory-driven evaluation provides much stronger and more complete evidence of theory implementation and influence than most other methods short of experimental designs (Forss et al. 2011). Even experimental designs have their limits—e.g., if program outcomes are or are not supported by an experiment, we won't know why we got that outcome. Certainly, the theory-driven evaluation provides more substantial evidence than decision makers' answers to a few questions in an interview. We repeat Weiss' (1997) conclusion: "If the evaluation can show a series of micro-steps that lead from inputs to outcomes, then causal attribution for all practical purposes seems to be within reach" (p.43). That is, confirming the links in the logic model is a powerful way to evaluate program influence but it is not designed to produce a single NTGR; there is no algorithm than can convert the enormous amount of quantitative and qualitative data that we obtained from various sources into a NTGR to two decimal places.

However, in California, the cost effectiveness of energy-efficiency programs requires an estimate of the percent of the observed savings that would not have happened absent the program, i.e., a NTGR that is used in calculating the total resource cost (TRC) test using the Cost-Effectiveness Tool (CET). Since the CET requires an NTGR, we went beyond what a theory-driven evaluation is designed to provide and converted these site-level T-DA scores to site-level NTGRs. If a given T-DA score was greater than 0.5, the POE NTGR was set to 1; if not, it was set to 0. In Figure 24, one can see that there are four sites whose T-DA scores were less than 0.50 (50%), indicating that their NTGRs were set to 0. For each PA, we calculated the simple average of the ones and zeroes to arrive at a POE NTGR and a POE NTGR weighted by life-cycle savings.

That we established *reasonable attribution* is reflected in the Table 38 where we show the unweighted average POE NTGR and the life-cycle-savings-weighted average[40] POE NTGRs across all the sites for each PA.

Table 38: Unweighted and Weighted POE NTGRs, by PA

	PG&E	SCE-SCG	SDG&E	Statewide
Unweighted POE NTGR	0.85	0.75	1.00	0.87
	(0.11)	—	—	(0.06)
Weighted POE NTGR	1.00	0.99	1.00	0.99
	—	—	—	—

The increases in the weighted POE NTGRs for PG&E and SCE-SCG are largely the result of sites that had a combination of POE NTGRs of zero and very small or no claimed savings. The confidence intervals for the weighted NTGRs are all missing. For PG&E, this is because two sites had NTGRs and the evaluated gross savings that were both zero, leaving only NTGRs that were equal to 1.0. For SCE-SCG, this is because they conducted a census, so there is no

[40] A weighted average of the site-specific NTGRs was calculated for each PA. These site-specific NTGRs were weighted by their respective lifecycle MMBtus.

sampling error. For SDG&E, it is because there was no variation in the NTGR, i.e., they were all 1.00.

This approach is consistent with CPUC Decision 16-08-019 which states:

> Strategic energy management is a holistic, whole-facility approach that uses NMEC and a dynamic baseline model to determine savings from all program activities at the facility, including capital projects, maintenance, and operations and retrocommissioning, as well as custom calculated projects. The customer engagement is long term. Because a well-designed strategic energy management approach provides for project tracking by the customer and the program administrator, these programs will facilitate identification of project influence and allow a default net-to-gross value of 1.0 to apply to custom projects when program influence is evident. (p. 41)

This evaluation has made a strong case that program influence is evident. The importance of the program in facilitating savings is reflected in the fact that 28 of the 35 participants (82%) have decided to participate in Cycle 2 of SEM program suggests that the cultural change that has occurred thus far will be maintained and likely increase over the next two years.

It is important to understand that this pattern of gross savings and NTGRs might not be representative of the typical pattern one might observe at another time in which the program is implemented in a less turbulent environment (e.g., one not impacted by such dislocating events as COVID-19) or for programs designed or implemented differently. To the extent that this is true, our ability to generalize these NTGR results to future participants and implementers is limited; future evaluations of the SEM Program could produce NTGR estimates that are less than 1.0. Until additional net impact evaluations are conducted, the characteristics of the population of customers for which SEM Program might be effective is undefined. A synthesis of findings across future net impact evaluations will provide stronger evidence than can a single evaluation about the generalizability of the effects observed.

3.5 Summary of COVID Effects

While COVID impacts were minor due to little impact on facility closers, the pandemic affected the energy consumption of industrial customers that participated in SEM to a small degree. Based on interviews with participants, COVID had more significant effects in terms of labor, supply chain, and other challenges. All facilities that participated in SEM continued to operate and consume energy much like before the pandemic. No facilities were drastically impacted or closed. The tables below summarize the gross savings, of the sampled sites only, when COVID effects are adjusted out of the savings. These tables demonstrate how COVID insignificantly affects the energy savings results of this impact evaluation. All subsequent evaluation results are presented with as-observed conditions.

Table 39: COVID Impact to First-Year Electric Gross Savings (MWH)

PA	COVID Impacts to First-Year Electric Gross Savings (MWH) *		
	Forecast Claimed	Evaluated Savings	
		As-observed with COVID	Adjusted for COVID
PG&E	31,292	29,751	28,925
SCE	11,967	12,647	12,785
SDG&E	4,342	4,892	4,899
Statewide	47,601	47,290	46,609

* Results presented in the above table are not extrapolated to the population, rather they represent the sample frame only.

Table 40: COVID Impact to First-Year Gas Gross Savings (therms)

PA	COVID Impact to First-Year Gas Gross Savings (Therms) *		
	Forecast Claimed	Evaluated Savings	
		As-observed with COVID	Adjusted for COVID
PG&E	2,026,087	1,455,309	1,460,414
SCG	387,569	287,087	314,378
SDG&E	36,618	30,862	30,862
Statewide	2,450,274	1,773,258	1,805,654

* Results presented in the above table are not extrapolated to the population, rather they represent the sample frame only.

3.6 Cost Effectiveness

We analyzed the cost-effectiveness of the SEM programs using the State of California's Cost-Effectiveness Tool (CET). The CET requires two input files: one that contains measure data, and one that contains program-cost data. We downloaded program-cost data from CEDARS and filtered the results to only include programs associated with the SEM evaluation sample. The program costs were further filtered to only include costs associated with 2018, 2019 and 2020.

The CET apportions program costs to energy-savings claims, so it is essential to consider all claims associated with the program costs when compiling the measure data. As such, the measure-data input file is a compilation of sampled measures and non-sampled measures. Sampled measures use the evaluated values for savings, measure costs, and rebates, and site-specific savings-weighted values for effective useful life (EUL). Non-sampled measures use claimed values for savings, measure costs, and rebates and evaluated PA values for EUL, realization rate, and net-to-gross ratio.

To evaluate the cost effectiveness of each program for the 2019-2020 evaluation period, we adjusted the CET input files so that all claims and program costs occurred in the fourth quarter of 2020, and used the 2020 version of the avoided costs when processing the measures in the CET.

Table 41: Life-Cycle Cost Effectiveness by PA

PA	TRC	PAC
PG&E	5.03	5.29
SCE	1.59	1.60
SCG	2.54	1.61
SDG&E	1.68	1.86

4 Recommendations

In this section, we present the recommendations that emerged from this evaluation. They are based on observations made while carrying out this study. Implementing these recommendations will not only improve the accuracy of program-savings claims, but also enhance future evaluators' ability to verify those claims expeditiously.

Table 42: Recommendations

RecID	Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
1	Inconsistent documentation of completed opportunities between PIs	The documentation requirements for each completed opportunity between PIs are inconsistent and do not always include essential details. In some instances, the evaluators could not determine that completed opportunities produced the listed savings.	Require that milestone incentives tied to the completion of the opportunity register include the information required in the M&V guide, particularly crucial performance indicators of affected equipment. This information will help provide evidence that modeled energy savings are a result of completing energy efficiency projects. The M&V guide does specify that the opportunity register should include "system or process, equipment type, size, capacity, load, and operating conditions" however, some opportunity registers lacked this information. M&V Guide V2.02 Section 5.4.1 Establishing the Opportunity Register: A general description: including a name, reference number, location, system or process, equipment type, size, capacity, load, and operating conditions.	Opportunity Registers
2	Savings claims unsupported by completed opportunities	Evaluators occasionally observed discrepancies between the savings claimed by the PA/PI and the projects completed on-site. For example, claiming natural gas savings as presented by the energy model when the site completed no natural gas savings projects.	Ensure that the savings generated using regression models reflect completed projects on the opportunity register, following sections 9.2.2 and 11.4.3 of the California Industrial SEM M&V Guide v2.02. Consider an examination of trends and inflection points in CUSUM graphs compared to timeline and savings magnitude of completed projects as a resource for ensuring savings claims are justified and note causes of significant deviations.	Savings Calculations - Model

RecID	Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
3	Errors in data roll-up	For many sites that rolled interval data into longer intervals (e.g., daily into weekly), evaluators found errors in the final result. The evaluators often traced the errors back to how the implementor rolled up the data between shorter to longer intervals. When the evaluators constructed the energy model or savings calculation with the incorrect data, they calculated the result in the documentation.	Energy modelers should account for exclusions and other adjustments when rolling up data into longer intervals. They can account for resulting variations in rolled-up time intervals (e.g., shorter weeks due to exclusions) through weighted regressions/averages or excluding impacted intervals all together. All data processing should be transparent and noted in energy model calculations.	Savings Calculations - Model
4	Claim annualized savings consistently, statewide	During program years 2018 and 2019, PAs did not calculate and report savings consistently. Savings claims which used bottom-up calculations represent annualized savings. When savings claims used an energy model, some PAs annualized those savings by extrapolating the savings rate at the end of the reporting period, as suggested by the M&V Guide. In contrast, other PAs used the avoided energy as the claimed savings.	We recommend that the PAs work together to develop a consistent approach that minimizes uncertainty and strives for a balance between simplicity and accuracy. A possible solution, which is the current method recommended by the M&V guide, is to annualize savings. Unless this solution changes, the PIs should be required to follow the specified annualization period or document the rationale for choosing an alternative period. However, we acknowledge the SEM Energy Savings Best Practices Workgroup's effort to improve savings reporting continuously. This group could recommend alternative approaches after conducting more research. We recommend researching the variation in results with alternate annualization of savings. Now that SEM has operated for multiple years, past energy models could help support this investigation.	Savings Calculations - Model
5	Annualization interval differs from model interval	Occasionally implementors used monthly intervals for annualization when energy models used daily intervals. This method introduces a risk of misrepresenting the impact of any adjustments made (such as exclusions of outliers) and overlooking the impact of varying	When annualizing energy savings, use the same time interval as the regression model, adhering to the methodology outlined in section 11.5.3 of the California Industrial SEM M&V Guide v2.02. To ensure accuracy of	Savings Calculations - Model

RecID	Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
		time intervals (e.g., varying days per month).	calculations, ensure that data collected during the annualization period is reviewed, adjusted, and documented per the guidance in section 11.5.2.	
6	Sites with multiple energy models for a single energy source do not have clearly defined guidance on calculating uncertainty	The program guidelines describe statistical requirements for individual adjustment models and conditions for using multiple models for a single energy source. However, the program guidelines do not provide rules or guidance for modelers to calculate statistical requirements using multiple models for a single energy source. The guidelines are unclear on whether multiple models for the same energy source that pass statistical tests individually remain valid if the combined uncertainty (FSU) is too high.	The M&V Guidelines should provide more specific guidance for statistical requirements of claims made using multiple models for a single energy source, particularly savings uncertainty. The guidelines should address which statistical requirements are only applicable to individual models and if any tests apply to the entire reporting period.	Savings Calculations - Model
7	Adopt improved guidance for the level of rigor required for bottom-up calculations	Evaluators found a varying level of detail for bottom-up calculations. In general, the higher the savings, then an enhanced level of rigor is expected.	We recommend further leveraging the statewide SEM Energy Savings Best Practices Workgroup for PA collaboration on solutions. All bottom-up calculations should define the baseline and proposed energy consumption and annual hours of operation. Additionally, we recommend adding an amendment to the statewide M&V Guidelines for documenting and determining each term within the energy calculations	Savings Calculations - Bottom-Up
8	Insufficient review of trend data for bottom-up calculations	When a PI cannot use a regression model, they often use trend data from control systems, loggers, or equipment sub-meters to support bottom-up calculations. Evaluators often identified unaccounted-for issues such as outliers, non-routine events, and unusual operating patterns in the data.	When using data for bottom-up calculations (e.g., BMS trends, submeter data, data loggers), follow similar M&V practices utilized when constructing energy models, such as examining data for outliers, non-routine events, and significant day-types.	Savings Calculations - Bottom-Up
9	Use accurate and reliable energy meters	Implementors should only use accurate and reliable energy meters for M&V. One sizeable natural gas project had a low gross realization rate due to inaccurate meter data in the	If participant-owned sub-meters are deemed inaccurate, PIs should not rely on the data for energy models or bottom-up calculations. Refer to the Industrial SEM M&V Guide	Savings Calculations

RecID	Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
		M&V calculations. The customer confirmed the meter is erroneous, exceeds the range of data collected, and was adjusted many times.	Section 5.3.3 for guidance on meter calibration.	
10	Lack of documentation for NRE adjustment methodology	Evaluators often had to interpret the various methodology for non-routine adjustments by reviewing model inputs rather than the supplied documentation.	Provide clear documentation of non-routine adjustment methodology in M&V reports and make notes or comments in modeling tools where applicable. All calculations and data processing must be transparent and retained within the model files for review and evaluation. Additionally, non-routine events include a start and end date, hence why they are "non-routine." If an open-ended non-routine event is specified, the modeler must state clear conditions for how and when to re-evaluate ending the adjustment. For example, if an air compressor fails and a backup unit is in place, the condition would be the repair of the air compressor, and shutdown of the backup unit would end the non-routine event.	Non-Routine Events
11	Missed non-routine events	Review of energy consumption, regression models, and production data, followed by discussions with the site, often identified non-routine events the energy model did not account for in PA/PI savings calculations.	Standardized methodologies greatly aid in the identification and documentation of non-routine events. We recommend the PIs create tools and templates based on the criteria in the California Industrial SEM M&V Guide and best practices for NRE identification, such as the "IPMVP Application Guide on Non-Routine Events & Adjustments" (e.g., heat maps, residual analysis, CUSUM inflection analysis, etc.). When examining data for NREs, consider filtering data into significant day-types or operating modes where appropriate to ensure that users can compare potential changes in static factors to relevant base conditions and aid in identifying substantial shifts.	Non-Routine Events

RecID	Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
			An NRE survey for participants is an additional tool that can be helpful for assessing changes to static factors.	
12	Evaluators might be underestimating the benefits of the SEM program since they cannot consider the longer-term impacts.	A significant belief or hypothesis underlying the SEM program is that changing the organizational culture for energy management will increase the likelihood that the behaviors and evaluated savings will persist and additional savings identified. We could not thoroughly test this in Cycle 1, given the longer-term nature of cultural change. However, that 82% of the participants in Cycle 1 have decided to participate in Cycle 2 presents an excellent opportunity to assess any additional changes in the organizational culture, the persistence of savings verified in Cycle 1, and the identification of additional opportunities to reduce energy use.	We recommend assessing the cumulative effect of the SEM program over several years since it is a rare opportunity to evaluate the Program's longer-term impacts. A primary goal of this research should be to better understand persistence and EUL of SEM.	Evaluation
13	While the implementers submitted logic models, they were inconsistent in some cases, and incomplete. The logic models also lacked an accompanying narrative that explains how specific actions lead to certain outcomes.	Developing a logic model and an accompanying narrative explaining why specific actions lead to certain outcomes is critical for such a complex program as SEM. The underlying theories can be based on social science and engineering principles or simply on past evaluations of what works and for which populations (i.e., "practical" program theories). In a statewide program involving multiple implementers, a collaboration between implementors to develop a single logic model and underlying narrative is essential. In addition, it is also critical that the evaluators and implementers agree on the key performance indicators early in the life of the Program and map them into the various links of the logic model	PAs should develop a statewide SEM program logic model and an underlying narrative based on social science theories and engineering principles or past evaluations of what works and for which populations (i.e., "practical" program theories). In addition, evaluators and implementers should agree on the key performance indicators early in the Program's life and map them into the various links of the logic model.	Evaluation
14	Support Evaluation Recruitment	The survey team asked energy team members to participate in a	PAs should remind participants that they must participate in multiple research efforts to	Evaluation

RecID	Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
		survey. They received a low response rate on this request.	estimate project savings as part of their program-participation agreement. The CPUC should consider stricter rules to ensure that customers meet this obligation.	
15	Share working energy models with live calculations and all data processing	When PIs, PAs, and evaluators share energy models for review, these should be working models with live calculations.	Raw data processing must be transparent and repeatable. Energy data, meter numbers, on-site generation, and production data must be accurate and consistent between model files and written reports. Section 5 in the Industrial SEM M&V Guide defines data collection protocols, including documentation of sources and processing.	Evaluation
16	SEM participants missing in claims dataset	Many claims for SEM participants were missing in a given program year dataset. PAs presented various reasons for why claims were not in CEDARs. The following reasons summarize all instances of a missing claim: 1. M&V was not completed within the deadline for program year entry. 2. Energy savings result were zero. The PA decided not to enter a claim. 3. The M&V method failed. The energy savings result was unknown and assumed zero for the reporting period. In a subsequent year, the implementor changed the M&V method to quantify savings. The PA decided not to enter a claim. 4. Energy savings result were negative, and the PA decided not to enter a claim. Missing claims affects an evaluator's ability to sample claims properly.	To aid in impact evaluation and thoroughly document participant results, PAs should be required to enter a claim for all SEM participants each program year. Evaluators expect to see a claim for each participant even if the result is no savings.	Reporting
17	Quantify and claim demand savings for all SEM projects	PAs inconsistently claimed demand savings across program years. All SEM project claims with electric energy savings should include demand savings.	We recommend that demand savings are quantified and claimed for all SEM projects. A demand savings calculator was developed and proposed by the evaluation team during the	Reporting

RecID	Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
			Group D contract. We recommend that the IOUs take ownership of that tool, continue improving it, and support claiming demand savings.	
18	Use correct EULs for SEM projects	Some claims entered by PAs had an EUL of 1 year for SEM projects.	PAs should ensure that EULs are assigned appropriately at 5 years.	Reporting
19	Standardize claim entries statewide	We observed variation in claims data entry from one PA to another and within PA claims. We found gross savings for SEM claims to be the product of two fields in CEDARS claims. For example, the first baseline kWh savings are "NumUnits" and "UnitkWh1stBaseline.x". Similar fields are available for therms, kW, and 2nd baseline.	We recommend that CPUC provide more specific guidance to the PAs to standardize claim entries. The preferred method would be to use a value of "1" in "NumUnits" and the unit value of savings in each savings-specific field. However, some PAs include multiple claim entries (one for each fuel) and use the "NumUnits" field to enter the unit value of savings, then putting a 1 in "UnitkWh1stBaseline.x".	Reporting
20	The evidence provided by some implementers of any increases in knowledge and awareness as a result of the workshops is weak.	Leidos administered a brief competency test at the conclusion of each workshop, but none of the other implementers did.	Administer a competency text at the conclusion of each workshop similar to the ones developed by Leidos. Coordinating this effort among the different implementers will ensure consistency in terms of the material covered, number of items on the test, and the degree of difficulty.	Workshops

5 Integrated Demand Side Management Observations

5.1 Overview

Integrated Demand Side Management (IDSM) was defined in the 2011 California Efficiency Strategic Plan[41] as:

> Energy efficiency, energy conservation, demand response, advanced metering, and distributed generation technologies are offered as elements of an integrated solution that supports energy and carbon reduction goals immediately, and eventually water and other resource conservation goals in the future.

For the purposes of this qualitative evaluation, IDSM consists of elements beyond energy efficiency defined as the following categories:

- on-site generation (solar, wind, fuel cells, etc.),
- combined heat and power (CHP),
- load shifting (i.e. shifting equipment operation time based on reducing peak demand),
- demand response (i.e. shedding load to reduce peak demand, typically by turning off or down equipment),
- energy storage (e.g. batteries and ice storage), and
- electric vehicle (EV) charging.

5.2 SEM Participant IDSM Characterization

Outside of energy efficiency, the majority of the industrial SEM participants in the evaluation sample incorporated additional IDSM elements into their energy-management portfolio. Seventeen of the thirty sampled sites had at least one IDSM element in place before participating in SEM, as shown in Table 43.

Table 43: IDSM Elements by SEM Participants

IDSM Strategy	Number of Participants
On-Site Generation	9
Combined Heat and Power (CHP)	6
Load Shifting	1
Demand Response	8

[41] The 2011 strategic plan can be viewed at https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/c/5303-caenergyefficiencystrategicplan-jan2011.pdf

IDSM Strategy	Number of Participants
Energy Storage	1
Energy Management System (EMS)	5
EV Charging	Unknown*

* Details of existing electric vehicle charging stations were not collected during SEM interviews.

On-site generation and demand response accounts for most IDSM at industrial SEM sites, each appearing at eight of the 30 sampled sites. Solar PV is the most common form of on-site generation, followed by wind and fuel cells. Demand response for these sites consists of participating in a utility-driven demand-response program. Table 44 summarizes the IDSM beyond energy efficiency at the sampled sites. SEM did not influence any of the on-site generation, demand response or energy storage listed in the below table. All of these assets pre-dated SEM. Section 5.3 below describes IDSM activities promoted by SEM.

Table 44: Summary of IDSM at SEM Sampled Sites

		PGE	SDG&E	SCE/SCG	Total
Energy Consumption	Annual kWh	413,850,244	144,185,556	320,600,000	**878,635,801**
	Peak kW	81,003	21,485	42,521	**145,009**
	Annual Therms	77,814,676	2,261,464	23,578,270	**103,654,410**
	Peak Therms	15,704	258	2,882	**18,844**
On-Site Generation	# of sites	7	2	0	**9**
	kWh	37,065,990	32,632,134	0	**69,698,124**
	kW	13,827	6,645	0	**20,472**
	therms	2,300,000	224,409	0	**2,524,409**
Load Shifting	# of sites	0	1	0	**1**
	kWh	0	2,000	0	**2,000**
	therms	0	0	0	**0**
Energy Storage	# of sites	0	1	0	**1**
	kWh	0	2,000	0	**2,000**
	kW	0	1,000	0	**1,000**
	ton-hours	0	0	0	**0**
	therms	0	0	0	**0**
Demand Response	# of sites	4	1	3	**8**
	kWh	36,000	2,000	9,000	**47,000**
	kW	8,800	1,000	4,000	**13,800**
	therms	0	0	0	**0**

		PGE	SDG&E	SCE/SCG	Total
CHP	# of sites	5	1	0	**6**
	Capacity (kW)	13,050	690	0	**13,740**
	kWh	70,752,118	0	0	**70,752,118**
Other Demand Resources	# of sites	0	0	0	**0**

5.3 IDSM Activities in SEM

Cycle 1 of the SEM program focuses on educating participants in energy efficiency and laying the foundation for establishing a broader energy-management system to build upon in future years of participation. Cycle 2 expands the focus to include education to help participants make informed decisions regarding the selection of multiple opportunities to improve energy performance (i.e., beyond energy efficiency), and introduces IDSM as a pillar of the program. As a result, IDSM activities during Cycle 1 are generally those identified naturally through site Treasure Hunts and customer interests, rather than as a result of the specific pursuit of IDSM elements. Cycle 2 and beyond will have a more directed approach to promoting IDSM, which, following the *California Industrial SEM Cycle 2 Design Guide*, will define the loading order for IDSM[42], include providing general education, providing IDSM case studies, providing IOU program-specific information, developing recommendations, and referring SEM participants to IOU staff or contractors for further support.

Promotion of IDSM in Cycle 1 typically occurred by identifying opportunities during the Treasure Hunts and developing relevant recommendations. Opportunity registers provided by the PAs included a variety of recommendations focused on IDSM, with each of the PAs recommending an average of one to two IDSM opportunities per participant. Most of the IDSM opportunities proposed are O&M[43] (56%); the rest were capital measures. Eight IDSM projects were completed at the thirty sampled sites, seven of which were O&M projects, particularly in the form of demand response. The focus on operational IDSM measures is consistent with trends observed for energy-efficiency measures and aligns with the purpose and goals of the SEM program. Section 5.3.2 contains more detail on completed projects.

Figure 25 shows the number of proposed and completed recommendations in each category.

[42] CPUC has defined the loading order consistent with the 2005 Strategic plan, which can be viewed here: https://docs.cpuc.ca.gov/word_pdf/REPORT/51604.doc

[43] We consider IDSM O&M to mean optimizing existing equipment the facility already owned. Some examples of IDSM related O&M opportunities found on opportunity registers include clean solar panels, adjust schedule to avoid peaks, recover additional waste heat from cogen system.

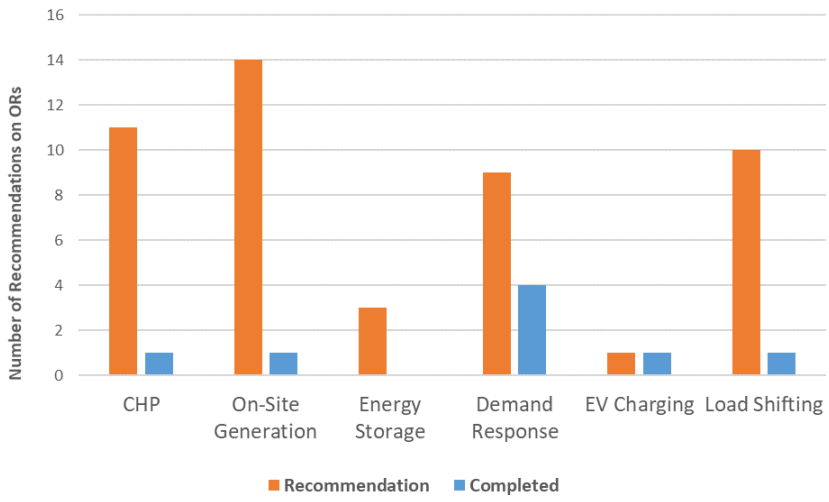

Figure 25: Number of opportunity-register recommendations and completed projects by IDSM category

5.3.1 How PAs Promote IDSM in SEM

We found that when considering IDSM opportunities, the industrial energy teams tended to focus on IDSM-specific equipment, such as on-site generation, CHP, energy storage, and EV charging, as opposed to identifying load-shifting and demand-response opportunities. This focus is not surprising for industrial sites, given that load-shifting and demand-response strategies are more likely to impact processing schedules (e.g., shutting down equipment or changing hours of operation), and may thus require more detailed planning and approval processes. The recommendations are not limited to simple optimization of existing generation, storage, or charging equipment, but also include suggestions to install new IDSM-specific equipment. Figure 26 shows the portion of opportunity-register measures attributed to each of the major IDSM categories.

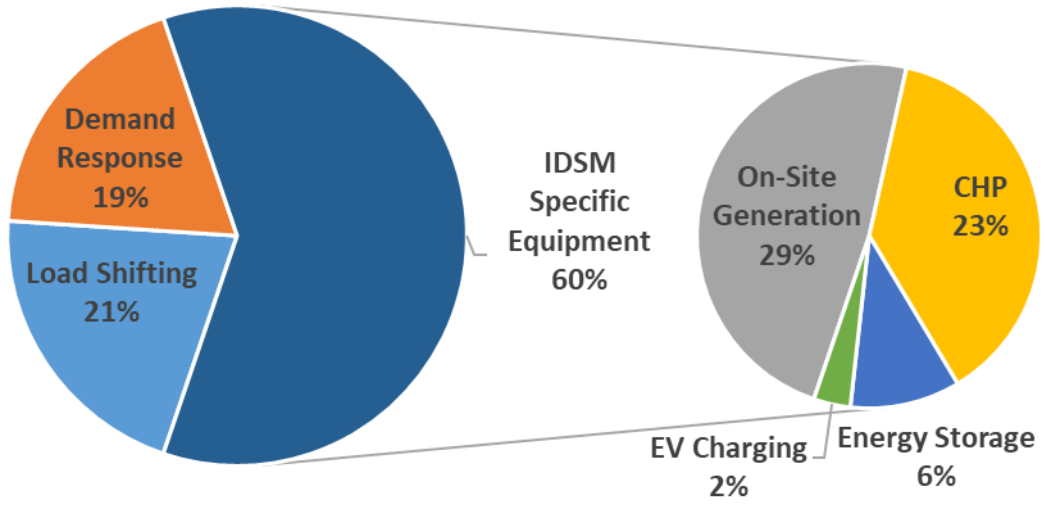

Figure 26: The share of opportunity-register recommendations in each IDSM category

5.3.2 Generating Demand Savings in SEM

Demand savings are a valuable result of implementing IDSM. Demand savings in industrial SEM is typically achieved by a combination of capital improvements and operational measures. Opportunity registers indicate a major component of achieving demand savings in SEM is investing in higher-efficiency equipment or improving the efficiency of existing equipment. An example of this would be installing VFDs on cooling-tower fans. With operational measures, demand savings can be achieved by simple opportunities such as increasing cooling-temperature setpoints or repairing compressed-air leaks. Incorporating IDSM elements into energy planning has the potential to achieve demand savings more directly by introducing opportunities that shift or dramatically reduce loads during peak periods or by changing the energy source of electric equipment, thus removing the demand from the grid.

Completed IDSM opportunities most often fall into the demand-response category. Demand-response and load-shifting opportunities in the opportunity registers often include reducing peak-demand charges, demonstrating that industrial SEM participants are often motivated to reduce billed energy costs.

Table 45: Summary of Completed IDSM Projects by Category in Cycle 1

Category	Number of Completed Projects
Demand Response	4
On-Site Generation	1
EV Charging	1
Load Shifting	1

Category	Number of Completed Projects
CHP	0
Energy Storage	0

5.4 IDSM Recommendations

1. Increase emphasis on IDSM elements. IDSM measures comprised a small portion of both recommendations and completed projects. PIs should encourage more demand side technology (EE, DG. DR. storage, etc.) opportunities while promoting the loading order in an attempt to develop more IDSM measures over time.
2. Further education on IOU-driven demand-response programs will help expand participation. The demand-response measures on the opportunity register typically focus on manual adjustments to equipment schedules to avoid peak charges.
3. Incorporate further investigation into combined heat and power plants where possible and bring in specialists when necessary. Of the six sites with CHP plants, only three of the opportunity registers included recommendations focused on optimization of the existing equipment (either through operational or efficiency improvements).
4. Establish a demand savings goal, independent of the electricity consumption goal, as part of the site energy-management plan.

6 Data Products

In this section, we describe the data products that substantiate the findings of this report.

6.1 Public

We provide an Excel workbook as a companion to this report. It does not contain any information that identifies individual customers served by the PAs. The workbook contains:

- **Primary Data**. Primary data from CEDARS, DEER, telephone surveys (decision makers and their vendors and operations staff), project documentation provided by the PAs, and site inspections and in-person interviews.
- **Products of Data Analysis**. Documentation of our sample selection, analysis of gross savings, analysis of NTGR, analysis of EUL, and the estimation of gross and net savings for sampled claims aggregated for projects, domains, PAs, and the state.
- **Report Tables and Plots**. Source tables and plots that appear in the body and appendices of the report.

6.2 PA-Specific

Other of our data products contain information that identifies individual electric or gas customers and are only available to the PAs that serve these customers. Folders containing all of our work products are available for PA-specific review in the Evaluation, Measurement, and Verification (EM&V) platform on the website www.deeresources.info.

Appendices

A. Detailed Findings and Recommendations

The tables in this section present our findings for gross and net savings and our recommendations. These tables conform to CPUC standard reporting guidelines.[44] We did not include the accelerated replacement tables as the SEM claims under evaluation were all BRO and do not include applicable measure application types.

A.1 Gross Life-Cycle Savings (MWh)

Table 46: Gross Life-Cycle Savings (MWh)

PA	Life-Cycle Electric Gross Savings (MWh)		Forecast Claimed GRR	% Ex Ante Passed Through	Eval GRR	Eval GRR RP (%) *
	Forecast Claimed	Evaluated				
PG&E	162,852	164,630	0.90	0	1.01	0.02
SCE	59,837	61,023	0.95	0	1.02	0.00
SDG&E	5,030	30,246	0.90	0	6.01	4.91
Statewide	227,719	255,899	0.91	0	1.12	2.15

* Relative precision at the 90% confidence level.

A.2 Gross Life-Cycle Savings (MW)

Table 47: Gross Life-Cycle Savings (MW)

PA	Life-Cycle Electric Gross Savings (MW)		Forecast Claimed GRR	% Ex Ante Passed Through	Eval GRR*	Eval GRR RP (%) **
	Forecast Claimed	Evaluated				
PG&E	10.43	20.95	0.90	0	1.01	0.02
SCE	2.62	8.10	0.90	0	1.02	0.00
SDG&E	0.26	3.89	0.90	0	6.01	4.91
Statewide	13.31	32.94	0.90	0	1.12	2.15

* MW GRR was established from MWh GRR

** Relative precision at the 90% confidence level.

[44] CPUC Energy Division Impact Evaluation Standard Reporting Guidelines, November 2015.

A.3 Gross Life-Cycle Savings (Therms)

Table 48: Gross Life-Cycle Savings (Therms)

PA	Life-Cycle Gas Gross Savings (Therms)		Forecast Claimed GRR	% Ex Ante Passed Through	Eval GRR	Eval GRR RP (%) *
	Forecast Claimed	Evaluated				
PG&E	10,220,077	13,390,036	0.90	0	1.31	0.95
SCG	1,937,845	1,326,655	0.90	0	0.68	0.06
SDG&E	88,555	376,183	0.90	0	4.25	0.03
Statewide	12,246,477	15,092,875	0.90	0	1.23	0.83

* Relative precision at the 90% confidence level.

A.4 Net Life-Cycle Savings (MWh)

Table 49: Net Life-Cycle Savings (MWh)

PA	Life-Cycle Electric Net Savings (MWh)		NRR	Forecast Claimed NTGR	Evaluated NTGR	% Forecast Passed Through	Eval Forecast Claimed NTGR	Eval Evaluated NTGR	Eval NTGR RP (%) *
	Forecast Claimed	Evaluated							
PG&E	162,852	164,630	1.01	1.00	1.00	0.00	1.00	1.00	0.00
SCE	59,837	60,481	1.01	1.00	0.99	0.00	1.00	0.99	0.00
SDG&E	5,030	30,246	6.01	1.00	1.00	0.00	1.00	1.00	0.00
Statewide	227,719	255,357	1.12	1.00	1.00	0.00	1.00	1.00	0.00

* Relative precision at the 90% confidence level.

A.5 Net Life-Cycle Savings (MW)

Table 50: Net Life-Cycle Savings (MW)

PA	Life-Cycle Electric Net Savings (MW)		NRR*	Forecast Claimed NTGR	Evaluated NTGR	% Forecast Passed Through	Eval Forecast Claimed NTGR	Eval Evaluated NTGR	Eval NTGR RP (%) **
	Forecast Claimed	Evaluated							
PG&E	10.43	20.95	2.01	1.00	1.00	0.00	1.00	1.00	0.00
SCE	2.62	8.03	3.06	1.00	0.99	0.00	1.00	0.99	0.00
SDG&E	0.26	3.89	14.89	1.00	1.00	0.00	1.00	1.00	0.00
Statewide	13.31	32.87	2.47	1.00	1.00	0.00	1.00	1.00	0.00

* Demand savings were not claimed in Year 1 as they were not included in the Industrial SEM M&V Guide. NRR for demand should not be considered applicable to future projects.

** Relative precision at the 90% confidence level.

A.6 Net Life-Cycle Savings (Therms)

Table 51: Net Life-Cycle Savings (Therms)

PA	Life-Cycle Gas Net Savings (Therms)		NRR	Forecast Claimed NTGR	Evaluated NTGR	% Forecast Passed Through	Eval Forecast Claimed NTGR	Eval Evaluated NTGR	Eval NTGR RP (%) *
	Forecast Claimed	Evaluated							
PG&E	10,220,077	13,390,036	1.31	1.00	1.00	0.00	1.00	1.00	0.00
SCG	1,937,845	1,314,872	0.68	1.00	0.99	0.00	1.00	0.99	0.00
SDG&E	88,555	376,183	4.25	1.00	1.00	0.00	1.00	1.00	0.00
Statewide	12,246,477	15,081,092	1.23	1.00	1.00	0.00	1.00	1.00	0.00

* Relative precision at the 90% confidence level.

A.7 Recommendations

RecID	Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
1	Inconsistent documentation of completed opportunities between PIs	The documentation requirements for each completed opportunity between PIs are inconsistent and do not always include essential details. In some instances, the evaluators could not determine that completed opportunities produced the listed savings.	Require that milestone incentives tied to the completion of the opportunity register include the information required in the M&V guide, particularly crucial performance indicators of affected equipment. This information will help provide evidence that modeled energy savings are a result of completing energy efficiency projects. The M&V guide does specify that the opportunity register should include "system or process, equipment type, size, capacity, load, and operating conditions" however, some opportunity registers lacked this information. M&V Guide V2.02 Section 5.4.1 Establishing the Opportunity Register: A general description: including a name, reference number, location, system or process, equipment type, size, capacity, load, and operating conditions.	Opportunity Registers
2	Savings claims unsupported by completed opportunities	Evaluators occasionally observed discrepancies between the savings claimed by the PA/PI and the projects completed on-site. For example, claiming natural gas savings as presented by the	Ensure that the savings generated using regression models reflect completed projects on the opportunity register, following sections 9.2.2 and 11.4.3 of the California Industrial SEM M&V	Savings Calculations - Model

RecID	Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
		energy model when the site completed no natural gas savings projects.	Guide v2.02. Consider an examination of trends and inflection points in CUSUM graphs compared to timeline and savings magnitude of completed projects as a resource for ensuring savings claims are justified and note causes of significant deviations.	
3	Errors in data roll-up	For many sites that rolled interval data into longer intervals (e.g., daily into weekly), evaluators found errors in the final result. The evaluators often traced the errors back to how the implementor rolled up the data between shorter to longer intervals. When the evaluators constructed the energy model or savings calculation with the incorrect data, they calculated the result in the documentation.	Energy modelers should account for exclusions and other adjustments when rolling up data into longer intervals. They can account for resulting variations in rolled-up time intervals (e.g., shorter weeks due to exclusions) through weighted regressions/averages or excluding impacted intervals all together. All data processing should be transparent and noted in energy model calculations.	Savings Calculations - Model
4	Claim annualized savings consistently, statewide	During program years 2018 and 2019, PAs did not calculate and report savings consistently. Savings claims which used bottom-up calculations represent annualized savings. When savings claims used an energy model, some PAs annualized those savings by extrapolating the savings rate at the end of the reporting period, as suggested by the M&V Guide. In contrast, other PAs used the avoided energy as the claimed savings.	We recommend that the PAs work together to develop a consistent approach that minimizes uncertainty and strives for a balance between simplicity and accuracy. A possible solution, which is the current method recommended by the M&V guide, is to annualize savings. Unless this solution changes, the PIs should be required to follow the specified annualization period or document the rationale for choosing an alternative period. However, we acknowledge the SEM Energy Savings Best Practices Workgroup's effort to improve savings reporting continuously. This group could recommend alternative approaches after conducting more research. We recommend researching the variation in results with alternate annualization of savings. Now that SEM has operated for multiple years, past energy models could help support this investigation.	Savings Calculations - Model

RecID	Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
5	Annualization interval differs from model interval	Occasionally implementors used monthly intervals for annualization when energy models used daily intervals. This method introduces a risk of misrepresenting the impact of any adjustments made (such as exclusions of outliers) and overlooking the impact of varying time intervals (e.g., varying days per month).	When annualizing energy savings, use the same time interval as the regression model, adhering to the methodology outlined in section 11.5.3 of the California Industrial SEM M&V Guide v2.02. To ensure accuracy of calculations, ensure that data collected during the annualization period is reviewed, adjusted, and documented per the guidance in section 11.5.2.	Savings Calculations - Model
6	Sites with multiple energy models for a single energy source do not have clearly defined guidance on calculating uncertainty	The program guidelines describe statistical requirements for individual adjustment models and conditions for using multiple models for a single energy source. However, the program guidelines do not provide rules or guidance for modelers to calculate statistical requirements using multiple models for a single energy source. The guidelines are unclear on whether multiple models for the same energy source that pass statistical tests individually remain valid if the combined uncertainty (FSU) is too high.	The M&V Guidelines should provide more specific guidance for statistical requirements of claims made using multiple models for a single energy source, particularly savings uncertainty. The guidelines should address which statistical requirements are only applicable to individual models and if any tests apply to the entire reporting period.	Savings Calculations - Model
7	Adopt improved guidance for the level of rigor required for bottom-up calculations	Evaluators found a varying level of detail for bottom-up calculations. In general, the higher the savings, then an enhanced level of rigor is expected.	We recommend further leveraging the statewide SEM Energy Savings Best Practices Workgroup for PA collaboration on solutions. All bottom-up calculations should define the baseline and proposed energy consumption and annual hours of operation. Additionally, we recommend adding an amendment to the statewide M&V Guidelines for documenting and determining each term within the energy calculations	Savings Calculations - Bottom-Up
8	Insufficient review of trend data for bottom-up calculations	When a PI cannot use a regression model, they often use trend data from control systems, loggers, or equipment sub-meters to support bottom-up calculations. Evaluators often identified unaccounted-for issues such as outliers, non-routine	When using data for bottom-up calculations (e.g., BMS trends, submeter data, data loggers), follow similar M&V practices utilized when constructing energy models, such as examining data	Savings Calculations - Bottom-Up

RecID	Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
		events, and unusual operating patterns in the data.	for outliers, non-routine events, and significant day-types.	
9	Use accurate and reliable energy meters	Implementors should only use accurate and reliable energy meters for M&V. One sizeable natural gas project had a low gross realization rate due to inaccurate meter data in the M&V calculations. The customer confirmed the meter is erroneous, exceeds the range of data collected, and was adjusted many times.	If participant-owned sub-meters are deemed inaccurate, PIs should not rely on the data for energy models or bottom-up calculations. Refer to the Industrial SEM M&V Guide Section 5.3.3 for guidance on meter calibration.	Savings Calculations
10	Lack of documentation for NRE adjustment methodology	Evaluators often had to interpret the various methodology for non-routine adjustments by reviewing model inputs rather than the supplied documentation.	Provide clear documentation of non-routine adjustment methodology in M&V reports and make notes or comments in modeling tools where applicable. All calculations and data processing must be transparent and retained within the model files for review and evaluation. Additionally, non-routine events include a start and end date, hence why they are "non-routine." If an open-ended non-routine event is specified, the modeler must state clear conditions for how and when to re-evaluate ending the adjustment. For example, if an air compressor fails and a backup unit is in place, the condition would be the repair of the air compressor, and shutdown of the backup unit would end the non-routine event.	Non-Routine Events
11	Missed non-routine events	Review of energy consumption, regression models, and production data, followed by discussions with the site, often identified non-routine events the energy model did not account for in PA/PI savings calculations.	Standardized methodologies greatly aid in the identification and documentation of non-routine events. We recommend the PIs create tools and templates based on the criteria in the California Industrial SEM M&V Guide and best practices for NRE identification, such as the "IPMVP Application Guide on Non-Routine Events & Adjustments" (e.g., heat maps, residual analysis, CUSUM inflection analysis, etc.). When examining data for NREs,	Non-Routine Events

RecID	Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
			consider filtering data into significant day-types or operating modes where appropriate to ensure that users can compare potential changes in static factors to relevant base conditions and aid in identifying substantial shifts. An NRE survey for participants is an additional tool that can be helpful for assessing changes to static factors.	
12	Evaluators might be underestimating the benefits of the SEM program since they cannot consider the longer-term impacts.	A significant belief or hypothesis underlying the SEM program is that changing the organizational culture for energy management will increase the likelihood that the behaviors and evaluated savings will persist and additional savings identified. We could not thoroughly test this in Cycle 1, given the longer-term nature of cultural change. However, that 82% of the participants in Cycle 1 have decided to participate in Cycle 2 presents an excellent opportunity to assess any additional changes in the organizational culture, the persistence of savings verified in Cycle 1, and the identification of additional opportunities to reduce energy use.	We recommend assessing the cumulative effect of the SEM program over several years since it is a rare opportunity to evaluate the Program's longer-term impacts. A primary goal of this research should be to better understand persistence and EUL of SEM.	Evaluation
13	While the implementers submitted logic models, they were inconsistent in some cases, and incomplete. The logic models also lacked an accompanying narrative that explains how specific actions lead to certain outcomes.	Developing a logic model and an accompanying narrative explaining why specific actions lead to certain outcomes is critical for such a complex program as SEM. The underlying theories can be based on social science and engineering principles or simply on past evaluations of what works and for which populations (i.e., "practical" program theories). In a statewide program involving multiple implementers, a collaboration between implementors to develop a single logic model and underlying narrative is essential. In addition, it is also critical that the evaluators and implementers	PAs should develop a statewide SEM program logic model and an underlying narrative based on social science theories and engineering principles or past evaluations of what works and for which populations (i.e., "practical" program theories). In addition, evaluators and implementers should agree on the key performance indicators early in the Program's life and map them into the various links of the logic model.	Evaluation

RecID	Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
		agree on the key performance indicators early in the life of the Program and map them into the various links of the logic model		
14	Support Evaluation Recruitment	The survey team asked energy team members to participate in a survey. They received a low response rate on this request.	PAs should remind participants that they must participate in multiple research efforts to estimate project savings as part of their program-participation agreement. The CPUC should consider stricter rules to ensure that customers meet this obligation.	Evaluation
15	Share working energy models with live calculations and all data processing	When PIs, PAs, and evaluators share energy models for review, these should be working models with live calculations.	Raw data processing must be transparent and repeatable. Energy data, meter numbers, on-site generation, and production data must be accurate and consistent between model files and written reports. Section 5 in the Industrial SEM M&V Guide defines data collection protocols, including documentation of sources and processing.	Evaluation
16	SEM participants missing in claims dataset	Many claims for SEM participants were missing in a given program year dataset. PAs presented various reasons for why claims were not in CEDARs. The following reasons summarize all instances of a missing claim: 1. M&V was not completed within the deadline for program year entry. 2. Energy savings result were zero. The PA decided not to enter a claim. 3. The M&V method failed. The energy savings result was unknown and assumed zero for the reporting period. In a subsequent year, the implementor changed the M&V method to quantify savings. The PA decided not to enter a claim. 4. Energy savings result were negative, and the PA decided not to enter a claim. Missing claims affects an	To aid in impact evaluation and thoroughly document participant results, PAs should be required to enter a claim for all SEM participants each program year. Evaluators expect to see a claim for each participant even if the result is no savings.	Reporting

RecID	Summary of Findings	Additional Supporting Information	Best Practice / Recommendations / Recipient	Category
		evaluator's ability to sample claims properly.		
17	Quantify and claim demand savings for all SEM projects	PAs inconsistently claimed demand savings across program years. All SEM project claims with electric energy savings should include demand savings.	We recommend that demand savings are quantified and claimed for all SEM projects. A demand savings calculator was developed and proposed by the evaluation team during the Group D contract. We recommend that the IOUs take ownership of that tool, continue improving it, and support claiming demand savings.	Reporting
18	Use correct EULs for SEM projects	Some claims entered by PAs had an EUL of 1 year for SEM projects.	PAs should ensure that EULs are assigned appropriately at 5 years.	Reporting
19	Standardize claim entries statewide	We observed variation in claims data entry from one PA to another and within PA claims. We found gross savings for SEM claims to be the product of two fields in CEDARS claims. For example, the first baseline kWh savings are "NumUnits" and "UnitkWh1stBaseline.x". Similar fields are available for therms, kW, and 2nd baseline.	We recommend that CPUC provide more specific guidance to the PAs to standardize claim entries. The preferred method would be to use a value of "1" in "NumUnits" and the unit value of savings in each savings-specific field. However, some PAs include multiple claim entries (one for each fuel) and use the "NumUnits" field to enter the unit value of savings, then putting a 1 in "UnitkWh1stBaseline.x".	Reporting
20	The evidence provided by some implementers of any increases in knowledge and awareness as a result of the workshops is weak.	Leidos administered a brief competency test at the conclusion of each workshop, but none of the other implementers did.	Administer a competency text at the conclusion of each workshop similar to the ones developed by Leidos. Coordinating this effort among the different implementers will ensure consistency in terms of the material covered, number of items on the test, and the degree of difficulty.	Workshops

B. Sample Strata

The table in this appendix documents the characteristics of the selected and completed sample by stratum. The sample was developed based on PA estimates of combined MMBtu savings for each site prior to the savings results were known. This unique sample design was required to support the Early Feedback SEM deliverable.

Table 52: Sample Strata - Counts, Bounds and Claimed Savings

Stratum Description	Project Counts					PA-Estimated Combined Savings (MMBtu)		
	All	Sampled		Completed		Stratum Bounds		Stratum Total
		Gross	Net	Gross	Net	Lower	Upper	
Early Feedback-Low	7	5	5	5	5	1,390	5,870	20,970
Early Feedback-Med	6	5	5	5	4	5,870	10,060	48,363
Early Feedback-High	5	5	5	5	5	10,283	21,033	71,279
No Early Feedback-Low	7	5	5	5	4	1,390	4,310	17,130
No Early Feedback-Med	5	5	5	5	4	4,310	8,780	30,700
No Early Feedback-High	5	5	5	5	4	9,283	16,033	66,656
Total	35	30	30	30	26	1,390	21,033	255,098

C. Statistical Estimation Procedures

This section summarizes our gross and net evaluation statistical estimation methods and our application of the results of sampled site-level evaluations to the estimation of SEM impacts for each PA and statewide.

C.1 PA and Statewide Impacts

We estimated evaluated program impacts based on the gross and net savings estimates calculated from the random sample of 30 projects. Our primary savings metric was MMBtu, but savings were also reported in their original fuels.

C.1.1 Gross Savings

The sample was divided into two domains, the *early-feedback* domain (N=19) and the *no-early-feedback* domain (N=18). From each of these two domains, we drew a stratified random sample of 15 projects. We estimated life-cycle gross MMBtu, kWh, kW and therm savings at the statewide and PA levels using stratified mean estimation.[45] While we designed the sample with the expectation of reporting savings and NTGRs at the domain level, this proved to be unnecessary and impractical because of the way the feedback was implemented. Nevertheless, since we sampled this way, we also calculated the mean savings this way. In addition, the initial sampling was done over three savings strata that were based on initial guesses by the PAs of how large the savings from each site would be. This translated to 6 strata (3 savings strata × 2 feedback conditions).

For the stratified mean gross savings estimation method, the basic steps are as follows:

1. Mean savings for each stratum, claimed and evaluated uses Equation 1.

$$\bar{y}_{st} = \sum_{h=1}^{L} W_h \bar{y}_h \quad (1)$$

where:

W_h = $\frac{N_h}{N}$ which is the stratum weight

N_h = population of stratum h

N = population of group

$\bar{y}_h$ = the mean of y for stratum h

$\bar{y}_{st}$ = the mean resulting from a stratified random sample (*st* for *stratified*).

2. Total savings overall, for each PA, for each fuel type, and statewide) uses Equation 2.

$$\hat{Y} = N \times \bar{y}_{st} \quad (2)$$

3. Variance of the reporting unit mean, s^2, uses Equation 3.

$$s^2(\bar{y}_{st}) = \sum_{h=1}^{L} \frac{W_h^2 s_h^2}{n_h} - \sum_{h=1}^{L} \frac{W_h s_h^2}{N} \quad (3)$$

[45] Cochran, William G. (1977). Sampling Techniques. New York: John Wiley & Sons.

where:

s_h^2 = the stratum variance and n_h is the stratum sample size.

The second term in the equation represents the finite population correction.

4. Relative precision of the reporting mean at 90% confidence uses Equation 4.

$$RP = \frac{1.645 \times s\bar{y}_{st}}{\bar{y}_{st}} \quad (4)$$

where:

$s_{\bar{y}_{st}}$=the standard error of the stratified mean

A Gross Realization Rate (GRR) was calculated for each PA and fuel using the extrapolated evaluated and forecast savings in MMBTU. The overall population N was ultimately 35 rather than 37 because two sites dropped out of the program before Cycle 1 was completed.

The workplan called for using Equations 5 through 7 to provide the relative precision of the PA and statewide estimates. However, as we describe here, we changed our approach as we got into the details of the actual analysis.

$$EB_{Domain} = RP_{Domain} \times \hat{Y}_{Domain} \quad (5)$$

For estimating the RP for the realization rate at the statewide level, the domain error bounds (EB Domain), were to be propagated across both domains to the statewide level using Equation 6, with RP calculated as Equation 7.

$$EB_{Statewide} = \sqrt{(\text{EB Domain}_1)^2 + (\text{EB Domain}_2)^2} \quad (6)$$

$$RP_{Statewide} = \frac{EB_{Statewide}}{\text{Gross } Savings_{Statewide}} \quad (7)$$

Our revised approach to estimating the relative precision of our estimates was to calculate a GRR at each level of analysis (PA, Fuel, SW) by dividing the sample-based mean evaluated savings estimate by the sample-based mean forecast savings, and calculating the variance by Equation 8, and the RP by Equation 9.

$$\hat{R} = \frac{\sum y_i}{\sum x_i} \quad (8)$$

where

$\hat{R}$ = ratio of ex post to ex ante savings

y_i = ex post or evaluated savings for site i

x_i = ex ante or forecast savings for site i

The variance of the ratio is estimated by:

$$v(\hat{R}) = \frac{(1-f)}{n\bar{x}^2}(s_y^2 + \hat{R}^2 s_x^2 - 2\hat{R}s_{yx}) \quad (9)$$

where:

$\hat{R}$ = The GRR

F = The sampling fraction

N = The size of the sample

s_x^2 = Variance of the sample forecast savings estimate

s_y^2 = Variance of the sample evaluated savings estimate

s_{yx} = covariance of x and y (forecast and evaluated sample savings)

The relative precision for this GRR is calculated:

$$RP_{GRR} = \frac{1.645 * se_{\widehat{R}}}{\widehat{R}} \quad (10)$$

where:

$$SE_{\widehat{R}} = \sqrt{v\left(\widehat{R}\right)} \quad (11)$$

5. The GRRs were applied to all forecast savings in each PA and fuel to produce evaluated savings in MMBTU.
6. Evaluated and forecast savings were summed over PAs to calculate a statewide GRR and total evaluated gross savings.
7. Savings calculated in MMBtu savings were then translated into their original fuels

C.1.2 Net Savings

We calculated the life-cycle gross savings-weighted NTGR using the self-report approach at the statewide and PA levels along with their respective relative precisions. We did not use a stratified means approach because none of the strata developed for gross savings estimates were correlated with NTGR. In addition, we interviewed and calculated NTGRs for all sites we could recruit after losing some to dropouts and pre-tests. We did, however, weight the NTGR by evaluated lifecycle gross savings and calculated the standard error, using Equations 12, 13, and 14.

$$s^2 = \frac{\left(\sum_{i=1}^{n} w_i (X_i - \bar{X})^2\right)}{\left(\frac{n-1}{n}\sum_{i=1}^{n} w_i\right)} \quad (12)$$

$$s = \sqrt{s^2} \quad (13)$$

$$se = s/\sqrt{n} \quad (14)$$

The relative precision of the NTGR was calculated as Equation 15.

$$RP_{ntgr} = \frac{1.645 * se_{ntgr}}{\overline{ntgr}} \quad (15)$$

D. Research on Effective Useful Life for SEM Programs

sbw
ENERGY + WATER + EFFICIENCY

Memorandum

FROM: Nick O'Neil and Chris Smith (Energy 350)
TO: Lisa Paulo, CPUC
DATE: May 7, 2021
RE: Research on Effective Useful Life for SEM Programs

Overview

This memo provides a summary of secondary research conducted to determine an appropriate Effective Useful Life (EUL)[46] for industrial Strategic Energy Management (SEM) programs[47] operating under CPUC purview. EUL studies are typically conducted by evaluating the persistence of measures over the years following their completion. Since the California SEM programs are quite new, primary EUL research is not yet practical, since the measures were recently completed.

Instead, we looked to the body of research that has been conducted on SEM EUL nationally, with a focus on industrial programs that have been operating for several years. This memo summarizes our literature review and associated SEM EUL findings.

Summary of Findings

To estimate an appropriate EUL for industrial SEM programs operating under CPUC purview, we researched findings from several published evaluation reports listed in the references section below. The Northwest SEM Collaborative recently published a document outlining the numerous SEM evaluation studies conducted over the last decade and current program estimated EULs. Multiple evaluations listed in the summary document evaluated SEM program energy savings using a bottom-up analysis[48] of individual measures. Though this method of evaluating energy savings can be very accurate, it is often difficult to use when determining persistence of savings directly associated with those measures. This is due to the demands of conducting post-engagement site visits and measure level data collection efforts. Additionally, it can be costly to obtain a reliable estimate of persistence across a larger sample of sites. Therefore, other more cost-effective methods of estimating industrial SEM persistence have been utilized by programs seeking to determine reliable EUL estimates, such as

[46] EUL is the estimate of the median number of years that the measures, technologies, or practices installed under the program are still in place and operable (retained).

[47] SEM is a holistic program that supports industrial facilities in making energy management part of their business culture. SEM is a long-term approach that provides training, technical support and incentives to industrial customers to improve the efficiency of their facilities and operations and assist them in maintaining that efficiency.

[48] Bottom-up analysis refers to the calculation of energy savings through engineering principles and calculations for each of the identified and implemented measures. This method is useful when whole facility energy modeling provides inadequate analysis and when sufficient data is available for the implemented measures.

literature reviews and post-engagement interviews. The table below summarizes several recent EUL persistence studies identified by the SEM Collaborative and the methodologies used in each.

Evaluation	Primary SEM EUL Persistence Method	Methodology Detail	Sample Size	Results
Energy Trust of Oregon: Persistence of O&M Energy-Efficiency Measures	Literature review	Literature review of common O&M measures and associated EULs, ranked by potential for human interference. Compared against O&M program verifications	68 measures	Reviewed program document and data and performed a literature review to assess the reasonableness of the three-year measure life used for O&M (and SEM) up until 2020. Found that in separate O&M verifications, 95% remained 2.5 years after implementation, suggesting that EUL is longer than 3 years.
Energy Trust of Oregon: Production Efficiency Strategic Energy Management Evaluation Final Report	Participant interviews	Interviews and site visits sampled from 2010 – 2013 SEM participants (n=46)	80 measures	89% of activities (71 of 80) asked about during the interviews were still in place between 2 - 6 years after participants' SEM engagements
Energy Trust of Oregon: Industrial O&M Persistence Study - Program Years 2010-17	Participant interviews followed by survival analysis (Kaplan-Meier)	Reviewed activities from largest projects to understand actions taken. Participant interviews deduced whether activity persisted, and if not, then evaluator estimated persistence. Program EUL estimated using Kaplan-Meier survival analysis.	252 measures, 75 participants	This study supports a 7-year measure life for O&M and SEM (including both gas and electric savings). No statistically significant differences in estimated measure life for standalone O&M and for first year and continuous SEM.
Bonneville Power Administration: Industrial Strategic Energy Management (SEM) Impact Evaluation Report	Regression analysis	Tracked savings of sites participating for 3- or 4-years during engagement period through MT&R.	9 facilities with 3 years of savings, 13 facilities with 4 years of savings	Overall, SEM savings as percentage of consumption in HPEM facilities appeared to persist over the first 3 or 4 program years. Evaluation did not find evidence that annual savings decayed over time.
CPUC: Energy Efficiency Potential and Goals Study for 2018 and Beyond (SEM EUL based on 2016 AEP Ohio SEM evaluation)	Whole building data collection	Collected 3 years of data usage for multi-year participants. Looked at savings trends for 30-40 customers.	30-40 customers	Found persistence to be between 4-5 years. Found models underestimated savings due to not perfectly aligning with changing operation over time. Claiming an EUL of 5 years for the program.

As seen in the table above, several evaluations rely on post-engagement interviews with facility staff regarding their energy management practices, goals and action plans, and which O&M measures and practices were still in place to estimate EUL. Results from these studies compared and contrasted findings from a sample of non-participant sites that received standalone O&M measures to determine the impact SEM had on measure persistence. The SEM Collaborative's review of these evaluation studies indicates a range of EUL estimates that are influenced by the type of SEM program being

provided, the duration of the engagement, and the target focus of the engagement. A comparison of programs included as part of the SEM Collaborative's literature review and the differing characteristics of each program are shown in the table below.[49]

Program Name	EUL (years)	Target Market Segments	Target Facility Size	Engagement Length (years)	Options for Multiyear Engagements
BC Hydro - SEM Cohort	5	Industrial – All Segments	4-20 GWh/yr consumption	2	Yes
BPA - High Performance Energy Management (HPEM)	6	Industrial and Municipal Water/ Wastewater	Cohort based: >= 4 GWh/yr average, 2 GWh/yr minimum per site	5	Required
Energy Trust of Oregon - SEM	7	Industrial – All Segments	$50k eligible energy spend8	1	Yes
Puget Sound Energy - Industrial SEM (I SEM)	3	Industrial	Greater than 3 GWh/yr/ site	3	Yes, up to 3

Several evaluated SEM programs offered an option of either first-year and/or continuous SEM engagements. Our findings from reviewing the Collaborative's document, as well as the individual evaluation studies, show that currently most Pacific Northwest utilities operate SEM programs with a minimum two-year engagement period, as well as offer additional multi-year options. This shift to a minimum two-year engagement period is in part due to findings from studies that indicate savings persist longer at facilities that invest in training to better engrain energy management practices into businesses. A two-year minimum engagement period allows more time to train staff and dedicate internal resources to saving energy, leading to an increased persistence of savings. Interviews conducted by evaluators across several Northwest programs found SEM cohorts that went through multi-year engagements showed a high percentage of energy-saving activities continuing past the initial engagement period. [50] This was the case for NEEA's Commercial Real Estate initiative, NEEA's Hospital and Healthcare initiative, Energy Trust of Oregon's Industrial SEM program, and BPA's Industrial SEM program. Furthermore, BPA's Industrial SEM program specifically evaluated facilities over a 3–4-year engagement period and found that savings and persistence of those savings increased throughout the engagement period. While only a sample of twenty-one sites, this finding suggests that a longer engagement period could lead to longer persistence of savings.

California SEM programs are similar to the programs currently operating in the Northwest in that they require a mandatory two-year engagement period with the option to extend further. Given the similar program design, we expect similar persistence levels from California programs where efficient practices are given more time to become engrained into a company culture.

Because O&M measures often comprise a large share of SEM activities, utility programs have conducted numerous evaluations to study the persistence of these activities across a variety of end-

[49] Importantly, several programs offer a choice of engagement period which effects the associated EUL. BPA's HPEM program for example claims a 1-year EUL for the first several years of engagement and then claims a 6-year EUL for measures implemented during the 5th year of engagement.

[50] The initial engagement period refers to the period of time with utility was actively involved with the site. For single year engagements that is one-year, and for multi-year engagements that is commonly 2-years but can also be 3, or 4 years.

uses. While O&M measures such as control system setpoint adjustments, compressed air leak repair, coil and filter cleaning, and optimization/sequencing changes can experience low persistence, evaluations show that most often low persistence is caused by the potential for humans to override adjustments. Therefore, SEM programs, which encourage sites to develop and execute goal setting and planning, and where there is focused training with a commitment to the ongoing process, can realize increased persistence through more holistic changes to Standard Operating Procedures, maintenance and work practices, and more permanent efficiency solutions. We found that a review of BPA's Industrial SEM program showed participants increased savings throughout the 3–4-year participation period in large part because of the focus SEM had on good O&M practices, training, and long-term planning. This suggests that facilities are likely to continue energy management practices beyond the initial SEM engagement period, supporting the notion that persistence is higher for O&M measures when done through the more holistic approach of SEM rather than standalone. Furthermore, BC Hydro's SEM cohort program claims a five- year measure life if a Sustainment Plan is employed at the site. This plan features guidelines on energy management best practices and Standard Operating Procedures (SOPs) that BC Hydro has found assist in sustaining real energy savings over time.

Since multi-year SEM programs were still relatively new only several years ago, programs previously aligned EUL assumptions with O&M measures as a conservative way to arrive at likely savings without assuming too much risk. Ongoing evaluations of longer-tenure programs offering a continuous engagement style of SEM, such as those administered by Energy Trust of Oregon and BPA, have resulted in increasing EULs from three years to five years. More recently, the Energy Trust of Oregon increased their EUL estimate to seven years for Industrial SEM cohorts after conducting a survival analysis demonstrating that at least 50% of energy savings activities were still active 6-7 years after they were first initiated.

While the SEM Collaborative document contains a long list of EUL reports and program evaluations, the table below summarizes key studies and their supporting evidence for deriving a program EUL estimate.

Report name	EUL Estimate	Supporting Evidence
CPUC - Energy Efficiency Potential and Goals Study for 2018 and Beyond	5 years	Strategic Energy Management is a long-term continuous improvement process that educates and trains business energy users to develop and execute long-term energy goal setting and strategic planning; and to integrate energy management into business practices throughout the organization, from the corporate board office to the boiler room and the work floor. Relied on primary data collected over 3 years for 30-40 customers enrolled in AEP Ohio's CEI program. Findings based determination of savings degrading to 50% of what was realized in year 1 which was projected to be 4-5 years.

Report name	EUL Estimate	Supporting Evidence
BPA Industrial Strategic Energy Management (SEM) Impact Evaluation Report	3 or 6 years depending on engagement length51	The evaluation team tracked the energy savings of sampled HPEM facilities that participated for three or four years. Facility savings increased throughout the participation period and SEM savings persisted after the first year and increased slightly in the last year. This persistence of savings suggests that facilities continued to practice energy management activities throughout the engagement. Overall, SEM savings as percentage of consumption in HPEM facilities appears to have persisted over the first three or four program years. We did not find evidence that annual savings decayed over time.
Energy Trust of Oregon: Industrial O&M Persistence Study - Program Years 2010-17	7 years	The results show that the current 3-year measure life assumed for tracked O&M measures underestimates the total value of the energy efficiency savings acquired by the program and that most actions completed since 2010 continue to provide savings today. DNV GL's analysis supports the use of a 7-year measure life for these measures (both gas and electric) in the future.
BC Hydro - DSM STANDARD Effective Measure Life and Persistence – Revision 11	5 years	ECM "SEM Cohort Model - Operational/Behavioral Measures Supported by Formal Sustainment Plan" is providing support for the energy savings projects implemented through the SEM Cohort program. This ECM is supporting the savings claim made at the end of year 2 of the Cohort agreement, and has a 5-year assigned persistence, ensured by the formal sustainment plan. Note the sustainment plan features guidelines on energy management best practices and Standard Operating Procedures (SOPs) to sustain real energy savings over time.

Conclusions

Based on our review of process and impact evaluation reports, as well as persistence studies on several Industrial SEM programs throughout the country, we find a 5-year measure life to be well supported by primary research conducted by similar programs. This conclusion is supported by these key findings from across several evaluation studies:

- Evaluation studies point to persistence being higher at sites where there is a high degree of training and commitment to the ongoing commissioning process, similar to what an SEM cohort would undertake.[52,53]
- Multi-year SEM engagements, such as the California SEM programs, have been shown to lead to more persistence of O&M measures.[54,55]
- Follow-up interviews with site participants indicate a high percentage are likely to develop efficiency projects after the engagement period concluded, lending strength to the persistence of savings even after an SEM engagement ends.[56]

[51] Similar to other programs that claim savings after each year of the engagement, BPA's SEM program offers different engagement lengths and therefore different EUL estimates are associated with those periods. BPA utilities that choose to offer a 3-year engagement use EUL estimates of : 1, 1, 3. BPA utilities that choose to offer a 5-year engagement use EUL estimates of : 1, 1, 1, 1, 6, suggesting that savings implemented in the final year continue to persist for 6 years.

[52] *BC Hydro DSM Standard Effective Measure Life and Persistence – Revision 11, March, 2019*

[53] *NEEA Hospitals and Healthcare Initiative: MPER 6. July 2, 2014. Evergreen Economics and SBW*

[54] *Ibid.*

[55] *Energy Trust Production Efficiency Strategic Energy Management Evaluation Final Report, February 28. 2019, The Cadmus Group*

[56] *BPA Industrial Strategic Energy Management (SEM) Impact Evaluation Report, February 2017, SBW & The Cadmus Group*

- Many SEM activities include operations and maintenance fixes, which have been shown to demonstrate an EUL of five years and longer when part of an SEM program compared to a stand-alone implementation.[57]
- Program Administrators that have been running SEM programs for several program cycles are increasing their EUL estimates based on evaluated persistence findings.[58]

These findings suggests that industrial SEM programs operating in the Pacific Northwest, which are 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.

References

The NW SEM Collaborative compiled a list of known evaluation reports and EUL assumptions for Northwest programs. This list is the first reference here. In addition, we listed several notable evaluation reports that were found to closely align with how industrial SEM programs currently operate in California.

- Effective Useful Life of Industrial SEM Programs: Northwest References and Resources, 2020. SEM Collaborative

  https://semhub.com/assets/resources/NW_SEM_Collaborative_MV_WG_Measure_Life_Doc_2020.pdf

- Energy Trust of Oregon: Industrial O&M Persistence Study- Program Years 2010-17. April 28, 2020. DNV GL

  https://www.energytrust.org/wp-content/uploads/2020/04/DNVGL_2019_Persistence_Study_Report_FINAL-w-SR.pdf

- NEEA Hospitals and Healthcare Initiative: Market Progress Evaluation Report 6. July 2, 2014. Evergreen Economics and SBW Consulting, Inc.

  https://neea.org/resources/neea-hospitals-and-healthcare-initiative-market-progress-evaluation-report-6

  BPA Industrial Strategic Energy Management (SEM) Impact Evaluation Report, February, 2017, SBW Consulting, Inc. & The Cadmus Group

  https://www.bpa.gov/EE/Utility/research-archive/Documents/Evaluation/170222_BPA_Industrial_SEM_Impact_Evaluation_Report.pdf

  CPUC Energy Efficiency Potential and Goals Study for 2018 and Beyond. August 23, 2017. Navigant

  https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M194/K614/194614840.PDF

[57] *Energy Trust of Oregon Persistence of O&M Energy-Efficiency Measures, October 19, 2017, DNV-GL*

[58] *Energy Trust of Oregon: Industrial O&M Persistence Study - Program Years 2010-17. April 28, 2020. DNV GL*

BC Hydro DSM STANDARD Effective Measure Life and Persistence – Revision 11, March, 2019

https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/reference-documents/F20_F21_RRA_BCUC_1_178_01_LES_01.pdf

PSE Industrial Systems Optimization Program Evaluation Report. 2017. DNV-GL

https://conduitnw.org/Handlers/conduit/FileHandler.ashx?RID=4118

E. Methods Related to Estimating Program Attribution

The methods used to assess program attribution differed somewhat from those presented in the Industrial SEM workplan. The major changes were as follows:

- We did not estimate NTGRs separately for BROs and capital equipment.
- We did not estimate NTGRs separately for early-feedback groups and non-early feedback groups.

E.1 Methods for Estimating Net Savings

Decision 16-08-019 calls for a default NTGR of 1.0 to apply to SEM projects when program influence is evident. The CPUC considered this NTGR of 1.0 to be a placeholder until program influence could be empirically investigated, which is the goal of our net analysis. However, the Industrial SEM program is far more complex than the standard down-stream rebate programs, since it involves multiple actors engaged in a variety of activities combined to produce the desired short-, mid-, and long-term impacts. Given this, we have concluded that relying solely on the traditional approach to estimating program influence is not appropriate and that a *theory-driven evaluation* using a preponderance of evidence (Davidson 2000) would be more effective in assessing program influence. *Note that this theory-driven estimate of program influence was designed to cover both reporting periods*.

The traditional self-report NTGR will be produced but embedded as one additional input into the more comprehensive theory-driven approach. We begin by describing the self-report approach followed by the theory-driven approach.

E.1.1 Self-Report Approach

In this section, we present the framework for estimating the NTGR, how we addressed the fact that participants adopted/installed more BROs (O&M changes) and capital measures than participants in traditional custom programs, and the targeted level of confidence and precision. This NTGR evaluation was designed to cover both SEM reporting periods.

The method used to estimate the NTGR is referred to as the California self-report approach (CA-SRA).[59] The CA-SRA involves asking one or more key participant decision-makers a series of closed and open-ended questions about their motivations for installing the energy-efficient (EE) equipment, about whether they would have installed the same EE equipment in the absence of the program, to establish the temporal sequence of program awareness relative to taking energy efficiency actions, as well as questions that attempt to rule out rival explanations for the action.[60] In the simplest case (e.g., residential customers), the CA-SRA is based primarily on quantitative data while, in more complex cases in the nonresidential programs such as the SEM program, the CA-SRA is strengthened by the

[59] To understand the place of the self-report approach in the social science literature, see Ridge et al. (2009).

[60] Scriven, Michael. 1976. "Maximizing the Power of Causal Explanations: The Modus Operandi Method." In G.V. Glass (Ed.), Evaluation Studies Review Annual (Vol. 1, pp.101-118). Beverly Hills, CA: Sage Publications; Yin, Robert K. 1994. *Case Study Research: Design and Methods*. Thousand Oaks, CA: SAGE Publications; Donaldson, Stewart I, Christina A. Christie and Melvin Mark (Eds.) 2009. *What Counts as Credible Evidence in Applied Research and Evaluation Practice?* Los Angeles, CA: SAGE.

inclusion of additional quantitative and qualitative data which can include, among others, in-depth, open-ended interviews, direct observation, whether competing demand side technologies were either already installed or installed during the program period, and review of customer and program records. Many evaluators believe that additional qualitative data regarding the economics of the customer's decision and the decision process itself can be very useful in supporting or modifying quantitatively based results.[61]

Throughout, we also adhered to the "Guidelines for Estimating Net-To-Gross Ratios Using the Self-Report Approaches" and the "Methodological Framework for Using the Self-Report Approach to Estimating Net-to-Gross Ratios for Nonresidential Customers," both developed for the Energy Division of the California Public Utilities Commission.

For all sites, the NTGR, which we call the Core NTGR, was first calculated using survey responses from the energy champion, the person who was most consistently involved in the decision to install the efficient equipment and/or make O&M changes. We included the Energy Champion questionnaire in Appendix F. We then collected and analyzed additional quantitative and qualitative data, sometimes resulting in adjustments, either upward or downward, to the Core NTGR resulting in the Adjusted NTGR.

In developing the Core NTGR methods and questionnaire, we drew on lessons learned from the most recent evaluations of the 2018 custom program in California, as well as SEM programs in other regions.[62] Using a draft of the enhanced NTGR questionnaire that reflected the unique characteristics of the SEM program, we conducted cognitive interviews[63] with two of the seven participants who were not included in the evaluation sample. We provided an incentive of $500 to each for completing the telephone interview. The primary objective of these cognitive interviews was to minimize measurement error by improving the clarity of the survey questions, particularly for counterfactual questions, so that they are correctly interpreted by those survey respondents who take the final version of the survey.

These cognitive interviews yielded some important insights and improvements in the design of the questionnaire and the training of the interviewers. Based on these cognitive interviews, we modified the original questionnaire. We then pretested the draft final questionnaire to ensure that the survey length was not onerous, that the question length and order were correct, that the wording was clear, and that skip logic and consistency checks were functioning correctly. This resulted in a few more useful changes before the questionnaire was finalized.

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61 Tashakkori, Abbas and Charles Teddlie. 1998. *Mixed Methodology: Combining Qualitative and Quantitative Approaches*. Thousand Oaks, CA: SAGE Publications.

62 For example: Itron, Opinion Dynamics, and Michaels Energy. (2016). *ComEd and Nicor Gas Strategic Energy Management (SEM) Evaluation Report*. Prepared for the Commonwealth Edison Company; NEEP. (2017). *Evaluation Measurement & Verification (EM&V) Best Practices & Recommendations for Industrial Strategic Energy Management Programs*; DNV-GL. (2016). *Impact Evaluation of Commercial Strategic Energy Management*. Prepared for the Energy Trust of Oregon; Stewart, James. 2017. *Chapter 24: Strategic Energy Management (SEM) Evaluation Protocol*. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68316. http://www.nrel.gov/docs/fy17osti/68316.pdf; PWP and Evergreen Economics. (2017). *Current Methods in Free Ridership and Spillover Policy and Estimation*. Prepared for the Energy Trust of Oregon.

63 See Willis, Gordon B. (2015). *Analysis of the Cognitive Interview in Questionnaire Design*. New York: Oxford University Press; Biemer, Paul P., Robert M. Groves, Lars E. Lyberg, Nancy A. Mathiowetz, and Seymour Sudman. (2004). *Measurement Error in Surveys*. Hoboken, NJ: John Wiley & Sons.

The final questionnaire assessed the influence of the following program factors:

- Technical support and information provided by the energy coach
- Availability of the program milestone and performance incentives
- Information provided through the energy treasure hunt
- Training or information provided in program workshops and peer-to-peer meetings
- The energy management assessment (EMA)
- Assistance in development of an energy management information system (EMIS)
- Recommendations from the energy team
- Support from the executive sponsor

To address other competing hypotheses for actions taken by participants, we also included a number of non-program factors such as:

- Previous experience with similar types of O&M and/or equipment changes
- Standard practice in participant's business/industry
- Recommendation by participants' utility account representative
- Participant's pre-existing corporate policies or guidelines that support sustainable energy reductions

We used the following three scores to calculate the core NTGR.

- **Program-attribution index 1 (PAI-1) score, which reflects the influence of the most important of various program and program-related elements in the customer's decision to adopt O&M changes and/or install capital measures.** It is based on the highest rating for a program influence divided by the sum of the highest rating for a program influence plus the highest rating for a nonprogram influence**.**
- **Program-attribution index 2 (PAI-2) score,** which captures the perceived importance of the program (whether milestone and performance incentives, recommendations, training, or other program interventions) relative to nonprogram factors in the decision to implement the specific measure that was eventually adopted or installed. We will determine this score by asking respondents to assign importance values to both the program and the nonprogram influences so that the two total to ten. We adjusted the program-influence score (i.e., divided by 2) if respondents say they had already made their decision **to adopt O&M changes and/or install capital measures** before they learned about the program.
- **Program attribution index 3 (PAI-3) score,** which captures the likelihood that they would have **adopted the same O&M changes and/or installed the same capital measures** if the program had not been available (the counterfactual). The PAI 3 score is calculated as 10 minus the likelihood of **adopting the same O&M changes and/or installing the same capital measures**.

We calculated the core NTGR as the average of these three program attribution index scores.

However, given the inherent complexity of SEM Projects, we embedded this traditional method in the broader methodological framework of the theory-driven evaluation and used it along with the data

provided by the SEM Implementers, the Energy Coach, the Executive Sponsor, the Energy Champion, members of the Energy Team and the gross savings estimation team to test the various causal linkages in the SEM logic model thereby providing an overall assessment of program influence in the short, intermediate and long term. To be clear, this NTGR, which captures the influence of the program from the perspective of the participants, will be just one of the inputs for assessing the overall efficacy of the SEM program.

One important task was to determine which actions would be addressed in the NTGR interviews. The actions that fall into the SEM category are many and varied, including both O&M changes and capital equipment actions. Asking about each one would be much too burdensome on the interviewee. In our experience, we can ask questions and get meaningful engagement with the respondent for about three actions. Given this, we had originally planned to randomly sample up to two O&M changes and two capital measures within each SEM project. However, during the cognitive interviews, we discovered that the participant's decision-making process was essentially the same for all actions taken within the O&M change category. We found essentially the same thing for all installations of capital measures. However, we discovered that the decision-making process was sometimes different for the group of O&M changes versus the group of capital measure installations. This meant that we could ask the NTGR battery of questions once covering all the O&M changes and once more covering all the capital measures, which significantly reduced the length of the interview and participant burden.

Before beginning the interview, we listed only those actions that had been verified by our team as having been completed by the end of the first reporting period and were listed on the opportunity register for the second reporting period.[64] To shorten this list and make it more manageable, the gross team grouped all actions that clearly pertain to the same piece of equipment or process. In some cases, actions listed in the opportunity register were distinct from others on the list, while other items in the register could be called multiple micro-actions taken on the same piece of equipment or process. We would not want to treat each micro-action on its own; they should be considered as a unified group that reduces the energy use of the equipment or process.

For the estimation of the self-report NTGR, we targeted the 90/10 level of confidence and precision at the statewide and PA levels.

E.1.2 Theory-Driven Evaluation

The SEM program involves a diverse group of actors including the Energy Coach, Executive Champion, Energy Champion, members of the Energy Team, IOU account representatives and interacting with energy-using technologies on a regular basis to identify and achieve sustainable energy savings. The relationships among these actors are complex, and the program is expected to extend over multiple years in a turbulent economic and social environment. These factors combine to make the assessment of program attribution for the SEM program similarly complex and uncertain.

[64] Normally, we would have waited until the gross evaluation team had verified the actions on the opportunity register. However, given that nearly 100% of the measures listed on the opportunity register covering the first reporting period were verified by the gross savings team, we were confident that, during the interview, we could list the unverified actions on the opportunity register covering the second reporting period as verified. This also meant that we would not have to wait until the gross savings team to verify the SEM actions before we could begin data collection. This turned out to be very important given the tight schedule.

Traditional evaluation approaches, which typically estimate net savings that have been achieved over a relatively short period of time, are not equipped to address such complex situations that extend over multiple years involving multiple actors. For a multi-layered program such as the SEM program, plausible causal mechanisms must be identified, and related hypotheses tested to build a case for attribution. This challenge requires a very different evaluation approach.

A theory-driven evaluation[65] is well suited to evaluate such programs,[66] [67] and has been used in previous evaluations of California energy efficiency and emerging technology programs.[68] Coryn defines theory-driven evaluation as "…any evaluation strategy or approach that explicitly integrates and uses stakeholders, social science, some combination of, or other types of theories in conceptualizing, designing, conducting, interpreting, and applying an evaluation".[69] Rogers (2000) has asserted that the key advantages of theory-driven strategies are that '' ... at their best, theory-driven evaluations can be analytically and empirically powerful and lead to better evaluation questions, better evaluation answers, and better programs'' (p. 209) ... [and they] ...''can lead to better information about a program that is important for replication or for improvement, which is unlikely to be produced by other types of program evaluation.'' (p. 232).

Coryn systematically examined 45 cases of theory-driven evaluations published over a twenty-year period to ascertain how closely theory-driven evaluation practices comport with the key tenets of theory-driven evaluation as described and prescribed by prominent theoretical writers. One output

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65 Donaldson (2007) notes that it is highly desirable if a program theory is rooted in, or at least consistent with, behavioral or social science theory or prior research. However, he notes that there are situations where sound theory and/or research is not always available. In such cases, other sources of information can be used to develop a program theory, including observations of the program in action and documentation of program operations. Wholey (1987) says that program theory identifies " . . . program resources, program activities, and intended program outcomes, and specifies a chain of causal assumptions linking program resources, activities, intermediate outcomes , and ultimate goals" (p. 78).

66 Coryn, C.L., L.A. Noakes, C.D. Westine, and D.C. Schröter. 2011. "A Systematic Review of Theory-Driven Evaluation Practice from 1990 to 2009," American Journal of Evaluation, 32(2); Forss, Kim, Mita Marra, and Robert Schwartz. (2011). *Evaluating the Complex: Attribution, Contribution and Beyond*. New Brunswick, New Jersey: Transaction Publishers; Rogers, P.J. 2000. "Program Theory Evaluation: Not whether programs work but how they work." In: D.L. Stufflebeam, G.F. Madaus, and T. Kelleghan (Eds.), Evaluation Models: Viewpoints on Educational and Human Services Evaluation, (pp. 209-232). Boston, MA: Kluwer; Weiss, C.H. 2004. "On Theory-based Evaluation: Winning Friends and Influencing People." The Evaluation Exchange, IX, 1-5; Chen, H.T. 1990. *Theory-Driven Evaluations*. Thousand Oaks, CA: Sage; Donaldson, Stewart I, Christina A. Christie and Melvin Mark (Eds.) 2009. *What Counts as Credible Evidence in Applied Research and Evaluation Practice?* Los Angeles, CA: SAGE; 4. Patton, M. Q. 2006. "The Debate about Randomized Controls in Evaluation: The Gold Standard Question." Paper presented at IPDET. June, Ottawa.

67 Stewart (2017), Violette and Rathbun (2017) and NEEP (2017) also agree that the standard approach to evaluating SEM programs is not appropriate and suggest that something like a theory-drive evaluation would be more appropriate and useful to the IOUs, implementers, and regulators.

68 Malinick, Todd and Richard Ridge. (2015). "California 2016-2019 Retail Products Platform Program Pilot." Prepared for the Pacific Gas & Electric Company; Malinick, Todd and Richard Ridge. (2015). *Evaluation Plan for PG&E's 2015 Retail Plug-Load Portfolio Program Trail*. Prepared for the Pacific Gas & Electric Company; Ridge, Richard. "A Theory-Based Evaluation of the 1999 California Residential Lighting and Appliance Program." A paper presented at the American Council for and Energy Efficient Economy Conference in August, 2000; Rasmussen, Tami, Steve Grover, Richard Ridge, Rohit Vaidya, John Mitchell, and Joe Clark. *An EPIC Program to Support California's Ambitious Energy Policy Goals*. A paper presented at the American Council for and Energy Efficient Economy Conference in August, 2018; Ridge, Richard and Kathleen McElroy. "Testing the Causal Linkage Between Training of Sales Personnel in Retail Lighting and Appliance Stores and Changes in Market Share of ENERGY STAR®-Qualifying Equipment." A paper presented at the International Energy Program Evaluation Conference, August, 2001; Caulfield, Tim, Richard Ridge, Mary Sutter, and Valerie Richardson. "Pacific Gas & Electric's 1998 Food Service Technology Center Market Effects Study." A paper presented at the American Council for and Energy Efficient Economy Conference in August, 2000.

6 9 Coryn, C.L., L.A. Noakes, C.D. Westine, and D.C. Schröter. 2011. "A Systematic Review of Theory-Driven Evaluation Practice from 1990 to 2009," American Journal of Evaluation, 32(2), p. 201.

from this analysis was the identification of the following five core principles of theory-driven evaluation, which will provide the basic framework for the evaluation of the SEM program:

1. Theory-driven evaluations/evaluators should formulate a plausible program theory
2. Theory-driven evaluations/evaluators should formulate and prioritize evaluation questions around a program theory
3. Program theory should be used to guide planning, design, and execution of the evaluation under consideration of relevant contingencies
4. Theory-driven evaluations/evaluators should measure constructs postulated in the program theory
5. Theory-driven evaluations/evaluators should identify breakdowns and side effects, determine program effectiveness (or efficacy), and explain cause-and-effect associations between theoretical constructs

Coryn goes on to state:

> All in all, the perceived value of theory-driven evaluation is, in part, generating knowledge such as not only knowing whether a program is effective or efficacious (i.e., causal description; that a causal relationship exists between A and B) but also explaining a program's underlying causal mechanisms (i.e., causal explanation; how A causes B). (p. 203)

Within a theory-driven framework, the assessment of program performance using multiple research designs and analyses of key leading indicators of program performance is the best way to manage the risks faced by each stakeholder.

This theory-driven approach relied on a mixed methods approach involving the collection and analysis of both quantitative and qualitative data covering program inputs, activities, outputs, and outcomes. This implies the need for a comprehensive, integrated analysis that involves both a process evaluation and an impact evaluation that extends over the life of the program. The process evaluation collected data from various members of our evaluation team and program implementers and was focused on assessing the operationalization of the program and validating much of the program theory. The impact evaluation, while also intended to validate aspects of the program theory and logic model, was focused on measuring the more quantitative program impacts, such as the evaluated gross savings and number of Energy Coach meetings, the number of peer-to-peer meetings, and the number and effectiveness of workshops.

If the SEM program does not achieve its short- and mid-term objectives, the theory-driven evaluation is designed to allow us to determine the extent it was due to a failure of implementation or a failure of theory (Rossi, Lipsey and Freeman 2004; Donaldson 2007; Chen 1990; Weiss 1972). Our first task was to assess the extent to which the SEM program might have deviated in important ways from the original implementation plan and why. [70] Significant deviations would explain at least some of the failure to fully achieve the objectives of the SEM program. On the other hand, if the program plan was faithfully implemented and the program objectives were not fully achieved, then the underlying social/economic theories are likely flawed and should be reassessed. Of course, ideally, the program is faithfully implemented, and the objectives are fully achieved.

[70] The process evaluation was designed to identify any deviations from the original plan and the reasons for these deviations.

Our evaluation was designed to identify both types of failure and recommend appropriate modifications to the design of the program and the identification of the appropriate social/economic theories that support these design changes.

Given the unique nature of the SEM program, estimating program attribution solely through traditional evaluation methods runs the risk of misstating the true scale of effects or possibly misattributing effects to the program. Thus, key to our evaluation design is the ability to validate the activities, outputs, and outcomes–as well as their hypothesized causal linkages, as denoted in the SEM logic model that follows, to draw well-supported conclusions regarding the performance and efficacy of the program in a way that also supports plausible estimates of attribution. As Weiss (1997) states: "If the evaluation can show a series of micro-steps that lead from inputs to outcomes, then causal attribution for all practical purposes seems to be within reach" (p.43).

One important implication of a theory-driven approach is that a single net-to-gross ratio as the sole indicator of program influence is not produced, but rather an internally consistent, coherent and plausible story about the efficacy of the SEM program using the preponderance-of-evidence approach that asks whether, after examining all of the evidence, [71] were we able to conclude that the probability that the program played a substantial role in causing the observed outcomes was greater than 50% (i.e., more likely than not)? Our aim was to demonstrate a *reasonable attribution* or *credible association* between the SEM program activities and the impacts that have occurred; we only sought to investigate whether or not there was a convincing case with a reasonable degree of confidence that the SEM program made a substantial contribution to any observed reductions in energy use and changes in the organization's culture with respect to energy use; we did not pretend to be able to provide absolute proof of this

E.1.2.1 Program Theory and Logic Model

E.1.2.1.1 Program Summary

Once an industrial facility is committed to participate in the program, the implementer identifies an energy coach who will be the primary point of contact for the program and makes available other technical resources as needed to help the participant identify and implement efficiency opportunities. The participant is expected to devote substantial internal resources to these efforts and designates an energy champion, members of the energy team, data master and executive sponsor. The energy champion is responsible for the success of the SEM program at the facility. This individual is responsible for coordinating both with the SEM coach and internally with any facility staff, including the energy team, data master, and executive sponsor. The data master is responsible for ensuring that a plan is created for collecting energy data and relevant variable data, that the plan is followed, and that data is properly screened and documented. The executive sponsor should be the highest-level manager available at the facility (typically the facility manager) and is responsible for ensuring the energy team has the resources it needs to succeed during the SEM program. Over a two-year period, this team of program and facility staff completed the activities including conducting the energy map, the treasure hunt, employee engagement, attendance at a series of energy management workshops and

[71] It is important to note that this preponderance approach is based more on the *quality* of the evidence (i.e., its probable truth or accuracy) than on the *quantity* of the evidence.

peer-to-peer meetings, energy management system assessment, and energy management information system (EMIS) planning and implementation that are intended to result in operation and maintenance (O&M) changes and/or the installation of capital measures in the short-run.

In addition to and equally important, a fundamental goal of the program is to effect cultural change in participating organizations where cultural change is defined by Schein (2017) as

> … the accumulated shared learning of that group as it solves its problems of external adaptation and internal integration; which has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, feel and behave in relation to those problems. This accumulated learning is a pattern or system of beliefs, values, and behavioral norms that come to be taken for granted as basic assumptions and eventually drop out of awareness. (p. 6)

Dias (2017) notes that it is critical that energy management system (EnMS) practices are driven deeper into the company culture to ensure that they and the savings they generate persist. ISO 50001 underscores the importance of cultural change:

> Successful implementation of an EnMS supports a culture of energy performance improvement that depends upon commitment from all levels of the organization, especially top management. In many instances, this involves cultural changes within an organization.

Clearly, this is not the broad cultural change discussed in the organizational development literature but cultural change with respect to a narrow slice of organizational concerns, the management of energy use. However, even if focused on a very specific component of an organization's culture having to do with behaviors and attitudes related to how an organization uses energy, such cultural change can take more than two years to occur. In the short term, there might not be sufficient evidence of such cultural changes but rather a number of leading indicators of cultural change. If these leading indicators do not support the possibility of long-term cultural change, the chances that the actions observed in the first two years are sustainable are reduced considerably.

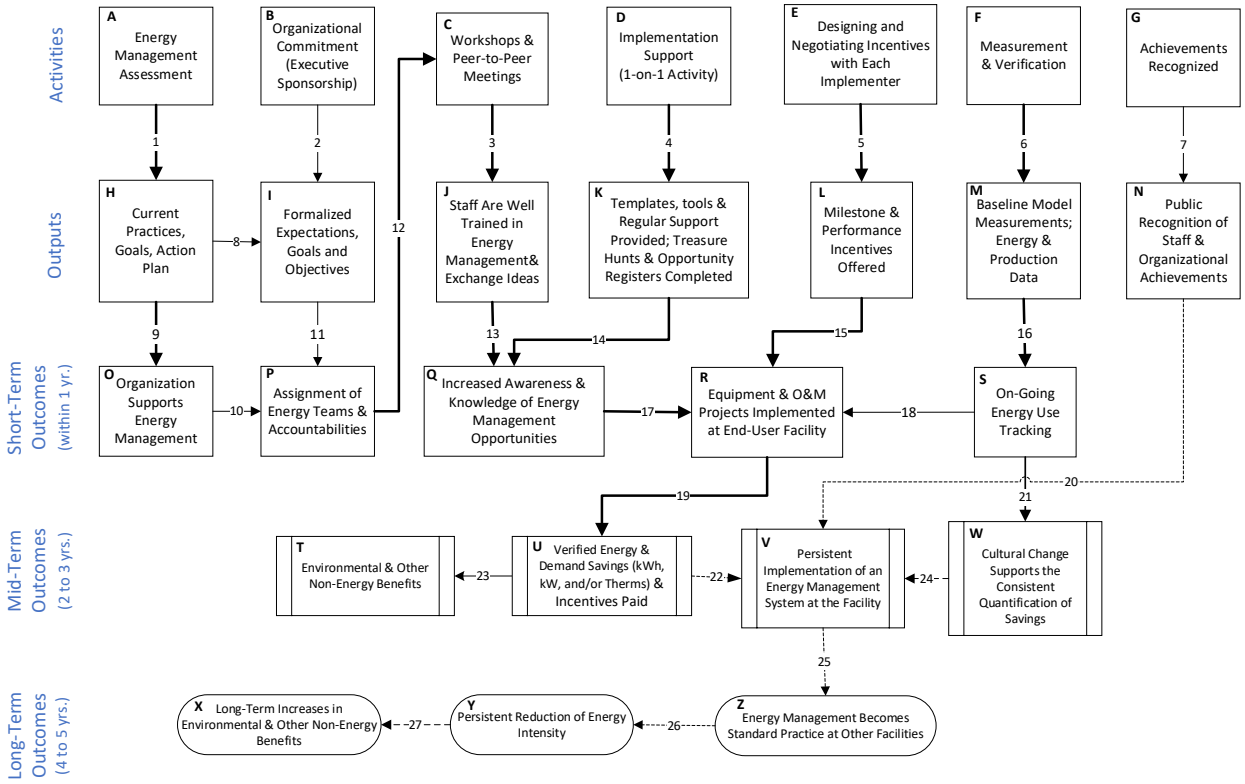
E.1.2.1.2 The SEM Logic Model

The four IOUs submitted SEM implementation plans that included logic models. The elements used to describe or represent a logic model include inputs, activities, and outputs, which in combination loosely form a program process theory, short-term outcomes (sometimes called initial, proximal, or immediate outcomes), mid-term outcomes (sometimes called intermediate or proximal outcomes), and long-term outcomes (sometimes called distal outcomes or impacts), which are intended to represent a program impact theory. In these logic models, activities are the actions undertaken to bring about a desired end, outputs are the immediate results of an action, and outcomes are the anticipated changes that occur over the mid and long term directly or indirectly as a result of inputs, activities, and outputs.

What is not shown in this logic model but is obviously critical are the resources (the inputs) that supported the activities that were hypothesized to produce the various outputs and outcomes. Understanding the magnitude of these resources is critical since it reflects to a large extent the level of effort put forth. The basic question is whether the level of effort, as measured by these resources, could possibly have led to the observed outputs and outcomes. The primary resources include money to

support the implementation and the commitment made by participating organizations in the form of executive sponsorship and active staff participation.

While all of the programs (PG&E, SCE/SoCal Gas and SDG&E) were designed to be consistent with the California Industrial SEM Design Guide the three logic models [72] were somewhat different. Since it was not cost effective to design a theory around each of the three logic models, we developed one common logic model that addressed the common SEM components reflected in each implementation plan and its accompanying logic model. Figure 27 presents the common logic model.



* Those linkages/hypotheses with the thickest lines received more attention than those with thin lines. Those with dashed lines received even less attention since they are associated with longer-term outcomes that could not be fully investigated.

Figure 27: Common SEM Logic Model

This model demonstrates that the SEM program is not just a single intervention (e.g., an incentive combined with technical information) delivered at a particular point in time but an intervention that involves multiple implementers and organizations in carrying out a shared responsibility over time that depends on faithfully implementing a complicated set of activities that are based on a number of explicit and implicit theories of individual and organizational behavior to produce sustainable energy savings.

[72] For SCE and SoCal Gas, there was only one logic model since the two utilities submitted one program design covering both utilities. These utilities also shared the same implementer.

It is important to recognize the following about this logic model:

- The numbers we assigned to each link do not represent the sequence in which activities, outputs and outcomes are expected to occur but are intended only to make it easier to refer to each link.
- It does not include every activity but only those activities that are considered to be essential to achieving the ultimate objectives of the program. In other words, the logic model is meant to convey the expected *causal* links between actions and outcomes. It is not meant to be a process model.
- The periods of time associated with short-term, mid-term and long-term outcomes were adopted from the PG&E logic model and appear plausible to our evaluation team. Based on the results of this evaluation and any subsequent evaluations, these timeframes might be revised.
- Given the inevitable budget constraints of any evaluation, we allocated evaluation resources to those linkages considered to be the most important in achieving the goals of the program. Those linkages with the thickest lines received more attention than those with thin lines. Those with dashed lines received even less attention since they are associated with longer-term outcomes which we could not investigate. As a result, we consider their associated metrics to be leading indicators of these longer-term outcomes about which there is greater uncertainty.
- It does not address site-specific participant spillover. We had several reasons for excluding it. As noted above, SEM can be defined as a holistic approach to managing energy use to continuously improve energy performance by achieving persistent energy and cost savings over the long term. It does this by focusing on changing business practices from senior management through shop-floor staff to affect organizational culture, reduce energy waste, and improve energy intensity. Given this, the goal of SEM is to identify all conceivable equipment changes and O&M changes that could cost-effectively reduce energy use. As a result, spillover is expected to be minimal since, after the energy treasure hunts and the completion of the opportunity registers, very few energy-saving actions would remain to be taken by any participants, i.e., actions that could be taken would already be included in elements of the SEM program.
- Certain outcomes are not the result of some subset of the linkages in the logic model but rather they are, to some degree, the result of all prior linkages since only the combination of all the prior activities, outputs and outcomes are sufficient to produce the desired outcomes. The energy and demand impacts and cultural change are such outcomes.
- In this model, feedback loops exist. For example, the feedback from the verified savings associated with a particular O&M change or capital measure can add support to additional capital and O&M changes at the end-user facility. However, we have chosen not to show such feedbacks loops in order to keep the logic model uncluttered and easier to follow.
- In Appendix G, we prepared a table that states each hypothesis for each link in the logic model and identifies the source(s) of data to support its testing.

It is not enough to confirm that an activity was launched and produced an output. This is easy. However, it is also critical that any given activity adhered to certain standards or was consistent with relevant theories such that the activity could reasonably be expected to produce the desired output (e.g., a staff well-trained in identifying energy management opportunities). If the expected outcome (e.g., increases in awareness and knowledge of energy management opportunities) is observed, then

the claim that there is a causal relationship between the output and the outcome is strengthened. If the expected outcome does not occur, then it could be due to a failure of implementation or a failure of theory.

It is also important to note that we sometimes stepped outside the model to explore other competing hypotheses and unanticipated outcomes. For example, in assessing attribution, we considered such factors as the COVID-19 pandemic, the increased acceptance that climate change is a serious threat, and the participants' predisposition to actively manage their energy use.

Logic models are usually supplemented with a narrative that describes the underlying social and/or economic theories that support each linkage (or causal mechanism). However, the IOUs cited very little if any peer-reviewed research in support of their claim that, in the non-residential sector, these SEM program activities and outputs will lead to (cause) the short-term, mid-term and long-term outcomes. This is likely due to the fact that there is very little empirical research into the effectiveness of such programs to deliver *net* savings in the nonresidential sector.

To confirm whether this might be the case, we conducted a brief review of the literature in order to assess the degree of empirical support for the various SEM strategies employed in the nonresidential sector to deliver net savings. While there have been a number of evaluations of SEM programs (e.g., Therkelsen et al., 2013; Lutz et al., 2018; Thollander and Palm, 2015; Vetromile and Collins, 2017; DNV-GL, 2019; CADMUS, 2019) none were found that estimated net-to-gross ratios or net savings. In addition, none were found that attempted to verify the hypothesized cause-and-effect relationships between SEM program activities and various outputs and outcomes. Note that it was these findings that suggested that the more traditional approaches were not deemed to be suitable and that another approach, a theory-driven evaluation, might better address the complexity of SEM-type programs.

Given this, the question is to what extent are the causal mechanisms illustrated in the logic model in Figure 27 plausible? That is, is it plausible that the program activities could lead to the expected outputs that, in turn, could lead to the expected short-term, mid-term and long-term outcomes?

E.1.3 Literature Review Summary

One of our first tasks was to assess the plausibility of the logic model in Figure 27. That is, what do the various organizational behavior theories say about the likelihood that these SEM resources and activities will lead to the expected outputs and outcomes depicted in the logic model. To address this issue, we conducted a brief review of the literature that included past evaluations of similar types of programs along with books and journal articles addressing organizational change and development. Below, we summarize our findings and provide the more detailed literature review and references in Appendix H.

We were unable to find any evaluations of SEM-type programs that estimated net impacts/NTGRs or attempted to verify any causal mechanisms. In the organizational change literature, with one exception, we found nothing that explicitly addressed changing organizations with respect to their energy management behavior. This one study supported the plausibility of many of the causal mechanisms illustrated in the SEM logic model. This is not to say that there isn't some uncertainty primarily due to the fact that much of their research focused on changing the behavior of small groups and individuals in the residential sector. However, they had much less to say about leadership, the

training of adults and effecting cultural change in complex organizations which prompted our review of the broader organizational behavior literature.

A review of the broader literature surrounding such important SEM-related topics as leadership, training and cultural changes only added to this uncertainty. With respect to leadership of executive sponsors, energy coaches, and energy champions, we concluded that it is certainly plausible that the leaders participating in the SEM program will have some degree of impact on individual employees, small groups and the entire organization. Having said that, we admit that we don't fully understand the challenges within each of the 35 participating organizations and know nothing about the various leadership styles and those they are attempting to lead, which creates additional uncertainty. Our review did reveal that there is substantial literature on training within organizations that suggests that, *if adult education workshops are designed and delivered according to adult education principles*, the established SEM workshop learning objectives could be achieved. In addition, while the SEM program has developed strategies that on their face could change an organization's culture, we found that much less is known in the empirical literature about how to measure and change culture in general or as it relates specifically to energy management and the role of leaders in promoting that cultural change.

Ultimately, our review suggests that, while there is some uncertainty about the key causal mechanisms in the SEM logic model, we find that the network of program activities could plausibly lead to the expected outputs and short- and mid-term outcomes. However, achieving persistent cultural change is far more uncertain even if narrowly focused on energy management since so much of what happens after the SEM program concludes is subject to the unique, complex, and evolving culture of each organization.

E.1.4 Data Collection

As noted earlier, given the size and inherent complexity of SEM projects, we conducted a theory-driven evaluation using data collected by the process and net impact evaluation team, the gross impact evaluation team, and the program implementers. Since one of our main tasks was to verify the causal mechanisms displayed in the logic model as part of our theory-driven evaluation, we used the logic model in Figure 27 to guide the development of all of the questionnaires in Appendix F and the identification of other documents that contained additional metrics. The table in Appendix G shows the final mapping of each survey question and other metrics into each link in the logic model.

Below, we describe each data collection effort and the identification of other important metrics such as the results of the EMAs.

E.1.4.1 Process and Net Impact Evaluation Team

This team was responsible for collecting data from the energy champions (the key decision makers), the executive sponsor, members of the energy teams, program implementers and the energy coaches. They also reviewed program documentation and extracted information relevant to the estimation of the final NTGR. For estimates of the savings and the list of O&M changes adopted and capital measures installed they relied on information provided by the gross savings evaluating engineers. Finally, for other information regarding the implementation of the program they relied on the implementers.

E.1.4.2 Core NTGR Interviews

The team conducted enhanced interviews with SEM participants from a sample of the 35 participants to gather the data necessary to calculate the core NTGRs at the enhanced level of rigor. The instrument used in these interviews began with the two cognitive interviews with participants who were not included in the evaluation sample; the results of the cognitive interviews were used to refine the instrument. Lastly, the instrument was further pre-tested with two additional SEM participants who were not included in the evaluation sample and refined as needed. Once the questionnaire was finalized, enhanced interviews were conducted with 26 of the 30 sampled SEM participants for a response rate of 89.7%. The reasons for not completing interviews with the four remaining sampled participants included participants being nonresponsive or having out-of-date/incorrect contact information.

E.1.4.3 Implementer Documentation

For each implementer, we obtained a variety of data related to the inputs as well as the various linkages in the logic model. For example, we obtained the EMA data from various documents such as the first- and second-year completion reports. We also obtained data related to training and development including workshop materials for the workshops conducted by an implementer for each of the four PAs during the first reporting period. Note that since the budget would not allow for a careful examination of all 40 workshops, we relied on a convenience sample of 5 workshops conducted during the first reporting period for each PA. The assumption is that these workshops represent the extent to which all workshops conducted by each implementer were designed and implemented according to similar principles. For these selected workshops, we obtained and reviewed each implementation plan, reviewed all instructional materials (e.g., PowerPoint presentations, student materials, the topics addressed, and the time allotted to each) and planned activities. We also obtained the responses for all the end-of-workshop surveys administered by the implementers.

Other data obtained from the implementer included:

- scoping reports,
- results of treasure hunts,
- energy maps,
- opportunity registers,
- ownership structure,
- management structure,
- existing corporate energy sustainability programs,
- description of any relevant relationship with utility programs (account executive, 3rd party contractors, etc.), project activity and history,
- pending projects, planned major capital projects,
- participant's ability and willingness to dedicate staff to the engagement,
- size of the energy team,

- number and dates of cohort meetings,
- size of cohort meetings,
- number of meetings between the energy champion and the energy team,
- various dates such as the date the energy team was established and the date the opportunity register was completed, and
- for each workshop, the date, number of attendees, topics covered, learning objectives, activities and measures of workshop effectiveness and satisfaction.

Implementer documentation also contains information that is relevant when analyzing free-ridership such as what the customer had planned to do in the absence of the program, explanations of the customer's reasons for taking the energy-management actions, and the emails referring to existing sustainability policies that played a role in taking the actions listed on the opportunity register or to barriers that had prevented their earlier implementation of energy-management actions. They can also contain calculations of return-on-investment (ROI) and payback period that can shed light on the role of the program in implementing recommended energy management actions.

Other data related to cultural change, training and development and other outcomes were collected through telephone interviews with the executive sponsor, energy coach, and an on-line survey of members of the energy team. Each is discussed below.

Finally, from each implementer, we obtained information about program inputs such as the program expenditures for administration, milestone incentives, performance incentives and measurement and verification. This was another important metric for establishing the level of effort put forth by each implementer during Cycle 1.

E.1.4.4 Energy Coach Interviews

We conducted in-depth interviews with the energy coach for each implementer. The "energy coach" actually consisted of several people, each possessing the specific skills necessary to support the participants. We invited all the members of the energy coach team to participate in the in-depth interview to make sure that informed answers could be provided to all questions. The interviews covered such topics as:

- Interactions with the energy champion and members of the energy team
- The design and delivery of the workshops
- Effectiveness of the workshops and the peer-to-peer meetings
- Organizational support for the energy champion and members of the energy team
- Organizational resistance to cultural change
- The effect of Covid-19 on their delivery of energy services to participants

E.1.4.5 Executive Sponsor Interviews

We conducted in-depth interviews with a sample of four executive sponsors to assess:

1. Their commitment to sustainable changes.

2. Their assessment of how much progress has been achieved thus far.
3. Any ideas they had for increasing the commitment of their managers and staff to the sustainability vision.
4. Any ideas they had for communicating the concept and importance of sustainability and changing the behavior of employees with respect to on-going energy management.
5. Their commitment to the on-going training and development of their employees with respect to energy management.

E.1.4.6 Program Implementer Interviews

We also interviewed each of the SEM program implementers and addressed such topics as:

- The percent of their California business depending on utility or government efficiency programs.
- The percent of their non-California business depending on utility or government efficiency programs.
- The probability of remaining in business if government and/or utility incentives were not available.
- The types of nonresidential measures, their frequency, their EULs, and (when appropriate) their efficiency that their firm has installed since 2017.
- The approximate proportion of the nonresidential measures they had installed over the last three years that was replacement on burnout versus early replacement.
- Nationally, when do they expect companies like theirs to no longer need government and/or utility support in providing SEM-like energy services to industrial customers.

E.1.4.7 Energy Team On-Line Surveys

For the 73 members of the Energy Team at each of the 30 sites for which we had e-mail addresses, we conducted an on-line survey to assess:

1. Their understanding of and commitment to sustainability.
2. How much progress has been achieved thus far in achieving cultural changes?
3. Their level of satisfaction with the program.
4. Any ideas they had for communicating the concept and importance of sustainability and changing the behavior of employees with respect to on-going energy management.

Despite efforts to legitimize the survey and up to three e-mail reminders to complete the on-line survey, the response rate was only 16.4%. Reasons for not responding included non-response; there were no partially completed surveys nor were there stated refusals to participate.

E.1.4.8 Gross Savings Team

In addition to helping to recruit participants for the NTGR survey, the gross savings estimation team provided for both reporting periods such information as:

- Establishment of energy management information systems,
- Verification of installations of capital measures and adoptions of O&M changes,
- Creation of baseline models,
- Verified gross energy and demand savings,
- Verified normal replacement versus accelerated replacement, and
- Expenditures by each participant.

E.1.5 Analysis

In the following section, we describe the analysis of the self-report NTGRs and the theory-driven analysis of the linkages described in the logic model in Figure 27.

E.1.5.1 Self-Report NTGR

After we collected and cleaned the data, we estimated final core NTGRs at the enhanced level of rigor using the algorithms and methods described earlier and calculated first-year- and life-cycle-savings-weighted NTGRs at the PA and statewide levels. We incorporated the self-report NTGR as one additional input into the more comprehensive theory-driven approach discussed in the next section.

E.1.5.2 Theory-Driven Analysis

Consistent with the theory-driven approach, the results of all the hypotheses tests were reviewed to determine the extent to which a case for attribution can be made using the preponderance-of-evidence (POE) approach. Recall that our aim is to demonstrate a *reasonable attribution* or *credible association* between the SEM program activities and the impacts that have occurred. A POE approach does not require that all indicators show overwhelming evidence of programmatic influence, but rather that multiple indicators show consistent direction. We only sought to assess whether the SEM program has made a substantial contribution to any reductions in energy use and changes in the organization's culture with respect to energy use. The question is, after examining all of the evidence, were we able to conclude that the probability that the program played a substantial role in causing the observed outcomes is greater than 50% (i.e., more likely than not)?

The data collected by the process and net impact evaluation team, the implementer, and the gross savings team were assembled at the PA level and mapped into the appropriate linkages in the logic model. As noted earlier, the table in Appendix G shows how each question as well as other metrics such as the EMA were mapped to each link in the logic model. We assessed each link individually and then grouped them into 8 categories each associated with a particular activity and a particular overarching hypothesis. Table 53 presents these groupings:

Table 53: Linkage Groups

Links	Program Elements
1, 2, 8, 9, 10, 11 & 12	Organizational Commitment
3 & 13	Workshops
4 & 14	Implementation Support
6, 16 & 21	Measurement & Verification
7	Achievement Recognition
5, 15, 17 & 18	Capital and O&M Projects Implemented
19 & 23	Energy & Environmental Impacts
20, 22 & 24	Persistent Implementation of EMS
25, 26 & 27	Sustainability

Note that leading indicators of cultural change (the change in EMAs) are included in our analysis of links 20,22 & 24. In effect, any cultural change is expected to be the result of activities, outputs and outcomes prior to link 24. Note also that we did not address Links 25, 26 and 27 in the logic model which are the expected long-term impacts (i.e., sustainability) since they were beyond the scope of our analysis.

To be credible, the preponderance of evidence approach must be rule-based, transparent, and repeatable. For each causal hypothesis, an objective case for causality was constructed based on all quantitative and qualitative data analyzed. Each case included a summary of the data collected, the analysis approach and results, an assessment of the validity and reliability of the data, and a discussion of the level of uncertainty surrounding the conclusions (e.g., a presentation of the achieved levels of confidence and precision—either a quantitative assessment or a qualitative assessment). When necessary, we stepped outside the model to explore other competing hypotheses and unanticipated outcomes. For example, in assessing attribution, we considered as contributors to the SEM outcomes 1) the COVID-19 pandemic and 2) the increased acceptance that climate change is a serious threat.

We based our analysis mostly on data that were specific to each site such as the self-report NTGR, EMA results, Treasure Hunt results, Energy Team surveys, Executive Sponsor surveys, evaluated savings and incentives paid, and baseline model performance. Other data were available at the PA-implementer level such as the structure of the workshops which affected all participants, the average participant responses to the end-of-workshop surveys and the surveys of the Energy Coaches covering topics about the collection of sites for which they were responsible. Because of our heavy reliance on site-specific data, we conducted a site-specific analysis restricted to the 26 sites for which we completed NTGR interviews.

We mapped the various quantitative and qualitative metrics into each link of the logic model in Appendix G and into each group of links presented earlier in Table 53. These maps served as our overall structure within which we conducted our theory-driven analysis We took the following four steps:

1. For each site for each PA, using the three-point scale (Weak Support=1, Moderate Support=2, and Strong Support=3), we assessed the extent to which the various metrics supported each link group based on the preponderance of evidence, which we called the *link support score*.
2. For each site for each PA, once we assigned a link-support score to each link group for a given site, we calculated the average of the link-support scores across all 8 link groups, which we called the *theory-driven attribution (T-DA) score*.
3. For each site for each PA, a T-DA score greater than 0.50 meant that we were more than 50% confident that the SEM program had played a substantial role in bringing about the O&M changes and equipment measures and the associated energy and demand savings for the site. In such a case, we set the POE NTGR to 1. If the T-DA score was less than or equal to 0.50, we set the POE NTGR to 0.
4. Finally, for each PA, we averaged the site-specific POE NTGRs across all sites to produce the overall PA POE NTGR. These PA results were then averaged across the PAs to yield the statewide POE NTGR.

Figure 28 illustrates this program-influence framework using the preponderance of evidence approach.

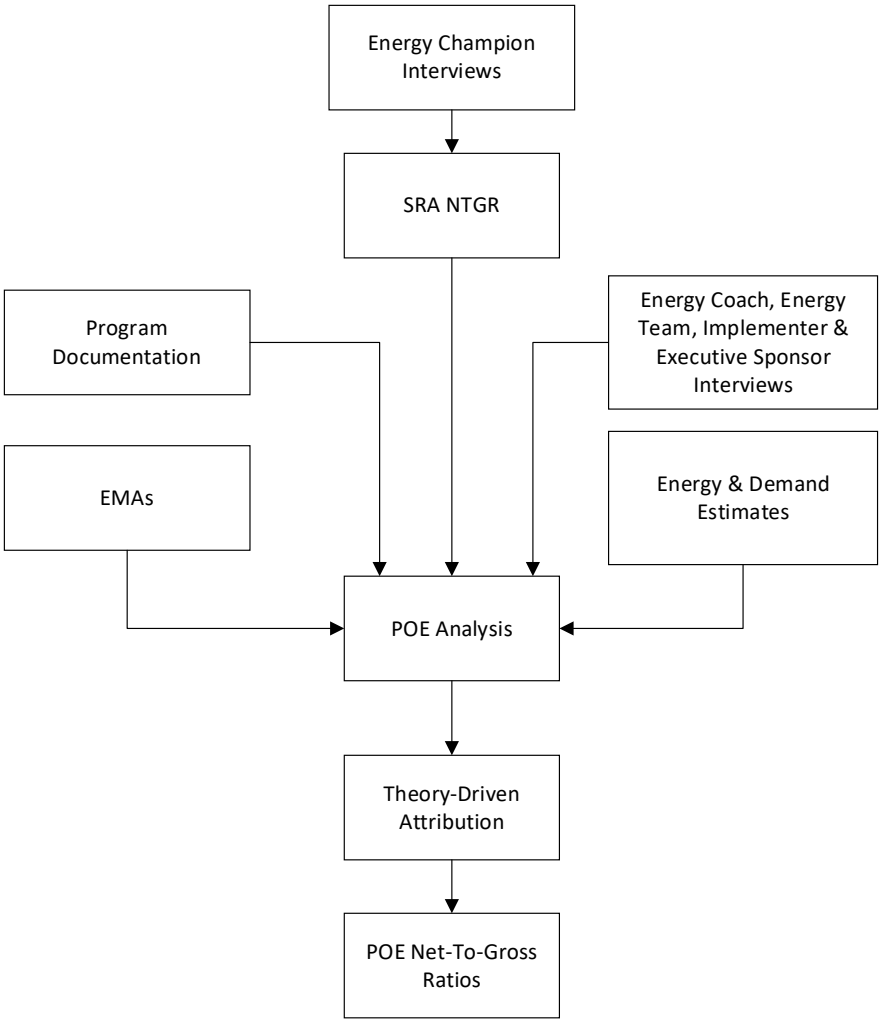


Figure 28: Program Influence Framework

E.1.5.3 Generalizability

Another important area of concern is generalizability. While we can generalize the results to the seven sites that were not sampled, to what extent can we generalize to those companies that did not participate in the SEM program? That is, to what other types of customers is an intervention similar to the SEM program likely to be effective? Even when it is reasonable to think that the Program influenced the observed impacts, this does not mean that the evaluation has examined all aspects of the intervention or how it will work in other settings or at other times or by other implementers. Until additional net impact evaluations are conducted, the characteristics of the population of customers for which SEM program might be effective is undefined. A synthesis of findings across future net impact evaluations will provide stronger evidence than can a single evaluation about the generalizability of the effects observed.

F. NTGR Questionnaires

California Public Utilities Commission
SEM Energy Champion Enhanced Interview Instrument

Background

Opinion Dynamics will conduct enhanced interviews with Industrial Strategic Energy Management (SEM) participants in the 2018 program year. The questionnaire used in these interviews began with two cognitive interviews, the results of which were used to refine the questionnaire, which will then pre-tested on two customers and refined as needed. Once the questionnaire is finalized, enhanced interviews will be conducted with 30 SEM participants subsequent to their ex-post virtual site visits.

Sample Variables and Read-Ins

<CONTACT>	Decision Maker Name
<PHONE>	Decision Maker Telephone
<NAICS>	Primary Business Code
<PA>	Program Administrators (all IOUs for SEM)
<IMPLEMENTER>	Program Implementers
<PROJECT_ID>	SBW Project ID
<CLAIM_ID>	Claim ID
<INTERVIEW_DATE>	Interview Date
<#_EQUIP>	Number of Equipment changes
<#_BEHAVE>	Number of behavioral (O&M) changes
<#ACTIONS>	Total number of O&M and equipment changes
<SECTOR>	Customer Sector where 1 = Industrial and 2 = Other
<BEHAVE_1> <BEHAVE _2> <BEHAVE_3>...<BEHAVE_10>	Listed behavioral, retro-commissioning and operational (BRO) energy saving actions (O&M changes)
<EQUIP_1> <EQUIP _2> <EQUIP_3>...<EQUIP_10>	Listed capital measure (equipment) energy saving actions
<START_DATE>	Participation Start Date
<END_DATE>	Participation End Date
<SEM CAPITAL>	Number of SEM-capital changes, i.e., capital equipment for which customer received a rebate from the PA

Calculated Variables

<PI_SCORE>	Program Influence Score based on responses to N41 and N42

Questionnaire

SCREENER

Introduction. May I please speak with <CONTACT>?

Hello. I'm calling from Opinion Dynamics on behalf of the California Public Utilities Commission as part of the evaluation of the 2018 Strategic Energy Management Program. I'll just refer to this as the "Program". We are interviewing customers that participated in the Program to gain a better understanding of how and why they decided to install energy efficiency measures or implement behavioral, retro commissioning, operational actions through this program. By participating in this Program, your organization agreed to participate in this follow-up study on your experiences with this Program.

The interview may take as much as 60 minutes, but it could be much shorter, and any information that is provided will remain strictly confidential. We will not identify or attribute any of your comments or organization information to others, including the CPUC.

(IF NECESSARY): If you like, you can contact the following individuals to verify the legitimacy of this survey. PGE – Name: Email, SCE – Name: Email, SDGE/SCG – Name: Email, CPUC - Lisa Paulo: lp1@cpuc.ca.gov.

1. **Proceed**
2. **Do not Proceed [TERMINATE]**

C1.

C2. Our records also show that you have been serving as the Energy Champion for your company. Is that correct? (Note: Go back and contact the executive sponsor or the person they refer to you if they say no)

1. **Yes**
00. **No. - Can you provide me the name and the contact info for the person who is serving as the energy champion? [OPEN END] [TERMINATE]**

C3. Are you the person who was most involved with the decision to implement these actions I just described? (Note: Go back and contact the person they refer to you if they say No)

1. **Yes**
00. **No. – Can you provide me the name and the contact info for the person who did make the decision? [OPEN END] (*Thank participant for their time)* [TERMINATE]**

EQUIPMENT AND O&M CHANGE VERIFICATION

First, we'd like to briefly confirm the energy saving actions you completed as part of your organization's participation in the Program. If possible, please have your Opportunity Register in front of you for your reference.

[ASK IF #_EQUIP>0]

A1. According to the Opportunity Register that <PA> provided to us, since <START_DATE>, you have made <#_EQUIP> equipment changes and <#_BEHAVE> operation and maintenance changes to reduce your energy use. I am going to read through these briefly just to make sure we are looking at the same Opportunity Register. **[READ IF NECESSARY]** Our list might be

shorter than yours since all measures that clearly pertain to the same piece of equipment or process were grouped. In some cases, actions listed in the opportunity register are distinct from others on the list, while other items in the register could be called micro-actions taken on the same piece of equipment or process.

Equipment-related Changes:
[READ IF EQUIP_1<> EMPTY] EQUIP_1
[READ IF EQUIP_2<> EMPTY] EQUIP_2
[READ IF EQUIP_3<> EMPTY] EQUIP_3
[READ IF EQUIP_4<> EMPTY] EQUIP_4
[READ IF EQUIP_5<> EMPTY] EQUIP_5
[READ IF EQUIP_6<> EMPTY] EQUIP_6
[READ IF EQUIP_7<> EMPTY] EQUIP_7
[READ IF EQUIP_8<> EMPTY] EQUIP_8
[READ IF EQUIP_9<> EMPTY] EQUIP_9
[READ IF EQUIP_10<> EMPTY] EQUIP_10

O&M-related Changes:
[READ IF BEHAVE_1<> EMPTY] BEHAVE_1
[READ IF BEHAVE_2<> EMPTY] BEHAVE_2
[READ IF BEHAVE_3<> EMPTY] BEHAVE_3
[READ IF BEHAVE_4<> EMPTY] BEHAVE_4
[READ IF BEHAVE_5<> EMPTY] BEHAVE_5
[READ IF BEHAVE_6<> EMPTY] BEHAVE_6
[READ IF BEHAVE_7<> EMPTY] BEHAVE_7
[READ IF BEHAVE_8<> EMPTY] BEHAVE_8
[READ IF BEHAVE_9<> EMPTY] BEHAVE_9
[READ IF BEHAVE_10<> EMPTY] BEHAVE_10

Do you agree that you implemented everything on this list?

Throughout this interview, I will refer to the operation and maintenance actions as **O&M changes** and we will refer to the equipment changes as simply **equipment changes**.

A2. Before beginning, could you tell me the primary reasons your company decided to adopt the <#_EQUIP> equipment changes and/or <#_BEHAVE> O&M changes I just listed??
- **00. [OPEN END]**
- **-98. Don't know**
- **-99. Refused**

PROGRAM AWARENESS

This next section will address such topics as how you first became aware of the Program, your company's past experience with reducing energy use and what energy services you have received thus far from the Program.

B1. What was your specific role in this Program?
- **00. [OPEN END]**
- **-98. Don't know**
- **-99. Refused**

B2. Were others heavily involved in the decisions about which projects to approve?
1. Yes. Please describe. [OPEN END]
2. No
-98. Don't know
-99. Refused

B4. How did the idea for participating in this Program originate? (Probe: Did your company develop the idea, was it suggested by a vendor, assigned account manager or consultant, or was it the result of an audit? Also, was it part of a larger expansion or remodeling effort?)
00. [OPEN END]
-98. Don't know
-99. Refused

B4a. Has your organization implemented similar O&M changes and/or energy efficient measures at this location in the past?
1. Yes. Please describe. [OPEN END]
2. No
-98. Don't know
-99. Refused

B5. Before you heard about the Program, was there a person who served the same function as the Energy Champion? **[READ IF NEEDED]** The Energy Champion is responsible for the success of the Program. This individual coordinates with Energy Management Coach and internally with any facility staff, including the Energy Team, Data Owner, and Executive Sponsor to ensure that the projects identified are being continuously pursued.)
1. Yes. Please describe [OPEN END]
2. No
-98. Don't know
-99. Refused

[ASK IF B5=1]
B5a. Approximately when was the Energy Champion role created in your company?
00. [OPEN END]
-98. Don't know
-99. Refused

B6. Before you heard about the program, was there a group of employees at your company who served the same function as the Energy Team?
1. Yes
2. No
-98. Don't know
-99. Refused

B7. Before you heard about the program, was there an executive(s) who provided leadership in reducing your company's energy use? **[READ IF NECESSARY]** For example, an executive sponsor might 1) Provide senior leadership support to the Energy Champion and energy team, 2) Help communicate throughout the facility that energy efficiency is important and requires the support of all facility staff, 3) Help resolve issues and make decisions to ensure success in the program, 4) Allow the Energy Champion and other energy team members to invest time in identifying and implementing energy saving projects, as well as participate in all SEM

activities, 5) Set reasonable expectations to review SEM accomplishments and facility energy performance with the Energy Champion and energy team members, and 6) Allocate sufficient budget to support viable energy capital projects.

1. Yes
2. No
-98. Don't know
-99. Refused

B8. Which of the following services did you receive through the Program?

Services	1. Yes	2. No	-98. Don't know
1 Technical support and information provided by the Energy Management Coach	☐	☐	☐
2 Milestone and/or performance incentives	☐	☐	☐
3 Energy Treasure Hunt	☐	☐	☐
4 Training in workshops & peer-to-peer meetings conducted by <IMPLEMENTER>	☐	☐	☐
5 Completion of the Energy Management Assessment	☐	☐	☐
6 Assistance in developing an Energy Management Information System	☐	☐	☐
7 Recommendations from the Energy Team	☐	☐	☐
8 Support from the Executive Sponsor	☐	☐	☐
9 **[IF SEM CAPITAL >0]** Rebate from another <PA> program	☐	☐	☐

NET-TO-GROSS MODULE

NTGR Screening

Next, I'd like to ask you a number of questions about why you chose to implement the equipment and O&M changes we have been talking about.

[ASK IF #_EQUIP> 0 AND #_BEHAVE > 0]

A3. Was the decision-making process for the implementation of these O&M changes and the installation of the equipment a single decision covering both O&M changes and installation of the equipment or was there a separate decision-making process for the O&M changes and a separate decision-making process for the equipment? To be clear, what we're interested in is how your company decided to complete these <#ACTIONS> changes. Of these, you made <#_EQUIP> equipment changes and <#_BEHAVE> O&M changes.

1. Were the decisions for all <#ACTIONS> changes part of the same process and decision criteria, and with the same people?
2. Or, did you have two separate decision processes, one for the bundle of <#_BEHAVE> O&M changes and one for the bundle of <#_EQUIP> equipment changes? [maybe because each bundle had a unique set of costs and benefits and you had to decide them separately]

[READ, IF NECESSARY]
For example, did the milestone and performance incentives play a bigger role in your decision to install the equipment than they did in your decision to implement the O&M changes? Or, did the Energy Treasure Hunt play a bigger role in the decision to implement O&M changes

than it did in the decision to install the equipment. If there were such differences, then the decision-making processes were different for O&M changes versus the equipment changes.

1. **Single**
2. **Separate**

NTGR Battery

[PROGRAMMING NOTE:

- **IF #_EQUIP > 0 and #_BEHAVE = 0, GO THROUGH NTGR BATTERY ONCE FOR EQUIP BUNDLE**
- **IF #_EQUIP = 0 and #_BEHAVE > 0, GO THROUGH NTGR BATTERY ONCE FOR BEHAVE BUNDLE**
- **IF A3=1, GO THROUGH NTGR BATTERY ONCE**
- **IF A3=2, GO THROUGH NTGR BATTERY ONCE FOR BUNDLE OF O&M BUNDLE AND ONCE FOR THE EQUIP BUNDLE]**

N2. Now I'd like to ask you about when your company decided to join the SEM program. Did your organization make the decision to . . .

[IF O&M & EQUIPMENT LOOP: "make the O&M changes and install this energy efficient equipment"]

[IF EQUIPMENT LOOP: "install the energy efficient equipment"]

[**IF O&M LOOP:** "make the O&M changes"]

before, after, or at the same time as you became aware of the performance and/or milestone incentives and technical support provided by the SEM Program?

1. **Before**
2. **After**
3. **At the same time**

Next, I'm going to ask you to rate the importance of the program as well as other factors that might have influenced your decision to . . .

[IF O&M & EQUIPMENT LOOP: "make these O&M changes and install this equipment"]

[IF EQUIPMENT LOOP: "install this equipment"]

[IF O&M LOOP: "make these O&M changes"**]**

through the SEM Program.

So, when responding to these questions, think in terms of the *group* of O&M changes or the *group* of capital measures.

Using a scale of 0 to 10 where 0 means "Not at All Important" and 10 means "Extremely Important", how would you rate the importance of . . .

[ASK IF B8_1=1]

N3a. Technical support and information provided by the Energy Management Coach. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

[ASK IF N3a>7]

N3aa. How, specifically, did the technical support and information provided by the Energy Management Coach enter into your decision to . . .

[IF O&M & EQUIPMENT LOOP: "implement these O&M changes and install this equipment"]

[IF EQUIPMENT LOOP: "install the equipment"]

[IF O&M LOOP: "implement the O&M change"]?

00. **[OPEN END]**

-98. **Don't know**

[ASK IF B8_2=1]

N3b. Availability of the **[IF <PA>=SDG&E:** "milestone incentives"; **ELSE:** "milestone and performance incentives"**]** *(IF NEEDED: to reduce the cost to install the equipment (or make these O&M changes)* **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

[ASK IF N3b >7]

N3bb. Why do you give it this rating?

00. [OPEN END]
-98. Don't know

[ASK IF B8_3=1]

N3c. Information provided through the Energy Treasure Hunt. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

[ASK IF N3c >7]

N3cc. How, specifically, did the information provided through the Energy Treasure Hunt enter into your decision to

[IF O&M & EQUIPMENT LOOP: "implement these O&M changes and install this equipment"]
[IF EQUIPMENT LOOP: "install the equipment"
IF O&M LOOP: "implement the O&M change"**]**?

00. [OPEN END]
-98. Don't know

[ASK IF O&M & EQUIPMENT LOOP OR EQUIPMENT LOOP]

N3d. Recommendation from an equipment vendor that sold you the equipment and/or installed it for you. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

N3e. Your previous experience with similar types of O&M changes and/or equipment. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

N3f. Your previous experience with a similar <PA> program. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

[ASK IF N3f >7]

N3ff. How did your previous experience with a similar utility sponsored program influence your decision to . . .

[IF O&M & EQUIPMENT LOOP: "implement these O&M changes and install this equipment"]
[IF EQUIPMENT LOOP: "install the equipment"]
[IF O&M LOOP: "implement the O&M changes"**]**?

00. [OPEN END]
-98. Don't know

[ASK IF B8_4=1]

N3g. Training or information provided in Program workshops and peer-to-peer meetings. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

[ASK IF N3g. >7]

N3gg. What type of information was provided during the Program training and peer-to-peer meetings?

00. [OPEN END]

-98. Don't know

[ASK IF N3g. >7]
N3ggg. How, specifically, did this enter into your decision to . . .
[IF O&M & EQUIPMENT LOOP: "implement these O&M changes and install this equipment"]
[IF EQUIPMENT LOOP: "install the equipment"]
[IF O&M LOOP: "implement the O&M change"**]**?
00. [OPEN END]
-98. Don't know

N3j. Standard practice in your business/industry. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important] [READ, IF NECESSARY**: Industry Standard Practice represents the typical equipment or commonly-used current practice that would be used absent the SEM Program. For example, maybe it has become routine for companies in your industry to repair leaks in their compressed air systems or install LED lights. In other words, it's become business-as-usual in your industry.]

N3l. Endorsement or recommendation by your account representative. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

N3m. Pre-existing corporate policies or guidelines that support sustainable energy reductions. [READ: When I say "pre-existing", I mean corporate policies or guidelines that existed before you decided to participate in the SEM Program. Also, corporate policies and guidelines that support sustainable energy reductions through equipment and O&M changes are typically general and do not always include specific recommendations such as changing thermostat settings or installing energy efficient HVAC systems but could nevertheless motivate employees to take specific actions that would reduce energy use.] **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

[ASK IF N3m. >7]
N3mm. How, specifically, did this enter into your decision to . . .
[IF O&M & EQUIPMENT LOOP: "implement these O&M changes and install this equipment"]
[IF EQUIPMENT LOOP: "install the equipment"]
[IF O&M LOOP: "implement the O&M change"**]**?
00. [OPEN END]
-98. Don't know

[**IF <SEM-CAPITAL> > 0**]
N3n. Incentives provided by some other <PA> program. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

[ASK IF (O&M & EQUIPMENT LOOP OR EQUIPMENT LOOP) AND SECTOR=1]
N3o. Improved product quality. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

[ASK IF N3o. >7]
N3oo. How, specifically, did this enter into your decision to install this equipment?
00. [OPEN END]
-98. Don't know

[ASK IF O&M & EQUIPMENT LOOP OR EQUIPMENT LOOP]

N3p. Compliance with state or federal regulations such as Title building 24 codes, Title 20 equipment codes, OSHA (Occupational Health and Safety Administration), FDA regulations, regional air quality management rules. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

[ASK IF N3p. >7]

N3pp. How, specifically, did this enter into your decision to **[IF EQUIPMENT LOOP:** "install the equipment" IF **O&M LOOP:** "implement the O&M change"**]**?

00. [OPEN END]
-98. Don't know

[ASK IF O&M & EQUIPMENT LOOP OR EQUIPMENT LOOP]

N3r. Compliance with your organization's normal equipment replacement practices. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

[ASK IF N3r. >7]

N3rr. How, specifically, did this enter into your decision to install this equipment?

00. [OPEN END]
-98. Don't know

[ASK IF B8_5=1]

N3r_a. The Energy Management Assessment. [**SCALE 0-10, 0=Not at all Important, 10=Extremely Important**] [**READ IF NECESSARY**: The Energy Management Assessment is a facilitated review of strategic energy management practices. The results of the Energy Management Assessment are designed to help staff at each participating site assess their progress and plan for continued improvement of their energy performance and Energy Management Information System.]

[ASK IF N3r_a. >7]

N3rr_a.How, specifically, did this enter into your decision to . . .
[IF O&M & EQUIPMENT LOOP: "implement these O&M changes and install this equipment"]
[IF EQUIPMENT LOOP: "install the equipment"]
[IF O&M LOOP: "implement the O&M change"**]**?

00. [OPEN END]
-98. Don't know

[ASK IF B8_6=1]

N3s_a. Assistance in Development of an Energy Management Information System. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]** [**READ IF NECESSARY]:** An Energy Management Information System can be any means that helps participants track key variables (e.g., energy use divided by the production level or the coefficient of performance of a refrigeration system.) at regular time intervals to develop a meaningful, normalized energy use profile. An energy management information system enables individuals and organizations to plan, make decisions and take effective actions to manage energy use and costs.

[ASK IF N3s_a. >7]
N3ss_a. How, specifically, did this enter into your decision to . . .
[IF O&M & EQUIPMENT LOOP: "implement these O&M changes and install this equipment"]
[IF EQUIPMENT LOOP: "install the equipment"]
[IF O&M LOOP: "implement the O&M change"**]**?
00. [OPEN END]
-98. Don't know

[ASK IF B8_7=1]
N3s_b. Recommendations from your Energy Team. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

[ASK IF B8_8=1]
N3s_c. Support from your Executive Sponsor. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

N3s_d. A desire for my company to be environmentally responsible. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

[ASK IF SECTOR=1]
N3t. Improved plant safety. **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

N3u. Were there any other factors we haven't discussed that were influential in your decision to . . .
[IF O&M & EQUIPMENT LOOP: "implement these O&M changes and install this equipment"]
[IF EQUIPMENT LOOP: "install this equipment"]
[IF O&M LOOP: "implement these O&M change"**]**?
00. [OPEN END]
-98. Don't know

[REPEAT FOR EACH ADDITIONAL MENTION]
N3uu. Again, using a scale of 0 to 10 where 0 means "Not at All Important" and 10 means "Extremely Important", how would you rate the importance of <OTHER>? **[SCALE 0-10, 0=Not at all Important, 10=Extremely Important]**

Corporate Policy Battery

[ASK IF N3m>7, ELSE SKIP TO SP1]

You indicated earlier that one of the reasons that you . . .
[IF O&M AND EQUIPMENT LOOP: "made these O&M changes and installed the equipment"]
[IF EQUIPMENT LOOP: "installed this equipment"]
[IF O&M LOOP: "made these O&M changes"**]**
was because of your pre-existing corporate policies or guidelines that support sustainable energy reductions. Some examples would be to "buy green" or use sustainable approaches to business investments and operations and maintenance procedures.

CP1. Approximately, in what year was this policy established?
00. [NUMERICAL OPEN END]
-98. Don't know
-99. Refused

CP2. May I obtain a copy of the policy? -

1. **Yes**
2. **No**

CP3. What specific corporate policy influenced your decision to . . .

[IF O&M & EQUIPMENT LOOP: "make these O&M changes and install this equipment"]
[IF EQUIPMENT LOOP: "install this equipment"]
[IF O&M LOOP: "make these O&M changes"**]**?

00. **[OPEN END]**
-98. **Don't know**
-99. **Refused**

CP4. Does your company ever deviate from these policies?

1. **Yes: [OPEN END] (Under what conditions does your company deviate?)**
2. **No**
-98. **Don't know**
-99. **Refused**

CP5. Had that policy caused you to . . .

[IF O&M AND EQUIPMENT LOOP: "make similar types of O&M changes and install similar types of energy efficient equipment**"]**
[IF EQUIPMENT LOOP: "install similar types of energy efficient equipment"]
[**IF O&M LOOP:** "make similar types of O&M changes"**]**
before <*START_DATE*>?

1. **Yes: (Record the location and dates) [OPEN END]**
2. **No**
-98. **Don't know**
-99. **Refused**

CP6. Did you receive any incentives from <PA> for these previous projects?

1. **Yes**
2. **No**
-98. **Don't know**
-99. **Refused**

Industry Standard Practice Battery

[ASK IF N3j>7, ELSE SKIP TO N41-42]

You indicated earlier that one of the reasons that you
[IF O&M & EQUIPMENT LOOP: made these O&M changes and installed this energy efficient equipment"]
[IF EQUIPMENT LOOP: "installed this energy efficient equipment"]
[**IF O&M LOOP:** "made these O&M changes"**]**
was because it was standard practice in your industry.

SP1. Approximately, how long have these types of energy efficiency equipment (and/or O&M changes) been standard practice in your industry?

00. **[OPEN END] (Record Number of Months or Years)**
-98. **Don't know**
-99. **Refused**

SP2. Does your company ever deviate from the industry standard practice?

1. Yes: [OPEN END] (Under what conditions does your company deviate?)
2. No
-98. Don't know
-99. Refused

SP3. How did this standard practice influence your decision to . . .
[IF O&M & EQUIPMENT LOOP: "make these O&M changes and install this energy efficient equipment"
[IF EQUIPMENT LOOP: "install this energy efficient equipment"
IF O&M LOOP: "make these O&M changes"]?

00. [OPEN END]
-98. Don't know
-99. Refused

SP4. And could you please rate the importance of the SEM Program versus this industry standard practice, in influencing your decision to . . .
[IF O&M & EQUIPMENT LOOP: "make these O&M and install this energy efficient equipment"**]**
[IF EQUIPMENT LOOP: "install this energy efficient equipment"]
[**IF O&M LOOP:** "make these O&M changes"].
Would you say it was very important, somewhat important, or not at all important?

1. The SEM program was not at all important compared to industry standard practice
2. The SEM program was somewhat important compared to industry standard practice
3. The SEM program was very important compared to industry standard practice
-98. Don't know
-99. Refused

SP5. What industry group or trade organization do you look to establish standard practice for your industry?

00. [OPEN END]
-98. Don't know
-99. Refused

N41-42. Next, with regards to the decision to . . .
[IF O&M & EQUIPMENT LOOP: "make these <#_ BEHAVE > O&M changes and install the <#_EQUIP> pieces of equipment"
[IF EQUIPMENT LOOP: "install the <#_EQUIP> pieces of equipment"
IF O&M LOOP: "make the <#_ BEHAVE > O&M changes"**]**
I would like you to rate the importance of the SEM Program as opposed to other non-program factors that may have influenced your decision.

(SCAN BELOW AND READ TO THEM THOSE FACTORS WITH RATINGS GREATER THAN 7 THAT INFLUENCED THEIR DECISION)

[**READ**]: The Program-related factors are . . .

[READ IF N3a>7] Technical support and information provided by the Energy Management Coach

[READ IF N3b>7] Availability of the program milestone and performance incentives
[READ IF N3c>7] Information provided in the Energy Treasure Hunt
[READ IF N3g>7] Training or information provided in program workshops and peer-to-peer meetings
[READ IF N3l>7] Endorsement or recommendation by your account rep
[READ IF N3n>7] Incentives provided by some other <PA> program
[READ IF N3r_a >7] The Energy Management Assessment
[READ IF N3s_a>7] Assistance in the Development of an Energy Management Information System
[READ IF N3s_b>7] Recommendations from the Energy Team
[READ IF N3s_c>7] Support from the Executive Sponsor
[READ IF N3u >7] <Other_1>:

[READ]: The non-Program-related factors are . . .

[READ IF N3d>7] Equipment vendor recommendation
[READ IF N3e>7] Your previous experience with similar types of energy efficient projects?
[READ IF N3f>7] Previous experience with a similar <PA> program
[READ IF N3j>7] Standard practice in your business/industry
[READ IF N3m>7] Pre-existing corporate policy or guidelines that support sustainable energy use reduction.
[READ IF N3o>7] Improved product quality
[READ IF N3p>7] Compliance with state or federal regulations such as Title 24 codes, Title 20 codes, OSHA (Occupational Health and Safety Administration), FDA regulations, regional air quality management rules
[READ IF N3r>7] Compliance with your organization's normal equipment replacement practices
[[READ IF N3s_d>7] A desire for my company to be environmentally responsible
[READ IF N3t>7] Improve plant safety
[READ IF N3u >7] <Other_1>:

N41-N42. If you were given 10 points to award in total, how many points would you give to the importance of the program factors and how many points would you give to these non-program factors?

Question	Score
N41. How many of the ten points would you give to the importance of the program in your decision?	[NUMERICAL OPEN END 0 – 10]
N42. and how many points would you give to all of these other non-program factors?	[NUMERICAL OPEN END 0 – 10]

-98. Don't Know
-99. Refused

[CALCULATE "TOTAL %" N41 + N42]; IF NONE OF N41 AND N42 = -98 AND TOTAL<>100%, show error message] Please ensure that all percentages add up to 100%.

N5. Using a likelihood scale from 0 to 10, where 0 is Not At All Likely and 10 is Extremely Likely, if the SEM Program, including the milestone and performance incentive, **had not been available**, what is the likelihood that you would have . . .
[IF O&M & EQUIPMENT LOOP: "made the **same** O&M changes and installed **exactly** the same energy efficient equipment**"]**
[**IF EQUIPMENT LOOP:** "installed **exactly** the same energy efficiency equipment"
IF O&M LOOP: "made the **same** O&M changes"**]**
that you did through the Program? **[SCALE 0-10, 0=Not at all Likely, 10=Extremely Likely]**

Consistency Checks

[ASK IF N3b>7 & N5>7]
N5a. When you answered with a rating of**<N3b>** for the question about the influence of the performance and/or milestone incentives, I would interpret that to mean that the incentives were quite important to your decision to . . .
[IF O&M & EQUIPMENT LOOP: "make these O&M changes and install this equipment**"**
[IF EQUIPMENT LOOP: "install this equipment"]
[IF O&M LOOP: "make these O&M change"**]**.

Then, when you just answered the previous question for how likely you would be to . . .
[IF O&M & EQUIPMENT LOOP: "make these O&M changes and install this equipment**"**
[IF EQUIPMENT LOOP: "install this equipment"
[**IF O&M LOOP:** "make these O&M changes"**]**
in the absence of the Program, including the performance and/or milestone incentives, it sounds like the incentives might not have been very important in your decision.

I want to check to see if I am misunderstanding your answers or if the questions may have been unclear. Will you explain in your own words, the role the Program performance and/or milestone incentives played in your decision to . . .
[IF O&M & EQUIPMENT LOOP: "make these O&M changes and install this equipment**"**
[IF EQUIPMENT LOOP: "install this equipment"
IF O&M LOOP: "make these O&M changes"**]**?
00. [OPEN END]
-98. Don't know
-99. Refused

NN5aa. Would you like for me to change your score on the importance of the incentive that you gave a rating of **<N3B>** and/or change your rating on the likelihood you would have . . .
[IF O&M & EQUIPMENT LOOP: "made these O&M changes and installed this equipment**"**
[IF EQUIPMENT LOOP: "installed this equipment"
IF O&M LOOP: "made these O&M changes"**]**
without the incentive which you gave a rating of **<N5>** and/or we can change both if you wish? [MULTIPLE RESPONSE UNLESS < 1]
1. No change
2. Rate the rebate influence [N3b] [OPEN END]
3. Rate the likelihood to install [N5] [OPEN END]
-98. Don't know

[REPLACE N3b=N5aa.2 IF N5aa=2]
[REPLACE N5=N5aa.3 IF N5aa=3]

[ASK IF O&M & EQUIPMENT LOOP OR EQUIPMENT LOOP]
N6. Now I would like you to think one last time about what action you would have taken if the program had not been available. Which of the following alternatives would you have been **MOST** likely to do?

1. Install/delamped fewer units
2. Install standard efficiency equipment or whatever is required by code
3. Installed equipment more efficient than code but less efficient than what you installed through the program
4. Done nothing (keep existing equipment as is)
5. Done the same thing you would have done as you did through the program
6. Repair/rewind or overhaul the existing equipment
00. [OPEN END]
-98. Don't know

[ASK IF N6=1]
N6a. If the Program had not been available, approximately how many of the <#_EQUIP> equipment changes would you have implemented? (It is okay to take an answer such as ...HALF...or 10 percent ... etc.)

00. [OPEN END]
-98. Don't know

[ASK IF O&M AND EQUIPMENT LOOP OR O&M LOOP]
N7. Now I would like you to think one last time about what action you would have taken if the program had not been available. Which of the following alternatives would you have been MOST likely to do?

1. Made fewer energy saving O&M changes
2. Done nothing (you would not have made any of the energy savings O&M changes)
3. Done the same things (you would have made the same energy saving O&M changes as you did through the Program)
00. [OPEN END]
-98. Don't know

[ASK IF N7=1]
N7a. If the Program had not been available, approximately how many of the <#_BEHAVE> O&M changes would you have made? (It is okay to take an answer such as ...HALF...or 10 percent . . . etc.)

00. [OPEN END]
-98. Don't know

[ASK IF O&M LOOP OR O&M AND EQUIPMENT LOOP]
N8. Before <START_DATE>, had you planned to make some of these <#_BEHAVE> O&M changes?

1. Yes
2. No
-98. Don't know
-99. Refused

[IF YES]

N8a. Approximately what percent of these O&M changes were you planning to make before <START_DATE>? (It is okay to take an answer such as ...HALF...or 10 percent, etc.)

00. [OPEN END]
-98. Don't know
-99. Refused

(END OF NTGR LOOP)

IF COVERING BOTH EQUIPMENT CHANGES AND O&M CHANGES, REPEAT PROGRAMMING LOOP FROM N1-N7a, ELSE SKIP TO PROCESS QUESTIONS]

PROCESS QUESTIONS

PRO2. Over the two-year reporting period, approximately how many different departments or workgroups were represented on your Energy Team?

00. [NUMERICAL OPEN END] [LIST THEM]
-98. Don't know
-99. Refused

PRO3. During the first reporting period, did you meet with your Energy Team for at least once a week, once a month or once a quarter or less?

1. Once a Week
2. Once a Month
3. Once a Quarter
4 Never
-98. Don't Know
-99. Refused

PRO4. During the first reporting period, approximately how many times in total did you meet with your Energy Team?

00. [NUMERICAL OPEN END]
-98. Don't know
-99. Refused

[ASK IF B8_3=1]
PRO11. Approximately how many hours did you spend participating in the Energy Treasure Hunt?

00. [NUMERICAL OPEN END] (Number of Hours)
-98. Don't know
-99. Refused

[ASK IF B8_3=1]
PRO12. Approximately how many hours on average did each member of your Energy Team spend participating in the Energy Treasure Hunt?

00. [NUMERICAL OPEN END] (Number of Hours)
-98. Don't know
-99. Refused

PRO17. Do you feel that you received adequate support from your Executive Sponsor?

1. Yes
2. No

-98. Don't know
-99. Refused

PRO18. Do you feel that you received adequate support from your Energy Management Coach?
1. Yes
2. No
-98. Don't know
-99. Refused

[ASK IF PRO18 = 2]
PRO18a. Why do you say that?
00. [OPEN END]
-98. Don't know
-99. Refused

PRO20. Since the beginning of your first-year performance period, have any of the following been replaced. [MULTIPLE RESPONSE UNLESS < 1]
1. Energy Management Coach
2. Energy Champion
3. Members of the Energy Team
4. Executive Sponsor
-97. No one has been replaced
-98. Don't know
-99. Refused

PRO21. On a scale of 0 to 10, with a "0" meaning "Not at All Effective" and a "10" meaning "Extremely Effective", how effective was the Energy Treasure Hunt in providing you with ideas to reduce energy use that that you had not previously known about?
00. [OPEN END]
-98. Don't know
-99. Refused

PRO22. On a scale of 0 to 10, with a "0" meaning "Not at All Effective" and a "10" meaning "Extremely Effective", how effective were the workshops and peer-to-peer meetings in providing you with ideas to reduce energy use that that you had not previously known about?
00. [OPEN END]
-98. Don't know
-99. Refused

[ASK IF PRO23<4]
PRO23. What concerns do you have about the Program, if any? *(IF NEEDED: What do you view as the primary features that need to be improved?)*
00. [OPEN END]
-98. Don't know
-99. Refused

CLOSING

Those are all the questions I have for you today. On behalf of the CPUC, I would like to thank you very much for your kind cooperation. Have a good day. **[TERMINATE]**

SEM Energy Coach Questionnaire

Introduction

The present document contains methodological information regarding the strategic energy management (SEM) 2018 and 2019 evaluations.

SEM programs are new to California; at the present there is no default forecast net-to-gross ratio (NTGR) for any SEM program. Given this, Decision 16-08-019 calls for a default NTGR of 1.0 to apply to SEM custom projects when program influence is evident. The Industrial SEM Program, however, is far more complex than the standard down-stream programs since it involves multiple actors engaged in a variety of activities combined to produce the desired short, intermediate- and long-term impacts. The evaluation team thus concluded that the traditional approach to estimating program influence is not appropriate and that a theory-driven evaluation using a preponderance of evidence would be more effective in assessing and understanding program influence.

The NTGR calculated from the Energy Champion interviews, which captures the influence of the program from the perspective of the participant, will be just one of the inputs for assessing the overall efficacy of the SEM Program. We will also interview Executive Sponsors, Implementers, Energy Coaches, and other members of the Energy Team to reach the preponderance of evidence necessary for assessing program influence.

The present instrument shows the questionnaire designed to interview the Energy Coaches. Since the Energy Coaches are the primary points of contact for the Program, the interviews are designed to assess how successful the level of interaction was with the other members of the team, and how engaged the other members of the team were across the meetings, workshops, and activities.

Opinion dynamics will conduct up to four interviews with the Energy Coaches.

Sample Variables and Read-Ins

<CONTACT>	Energy Coach Name
<PHONE>	Energy Coach Telephone
<DATE>>	Date of Interview
<PA>	Program Administrator
<IMPLEMENTER>	Program Implementer
<REPORTING DATES>	The begin date for first reporting period and the end date for the second reporting period.

Survey Instrument

Introduction

Introduction. May I please speak with **<CONTACT>**?

Hello. I'm calling from Opinion Dynamics on behalf of the California Public Utilities Commission as part of the evaluation of the Strategic Energy Management Program. I'll just refer to this as the "Program". We are interviewing Energy Coaches who assisted **<IMPLEMENTER>** in delivering the Program to customers to gain a better understanding of how the Program was implemented during the first and second reporting periods from **<REPORTING DATES>**.

The interview may take as much as 20 minutes, but it could be much shorter, and any information that is provided will remain strictly confidential. We will not identify or attribute any of your comments or organization information to others, including the CPUC.

(IF NECESSARY): If you like, you can contact the following individual to verify the legitimacy of this survey. CPUC - Lisa Paulo: lp1@cpuc.ca.gov.

Table 1. PAs by Implementers

	Cascade	CLEAResult	Leidos	Total
SCE-SCG	8			8
SDG&E	7			7
PG&E		12	10	22
Total	15	12	10	37

Table 2. Number of Participant Sites Served, by Implementer and PA

Implementer	Participant(s)	Number Served
CLEAResult	PG&E	12
Leidos	PG&E	10
Cascade	SCE/SCG	8
Cascade	SDG&E	7

[IF CLEAResult] In California, as part of the Program, CLEAResult provided energy services to 12 PG&E customers.

[IF Leidos] In California, as part of the Program, Leidos provided energy services to 10 PG&E customers.

[IF Cascade and SCE-SCG] In California, as part of the Program, Cascade provided energy services to 8 customers served by Southern California Edison and Southern California Gas.

[IF Cascade and SDG&E] In California, as part of the Program, Cascade provided energy services to 7 customers served by San Diego Gas and Electric.

Survey

1.0. Approximately, for how many years have you been working as an Energy Coach?
- 00. Number of Years **[OPEN END]**
- 98. Don't Know
- 99. Refused

1. In general, during the two reporting periods, **<REPORTING DATES>**, how frequently did you and members of your Energy Coach Team meet with the Energy Champion (and members of the Energy Team) at each site?
   01. Weekly
   02. Monthly
   03. Quarterly
   00. Other **[Open End]**
   98. Don't Know
   99. Refused

2. Of these, approximately what percent were in-person, telephone, or computer (e.g., ZOOM)
   01. Percent In-Person **[OPEN END]**
   02. Percent Telephone **[OPEN END]**
   03. Percent Computer **[OPEN END]**
   98. Don't Know
   99. Refused

3. You were responsible for providing services to **(SEE TABLE 2)** sites. Was that number of sites too many to adequately serve, about the right number of sites to adequately serve, or could you have served more adequately?
   01. Too Many
   02. About Right
   03. Could Have Served More
   98. Don't Know
   99. Refused

4. Of the workshops you conducted during the first two reporting periods at the **<PA>** sites, how many were cohort-style?
   00. Number of Cohort-Style Workshops **[OPEN END]**
   98. Don't Know
   99. Refused

4b. Approximately, how many years have you taught adults in similar types of workshops?
   00. Number of Years **[OPEN END]**
   98. Don't Know
   99. Refused

5. On a scale of 0 to 5 with a "0" meaning "Not at All Involved" and a "5" meaning "Extremely Involved", to what extent were you involved in the design and delivery of these workshops?

0	1	2	3	4	5
Not at All Involved					Extremely Involved

   98. Don't Know
   99. Refused

3

5b. On a scale of 0 to 5 with a "0" meaning "Not at All Involved" and a "5" meaning "Extremely Involved", to what extent were the members of your Energy Coach Team involved in the design and delivery of these workshops?

0	1	2	3	4	5
Not at All Involved					Extremely Involved

98. Don't Know
99. Refused

6. In general, were the design and delivery of these workshops consistent with adult education principles? [**READ IF NECESSARY**: Research has shown that adults learn best under the following circumstances: 1) The learning is self-directed, 2) The learning is experiential and utilizes background knowledge, 3) The learning is relevant to current roles, 4) The instruction is problem-centered, and 5) The students are motivated to learn. These are some basic adult education principles.]
   01. Yes
   02. No
   98. Don't Know
   99. Refused

6b. Did **<IMPLEMENTER>** ever hire an adult-education specialist to assist in developing your workshops?
   01. Yes
   02. No
   98. Don't Know
   99. Refused

6c. Have you ever received any instruction on how to train adults?
   01. Yes
   02. No
   98. Don't Know
   99. Refused

7. On a scale of 0 to 5 with a "0" meaning "Not at All Effective" and a "5" meaning "Extremely Effective" how effective were the peer-to-peer meetings in getting participants to share new ideas about how to manage energy use?

0	1	2	3	4	5
Not at All Effective					Extremely Effective

98. Don't Know
99. Refused

8. On a scale of 0 to 5 with a "0" meaning "Not at All Engaged" and a "5" meaning "Extremely Engaged", how engaged *on average* was the Energy Champion for each of the **(SEE TABLE 1)** participants.

4

0	1	2	3	4	5
Not at All Engaged					Extremely Engaged

98. Don't Know
99. Refused

9. On a scale of 0 to 5 with a "0" meaning "Not at All Engaged" and a "5" meaning "Extremely Engaged", how engaged *on average* were the other members of the Energy Team for each of the **(SEE TABLE 1)** participants.

0	1	2	3	4	5
Not at All Engaged					Extremely Engaged

98. Don't Know
99. Refused

20. In the context of the SEM Program, how do you define sustainability? **[IF NECESSARY, PROBE**: For example, do you define it as reducing a company's dependence on fossil fuels or ensuring that the continuous improvement of the energy management system becomes a norm within your organization's culture or ensuring that the savings from already adopted measures and practices persist, or do you define in a variety of ways?**].**

00. List Strategies **[OPEN END]**
98. Don't Know
99. Refused

10. What strategies for sustainability did you share with participants?

00. List Strategies **[OPEN END]**
98. Don't Know
99. Refused

[ASK IF Q10 = 00, ELSE SKIP TO Q12]

11. On a scale of 0 to 5 with a "0" meaning "Not at All Effective" and a "5" meaning "Very Effective", ***so far***, how effective on average have these strategies for sustainability been?

0	1	2	3	4	5
Not at All Effective					Very Effective

98. Don't Know
99. Refused

12. On a scale of 0 to 5, with a "0" meaning "Poor" and a "5" meaning "Excellent", how would you rate the support that you received from your executive sponsor?

0	1	2	3	4	5
Poor					Excellent

98. Don't Know
99. Refused

5

13. On a scale of 0 to 5, with a "0" meaning "No Resistance" and a "5" meaning "Significant Resistance", how much resistance, if any, did you observe among the Energy Champion and members of the Energy Teams at **(SEE TABLE 1)** to implementing the SEM strategies to manage their company's energy use? (PLEASE THINK ABOUT THE MOST RESISTANT SITE)

0	1	2	3	4	5
No Resistance					Significant Resistance

98. Don't Know
99. Refused

14. What have been some of the biggest challenges in carrying out the recommendations identified in the energy treasure hunt?
    00. **[OPEN END]**
    98. Don't Know
    99. Refused

[ASK Q15 IF COVID-19 NOT MENTIONED IN Q14, ELSE SKIP TO Q16]

15. On a scale of 0 to 5 with a "0" meaning "No Effect" and a "5" meaning a "Significant Effect", to what extent did the Covid-19 pandemic affect your ability to deliver energy services to these **<SEE TABLE 1>** participants?

0	1	2	3	4	5
No Effect					Significant Effect

98. Don't Know
99. Refused

[ASK Q16 IF COVID-19 MENTIONED IN Q14 OR Q15 > 0, ELSE SKIP TO Q17]

16. How did Covid-19 affect your ability to deliver energy services to the **(SEE TABLE 1)** participants?
    00. **[OPEN END]**
    98. Don't Know
    99. Refused

17. What recommendations, if any, do you have to improve the Program?
    00. **[OPEN END]**
    98. Don't Know
    99. Refused

18. Can you briefly describe the process of completing the Energy Management Assessments?
    00. **[OPEN END]**

END: On behalf of the CPUC, we would like to thank you very much for your kind cooperation. Have a good day!

SEM Energy Team Questionnaire

Introduction

The present document contains methodological information regarding the strategic energy management (SEM) 2018 and 2019 evaluations.

SEM programs are new to California; at the present there is no default forecast net-to-gross ratio (NTGR) for any SEM program. Given this, Decision 16-08-019 calls for a default NTGR of 1.0 to apply to SEM custom projects when program influence is evident. The Industrial SEM Program, however, is far more complex than the standard down-stream programs since it involves multiple actors engaged in a variety of activities combined to produce the desired short, intermediate- and long-term impacts. The evaluation team thus concluded that the traditional approach to estimating program influence is not appropriate and that a theory-driven evaluation using a preponderance of evidence would be more effective in assessing and understanding program influence.

The NTGR calculated from the Energy Champion interviews, which captures the influence of the program from the perspective of the participant, will be just one of the inputs for assessing the overall efficacy of the SEM Program. We will also interview Executive Sponsors, Implementers, Energy Coaches, and other members of the Energy Team to reach the preponderance of evidence necessary for assessing program influence.

The present instrument shows the questionnaire designed to survey members of the Energy Teams. Since the members of the Energy Teams work with the Energy Champion to reach completion of the various Program activities and culture changes throughout the participating facility, the interviews are designed to measure the members of the Energy Team for

- their understanding of and commitment to sustainability,
- how much progress has been achieved thus far in achieving cultural changes,
- their level of satisfaction with the Program, and
- any ideas they might have for communicating the concept and importance of sustainability and changing the behavior of employees with respect to on-going energy management.

Opinion dynamics will conduct up to 180 online surveys with a sample of the members Energy Team across the 30 sites.

Sample Variables and Read-Ins

<CONTACT>	Energy Team Name
<PHONE>	Energy Team Telephone
<DATE>	Date of Interview
<PA>	Program Administrator
<DATE1a>	Beginning of first reporting period

<DATE1b>	End of first reporting period
<DATE2a>	Beginning of second reporting period
<DATE2b>	End of second reporting period
<REPORTING DATES>	The begin date for first reporting period and the end date for the second reporting period.
<BRO> Measures	Yes/No
<Capital> Measures	Yes/No

Survey Instrument

Introduction (Landing Page)

Opinion Dynamics is conducting this on-line survey on behalf of the California Public Utilities Commission as part of the evaluation of the 2018-2019 Strategic Energy Management Program. We are surveying customers who participated in the Program to gain a better understanding of their experience in the Program.

This survey is expected to take about 15 minutes to complete. Your responses will be kept strictly confidential; we will not identify or attribute any of your comments or organization information to others, including the CPUC.

If you like, you can contact the following individual to verify the legitimacy of this survey: CPUC - Lisa Paulo at *lp1@cpuc.ca.gov*.

According to our records, you have participated in two reporting periods with the SEM Program. The first covered from <DATE1a> to <DATE1b>, and the second went from <DATE2a> to <DATE2b>. Some of the following questions will refer to those periods.

Survey

INTRO. According to the Opportunity Register that <PA> provided to us, since <DATE1a>, your company has made several equipment changes and operation and maintenance (O&M) changes to reduce your energy use including:

Equipment-related Changes:
[READ IF EQUIP_1<> EMPTY] EQUIP_1
[READ IF EQUIP_2<> EMPTY] EQUIP_2
[READ IF EQUIP_3<> EMPTY] EQUIP_3
[READ IF EQUIP_4<> EMPTY] EQUIP_4
[READ IF EQUIP_5<> EMPTY] EQUIP_5
[READ IF EQUIP_6<> EMPTY] EQUIP_6
[READ IF EQUIP_7<> EMPTY] EQUIP_7
[READ IF EQUIP_8<> EMPTY] EQUIP_8
[READ IF EQUIP_9<> EMPTY] EQUIP_9
[READ IF EQUIP_10<> EMPTY] EQUIP_10

O&M-related Changes:
[READ IF BEHAVE_1<> EMPTY] BEHAVE_1
[READ IF BEHAVE_2<> EMPTY] BEHAVE_2
[READ IF BEHAVE_3<> EMPTY] BEHAVE_3
[READ IF BEHAVE_4<> EMPTY] BEHAVE_4
[READ IF BEHAVE_5<> EMPTY] BEHAVE_5
[READ IF BEHAVE_6<> EMPTY] BEHAVE_6
[READ IF BEHAVE_7<> EMPTY] BEHAVE_7
[READ IF BEHAVE_8<> EMPTY] BEHAVE_8
[READ IF BEHAVE_9<> EMPTY] BEHAVE_9
[READ IF BEHAVE_10<> EMPTY] BEHAVE_10

Before beginning, could you tell me the primary reasons your company decided to adopt these equipment changes and/or O&M changes?

00. **[OPEN END]**
98. Don't know
99. Refused

1. What department within your company do you represent?
   00. **[OPEN END]**
   98. Don't Know
   99. Refused

2. During the first two reporting periods, **<REPORTING DATES>**, approximately how many months did you serve on the Energy Team?
   00. Average Number of Months Served **[OPEN END]**
   98. Don't Know
   99. Refused

3.0. In your own words, please describe the roles for each of the following:
   a. Implementor **[OPEN END]**
   b. Energy Coach/SEM Coach **[OPEN END]**
   c. Energy Champion **[OPEN END]**
   d. Executive Sponsor **[OPEN END]**
   e. Data Master/Data Owner **[OPEN END]**
   f. Energy Team **[OPEN END]**

3. During the first two reporting periods, **<REPORTING DATES>**, on average, how often did you (or the Energy Team) meet each month with your Energy Champion? Note: The Energy Champion is the person from the participating facility that is responsible for the success of the SEM Program at that facility; they coordinate with the SEM Coach and with the internal Energy Team.
   00. Average Number of Meeting(s) Per Month **[OPEN END]**
   98. Don't Know
   99. Refused

4. Was the frequency of meetings with your Energy Champion seem appropriate or not?
   01. Yes
   02. No
   98. Don't Know
   99. Refused

[ASK Q5 IF Q4 = 02, ELSE SKIP TO Q6]

5. How many times per month do you feel would have been more appropriate?
   00. Number of Times Per Month **[OPEN END]**
   98. Don't Know
   99. Refused

6. On a scale of 0 to 5, with a "0" meaning "Not at All Helpful" and a "5" meaning "Extremely Helpful", how helpful was your Energy Champion in coordinating efforts to reach completion of the various Program activities and support the continuous improvement of energy management system?

0	1	2	3	4	5
Not at All Helpful					Extremely Helpful

   98. Don't Know
   99. Refused

7. What, if anything, could the Energy Champion have done better?
   00. **[OPEN END]**
   98. Don't Know
   99. Refused

8. During the first two reporting periods from **<REPORTING DATES>**, on average, how often did you meet each month with your Energy Coach? Note: The Energy Coach is a member of the implementing staff who works with the Energy Champion as the primary point of contact for the Program; the Energy Coach also makes available other technical resources to help the participant identify and implement efficiency opportunities.
   00. Average Number of Meeting(s) Per Month **[OPEN END]**
   98. Don't Know
   99. Refused

9. Was the frequency of meetings with your Energy Coach about right, or not?
   01. Yes
   02. No
   98. Don't Know
   99. Refused

[ASK Q10 IF Q9 = 02, ELSE SKIP TO Q11]

10. How many times per month do you feel would have been right?
    - 00. Number of Times Per Month **[OPEN END]**
    - 98. Don't Know
    - 99. Refused

11. On a scale of 0 to 5, with a "0" meaning "Not at All Helpful" and a "5" meaning "Extremely Helpful", how helpful was your Energy Coach/ SEM Coach in helping your facility to identify and implement efficiency opportunities and offer strategies for the continuous improvement of energy management?

0	1	2	3	4	5
Not at All Helpful					Extremely Helpful

    - 98. Don't Know
    - 99. Refused

12. What, if anything, could the Energy Coach have done better?
    - 00. **[OPEN END]**
    - 98. Don't Know
    - 99. Refused

13. On a scale of 0 to 5, with a "0" meaning "Not at All Supportive" and a "5" meaning "Extremely Supportive", how supportive was your Executive Sponsor?

0	1	2	3	4	5
Not at All Supportive					Extremely Supportive

    - 98. Don't Know
    - 99. Refused

14. What, if anything, could the Executive Sponsor have done better?
    - 00. **[OPEN END]**
    - 98. Don't Know
    - 99. Refused

15. On a scale of 0 to 5, with a "0" meaning "Not at All Useful" and a "5" meaning "Extremely Useful", how useful was the Energy Treasure Hunt in providing you with ideas to reduce energy use that that you had not previously known about?

0	1	2	3	4	5
Not at All Useful					Extremely Useful

    - 98. Don't Know
    - 99. Refused

15a. On a scale of 0 to 5, with a "0" meaning "Not at All Effective" and a "5" meaning "Extremely Effective", how effective was the Energy Treasure Hunt in raising your general levels of energy efficiency awareness?

0	1	2	3	4	5
Not at All Effective					Extremely Effective

98. Don't Know
99. Refused

16. On a scale of 0 to 5, with a "0" meaning "Not at All Useful" and a "5" meaning "Extremely Useful", how useful were the workshops and peer-to-peer meetings in providing you and your team with ideas to reduce energy use that that you had not previously known about?

0	1	2	3	4	5
Not at All Useful					Extremely Useful

98. Don't Know
99. Refused

16a. On a scale of 0 to 5, with a "0" meaning "Not at All Effective" and a "5" meaning "Extremely Effective", how effective were the workshops and peer-to-peer meetings in raising your general levels of energy efficiency awareness?

0	1	2	3	4	5
Not at All Effective					Extremely Effective

98. Don't Know
99. Refused

17. What strategies did your Energy Team use to communicate your energy reduction plan to all of the employees in your organization?
    00. **[OPEN END]**
    98. Don't Know
    99. Refused

18. Since joining the SEM Program, has your company adopted or updated written energy management policies?
    01. Yes
    02. No
    98. Don't Know
    99. Refused

20. On a scale of 0 to 5, with a "0" meaning "Not at All Active" and a "5" meaning "Extremely Active," ***before*** participating in the SEM Program, how active had your company been in managing its energy use? For example, before participating in the SEM Program, were there staff responsible for the regular management of energy use? Or, before participating in the SEM Program, did your company regularly monitor its energy use?

0	1	2	3	4	5
Not at All Active					Extremely Active

98. Don't Know
99. Refused

[ASK Q21 IF Q20 > 3, ELSE SKIP TO Q22]

21. For approximately how many years was your company actively engaged in managing its energy use before participating in the SEM Program?
    00. How Many Years **[OPEN END]**
    98. Don't Know
    99. Refused

[ASK IF <BRO> = YES]

22. Had any of the BRO Operations and Maintenance (O&M) changes from the Opportunity Register that your company adopted during the first two reporting periods been planned and budgeted for before participating in the SEM Program?
    01. Yes
    02. No
    98. Don't Know
    99. Refused

[ASK Q23 IF Q22 = 01, ELSE SKIP TO Q24]

23. Approximately, what percent of the operation and maintenance changes had been planned and budgeted for before participating in the SEM Program?
    00. Approximate Percent **[OPEN END]**
    98. Don't Know
    99. Refused

[ASK IF <CAPITAL> = YES]

24. Had any of the BRO-capital measures from the Opportunity Register that your company installed during the first two reporting periods been planned before participating in the SEM Program?
    01. Yes
    02. No, the capital measures were not planned before participating in the SEM Program
    03. No, there were no capital measures installed
    98. Don't Know
    99. Refused

[ASK Q25 IF Q24 = 01, ELSE SKIP TO Q26]

25. Approximately, what percent of the BRO-capital measures had been planned before participating in the SEM Program?
    00. Approximate Percent **[OPEN END]**
    98. Don't Know
    99. Refused

26. Do you (and your team) feel that your roles as members of the Energy Team are well defined within your organization, or not?
    01. Yes
    02. No
    98. Don't Know
    99. Refused

27. Is participation on the Energy Team a part of your written job description?
    01. Yes
    02. No
    03. Do Not Have a Written Job Description
    98. Don't Know
    99. Refused

28. Since began participating in the SEM Program, have you and your Energy Team been recognized for your energy-management work?
    01. Yes
    02. No
    98. Don't Know
    99. Refused

29. What have been some of the biggest challenges in carrying out the recommendations identified in the energy treasure hunt?
    00. **[OPEN END]**
    98. Don't Know
    99. Refused

33. On a scale of 0 to 5, with a "0" meaning "Extremely Dissatisfied" and a "5" meaning "Extremely Satisfied", how satisfied are you with the SEM Program?

0	1	2	3	4	5
Extremely Dissatisfied					Extremely Satisfied

    98. Don't Know
    99. Refused

33a. Please describe why you gave it that rating.
    00. **[OPEN END]**
    98. Don't Know
    99. Refused

34. On a scale of 0 to 5, with a "0" meaning "No Resistance" and a "5" meaning "Significant Resistance", how much resistance among members of your Energy Team, if any, was there to implementing the SEM strategies to manage your company's energy use?

0	1	2	3	4	5
No Resistance					Significant Resistance

    98. Don't Know
    99. Refused

35. On a scale of 0 to 5, with a "0" meaning "No Resistance" and a "5" meaning "Significant Resistance", how much resistance among the employees of your company, if any, was there to implementing the SEM strategies to manage your company's energy use?

0	1	2	3	4	5
No Resistance					Significant Resistance

98. Don't Know
99. Refused

35a. On a scale of 0 to 5, with a "0" meaning "Not at all likely" and a "5" meaning "Extremely likely", how likely is your company to continue producing quantified usage and savings estimates?

0	1	2	3	4	5
Not at all likely					Extremely likely

98. Don't Know
99. Refused

36. What recommendations, if any, do you have for communicating the concept and importance of making continual improvements to energy management systems to the employees of your company?
    00. **[OPEN END]**
    98. Don't Know
    99. Refused

37. What recommendations, if any, do you have for changing the behavior of employees with respect to on-going energy management?
    00. **[OPEN END]**
    98. Don't Know
    99. Refused

[ASK IF <BRO> = YES]

38. On a 0 to 5 scale, with "0" meaning "No Influence" and "5" meaning "A Great Deal of Influence", how much influence did the SEM Program have on the company's decision to make **the O&M changes** that they did (PLEASE CONSIDER ALL PROGRAM INFLUENCES INCLUDING THE ENERGY COACH, THE PEER-TO-PEER MEETINGS, THE WORKSHOPS, THE TREASURE HUNT, ETC).

0	1	2	3	4	5
No Influence					A Great Deal of Influence

98. Don't Know
99. Refused

[ASK IF <CAPITAL> = YES]

39. On a 0 to 5 scale, with "0" meaning "No Influence" and "5" meaning "A Great Deal of Influence", how much influence did the SEM Program have on the company's decision to make the **CAPITAL changes** that they did (PLEASE CONSIDER ALL PROGRAM INFLUENCES INCLUDING THE ENERGY COACH, THE PEER-TO-PEER MEETINGS, THE WORKSHOPS, THE TREASURE HUNT, ETC).

0	1	2	3	4	5
No Influence					A Great Deal of Influence

98. Don't Know
99. Refused

40. On a 0 to 5 scale, with "0" meaning "Not at all Successful" and "5" meaning "Very Successful", how successful were you in applying the knowledge and techniques for managing energy use that you learned in the workshops you attended during the first two reporting periods.

0	1	2	3	4	5
Not at all Successful					Very Successful

98. Don't Know
99. Refused

41. On a scale of 0 to 5, with 0 meaning "Not at All Important", and 5 meaning "Extremely Important", before participating in the SEM Program, how important was your on-going training and development to your company?

0	1	2	3	4	5
Not at all Important					Extremely Important

98. Don't Know
99. Refused

42. Before participating in the SEM Program, had you earned any professional certifications in energy efficiency, energy management or sustainability?
    01 Yes
    02 No
    98. Don't Know
    99. Refused

[ASK IF Q42 = 01]

43. From which organization(s) did you earn certification and when?
    00. **[OPEN END]**
    98. Don't Know
    99. Refused

30. On a scale of 0 to 5, with a "0" meaning "No Impact" and a "5" meaning "Significant Impact", how much did the Covid-19 pandemic impact your ability to adopt O&M changes and energy efficient equipment identified in the Energy Treasure Hunt?

0	1	2	3	4	5
No Impact					Significant Impact

98. Don't Know
99. Refused

10

[ASK Q31 IF Q30 > 0, ELSE SKIP TO Q33]

31. Since March 2020, have you sometimes been unable to go to your worksite because of Covid-19?
    01. Yes
    02. No
    98. Don't Know
    99. Refused

[ASK Q32 IF Q31 = 01, ELSE SKIP TO Q33]

32. Since March 2020, for approximately how many weeks have you been unable to go to your worksite?
    00. Weeks [**OPEN END]**
    98. Don't Know
    99. Refused

44. Since the end of the second reporting period <DATE2b>, has your company participated in any other energy efficiency programs in California?
    01. Yes
    02. No
    98. Don't Know
    99. Refused

[IF Q44=01, ASK Q45]

45. Which one's did you participate in?
    00. **[OPEN END]**
    98. Don't Know
    99. Refused

[IF Q44=02, ASK Q46]

46. Do you plan to participate in any other energy efficiency programs in California?
    01. Yes
    02. No
    98. Don't Know
    99. Refused

[IF Q46=01, ASK Q47]

47. Which ones do you plan to participate in?
    00. **[OPEN END]**
    98. Don't Know
    99. Refused

END: On behalf of the CPUC, we would like to thank you very much for your kind cooperation. Have a good day!

SEM Executive Sponsor Questionnaire

Introduction

The present document contains methodological information regarding the strategic energy management (SEM) 2018 and 2019 evaluations.

SEM programs are new to California; at the present there is no default forecast net-to-gross ratio (NTGR) for any SEM program. Given this, Decision 16-08-019 calls for a default NTGR of 1.0 to apply to SEM custom projects when program influence is evident. The Industrial SEM Program, however, is far more complex than the standard down-stream programs since it involves multiple actors engaged in a variety of activities combined to produce the desired short, intermediate- and long-term impacts. The evaluation team thus concluded that the traditional approach to estimating program influence is not appropriate and that a theory-driven evaluation using a preponderance of evidence would be more effective in assessing and understanding program influence.

The NTGR calculated from the Energy Champion interviews, which captures the influence of the program from the perspective of the participant, will be just one of the inputs for assessing the overall efficacy of the SEM Program. We will also interview Executive Sponsors, Implementers, Energy Coaches, and other members of the Energy Team to reach the preponderance of evidence necessary for assessing program influence.

The present instrument shows the questionnaire designed to interview Executive Sponsors. Since the Executive Sponsor should be the highest-level manager available at the facility and is responsible for ensuring the Energy Team has the resources it needs to succeed during the SEM Program, the interviews are designed to measure the Executive Sponsors'

- commitment to sustainable changes,
- assessment of how much progress has been achieved thus far,
- additional ideas for increasing the commitment of their managers and staff to the sustainability vision, and
- any thoughts they might have for communicating the concept and importance of sustainability and changing the behavior of employees with respect to on-going energy management.

Opinion dynamics will conduct up to six in-depth interviews with a sample of the Executive Sponsors.

Sample Variables and Read-Ins

<CONTACT>	Executive Sponsor's Name
<PHONE>	Executive Sponsor's Telephone
<DATE>>	Date of Interview
<PA>	Program Administrator

1

<DATE1a>	Beginning of first reporting period
<DATE1b>	End of first reporting period
<DATE2a>	Beginning of second reporting period
<DATE2b>	End of second reporting period
<REPORTING DATES>	The begin date for first reporting period and the end date for the second reporting period.

Survey Instrument

Introduction

May I please speak with **<CONTACT>**?

Hello. I'm calling from Opinion Dynamics on behalf of the California Public Utilities Commission as part of the evaluation of the Strategic Energy Management Program. I'll just refer to this as the "Program". We are interviewing Executive Sponsors whose companies participated in the Program to gain a better understanding of how the Program was implemented.

The interview may take as much as 20 minutes, but it could be much shorter, and any information that is provided will remain strictly confidential. We will not identify or attribute any of your comments or organization information to others, including the CPUC.

(IF NECESSARY): If you like, you can contact the following individual to verify the legitimacy of this survey. CPUC - Lisa Paulo: lp1@cpuc.ca.gov.

Table 1. PAs by Implementers

	Cascade	CLEAResult	Leidos	Total
SCE-SCG	8			8
SDG&E	7			7
PG&E		12	10	22
Total	15	12	10	37

[IF CLEAResult] In California, as part of the Program, CLEAResult provided energy services to 12 PG&E customers.

[IF Leidos] In California, as part of the Program, Leidos provided energy services to 10 PG&E customers.

[IF Cascade] In California, as part of the Program, Cascade provided energy services to 8 customers served by Southern California Edison and Southern California Gas and 7 customers served by San Diego Gas and Electric.

According to our records, you have participated in two reporting periods with the SEM Program. The first covered from DATE1a to DATE1b, and the second went from DATE2a to DATE2b. Some of the following questions will refer to those periods.

Survey

INTRO. According to the Opportunity Register that <PA> provided to us, since <DATE1a>, your company has made several equipment changes and operation and maintenance (O&M) changes to reduce your energy use including:

Equipment-related Changes:
[READ IF EQUIP_1<> EMPTY] EQUIP_1
[READ IF EQUIP_2<> EMPTY] EQUIP_2
[READ IF EQUIP_3<> EMPTY] EQUIP_3
[READ IF EQUIP_4<> EMPTY] EQUIP_4
[READ IF EQUIP_5<> EMPTY] EQUIP_5
[READ IF EQUIP_6<> EMPTY] EQUIP_6
[READ IF EQUIP_7<> EMPTY] EQUIP_7
[READ IF EQUIP_8<> EMPTY] EQUIP_8
[READ IF EQUIP_9<> EMPTY] EQUIP_9
[READ IF EQUIP_10<> EMPTY] EQUIP_10

O&M-related Changes:
[READ IF BEHAVE_1<> EMPTY] BEHAVE_1
[READ IF BEHAVE_2<> EMPTY] BEHAVE_2
[READ IF BEHAVE_3<> EMPTY] BEHAVE_3
[READ IF BEHAVE_4<> EMPTY] BEHAVE_4
[READ IF BEHAVE_5<> EMPTY] BEHAVE_5
[READ IF BEHAVE_6<> EMPTY] BEHAVE_6
[READ IF BEHAVE_7<> EMPTY] BEHAVE_7
[READ IF BEHAVE_8<> EMPTY] BEHAVE_8
[READ IF BEHAVE_9<> EMPTY] BEHAVE_9
[READ IF BEHAVE_10<> EMPTY] BEHAVE_10

Before beginning, could you tell me the primary reasons your company decided to adopt these equipment changes and/or O&M changes?

00. **[OPEN END]**
98. Don't know
99. Refused

1. What are the primary reasons why your company decided to participate in the Program?
   00. **[OPEN END]**
   98. Don't Know
   99. Refused

2. What strategies did your company use to communicate your energy reduction plan to your employees?
   00. **[OPEN END]**
   98. Don't Know
   99. Refused

5. In what ways have you supported your energy champion and members of the Energy Team?
   00. **[OPEN END]**
   98. Don't Know
   99. Refused

6. Did your company have a sustainability energy policy before participating in the Program?
   01. Yes

02. No
98. Don't Know
99. Refused

7. Since joining the SEM Program, has your company adopted or updated written energy management policies?
   01. Yes
   02. No
   98. Don't Know
   99. Refused

[ASK Q8 IF Q7 =02, ELSE SKIP TO Q10]

8. Do you plan on implementing such a policy in the future?
   01. Yes
   02. No
   98. Don't Know
   99. Refused

[ASK Q9 IF Q7 = 01, ELSE SKIP TO Q10]

9. Could you please provide these policies or provide a link to these policies on your company's website?
   01. Yes
   02. No
   98. Don't Know
   99. Refused

10. Did you serve as the Executive Sponsor for all of the first two reporting periods defined as **<REPORTING DATES>**?
   01. Yes
   02. No
   98. Don't Know
   99. Refused

[ASK Q11 IF Q10 = 02, ELSE SKIP TO Q12]

11. Approximately, for what percent of the first two reporting periods did you serve as the Executive sponsor?
   00. Percent **[OPEN END]**
   98. Don't Know
   99. Refused

[ASK Q11b IF Q10 = 02, ELSE SKIP TO Q12]

11b. Did someone else act as Executive Sponsor when you were not in that role?
   01. Yes
   02. No
   98. Don't Know
   99. Refused

12. What have been some of the biggest challenges in carrying out the recommendations identified in the energy treasure hunt?
   00. **[OPEN END]**
   98. Don't Know

99. Refused

14. On a scale of 0 to 5, with 0 meaning "no influence", and 5 meaning "a great deal of influence", how influential was the SEM Program in your company's decision to make the operational and maintenance changes and/or capital changes that you did?

0	1	2	3	4	5
No influence					A great deal of influence

98. Don't Know
99. Refused

15. On a scale of 0 to 5, with 0 meaning "not at all likely", and 5 meaning "extremely likely", how likely is your company to continue to look for more energy efficient projects after the Program ends?

0	1	2	3	4	5
Not at all likely					Extremely likely

98. Don't Know
99. Refused

[ASK Q16 IF Q15< 3]

16. Your answer suggests that it's somewhat unlikely that your organization will continue to look for more energy efficient projects after the Program ends. Can you briefly explain why?
    00. **[OPEN END]**
    98. Don't Know
    99. Refused

17. On a scale of 0 to 5, with 0 meaning "Not at All Important", and 5 meaning "Extremely Important", going forward, how important is the on-going training of your employees with respect to energy management?

0	1	2	3	4	5
Not at all Important					Extremely Important

98. Don't Know
99. Refused

18. Does your company have facilities at other locations in California?
    01. Yes
    02. No
    98. Don't Know
    99. Refused

[IF Q18=01, ASK Q19, ELSE SKIP TO Q20]

19. As a result of your participation in the SEM Program, do you plan on having some of these other locations participate in the SEM Program at some time in the future?
    01. Yes
    02. No

98. Don't Know
99. Refused

[IF Q19=01, ASK Q20, ELSE SKIP TO Q21]

20. Approximately, how many locations do plan on participating in the SEM Program?
    00. **[OPEN END]**
    98. Don't Know
    99. Refused

21. Before participating in the SEM Program, was your company ever certified for such things as being a green business and sustainable?
    01. Yes
    02. No
    98. Don't Know
    99. Refused

[IF Q21=01, ASK Q212 ELSE SKIP TO Q23]

22. Which organizations provided the certification(s)?
    00. **[OPEN END]**
    98. Don't Know
    99. Refused

23. Since the end of the second reporting period <DATE2b>, has your company participated in any other energy efficiency programs in California?
    01. Yes
    02. No
    98. Don't Know
    99. Refused

[IF Q23=01, ASK Q24]

24. Which one's did you participate in?
    00. **[OPEN END]**
    98. Don't Know
    99. Refused

[IF Q23=02, ASK Q25]

25. Do you plan to participate in any other energy efficiency programs in California?
    01. Yes
    02. No
    98. Don't Know
    99. Refused

[IF Q25=01, ASK Q26]

26. Which ones do you plan to participate in?
    00. **[OPEN END]**
    98. Don't Know
    99. Refused

27. What recommendations, if any, do you have to improve the Program?
    00. **[OPEN END]**
    98. Don't Know

99. Refused

3. On a scale of 0 to 5 with a "0" meaning "No Effect" and a "5" meaning a "Significant Effect", to what extent did the Covid-19 pandemic affect your ability to actively participate in the Program?

0	1	2	3	4	5
No Effect					Significant Effect

98. Don't Know
99. Refused

[ASK Q4 IF Q3 > 0, ELSE SKIP TO Q5]

4. What, if anything, have you done to ensure that the progress you have enjoyed in managing your company's energy use continues and is sustainable?
   00. **[OPEN END]**
   98. Don't Know
   99. Refused

28. Is there anything else you would like to add before we wrap up the interview?
   00. **[OPEN END]**
   98. Don't Know
   99. Refused

On behalf of the CPUC, we would like to thank you very much for your kind cooperation. Have a good day!

Opinion Dynamics

SEM Implementer Questionnaire

Introduction

The present document contains methodological information regarding the strategic energy management (SEM) 2018 and 2019 evaluations.

SEM programs are new to California; at the present there is no default forecast net-to-gross ratio (NTGR) for any SEM program. Given this, Decision 16-08-019 calls for a default NTGR of 1.0 to apply to SEM custom projects when program influence is evident. The Industrial SEM Program, however, is far more complex than the standard down-stream programs since it involves multiple actors engaged in a variety of activities combined to produce the desired short, intermediate- and long-term impacts. The evaluation team thus concluded that the traditional approach to estimating program influence is not appropriate and that a theory-driven evaluation using a preponderance of evidence would be more effective in assessing and understanding program influence.

The NTGR calculated from the Energy Champion interviews, which captures the influence of the program from the perspective of the participant, will be just one of the inputs for assessing the overall efficacy of the SEM Program. We will also interview Executive Sponsors, Implementers, Energy Coaches, and other members of the Energy Team to reach the preponderance of evidence necessary for assessing program influence.

The present instrument shows the questionnaire designed to interview the SEM Implementers. Since the SEM Implementers identify Energy Coaches and make available other technical resources as needed to help the participant identify and implement efficiency opportunities, the interviews are designed to inquire about:

- The percent of their California business depends on utility or government efficiency programs
- The percent of their non-California business depends on utility or government efficiency programs
- The probability of remaining in business if government and/or utility incentives were not available
- The types of customers do you target
- The types of training provided to energy coaches
- The role of an organization's culture in achieving sustainability goals?

Opinion dynamics will conduct three interviews with the SEM Implementers.

Sample Variables and Read-Ins

<CONTACT>	Implementer Name
<PHONE>	Implementer Telephone
<DATE>	Date of Interview
<PA>	Program Administrator
<IMPLEMENTER>	Program Implementer
<REPORTING DATES>	The begin date for first reporting period and the end date for the second reporting period.

Survey Instrument

Introduction

May I please speak with **<CONTACT>**?

Hello. I'm calling from Opinion Dynamics on behalf of the California Public Utilities Commission as part of the evaluation of the Strategic Energy Management Program. I'll just refer to this as the "Program". We are interviewing implementers that participated in the Program to gain a better understanding of how the Program was implemented.

The interview may take as much as 20 minutes, but it could be much shorter, and any information that is provided will remain strictly confidential. We will not identify or attribute any of your comments or organization information to others, including the CPUC.

(IF NECESSARY): If you like, you can contact the following individual to verify the legitimacy of this survey. CPUC - Lisa Paulo: lp1@cpuc.ca.gov.

Table 1. PAs by Implementers

	Cascade	CLEAResult	Leidos	Total
SCE-SCG	8			8
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PG&E		12	10	22
Total	15	12	10	37

[IF CLEAResult] In California, as part of the Program, CLEAResult provided energy services to 12 PG&E customers.

[IF Leidos] In California, as part of the Program, Leidos provided energy services to 10 PG&E customers.

[IF Cascade] In California, as part of the Program, Cascade provided energy services to 8 customers served by Southern California Edison and Southern California Gas and 7 customers served by San Diego Gas and Electric.

Survey

1. Approximately, how many years has **<IMPLEMENTER>** been in business?
   00. Years **[OPEN END]**
   98. Don't Know
   99. Refused

2. How long has **<IMPLEMENTER>** been offering energy reduction services in California?
   00. Years **[OPEN END]**
   98. Don't Know
   99. Refused

3. Do you provide similar services in other states?
   01. Yes
   02. No
   98. Don't Know
   99. Refused

[ASK Q4 IF Q3=1, ELSE SKIP TO Q8]

4. Which states?
   00. **[OPEN END]**
   98. Don't Know
   99. Refused

5. Approximately, what percent of your non-California business depends on utility or government efficiency programs?
   00. Percent **[OPEN END]**
   98. Don't Know
   99. Refused

6. In these states, do the utilities or state and local governments typically provide incentives for behavioral (O&M changes) and/or capital measures?
   01. Yes, incentives for O&M changes
   02. Yes, incentives for capital measures
   03. Neither
   98. Don't Know
   99. Refused

[ASK Q7 IF 6 = 01 AND/OR 02, ELSE SKIP TO Q8]

7. In general, how do the size of these incentives compare to those in CA? More generous, less generous, or about the same?
   01. More generous
   02. Less generous
   03. About the same
   98. Don't Know
   99. Refused

8. Since 2017, approximately, how many nonresidential customers has **<IMPLEMENTER>** served?

00. Number of customers served**[OPEN END]**
98. Don't Know
99. Refused

9. Since 2017, approximately, what percent of these nonresidential customers has been in California?
   00. Percent of Nonresidential Customers **[OPEN END]**
   98. Don't Know
   99. Refuse

10. Since 2017, approximately what percent of your savings in California come from behavioral, retrocommissioning and operational (BROs) actions versus capital measures?
   01. Percent O&M Changes **[OPEN END]**
   02. Percent Capital Measures **[OPEN END]**
   98. Don't Know
   99. Refused

11. Since 2017, approximately, what percent of your California business depends on utility or government efficiency programs?
   00. Percent California Business **[OPEN END]**
   98. Don't Know
   99. Refused

12. What basic strategies did you use to recruit customers into the SEM Program?
   01. Flyers (paper or electronic)
   02. Relied on customers previously served by <IMPLEMENTER>
   03. Trade Forums
   04. Individual Presentations
   00. Other **[OPEN END]**
   98. Don't Know
   99. Refused

13. On a scale of 0 to 5, with a "0" meaning "No Effort" and a "5" meaning "Significant Effort", how much of an effort do you make to recruit hard-to-reach customers?

0	1		2	3	4	5
No Effort						Significant Effort

   98. Don't Know
   99. Refused

14. Since 2017, what sectors does **<IMPLEMENTER>** typically target (residential commercial, industrial agricultural-choose all that apply)?
   01. Residential
   02. Commercial
   03. Industrial
   04. Agricultural
   98. Don't Know
   99. Refused

4

15. Do you provide any training to your Energy Coaches?
    01. Yes
    02. No
    98. Don't Know
    99. Refused

[ASK Q16 IF 15 = 01, ELSE SKIP TO Q18]

16. What sort of training do you provide? **[READ IF NECESSARY]**: engineering, statistical modeling, curriculum design, techniques to train others, etc.]
    00. Types of Training **[OPEN END]**
    98. Don't Know
    99. Refused

17. Approximately, how many days per year are your Energy Coaches in this training?
    00. Days of Training **[OPEN END]**
    98. Don't Know
    99. Refused

18. On average each year, how many sites is each Energy Coach responsible for?
    00. Average Number of Projects **[OPEN END]**
    98. Don't Know
    99. Refused

19. What role does an organization's culture play in achieving its sustainability goals?
    00. **[OPEN END]**

20. When in the future do you expect see the financial support of utilities for delivering strategic energy management services to non-residential customers as no longer being necessary?
    [OPEN END]

On behalf of the CPUC, we would like to thank you very much for your kind cooperation. Have a good day!

5

G. Mapping of Metrics/Survey Questions to Logic Model

The table below contains 27 causal/communication linkages between facility activities and immediate, intermediate, and long-range outcomes.

Note: ECQ: Energy Coach Questionnaire

ETQ: Energy Team Questionnaire

IQ: Implementor Questionnaire

ESQ: Energy Sponsor Questionnaire

ChampQ: Energy Champion Questionnaire

Table 54: Mapping of Data to Logic Model Linkages

Link	Program Hypotheses That Underlie Each Causal Link in Logic Model	Sources	Specific Survey Questions
1	The First Energy Management Assessment measured the current energy management practices at a participant site. Based on the gap analysis, goals were formally established to close the gaps. A second EMA late in the second reporting period measures progress towards that goal.	First EMA scores	
2	An executive is identified who is willing to commit to the effort to improve energy management practices leading to their eventual support of the formalized expectations, goals, and objectives.	ETQ: Q13 ESQ: Q1 Champ B6-B7 Scoping Reports	ESQ Q1, Q2, Q5: Reasons for participation ESQ Q13, Q14 ETQ: Q13: how supportive was the sponsor? Champ B6-B7: Were they already doing something like this ETQ: Q5-12: How many meetings with the sponsor happened, was that enough/helpful? ESQ Q2: How they communicate knowledge to the rest of the company
3	Workshops are designed and conducted using adult education principles to teach energy management concepts and strategies along with peer-to-peer meetings will result in a critical mass of staff being more aware and better informed about energy management.	ECQ: Q6 ETQ: Q3-Q7 ETQ: Q9 ETQ: Q16 Champ Pro3-Pro4 Program files B8.4 ECQ: Q4	ECQ Q6: We expect "yes" for Q6; ECQ: Q6b: Do you use an adult-education specialist to assist in developing your workshops? ECQ: Q6c: Ever trained to train adults? ECQ: Q7: We want to see how effective they rate it Champ B8.4 Did champion receive Training in workshops & peer-to-peer meetings conducted by the implementor ECQ 4: Q4: How many cohort style

Link	Program Hypotheses That Underlie Each Causal Link in Logic Model	Sources	Specific Survey Questions
		EQ: Q7 ECQ: 8-10 ETQ: Q13 * Number of trainees at the workshops *Program files- How many participants in workshops? Review of workshop materials including PowerPoint presentations, learning objectives, handouts, spacing of workshops, contact hours of instruction, spacing of workshops (dates), post-workshop surveys *How many cohort style workshops were there versus individual workshops *Post-workshop surveys	workshops were there? ECQ: Q5, Q5b: How involved was the Energy Coach and their team in the design and delivery of these workshops? ECQ: Q6
4	The treasure hunt conducted by a team of facility staff and SEM implementers and identify opportunities for energy reduction found are populated in the Opportunity Register. Regular technical support from the Energy Coach assists in implementation.	ECQ: Q8-Q10 Champ B8.3 ECQ: Q1-Q2 ETQ: Q8 Gross Savings Team Number of O&M Changes and capital measures identified in Treasure Hunt and Opportunity Register	ECQ Q8-10: how engaged was everyone and was information was shared ETQ: Q3-Q4: How many meetings happened, was that enough? ETQ: Q5-12: How many meetings with the sponsor happened, was that enough/helpful? ETQ: Q16: how effective were the meetings with providing you with ideas to reduce use ETQ: Q9: was the frequency of the meetings with the coach about right? Champ Pro3-Pro4: How many meetings happened ECQ Q8-10: how engaged was everyone and was information was shared ECQ Q1/2: how often do the coaches meet with the energy champ/team and using what methods (expect to see in-person best). ETQ: Q8: How often did the team meet with the energy coach? ECQ Q5: we want to see if any coaches are responsible for too many projects (probably compared to the others) ECQ Q3: did they feel they did enough training services IQ Q15, 16, 17, 18: we want to see if any coaches are responsible for too many projects (probably compared to the others).

Link	Program Hypotheses That Underlie Each Causal Link in Logic Model	Sources	Specific Survey Questions
			ETQ: Q13: how supportive was the sponsor?
5	The implementer decides on specific milestone and performance incentives for reducing energy use through various behavioral/capital changes and offers these incentives to participants.	Champ B8.2 Gross Savings Team Program documentation (Table of milestone payments and performance Incentives offered)	What milestone and performance incentives were offered to participants?
6	Measurement and verification begins with the collection of energy and production data, which is then used to develop baseline models against which future energy use is compared to estimate savings.	Gross Savings Team Brief summary of baseline models and their quality	
7	The energy champion and members of the energy team are recognized for their energy-saving achievements	ETQ: Q28	ETQ: Q28: did they get recognition for their efforts
8	The EMA results form the foundation of formalized expectations, goals, and objectives with respect to energy management.	Program documentation such as scoping reports and first-year completion reports.	
9	The action plan is supported by the organization's management.	ETQ: Q13 Program documents; scoping study; year-1 completion report	
10	Organizational support leads to the identification of an energy champion and staff to serve on the energy team and the development of their defined roles and accountabilities.	Program documentation ETQ: Q5-Q7 ETQ: Q26-Q27 ESQ: Q5 ESQ: Q11-11b Champ B1-B5a Champ B8.7-B8.8 Champ Pros 17 Number of people assigned to energy teams	
11	The development of formal expectations, goals and objectives leads to the identification of an energy champion and staff to serve on the energy team and the development of their defined roles and accountabilities.		
12	Energy team members are assigned to attend workshops.	List of Workshops Completed (with dates and length)	
13	The training provided during the workshops leads to increased awareness and knowledge of energy management opportunities.	ETQ: Q16, Q16a End-of-Workshop Surveys: Self-reported increases in awareness and knowledge	ETQ: Q16: how useful were the workshops and peer-to-peer meetings in providing you and your team with ideas to reduce energy use that that you had not previously known about? ETQ: Q16a: how effective were the

Link	Program Hypotheses That Underlie Each Causal Link in Logic Model	Sources	Specific Survey Questions
		Leidos competency exam	workshops and peer-to-peer meetings in raising your general levels of energy efficiency awareness?
14	The treasure hunt and recommended opportunities overcome the information-search barrier and asymmetric information barrier by increasing awareness and knowledge of energy management opportunities.	ECQ: Q11-Q14 ETQ: Q15 Champ Pro11-Pro12 ETQ: Q15a ETQ: Q16	ECQ: Q11-Q14: how effective was the transfer of knowledge, if the participants received adequate support, and what challenges were present ETQ: Q15: How useful was the treasure hunt with providing you with ideas to reduce use Champ Pro11-Pro12: how much time was spent on the treasure hunt ETQ: Q15a: How effective was the Energy Treasure Hunt in raising your general levels of energy efficiency awareness? ETQ: Q16: How useful were the workshops and peer-to-peer meetings in providing you and your team with ideas to reduce energy use that that you had not previously known about? ECQ: Q15-Q18: Effect of Covid-19
15	The offer of milestone and performance incentives reduce the costs of making O&M changes and the incremental costs of installing capital measures and increase the likelihood of their adoption.	ETQ: Q38-Q39 ChampQ: QN3b, QN3bb	ETQ: Q38-Q39 how much influence did the program have on implementing the measures ChampQ: QN3b, QN3bb
16	The development of baseline models and production data allow for the on-going tracking of energy use.	Gross Team Reports	Gross Team reports on baseline model performance
17	Increased awareness and knowledge of energy management opportunities motivates participants to implement capital measures and O&M changes.	ETQ: 20-25 ETQ: Q29 ETQ: Q34-Q36 ETQ: Q38-Q39 ESQ: Q12 & Q14 ChampQ: QN3a, N3c, N3g, N3r_a, N3c, N3g, N3r_a, N3s_a, N3s_b, N3s_c	ETQ: Q20-Q25: How much influence did the program have on the new measures ETQ: Q29- challenges to using the treasure hunt knowledge ETQ: Q34-Q363Q6- any push back from members at company ETQ: Q38-Q39 how much influence did the program have on implementing the measures ESQ: Q12 & Q14: Do projects/recommendations come out of the program, how much did the program influence those decisions? ChampQ: N3a: Technical support and information provided by the Energy Management Coach ChampQ: N3c: Information provided in the Energy Treasure Hunt

Link	Program Hypotheses That Underlie Each Causal Link in Logic Model	Sources	Specific Survey Questions
			ChampQ: N3g: Training or information provided in program workshops and peer-to-peer meetings ChampQ: N3r_a: The Energy Management Assessment ChampQ: N3s_a: Assistance in the Development of an Energy Management Information System ChampQ: N3s_b: Recommendations from the Energy Team ChampQ: N3s_c: Support from the Executive Sponsor
18	On-going monitoring of energy use leads to the identification and implementation of capital measures and O&M changes.	Gross Team Reports	
19	The implementation of capital measures and O&M changes lead to energy and demand savings.	Gross Savings Team Verified energy and demand savings	Energy and demand impacts provided by Gross Savings Team Is there a system in place to produce quantified usage and savings? If yes, ask if team plans to continue consistent tracking of savings. RR: Let's discuss. Champ B8.2 Did champion receive Milestone and/or performance incentives?
20	Being recognized for their energy saving abilities will lead to their persistent implementation of an energy management plan.	ETQ: 37 ESQ: Q4	ETQ: Q37: recommendations for continual energy management ESQ: Q4: how does the sponsor ensure continuation of actionable energy knowledge Will the company continue to look for more EE projects after the program ends?
21	Continued tracking of energy use supports the consistent quantification of savings.	Gross savings team (did participants find that the tracking of savings reinforced their consistent quantification of savings) -Second-Year Completion Report	
22	Verified energy and demand savings along with incentives encourage the persistent implementation of an energy management system at the facility	ESQ: Q4 ESQ: Q15	ESQ: Q4: How does the sponsor ensure continuation of actionable energy knowledge Will the company continue to look for more EE projects after the program ends? We could add a 0-10 question to the Executive Sponsor survey? ESQ: Q15: Will the company continue to look for more EE projects after the program ends? We

Link	Program Hypotheses That Underlie Each Causal Link in Logic Model	Sources	Specific Survey Questions
			could add a 0-10 question to the Executive Sponsor survey?
23	Energy and demand savings leads to environmental and other non-energy benefits.	Provided by the Gross Savings Team CPUC-approved CO2 reductions per kWh and therm	
24	Consistent quantification of savings supports the persistent implementation of an energy management system at the facility	ESQ: Q7, Q8, Q9	ESQ: Q7, Q8, Q9: Did a policy get put into place at the company (or is there a plan to implement one) and we get a copy of that policy?
25	Persistent implementation of an energy management system eventually becomes standard practice.at other facilities	ESQ: Q7, Q8, Q9, Q15, Q17,	ESQ: Q7, Q8, Q9: Did a policy get put into place at the company (or is there a plan to implement one) and we get a copy of that policy? ESQ: Q15: How likely is your company to continue to look for more energy efficient projects after the Program ends? ESQ: Q17: How important is the on-going training of your employees with respect to energy management?
26	The standard practice of implementing an energy management system will lead to the persistent reduction of energy intensity	ESQ: Q15, Q19	ESQ: Q15: how likely is your company to continue to look for more energy efficient projects after the Program ends? ESQ: Q19: do you plan on having some of these other locations participate in the SEM program?
27	Persistent reduction in energy intensity will lead to long-term increases in environmental and other non-energy benefits	Linked to the probability of that Link 26 is confirmed.	

H. Literature Review: An Assessment of the Plausibility of the SEM Program Design

To assess the plausibility of the SEM program design, we conducted a relatively brief review of the literature to determine whether it is plausible that the SEM Program activities could lead to the expected outputs and whether these outputs could plausibly lead to the expected short-, mid-, and long-term outcomes[73]. The literature we reviewed covered such areas as:

- Prior net impact evaluations of SEM programs
- Best practices in SEM program design
- Adult education
- Organizational change and development
- Organizational behavior
- Theory-driven evaluation

While we were unable to find any evaluations of SEM-type programs that estimated net impacts/NTGRs or attempted to verify any causal mechanisms, we were able to find one very useful report by Wolfe et al. (2014) who conducted a comprehensive review of the peer-reviewed behavioral-change literature that addressed effective strategies to motivate organizations and the individuals within them to produce sustainable energy savings. However, they note that the majority of their research draws on psychological frameworks and involves mechanisms that act on individuals or small groups; relatively little is focused on the behavior of complex formal organizations. For individuals and small groups, they were able to identify the following key strategies for promoting behavioral change:

Table 55: Interventions to Promote Behavioral Change

Intervention	Description
Providing information and outreach	Systematic attempts to provide important knowledge beyond standard norms to particular segments of a community, with the intent of initiating change
Giving feedback	Provide information on how well an individual or group is performing relative to a specified goal, how current behavior outcomes compare to past outcomes, or how personal behavior outcomes compare to those of other individuals or groups
Persuading	Persuasion is the influence of beliefs, attitudes, intentions, motivations, or behaviors. Persuasion techniques go a step beyond information and outreach in that they explicitly aim to convince people to take certain actions.
Offering rewards and incentives	Rewards and incentives serve to induce or motivate behavioral change

[73] The references for this literature are presented in Appendix I.

Intervention	Description
Changing defaults, nudging choice, and enabling adaptive comfort	How building space is configured and how options are presented can make huge differences in the choices people make.
Gaining commitment	Commitments are oral or written pledges to change behavior
Tapping into social norms	Social norms are the explicit or implicit rules specifying what behaviors are acceptable within a society or group.
Using social marketing in communities	Community-based social marketing is a programmatic approach focused on barriers to and benefits of changing behavior at the community or group level.
Responding to an urgent situation	Urgency is a quality or condition suggesting immediate or pressing importance.

With the exception of the use of social marketing, all are evident in the Program documentation and the Design Guide.

They go on to note some limitations of the available research:

> While there is a growing body of peer-reviewed literature on behavioral change, many significant gaps remain. In particular, the research on behavioral change related to sustainability has focused on individual behavior and primarily for the residential setting; it remains to be shown whether this knowledge is applicable wholly or in part to social action oriented toward energy and resource efficiency in agency workplace settings and across different subpopulations (e.g., building/energy managers, organizational managers, office workers. (p. 9-1)

Their review also found support for establishing key rules, roles and tools that can help structure an action plan for behavior change to achieve sustainability and building performance goals:

- Rules: Individual, group, and institutional rules, both formal and informal, directly influence occupant behaviors and must be identified and addressed. What are the policies, procedures, and norms that support the present behaviors and the principles that apply to changing those rules?
- Roles: It is important to determine the roles that are essential in achieving a goal and who, in which roles, can effect change that will solve the problem. What/whose behavior matters with regard to that problem? What needs to change?
- Tools: It is essential to assure that the organization's infrastructure is in alignment with the behavioral changes necessary for achieving sustainability objectives. What technologies, processes, and systems are in place or needed to support desired behavior changes and outcomes?

We reviewed the SEM program implementation plan and other documentation such as the EMA documentation for each PA and implementer and the Design Guide and found evidence that these elements appear to be in place. For example, the EMAs all assess current policy (rules) regarding energy use, the Design Guide describes the responsibilities of the Energy Coach, Executive Sponsor, Energy Champion and members of the Energy Team (roles), the implementation plans describe various tools to model and track energy performance (energy adjustment model) and to help assess progress on the Energy Management System.

While it might be intuitively appealing to assume that the same strategies will be effective for non-residential customers, we still must empirically evaluate the extent to which these SEM strategies cause the outcomes (identified in the SEM logic model) among these non-residential participants.

They added one more caveat:

> The number of case studies (both anecdotal and systematic) is growing: however, success stories often do not draw on scientific theory and methods to generate an improved evidence base. Thus, more rigorous analysis and social science expertise are needed to identify what does and does not work. (p. 9.1)

This evaluation, within its budget constraints, attempted to contribute to the body of evidence about what does and does not work.

While Wolfe et al. (2014) provided some support regarding the plausibility of the SEM designs being implemented, there are several areas on which Wolfe et al. (2014) had much less to say. For example, leadership, training effectiveness, and effecting cultural change[74]. To address these issues, we expanded our review to include the broader organizational literature that discusses leadership and organizational change and development and adult education literature in order to identify any empirical research that could be used to assess the plausibility of the SEM causal mechanisms.

Leadership

There are many definitions of leadership but one of the most straightforward is provided by Robbins and Judge (2019) who define it as ". . . the ability to influence a group toward the achievement of a vision or set of goals" (p.394). Although leadership is traditionally associated with the behavior of senior executives, leadership can be exercised throughout the organization. The SEM program is a good example since within each participating organization there are several leaders, the Executive Sponsor, the Energy Champion and the members of the Energy Team[75]. Note that leadership is not mentioned in the logic model; it is only implicit and manifested in the extent to which they are successful in engaging and motivating those below them to improve management of energy use within their organizations.

Now, there is general agreement that leaders can impact an organization's performance (Weiner and Mahoney 1981; Barrick et al. 1991; Hambrick 1989; Hitt and Tyler 1991). However, the literature is less clear about the impact of leadership on organizational change. Kotter and Heskett (1992) found that the "Single most visible factor that distinguishes major cultural change that succeed from those that fail is competent leadership" (p. 84) while others are less sanguine about their effectiveness (Burke, 2018; O'Reilly at al., 2014). Burke (2018) notes that:

> What has not been clear from the literature is the impact of leadership on organizational change. There are numerous cases that anecdotally support the argument that leadership

[74] Wolfe et al. (2014) also said nothing about how to *evaluate* the multiple causal mechanisms inherent in the very complex SEM-type programs.

[75] The Energy Coaches are not listed since they are external to the organization, and although they can instruct and influence those within the participating organizations, they have no formal organizational authority. Energy Coaches can provide strategies for sustainability but ultimately it is the responsibility of the leaders within the organization to achieve it.

> matters in times of change; see, for example, Burke and Trahant (2000). But there has been little evidence that scientifically demonstrates the leader's impact (p. 298).

However, we agree with Burke who went on to note that:

> It seems reasonable to assume, nevertheless, that because there is mounting evidence that leaders affect organizational performance in general, surely, they have an impact on organizational change in particular. (p. 298)

Another complicating factor that introduces additional uncertainty is that, within any of the 35 participant organizations, there is likely some variation in the leadership styles among Executive Sponsor, the Energy Champion and members of the Energy Team. Over the years, researchers have developed many leadership types (Robins and Judge 2019; Schein 2017). For example, some leaders might be autocratic while others might be democratic or even completely "hands off." What they agree upon is that a particular type of leadership must match the situation (e.g., a crisis situation versus day-to-day tasks) and the type of people they are attempting to lead (e.g., some people might not respond well to an autocratic leader). Since we don't fully understand the challenges within each of the 35 participating organizations and have no idea about the various leadership styles and those they are attempting to lead, it is impossible to predict how successful these leaders will ultimately be.

While leaders are not always effective, we concluded that it is certainly plausible that the leaders participating in the SEM program will have some degree of impact on individual employees, small groups and the entire organization. To assess the effectiveness of leadership in short-, mid- and long-term outcomes, we surveyed the Executive Sponsors, the Energy Champions, and members of the Energy Team.

Training and Development

Training and development is critical in achieving short-term change. It is also a critical first step in achieving the cultural change necessary for maintaining the savings achieved during Cycle 1 and increasing savings over the mid- and long-term. Effective training is only the first step since the verified savings might not persist and new savings might never materialize unless there are structural changes including new policies, procedures, and job descriptions that codify and enforce continuous improvement in energy management. In this Section, we focus on the adult education theories that support the training.

The SEM program has multiple objectives but the one that is most relevant to workshop training is to identify, prioritize, and implement facility-wide energy savings opportunities. This objective at a very general level tells us what participants must learn through the coaching and workshops. It is critical that the more specific objectives for each of the workshops are anchored in this very general objective. The general hypothesis is that workshops organized and delivered by experience trainers in a manner that is consistent with adult education principles will increase the awareness and knowledge of energy management, leading to the implementation of O&M and equipment projects that will produce energy and demand reductions. In the SEM logic model in Figure 27, we see that that there are three linkages (i.e., causal mechanisms) related to these general hypotheses for Links 3, 13, and 17.

To be effective, these workshops & peer-to-peer meetings must be designed and conducted according to adult education principles and result in participants gaining the necessary awareness, knowledge

and techniques of energy management that can be applied cost-effectively at their facility. If we cannot confirm any one of these three causal mechanisms, using the preponderance of evidence criterion, we will be less confident that the workshops were effective and that the Program caused the mid- and long-term outcomes.

Although the implementers did not mention adult education and its underlying social science theories, we conducted a brief review of the literature in order to identify useful metrics by which we could verify these three causal mechanisms. Below, we focus on each of these three causal mechanisms.

The hypothesis for causal mechanism #3 is pretty mechanical and easily confirmed – implementers conduct workshops that result in a verified number of people being trained. The key area of uncertainty is the extent to which the curriculum materials and activities used in these SEM workshops conformed to best practices in adult education (Knowles, Holton and Swanson, 2015; Caffarella 2002; Galbraith 2004; Jarvis, 2010; Beich 2014)). If they were, then the resulting self-reported levels of awareness and knowledge regarding energy management should be greater than if they were not. While many of these authors have listed any number of adult education principles, we focused on four primary principles of designing and delivering an adult education program (Caffarella 2002): 1) developing learning objectives, 2) selecting instructional techniques, 3) assessing results and 4) devising transfer of learning plans. We discuss best practices in the following sections.

Development of Learning Objectives: The first is the development of clear and understandable learning objectives for each instructional session and ensure that they match the proposed learning outcomes. Learning objectives are useful for four major reasons. They provide: 1) a focus and consistency for the design of instruction, 2) guidelines for choosing course content and instructional methods, 3) a basis for evaluating what participants have learned and 4) directions for learners to help them organize their own learning (Bloom 1949; Smith and Ragan, 1999; Anderson and Krathwohl, 2001). Tracey (1992) outlined five general rules for communicating objectives clearly and correctly: 1) avoid unfamiliar words, 2) do not confuse or misuse words, 3) be concise, 4) seek simplicity and 5) review what has been proposed to make sure the objectives say what you want them to say.

In addition, each objective 1) should reflect, experiences and abilities and potential participants, 2) is practical and doable, 3) is attainable in the time period proposed, and 4) is measurable. The identification of what trainees must learn is grounded in the learning objectives and guides the formation of course content.

Selecting Instructional Techniques: Next, program implementers must choose instructional techniques 1) that match the proposed learning outcomes and 2) that the instructor is capable of using.

Given the objectives of these workshops, a variety of instructional techniques can be used and it is important to match the technique to each objective. For example:

- A lecture might be appropriate if the particular learning objective is to present basic facts, concepts or principles.
- For a learning objective that involves problem solving, one could divide into smaller groups and engage in a relatively unstructured peer-to-peer exchanges of ideas about a specific problem or issue. That adult learners can benefit from exchanging their experiences with each other while connecting them to new learning has been identified as a critical factor in adult education

(Donavant et al., 2013; Freedman et al., 2012; Kenner & Weinerman, 2011; Quinn & Leligdon, 2014).

- For a learning objective that involves carrying out a specific set of activities, an instructor could use a demonstration-with-return-demonstration approach in which a resource person performs a specific operation or task showing others how to do it. The participants then practice the same action. Or, the groups can perform an activity characterized by structured competition that provides the opportunity to practice specific skills.

Another basic question in selecting techniques is whether the instructors have the knowledge, skill and confidence to handle a particular technique. Does he or she feel comfortable using it? If not, the instructor's discomfort may be distracting.

Assessment of Results: Assessment of the results is also considered to be best practice in adult education. Instructional assessment or evaluation is done for a variety of reasons (Kirkpatrick, 2016; Brookfield, 1992; Diamond, 1998; Wiggins, 1998; McMillian, 2001):

- To assess participants' background, experiences, and readiness for learning when they enter an activity or program.
- To improve the instructional process and materials
- To ascertain whether the instructional event has actually produced the desired results
- To assist participants to be more effective learners
- To provide data for the overall program evaluation.

Devising Transfer-of-Learning Plans: Transfer of learning is the effective application of program participants of what they have learned as a result of attending an education or training program (Kemerer, 1991; Killion and Kaylor, 1991). This is not a new component of the planning process but one that is receiving more attention as both participants and sponsors of education and training programs demand more concrete and useful results.

There are a number of factors than can enhance transfer of learning including the program participants, the program design and execution, program content, changes required to apply learning, and organizational context. Examples of each are listed below:

- Program Participants
  - Collaborative teams are best
  - Predisposition to learning and applying what is learned
- Program Design and Execution
  - Active learning, including application exercises, is used extensively
  - Close match between the training environment and the applications context
- Program Content
  - Focus of content is on application
  - Relevant, useful and practical
- Changes required to Apply Learning

  - Time needed to make changes is recognized
  - Opportunities exist to integrate what is learned into current roles
- Organizational Context
  - Peers, key leaders and supervisors offer concrete and useful support
  - Tangible rewards for learning transfer are apparent

There are a variety of techniques that can increase the transfer of learning such as:

- Coaching: Peers or supervisors can assist learners in making specific changes in their roles.
- Mentoring: A person with more experience works over an extended time period with a less experienced person to promote professional development through guidance, feedback, support, sharing of resources, and access to networks of other helpful people.
- Transfer Team: Teams of people are formed prior to the education and training program who are committed to working together before, during and after the event to assist each other in the transfer of learning process.
- Support Groups: Groups of participants who meet regularly to share problems or practices related to learning transfer.

For this analysis, we relied primarily on two key sources of data provided by the implementer:

- Analysis of responses for all of the end-of-workshop surveys administered by the Energy Coach for each of the four PAs.
- Review of workshop materials for the workshops conducted by implementer for each of the four PAs during the first reporting period. Note that since the budget would not allow for a careful examination of all 40 workshops, we relied on a convenience sample of 5 workshops conducted during the first reporting period for each PA. The assumption is that these workshops represent the extent to which all workshops conducted by each implementer were designed and implemented according to similar principles. For these selected workshops, we obtained and reviewed each implementation plan, reviewed all instructional materials (e.g., PowerPoint presentations, student materials, topics covered and the time allotted to each) and planned activities.

Other data collected to support this analysis are described in Section E.1.4.

Throughout our analysis, we relied on our prior experience in adult education and the evaluation of training programs as well as standard sources of adult education best practices mentioned in Section 1 to guide this assessment. Based on all of these quantitative and qualitative data, we assessed the extent to which they are consistent with principles listed earlier. Using a scale of 0 to 5, where a 0 means "Not at All Consistent" and a 5 means "Extremely Consistent", we assessed the extent to which the 1) learning objectives, 2) instructional techniques, 3) the assessment results and 4) the transfer of learning plans were consistent with the adult education principles.

Causal mechanism #13 is concerned with whether the workshops, designed and implemented according to basic adult education principles, resulted in an increased awareness and knowledge of energy management opportunities. The hypothesized mechanism is that the training of staff in energy

management and exchanging ideas with peers will result in an increase in awareness and knowledge of energy management opportunities.

For this analysis, we relied primarily on end-of-workshop survey data provided by each implementer for the four PAs. The survey instruments in Appendix F cover relevant topics such as the extent to which they gained new information about energy management and whether they planned to use the skills acquired in the workshops.

Finally, causal mechanism #17 is concerned with whether the increased awareness and knowledge resulted in the application of this awareness and knowledge to better manage the energy use at their facility and implementation of O&M and equipment projects.

Cultural Change

As noted above, the SEM program also attempts to transform the organizational culture with respect to energy use so that any short-term reductions and energy management and continuous improvement strategies and associated savings persist[76]. This is consistent with many scholars who suggest that the pathway for the adoption of corporate sustainability principles leads via the adoption of a sustainability-oriented organizational culture (Linnenluecke and Griffiths 2009). Schein (2017) defines organizational culture as:

> … the accumulated shared learning of that group as it solves its problems of external adaptation and internal integration; which has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, feel and behave in relation to those problems. This accumulated learning is a pattern or system of beliefs, values, and behavioral norms that come to be taken for granted as basic assumptions and eventually drop out of awareness. (p. 6)

This definition suggests that changing a culture can be difficult and cannot be done quickly. Some, such as Fitzgerald (1988), argue that it's impossible to change an organization's culture. Others are more hopeful and have written many books proposing a variety of models for doing just that (Cameron and Ettington 1988; Martin 1992; Beyer and Cameron 1997).

It's important to point out that, while cultural change does not appear as an outcome in the logic model, it is clearly implicit since 1) the persistent implementation of an energy management plan, 2) the consistent quantification of savings, and 3) the standard practice of energy management do not occur unless there is sufficient cultural change. This means that we must examine the entire network of the causal mechanisms prior to causal mechanism #21 in our attempt to verify, using the preponderance of evidence, the role of the Program in causing any measurable changes in organizational culture. This, of course is the rationale for adopting a theory-driven approach which involves the investigation of multiple causal mechanisms or lines of influence.

The general hypothesis is that, over a two-year period, organizational commitment, technical support and training in energy management, on-going feedback about energy use, staff recognition of their energy management efforts, and performance and milestone incentives will lead to energy and demand savings in the mid-term and cultural change in the long term sufficient to continuously

[76] The current EUL for SEM programs is 5 years was adopted in DD.17-09-025.

improve the energy management framework and increase savings. Linnenluecke and Griffiths (2010) emphasize that cultural change is critical since organizational culture is often cited as the primary reason for the failure of implementing organizational change programs. They go on to note that researchers have suggested that while the tools, techniques and change strategies may be present, failure occurs because the fundamental culture of the organization remains the same (Cameron & Quinn, 2006; Cameron et al., 1993; Jarnagin & Slocum, 2007).

While there is a vast literature of organizational culture and how to change it, we selected Schein's basic framework for thinking about culture that includes artifacts, espoused beliefs and basic underlying assumptions. *Artifacts* are the observable (and self-reported) routines and rituals as well as the organizational processes by which such behavior becomes routine. This includes such structural elements as charters and formal descriptions of how the organization works such as corporate policies and procedures. *Espoused beliefs* and values include ideals, goals aspirations and ideologies and are often reflected in a company's mission statement. *Basic underlying assumptions* are the unconscious, taken-for-granted beliefs and values that determine behavior, perception, thought and feeling. As one moves from artifacts to basic underlying assumptions, one moves deeper into culture of the organization. Achieving deep cultural change with respect to energy use suggests the energy-use related behaviors must become so routine that they are simply taken for granted.

To complicate matters further, organizational cultures can be categorized. For example, Robbins and Judge (2019) developed four types of organizational culture.

1. "The Clan." A culture based on human affiliation. Employees value attachment, collaboration, trust, and support.
2. "The Adhocracy." A culture based on change. Employees value growth, variety, attention to detail, stimulation, and autonomy.
3. "The Market." A culture based on achievement. Employees value communication, competence, and competition.
4. "The Hierarchy." A culture based on stability. Employees value communication, formalization, and routine. (p. 545)

These four types differ in terms of their internal versus external focus and their flexibility and stability. For example, a culture that is consistent with the Hierarchy type might be more resistant to changes with respect to the routines of energy management. While we cannot know the various type of cultural among the 30 sampled projects, we can be sure that they are not the same and will likely differ in terms of how they respond to the more or less standard set of SEM interventions that were offered in order to achieve lasting cultural change with respect to energy management.

While cultural change with respect to energy management is arguably the most important long-term outcome of the SEM program, it is also one of the most difficult outcomes to measure accurately. Various factors make it even more difficult to attribute cultural change to a given intervention such as the SEM program. First, it involves a set of interrelated program activities over time. This means that no single linkage is sufficient to bring about cultural change that is expected to lead to the continuous improvement of the energy management system and the resulting persistence of existing savings and the generation of new savings. Rather, each program activity, output and outcome is to some degree *necessary* to bring about cultural change.

The second factor is that lasting cultural change could take more than two to three years to complete. This means that any cultural change in the short term might be small and only suggestive of longer-term cultural change. To assess the full extent and persistence of cultural change will require the tracking of participants over time. Both of these factors make the analysis of the SEM program's contribution to any lasting cultural change more complex and uncertain.

For the SEM program, this complexity is somewhat reduced since, as noted earlier, the goal of the SEM program is not to seek the broad cultural change discussed in the organizational development literature but cultural change with respect to a narrow slice of organizational concerns, the management of its energy use. To that end, participants have identified an Executive Sponsor whose role was to develop a mission statement about sustainability and support the overall effort and perhaps eventually to codify these new behaviors in the form of guidance documents or corporate policies. They are implementing a set of activities that, if faithfully and effectively carried out, are expected to result in some degree of cultural change. For example, they have identified someone to serve as their organization's Energy Champion and formed an Energy Team representing the various departments and trained them throughout the two reporting periods with the on-going support of the implementer's Energy Coach. While there is little empirical support for the link between organizational culture and sustainability, there are numerous anecdotes and organizational theories that suggest that such strategies can plausibly change an organization's culture in ways that can persist with respect to energy use (Galpin, 2015; Linnenluecke and Griffiths, 2009; Wolfe et al., 2014).

Unfortunately, there is always some resistance to cultural change. As was mentioned earlier, Schein (2004) found that there are different dimensions of organizational culture: the observable culture (the visible organizational structure, processes, and behaviors), espoused values (strategies, goals, and philosophies), and underlying assumptions (unconscious beliefs and perceptions which form the ultimate source of values and action). To the extent that the underlying assumptions are inconsistent with the organization's sustainability vision, resistance within certain subgroups will pose a barrier to change. Harris and Crane (2002) also note that the diffusion of a sustainability-oriented culture is hindered by the presence of various subcultures who hold opposing values. For example, some members of the Energy Team might feel that the additional duties will require time and effort and, as a result, compromise their ability to carry out their primary job responsibilities. Still others might not fully agree that the climate crisis is that serious and is only a distraction. All we can do as evaluators is to observe what strategies the participating organizations used to transform their cultures and assess how well they worked. These results will contribute to the evidence base for behavioral and institutional strategies aimed at saving energy and at operating buildings sustainably over the long term.

Our job as evaluators was to assess how faithfully these activities were implemented and how effective they were as well as measuring any changes in the organizational culture that would indicate that this energy management framework will persist. Because our sample of 30 participants represents 30 unique organizations and cultures, to develop a valid and reliable measure of organizational culture with respect to energy use was far beyond the scope of this evaluation. Therefore, using the logic model and organizational change and development literature (Burke, 2018; Wolfe et al., 2014) as guides, we identified and developed a variety of cultural-change metrics. Data sources, described in the Section E.1.4, included interviews with the management at each implementer, the Energy Coaches, Executive Sponsors, Energy Champion, and on-line surveys of members of the Energy

Team. From each implementer, we also obtained the energy management assessments (EMAs) that were conducted during the beginning of the first reporting period and at the conclusion of the second reporting period.

The surveys of the Energy Coach, Energy Team members, and the Executive Sponsor (described below in Section E.1.4) focused on such topics as the sustainability of energy management strategies, barriers to cultural change, and whether on-going energy management has been incorporated into the job descriptions of the Energy Team.

However, the primary metric of organizational culture with respect to energy management was the energy management assessment (EMA) developed by each implementer and administered once early in the first reporting period and again late in the second reporting period. The EMAs involved collecting a combination of quantitative and qualitative data at each site. Note that while the three EMAs are organized differently and contain different levels of detail, they recognize that cultural transformation takes commitment from all levels of the organization and share certain common themes such as:

- management support
- energy policy,
- planning,
- employee engagement,
- implementation,
- measuring and reporting, and
- third-party certification.

This is not surprising since all four PAs were guided by the same design and EM&V guidelines (Dias, 2017; Therkelsen, 2017).

While not formally recognized by the implementers as a measure of organizational culture, we treated the EMAs as a measure of the organization's culture since they address the obvious artifacts and espoused values related to energy use. However, as a measure of organization culture with respect to energy use and sustainability, the EMA is somewhat limited since it is based on an input from a small subset of employees rather than a survey of all employees. While the EMAs have no established measure of validity, we concluded that the EMAs have what is called "face validity," i.e., they appear to be measuring what they are supposed to be measuring and were designed to help organizations define and diagnose their organizational culture to determine if it is healthy and well aligned with the organization's mission to integrate sustainability into their business. The findings of the EMAs were designed to support the organization so that it can really tailor and fine tune its journey as it attempts to transition from the current patterns of behaviors to those that will underpin the strategic goals of the organization. In Appendix I, we summarize the general framework and scoring of the EMAs for each of the three implementers and describe the EMA data provided by the implementers covering both reporting periods to support the analyzes of cultural change.

We conclude by noting that Figure 1 only addresses activities that were carried out during the Cycle 1 (year 1 and year 2), which were the focus of this evaluation. However, it is possible that participants choose to continue participating into a third and fourth year, referred to as Cycle 2. A Cycle 2

program design guide has been developed (a Cycle 3 design guide is under development). From a participating customer's perspective, the Cycle 2 Design Guide states that the objectives for Cycle 2 are:

1. Continue to implement energy performance improvement opportunities2 and save energy and
2. Develop a systematic approach to managing energy that can continue with targeted program support.

Cycle 2 Design Guide also states that at the end of the fourth year the participant will:

1. Have identified and implemented cost-effective energy performance improvement opportunities to meet their energy performance targets.
2. Have understood and prioritized IDSM opportunities as part of their overall energy performance improvement opportunities, and knows how and when to implement those opportunities.
3. Have an energy team that understands, owns, and leads their energy business practices with targeted program support.
4. Will have developed and implemented energy business practices to continuously manage energy and to continuously improve and track energy performance.

The key differences, from a participant's perspective, between Cycle 1 and Cycle 2 are that the Program's role shifts:

1. *From* education focused on energy efficiency *to* education that helps a participant make informed decisions regarding the selection of multiple energy performance improvement opportunities, including Integrated Demand Side Management opportunities, that best meet the customer's needs.
2. *From* leading customers through prescriptive activities (goal setting, treasure hunts, etc.) *to* helping each customer develop, implement, and maintain business practices that lead to the continual application of an energy management system.

Continued participation on the SEM program is expected to increase the likelihood of cultural change which is hypothesized to 1) increase the likelihood that the verified savings in the Cycle 1 will persist, 2) lead to the routinization of continuous improvement, and 3) lead to additional persistent savings. Cycle 2 participation can be viewed as another indicator of organization commitment to identifying new strategies for energy management *that are unlikely to have been identified absent the SEM program*. Given the potentially large impact of Cycle 2 participation on key outcomes, we identified those customers who have thus far signaled their intent to participate in Cycle 2.

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J. General EMA Framework and Scoring

J.1 Leidos

The objective of the Leidos Energy Management Assessment tool is to measure the degree of implementation of energy management practices for a SEM participant as defined in ISO 50001:2011. The ISO 50001 standard is based on the management system model of continual improvement ("Plan-Do-Check-Act") and allows us to identify and to characterize EnMS practices in the participant organization. ISO 50001 consists of seven Primary categories and within each primary category, there are a number of sub-categories. The overall progress is the average of the equally weighted primary level categories. Below, we list the primary level categories and the subcategories within each. Each subcategory is scored from 0% to 100% (note the category numbering is carried over from Leidos).

- 4.1. General Requirements
- 4.2. Management Responsibility
  - 4.2.1. Top mgmt. responsibility
  - 4.2.2. Management Representative
- 4.3. Energy Policy
- 4.4. Energy Planning
  - 4.4.1. General
  - 4.4.2. Legal requirements and other requirements
  - 4.4.3 Energy review
  - 4.4.4 Energy baseline
  - 4.4.5 Energy performance indicators
  - 4.4.6 Energy objectives, energy targets and energy management action plans
- 4.5. Implementation and Operation
  - 4.5.1. General
  - 4.5.2 Competence, training and awareness
  - 4.5.3 Communication
  - 4.5.4 Documentation
    - 4.5.4.1 Documentation requirements
    - 4.5.4.2 Control of documents
  - 4.5.5 Operational control
  - 4.5.6 Design
  - 4.5.7 Procurement of energy services, products, equipment and energy
- 4.6. Checking

4.6.1 Monitoring, measurement and analysis

4.6.2 Evaluation of compliance with legal requirements and other requirements

4.6.3 Internal audit of the EnMS

4.6.4 Nonconformities, correction, corrective action and preventive action

4.6.5 Control of records

4.7. Management Review

4.7 .1. General

The SEM Energy Coach leads a gap analysis work session with the participant where the requirements in each of the sub-categories are reviewed and the degree of compliance with each requirement is scored. The SEM Energy Coach actually conducts the EMA assessment and uses the tool and manages the scoring. Based on the gap as measured during year-1 of participation, a workplan is developed for closing specific gaps as determined between the participant and the SEM implementer.

J.2 CLEAResult

The Energy Management Assessment (EMA) is designed to help a company evaluate the current state of their energy management program, identify gaps and opportunities for improvement and establish what activities are needed to reach a desired future state. This is accomplished through interactive discussion and self-rating around the following 12 management areas.

1. Executive Understanding and Commitment
2. Policy/Charter & Goals
3. Planning & Budgeting
4. Energy Team
5. Employee Engagement
6. Training Development
7. Procurement & Partnering
8. Data Collection & Management
9. Performance, Measurement & Reporting
10. Audit, Review & Control
11. Third Party Certification & Recognition
12. Overall Effectiveness

For each management area, the CLEAResult facilitator asks participants to discuss and rate what level they are currently at. They then ask participants to discuss and determine what level they desire to be, i.e., their goal. The score on each is divided by the goal set for each management area to yield a score between 0% and 100% relative to the achievement of its goal, which ranged from 1 to 3. The

overall score is calculated as the sum of all the scores across all 12 management areas divided by the sum of the goals across all management areas, again yielding an overall score between 0% and 100%. Table 56 illustrates the scoring across the four stages of plan, do, check and act.

Table 56: Scoring of Management Areas

	Management Areas	EMA	Goal	Score
Plan	Executive Understanding & Management	1	3	33%
	Policy/Charter & Goals	1	2	50%
	Planning & Budgeting	1	3	33%
Do	Energy Team	2	3	67%
	Employee Engagement	2	3	67%
	Training & Development	1	3	33%
	Procurement & Partnering	2	3	67%
Check	Data Collection & Management	1	3	33%
	Performance, Measurement & Reporting	1	3	33%
Act	Audit, Review & Control	1	3	33%
	Third-Party Certification & Recognition	2	3	67%
	Overall Effectiveness	2	3	67%
	Overall Score	**17**	**35**	**49%**

J.3 Cascade

The energy management assessment (EMA) is a facilitated conversation designed to identify and characterize SEM practices at an industrial facility. The EMA occurs at a participant's site and is facilitated by the SEM Energy Coach. SEM participants completed an EMA during their first year of SEM, though regular (e.g., annual) EMAs can prove beneficial in keeping an Energy Team focused and motivated on improvement.

The EMA exercise is based on an Excel assessment tool that includes 38 questions focused on all aspects of SEM, as defined by the following nine minimum elements related to customer commitment, planning and implementation and measuring and reporting energy performance, each with three elements. Table 57 summarizes this information.

Table 57: Assessment Points, by Question Number and Central Theme

	ASSESSMENT POINT	QUESTION NUMBER	CENTRAL THEME
Organizational Commitment	Policy and Goals	1-2	Formalized (written) energy policy and energy goal
	Resources	3-7	People and capital devoted to energy efficiency
	Communication	8-10	Company-wide practices for sharing energy information
Planning and Implementation:	Project Management	11-20	Organizational structure that allows the effective pursuit of energy projects
	Employee Engagement	21-26	Employee awareness, training, and involvement

	ASSESSMENT POINT	QUESTION NUMBER	CENTRAL THEME
	Reassessment	27-30	Regular reviews to make energy practices and savings stick
Measuring and Reporting	Data Collection and Availability	31-33	Frequency and ease of referring to and using energy information
	Analysis	34-35	Active consideration of the energy model and KPIs to assess energy impact
	Reporting	36-38	Tracking and reporting information on SEM practices, energy projects and performance

Scores for each of the 38 questions range from 1 to 5, in each of the three categories are averaged based on responses to the questions in that category.

K. Responses to Stakeholder Comments

In this appendix we provide responses to stakeholder comments.

K.1 Comments on the Public Report

The following table contains comments and responses that refer to portions of the draft evaluation report or the accompanying workbook posted on April 1, 2020 in the public documents area of Energy Data Web (www.energydataweb.com/).

Source	Section	Topic	Page	Comment	SBW Response
Source 1		Topic A		Placeholder	Response to placeholder

Source	Section	Topic	Page	Comment	SBW Response

Source	Section	Topic	Page	Comment	SBW Response

K.2 Comments on Confidential PA-Specific Work Products

The following table contains comments and responses that refer to portions of our project- and claim-specific work products. The comments in this section were submitted by PAs who have access to this project- and claim-specific data, which are not available to the general public. We provide these questions and associated responses, while protecting the anonymity of customer information.

Source	Project ID	Topic	Comment	SBW Response
IOU A	xxx.xx	Topic	Placeholder	Response to placeholder

L. Report Releases

This report was first released for stakeholder comments on December 27, 2021. *For now, this section is a place holder. If/when future revisions are made to this report, they will be documented here.*

In this appendix, we describe the substantive differences between the findings provided by these releases.

L.1 Summary of Report Changes

Table 58 summarizes the changes that have been made to this report. We further describe these changes in the balance of this appendix.

Table 58: Changes Made to this Report

Changes from Previous Release	<date 1> Release	<date 2> Release
Change	Correction made	No change

Glossary of Terms

Term	Abbreviation	Explanation
Accelerated Replacement	AR	Replacement of existing equipment prior to the end of its useful life.
Add-On Equipment	AOE	Equipment installed onto an existing host improving the nominal efficiency of the host system. The existing host system must be operational without the AOE, continue to operate as the primary service equipment for the existing load, and be able to fully meet the existing load without the add-on component. The AOE must not be able to operate on its own. The actual energy reduction occurs at the host equipment, not at the add-on component, although any add-on component energy usage must be subtracted from the host savings
Annualization of Energy Savings		The process of extrapolating an observed daily, weekly, or monthly rate of savings to estimate a typical year of energy savings.
Annualization Period		Defined period of time selected for the annualization of energy savings.
Baseline		Baseline is a quantitative reference to what the energy consumption or energy consuming conditions were prior to implementation of changes. Baseline is used as a basis for comparison when defining energy savings. For SEM, baseline is commonly a 12-month period of operations immediately prior to the Engagement Period (see Engagement Period).

Term	Abbreviation	Explanation
Behavior, Retrocommission-ing and Operation-al	BRO	Measures installed within the BRO installation type include measures that either restore or improve energy efficiency and can be reasonably expected to produce multi-year savings. Savings from correcting deferred maintenance, performance restoration and operational characteristics are considered within this category.
California Energy Data and Reporting System	CEDARS	A system that securely manages data associated with California demand-side management (DSM) programs, ensuring quality and improving communication between DSM Program Administrators (PAs), the CPUC, and the public.
California Public Utilities Commission	CPUC or Commission	The state government agency with regulatory authority over Investor Owned Utility companies and Energy Efficiency Program Administrators, and author of this contract.
Database of Energy Efficiency Resources	DEER	A database maintained by the California Public Utilities Commission which contains standard savings estimates for many typical energy efficiency interventions.
Data Owner	The Data Owner is responsible for ensuring that a plan is created for collecting energy data and relevant variable data, that the plan is followed, and that data is properly screened and documented.	
Decision		An opinion or judgment of the PUC that decides the resolution of a proceeding, usually written in the format D.01-02-003. A proposed decision is usually written by a PUC Administrative Law Judge (ALJ), it is then reviewed and voted upon by the Commissioners.
Deemed Measures		See Measures, Deemed
Disposition		A final determination of a case or issue.
Effective Useful Life	EUL	An estimate of the median number of years that a measure stays in place and is still operational
Energy Champion	The Energy Champion is responsible for the success of the SEM program at the facility. This individual is responsible for coordinating both with the SEM Coach and internally with any facility staff, including the Energy Team, Data Owner, and Executive Sponsor.	
Energy Division		A division of the Commission responsible for regulating Investor Owned Utility Companies, and for overseeing energy efficiency programs funded through ratepayer funds. Energy Division will be managing this contract.
Energy Efficiency		Activities or programs that stimulate customers to reduce customer energy use by making investments in more efficient equipment or controls that reduce energy use while maintaining a comparable level of service as perceived by the customer.*
Energy Management System	A management system to establish an energy policy, objectives, energy targets, action plans and processes(es) to achieve the objectives and energy targets.	
Energy Savings		See Savings, Energy
Energy Team	The Energy Team is typically a cross-functional team (i.e. management, production, procurement, maintenance, HR) that meets regularly to discuss.	
Engagement Period	The SEM engagement period defines when a participant starts working with a program on SEM and when the SEM program ends.	
Evaluation, Impact		A study in which Evaluation, Measurement and Verification techniques are used to estimate net changes in electricity usage, electricity demand, natural gas usage, and/or behavioral impacts that are expected to produce changes in energy use and demand.*
Evaluation, Measurement and Verification	EM&V	Activities that evaluate, monitor, measure, and verify performance or other aspects of energy efficiency programs or their market environment.*

Term	Abbreviation	Explanation
Ex Ante		Estimated savings calculated based on assumptions prior to the evaluation of the portfolio cycle. These savings reflect the IOU reported savings, which are trued up with final evaluation.*
Ex Post		Estimated savings are based on evaluation, and all incentives are held until after evaluation is complete. Custom and uncertain deemed measures are incentivized based on ex post savings estimates.
Executive Sponsor	The Executive Sponsor should be highest-level manager available at the facility (typically the facility manager) and is responsible for ensuring the Energy Team has the resources it needs to succeed during the SEM program.	
Free Rider		A program participant who would have implemented the program measure(s) or practice(s) in the absence of the program.
Gross Energy Savings		See Savings, Gross Energy
Gross Realization Rate	GRR	Ratio of the gross savings estimated by an evaluation to the savings claimed by a PA
Impact Evaluation		See Evaluation, Impact
Incremental Cost		The cost that the customer will incur above and beyond the cost associated based on their original design of the building. These costs are associated with the implementation of program recommended energy savings technologies that enable the facility's efficiency to exceed current Title 24 standards.
Independent Variable	A quantifiable factor that affects energy performance and routinely changes. Other common terms used for independent variable is energy driver or relevant variable.	
Indicator Variable	Also known as categorical variable, Indicator Variables are used in energy models to represent binary changes in operations. For example some common applications of indicator variables are: maintenance outages, weekends, non-production days, and holidays.	
Investor-Owned Utility Companies	IOU	Privately owned, publicly traded companies responsible for generation and transmission of electricity and/or natural gas to ratepayers, regulated by the California Public Utilities Commission.
Measure		A specific intervention addressing a specific existing condition in a specific environment, with the intended result of reducing energy use from a certain baseline. A measure may constitute a customer action or an installed product.
Measurement and Verification	M&V	A data-collection component of energy efficiency programs from which gross estimates of energy savings are calculated.
Measurement and Verification Evaluation		See Evaluation, Measurement and Verification
Measures, Custom		Measures which require site-specific analysis in order to determine energy savings estimates. Custom measures are implemented through Custom Programs, and incentives are paid only after completion of ex post analysis for the associated project year.
Measures, Deemed		A prescriptive energy efficiency intervention which, in many cases, is implemented across an IOU or the state. Includes both DEER and work paper measures, and can be paid either through the ex ante or ex post incentive mechanisms, depending on inclusion in the Uncertain Measures List for the applicable program year.
Net-to-Gross Ratio	NTGR	The ratio of program-induced savings to total savings
Net Energy Savings		See Savings, Net Energy

Term	Abbreviation	Explanation
Non-Routine Adjustment		Adjustments made to energy savings calculations to compensate for Non-Routine Events.
Non-Routine Event		Events that are unrelated facility-changes that impact savings and are not accounted for in the calculations.
Program Administrator	PA	An entity which has been authorized by the California Public Utilities Commission to use Ratepayer funds to coordinate energy efficiency programs within a specified service territory. Current Program Administrators include Investor Owned Utilities, Community Choice Aggregators, and Regional Energy Networks.
Ratepayer		Those customers who pay for gas or electric service under regulated rates and conditions of service. *
Remaining Useful Life	RUL	An estimate of the median number of years a technology or piece of equipment would remain in service and operational had the program intervention not caused the replacement or alteration; default Commission policy assumes that RUL is equal to one-third of the EUL
Remote Ex Ante Database Interface	READI	A utility for viewing CPUC's database of ex ante measure information including measures, support tables, and technologies.
Reporting Period	Defined period of time selected for calculation and reporting of energy performance.	
Rolling Portfolio		The current structure of combined program implementation and evaluation used by all California Energy Efficiency Program Administrators, as defined in Commission Decision D.15-10-028.
Ruling		An interpretation of a Decision. Rulings can come from an Administrative Law Judge or an Assigned Commissioner.
Savings, Energy		The amount of reduced electric energy consumption or demand, and/or natural gas consumption, associated with a given set of energy efficiency interventions.
Savings, Gross Energy		The calculated energy savings before accounting for evaluated parameters.
Savings, Net Energy		The calculated energy savings after accounting for evaluated parameters.
Static Factor	Identified factor that impacts energy performance and does not routinely change. Examples of static factors include: facility size, design of installed equipment, the number of weekly production shifts, the number or type of occupants, range of products.	
Title 24		California Code of Regulations relating to building design and construction. Part 6 of Title 24 is the Energy Efficiency Standards for Nonresidential Buildings. Title 24 sets minimum efficiency requirements for building construction materials and energy-consuming equipment in the state of California.

* From *Energy Efficiency Policy Manual*, Version 5, enacted July 2013 as part of Commission Resolution 09-11-014, available at http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy__Electricity_and_Natural_Gas/EEPolicyManualV5forPDF.pdf.