GROUP D

Strategic Energy Management (SEM) 2021-2022 Impact Evaluation

California Public Utilities Commission
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Glossary of key terms and acronyms[1]

As-built conditions – Refers to any site-specific or measure-specific parameters that could influence the energy savings, including quantities, sizes, load profiles, sequences of operation, setpoints, etc., as found and verified by the evaluators during the data collection phase.

Baseline period – The baseline period is the 12 or 24 months leading up to the energy efficiency intervention or retrofit.

Bottom-up savings calculation – A savings methodology that calculates the SEM energy savings utilizing measure-level calculations. This methodology uses measure-specific formulas, inputs, and assumptions, etc., to calculate the measure-specific savings. The overall site savings are then calculated by aggregating the energy savings of all implemented measures.

BRO measures – Refers to implemented or planned SEM measures that are behavioral, retrocommissioning, and operations.

CCT – Refers the Custom Core Template which is an Excel-based tool utilized by the SEM evaluation team to report site-specific data collection efforts, review of participant documentation and methods, and documenting SEM evaluation team's methods and findings.

Calculated savings – The calculated savings for NMEC projects are a sum of the initial claimed savings and true-up savings found in CEDARS. Calculated savings is expected to equal normalized savings.

California Database for Energy Efficiency Resources (DEER) – Refers to the Database for Energy Efficient Resources. This database contains information on energy efficient technologies and measures. DEER provides estimates of the energy-savings potential for these technologies in residential and non-residential applications. DEER is used by California Energy Efficiency (EE) Program Administrators (PAs), private sector implementers, and the EE industry across the country to develop and design energy efficiency programs.[2]

California Energy Data and Reporting System (CEDARS) – Refers to the database that securely manages California Energy Efficiency Program data reported to the Commission by Investor-Owned Utilities, Regional Energy Networks (RENs), and certain Community Choice Aggregators (CCAs).[3]

Custom measure and project archive (CMPA) – Refers to the CPUC regulatory supervision website (Energy Division Non-DEER Resources) which is the archive of custom measures and projects utilized by California investor-owned utilities (IOUs) and reviewed by Energy Division staff. Every project supports secure uploading and browsing of files.

Custom project review (CPR) – Refers to the process of selecting custom projects, submitted biweekly by the PAs, for review of all forecasted savings parameters and documents of selected projects.

Effective useful life (EUL) – An estimate of the median number of years that the measures installed under the program are still in place and operable.

F**orecasted savings** – Engineering-based savings estimate derived before installation.

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1 Please refer to the Energy Efficiency Policy Manual for additional terms and definitions: https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/e/6442465683-eepolicymanualrevised-march-20-2020-b.pdf

2 Public utilities commission of California, Resolution E-5152, August 5, 2021. http://www.deeresources.com/files/DEER2023/Resolution%20E-5152%20DEER2023%20Complete.pdf

3 California Energy Data and Reporting System (CEDARS), "Welcome to CEDARS," cedars.sound-data.com, https://cedars.sound-data.com/

Gross realization rate (GRR) – Refers to the ratio of achieved energy savings to predicted energy savings; as a multiplier on Unit Energy Savings, the GRR considers the likelihood that not all CPUC approved projects undertaken by IOUs will come to fruition.

Gross savings – Gross savings count the energy savings from installed energy efficiency measures irrespective of whether those savings are from free riders, i.e., those customers who would have installed the measure(s) even without the financial incentives offered under the program.

Initial claimed savings – For SEM projects, the savings claimed in CEDARS following project implementation.

Lifecycle savings – Refers to the savings associated with the lifetime of an efficiency measure undertaken by a program participant. Equipment replaced early in its useful life might receive reduced savings for a portion of its lifetime.

Measure – Specific customer action that reduces or otherwise modifies energy end-use patterns. A product whose installation and operation at a customer's premises reduces the customer's on-site energy use, compared to what would have happened otherwise.

Measure application type (MAT) – Refers to the installation basis for each claim. There are seven approved measure application types: Add-on Equipment, Accelerated Replacement, BRO-Behavioral, BRO-Operational, BRO-Retro-commissioning (RCx), New Construction, and Normal Replacement.

Net savings – The savings realized when free-ridership is accounted for. Savings are calculated by multiplying the gross savings by the net-to-gross ratio.

Net-to-gross ratio (NTGR) – A ratio or percentage of net program savings divided by gross or total impacts. NTGRs are used to estimate and describe the free ridership that may be occurring within energy efficiency programs.

Non-routine adjustment (NRA) – Non-routine adjustments are used to account for the effects of non-routine events, where the changes affected by the NRE are not suitable to the baseline or reporting period adjustment models. Non-routine adjustments occur separately from the routine adjustments made using independent variables in the adjustment model. Non-routine adjustments are developed using methods including but not limited to engineering analysis, sub-metering, or other analyses using the metered energy use data.

Non-routine event (NRE) – A non-routine event is an externally driven (i.e., not related to the energy efficiency intervention) significant change affecting energy use in the baseline or the reporting period and therefore must be accounted for in savings estimations. Typical NREs include changes in facility size, changes in facility activity not affected by the energy efficiency measures (such as addition or removal of a data center) or other modifications to the facility or its operation that alter energy consumption patterns and are unrelated to the program intervention.

Normalized savings – Savings calculated as the difference between the weather normalized baseline and performance period statistical models.

Program administrator (PA) – An entity tasked with the functions of portfolio management of energy efficiency programs and program choice (i.e., Marin Clean Energy (MCE),[4] Pacific Gas & Electric (PG&E), Southern California Edison (SCE), Southern California Gas (SCG), San Diego Gas & Electric (SDG&E)).

Peak demand – Refers to the average demand impact, for installed or implemented measures, as would be applied to the electric grid. CPUC Resolution E-4952 approved the Database for Energy-Efficient Resources (DEER) for 2020.

[4] MCE is a not-for-profit public agency that MCE provides electricity service to more than 1 million residents and businesses in 37 member communities across four Bay Area counties: Contra Costa, Marin, Napa, and Solano.

Additionally, this resolution revised the DEER Peak Period definition from 2:00 p.m. to 5:00 p.m. to 4:00 p.m. to 9:00 p.m. effective January 1, 2020. In accordance with the CPUC memo issued on 03/21/19, operationalizing the 2020 DEER Peak Period change, effective January 1, 2020, per CPUC Res E-4952 for custom projects shall follow the Statewide Custom Project Guidance Document, Version 1.4.

Relative precision – A ratio of the error bound divided by the value of the measurement itself. This provides the error on a relative basis that is frequently used to show uncertainty as a fraction of a quantity. In this report, all relative precisions are provided at the 90% confidence interval, which means that in repeated sampling 90 times out of 100 the true value will fall within the lower and upper bounds of the estimate.

Top-down savings calculation – A savings methodology that calculates the SEM energy savings using facility models on the site level. This methodology uses a billing analysis utilizing multivariable regressions of utility meter data along with the relevant independent variables (such as levels of production or weather conditions) between the baseline period and the reporting period.

True-up savings – The savings claimed in CEDARS following the end of the performance period. This value is expected to be the difference between initial claimed savings and the normalized savings.

1 EXECUTIVE SUMMARY

INTRODUCTION

This report presents key findings of the Strategic Energy Management (SEM) program impact evaluation conducted by DNV and Guidehouse (the DNV team) on behalf of the California Public Utilities Commission (CPUC) for program years (PY) 2021 and 2022. The DNV team determined how much electric demand and how much electric and natural gas energy were reduced by participants in the SEM program.

The SEM program in California is offered to industrial customers to reduce energy consumption through low- to no-cost operations, maintenance, and behavioral opportunities that can be maintained year over year. This program requires a program-approved energy model to estimate energy savings.

Evaluation objectives

1. Quantify the first-year and lifecycle gross kWh, peak (highest demand) kW, and therm savings by sampling domain (e.g., PA).
2. Calculate the ratio of evaluated savings to the savings claimed by program administrators (PAs), referred to as the gross realization rate (GRR), by sampling domain. GRR is calculated by comparing the actual energy savings evaluated (or realized) to the estimated energy savings that were predicted before the implementation of the energy efficiency measures.
3. Provide an analysis of the drivers of the GRR.
4. Recommend how GRRs can be improved.
5. Quantify the ratio between the program's evaluated gross and net savings, referred to as the net-to-gross ratio (NTGR), by sampling domain.
6. Share the factors that characterize free ridership, and as required, provide recommendations on how the NTGR might be improved. Note that free ridership occurs when participants would have installed the same equipment or technologies in the absence of the program. We refer to such participants as free riders because they receive benefits from programs for actions they would have taken in the absence of the program.
7. Identify gaps in the planned evaluation, measurement, and verification (EM&V) activities for the SEM program and share what emerging evaluation issues should be addressed going forward.
8. Provide actionable recommendations to address gaps and improve programs and projects in the future.

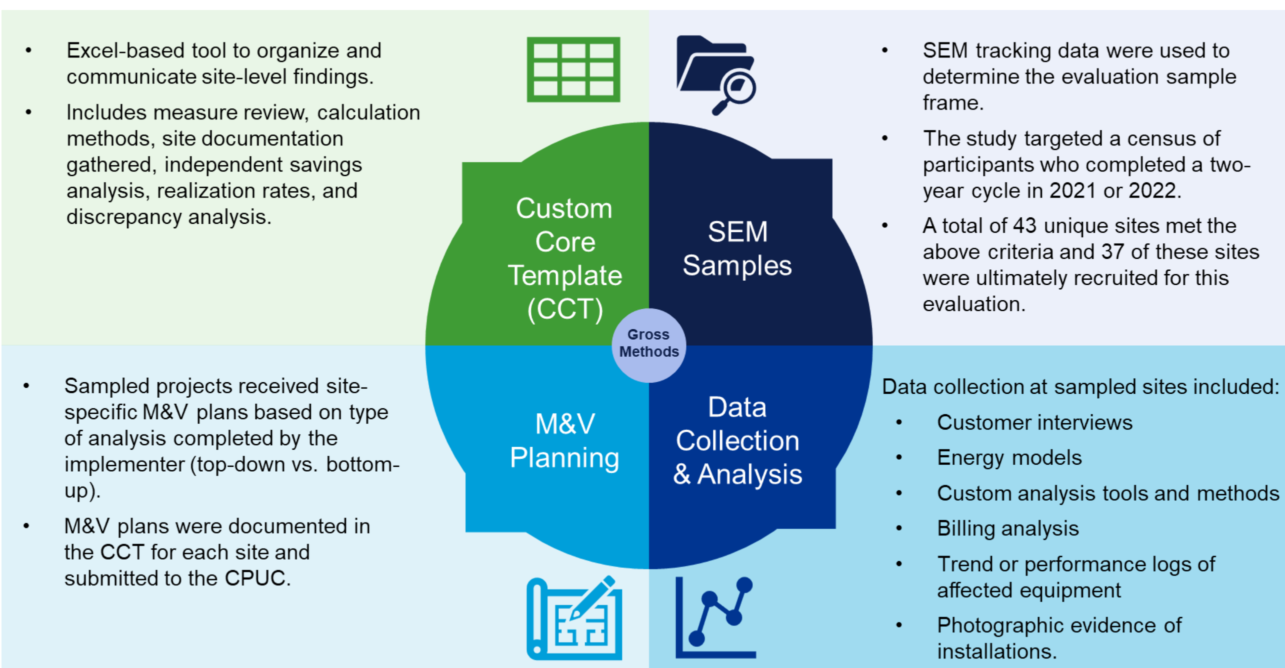
METHODOLOGY OVERVIEW

The DNV team estimated the accuracy of gross and net savings the PAs claimed for SEM projects installed in PY 2021 and 2022. Our gross and net savings calculation methods are described in the final study work plan[5] and summarized below. This study adhered to the International Performance Measurement and Verification Protocol (IPMVP)[6] and the California Evaluation Protocol.[7] Figure ES-1 shows the overall evaluation process.

Figure ES-1. SEM gross and net savings methods PY2022

Gross methods

The DNV team determined the appropriate evaluation approach for each site based on the project documentation review and the collected data and information from the site contacts. The team presented all site-specific M&V plans and evaluation findings in the Custom Core Template (CCT) tool. Data collection consisted mostly of participant interviews to determine which measures were installed and operating, photographs to verify installed measures, consumption data to estimate savings, and in some cases, trend data or performance logs to confirm operation.



[5] 2021-2022 Strategic Energy Management (SEM) Impact Evaluation Workplan (Final), California Public Utilities Commission, July 7, 2022.

[6] IPMVP is a protocol that facilitates a common approach to measuring and verifying energy efficiency investments. IPMVP incorporates M&V best practices in a non-prescriptive framework that allows it to be applied flexibly based on a measure's application and the information available.

[7] The California Evaluation Protocol (CEP) is a set of guidelines and procedures developed by the California Public Utilities Commission (CPUC) for conducting evaluations of energy efficiency programs.

Net methods

A net-to-gross (NTG) assessment estimates the portion of gross energy savings attributable to the financial incentives or activities (e.g., audits, technical assistance) of an energy efficiency program. The **NTG approach** used in this study is a hybrid approach that combines the 1.0 NTGR for non-capital measures, as initially allowed for in D.16-08-019 and found through research as part of the prior evaluation, with a NTGR developed from **participant surveys for capital measures.** The NTGR for capital measures was based on the standard NTGR[8] questions and the standard method for scoring NTGR survey questions (standard scoring), as has been used in prior CPUC EE impact analyses. However, the DNV team modified the standard surveys to incorporate a **series of NTG questions for capital measures**. In addition to the new questions, we introduced a revised method for scoring the NTGR (SEM scoring). All these revisions to the questions and scoring method were made in order to account for the immersive nature of SEM. The new SEM scoring more heavily relies on the respondent's assessment of the factors influencing the measure installation whereas the standard scoring averages the factors. The results using the new SEM and prior standard scoring are compared below. **The DNV team completed 13 participant surveys** with customers who installed **capital measures** to inform the capital NTGR.

EVALUATED PROGRAM SAVINGS CLAIMS

The SEM impact evaluation focused on customers who completed a two-year cycle in 2021 or 2022 and reported two years of savings in 2020/2021 or 2021/2022, respectively. This means that the evaluation team verified the aggregated two years of savings for each site that was reviewed. Table ES-1 provides a summary of this SEM population. There was a total of 53 unique customers in this SEM participant pool who met these criteria. Of these 53 customers, 43 completed and reported savings for electric saving measures, while 28 of these customers completed gas saving measures. Given the nature of SEM and the focus on the whole facility, approximately 50% of the participants implemented both electric and gas saving measures. Table ES-1 shows the number of participants and the first-year and lifecycle savings that were claimed for this group of customers.

Table ES-1. SEM PY2021/2022 evaluation population summary

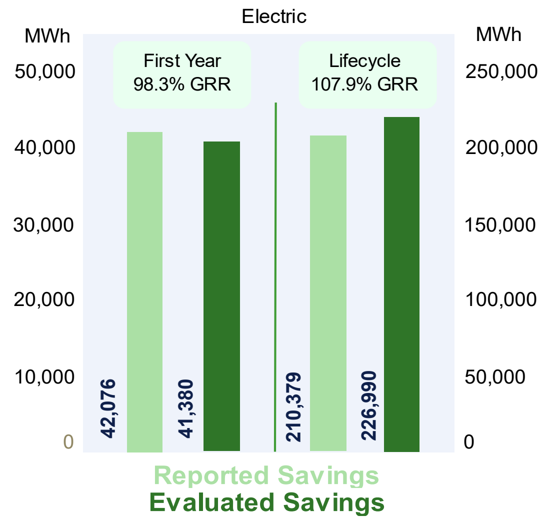
Savings Parameter	Number of Participants	Reported Savings	
		MWh	MW
Electric First Year Savings	43	42,076	6.1
Electric Lifecycle Savings	43	210,379	30.5
		Therms (1,000)	
Natural Gas First Year Savings	28	3,101	
Natural Gas Lifecycle Savings	28	15,504	
		MMBtu	
Total Energy First Year Savings	53	453,575	
Total Energy Lifecycle Savings	53	2,267,873	

[8] DNV. *Evaluation, Measurement, & Verification of Program Year 2022 Commercial, Industrial, and Agriculture Custom Projects Work Plan*, Section 4.2. September 20, 2023. https://pda.energydataweb.com/#!/documents/3867/view

RESULTS

Gross Savings Results

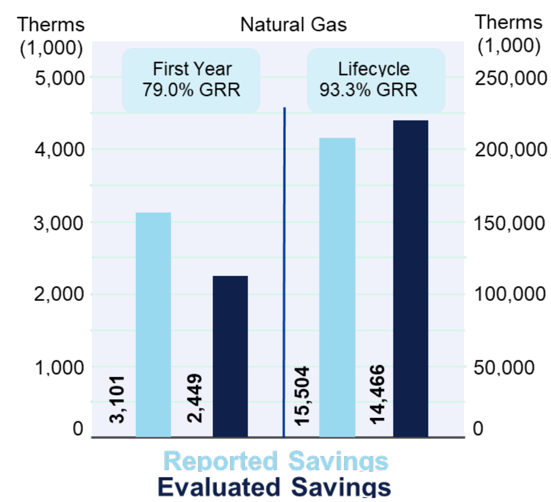
This section presents the overall statewide electric and natural gas savings and gross realization rates. “Statewide” refers to all PAs and represents the overall results for SEM in California. All relative precisions in the tables that follow are calculated at the 90% confidence level.



Key Electric Gross Findings

- As shown in the chart to the right, the SEM participants who completed two-year cycles in 2021 or 2022 **achieved an aggregated first-year gross electric savings of 41,380 MWh** and **lifecycle gross electric savings of 226,990 MWh** with statewide GRRs of 98% and 108%, respectively. We recommend that the PAs use the statewide GRRs.
- Key drivers of the electric first-year and lifecycle realization rates include annualization errors in which participants calculated the energy savings by prorating the savings calculated within a short period of time to annual savings, instead of using all available valid data points recorded within the year. Other key drivers included using as-built parameters such as hours of operation, compressed air systems setpoints, and load profiles. Those two factors impacted the first-year savings GRR. The DNV team found that the majority of the capital projects had an effective useful life (EUL) higher than 5 years, which impacted the forecasted lifecycle savings and thus the lifecycle GRR.

Key Gas Gross Findings



- As shown in the chart to the right, the SEM customers who completed two-year cycles in 2021 or 2022 achieved an aggregated first-year gross natural gas savings of 2,449 thousand therms and lifecycle gross natural gas savings of 14,466 thousand therms with statewide GRRs of 79% and 93%, respectively. We recommend that the PAs use the statewide GRRs.

  Key drivers of the natural gas first-year and lifecycle realization rates are annualization errors and model adjustments the DNV team performed to improve the statistical significance of the models and to accurately model typical operation. These two factors impacted the first-year savings GRR. We used capital projects whose EUL we found to be higher than 5 years to calculate forecasted lifecycle savings; these projects affected the lifecycle GRR.

Table ES-2 presents the electric first-year and lifecycle evaluated energy and demand gross savings and precisions, both statewide and by PA. Most parameters of interest achieved a relative precision of ±10% or better for energy savings. This is primarily the result of evaluating 88%, or a near census, of the SEM population of interest, which reduces the statistical uncertainty of the results.

Table ES-2. Electric first-year and lifecycle evaluated gross energy savings by PA (SEM algorithm)

PA	First-year				Lifecycle			
	Forecasted savings	Evaluated savings	GRR	Relative precision	Forecasted savings	Evaluated savings	GRR	Relative precision
Energy (MWh)								
MCE	2,660	2,406	90.4%	4.7%	13,301	12,704	95.5%	5.3%
PG&E	28,765	29,238	101.6%	0.7%	143,825	152,935	106.3%	1.1%
SCE	6,220	5,616	90.3%	3.3%	31,098	31,323	100.7%	1.5%
SDG&E	4,431	4,120	93.0%	4.4%	22,155	30,027	135.5%	12.1%
Statewide	**42,076**	**41,380**	**98.3%**	**0.8%**	**210,379**	**226,990**	**107.9%**	**1.8%**
Demand (MW)								
MCE	0.2	0.4	200%	40%	1.0	2.1	211%	41%
PG&E	4.0	4.1	101%	1%	20.2	21.4	106%	1%
SCE	1.3	0.7	57%	8%	6.5	4.1	64%	7%
SDG&E	0.6	0.5	93%	4%	2.9	3.5	123%	16%
Statewide	**6.1**	**5.8**	**94%**	**3%**	**30.5**	**31.1**	**102%**	**4%**

A discussion of the drivers of each PA's realization rates is provided below:

MCE: The evaluated electric savings for MCE were smaller than forecasted due to model adjustments made by the DNV team which largely impacted two sites. For the first site, the DNV team improved the model statistical significance by removing data points that were above the observed statistical threshold. For the second site, the DNV team adjusted the modeled baseline period to account for COVID impacts on the site's energy consumption. The evaluated demand savings for MCE were higher than forecasted as several sites that implemented SEM projects in PY2021 did not claim any demand savings.

PG&E: The evaluated electric savings for PG&E were slightly higher than forecasted savings mainly due to updated inputs and parameters based on as-built conditions, collected by the DNV team from the participants.

SCE: The evaluated electric savings for SCE were smaller than forecasted savings primarily due to annualization. The DNV team calculated evaluated savings using all available and statistically valid data points and did not annualize. The evaluated demand savings for SCE were smaller than forecasted primarily due to tracking errors as the incremental demand savings for multiple sites were not calculated correctly.

SDG&E: The evaluated electric savings for SDG&E were smaller than forecasted savings primarily due to updated operating conditions such as operation hours and setpoints. The DNV team updated the savings calculation for sites based on as-built data and information collected from SEM participants. The forecasted demand savings for SDG&E were smaller than forecasted due to annualization errors and updated operating conditions such as operation hours and setpoints.

Table ES-3 presents the gas first-year and lifecycle evaluated therm gross savings and precisions statewide, by PA. Similar to electric, the gas relative precisions were all very good, including ±3.8% at the statewide level for first-year and ±4.2% for lifecycle savings.

Table ES-3. Natural gas first-year and lifecycle evaluated gross energy savings by PA

PA	First-year				Lifecycle			
	Forecasted savings	Evaluated savings	GRR	Relative precision	Forecasted savings	Evaluated savings	GRR	Relative precision
Energy (Therms/1,000)								
MCE	315	139	44.2%	6.3%	1,575	867	55.1%	26.5%
PG&E	1,931	1,611	83.4%	5.2%	9,655	9,947	103.0%	5.3%
SCG	765	610	79.8%	6.6%	3,823	3,208	83.9%	5.5%
SDG&E	90	89	98.4%	1.8%	451	444	98.4%	1.8%
Statewide	**3,101**	**2,449**	**79.0%**	**3.8%**	**15,504**	**14,466**	**93.3%**	**4.2%**

MCE: The evaluated gas savings for MCE were smaller than forecasted savings primarily due to the DNV team adjusting the model for one site -largest gas saver in the MCE sample- by removing outlier data points that were above the observed statistical threshold.

PG&E: The evaluated gas savings for PG&E were smaller than forecasted savings primarily due to annualization, because the PA analysis did not properly account for the seasonality of the typical annual operation of the facilities. This resulted in inaccurate savings estimates for the PAs. The DNV team evaluated savings using 12 months post data along with all available and statistically valid data points but did not annualize the savings.

SCG: The evaluated gas savings for SCG were smaller than forecasted savings primarily due to annualization. The DNV team evaluated savings using 12 months of post data along with all available and statistically valid data points; we did not annualize the savings.

SDG&E: The evaluated electric savings for SDG&E smaller than forecasted savings primarily due to updated inputs and parameters based on as-built conditions, collected by the DNV team from the participants.

Net Savings Results

The DNV team calculated net savings using both the standard and the new SEM scoring methods to score the participant survey responses for calculating the NTGR. The SEM scoring is an adaption of the standard algorithm to better account for the immersive nature of SEM.

Figure ES-2 presents a comparison of the standard and SEM scored NTGRs by PA and statewide. The standard scoring NTGR values are about 2% lower than the NTGR developed using the SEM scoring. While not appearing in the graph, the lifetime NTGR values were within 3% of the first-year NTGR values. PA relative precisions were 7% or better and the statewide precision was ±2.5% or better. The final program NTGR values were close to 1 across PAs, as presented in Figure ES-2 below, by the gold line representing a NTG of 1.0.

Figure ES-2. Electric first-year NTGR by PA

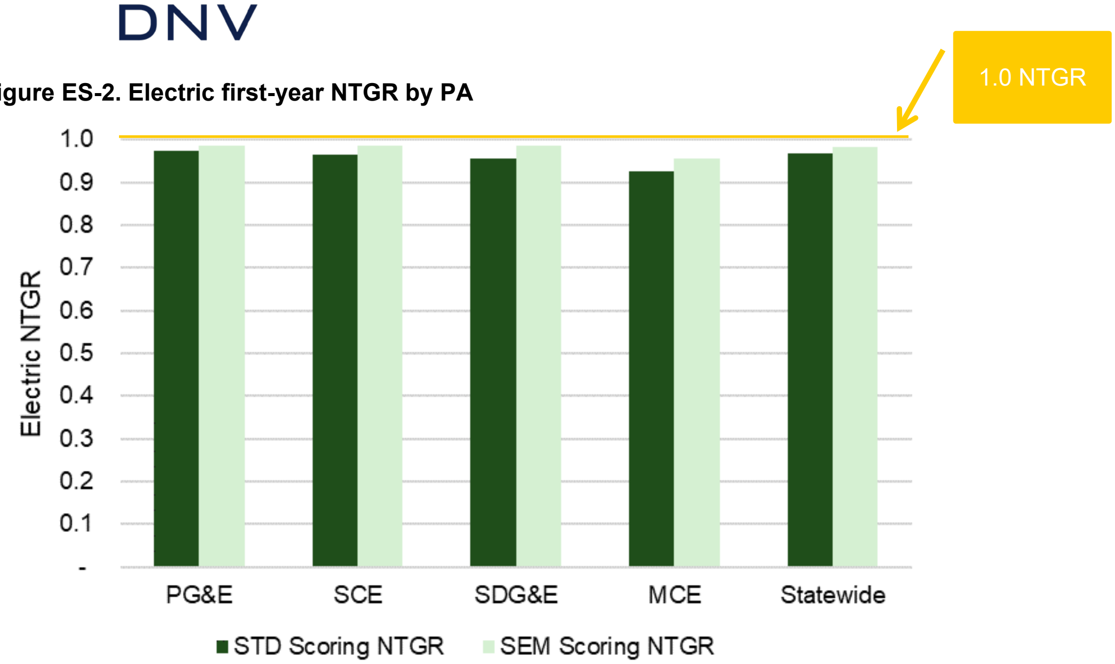
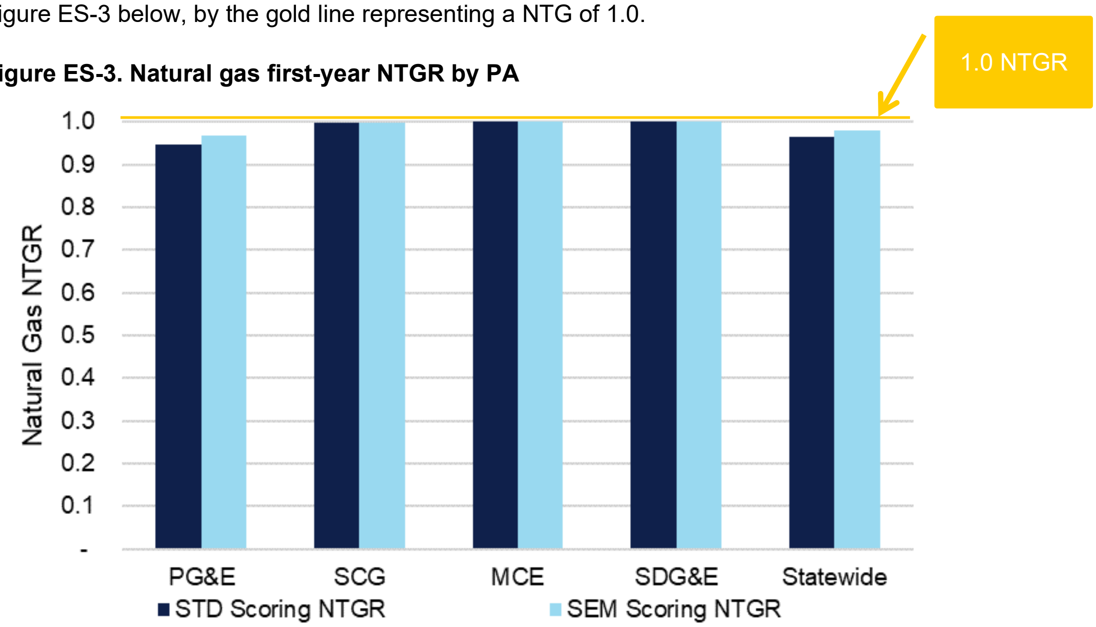


Figure ES-3 presents a comparison of the standard and SEM scored NTGR by PA and statewide. The standard scoring NTGR values are about 1.5% lower than the NTGR developed using the SEM scoring. While not appearing in the graph, the lifetime NTGR values were within 1% of the first-year NTGR values. PA relative precisions were 6% or better and the statewide precision was ±3.5% or better. The final program NTGR values were close to 1 across PAs, as presented in Figure ES-3 below, by the gold line representing a NTG of 1.0.

Figure ES-3. Natural gas first-year NTGR by PA



CONCLUSIONS, FINDINGS, & RECOMMENDATIONS

The DNV team developed the key conclusions and recommendations below from all reported impact evaluation activities. We provide these recommendations to inform the PAs about items that improve savings estimation practices and support future evaluation efforts as this program continues to evolve and grow.

SEM savings analysis methodology findings

The SEM M&V guide states that the top-down modeling approach is the preferred methodology to calculate SEM savings. The guide requires participants to provide justification if bottom-up calculations are used instead of top-down modeling approach, which was followed by all participants who used bottom-up calculations. The top-down modeling approach is more capable of capturing the full impact of SEM BRO measures since these types of measures can affect different spaces and pieces of equipment throughout a facility. The SEM M&V guide supports bottom-up savings estimation when a top-down approach is not feasible. The DNV team found that 45% of SEM participants used a top-down analysis approach to calculate the SEM savings (for both electric and natural gas) over the two years of their SEM cycle. Around 40% of the sites that used bottom-up calculations reported having attempted to calculate savings using top-down model. However, only a few sites included the attempted top-down model in the project documentation they provided to evaluators. The most prevalent observed reasons for using bottom-up calculations were metering issues and major operational changes such as the addition of new equipment or processes.

Recommendations

- Prioritize calculating energy savings using top-down approach to bottom-up calculations. Bottom-up calculations should only be used when a top-down model is proven to not be feasible.
- Prioritize identifying and addressing issues that impede creating a valid top-down model as early as possible during SEM participation.
- Attempt top-down models and include them in the project files even when using bottom-up calculations. This will allow the PAs and the evaluators an opportunity to review those models to confirm the reasons for using bottom-up calculations.
- When using a bottom-up approach, SEM participants should take the following actions:
  - Continue providing thorough documentation to justify calculating the SEM savings using bottom-up calculations.
  - Use on-site metering and trend data to determine the most accurate values for parameters used in measure-level calculations. Using as-built values lead to accurate savings estimation.
  - Provide thorough documentation of all inputs and parameters used in bottom-up calculations.
  - Expect and prepare to fulfil data requests made by the evaluators to validate measure-specific parameters.

Savings annualization

Savings annualization refers to prorating the savings calculated within a short period of time to annual savings. The typical observed annualization period is 3 months within the final 5 months of the reporting period in consideration. This approach was required by older versions of the SEM M&V guide.[9] The current version of the guide limited the use of annualization to only when the model is being retired or a customer will not be participating in the SEM program after the current reporting

[9] Sergio Dias Consulting. “California Industrial SEM M&V Guide, Version 2.01.” Section 11.5.1. September 12, 2020. https://pda.energydataweb.com/api/downloads/2525/CA_Industrial_SEM_M%26V%20Guide_v2.01.pdf

period, with PA authorization.[10] The DNV team acknowledges that program participants who used annualization followed the SEM M&V guidelines. However, the annualization approach often overlooks seasonality in the typical annual operation for facilities, which results in inaccurate savings estimation. The DNV team observed this through this impact evaluation, finding that the use of savings annualization accounted for approximately 56% of the difference between forecasted and evaluated savings estimates.

Recommendations

- Follow the current SEM M&V guidelines that recommended limiting the annualization to only when the model is being retired or a customer will not be participating in the SEM program after the current reporting period, with PA authorization. Hence, annualized savings will be rejected when annualization is likely to produce inaccurate annual savings, such as seasonally impacted savings, or where savings are not steady from time period to time period, such as with shutdown-type measures.

Model adjustments

Model adjustments performed by the DNV team accounted for approximately 27% of the difference between forecasted and evaluated savings. The DNV team reviewed all top-down models that were used by SEM participants to calculate savings for projects implemented in PY2021/2022. Overall, we determined that the sites that employed top-down models were consistent and utilized well-developed models. However, we identified several models that required adjustments to improve the model statistical significance, reflect typical operation, and calculate more accurate savings.

Recommendations

- Follow the SEM M&V guidelines on creating top-down models and assess their validity.[11] Below are some examples of the steps to take in ensuring the M&V guidelines are followed:
  - Ensure that the model is reflective of the sites' typical operation for both baseline and reporting periods.
  - Ensure that any short-term changes (such as shutdowns) are included in the model as accurately as feasible. Including the actual days of shutdowns results in a higher correlation with energy consumption than simply using an indicator of either 1 or 0.
  - Investigate the reasons for data points that reflect high residuals or fall outside of the range of the variable statistical significance and adjust the model accordingly. Tracking and documenting sources of outliers is more feasible during the model development phase as variables are being actively monitored.
  - Ensure that the model is using variables that are relevant and not correlated.
- Avoid using hard-coded values in the savings calculations. The use of hard-coded values prevents the participants, PA reviewers, and evaluators from tracking the sources of the used values and complicates the process of updating and validating model results.

[10] Sergio Dias Consulting. "California Industrial SEM M&V Guide, Version 3.02." Section 1.4. July 6, 2022. https://pda.energydataweb.com/api/view/2648/CA_SEM_MV_Guide_v3.02.pdf

[11] Sergio Dias Consulting. "California Industrial SEM M&V Guide, Version 3.02." Sections 4, 6, and 7. July 6, 2022. https://pda.energydataweb.com/api/view/2648/CA_SEM_MV_Guide_v3.02.pdf

Project documentation inconsistencies

The DNV team identified 5 sites for which the claimed savings were reported based on the conducted technical review and were different than the provided modeled savings. Final documentation, including the completion report, was not updated based on the technical review findings. The DNV team recognizes that the project documentation provided by program participants follows the sequential process of developing SEM projects from project initiation to savings claims submission. However, providing completion reports and savings calculation models that do not correspond to the final savings claim complicates the process of validating savings.

Recommendations

- Update relevant project documents such as the completion report and the calculation models to reflect any changes implemented during the technical review phase.
- Include any updated models or final savings estimates in the project documentation package.

SEM NTGR methods and results

The methodological approach for the present evaluations is informed by D16-08-019 which states that a well-designed SEM program's holistic and long-term approach encourages implementation of BRO measures as well as custom and capital measures. The decision concludes that capital measures, when program influence is demonstrated, may apply the SEM default NGTR of 1.00. This report uses participant surveys to evaluate the degree to which SEM programs demonstrate influence on the implementation of capital measures. The standard program evaluation survey instruments were adapted for evaluating SEM capital measures with additional questions addressing capital measure decision making. The method for scoring surveys was revised to rely more heavily on the respondent's assessment of the factors influencing the measure installation rather than using the standard scoring method of averaging the factors. Appendix A of this report presents a memo describing the recommended SEM scoring with comparisons to the standard scoring.

Program influence on capital measures and NTGR results

The DNV team found that 16% of program claimed savings were derived from capital measures. The results show that the SEM program had a substantial influence on the installation of capital measures with a statewide average capital NTGR value of 0.79[12] on an MMBtu basis which holistically captures both electric and natural savings for each site using the SEM algorithm. This indicates that SEM's immersive nature is successfully leading customers to install more capital projects than they would have without program participation. The evaluated SEM program NTGR values blend capital and non-capital NTGR results into a single program value that is applied to a site, regardless of the composition of capital and non-capital measures at that site. The comparative standard scoring method's average capital NTGR value was 0.64.

The final program NTGR values were close to 1 across PAs and fuels. The combined program NTGR precisions were also robust.

[12] These values reflect the findings from this population and are subject to change in the research of future populations.

Implications

- While there are variations between fuels and PAs, the assumption that the NTGR of the SEM program is 1 essentially stands.
- The convention is that CEDARS will incorporate a unique fuel specific NTGR for each PA for calculating net savings. CPUC staff may wish to consider a single statewide SEM NTGR value of 1 for both electric and gas savings, given the clustering of the results around 1.

Recommendations

- Evaluators recommend using the combined SEM NTGR and to apply it to all sites and to all measures regardless of the combination of capital or non-capital present. The combined NTGR accuracy is superior to the capital NTGR alone. Attempting to apply separate NTGR values to capital and non-capital would require savings to be reported as capital and non-capital in CEDARS, adding an unnecessary administrative burden. A requirement for separate applications of a capital and non-capital NTGR could also lead to perverse incentives to classify more measures in the Opportunity Register as non-capital.

Identifying capital measures

Capital measures were successfully distinguished from non-capital measures leveraging program required documentation, like the Opportunity Registers, but required interviews with knowledgeable staff to confirm the measure type. The Opportunity Register, which record site identified savings opportunities and tracks their implementation, has fields for measure cost and savings that could be used to streamline the measure type as the program scales; however, these fields are often not populated. The measure savings and measure cost estimates have further utility as a basis for estimating program measure life and as inputs to program cost-effectiveness.

Implications

- The Opportunity Register is an important source of information for identifying measure types to support evaluation. The measure type field is well populated and is 90% accurate.
- Two other important fields, measure cost and measure savings, are not well populated in the Opportunity Register. Both fields can be used to inform EUL calculations and program cost-effectiveness and can aid in the customer's prioritization of measures.

Recommendations

- Evaluators recommend that the program implementers populate the applicable fields for any completed measure with estimated savings and costs. The savings and costs are effective tools for customers to prioritize measures and can streamline identification of capital measures as the program scales.

NTG methods

The DNV team's attribution research is designed to determine program influence on capital projects as directed in D16-08-019. The specific survey instruments and algorithms used in this study were adapted from the current Commercial, Industrial, and Agriculture Custom (CIAC) NTG survey battery to account for the immersive design of the SEM program. The specific adaptions are described in detail in Appendix A with analysis supporting the adoption of the method. SEM's immersive character and the high degree of customer commitment required of participants is likely to incline a participant to highly rate program factors, thus boosting the score. For another program where the customer is less engaged, the SEM approach might yield a lower score.

Implications

- A comparison of the new SEM with the standard scoring method shows an increase of about 0.15 points in the average capital NTGR in this round of research, reflecting the participants' valuation of the program. Because capital measures account for only about 16% of programs savings, the SEM program NTGR changes only by 1-2%.
- For another program where the customer is less engaged or where other non-program factors are present, that same weighting might yield a lower score using the SEM scoring method. The method is not inherently biased upwards.

Recommendations

- The DNV team recommends adopting the SEM survey instruments and SEM scoring method to estimate NTG for SEM capital measures in for this study and in future capital NTG research.

2 INTRODUCTION

This report presents key findings of the Strategic Energy Management (SEM) program impact evaluation conducted by the DNV team on behalf of the California Public Utilities Commission (CPUC) for program years (PY) 2021 and 2022. The overall purpose of this study is to evaluate energy and demand savings for SEM projects implemented in PY2021 and 2022. This impact evaluation quantifies the evaluated gross and net first-year and lifecycle electric and gas energy savings and peak demand reduction. The study also presents recommendations aimed at improving program delivery, the quality of documentation and savings estimation practices, and the submission of program savings claims. This evaluation effort is guided by the SEM final workplan dated July 7, 2022.[13]

2.1 Background

SEM is a unique program under California's statewide energy efficiency (EE) portfolio. The purpose of SEM is to promote holistic, long-term energy savings in facilities through ongoing engagement, continuous education, and measurement of performance. The program, originally focused on industrial customers, enrolled the first cohort of participants in 2018. SEM has a separate statewide Design Guide[14] and M&V Guide[15] which all SEM program implementers are required to use. Most SEM energy savings calculations leverage the normalized meter energy consumption (NMEC) analysis method while adhering to the SEM M&V Guide.

The PAs and other stakeholders recently expressed an interest in expanding SEM beyond the industrial sector to include non-industrial market sectors such as commercial, agricultural, education, and public sectors. As a result, on February 2, 2023, the CPUC was directed to initiate a study to understand whether the guidance from the industrial SEM guidebook could be emulated for non-industrial SEM programs. Marin County Energy (MCE) was granted special consideration to enroll non-industrial customers prior to this rulemaking. As such, this evaluation includes two non-industrial customers from MCE.

This is the second impact evaluation of the SEM program done on behalf of the CPUC. The first study was completed on the 2018 and 2019 program years.[16] This study's overall purpose was to evaluate energy and demand savings for sites that completed SEM cycles in PY2021 and PY2022. This impact evaluation quantified evaluated gross and net first-year and lifecycle electric and gas energy savings and peak demand reduction. The study presents recommendations for improving program delivery quality control, appropriate maintenance, and submission of project documentation and savings claims. This evaluation also assessed the PAs' project-specific documentation of calculation methods, baselines, and savings parameters used to estimate forecasted savings.

2.2 Evaluation objectives

The six primary objectives of this study were to:

1. Develop first-year and lifecycle evaluated net and gross savings for SEM savings claims at a high level of precision.
2. Determine reasons for differences between evaluated (ex-post) and forecasted (ex-ante) savings, and as necessary, assess how to improve the ratio of evaluated savings to forecasted savings (realization rates). Identify issues regarding

[13] 2021-2022 Strategic Energy Management (SEM) Impact Evaluation Workplan (Final): https://pda.energydataweb.com/#!/documents/2649/view

[14] "The California Industrial SEM Design Guide" provides the program requirements for qualifying as a SEM Program. The guide includes the sequence and curriculum for the program participants and is delivered by program implementers.

[15] "The California Industrial SEM M&V Guide" establishes an M&V process to which industrial facilities as part of the SEM program must adhere for program engagement. The framework defines the protocols to determine a participant's energy baseline, track energy performance throughout the engagement, document energy savings, and qualify the methods. M&V in SEM typically relies on a consumption-based energy model or measure-level engineering calculations.

[16] 2018-2019 Strategic Energy Management (SEM) Program Impact Evaluation Final Report: https://pda.energydataweb.com/#!/documents/2582/view

reported savings estimation methods, inputs, and program procedures, and make recommendations to improve savings estimates and realization rates of the evaluated programs.

3. Provide results, data, and recommendations that will assist with future statewide SEM design and M&V guide updates.
4. Estimate the proportion of the program-installed measures and actions that would have been implemented absent program participation (free ridership), determine the factors that characterize free ridership, and as necessary, provide recommendations on how free ridership can be reduced.
5. Provide timely feedback to the CPUC, PAs, and other stakeholders on the evaluation research study to facilitate timely program improvements and support future program design efforts.
6. Provide meaningful and actionable recommendations to improve program performance in delivering energy efficiency savings.

2.3 CPUC policies and guidance

In designing and implementing this evaluation, the DNV team considered the following guidance documents and CPUC policies that were in effect at the time of project approval:

- *The California Industrial SEM Design Guide*
- *The California Industrial SEM M&V Guide v2.01*
- *Energy Intensity Model Guidelines v2.02*
- *ASHRAE Guideline 14-2014*
- CPUC Energy Efficiency Policy and Procedures Manual Version 6
- *PA-specific program policy and procedures manuals*
- *Energy Efficiency Industry Standard Practice (ISP) Guidance v. 3.1*
- *Fuel Substitution Technical Guidance for Energy Efficiency V2.0*
- *CPUC resolution E-4867 approving the DEER updates for 2020*
- *CPUC resolution E-4952 revising DEER update for 2020*
- *CPUC resolution E-4818 affecting assignment of project baselines*
- *CPUC D.19-08-009 Fuel Substitution Decision*[17]

[17] D.19-08-009 adopted the fuel substitution test and ordered the creation of this fuel substitution guidance document. D.19-08-009 provides direction on the fuel substitution test, fuel substitution measure eligibility, and utility credits for savings claims.

3 METHODOLOGY

This section presents the methods the DNV team used to fulfill the evaluation objectives listed in Section , including the planned sample design, achieved sample sizes, gross savings, measurements & verification (M&V) activities, net savings approach, and final expansion procedures.

The DNV team reviewed 53 gross sample points across 47 unique customer sites and 30 net sample points.[18] We assessed the provided project files for those data points, conducted phone interviews to verify project specifics, reviewed billing data and model parameters, and collected site-specific trend data and photographs, when applicable. The net evaluation focused on capital measures only and used an interview-based approach to determine capital NTG scores. Capital NTG scores were combined with non-capital NTG scores from the prior evaluation to produce program-level NTG results. Both gross and net evaluation results are presented in Section of this report.

3.1 Sample design

The Group D PY2021/2022 SEM work plan included a description of the overall approach to SEM sampling which accounts for SEM's unique two-year implementation as well as the two-year evaluation cycle. The following sections provide a summary of tracking data, which is complicated by SEM's multi-year delivery, and sample design reflecting the full PY2021/2022 population of SEM participants. The populations presented in this report are based on the claims from the final ED tracking data for PY2020, 2021, and 2022.

3.1.1 Gross and net savings sample design overview

The sample design focused on SEM projects that completed a full two-year cycle in PY2021 or PY2022. The PY2021 projects are made up of two years' worth of savings claims from both PY2020 (Year 1) and PY 2021 (Year 2) and the PY2022 projects are made up of savings claims from both PY2021 (Year 1) and PY2022 (Year 2). Table presents a summary of the SEM sample design approach for this study. Given the population size, a census was targeted as the sample for this study.

Table 3-1. SEM sample design assumptions and approach

Parameter	Description
Population	Tracking data set for the program year, aggregated at the cycle level for each participant. PY2021 cycle: 2020 Year 1 claims + 2021 Year 2 claims PY2022 cycle: 2021 Year 1 claims + 2022 Year 2 claims
Explicit sampling strata	PA, Size
Gross sample allocation	47 projects for the combined waves, allocated for best overall precision while targeting 90/10 results by fuel type and 90/10 overall (MMBtu)
NTGR sample Allocation	Separate sample allocation, starting by attempting NTGR surveys for all projects in the gross impact sample for customers who installed capital measures (22 capital). Survey responses combined with non-capital NTGR from prior evaluation.
Sample design approach	Due to population size, census was targeted
Target parameters	GRR, NTGR
Analysis domains	PA, Fuel, Analysis type (top-down, bottom-up, mixed)
Error ratios	Assumed value of 0.5

[18] A sample point is defined as an individual customer SEM program participant by PA.

Parameter	Description
Projected Precision at 90% confidence (based on current error ratio assumptions)	Gross MMBtu savings by energy unit (electric): ±10% Gross MMBtu savings by energy unit (gas): ±10% NTGR by electric fuel type: ±10% NTGR by gas fuel type: ±10%
Savings size stratification	Custom – up to 3 levels based on savings, depending on the number of samples in the cell
Contingency and back-up sample	Gross impact sample: A census was the target for this sample due to the number of participants that meet the criteria of this study. No backups are available for this study. NTGR sample: All gross impact primary samples that installed capital measures are included in this sample. Since the gross impact sample is targeting a census, the NTGR sample was intended to be a census of all sites that installed a capital measure. No backups are available for this study.

The DNV team finalized the SEM population after performing extensive data cleaning to identify Year 1 and Year 2 savings claims across multiple program years. Each participant's Year 1 and Year 2 savings were aggregated to represent a completed 2-year cycle. The DNV team used forecasted savings calculated by removing the default GRRs[19] that had been applied by the system in calculating the savings reported in the ED tracking data. Table provides a summary of the SEM program population determined for this study, which also represents the targeted sample. Note that some participants included both electric and gas savings measures while some had measures that impacted only one of the fuels.

Table 3-2. SEM PY2021/2022 population summary

PA/Evaluation cycle	# Unique Participants	# Electric	# Gas	FY MWh Savings	FY MW Reduction	FY Therms Savings	FY MMBtu Savings
MCE Total	**7**	**6**	**3**	**2,660**	**0.2**	**315**	**40,561**
MCE PY2021	4	3	2	988	0.0	221	25,486
MCE PY2022	3	3	1	1,672	0.2	94	15,075
PG&E Total	**18**	**17**	**12**	**28,765**	**4.0**	**1,931**	**291,213**
PG&E PY2021	4	4	3	1,236	0.2	208	25,041
PG&E PY2022	14	13	9	27,529	3.9	1,723	266,172
SCE Total	**13**	**13**	**0**	**6,220**	**1.3**	**0**	**21,222**
SCE PY2021	13	13	0	6,220	1.3	0	21,222
SCE PY2022	0	0	0	0	0.0	0	0
SCG Total	**8**	**0**	**8**	**0**	**0.0**	**765**	**76,435**
SCG PY2021	6	0	6	0	0.0	464	46,369
SCG PY2022	2	0	2	0	0.0	301	30,066
SDG&E Total	**7**	**7**	**5**	**4,431**	**0.6**	**90**	**24,144**
SDG&E PY2021	0	0	0	0	0.0	0	0
SDG&E PY2022	7	7	5	4,431	0.6	90	24,144
Total	**53**	**43**	**28**	**42,076**	**6.1**	**3,101**	**453,575**

3.1.2 Gross sample completions and response rates

Table presents the population counts, sample design quotas, and final sample achieved for key analysis dimensions, including PA and fuel for the gross sample. Overall, 88% of electric and 82% of gas projects in the primary sample design were recruited. While this study attempted to recruit a census of participants, this level of recruitment success is sufficient to achieve the precision targets of ±10% relative precision for both electric and gas first-year energy savings.

[19] CPUC, "Default Custom Measure Gross Realization Rates,": D1107030 Attachments A-B (ca.gov)

Table 3-3. Overall gross sample response rate by fuel and PA

PA	Electric				Natural gas			
	Population (N)	Sample design quota	Final sample (n)	% Complete	Population (N)	Sample design quota	Final sample (n)	% Complete
PA								
MCE	6	6	5	83%	3	3	2	67%
PG&E	17	17	16	94%	12	12	11	92%
SCE	13	13	12	92%	N/A	N/A	N/A	N/A
SCG	N/A	N/A	N/A	N/A	8	8	6	75%
SDG&E	7	7	**5**	71%	**5**	5	4	80%
Total	**43**	**43**	**38**	**88%**	**28**	**28**	**23**	**82%**

3.1.3 Net sample completions and response rates

The NTG sample for this study targeted all sites with capital measures installed. Table shows the sample design quotas for sites with and without capital measures. NTG surveys were only conducted with sites that installed capital measures. Non-capital measure savings were given the NTGR of 1.0 as determined by the prior impact evaluation. For sites with capital measures, surveys were attempted with both the Energy Champion and the Executive Sponsor at each site. Surveys were completed with 14 SEM customers to determine the capital NTGR. When combined with the sites that included no capital measures, a total of 31 sites were included in the overall program NTGR calculation.

Table 3-4. Overall net sample response rate by fuel and PA

PA	No Capital Measures				Includes Capital Measures			
	Population (N)	Sample design quota	Final sample (n)[a]	% Complete	Population (N)	Sample design quota	Final sample (n)*	% Complete
PA								
MCE	2	2	1	50%	5	5	2	40%
PG&E	8	8	8	100%	10	10	4	40%
SCE	3	3	2	67%	10	10	5	50%
SCG	6	6	4	67%	2	2	1	50%
SDG&E	3	3	**2**	67%	**4**	4	1	25%
Total	**22**	**22**	**17**	**77%**	**31**	**31**	**13**	**42%**

Non-capital savings were given the 1.0 NTGR observed through the prior evaluation.
(*) – The final sample was less than the sample design quota primarily due to recruitment difficulties.

3.2 Gross savings methods

3.2.1 Methods overview

This section describes the DNV team's approach to evaluating gross savings. The team determined the appropriate evaluation approach for each site based on the project documentation review and the collected data and information from the site contacts following initial dis. The team presented all site-specific M&V plan and evaluation findings in the CCT tool. The following subsections provide more details on the DNV team's approach.

3.2.2 Custom Core Template (CCT)

The team utilized the Excel-based CCT—also used by other evaluation teams such as CIAC—to organize and communicate evaluation information for each sample project that was selected for evaluation. The CCT served as the final site-specific evaluated savings deliverable and was the common source for reference material the engineering team used to create M&V plans and document data collected in developing estimates of impacts.

The CCT stored claim information downloaded from the tracking database, organized M&V activities, savings calculation methodologies, supplemental data, energy model references, site visit documentation, and realization rate determination in a common format shareable as site-level deliverables. The consistency and uniformity of the CCT ensured the team followed CPUC guidelines and consistently developed and systematically followed best practices for pre-implementation review/evaluation.

3.2.3 Project documentation review

The DNV team conducted a comprehensive review of the project files for the 47 sites that completed their two-year SEM cycle participation in PY2021 or PY2022. For each site, the DNV team aimed to assess the SEM participants' calculations methods, assumptions and inputs, project documentation, and savings claims to determine if they were appropriate and if they adhered to the SEM M&V guide in effect at the time. The DNV team relied on the following documents as the basis of this evaluation study including this review:

1. **Opportunity Register:** used to list all the measures targeted by SEM participants, and measures' completion statuses, dates of installation, and impacted systems. The DNV team noted that some opportunity registers reported savings and costs estimates for some of the measures but not consistently.
2. **Calculation files:** used by SEM participants to estimate the savings for each reporting period. This includes site-level top-down models, measure-level bottom-up calculations, and/or demand savings calculators. The DNV team reviewed the savings reported in these calculators and the program-claimed savings to check for any tracking errors. The DNV team also reviewed the calculation approach, inputs, variables and parameters, and results for each site to determine if they were appropriate and if they adhered to the SEM M&V guide in effect at the time.
3. **Completion Report/Performance Period Report:** used to capture the overall summary of sites' SEM activities for each reporting period. The DNV team reviewed the reported savings and list of installed measures in the completion report to verify they aligned with the provided calculation files and the opportunity register.
4. **M&V report or energy savings report:** used to provide participant notes on the data and inputs used in the calculation models used to calculate the SEM savings. This includes but is not limited to non-routine events (NREs), annualization considerations, range validity of variables, and any other relevant data observations.
5. **No model memo:** used to provide the participant's rationale for using bottom-up calculations instead of a model. The DNV team reviewed the rationale provided by each participant that used bottom-up calculations to determine their validity.
6. **Technical review:** used to support the savings model's inputs and findings to verify the model parameters meet the statistical significance requirements.
7. **Utility bills:** used to the verify the participation of SEM participants in the public purpose program (PPP).

The DNV team reviewed other provided project documentation when more details were needed to supplement the documents listed above. The team requested any missing files directly from the PAs and program implementers when deemed necessary.

3.2.4 Recruitment and data collection

Prior to the start of the recruitment and data collection process, the DNV team reached out to each PA to establish a PA-approved communication protocol. The DNV team shared a proposed recruitment cover letter with each PA and allowed them the opportunity to comment and make recommendations. The team also shared the list of sampled sites for each PA and their facility contacts, as provided in the project documentation. The PAs and program implementers supported the DNV team's recruitment efforts in several ways, including:

- Answering participants' inquiries about the SEM evaluation process and requirements
- Making introductory calls connecting the DNV team and sampled sites
- Providing updated contacts in cases of personnel changes or turnovers
- Providing context and more information about facilities in cases of changes in their SEM participation or ownership changes
- Supporting the DNV team's data requests from participants, when requested

The DNV team started the recruitment process for each sampled site upon the completion of a site-specific M&V plan. The DNV team used the "Measure List" tab in the CCT to import the list of projects noted as completed in the Opportunity Register for each reporting period of the cycle under evaluation. For each completed measure, we planned to answer the following questions:

1. Was the measure installed as described in the Opportunity Register and project documentation? If not, why was the measure not installed?
2. Is the measure still in operation? If not, when did the measure stop realizing savings? What are the reasons for the measure discontinuance?
3. Does the measure impact a single IOU meter?
4. Is the measure capital?

In addition to the participants' answers to the questions below, the DNV team collected any additional measure-specific information or customer feedback on their program participation.

For bottom-up and mixed[20] sites, the team aimed to collect additional measure-specific data as needed. This included verification of operation parameters, trend data, equipment nameplates, photographs of equipment and setpoints, and facility operation and shutdown schedules.

For top-down sites, the team aimed to collect more information on any observations or questions developed during the initial model review. This includes NREs, explanations for any unexplained energy consumption spikes or drops, shutdowns, data points removal or adjustment, negative or zero savings claims, and any capital measures removed from the model savings.

3.2.5 Site analysis methodologies

This subsection addresses the site-specific analysis methodologies used by the DNV team to evaluate the savings forecasted by program participants.

[20] Mixed sites are sites that used both top-down and bottom-up analysis methods in some way. Typically, this would involve a bottom-up analysis approach in Year 1 of a cycle and a top-down modeling approach in Year 2 of that cycle. In some cases, this was done when estimating savings for both fuels where one fuel would use one approach and the other fuel would use the other to estimate savings.

The DNV team classified the savings calculation methodologies used by program participants to calculate forecasted savings (for both electric and natural gas) over the two years of participation into three analysis methodologies, as summarized in Table . A description of each method follows the table.

Table 3-5. Breakdown of savings calculation methodologies

Parameter	Top-down	Bottom-up	Mixed analysis (top-down & bottom-up)
Reviewed projects, n=47	21	18	8
Percentage by count	45%	38%	17%
Percentage of electric savings	59%	30%	11%
Percentage of gas savings	33%	40%	26%

Top-down: This savings methodology is used to calculate the SEM energy savings using facility models on the site level. This methodology uses a billing analysis utilizing multivariable regressions of utility meter data along with the relevant independent variables (such as levels of production or weather conditions) between the baseline period and the reporting period. The SEM guide notes this is the preferred method for calculation savings.

Bottom-up: This savings methodology is used to calculate the energy savings on the measure level. This methodology uses measure-specific formulas, inputs, and assumptions, to calculate the measure-specific savings. The overall site savings are then calculated by aggregating the energy savings of each installed measure.

Mixed analysis: This methodology uses a mix of top-down and bottom-up approaches to calculate the energy savings.

For each sampled site, the DNV team used the same savings calculation methodology as the participant (top-down, bottom-up, or mixed). The subsections below provide more details on the specific tasks completed by the DNV team for each savings calculation methodology.

3.2.5.1 Top-down models

The DNV team performed the following evaluation process for sites that calculated forecasted savings using top-down methodology:

- Reviewed the statistical significance of top-down model parameters and ensured they were within the required range.
- Reviewed the provided utility billing data and ensured it corresponded to the baseline and reporting periods as noted in the project documentation.
- Verified the selected relevant variables adhered to the SEM M&V guidelines.
- Identified any model adjustments such as removal or adjustment of any data points. In such cases, the DNV team determined whether to use the same approach as the participant or otherwise based on the provided documentation of the adjustment or any additional feedback provided by the participant during the site interview.
- Reviewed annualization methods, reasoning, and periods, when used, to verify their adherence to the SEM M&V guidelines.
- Verified the top-down model accounted appropriately for seasonality depending on the type and schedule of site operations.
- Verified the top-down model accounted appropriately for any non-SEM projects completed during the baseline or/and the reporting periods.
- Conducted measure-specific data collection, as described in Section . for all measures noted as “Completed” in the provided opportunity registers. However, top-down models calculate energy savings on the site level.

3.2.5.2 Bottom-up calculations

The DNV team performed the following evaluation process for the sites that calculated their forecasted savings using bottom-up methodology:

- Conducted measure-specific data collection as described in Section for all measures noted as "Completed" in the provided opportunity registers.
- Sampled the two highest savings measures for an in-depth review. If the opportunity registers listed any completed measures as capital, the DNV team selected the highest savings capital measure as one of the two sampled measures.
- Conducted an in-depth review of the participant's engineering approach for the two sampled measures. This included a review of the participant's methodology, formulas, assumptions, and inputs. If the participant's calculations were deemed appropriate, the DNV team used the same approach with updated inputs based on data and information collected from the site personnel. Otherwise, the DNV team made changes to the PA-provided analysis as needed to improve the accuracy of the estimated savings.
- Adjusted the overall site savings by removing the savings of any measures that were verified to have not been installed. The DNV team also prorated the savings of any measures that were installed and then removed within the SEM program EUL of 5 years.

3.2.5.3 Demand savings calculation

Program participants claimed demand savings for approximately 90% of the electric energy savings claims. Most of the electric energy savings claimed with no demand savings were for projects completed in 2020, which the DNV team believes was due to the lack of program guidance on demand savings determination. For the site that claimed demand savings, the DNV team identified two different demand calculators used to calculate demand savings for SEM projects completed in PY2021/2022:

1. The SEM Demand Calculator: this calculator uses publicly posted load profiles documented by PAs to determine the summer peak hours (320 hours for all PAs) and percentage of kWh on-peak (4.07%, 4.25%, 4.11% for PGE, SCE, and SDG&E, respectively). Approximately, 60% of the total count of demand savings claims were calculated using this calculator. This calculator was used by PGE, SCE, and SDGE.
2. The SEM-NMEC Demand Savings Calculator: this calculator uses the load shapes of the facility to calculate its demand savings. The calculator determines the summer peak hours by PA (742 hours for SDGE, and 786 hours for both PGE and SCE). This calculator determines the appropriate kWh summer on-peak percentage based on the facility's sector (commercial, industrial, or agricultural) and its type of operation (refrigeration, HVAC, lighting, etc.). Approximately, 40% of the total count of demand savings claims were calculated using this calculator. This calculator was used by PGE and MCE.

As a consistency check, the DNV team calculated the demand savings using the SEM Demand Calculator for all sites. The DNV found the difference in demand savings was within the range of ±10% for the sites that used the SEM-NMEC Demand Savings Calculator. However, the DNV team recognizes that this margin could fall outside of this range depending on the facility's sector and load shape.

The DNV team notes that both demand calculators use the overall electric energy savings per reporting period to calculate the demand savings. This overlooks the different application types of the installed measures and their possibly different impacts on the overall demand which could result in an inaccurate estimation of the demand savings. However, the team acknowledges that the SEM M&V guide, in effect at the time, did not provide program participants with additional specific guidelines for calculating demand savings. The team also recognizes that the reported demand savings were not considered a factor in determining the program performance-based incentives. Hence, the team determined that the calculators were used appropriately by participants and as instructed by the program.

Accordingly, the DNV team calculated the evaluated demand savings using the same calculator used by the participants and updated only the electric energy savings input to use the evaluated savings instead of forecast claimed savings.

3.3 EUL methods

The DNV team reviewed the list of measures provided in the opportunity registers for each sampled site. The opportunity registers were consistent noting the measure classification (whether it's BRO or capital). The DNV team then interviewed program participants -as described in section - to review the list of completed measures and to confirm the measures classifications.

Upon completion of data collection, the DNV team determined to allocate the estimated savings for each implemented measure. For sites that used bottom-up calculations, the DNV team used the measure-level calculated savings. For sites that used top-down approach, the DNV team performed the following tasks to estimate the savings for each implemented measure:

- The opportunity registers typically included a classification noting whether the savings impacts of the measure were considered high, medium, or low. The DNV team assigned a savings grade for each measure: 1, 2, and 3, for low, medium, and high, respectively.
- The opportunity registers also typically noted the type of fuel impacted by each measure. If the entry of fuel impact is not provided, the DNV team used our best engineering judgement to determine whether the implemented measure impacts electricity, gas, or both.
- The DNV team then calculated weighted savings for each measure using the overall site's forecasted savings per fuel and the savings grade of each measure.

After the forecasted savings for each measure were estimated, the DNV team targeted updating the EUL for each measure. For non-capital projects, the DNV team maintained the SEM EUL of 5 years. For capital measures, the team reviewed the Remote Ex Ante Database Interface (READI) to determine the appropriate EUL. If the capital measure is unique and the DNV team was not able to identify its appropriate EUL, the preexisting SEM EUL of 5 years was used.

3.4 Net savings methods

The methodological approach for the present evaluations is informed by D16-08-019 which states that a well-designed SEM program's holistic and long-term approach encourages the implementation of BRO measures as well as custom and capital measures. The decision concludes that capital measures, when program influence is demonstrated, may apply the SEM default NGTR, which has been 1.00. This report evaluates the degree to which SEM programs demonstrate influence on the implementation of capital measures using surveys of participants in a self-reported approach (SRA).

In the next evaluation cycle, targeting PY23 and PY24 participants, the DNV team will evaluate the NTGR of non-capital measures using a more market-based approach.

3.4.1 SRA capital project-level NTGRs

The survey instrument and algorithms for scoring the survey responses follow California's standard Nonresidential NTG framework and comply with the California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals and the CPUC's Guidelines for Estimating Net-To-Gross Ratios Using the Self-Report Approaches.

The specific survey instruments and algorithms used in this study were adapted from the current Commercial, Industrial, and Agriculture Custom (CIAC) NTG survey battery. However, the immersive design of the SEM program required adjustments to many of the CIAC questions to better align with the factors impacting decisions to pursue SEM opportunities. The team submitted these edits to the CPUC for approval prior to the NTG data collection process. Adjustments were also made to the CIAC NTGR scoring method (standard method) to reflect the unique design of the SEM program which includes long-term engagement, continuous identification of opportunities, and strengthened internal organizational support. The key difference between the standard and SEM scoring methods is a technical fine point. In the standard scoring algorithm, the highest rated program and non-program factors[21] are averaged, while in the SEM scoring, the respondent is asked to weigh the program and non-program factors.[22] The algorithm adaptions are described in detail in Appendix A.

For projects with more than one capital project, separate NTGRs were calculated for each capital component (up to three) and then combined, proportional to the savings of each measure, into a composite capital NTGR. The final site NTGR combined the composite capital NTGR and the non-capital NTGR, proportional to the savings contribution of capital and non-capital measures at that site. The NTGR for non-capital activities remains at the default value of 1.00.

3.4.2 Identifying capital measures

The current evaluation cycle focuses on NTG research for capital projects identified and pursued through the SEM program. To differentiate capital projects from non-capital activities in the NTGR interviews, the interviewees were asked to consider capital and non-capital activity defined as follows:

A Capital Project is:

> *A project that is a budgeted 'line item' in a capital budgeting plan and approved at the corporate level in advance of the project implementation. A capital project typically entails larger dollar expenditures.*

And a non-capital activity as:

> *A project that is funded out of an annually approved expense operation and maintenance budget. The facility manager has the discretion to allocate budget to funding individual projects. This typically entails smaller dollar expenditures for equipment or services to repair, add-on to, or replacement of minor components like controls, diagnostics, or lower cost equipment replacements.*

Interviewees were then asked if this definition aligned with their company's practice. With few exceptions, Energy Champions, Executive Sponsors, and other stakeholders agreed on the definitions. The role of the Energy Champion and Executive Sponsor are defined by the SEM program and each project is required to identify appropriate staff members as a requirement of participation. Only one site provided a slightly different concept for capital expenditures, but this only impacted one of the 22 capital projects in the sample.

The DNV team applied the definition of capital projects to the complete list of installed projects from the PY21-22 program years, using the following steps:

1. **Opportunity Register Review**: Each site maintains an Opportunity Register throughout their participation in the program, which tracks all potential measures from inception through implementation or rejection. Each opportunity can be classified as "capital" or "non-capital" based on the measure type label assigned by the customer. The DNV team

[21] program factor include technical support from the SEM coach, training; non-program factors include improving product quality, corporate environmental goals.

[22] After rating nearly 20 different program and non-program factors on a scale of 0-10 where 0 means "Not at all Important" and 10 means "Extremely Important", the NTG survey asked a very specific question to SEM participants: "If you were given 10 points to award, how many points would you give to the importance of the group of program factors in your decision to install the capital project and how many points would you give to the importance of the group of non-program factors in your decision?" The NTG team used the response to this question to weight the maximum program and non-program factors in the final NTGR scoring. See Appendix A for more detail.

used these labels as a starting point when conducting capital project NTG research. Initial results found that approximately 15% of projects and activities by measure count were classified as capital.

2. **Energy Champion Confirmation**: During the engineering interview with Energy Champions, the DNV team confirmed the classifications of capital versus non-capital, along with other measure characteristics. We found that the projects and activities were correctly classified in the Opportunity Register about 90% of the time.
3. **Executive Sponsor Confirmation**: The DNV team also confirmed the list of capital projects with the Executive Sponsor of each site to ensure consistency with the Energy Champion's assessment. The team did not find any deviations in the projects listed as capital.

3.4.3 NTG data collection

Enhanced rigor surveys and interviews were used for all sites due to the complexity of the SEM program. The primary survey target was the Energy Champion with an additional interview with the Executive Sponsor of each site to check for consistency in responses.

The DNV team used SRA instruments to collect the NTG data, the first was a telephone survey instrument used with Energy Champions that consisted predominantly of multiple choice and 0-10 scale questions. The team kept the open-ended response type questions to a minimum to reduce burden on the participating Energy Champion. The second instrument was a conversational interview with Executive Sponsors to check the lists of capital versus non-capital projects and ask about the facility's energy management policies prior to participating in SEM. These responses were triangulated with the survey results with Energy Champions to ensure consistency and better understand the impact of the SEM program on the site. Where inconsistencies arose, the team reached back out to the Energy Champion to clarify responses.

The NTG survey data collection process was fully compliant with the CPUC's Self-Report Guidelines. Professional staff, experienced in attribution research and trained in the nuances of these survey instruments conducted the surveys.

4 RESULTS

This section presents the results of the gross and net savings by key reporting dimensions. We have included reasons for any deviations between forecasted and evaluated gross savings, and a comparison of the results to the prior 2018-19 SEM impact evaluation. This section also discusses net savings results and ratios which also addresses capital measures and their contribution to overall program savings.

4.1 Gross savings and realization rates

The following sections present the results of our gross savings analysis, starting with electric energy and demand savings. Both first year and lifecycle savings are provided for each PA and at the statewide level. Savings have been expanded from the site level to population level using the site weights provided in the sample design, as described in section .

4.1.1 Electric savings

Table presents the first year and lifecycle forecasted savings, evaluated savings, GRR, and relative precision at the PA and statewide levels for electric savings. Relative precisions are provided at the 90% confidence interval.

Table 4-1. Gross electric energy and demand savings by PA

PA	First year				Lifecycle			
	Forecasted savings [a]	Evaluated savings	GRR	Relative precision	Forecasted savings [a]	Evaluated savings	GRR	Relative precision
Energy (MWh)								
MCE	2,660	2,406	90.4%	4.7%	13,301	12,704	95.5%	5.3%
PG&E	28,765	29,238	101.6%	0.7%	143,825	152,935	106.3%	1.1%
SCE	6,220	5,616	90.3%	3.3%	31,098	31,323	100.7%	1.5%
SDG&E	4,431	4,120	93.0%	4.4%	22,155	30,027	135.5%	12.1%
Statewide	**42,076**	**41,380**	**98.3%**	**0.8%**	**210,379**	**226,990**	**107.9%**	**1.8%**
Demand (MW)								
MCE	0.2	0.4	200%	40%	1.0	2.1	211%	41%
PG&E	4.0	4.1	101%	1%	20.2	21.4	106%	1%
SCE	1.3	0.7	57%	8%	6.5	4.1	64%	7%
SDG&E	0.6	0.5	93%	4%	2.9	3.5	123%	16%
Statewide	**6.1**	**5.8**	**94%**	**3%**	**30.5**	**31.1**	**102%**	**4%**

[a] Forecasted savings represent engineering estimates and do not include the realization rate that has been applied in savings presented in ED Tracking data

4.1.2 Gas savings

Table presents the first year and lifecycle forecasted savings, evaluated savings, GRR, and relative precision at the PA and statewide levels for gas savings. Relative precisions are provided at the 90% confidence interval.

Table 4-2. Gross gas energy savings by PA

PA	First year				Lifecycle			
	Forecasted savings [a]	Evaluated savings	GRR	Relative precision	Forecasted savings [a]	Evaluated savings	GRR	Relative precision
Energy (Therms/1,000)								
MCE	315	139	44.2%	6.3%	1,575	867	55.1%	26.5%
PG&E	1,931	1,611	83.4%	5.2%	9,655	9,947	103.0%	5.3%
SCG	765	610	79.8%	6.6%	3,823	3,208	83.9%	5.5%
SDG&E	90	89	98.4%	1.8%	451	444	98.4%	1.8%
Statewide	**3,101**	**2,449**	**79.0%**	**3.8%**	**15,504**	**14,466**	**93.3%**	**4.2%**

[a] Forecasted savings represent engineering estimates and do not include the realization rate that has been applied in savings presented in ED Tracking data

4.1.3 Total MMBtu savings

Table presents first year and lifecycle forecasted savings, evaluated savings, GRR, and relative precision at the PA and statewide levels for total MMBtu savings. Relative precisions are provided at the 90% confidence interval.

Table 4-3. Gross total energy MMBtu savings by PA

PA	First year				Lifecycle			
	Forecasted savings [a]	Evaluated savings	GRR	Relative precision	Forecasted savings [a]	Evaluated savings	GRR	Relative precision
Energy (MMBtu)								
MCE	40,561	21,517	53.0%	12.4%	202,804	126,535	62.4%	24.7%
PG&E	291,213	260,852	89.6%	3.3%	1,456,064	1,496,693	102.8%	4.9%
SCE	21,222	19,164	90.3%	3.3%	106,109	106,880	100.7%	1.5%
SCG	76,435	60,989	79.8%	6.6%	382,177	320,699	83.9%	5.5%
SDG&E	24,144	23,010	95.3%	1.1%	120,718	121,628	100.8%	46.2%
Statewide	**453,575**	**385,532**	**85.0%**	**2.5%**	**2,267,873**	**2,172,434**	**95.8%**	**4.5%**

4.1.4 Discrepancy analysis

This section presents an analysis of what caused forecasted savings to differ from the evaluated savings estimates for the sampled projects. This analysis is based on the discrepancies associated with first-year gross savings and is calculated on a MMBtu basis. Table below summarizes the discrepancy categories that led the evaluated savings to differ from forecasted savings.

Table 4-4. Categories of savings discrepancies

Category	Description
SEM-specific discrepancies	Differences attributed to annualization errors, non-routine adjustments, long-term and short-term operational changes, incremental savings adjustment.
Tracking data	Differences attributed to inconsistencies between savings claimed and savings calculated in the provided models and/or completion report. This also includes discrepancies in savings due to unexplained or non-documented changes.
Inoperable measure	Differences attributed to measures that were removed and were no longer in operation. This includes measures that were not installed, failure of installed equipment, and business closure.
Inappropriate baseline	Represents a difference in evaluated and reported baseline, including any baseline periods adjustment in the models used to estimate forecasted and evaluated savings. This also includes any savings deviation due to a different ISP, code, or pre-existing baseline.
Operating conditions	Collected trend data or photographs of setpoints informs different operating parameters, including hours of use, setpoints, efficiency, etc.
Calculation methods	Differences attributed to changes in calculation methodology between that used for forecasting savings and evaluation analysis. The evaluator only changed analysis methodology when necessary to accurately calculate savings such as employing an 8760 model.

As the DNV team calculated site-specific results for each sampled site, we noted the reasons for any deviation of the evaluated savings from forecasted for each site into those listed categories. We then calculated the contribution of each category of discrepancy to the overall difference between forecasted and evaluated savings.

Table shows the number of instances a given discrepancy occurred, and its impact on overall gross MMBtu realization rates.

Table 4-5. Key drivers behind overall GRR (MMBtu)

Discrepancy Sub-category	Counts	Impact on RR
SEM-Specific discrepancies	20	-8.4%
Calculation methods	29	-3.5%
Tracking discrepancy	15	-2.6%
Inoperable measure	2	-0.5%
Operation conditions	8	0.0%
Inappropriate baseline	2	0.0%
Total	**76**	**-15.0%**

Further discussion on each discrepancy is provided below:

SEM-specific discrepancies: Annualization errors accounted for most of this discrepancy. More details regarding annualization errors are provided in Section

Calculation methods: Modeling adjustment and calibration accounted for most of this discrepancy. More details regarding model adjustments are provided in Section . Additionally, the change of inputs used in savings calculation was a small contributor to this discrepancy.

Tracking discrepancy: Deviations between the savings claimed and savings forecasted in the participant models were a major contributor to this discrepancy. Examples of inconsistencies between the claimed savings and the provided model-calculated savings are provided in Section

Inoperable measure: The major contributors to this discrepancy are sites that experienced business closure or change of ownership where the SEM measures were removed.

Operating conditions: The major contributors to this discrepancy are sites for which the DNV team collected as-built trend data or documentation of setpoints that were different from values and parameters used to estimate the forecasted savings.

Inappropriate baseline: The impact of this discrepancy was minimal and was attributed to sites for which the DNV team adjusted the baseline period in the model to improve the model's statistical significance.

4.1.5 Comparison to previous evaluation findings

Table compares the evaluation estimates of electric and gas lifecycle GRRs by PA and statewide to the previous 2018/19 SEM impact evaluation. Some observations from this comparison included the following:

Table 4-6. Comparison of lifecycle GRR results by evaluation year and PA

PA	Lifecycle GRR					
	2018/19	2021/22	2018/19	2021/22	2018/19	2021/22
	Electric		Gas		MMBtu	
MCE	N/A	96%	N/A	55%	N/A	62%
PG&E	101%	106%	131%	103%	120%	103%
SCE	102%	101%	N/A	N/A	102%	101%
SCG	N/A	N/A	68%	84%	68%	84%
SDG&E	120%	136%	85%	98%	541% [a]	101%
Statewide	**112%**	**108%**	**123%**	**93%**	**119%**	**96%**

[a] Large SDG&E EUL error was corrected for electric and gas savings but was not corrected for MMBtu savings. Actual MMBtu lifecycle GRR likely around 100%.

The overall evaluated gas savings were smaller than forecasted. This is due to annualization errors and model adjustments performed by the DNV team to improve the statistical significance of the gas models and to accurately model typical operation. Hence, these adjustments are the primary reasons leading the evaluated lifecycle to be smaller than forecasted.

4.2 Net savings results and ratios

The following sections present the results of the net savings analysis, starting with electric energy and demand savings. Both first year and lifecycle savings are provided for each PA and at the statewide level. Savings have been expanded from the site level to population level using the site weights provided in the sample design, as described in section . The site-level NTGR is a saving-weighted blend of the calculated NTGR for capital projects and the NTGR of 1.0 for non-capital activities. The NTGR for capital projects is calculated by scoring the survey responses using the CIAC and the new SEM algorithm described in Section

4.2.1 Electric net savings

Table presents the first year and lifecycle forecasted savings, evaluated gross and net savings, NTGR, and relative precision at the PA and statewide levels for electric savings using the standard algorithm. Relative precisions are provided at the 90% confidence interval. Table follows with electric first year and lifecycle forecasted savings using the SEM algorithms. As a comparison, the most recent CIAC custom electric first year NTGR was 0.61.

Table 4-7. Electric net savings and NTGR using standard scoring method

PA	First year				Lifecycle			
	Evaluated gross savings	Net Savings	NTGR	Relative precision	Evaluated gross savings	Net savings	NTGR	Relative precision
Energy (MWh)								
MCE	2,406	2,227	92.6%	1.8%	12,704	11,759	92.6%	1.8%
PG&E	29,238	28,508	97.5%	1.5%	152,935	148,310	97.0%	1.7%
SCE	5,616	5,431	96.7%	0.5%	31,323	30,139	96.2%	0.5%
SDG&E	4,120	3,940	95.6%	5.3%	30,027	27,949	93.1%	7.0%
Statewide	**41,380**	**40,087**	**96.9%**	**1.2%**	**226,990**	**218,306**	**96.2%**	**1.4%**
Demand (MW)								
MCE	0.4	0.4	92.5%	1.9%	2.1	2.0	92.5%	1.9%
PG&E	4.1	4.0	97.7%	1.4%	21.4	20.8	97.1%	1.6%
SCE	0.7	0.7	96.7%	0.5%	4.1	4.0	96.2%	0.5%
SDG&E	0.5	0.5	95.6%	5.3%	3.5	3.3	93.1%	7.0%
Statewide	**5.8**	**5.6**	**97.1%**	**1.0%**	**31.1**	**30.0**	**96.4%**	**1.3%**

Table 4-8. Electric net savings and NTGR using SEM scoring method

PA	First year				Lifecycle			
	Evaluated gross savings	Net savings	NTGR	Relative precision	Evaluated gross savings	Net savings	NTGR	Relative precision
Energy (MWh)								
MCE	2,406	2,304	95.7%	1.4%	12,704	12,164	95.7%	1.4%
PG&E	29,238	28,811	98.5%	0.9%	152,935	150,368	98.3%	1.0%
SCE	5,616	5,539	98.6%	0.2%	31,323	30,828	98.4%	0.2%
SDG&E	4,120	4,065	98.7%	1.6%	30,027	29,395	97.9%	2.0%
Statewide	**41,380**	**40,713**	**98.4%**	**0.6%**	**226,990**	**222,741**	**98.1%**	**0.7%**
Demand (MW)								
MCE	0.4	0.4	95.7%	1.5%	2.1	2.0	95.7%	1.5%
PG&E	4.1	4.0	98.6%	0.8%	21.4	21.0	98.4%	0.9%
SCE	0.7	0.7	98.6%	0.2%	4.1	4.1	98.4%	0.2%
SDG&E	0.5	0.5	98.7%	1.6%	3.5	3.4	97.9%	2.0%
Statewide	**5.8**	**5.7**	**98.5%**	**0.6%**	**31.1**	**30.6**	**98.3%**	**0.6%**

4.2.2 Gas savings

Table presents the first year and lifecycle forecasted savings, evaluated gross and net savings, NTGR, and relative precision at the PA and statewide levels for gas savings using the standard scoring method algorithms. Relative precisions are provided at the 90% confidence interval. Table Table follows with natural gas first year and lifecycle forecasted savings using the SEM algorithms. As a comparison, the most recent CIAC custom gas first year NTGR was 0.76.

Table 4-9. Gas net savings and NTGR using standard scoring method

PA	First year				Lifecycle			
	Evaluated gross savings	Net savings	NTGR	Relative precision	Evaluated gross savings	Net savings	NTGR	Relative precision
Gas (Therms)								
MCE	139	139	100.0%	0.0%	867	867	100.0%	0.0%
PG&E	1,611	1,527	94.8%	6.3%	9,947	9,414	94.6%	5.7%
SCG	610	608	99.7%	0.3%	3,208	3,192	99.5%	0.5%
SDG&E	89	89	100.0%	0.0%	444	444	100.0%	0.0%
Statewide	**2,449**	**2,368**	**96.7%**	**3.9%**	**14,466**	**13,966**	**96.5%**	**3.5%**

Table 4-10. Gas net savings and NTGR using SEM scoring method

PA	First year				Lifecycle			
	Evaluated gross savings	Net savings	NTGR	Relative precision	Evaluated gross savings	Net savings	NTGR	Relative precision
Gas (Therms)								
MCE	139	139	100.0%	0.0%	867	867	100.0%	0.0%
PG&E	1,611	1,559	96.8%	4.1%	9,947	9,654	97.1%	3.5%
SCG	610	609	99.9%	0.1%	3,208	3,201	99.8%	0.2%
SDG&E	89	89	100.0%	0.0%	444	444	100.0%	0.0%
Statewide	**2,449**	**2,399**	**98.0%**	**2.5%**	**14,466**	**14,194**	**98.1%**	**2.2%**

4.2.3 Total MMBtu savings

Table presents first year and lifecycle forecasted savings, evaluated savings, GRR, and relative precision at the PA and statewide levels for total MMBtu savings using the CIAC algorithms followed by Table which uses the SEM algorithms. Relative precisions are provided at the 90% confidence interval.

Table 4-11. Total MMBtu net savings and NTGR using CIAC algorithms

PA	First year				Lifecycle			
	Evaluated gross savings	Net savings	NTGR	Relative precision	Evaluated gross savings	Net savings	NTGR	Relative precision
Energy (MMBTU)								
MCE	21,517	19,915	92.6%	2.1%	126,535	117,119	92.6%	2.1%
PG&E	260,852	249,849	95.8%	3.9%	1,496,693	1,451,142	97.0%	2.1%
SCE	19,164	18,531	96.7%	0.5%	106,880	102,840	96.2%	0.5%
SCG	60,989	60,804	99.7%	0.3%	320,699	319,111	99.5%	0.5%
SDG&E	23,010	22,205	96.5%	4.1%	121,628	115,423	94.9%	5.1%

PA	First year				Lifecycle			
	Evaluated gross savings	Net savings	NTGR	Relative precision	Evaluated gross savings	Net savings	NTGR	Relative precision
Statewide	**385,532**	**371,013**	**96.2%**	**2.5%**	**2,172,434**	**2,103,974**	**96.8%**	**1.4%**

Table 4-12. Total MMBtu net savings and NTGR using SEM algorithm

PA	First year				Lifecycle			
	Evaluated gross savings	Net savings	NTGR	Relative precision	Evaluated gross savings	Net savings	NTGR	Relative precision
Energy (MMBTU)								
MCE	21,517	20,601	95.7%	1.7%	126,535	121,154	95.7%	1.7%
PG&E	260,852	253,076	97.0%	3.0%	1,496,693	1,476,696	98.7%	1.0%
SCE	19,164	18,899	98.6%	0.2%	106,880	105,189	98.4%	0.2%
SCG	60,989	60,913	99.9%	0.1%	320,699	320,052	99.8%	0.2%
SDG&E	23,010	22,765	98.9%	1.2%	121,628	119,739	98.4%	1.5%
Statewide	**385,532**	**376,138**	**97.6%**	**1.9%**	**2,172,434**	**2,141,396**	**98.6%**	**0.7%**

4.2.4 Other NTGR results

This section discusses ancillary results related to the NTGR research which includes the contribution of capital measures to program saving, customer understanding of capital measures, and the NTGR outcome of capital measures.

4.2.4.1 Contribution of capital measures to program savings

As noted previously, SEM measures are tracked by the customer in the Opportunity Register. Each measure record includes fields for a measure description, the origin of the measure (for example, through the Treasure Hunt), estimates of savings and costs, and relevant to this discussion, the measure type, as well as other characteristics. The measure type is a label, which identifies whether a measure is a behavioral, retro-commissioning, maintenance, or capital type measure facilitating a direct mapping to a capital or non-capital classification.

The DNV team collected all the Opportunity Registers from the selected sites and combined them into one dataset. For the cases where the savings estimate field was empty, the engineers gave a rough estimate (note, the same allocation was used to calculate a site level EUL). Table shows the percentage of capital measures in program tracking savings by PA as reported in the Opportunity Registers. Capital measures make up about 16% of tracking savings, with some differences by PA and fuel.

Table 4-13. Contribution of capital measure to SEM program tracking savings

PA	Total MMBtu savings	Percent of capital MMBtu	Total kWh savings	Percent of capital kWh	Total therm savings	Percent of capital therm
MCE	40,561	12%	2,660,252	21%	314,916	9%
PG&E	291,213	16%	28,764,984	8%	1,931,087	20%
SCE	21,222	11%	6,219,519	11%	0	0%
SCG	76,435	11%	0	0%	764,536	11%
SDG&E	24,134	22%	4,428,144	36%	90,268	0%
Statewide	**453,565**	**18%**	**42,072,898**	**23%**	**3,100,807**	**16%**

We found that the measure type field was well populated and accurately identified capital measures about 90% of the time based on follow-up interviews with site staff. Other associated fields intended to capture measure savings and costs were often not populated.

4.2.4.2 Customer understanding of capital measures

The DNV team completed SRA phone surveys with 13 Energy Champions who provided specific feedback on a total of 22 capital projects through the SEM program. The initial capital classification found in the Opportunity Registers were largely correct as confirmed by the Energy Champion and Executive Sponsor.

A wide variety of measures were classified as capital measures and non-capital measures. The measure descriptions were often cryptic as can be seen in Table , and not necessarily indicative of the customer's classification. The cost field was also not usually populated, which can be another method for flagging capital expenditures. However, the customers in the interviews were usually clear on what they considered to be capital and non-capital and overall, consistent with the Opportunity Register classification.

Table 4-14. Illustrative measure descriptions by type for completed measures

Example measure descriptions with customer measure type classifications	
Capital	
3x6 Install VFD on dust collector	Install new cooling tower
Add lighting occupancy sensors to the warehouse	Replace bearings or perform other maintenance on high pressure fan to eliminate cooling fan
Fix the gap in door to the vegetable walk-in box	Replace warehouse lighting w/LEDs
Purchase new water chiller and make it as efficient as possible	Using cooling tower water to cool hydraulic oil at the huskies.
Insulate steam piping	Wash Line Installation
Plant LED project	(3x6) Insulate Steam Lines in Anodizing
Behaviours	
Add better controls to slow conveyers when running without product	Develop SOPs for cleaning/changeover/breaks to minimize running equipment when no product is running.
Add VFDs to Baghouses	Install LEDs in Dryer area in Onion facility
Cleaning dust collection system sections to reduce pressure drop across the system	Institute a periodic air leak detection program to identify and repair air leaks
Conduct steam leak survey and repairs at Dryer C	Shut down air compressors when not needed during off-season.
Develop or enhance SOP to ensure equipment is shut down when not running product	Stopped using Kaeser air compressor (20hp) on Sundays. Modified air valve for cooling system in batter mixing room
O&M	
(3x6) Develop regular air leak program	Start tracking elevator unloads vs energy usage
3x6 Fix 80% of natural gas leaks from audit	Steam Trap Replacement (Phase 1)
3x6 Further reduce comp air discharge pressure 5 psig	Stop drying the floor with beast compressed air line
Add a sensor to truck unload	Turn off lights when no one is present
Add light occ sensors to breakroom	Upgrade lighting in key areas
Adjust HVAC setpoints	Use light meter to see if areas should be de-lamped
Standardize SOPs for engineering team	Roll out employee engagement boards

4.2.4.3 NTGR outcome of capital measures

The final SEM NTGR is a blend of the estimated value for capital projects, using the self-reported approach (SRA) survey responses described in Section , and the default value of 1.0 for non-capital activities. The verified electric and gas savings, converted to MMBtu, was used to weight the capital project and non-capital NTGRs to estimate the total program result. Table presents an estimate of the capital NTGR using both algorithm approaches weighted by combined electric and gas savings based on MMBtu by PA, and then statewide for gas and electric contributions. These values are intended to illustrate the approximate differences in NTGR due to the algorithms and are not intended to be applied to programs directly.

Table 4-15. Approximate differences in NTGR due to an algorithm change

PA	Number of sites surveyed	Capital tracking savings (MMBtu)	Capital savings as Pct of PA total	SEM capital NTGR – standard method	SEM capital NTGR – SEM method	Difference
MCE	2	40,561	12%	0.58	0.74	0.16
PGE	4	291,213	16%	0.59	0.74	0.15
SCE	5	21,222	11%	0.73	0.88	0.15
SCG	1	76,435	11%	0.73	0.79	0.06
SDGE	1	24,134	22%	0.77	0.93	0.16
Statewide MMBtu		453,565	15%	0.63	0.79	0.16
Statewide Electric (kWh)		42,072,898	12%	0.64	0.80	0.09
Statewide Gas – (therms)		3,100,807	16%	0.58	0.74	0.16

An important point from Table is that the program influence is below (1.0) for capital measures, no matter what method is used. However, SEM measures constitute a solid but small portion of program savings. Thus, when blending the NTGR of 1 for non-capital measures, the composite site and program NTGR are close to 1. A second point is that the SEM method overall yields a higher NTGR *for this program* compared to the standard method. Since the standard algorithm averages the program and non-program factors, the results tend to converge on 0.5, reducing site to site variations. The SEM algorithm uses the participant's weighting of the importance of program factors versus non-program factors directly. SEM's immersive character and the high degree of customer commitment required to participants is likely to incline a participant to highly rate program factors, thus boosting the score. For another program where the customer is less engaged, that the SEM approach might yield a lower score, if the customer sees non-program factors as more important.

As a final point, the relative precision of the NTGR results presented in Section are excellent, less than ±5% for statewide and PA level results. This was accomplished with a small number of capital NTG surveys (n = 13), because in the expansion of the results, sites with no capital measures were factored into the analysis with a NTGR of 1 with no additional variation. The relative precision of the capital NTGR alone, will be much poorer.

5 FINDINGS AND RECOMMENDATIONS

This section summarizes all findings from the SEM impact evaluation study and highlights the implications from the findings and recommendations from the DNV team.

5.1 Analysis methodology

The SEM M&V guide states that the top-down modeling approach is the preferred methodology to calculate SEM savings. The guide requires participants to provide justification if bottom-up calculations are used instead of top-down modeling approach, which was followed by all participants who used bottom-up calculations. The top-down modeling approach is more capable of capturing the full impact of SEM BRO measures since these types of measures can affect different spaces and pieces of equipment throughout a facility. The SEM M&V guide provides examples for these situations which include but are not limited to the unavailability of energy consumption and relevant variables data, number of energy meters exceeding 10 at the facility, nonexistence of on-site generation metering, and high variability of production.

The evaluators classified the savings calculation methodologies used by program participants to calculate the SEM savings (for both electric and natural gas) over the two years of participation into three categories as summarized in Table .

Table 5-1. Breakdown of savings calculation methodologies

Parameter	Top-down	Bottom-up	Mixed analysis (top-down & bottom-up)
Reviewed projects, n=47	21	18	8
Percentage by count	45%	38%	17%
Percentage of electric savings	59%	30%	11%
Percentage of gas savings	33%	40%	26%

The evaluators found that only 45% of the SEM participants used top-down analysis approach to calculate the SEM savings (for both electric and natural gas) over the two years of their SEM cycle. The evaluators reviewed the justification provided by each site for using bottom-up calculation which are summarized in Table below.

Table 5-2. Bottom-up/mixed analysis calculation rationales

Justification for bottom-up/mixed analysis	Quantity
Top-down model did not meet statistical criteria due to significant operation changes or flat production profile	5
Metering complications & large facility/too many meters	4
Major operational changes	3
Meter shared with other facility/hosts process or equipment for external subcontractors	3
Complications with on-site generation data	2
Energy consumption change due to added equipment	2
Operation changes due to COVID	2
Production tracking complications	2
Large facility/too many meters	1
Metering complications	1
Production tracking & metering complications	1

Based on the provided project documentation, the evaluators found that approximately 40% of the sites that used bottom-up calculations, or the mixed analysis approach reported having attempted to calculate savings using the top-down model. However, only a few sites included the attempted top-down model in their project documentation that was provided to the evaluators.

Implications

- Bottom-up approach calculates SEM energy savings on the measure level. However, the majority of the implemented SEM projects are BRO measures that generate interactive effects which impact other systems in addition to the system targeted by the measure. This impact is often difficult to calculate accurately at the measure level and could only be captured by the overall impact on the site's total energy consumption.
- Bottom-up approach uses measure-specific formulas, inputs, and assumptions, to calculate the measure-specific savings. Since installed measures could vary significantly, this poses a complication in ensuring that all measure calculations meet the appropriate rigor to calculate accurate savings.
- The overall bottom-up savings are calculated by aggregating the energy savings of each installed measure. The participant is expected to provide documentation to supplement the savings calculation of each measure. This includes documentation of quantities, sizes, hours of operation, and any other measure-specific parameter. Additionally, when bottom-up sites are selected for evaluation, they are expected to provide supplemental information as requested by the evaluators. This includes but is not limited to trend data, photographs of nameplates or equipment, verification of quantities (such as invoices), and any other measure-specific documentation. This creates an additional burden on program participant to provide such documentation when using the bottom-up approach compared to the top-down approach.

Recommendations

- Prioritize calculating energy savings using top-down approach to bottom-up calculations. Bottom-up calculations should only be used when a top-down model is proven to not be feasible.
- Prioritize identifying and addressing issues that impede creating a valid top-down model as early as possible during SEM participation.
- Attempt top-down models and include them in the project files even when using bottom-up calculations. This will allow the PAs and the evaluators an opportunity to review those models to confirm the reasons for using bottom-up calculations.
- When using a bottom-up approach, SEM participants should take the following actions:
    - Continue providing thorough documentation to justify calculating the SEM savings using bottom-up calculations.
    - Use on-site metering and trend data to determine the most accurate values for parameters used in measure-level calculations. Using as-built values lead to accurate savings estimation.
    - Provide thorough documentation of all inputs and parameters used in bottom-up calculations.
    - Expect and prepare to fulfil data requests made by the evaluators to validate measure-specific parameters.

5.2 Savings calculation considerations

This subsection summarizes the DNV team's findings regarding the top-down models and bottom-up calculations used by SEM participants.

5.2.1 Savings annualization

Savings annualization refers to prorating the savings calculated within a short period of time to annual savings. Annualization is often used when SEM projects were installed late in the year and consequently, the full annual impact of those savings would not appear in the billing analysis. The typical observed annualization period is 3-months within the final five months of the reporting period in consideration. This approach was required by older versions of the SEM M&V guide.[23] The current version of the guide limited the use of annualization to only when the model is being retired or a customer will not be participating in the SEM program after the current Reporting Period, with PA authorization.[24] The DNV team acknowledge that program participants who used annualization followed the SEM M&V guidelines. However, the annualization approach often overlooks the seasonality in the typical annual operation for facilities which results in inaccurate savings estimation. The DNV team found that the use of savings annualization accounted for approximately 57% of difference between forecasted and evaluated savings estimates, as presented in section . Further details on the impacts of the savings annualization are summarized in Table .

Table 5-3. Savings annualization impacts

Parameter	PY2021	PY2022	Total
Sites with savings annualization discrepancy	12	7	19
Total number of sites	21	26	47
Percentage by count	57%	27%	40%

The DNV team found that savings annualization resulted in overestimation of the SEM savings in approximately 70% of the sites that calculated savings using this approach.

Implications

- Savings annualization carries a significant savings miscalculation risk as sites' operations and production during the annualization period may be misrepresentative of typical operations over a full year.
- Savings annualization is not consistent with the SEM's performance-based approach to estimating savings using billing analysis, and it creates analytic difficulties in truing up savings in subsequent years.

Recommendations

- Follow the SEM M&V guidelines which recommended limiting the annualization to only when the model is being retired or a customer will not be participating in the SEM program after the current reporting period, with PA authorization. Hence, annualized savings will be rejected when annualization is likely to produce inaccurate annual savings, such as seasonally impacted savings, or where savings are not steady from time period to time period, such as shutdown-type measures.

5.2.2 Modeling adjustments

Model adjustments performed by the DNV team accounted for 27% of difference between forecasted and evaluated savings. The DNV team reviewed all top-down models that were used by SEM participants to calculate savings for projects implemented in PY2021/2022. Overall, the DNV team determined that the sites that employed top-down models were consistent and well-developed. However, the DNV team identified several models that required adjustments to improve the

[23] Sergio Dias Consulting. "California Industrial SEM M&V Guide, Version 2.01." Section 11.5.1. September 12, 2020. https://pda.energydataweb.com/api/downloads/2525/CA_Industrial_SEM_M%26V%20Guide_v2.01.pdf

[24] Sergio Dias Consulting. "California Industrial SEM M&V Guide, Version 3.02." Section 1.4. July 6, 2022. https://pda.energydataweb.com/api/view/2648/CA_SEM_MV_Guide_v3.02.pdf

model statistical significance, reflect typical operation, and calculate more accurate savings. To achieve these model's improvements, the DNV team made site-specific model adjustments which included:

- For models that experienced operation changes due to COVID but did not appropriately account for the reduction in energy consumption due to COVID, the DNV team adjusted the models by either adding a COVID indicator or by removing the impacted periods from the reporting period. The DNV team implemented this change to ensure that only the savings associated with SEM implemented projects are claimed.
- For models that accounted for inconsistent shutdowns by using an indicator of 1 or 0 to reflect whether a specific period experienced shutdown, the DNV team adjusted the model to include the actual days of shutdowns since the energy impact of shutdowns varies depending on the duration of the shutdown.
- For models that used different baselines to calculate the savings for the first and second reporting periods, the DNV team calculated the savings for both reporting periods using the baseline that showed more accurate representation of the sites' typical operation. The DNV team verified this by comparing the statistical significance of each model and by any additional intel collected during the site interview.
- For models that used included data points for variables that were beyond the ±10% of the energy baseline data set and fell outside of the standard deviation limit, the DNV team deemed those data points as outliers and removed them from model consideration.
- .
- For models that used variables showing high correlation, the DNV team verified the correlation by reviewing the project documentation and collecting additional information during the site interview to understand the sites' operation. When verified, the DNV team either consolidated variables that are directly connected (such as production of different units) or only included variables that improve the model statistical significance.
- For models that included hard-coded values without referencing the source of those values, the DNV team regenerated the participant's model to compare the outputs. In case the regenerated savings did not match the hard-coded values reported by the participant, the DNV team referred to the regenerated savings. This issue was not common among the reviewed models; hence, the DNV team considered it an incidental error.

Overall, model adjustments conducted by the DNV team contributed 27% to the overall discrepancy between forecasted and evaluated savings, as presented in section

Recommendations

- Follow the SEM M&V guidelines on creating top-down models and assess their validity.[25] Below are some examples of the steps to take in ensuring the M&V guidelines are followed:
  - Ensure that the model is reflective of the facilities' typical operation for both baseline and reporting periods.
  - Ensure that any short-term changes (such as shutdowns) are included in the model as accurately as feasible. Including the actual days of shutdowns results in a higher correlation with energy consumption than simply using an indicator of either 1 or 0.
  - Investigate the reasons for data points that reflect high residuals or fall outside of the range of the variable statistical significance and adjust the model accordingly. Tracking and documenting sources of outliers is more feasible during the model development phase as variables are being actively monitored.
  - Ensure that the model is using variables that are relevant and not correlated.
- Avoid using hard-coded values in the savings calculations. The use of hard-coded values prevents the participants, PA reviewers, and evaluators from tracking the sources of the used values and complicates the process of updating and validating model results.

5.3 Project documentation inconsistencies

The DNV team identified five sites for which the forecasted savings were reported based on the conducted technical review. For those sites, the DNV team flagged project documentation inconsistencies as the provided model was completed prior to the technical review and the remaining project documentation (e.g., completion report) was not updated based on the technical review findings and recommendation. Below is the DNV team's findings for each site:

- **Site A:** For the electric savings, the participant's forecasted savings represented 91% of the model-calculated savings. This is due to the technical review recommendation of using the savings annualization of the last three months of the second reporting period instead of using all available and valid data points. The project documentation indicated this adjustment was performed to adhere to the guidelines of the SEM M&V in effect at the time.
  - For the gas savings, the model calculated negative savings for the second reporting period that would decrease the overall cycle gas savings by 4%. The technical review indicated that the gas savings were updated by applying savings annualization and will reduce the overall cycle gas savings by 3%. However, the participant claimed 0 gas savings for the second reporting period which resulted in a slight savings overestimation over the two-year cycle.
- **Site B:** For the electric savings, the participant's forecasted savings represented 103% of the model-calculated savings. This is due to the technical review recommendation of using the savings annualization of the last three months of the second reporting period instead of using all available and valid data points. The project documentation indicated this adjustment was performed to adhere to the guidelines of the SEM M&V in effect at the time. However, the technical review referenced a different value for the electric savings estimated prior to the technical review compared to the values listed in the completion report.
  - For the gas savings, the site claimed savings for the first reporting period despite being within the noise of the model. The completion report notes that claiming those savings was based on the technical review recommendation. The completion report noted that the model was redeveloped for the second reporting period and

[25] Sergio Dias Consulting. "California Industrial SEM M&V Guide, Version 3.02." Sections 4, 6, and 7. July 6, 2022. https://pda.energydataweb.com/api/view/2648/CA_SEM_MV_Guide_v3.02.pdf

the calculation of the gas savings over the cycle yielded no savings. Consequently, the completion report indicated that the gas savings for the second reporting period should be reversed. The provided model resulted in negative gas savings for the cycle. The technical review for the second reporting period indicated the model was deemed invalid and no savings will be claimed without no recommendation to reverse the savings claimed in the first reporting period. The claimed savings aligned with the technical review recommendations but are not consistent with the provided model and the completion report.

- **Site C:** For the electric savings, the participant's forecasted savings represented 73% of the savings reported in the bottom-up calculations for the first reporting period. The participant reported three different values for the savings in the completion report, bottom-up calculations, and the technical review. The DNV team was able to track the discrepancy between the completion report and the bottom-up calculations as it was due to on-site generation adjustment (non-IOU analysis). However, the DNV team was unable to track the savings value listed in the technical review. The available documentation section of the technical review indicated that a second iteration of the bottom-up calculation and the completion report were created; however, they were not included in the project documentation package that was provided to the DNV team.
  - For the gas savings, the participant's forecasted savings represented 98% of the savings reported in the bottom-up calculations. The forecasted gas savings were referenced in the technical review which was based on an updated version of bottom-up calculations that were not included in the project documentation provided to the DNV team.
- **Site D:** For the electric savings, the participant's forecasted savings represented 88% of the model-calculated savings for the second reporting period. This is due to the technical review recommendation of using the savings annualization of the last three months of the second reporting period instead of using all available and valid data points. The project documentation indicated this adjustment was performed to adhere to the guidelines of the SEM M&V in effect at the time. No gas savings were claimed for this site.
- **Site E:** For the electric savings, the participant's forecasted savings represented 73% of the model-calculated savings for the second reporting period. The forecasted savings reported the program were based on the recommendation of the technical review. No gas savings were claimed for this site.

The DNV team used the claimed savings in calculating the evaluation results. However, the savings calculation methodology used by the DNV team's is based on the review of the participant's provided calculators and inputs. In the cases listed above, the provided calculation models and completion reports were not updated based on the technical review recommendation while the claimed savings were.

Implications

- The DNV team recognizes that the project documentation provided by SEM participants follow the sequential process of developing SEM projects from project initiation to savings claims submission. However, providing completion reports and savings calculation models that do not correspond to the final forecast savings claim does not allow for the validation of the final forecasted savings.

Recommendations

- Update relevant project documents such as the completion report and the calculation models to reflect any changes implemented during the technical review phase.
- Include any updated models or final savings estimates in the project documentation package.

5.4 NTGR methods and results

The SEM program has enjoyed a default NTGR of 1 since its inception. This assumption was further supported by the previous impact evaluation which used a theory-driven NTGR approach which confirmed the NTGR of 1. Decision 16-08-019 directs us to consider whether program influence is evident for custom measures and by extension capital measures:

> *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 retro-commissioning, 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****.*[26]

The DNV team's attribution research is designed to meet the objective of demonstrating program influence on capital projects as directed in 16-08-019.

Program influence on capital measures and NTGR results

The research shows that the SEM program had a substantial influence on the installation of capital measures with a statewide average NTGR value of 0.63 and 0.79 based on MMBtu using the standard and SEM algorithms, respectively. This indicates that SEM's immersive nature is successfully leading customers to install more capital projects than they might otherwise have without program participation.

The NTGR surveys were successfully completed and NTGR ratios were calculated for each PA and by fuel producing an updated SEM NTGR. This SEM NTGR combines the NTGR of capital measures determined in the research and the non-capital measures using a NTGR of 1.0. The final program NTGR was close to 1 across PAs and fuels. The combined program NTGR precisions were also robust due to the contribution of non-capital measures to the overall NTGR.

Implications

- While there are slight variations between fuels and PAs, the assumption that the NTGR of the SEM program is 1, essentially, stands.
- The convention is that CEDARS will incorporate a unique fuel-specific NTGR for each PA for calculating net savings. The CPUC may wish to consider authorizing a single statewide SEM NTGR value of 1 for both electric and gas savings, given the clustering of the results around 1.

Recommendations

- Evaluators recommend using the combined SEM NTGR and to apply it to all measures whether capital or non-capital. The combined NTGR accuracy is superior to the capital NTGR alone. Attempting to apply separate NTGR values to capital and non-capital would require savings to be reported as capital and non-capital in CEDARS, adding an unnecessary administrative burden. A requirement for separate applications of a capital and non-capital NTGR could also lead to perverse incentives to classify more measures in the Opportunity Register as non-capital.

[26] Decision 16-08-019. *Decision Providing Guidance for Initial Energy Efficiency Rolling Portfolio Business Plan Filings*. November 14, 2013..https://ccag.ca.gov/wp-content/uploads/2016/10/6.5-Attachment-ALJ-Decision-16-08-019-081816.pdf

Identifying capital measures

Capital measures were successfully distinguished from non-capital measures leveraging the Opportunity Registers but required interviews with knowledgeable staff to confirm the measure type. The Opportunity Register has fields for measure cost and savings which could be used to streamline the measure type as the program scales; however, these fields are often not populated, even for measures that were completed. The measure savings and measure cost estimates have further utility as a basis for estimating program measure life and as input to program cost effectiveness.

The measure savings estimates recorded in the Opportunity Register are not intended to be used for claiming savings, thus, they do not require the rigor of bottom-up estimates.

Implications

- The Opportunity Register is an important source of information for identifying measure types to support evaluation. The measure type field was well populated and was 90% accurate.
- Two other important fields, measure cost and measure savings, are not well populated in the Opportunity Register. Both fields can be used to inform EUL calculations and program cost-effectiveness and can aid in the customer's prioritization of measures.

Recommendations

- Evaluators recommend that the program implementers populate the applicable fields for any completed measure with estimated savings and costs. The savings and costs are effective tools for customers to prioritize measures and can streamline identification of capital measures as the program scales.

NTG Methods

The DNV team's attribution research is designed to determine program influence on capital projects as directed in 16-08-019. The specific survey instruments and standard algorithms used in this study were adapted from the current Commercial, Industrial, and Agriculture Custom (CIAC) NTG survey battery to account for the immersive design of the SEM program. The specific adaptions are described in detail in with analysis supporting the adoption of the method. In summary, in the standard scoring method, the highest rated program and non-program factors[27] are averaged, while in the SEM scoring, the respondent is asked to weigh the program and non-program factors.[28] SEM's immersive character and the high degree of customer commitment required of participants is likely to incline a participant to highly rate program factors, thus boosting the score. For another program where the customer is less engaged, the SEM approach might yield a lower score.

[27] Program factors include technical support from the SEM coach and training; non-program factors include improving product quality and corporate environmental goals.

[28] After rating nearly 20 different program and non-program factors on a scale of 0-10 where 0 means "Not at all Important" and 10 means "Extremely Important", the NTG survey asked a very specific question to SEM participants: "If you were given 10 points to award, how many points would you give to the importance of the group of program factors in your decision to install the capital project and how many points would you give to the importance of the group of non-program factors in your decision?" The NTG team used the response to this question to weight the maximum program and non-program factors in the final NTGR scoring. See for more detail.

Implications

- A comparison of the new SEM with the standard scoring method shows an increase of about 0.15 points in this round of research, reflecting the participant's valuation of the program. Because capital measures account for only about 16% of programs savings, the SEM NTGR changes only by 1-2%.
- For another program where the customer is less engaged or where other non-program factors are present, that same weighting might yield a lower score using the SEM algorithm. The method is not inherently biased upwards.

Recommendations

- The DNV team recommends adopting the SEM survey instruments and SEM scoring method to estimate NTG for SEM capital measures in the future.

APPENDIX A. NTGR ALGORITHM AND FACTOR ANALYSIS

The memo covers two key topics 1) a detailed analysis of program and non-program factors driving influence of the SEM program on capital project installations. 2) a sensitivity analysis of how the NTGR results would change by adjusting the algorithm scoring that weights program influence.

In 2023, CPUC approved the self-reported approach (SRA) SEM NTGR survey instruments which had been revised from the Commercial, Industrial, and Agriculture Custom (CIAC) program to reflect the unique aspects of the SEM program. At that time, the DNV team presented two different methods for calculating NTGR ratios using the SRA responses, the current algorithm used by CIAC (standard method), and the proposed algorithm for SEM (SEM algorithm). This memo provides a sensitivity analysis of the NTGR results using both scoring algorithms for SEM in the impact evaluation report to better inform the CPUC's decision.

Specifically, this appendix is broken down in the following sections:

- **Evaluation Plan Background** – an overview of the NTGR evaluation plan.
- **NTGR Algorithms** – a description of the CIAC and the new proposed SEM algorithms, a comparison of NTGR results between the two methods, and a rational for using the new method.

NTGR Evaluation Plan

The methodological approach for the present evaluations is influenced by the direction in D16-08-019 which states that a well-designed Strategic Energy Management (SEM) program's holistic and long-term approach encourages implementation of BRO measures as well as custom and capital measures. The decision concludes that capital measures, when program influence is demonstrated, may apply the SEM NGTR, which is currently 1.0.

The SEM workplan describes two NTGR research cycles. The first targets Program Year 2021 (PY21) and PY21 participants where the DNV team is evaluating capital measures using a self-reported approach (SRA). The second evaluation cycle targeting PY23 and PY24 participants will evaluate the NTGR of BRO measures using a more market-based approach. This memo addresses the PY21-22 evaluation of capital measures.

This document uses the survey responses from interviews completed to date so that we can compare the NTGR estimates using two different algorithm approaches, the current algorithm adopted by the CPUC for the CIAC downstream program, and the proposed algorithm more relevant to the SEM program design. Overall, the survey instrument and both algorithms follow California's standard framework, including decision rules for integrating findings from both quantitative and qualitative information in the calculation of the NTGR in a systematic and consistent manner. This approach was designed to comply with the California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals and the CPUC's Guidelines for Estimating NTGRs Using the Self- Report Approaches. We note that the sole purpose of sharing the survey responses is for the purpose of illustrating the differences in the two methods. Until all the surveys are completed and the results appropriately weighted, the final capital NTGR is unknown.

Leveraging the design in the NTGR research

D16-08-019 states that "a well-designed strategic energy management approach provides for project tracking by the customer and the program administrator … to facilitate identification of project influence." The survey instrument leverages the SEM program design as follows:

The SEM defines formal roles (i.e., Energy Champion, Executive Sponsor) thus, the NTGR survey targets the named individuals since they should have the knowledge of the program implementation and site context to reliably respond to the questions.

By reviewing the SEM defined activities with the interviewee, we can confirm which activities were implemented and remind the interviewee of the different aspects of the program in preparation of their responses.

The Opportunity Register logs the mechanism by which a capital project was identified and when it was identified. This information is referenced in the NTGR question panels.

SEM attempts to create Energy Teams at each facility to help identify energy saving opportunities and promote changes in energy use. A broader group of facility staff can therefore have a voice in the decisions around energy improvements and increase the number of factors considered when installing capital projects.

NTG algorithms

The CPUC's guidelines for estimating NTGR include three scoring metrics:

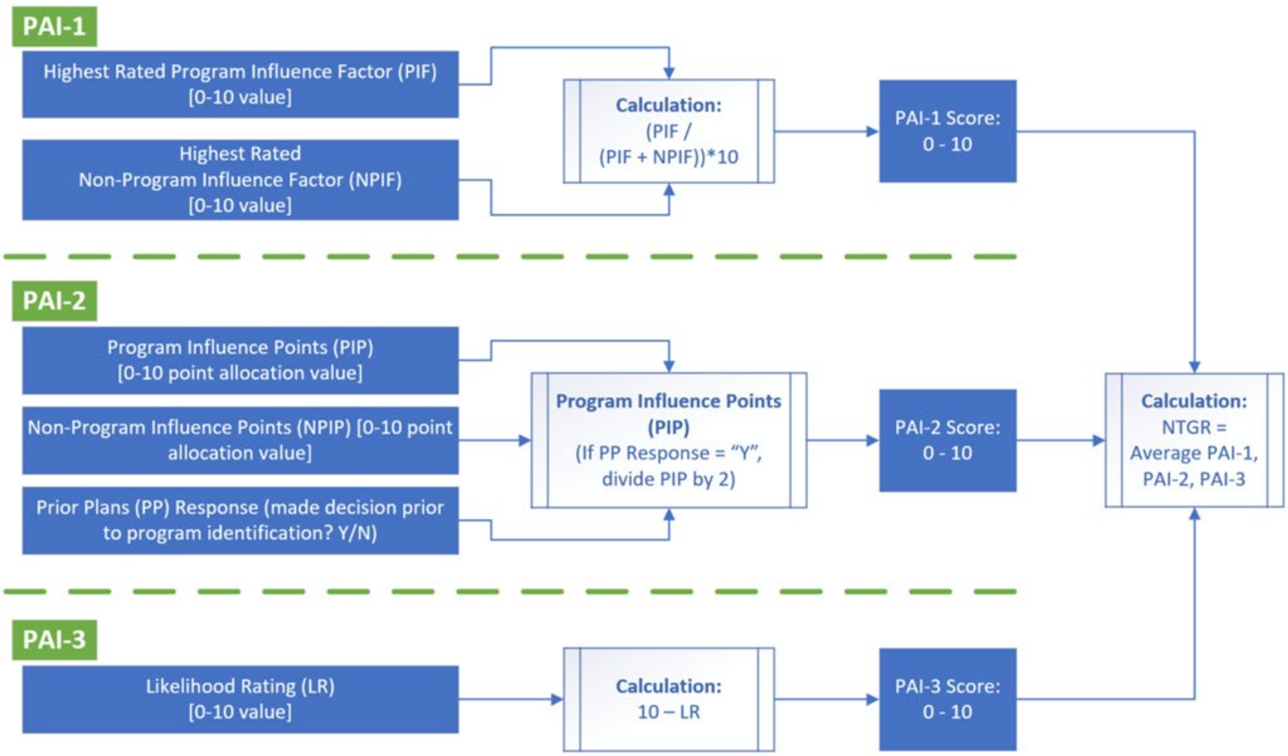
- Program attribution index 1 (PAI–1) score reflects the influence of the most important of various program and non-program-related elements in the customer's decision to install capital measures at the time. It is based on the customer rating on a scale of 0-10 of about 20 different program and non-program factors.
- Program attribution index 2 (PAI–2) score captures the perceived relative importance of the program factors compared to non-program factors in the decision to install the capital project(s). This score is determined by asking respondents to assign 10 points across the identified list of both program and non-program factors.[29] If the respondent knew about the capital project prior to the SEM program identifying it, and the site had plans and budget in place to install the capital measure, the program factor point allocation is cut in half.[30]
- Program attribution index 3 (PAI–3) score captures the likelihood (on a scale of 1 to 10) that they would have 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 installing the same capital measures.

Both the standard and SEM algorithms for scoring the NTGR for SEM involve these scoring metrics but combine them in a slightly different way to better align with the SEM program design.

Standard scoring algorithm

The NTGR is currently calculated as an average of three scores, PAI-1, PAI-2, and PAI-3 with the elements of each described in the flow diagram below.

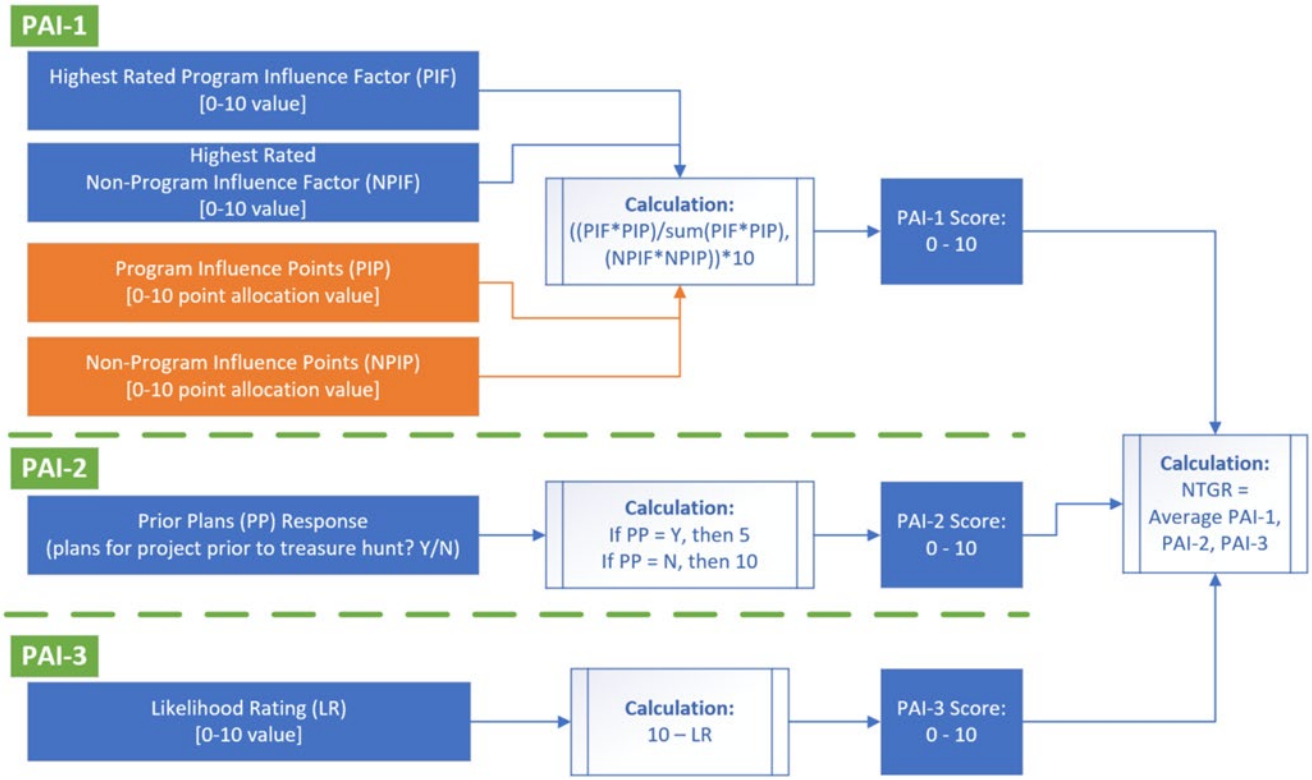
[29] The "identified lists" include any factors the respondent reported as highly influential (8, 9, or 10) in their decision to install the capital measure.
[30] The halving of the program factor point allocation is a decision made by the CIAC team and adopted by SEM for consistency.



The resulting self-reported NTGR in most cases is simply the average of the PAI-1, PAI-2, and PAI-3 score values, divided by 10.

SEM Scoring Method

The DNV team proposes one major change to the overall algorithm that in turn impacts the PAI-1 and PAI-2 scoring calculations. This change involves weighting the relative importance of the maximum program and maximum non-program factors by the 10-point allocation to each category provided by the responder in the PAI-2 battery. The design of the SEM program to involve a broader range of facility staff in energy efficiency decisions, increases the likelihood that more program and non-program factors get rated a 10 on the influence they had on the decision to install the capital project. Weighting the top program and top non-program factors by the allocation of the 10 points, provides a clearer picture of how influential the SEM program was in the final capital project decisions. The new algorithm looks like this:



Revised PAI-1 – Weighted Program Influence. The proposed changes to PAI-1 include weighting the highest program rated factor and highest non-program related factor by the 10-point allocation response. For example, if for individual influence ratings a respondent gave a "10" to the influence of the 'availability of the program's milestone incentive', and gave a "10" to the influence of their facility 'wanting to be environmentally responsible', but when allocating 10 total points gave 9 points to the program factor and only 1 point to the non-program factor, the resulting calculation would be (10*9) / sum (10*9) + (10*1) (all multiplied by 10) for a total of 9.

Revised PAI-2 – Prior Plans Response. The 10-point allocation response originally applied in PAI-2, now shifts to the weighted scoring in PAI-1, leaving PAI-2 as simply the "prior plans" response, or whether the site had plans in place and budget set aside for the capital project prior to the SEM program identifying it through the treasure hunt. Keeping intact the integrity of the current algorithm with the proposed algorithm as much as possible, the PAI-2 score is left as a 50% deduction if the site did indeed have prior plans and budget in place.

Sensitivity Analysis of Standard and SEM Algorithms

The DNV team applied the self-reported NTG responses to both the standard and SEM NTG algorithms to analyze the sensitivity and differences in the results. The table below shows the actual responses for two survey respondents to understand how the changes in algorithms impact the final NTG scores.

Self-Reported Survey Question	Respondent A	Respondent B
Did SEM identify the project?	Yes	Yes
Did you know about the project prior to SEM?	No	No
If yes, did you have plans to install the project?	-	-
If yes, did you have budget set aside?	-	-
Top Program Factor	Assistance in Development of an Energy Management Information System [10]	Technical support and information provided by the Energy Management Coach and/or Technical Lead [10]; ROI [10]
Top Non-Program Factor	Compliance with state or federal regulations [10] *(although the respondent said the specific project was not required for compliance)*	Your previous experience with another PA program [7]
Maximum program factor score	10	10
Maximum non-program factor score	10	7
Program point allocation	4	10
Non-program point allocation	6	0
Likelihood to conduct the same project without the program	0	0
Current Algorithm Result	**Score**	**Score**
PAI-1 (top program factor / (top program factor + top non-program factor)) * 10	5.00 = (10 / (10+10))*10	5.88 = (10 / (10+7))*10
PAI-2 Program point allocation (divide program point allocation by 2 if site had specific plans to install the project before participating in SEM)	4.00	10.00
PAI-3 10 – the likelihood score	10.00	10.00
NTG Result Average PAI-1, PAI-2, and PAI-3	**6.33**	**8.63**
New Algorithm Result	**Score**	**Score**
PAI-1 (top program factor * program point allocation / ((top program factor * program point allocation) + (top non-program factor * non-program point allocation)) * 10	4.00 = (10*4) / ((10*4) +10*6))*10	10.00 = (10*10) / ((10*10)+10*0)))*10

PAI-2 If site had specific plans to install the project before participating in SEM, then 5.00. Otherwise, 10.00	10.00	10.00
PAI-3 10 – the likelihood score	10.00	10.00
NTG Result Average PAI-1, PAI-2, and PAI-3	**8.00**	**10.00**

As the table shows, using the 10-point allocation response to weight the maximum program and non-program scores has a significant impact on the final NTG result. However, the NTG team concludes the new SEM algorithm results more accurately reflect the sentiments of the respondents when asked to think specifically about the list of identified program factors versus the list of identified non-program factors and indicate which had the greater influence.

Rational for Revised Algorithm

The team recommends using the second algorithm, the SEM algorithm, to estimate NTG for SEM based on the following rational.

Multiple Influences from Multiple Parties

SEM requires formulating a large Energy Team at each site (with a minimum of four named roles) with a long engagement of up to six years. Due to the increased number of facility staff, in both number and over time, able to weigh in on a capital project decision through the SEM program, the number of identified influences will accumulate. The NTG team interviewed multiple contacts to check for consistency in responses and triangulate the NTG results. Energy Champions provided responses to the NTG survey which the team used to score the NTGR through both the current and proposed algorithms. The team also interviewed Executive Sponsors regarding the installed capital projects, but used these responses as consistency checks of the Energy Champions rather than scoring their results through an algorithm. The team followed up with Energy Champions wherever inconsistencies were found to refine the NTG estimates.

Factor Analysis

Many different factors can influence a site's decisions to install energy efficient technologies and the current NTG survey allows respondents to rate nearly 20 factors on a 0-10 scale. Respondents tend to give a high rating to many different factors, as they should, based on the information available to them at the time of purchase. However, while there may be many influential factors, a final decision may come down to one or two primary considerations. Thus, it's not important what the average influence score was among program and non-program factors. What matters is the strongest influence in each category. The standard PAI1 method counts the strongest program influence factor compared to the strongest non-program.

A limitation of this treatment is that the greater the number of possible factors offered, the greater the chance that one in each category is given a high score by the respondent, and the less likely the respondent is to assess carefully whether the scores they gave appropriately reflect the relative influence of the different factors. This can lead to a tendency to maximum scores of 10 for both program and non-program factors, resulting in PAI1 scores around 0.5. This tendency has been observed in some prior CIAC work, as well as in our initial SEM results as discussed further below. The SEM PAI2 score does a better job of getting the relative importance of program and non-program factors. However, it's also possible that none of the offered factors had a strong role in the decision. Weighting both program and nonprogram maximum influence by the relative importance of each of these categories better reflects the role of the program in the decision.

Given the multiple touch points of SEM, including stimulation of broader decision making that might include nonprogram factors, SEM creates more opportunities for high maximum influence scores in both groups. The proposed algorithm mitigates this effect.

Social Responsibility Bias

As mentioned, customers do not make capital improvement decisions in a vacuum and many different factors can influence their decisions to install energy efficient technologies. With more attention given to the impacts of climate change and climate related emissions targets, many customers are feeling the need to be more socially responsible when it comes to their energy use. However, this sentiment can cause Social Responsibility Bias in a self-reporting approach to NTG as customers are likely to inflate the importance of factors such as “a desire for your company to be environmentally responsible”[31] because they are answering about their good intentions of being responsible, even if they are not exactly sure how to pursue those responsibilities directly. In the case of the SEM program, the wholistic approach to energy reduction, and immersive program design, provides customers with many opportunities to pursue these well intended social responsibilities and the program should get credit.

During the SEM surveys, interviewers encountered Social Responsibility Bias directly when asking participants to rate the influence of the non-program factor: “A desire for my company to be environmentally responsible.” Nearly 65% of respondents gave this factor an influence score of “10” on a 0-10 scale. One individual even said “Well, I know I need to be doing that, so a 10.” Interviewers consistently reminded participants to keep only the capital project in mind when rating the factors influencing their decisions. However, the sheer number of factors being asked about continued to confuse respondents and distracted them from the capital project being discussed.

The DNV team concludes that one way to reduce Social Responsibility Bias in the SEM program, is to weight the maximum program and maximum non-program factors by the 10-point allocation response as described in the proposed algorithm above. This method paints a clearer picture of how influential the program was in their decision to install the capital project.

Sample Program and Non-Program Factor Results

The following table provides the program and non-program influence responses from 11 survey participants, as well as the 10-point allocation responses. The current algorithm produces almost identical PAI-1 results across the 11 responses with an average of 5.2 and a variation of ±1.25. The PAI-1 results using the same survey responses through the proposed algorithm produces an average of 6.7 with a variation of ±3.3. The current algorithm averages, hence, tends to produce an average output of 5.0 – even though the factors respondents rated as highly influential were very different. Also of note, the proposed algorithm lowered scores that were weighted toward non-program factors, showing the proposed algorithm does not work in one direction only.

[31] This is an actual Non-Program Factor from the SEM NTG Energy Champion Survey

Program Factors	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**
Technical support and information provided by the Energy Management Coach and/or Technical Lead	8	5	7	10		8	8	10	8	6	8	8	10
Availability of the program's milestone and other incentives	8	3	9	6	10	9	9	8	5	7	5	7	10
Information provided through the Energy Treasure Hunt	10	2	9		8	6	9	10	8	8	10	8	10
Other projects or activities conducted through the SEM program	9	2	8		10	6	7	7	5	7	10	9	10
Training or information provided in Program workshops and peer-to-peer meetings	10	5	8	0	8	6	8	10	6	7	10		10
Recommendation by your utility account representative	0	1	4	0		4	9	0	8	5	8		10
The Energy Management Assessment	8	9	8	0	10	4	10						
Assistance in Development of an Energy Management Information System	6	3	10	0	9	8	8	3	8		7		10
Recommendations from your Energy Team	8	3	9	0	8	7	9	10	8	5	8	8	10
Support from your Executive Sponsor	10	10	6	0	9	3	8	6	8	10	10		10
Non-Program Factors													
Recommendation from an equipment vendor that sold you the equipment and/or installed it for you	0	8	5	0	7	3	7	4	8	0			10
Your previous experience with similar types of energy efficient equipment	7	6	4	6	8	6	8	4	8	8	7	6	10
Your previous experience with another PA program	5	1	0	7		0	5	4	8	5	5		10
Standard practice in your business/industry	7	5	5	0	8	5	8	6	3	2	0	3	10
Pre-existing corporate policies or guidelines that support energy reductions.	8	9	2	0	9	6	9	6	3	0	10	4	
Compliance with state or federal regulations	0	3	10	0	10	1	9	4	8	7	10	7	10
Compliance with your organization's normal equipment replacement practices	0	9	8	0	10	0	9	5	3	5	10	3	10
A desire for my company to be environmentally responsible	10	10	6	4	10	4	10		10	10	10	3	1
Current PAI-1 Score	5.00	5.00	5.00	5.88	5.00	6.00	5.00	6.25	4.44	5.00	5.00	5.63	5.00
Maximum Program Factor Score	10	10	10	10	10	9	10	10	8	10	10	9	10
Maximum Non-Program Factor Score	10	10	10	7	10	6	10	6	10	10	10	7	10
Program Factor Weight (N41)	8	7	4	10	5	8	5	9	6	7	4	10	8
Non-Program Factor Weight (N42)	2	3	6	0	5	2	5	1	4	3	6	0	2
Proposed PAI-1 Score	8.00	7.00	4.00	10.00	5.00	8.57	5.00	9.38	5.45	7.00	4.00	10.00	8.00

APPENDIX B. ELECTRIC PROJECT RESULTS

Table B-1 presents electric project-level results, including the project sample weight, forecasted and evaluated first-year savings, and GRR. The sampling weights reflect the number of customers in the population that a sample customer represents for given strata. The sampling weights also incorporate sample and population characteristics not used for explicit stratification.

Table B-1. Gross electric savings and GRR

		First year (kWh)		
DNV Project ID	Sampling weight	Forecasted	Evaluated	GRR
FPC18.05	1.08	91,990	152,852	166%
FPC18.06	1.08	822,927	799,293	97%
SEM_MFR_05	1.08	252,304	478,263	190%
SEM_MFR_06	1.08	68,618	-	0%
MC1S002	1.00	431,471	189,046	44%
MC1S003	2.00	451,426	460,834	102%
MC1S005	1.00	105,402	120,157	114%
7129.P4a	1.00	212,623	212,623	100%
7129.P1	1.33	623,219	623,219	100%
7129.P5	1.00	1,489,036	1,597,176	107%
7129.P6	1.00	225,973	225,973	100%
7129.P2	1.00	214,159	138,667	65%
7129.P3	1.33	957,047	977,861	102%
7129.P7	1.00	200,436	47,809	24%
7109.P7	1.33	354,296	445,098	126%
7109.01	1.00	114,561	174,067	152%
7109.P2	1.00	272,970	272,970	100%
7109.P4	1.00	999,471	368,055	37%
7109.P5	1.00	199,060	111,103	56%
FPC18.01	1.00	4,593,901	2,833,954	62%
FPC18.04	1.08	731,910	491,500	67%
FPC20.02	1.08	513,625	537,205	105%
FPC20.07	1.00	2,328,324	2,319,522	100%
FPC20.08	1.08	283,315	224,248	79%
FPC20.13	1.08	320	320	100%
FPC20.14	1.00	6,765,774	6,784,362	100%
FPC20.16	1.08	304,004	108,076	36%
FPC20.17	1.08	3,080	3,080	100%
FPC20.18	1.08	847,942	911,116	107%
MFR20.12	1.08	4,291,469	4,347,048	101%
MFR20.15	1.00	6,558,151	8,959,273	137%
MC2S061	1.00	1,189,110	1,143,142	96%

DNV Project ID	Sampling weight	First year (kWh) Forecasted	Evaluated	GRR
MC2S090	1.00	250,706	230,411	92%
SDGE801	1.40	185,393	179,747	97%
SDGE802	1.40	571,603	397,213	69%
SDGE803	1.40	695,812	695,812	100%
SDGE806	1.40	1,488,512	1,430,244	96%
SDGE807	1.40	332,265	340,597	103%

APPENDIX C. NATURAL GAS PROJECT RESULTS

Table C-1 present the natural gas project-level results, including the project sample weight, forecasted and evaluated first-year savings, and GRR. The sampling weights reflect the number of customers in the population that a sample customer represents for given strata. The sampling weights also incorporate sample and population characteristics not used for explicit stratification.

Table B-1. Gross electric savings and GRR

DNV Project ID	Sampling weight	First year (therm)		
		Forecasted	Evaluated	GRR
FPC18.05	1.08	17,928	15,904	89%
FPC18.06	1.08	43,901	(83,214)	-190%
SEM_MFR_05	1.08	146,459	-	0%
MC1S003	2.00	192,561	80,090	42%
MC1S006	1.00	28,625	22,556	79%
7109.P7a	1.50	77,165	60,169	78%
7109.01a	1.50	61,694	77,637	126%
7109.P2a	1.50	22,073	22,073	100%
7109.P4a	1.50	34,460	17,495	51%
7109.P5a	1.00	247,325	179,101	72%
FPC18.01	1.00	189,065	189,433	100%
FPC20.02	1.08	47,898	55,566	116%
FPC20.07	1.00	486,682	496,803	102%
FPC20.10	1.00	735,964	758,820	103%
FPC20.13	1.08	123,726	95,381	77%
FPC20.16	1.08	19,908	19,928	100%
FPC20.17	1.08	14,273	11,488	80%
MFR20.15	1.00	85,225	52,949	62%
6546.P7	1.00	284,676	213,188	75%
SDGE801	1.40	4,426	4,426	100%
SDGE802	1.40	69,657	69,657	100%
SDGE803	1.40	3,436	3,436	100%
SDGE807	1.40	5,838	4,530	78%

Gross Lifecycle Savings (MWh)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
MCE	SEM	11,971	12,704	1.06	0.0%	1.06
MCE	**Total**	**11,971**	**12,704**	**1.06**	**0.0%**	**1.06**
PGE	SEM	129,442	152,935	1.18	0.0%	1.18
PGE	**Total**	**129,442**	**152,935**	**1.18**	**0.0%**	**1.18**
SCE	SEM	29,029	31,323	1.08	0.0%	1.08
SCE	**Total**	**29,029**	**31,323**	**1.08**	**0.0%**	**1.08**
SCG	SEM	0	0			
SCG	**Total**	**0**	**0**			
SDGE	SEM	19,939	30,027	1.51	0.0%	1.51
SDGE	**Total**	**19,939**	**30,027**	**1.51**	**0.0%**	**1.51**
	Statewide	***190,382***	***226,990***	***1.19***	***0.0%***	***1.19***

Net Lifecycle Savings (MWh)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
MCE	SEM	11,971	12,799	1.07	0.0%	1.00	1.01	1.00	1.01
MCE	**Total**	**11,971**	**12,799**	**1.07**	**0.0%**	**1.00**	**1.01**	**1.00**	**1.01**
PGE	SEM	129,442	158,348	1.22	0.0%	1.00	1.04	1.00	1.04
PGE	**Total**	**129,442**	**158,348**	**1.22**	**0.0%**	**1.00**	**1.04**	**1.00**	**1.04**
SCE	SEM	29,029	32,456	1.12	0.0%	1.00	1.04	1.00	1.04
SCE	**Total**	**29,029**	**32,456**	**1.12**	**0.0%**	**1.00**	**1.04**	**1.00**	**1.04**
SCG	SEM	0	0						
SCG	**Total**	**0**	**0**						
SDGE	SEM	19,939	31,130	1.56	0.0%	1.00	1.04	1.00	1.04
SDGE	**Total**	**19,939**	**31,130**	**1.56**	**0.0%**	**1.00**	**1.04**	**1.00**	**1.04**
	Statewide	***190,382***	***234,733***	***1.23***	***0.0%***	***1.00***	***1.03***	***1.00***	***1.03***

Gross Lifecycle Savings (MW)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
MCE	SEM	0.9	2.1	2.35	0.0%	2.35
MCE	**Total**	**0.9**	**2.1**	**2.35**	**0.0%**	**2.35**
PGE	SEM	18.1	21.4	1.18	0.0%	1.18
PGE	**Total**	**18.1**	**21.4**	**1.18**	**0.0%**	**1.18**
SCE	SEM	6.0	4.1	0.68	0.0%	0.68
SCE	**Total**	**6.0**	**4.1**	**0.68**	**0.0%**	**0.68**
SCG	SEM	0.0	0.0			
SCG	**Total**	**0.0**	**0.0**			
SDGE	SEM	2.6	3.5	1.37	0.0%	1.37
SDGE	**Total**	**2.6**	**3.5**	**1.37**	**0.0%**	**1.37**
	Statewide	***27.7***	***31.1***	***1.13***	***0.0%***	***1.13***

Net Lifecycle Savings (MW)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
MCE	SEM	0.9	2.1	2.36	0.0%	1.00	1.01	1.00	1.01
MCE	**Total**	**0.9**	**2.1**	**2.36**	**0.0%**	**1.00**	**1.01**	**1.00**	**1.01**
PGE	SEM	18.1	22.1	1.22	0.0%	1.00	1.04	1.00	1.04
PGE	**Total**	**18.1**	**22.1**	**1.22**	**0.0%**	**1.00**	**1.04**	**1.00**	**1.04**
SCE	SEM	6.0	4.3	0.71	0.0%	1.00	1.04	1.00	1.04
SCE	**Total**	**6.0**	**4.3**	**0.71**	**0.0%**	**1.00**	**1.04**	**1.00**	**1.04**
SCG	SEM	0.0	0.0						
SCG	**Total**	**0.0**	**0.0**						
SDGE	SEM	2.6	3.6	1.42	0.0%	1.00	1.04	1.00	1.04
SDGE	**Total**	**2.6**	**3.6**	**1.42**	**0.0%**	**1.00**	**1.04**	**1.00**	**1.04**
	Statewide	***27.7***	***32.2***	***1.16***	***0.0%***	***1.00***	***1.03***	***1.00***	***1.03***

Gross Lifecycle Savings (MTherms)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
MCE	SEM	1,417	867	0.61	0.0%	0.61
MCE	**Total**	**1,417**	**867**	**0.61**	**0.0%**	**0.61**
PGE	SEM	8,690	9,947	1.14	0.0%	1.14
PGE	**Total**	**8,690**	**9,947**	**1.14**	**0.0%**	**1.14**
SCE	SEM	0	0			
SCE	**Total**	**0**	**0**			
SCG	SEM	2,131	3,208	1.51	0.0%	1.51
SCG	**Total**	**2,131**	**3,208**	**1.51**	**0.0%**	**1.51**
SDGE	SEM	406	444	1.09	0.0%	1.09
SDGE	**Total**	**406**	**444**	**1.09**	**0.0%**	**1.09**
	Statewide	***12,644***	***14,466***	***1.14***	***0.0%***	***1.14***

Net Lifecycle Savings (MTherms)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
MCE	SEM	1,417	910	0.64	0.0%	1.00	1.05	1.00	1.05
MCE	**Total**	**1,417**	**910**	**0.64**	**0.0%**	**1.00**	**1.05**	**1.00**	**1.05**
PGE	SEM	8,690	10,124	1.17	0.0%	1.00	1.02	1.00	1.02
PGE	**Total**	**8,690**	**10,124**	**1.17**	**0.0%**	**1.00**	**1.02**	**1.00**	**1.02**
SCE	SEM	0	0						
SCE	**Total**	**0**	**0**						
SCG	SEM	2,131	3,364	1.58	0.0%	1.00	1.05	1.00	1.05
SCG	**Total**	**2,131**	**3,364**	**1.58**	**0.0%**	**1.00**	**1.05**	**1.00**	**1.05**
SDGE	SEM	406	466	1.15	0.0%	1.00	1.05	1.00	1.05
SDGE	**Total**	**406**	**466**	**1.15**	**0.0%**	**1.00**	**1.05**	**1.00**	**1.05**
	Statewide	***12,644***	***14,865***	***1.18***	***0.0%***	***1.00***	***1.03***	***1.00***	***1.03***

Gross First Year Savings (MWh)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
MCE	SEM	2,394	2,406	1.00	0.0%	1.00
MCE	**Total**	**2,394**	**2,406**	**1.00**	**0.0%**	**1.00**
PGE	SEM	25,888	29,238	1.13	0.0%	1.13
PGE	**Total**	**25,888**	**29,238**	**1.13**	**0.0%**	**1.13**
SCE	SEM	5,806	5,616	0.97	0.0%	0.97
SCE	**Total**	**5,806**	**5,616**	**0.97**	**0.0%**	**0.97**
SCG	SEM	0	0			
SCG	**Total**	**0**	**0**			
SDGE	SEM	3,988	4,120	1.03	0.0%	1.03
SDGE	**Total**	**3,988**	**4,120**	**1.03**	**0.0%**	**1.03**
	Statewide	***38,076***	***41,380***	***1.09***	***0.0%***	***1.09***

Net First Year Savings (MWh)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
MCE	SEM	2,394	2,424	1.01	0.0%	1.00	1.01	1.00	1.01
MCE	**Total**	**2,394**	**2,424**	**1.01**	**0.0%**	**1.00**	**1.01**	**1.00**	**1.01**
PGE	SEM	25,888	30,273	1.17	0.0%	1.00	1.04	1.00	1.04
PGE	**Total**	**25,888**	**30,273**	**1.17**	**0.0%**	**1.00**	**1.04**	**1.00**	**1.04**
SCE	SEM	5,806	5,820	1.00	0.0%	1.00	1.04	1.00	1.04
SCE	**Total**	**5,806**	**5,820**	**1.00**	**0.0%**	**1.00**	**1.04**	**1.00**	**1.04**
SCG	SEM	0	0						
SCG	**Total**	**0**	**0**						
SDGE	SEM	3,988	4,271	1.07	0.0%	1.00	1.04	1.00	1.04
SDGE	**Total**	**3,988**	**4,271**	**1.07**	**0.0%**	**1.00**	**1.04**	**1.00**	**1.04**
	Statewide	***38,076***	***42,787***	***1.12***	***0.0%***	***1.00***	***1.03***	***1.00***	***1.03***

Gross First Year Savings (MW)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
MCE	SEM	0.2	0.4	2.22	0.0%	2.22
MCE	**Total**	**0.2**	**0.4**	**2.22**	**0.0%**	**2.22**
PGE	SEM	3.6	4.1	1.13	0.0%	1.13
PGE	**Total**	**3.6**	**4.1**	**1.13**	**0.0%**	**1.13**
SCE	SEM	1.2	0.7	0.61	0.0%	0.61
SCE	**Total**	**1.2**	**0.7**	**0.61**	**0.0%**	**0.61**
SCG	SEM	0.0	0.0			
SCG	**Total**	**0.0**	**0.0**			
SDGE	SEM	0.5	0.5	1.03	0.0%	1.03
SDGE	**Total**	**0.5**	**0.5**	**1.03**	**0.0%**	**1.03**
	Statewide	***5.5***	***5.8***	***1.04***	***0.0%***	***1.04***

Net First Year Savings (MW)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
MCE	SEM	0.2	0.4	2.23	0.0%	1.00	1.01	1.00	1.01
MCE	**Total**	**0.2**	**0.4**	**2.23**	**0.0%**	**1.00**	**1.01**	**1.00**	**1.01**
PGE	SEM	3.6	4.2	1.17	0.0%	1.00	1.04	1.00	1.04
PGE	**Total**	**3.6**	**4.2**	**1.17**	**0.0%**	**1.00**	**1.04**	**1.00**	**1.04**
SCE	SEM	1.2	0.8	0.63	0.0%	1.00	1.04	1.00	1.04
SCE	**Total**	**1.2**	**0.8**	**0.63**	**0.0%**	**1.00**	**1.04**	**1.00**	**1.04**
SCG	SEM	0.0	0.0						
SCG	**Total**	**0.0**	**0.0**						
SDGE	SEM	0.5	0.5	1.07	0.0%	1.00	1.04	1.00	1.04
SDGE	**Total**	**0.5**	**0.5**	**1.07**	**0.0%**	**1.00**	**1.04**	**1.00**	**1.04**
	Statewide	***5.5***	***6.0***	***1.08***	***0.0%***	***1.00***	***1.03***	***1.00***	***1.03***

Gross First Year Savings (MTherms)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
MCE	SEM	283	139	0.49	0.0%	0.49
MCE	**Total**	**283**	**139**	**0.49**	**0.0%**	**0.49**
PGE	SEM	1,738	1,611	0.93	0.0%	0.93
PGE	**Total**	**1,738**	**1,611**	**0.93**	**0.0%**	**0.93**
SCE	SEM	0	0			
SCE	**Total**	**0**	**0**			
SCG	SEM	426	610	1.43	0.0%	1.43
SCG	**Total**	**426**	**610**	**1.43**	**0.0%**	**1.43**
SDGE	SEM	81	89	1.09	0.0%	1.09
SDGE	**Total**	**81**	**89**	**1.09**	**0.0%**	**1.09**
	Statewide	***2,529***	***2,449***	***0.97***	***0.0%***	***0.97***

Net First Year Savings (MTherms)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
MCE	SEM	283	146	0.52	0.0%	1.00	1.05	1.00	1.05
MCE	**Total**	**283**	**146**	**0.52**	**0.0%**	**1.00**	**1.05**	**1.00**	**1.05**
PGE	SEM	1,738	1,639	0.94	0.0%	1.00	1.02	1.00	1.02
PGE	**Total**	**1,738**	**1,639**	**0.94**	**0.0%**	**1.00**	**1.02**	**1.00**	**1.02**
SCE	SEM	0	0						
SCE	**Total**	**0**	**0**						
SCG	SEM	426	640	1.50	0.0%	1.00	1.05	1.00	1.05
SCG	**Total**	**426**	**640**	**1.50**	**0.0%**	**1.00**	**1.05**	**1.00**	**1.05**
SDGE	SEM	81	93	1.15	0.0%	1.00	1.05	1.00	1.05
SDGE	**Total**	**81**	**93**	**1.15**	**0.0%**	**1.00**	**1.05**	**1.00**	**1.05**
	Statewide	***2,529***	***2,518***	***1.00***	***0.0%***	***1.00***	***1.03***	***1.00***	***1.03***

Per Unit (Quantity) Gross Energy Savings (kWh)

PA	Standard Report Group	Pass Through	% ER Ex-Ante	% ER Ex-Post	Average EUL (yr)	Ex-Post Lifecycle	Ex-Post First Year	Ex-Post Annualized
MCE	SEM	0	0.0%	0.0%	5.0	1,058,677.7	200,507.2	211,735.5
PGE	SEM	0	0.0%	0.0%	5.0	105.9	20.2	21.2
SCE	SEM	0	0.0%	0.0%	5.0	4.8	0.9	1.0
SCG	SEM	0	0.0%	0.0%	5.0	0.0	0.0	0.0
SDGE	SEM	0	0.0%	0.0%	5.0	2,144,815.4	294,262.0	428,963.1

Per Unit (Quantity) Gross Energy Savings (Therms)

PA	Standard Report Group	Pass Through	% ER Ex-Ante	% ER Ex-Post	Average EUL (yr)	Ex-Post Lifecycle	Ex-Post First Year	Ex-Post Annualized
MCE	SEM	0	0.0%	0.0%	5.0	72,258.1	11,590.4	14,451.6
PGE	SEM	0	0.0%	0.0%	5.0	6.9	1.1	1.4
SCE	SEM	0	0.0%	0.0%	5.0	0.0	0.0	0.0
SCG	SEM	0	0.0%	0.0%	5.0	229,125.1	43,573.8	45,825.0
SDGE	SEM	0	0.0%	0.0%	5.0	31,732.3	6,346.5	6,346.5

Per Unit (Quantity) Net Energy Savings (kWh)

PA	Standard Report Group	Pass Through	% ER Ex-Ante	% ER Ex-Post	Average EUL (yr)	Ex-Post Lifecycle	Ex-Post First Year	Ex-Post Annualized
MCE	SEM	0	0.0%	0.0%	5.0	1,066,556.5	201,999.4	213,311.3
PGE	SEM	0	0.0%	0.0%	5.0	109.6	21.0	21.9
SCE	SEM	0	0.0%	0.0%	5.0	5.0	0.9	1.0
SCG	SEM	0	0.0%	0.0%	5.0	0.0	0.0	0.0
SDGE	SEM	0	0.0%	0.0%	5.0	2,223,569.2	305,066.8	444,713.8

Per Unit (Quantity) Net Energy Savings (Therms)

PA	Standard Report Group	Pass Through	% ER Ex-Ante	% ER Ex-Post	Average EUL (yr)	Ex-Post Lifecycle	Ex-Post First Year	Ex-Post Annualized
MCE	SEM	0	0.0%	0.0%	5.0	75,871.0	12,170.0	15,174.2
PGE	SEM	0	0.0%	0.0%	5.0	7.0	1.1	1.4
SCE	SEM	0	0.0%	0.0%	5.0	0.0	0.0	0.0
SCG	SEM	0	0.0%	0.0%	5.0	240,298.2	45,698.6	48,059.6
SDGE	SEM	0	0.0%	0.0%	5.0	33,318.9	6,663.8	6,663.8

APPENDIX F. RESPONSES TO COMMENTS ON DRAFT REPORT

Table F-1 presents DNV's responses to the comments on the draft report that were received during the public review period.

Table F-1. Responses to comments on draft report

From	Comment	DNV Response
PG&E	Regarding top-down modeling versus bottom-up calculations of energy-savings in SEM, evaluators should understand that PG&E implementers (modelers) often utilize hybrid approaches for many large energy users, whereby they create "mini-top-down models" or individual regressions models for specific processing systems, equipment, or unique energy boundaries for a more accurate energy savings model than a top-down model could produce.	As stated in Section 5.1, top-down modeling approach is the preferred methodology to calculate SEM savings. However, the evaluator recognizes that certain projects may require the use of hybrid approach or/and multiple mini-top-down models to estimate savings accurately. The evaluator deems this approach acceptable if the projects adhere to the documentation guidelines listed below, in addition to the top-down guidelines provided in the SEM M&V guide: a) Explain the rationale behind modeling each system/process separately and the interaction between those systems. b) Detail the selection process for the variables considered in each model. c) Unless each system/process is metered separately, detail how the energy usage is tracked and determined for each system/process.
SDG&E	Evaluator recommendation: "Follow the current SEM M&V guidelines that recommended limiting the annualization to only when the model is being retired or a customer will not be participating in the SEM program after the current reporting period, with PA authorization. Hence, annualized savings will be rejected when annualization is likely to produce inaccurate annual savings, such as seasonally impacted savings, or where savings are not steady from time period to time period, such as with shutdown-type measure." SDG&E agrees that capturing data for a longer time period results in more accurate savings. The project implementer has to finish data collection within the first few months to determine the savings methodology and calculate estimated savings before the installation starts while adjustments can be made later if needed. According to SEM M&V Guide, Version 2.01 Section 11.5.1 the annualization that occurred followed the guidance of the SEM M&V Guide that was in place for projects during the evaluation period which states, "The typical observed annualization period is 3 months within the final 5 months of the reporting period in consideration." The SEM M&V Guide addressed how the Annualization Period should be handled and was used to determine energy savings. The SEM M&V Guide states that "Annualization of energy savings is dependent upon extrapolating energy savings calculated during a short time period established towards the end of the Reporting Period. This time period, the Annualization Period, shall be 90 consecutive days within the final five months of the Reporting Period."	The evaluator recommends the implementers ensure that the savings should be claimed at the end of the cycle of the project. This reflects the actual savings for the project that are expected to be realized within only that cycle. Additionally, the SEM M&V Guide (V3.02) clearly provides guidance to not to use annualization to calculate savings unless the model is being retired or the customer will not be participating in the SEM program after the current reporting period, with PA authorization. This guidance should be followed for all SEM projects.
SoCalGas	The areas of focus pertain to the annualization methodology used to calculate the gross realization rate.	The ex-ante estimate forecasts savings, but the scope of the evaluation is to quantify the grid

From	Comment	DNV Response
	Key Findings – Gross Realization Rate – Page 4 of Report 4.1 Gross Savings and Realization Rates – Page 28 of Report SoCalGas respectfully requests DNV to amend the report and recommendations to determine evaluated savings for SEM projects based on examining savings for a two-year period to annualize savings. Annualizing by prorating a three-month period may create a variation between claimed and evaluated savings. In some cases, due to the nature of SEM projects, which span over several years, prorating with current methods may understate actual gross savings. Annualization calculated by a two-year period may reduce the likelihood of calculating claimed savings that are different from evaluated savings, which can result in improved gross realization rates in future evaluation cycles	impact within a specified historic period (PY2021 and PY2022). Moreover, the evaluator found that the utilization of annualization with short-term data led to inaccurate estimation of the SEM savings. Therefore, we recommend using all available and valid data points to estimate the ex-ante savings which is in-line with the updated M&V guide version 3.02. Additionally, As SEM project span over several years, the evaluator assert that future savings should be claimed and evaluated in their corresponding cycles.
PG&E Tech Reviewer	Section 14.1.7 of the CA SEM M&V Guide details the year-end reporting requirements when an energy consumption adjustment model is used to determine site-wide energy savings. Sub-bullet 2 of this section requires that the Energy Consumption Adjustment Model Development Tool be provided. This is the tool used by the implementer to develop the model. In cases when an energy consumption adjustment model is not used to report savings per the M&V Guide the Energy Consumption Adjustment Model Development Tool is not required to be submitted. Rather, an approved Notification of Bottom-up Method of Determining Energy Savings needs to be submitted along with supporting calculations for each EPIA for which savings are being claimed. The requirements of the Notification of Bottom-up Method of Determining Energy Savings are specified in section 7.2 "Assessing if Modeling Should be Attempted". There are a few possible reasons listed in this section (7.2) for why an energy consumption adjustment model would not be developed or even if developed not used to report savings. The guidance to not require submission of energy consumption adjustment models or the associated Development Tool when not used to report energy savings was made intentionally in the development process of the M&V guide, which included input from IOUs, implementers, external experts, and CPUC staff. This guidance was formulated based on modeling experience and rationale for when to cease attempting top-down modeling, and that the Notification of Bottom-up Method of Determining Energy Savings, rather than a possibly failed model, is of primary relevance when assessing whether a bottom-up approach is justified, provided that the Notification is sufficiently descriptive. This reflects that there are many considerations beyond statistical model fit when considering if modeling should be attempted or if a developed model should be used to report savings.	This recommendation was based on the findings of this evaluation. The evaluators found that only 45% of the sites used top-down approach to estimate SEM savings. This runs counter to the intent of the modeled based SEM program design and to the M&V guide's declaration that top-down is the preferred methodology to calculate SEM savings. The evaluator asserts that initiating a top-down model should constitute the initial phase of SEM projects. Sites inherently incapable of developing top-down models may not be a great fit for SEM, a factor worthy of consideration. While recognizing certain circumstances may impede the complete development and utilization of top-down models, it's imperative that the initial models and the effort to develop them is documented and included in the project documentations for the evaluation team, in addition to the bottom-up notification. This will help the evaluation team review the models and provide insights on why certain top-down models may not be a great fit for future SEM program.

From	Comment	DNV Response
	PG&E acknowledges the importance of having and submitting well-documented and supported notifications of bottom-up methods for each year of SEM participation.	
CLEAResult	**Page 4 - Annualization** The gross realization rate (GRR) should be assessed based on the guidance documents at the time of submission instead of the guidelines that were developed years later. The implications of measuring with one guide when another was in place at the time of submission resulted in lower GRR than would otherwise have been calculated and that impacted a significant portion of customers in the statewide SEM offering evaluation. Since the savings submissions are being evaluated on a single cycle, the impact of the annualized savings on future savings is not adequately captured. Annualized savings, for instance, in the second program year which are higher in the ex-ante calculations than the ex-post will be deducted at that higher rate from the savings that are submitted in the third year. This creates a compounding overly underrepresented level of savings that are achieved due to the nature of claiming incremental savings on an ongoing basis. We agree with the assessment that the new guidance language around avoided versus annualized savings is the more accurate treatment of SEM savings on an ongoing basis. However, evaluating the savings in the first cycle delivered using one version of the guide against another guide does not capture the impacts of those savings on future incremental savings calculations. We recommend that at a minimum an adjusted GRR be added with the treatment of annualization in the ex-post calculation to follow the approved guidelines at the time of project submission	The evaluator acknowledges the concerns raised in this comment regarding the approach used by the evaluation team to estimate ex-post savings, which, in some cases, diverged from the ex-ante approach permitted by the SEM M&V guide in effect at the time. It is pertinent to note that the M&V guide offers direction on forecasting ex-ante savings based on the data and information available to the implementers. Whereas the impact evaluation calculates the actual grid impact based on the available data during the evaluation period. The evaluator found that the use of annualization, in many cases, resulted in inaccurate savings. Hence, the evaluators used the avoided energy approach in all cases. The evaluator also anticipates that those incremental savings for these sites will be captured in upcoming cycles when they are evaluated again.
CLEAResult	**Page 11 – Estimated savings and costs for all completed measures** This seems unnecessary given that the models will more accurately calculate energy savings at the site level based on actual performance and not on estimates of each implemented EPIA. Calculations of measure by measure costs and savings is cost prohibitive and leads away from the nature of what the SEM program is supposed to embody. Prioritization of projects is important for customers but can be based on orders of magnitude of change, difficulty, etc. at the customers direction on which impacts and drawbacks are most influential to their business decisions **3.2.3** Same comment as above about energy saving estimates on the Op Register – the model obviates the need for this data. This data was not present but the evaluation results for GRR and NTG ratios was very good, which indicates that this data is not really needed to ensure acceptable results.	A general estimation of the savings serves as a sanity check for the overall claimed savings. It also helps in identifying any savings not attributable to SEM savings (i.e., savings resulting from non-SEM projects or from non-SEM changes in processes or schedules). At the very least, estimating the savings per EPIA using the overall reporting period savings and EPIAs' weighted savings (utilizing matrices 1, 2, and 3 for representing small, medium, and large savings, respectively) should suffice. Program participants and implementers are better equipped to make accurate savings and costs estimation for the different measures. Providing those estimates along with a breakdown categorizing measures into capital and non-capital, significantly enhances the NTGR process and subsequent results calculations. In conclusion, the evaluators strongly recommend incorporating estimations of both EPIAs' savings and associated costs in the OR.
CLEAResult	**3.1 Sample Design** The length of time between project completion and evaluation should be shortened in order to ensure that the original site	The evaluator agrees in principle that minimizing the duration between project implementation and evaluation enhances the preservation and transfer of pertinent data and information to evaluators. Acknowledging the inevitability of

From	Comment	DNV Response
	personnel are present for both the original project implementation as well as the evaluation. This change will better align with the evaluation goal outlined in section 2.2 item 5 and will allow for more accurate and complete information collection during participant interviews. • Several projects that were evaluated were implemented in 2019 but were evaluated in 2024 – a 5-year time span. While SEM is focused on change management, even the best change management plans can have unavoidable and/or unexpected turnover. In this length of time, it is common for participant staff to change. For example, Energy Champions, Energy team members and Executive sponsors leave the participant organization. This is a common experience, therefore the original personnel at the participant may no longer be present. This situation can lead to potential for different information being collected during evaluation than when the project was implemented because different participant personnel are present.	employee turnovers and staff changes, the evaluator's recommendation centers around improving the documentation, storing, and data transfer upon projects completions. The evaluator urges participants and implementers to refine these processes to mitigate any adverse impact stemming from such transitions on SEM projects. It's pertinent to keep in consideration that SEM is a comprehensive approach for aligning energy efficiency with business practices and goals to achieve long-term benefits and without adequate documentation, valid measurement, and proper tracking and reporting, it is difficult to achieve the SEM intended program benefits.
CLEAResult	**5.1** "Attempt top-down models and include them in the project files even when using bottom-up calculations. This will allow the PAs and the evaluators an opportunity to review those models to confirm the reasons for using bottom-up calculations." (p. 35) Consider revising this recommendation in relation to the current M&V Guide v3.02, indicating whether it differs from the current guidance provided in section 7.2 "Assessing if Modeling Should be Attempted" and reporting requirements of section 14.1 "SEM Reporting Period Performance Report Requirements". Depending on the various reasons that may require pivoting to bottom-up calculations throughout a Reporting Year, the level of reasonable top-down model development documentation applicable for PA and evaluator review varies.	The evaluators assert that initiating a top-down model should constitute the initial phase of SEM projects. Sites inherently incapable of developing top-down models may not be a great fit for SEM, a factor worthy of consideration. While recognizing certain circumstances may impede the complete development and utilization of top-down models, it's imperative that the initial models and the approach to develop them is documented and included in the project documentation. This will help the evaluation team review the models and provide insights on why certain top-down models may not be a statistically well suited for future SEM program.
CLEAResult	5.2.2 "For models that used data points that reflected high residuals or fell outside of the range of the variable statistical significance, the DNV team deemed those data points as outliers and removed them from model consideration. The DNV team also removed data points that were found to be above the 90th percentile of values observed during the baseline period." (p. 37) Consider clarifying which values (energy use, residual energy use, variable values, etc.) are being evaluated in the statement, "…also removed data points found to be above the 90th percentile of values observed during the baseline period". Assuming this referred to model variable values in the Reporting Year, this method would result in more exclusions than the guidance provided in M&V Guide v3.02 Section 7.10 which recommends, "Individual data intervals in the Reporting Period should be flagged as an outlier if a relevant variable data point is ±10% beyond the bounds of the energy baseline data set". The flagged observations must also meet additional criteria prior to exclusion. The	The evaluator revised the language to accurately reflect their process for confirming the validity of the model. They flagged data points that were beyond the ±10% of the energy baseline data set. For variables, the evaluator only removed data points that exceeded the standard deviation limit. Although the evaluator adjusted the standard deviation limit for some sites from the three-sigma limit (±3σ) when it was determined to better represent site operations, they recommend adhering to the three-sigma limit as recommended in the SEM M&V guide V3.02 for consistency. They will utilize the same standard deviation limit for evaluation moving forward.

From	Comment	DNV Response
	subsequent evaluator recommendations (p. 38) include following the SEM M&V Guidelines (citing v3.02) for assessing validity while the methods used to assess validity in this impact evaluation vary from the cited guidelines.	
Not Listed	At what point will EUL be assessed during 1) a CA SEM Impact Evaluation (with a big-enough sample from Cohort #1) or 2) the next Potential & Goals Study?	No decision has been reached regarding the evaluation of the SEM-designated EUL of 5 years. The evaluators will promptly communicate any EUL assessment updates to the stakeholders.

About DNV

DNV is a global quality assurance and risk management company. Driven by our purpose of safeguarding life, property and the environment, we enable our customers to advance the safety and sustainability of their business. We provide classification, technical assurance, software and independent expert advisory services to the maritime, oil & gas, power and renewables industries. We also provide certification, supply chain and data management services to customers across a wide range of industries. Operating in more than 100 countries, our experts are dedicated to helping customers make the world safer, smarter and greener.