GROUP D

Site-Level Normalized Metered Energy Consumption (NMEC) Impact and Net-to-Gross Evaluation, Program Years 2020–2022

California Public Utilities Commission
CALMAC ID: CPU0377.01

Date: May 23, 2024

Information	Details
Project sponsor	Tyler Mahone
Project manager	Stephanie Whalley
Telephone number	+1 (510) 891-0446
Mailing address	155 Grand Ave. Suite 600, Oakland CA 94612
Email address	Tyler.mahone@dnv.com; stephanie.whalley@dnv.com
Report location	https://pda.energydataweb.com/

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Glossary of key terms and acronyms[1]

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

Calculated savings – The calculated savings for NMEC projects is 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]

Coefficient of determination (R-squared or R^2) – Refers to a model goodness-of-fit statistic that gives the proportion of the variation in the dependent variable (energy consumption) explained by the regression model. The higher the R^2, the better the model explains variation in the dependent variable.

Coefficient of variation of the root mean square error (CV(RMSE)) – Refers to a model goodness-of-fit statistic that is a measure of variability (the square root of the consumption model's squared error) relative to the average value of the variable (average energy consumption) used to determine how well the model predicting the variable (baseline consumption) fits the data. The lower the CVRMSE, the better the model fit.

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

Disposition – Usually, the review findings disposition document for CPUC Project Reviews that summarizes any issues or comments related to project eligibility, baseline, savings calculation, or program influence documentation.

Documented realization rate (DRR) – The ratio of the savings verified through the evaluation relative to the savings provided in the project documentation.

Early Opinion – Review that allows the PAs to request clarification from CPUC staff of custom project related CPUC policies or rules before submitting a project.

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.

Forecasted savings – Engineering-based savings estimate derived before installation.

Fractional savings – Refers to the percent of annual energy usage saved through program participation. For NMEC projects, the rulebook recommends that projects have a forecasted fractional savings of at least 10%.

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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/

Fractional savings uncertainty (FSU) – FSU combines CV(RMSE) and percent savings. It is similar to relative precision in that it measures the uncertainty around the expected savings. As the value FSU decreases, confidence in the estimated savings level increases.

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 NMEC projects, the savings claimed in CEDARS following project implementation.

International Performance Measurement and Verification Protocol (IPMVP)[4] – Protocol that facilities 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.

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. Net-to-gross ratios 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 which 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.

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[4] IPMVP - Efficiency Valuation Organization (EVO), evo-world.org, https://evo-world.org/en/

Normalization – A process by which consumption estimates from two different periods are put on a common basis. Baseline and performance period model predictions are observed at common values for model independent variables (e.g. temperature variables from TMY data). This prevents differences in underlying drivers of consumption from baseline to performance period from being included in the savings estimate.

Normalized mean bias error (NMBE) – Refers to a statistical model goodness-of-fit statistic that can indicate whether a model is over or under estimating energy use.

Normalized metered energy consumption (NMEC) – Refers to high opportunity programs or projects that provide incentives based on metered energy consumption. This initiative fulfills the directive for utilities to quickly identify high energy-efficiency savings opportunities in existing buildings using a program and project approach where incentive payment and claimed savings are based on NMEC and include only approved NMEC building programs.

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

Occupied/unoccupied split – The standard TOWT (see below) model structure permits two separate models to be fit based on whether a given time-of-week value is considered occupied or unoccupied. This allows for an occupancy-temperature interaction to be captured in the model.

Parameter – Output of a regression model, for NMEC models it measures how the fuel consumption changes in response to a change in a given independent variable.

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. 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.

Performance period – The performance period is the 12-month period following the energy efficiency intervention or retrofit, during which savings are realized.

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),[5] Pacific Gas & Electric (PG&E), Southern California Edison (SCE), Southern California Gas (SCG), San Diego Gas & Electric (SDG&E)).

p value – The probability that a given parameter's true value is different than zero.

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.

Savings delta – The difference between normalized savings and forecasted savings.

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[5] 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.

Spline – A model that is a collection of lines with different slopes that change at defined points (nodes), allowing for more flexible response to the given independent variable than a constant linear relationship.

Temperature node – A boundary temperature in a temperature spline model at which the slope changes.

Time-of-week and temperature model (TOWT) – A standard regression model approach whereby fuel consumption is modeled against temperature included as a spline and a set of time-of-week indicator variables, generally at daily or hourly level. May be split into occupied and unoccupied models and other variables may also be included.

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.

Typical Meteorological Year (TMY) – A data set of temperatures representing a typical year that is used to normalize NMEC models to weather conditions. The CALEE CZ data sets are the standard used for NMEC.

1 EXECUTIVE SUMMARY

This report presents DNV's evaluation of the Site-Level Normalized Metered Energy Consumption (site-level NMEC) Programs for program years (PY) 2020 to 2022 on behalf of the California Public Utilities Commission (CPUC). DNV determined how much electric and natural gas energy use was reduced by the NMEC programs.

1.1 Study background

NMEC is a set of statistical tools and approaches that estimate the energy consumption impact of energy efficiency programs by comparing pre- and post-intervention meter data. While most other energy efficiency programs claim final savings based on deemed[6] or calculated results, NMEC programs calculate and claim final savings based on measured impacts at the meter. This evaluation focuses on site-level NMEC projects where savings are estimated at the individual commercial site level. The impact evaluation provides savings estimates for site-level NMEC projects with initial claims[7] in program years (PY) 2020 or 2021 that were trued-up in PY2020, PY2021, or PY2022. The net-to-gross (NTG)[8] evaluation provides program attribution for site-level NMEC projects with initial claims in PY2020 – PY2022.

This evaluation and last year's site-level NMEC Evaluability Study[9] were the first comprehensive site-level NMEC evaluations since the NMEC pathway expanded beyond the pilot phase. The research efforts were guided by the Commercial, Industrial, and Agriculture Custom (CIAC) Projects work plan, [10] the site-specific NMEC evaluation work plan[11] dated November 30, 2022, and the Group D site-level NMEC sampling memo.[12]

1.2 Evaluation objectives

For this evaluation, we estimated the gross[13] and net savings of site-level NMEC programs, leveraging each site's embedded performance measurements, and assessed the application of NMEC program requirements. We determined the programs' application of NMEC requirements by referring to the Rulebook for Programs and Projects Based on NMEC,[14] which includes the CPUC's specific requirements for NMEC programs and measurement and verification (M&V) plans.

The objectives of this evaluation were:

- Estimate gross kWh, peak kW, and therm savings for site-level NMEC projects with initial claims in PY2020–PY2021.
- Estimate net kWh, kW, and therm savings for site-level NMEC projects with initial claims in PY2020–PY2022.
- Assess the methods used by the implementers to estimate meter-based savings.
- Provide timely feedback to the CPUC, Program Administrators (PAs),[15] and other stakeholders to facilitate timely program improvements and support future program design efforts.

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6 Deemed refers to researched, vetted, and predictable savings for EE technologies and services with well-established properties. This contrasts with custom savings for EE technologies and services that require unique calculations and do not use predefined values.

7 Site-level NMEC projects typically have two claims, with the initial claim occurring at the time of installation and the true-up claim occurring following the 12-month performance period.

8 Net savings are changes in energy use attributable to a particular energy efficiency program and consider savings from participants who would not have purchased energy-efficient technologies without the program. Savings attributable to participants who would have purchased energy-efficient technologies with or without the program influence are excluded from net savings. These participants whom the program did not influence are considered free riders.

9 DNV. "Site-Level NMEC Evaluability Study, Program Years 2020-2021." calmac.org. 12.07.2023, https://www.calmac.org/publications/Site-Specific_NMEC_Evaluability_Study_Report_-_Final.pdf.

10 California Public Utilities Commission. "California Energy Efficiency Energy Contracts-Program Year 2020-2021 Commercial, Industrial, and Agriculture Custom (CIAC) Projects Evaluation Work Plan-Final." pda.energydataweb.com. 4/28/23, https://pda.energydataweb.com/#!/documents/2629/view.

11 DNV. "Group D Site-Specific NMEC Evaluation Approach for PY2020 and PY20201." 11/30/2022, https://pda.energydataweb.com/api/downloads/2629/Site-Level%20NMEC%20Evaluation%20Approach%20Workplan%20Addendum.pdf.

12 DNV. "Group D Site-level NMEC Sampling Memo for PY2020 and PY 2021." 7/25/2023.

13 Gross savings are a measure of change in energy use due to energy efficiency programs, regardless of why customers participated.

14 CPUC. "Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption-Version 2.0." January 7, 2020. https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/n/6442463694-nmec-rulebook2-0.pdf.

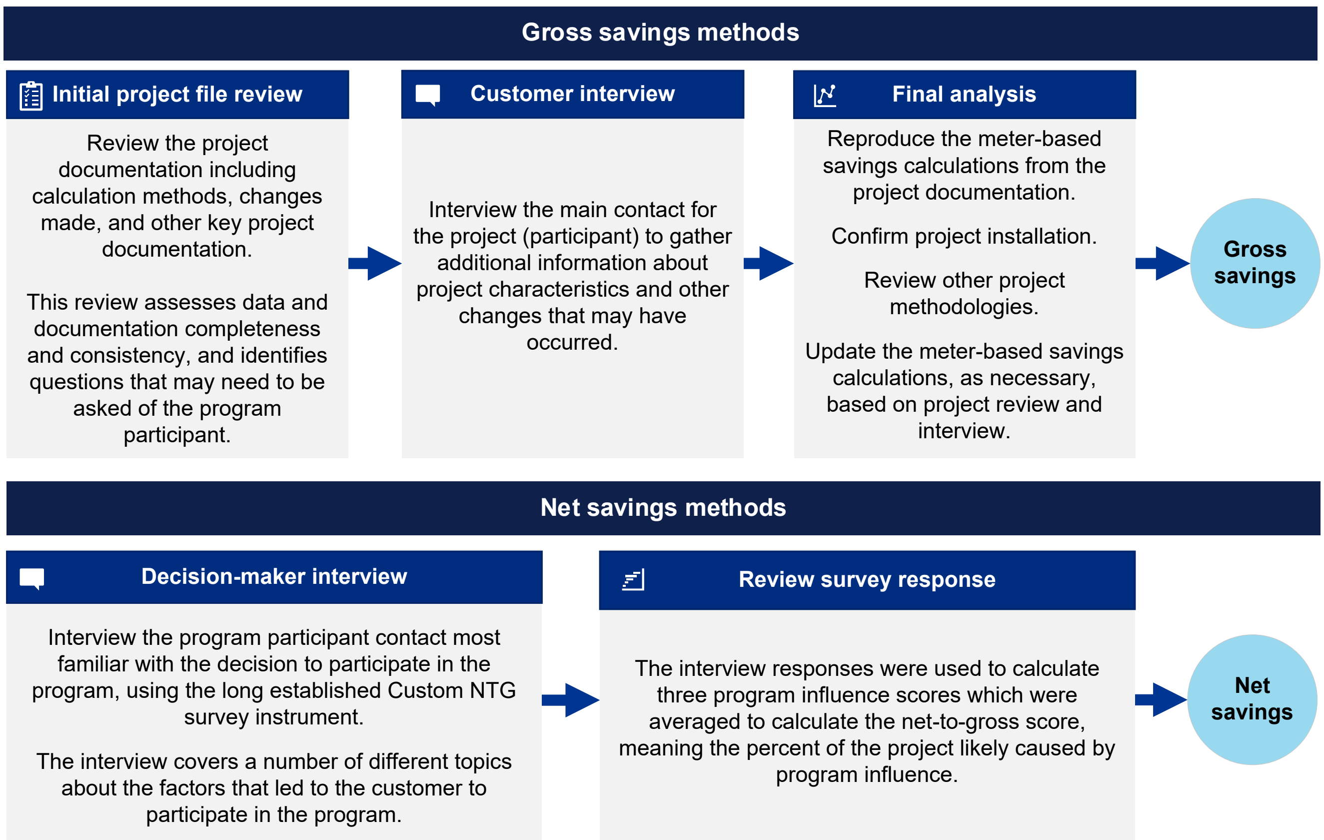
15 A program administrator is an entity tasked with the functions of portfolio management of energy efficiency programs and program choice.

- Provide meaningful and actionable recommendations to improve program performance in delivering energy efficiency savings.

1.3 Study approach

This study included both a gross and net savings evaluation. In the gross evaluation component, we reviewed important project documentation and updated the project's approach where necessary to calculate project-level savings. In the net-to-gross part of the evaluation, we investigated how much the program influenced the participant's decision-making to make energy-efficient improvements. Figure 1-1 illustrates the gross and net savings methodology in more detail.

Figure 1-1. Site-level NMEC gross and net savings methods



1.4 Evaluated projects

This evaluation included all 49 projects from PY2020–PY2022 which were ready for impact evaluation and an additional 29 projects for a total of 78 projects that were ready for NTG evaluation. The impact and NTG populations were different because the evaluations could be conducted at different project stages. We expected each site-level NMEC project to have an initial claim following project installation using engineering-based forecasted savings and a true-up claim[16] following the 12-month performance period after installation, during which savings were assessed. The impact evaluation included

[16] True-up claims occur at least a year after the installation of the project and are positive or negative savings differences that adjust the initial claim up or down so that it is aligned with the meter-based normalized savings.

projects with initial claims and true-up claims occurring in PY2020–PY2022, while the net evaluation included all projects with initial claims made in PY2020–PY2022 (see Table 1-1).

Table 1-1. Site-level NMEC evaluation population and savings claims

PA* & PY	Projects	First year savings			Lifecycle savings	
		kWh	kW	Therms	kWh	Therms
Impact evaluation population						
PG&E	25	7,994,128	64	104,280	41,979,642	1,590,733
SCE	14	1,398,331	0	0	16,021,861	0
SCG	2	0	0	4,951	0	50,261
SoCalREN	8	1,011,894	79	0	12,752,149	0
Total	**49**	**10,404,353**	**143**	**109,232**	**70,753,652**	**1,640,994**
Net evaluation population						
2020	20	2,722,651	84	4,951	31,881,250	50,261
2021	31	8,501,066	45	104,280	53,180,551	1,590,733
2022	26	6,840,060	1,181	10,194,416	49,093,757	30,651,324
Total	**77**	**18,063,776**	**1,310**	**10,303,648**	**134,155,558**	**32,292,318**

*Pacific Gas & Electric (PG&E); Southern California Edison (SCE); Southern California Gas (SCG)

1.4.1 Gross savings

This section presents the gross savings realization rates resulting from the impact evaluation. Table 1-2 through Table 1-4 present the electricity, demand, and gas gross savings results. There were many reporting and data quality issues that resulted in the claimed savings in the tracking data not matching the final meter-based savings provided by the PAs in the project documentation. Generally, the project documentation reflected the verifiable performance-based savings, but the tracking data did not. Consequently, the evaluation presented two sets of realization rates: a gross realization rate (GRR), which compared the evaluated (Verified) savings with the sometimes erroneous savings claimed in the tracking data (PA Claimed), and a documented realization rate (DRR), which compared the evaluated savings with the savings provided in the project documentation (Documented). If the savings reporting had been done correctly, the two realization rates would be the same. When reporting issues were removed from the results, as they were in the DRR, the realization rates were substantially higher for kWh and therms. The particularly low GRR for SCE was in part due to reporting that effectively double-counted savings. Aside from reporting issues, SCE's realization rate was greater than 100%.

Table 1-2. Gross electricity savings in kWh

PA	PA Claimed	Documented	Verified	GRR	RP%*	DRR	RP%*
First-year savings							
PG&E	7,994,128	8,626,651	6,373,719	79.7%	±9.0%	79.6%	±10.0%
SCE	1,398,331	410,386	387,058	27.7%	±0.0%	105.3%	±0.0%
SoCalREN	1,011,894	971,737	794,944	78.6%	±19.0%	81.8%	±18.0%
Statewide	**10,404,353**	**10,008,774**	**7,555,721**	**70.9%**	**±8.0%**	**81.2%**	**±9.0%**
Lifecycle savings							
PG&E	41,979,642	48,743,814	34,406,514	82.0%	±15.0%	84.1%	±13.0%
SCE	16,021,861	4,718,557	4,468,497	27.9%	±0.0%	105.2%	±0.0%
SoCalREN	12,752,149	12,248,112	9,867,613	77.4%	±19.0%	80.6%	±19.0%
Statewide	**70,753,652**	**65,710,483**	**48,742,624**	**65.6%**	**±9.0%**	**85.2%**	**±11.0%**

*Relative precision at the 90% confidence level.

Forty-seven of the 49 projects included in the impact evaluation claimed kWh savings, while only five claimed kW savings (one of these projects claimed a negative demand impact). Three projects claimed gas savings. The relative scarcity of kW and gas savings is discussed in the evaluability study and in the body of this report. The low number of kW savings claims explains the large relative precisions for the kW savings estimates. The SCG gas projects were incorrectly claimed despite being canceled, so produced zero savings claims and zero precisions. The precision for the PG&E gas claim is zero because there was only one project that claimed gas savings.

Table 1-3. First-year gross demand savings in kW

PA	Claimed	Documented	Verified	GRR	RP%*	DRR	RP%*
PG&E	64.3	390.1**	55.8	86.8%	±63.0%	73.8%	±56.0%
SoCalREN	79.2	68.8	100.9	127.4%	±35.0%	146.6%	±33.0%
Statewide	**143.5**	**458.9**	**156.7**	**100.1%**	**±41.0%**	**93.0%**	**±41.0%**

*Relative precision at the 90% confidence level.
**One project included in the evaluability study had negative claimed demand but large documented demand in the final report. DNV was unable to contact this participant as part of the evaluation and this difference does not impact the documented realization rate.

Table 1-4. Gross natural gas savings in therms

PA	Claimed	Documented	Verified	GRR	RP%*	DRR	RP%*
First-year savings							
PG&E	104,280	26,645	37,301	35.8%	±0.0%	103.2%	±0.0%
SCG	4,951	0	0	0.0%	±0.0%	0.0%	±0.0%
Statewide	**109,232**	**26,645**	**37,761**	**34.6%**	**±0.0%**	**103.2%**	**±0.0%**
Lifecycle savings							
PG&E	1,590,733	436,896	454,472	28.6%	±0.0%	103.2%	±0.0%
SCG	50,261	0	0	0.0%	±0.0%	0.0%	±0.0%
Statewide	**1,640,994**	**436,896**	**454,472**	**28.6%**	**±0.0%**	**103.2%**	**±0.0%**

*Relative precision at the 90% confidence level.

1.4.2 Net savings

Site-level NMEC electric net-to-gross ratios ranged between 40% and 50%, which is similar to the net-to-gross ratios (NTGRs) typically seen in the Group D Commercial Industrial and Agricultural Custom (CIAC) program. Table 1-5 shows the NTGRs for electric energy savings, peak demand savings, and natural gas savings. In the table, "Verified" means evaluation-verified savings for projects included in the impact evaluation or tracked savings for projects not included in the impact evaluation.

Table 1-5. Net electric energy savings results by PA

PA	First-year net savings				Lifecycle net savings			
	Verified	Net	NTGR	RP%**	Verified	Net	NTGR	RP%**
Energy (kWh)								
PG&E	12,427,824	6,179,114	49.7%	±16.0%	77,500,848	35,720,141	46.1%	±15.0%
SCE	1,821,339	686,645	37.7%	±42.0%	21,098,727	7,882,484	37.4%	±43.0%
SoCalREN	2,319,285	740,610	32.6%	±25.0%	24,846,998	7,695,115	31.0%	±26.0%
Statewide	**16,568,448**	**7,606,369**	**45.9%**	**±11.0%**	**123,446,573**	**51,297,740**	**41.1%**	**±12.0%**
Demand (kW)								
PG&E	596	277	46.4%	±22.0%	NA			
SoCalREN	713	269	37.7%	±13.0%				
Statewide	**1,310**	**545**	**41.7%**	**±12.0%**				
Natural gas (therms)								
Statewide	**10,187,469**	**2,444**	**46.5%**	**±86.0%**	**503,709**	**218,559**	**43.4%**	**±44.0%**

*Verified savings do not match Table 1-4 because the NTG population was larger. When savings were not verified as part of the impact evaluation, tracked savings were used in the ratio estimation.
**Relative precision at the 90% confidence level.

1.5 Key findings and recommendations

1.5.1 Gross and net savings findings and recommendations

Site-level NMEC gross realization rates compared positively to other programs in CIAC.

Overall, both the site-level NMEC GRR and the DRR were significantly higher than what is typically seen for similar customers in other CIAC programs. For electric savings (kWh), site-level NMEC achieve a GRR of 71.5% that would have risen to 81.8% (DRR) if the savings claims had been made correctly by the PAs. Similarly, the program achieved lifecycle kWh savings GRR and DRR of 67.1% and 87.1%. The PY2020-2021 CIAC programs electric first-year GRR was 59%, while the lifecycle GRR was 48%.[17] Gas and kW results follow a similar pattern.

The net-to-gross interviews found substantial program influence on project scope and timing, but these factors account for only part of the current NTGR methodology.

NTGR methodology: The current methodology may not be well suited for measuring NMEC program influence. The well-established NTG methodology that has been used for many years for custom evaluations includes three equally weighted program attribution indicators. Two are based on rating program and non-program influences while only the third focuses on project scope and time. However, project timing and project scope are expected to be particularly important to NMEC program influence because of the objective of unlocking the stranded savings in buildings that are otherwise able to maintain and repair below-code systems. Aligning the methodology with this intent would offer a better representation of the programs' net impact.

Project scope: Respondents indicated that without the programs, they would likely have implemented a more limited project scope. When asked to rate the likelihood of completing the exact same project without the program on a ten-point scale, 53% of respondents gave a rating of 3 or less, indicating that it was unlikely that they would have completed the same scope without the program. For example, one respondent said, "We wouldn't have known about [the measures]. Their analysis helped us see what the change would be and without someone showing us that change we wouldn't have done it."

Project timing: Additionally, respondents indicated that without the program they would have implemented their projects multiple years later than they actually did or never have implemented them at all. When asked how much later they would have implemented their projects without the program, 33% of respondents, representing 23% of sites, said they would have never implemented the project (see Table 1-6). Another 40% of respondents, representing 64% of sites, said they would have implemented their projects two or three years later than they did. Only 20% of respondents, representing 11% of sites said they would have done that project at the same time or earlier.

Table 1-6. Project timing

Without the assistance received from the program…would your organization have completed the whole project…	Percent of respondents	Percent of sites
About the same time or earlier than you did	20%	11%
At least a year later than you did	0%	0%
At least two years later than you did	13%	32%
At least three years later than you did	27%	32%
Or never	33%	23%
Or would the timing have varied by measure?	7%	2%

[17] https://pda.energydataweb.com/api/downloads/2816/CIAC%202020-2021%20Evaluation%20Final%20Report%20-%20Revised.pdf

Recommendation

The CPUC should revisit the current NTGR methodology instrument and assess if the instrument and algorithm is in line with the actual NMEC program design and delivery. Opportunities for improvement include more timely NTG surveys, new questions to determine whether projects address stranded potential and to consider re-weighting current NTG algorithms to give more weight to project timing and scope.

1.5.2 Documentation findings and recommendations

Incorrectly entered savings claims in the tracking database system were the largest source of savings discrepancies.

The NMEC savings claim process is more complicated than the typical custom claim process to accommodate the final savings estimate calculated after performance period over a year after implementation. Engineering-based, forecasted savings are claimed the year the project is implemented. A year later, after the performance period, the meter-based normalized savings for the project are calculated. A true-up claim that represents the difference between the two values is entered into tracking the following year. The two claims should sum to the final meter-based savings estimate. The novel claims process for NMEC led to some reporting inaccuracies.

Double claimed projects: Thirteen projects, three of which were sampled in the impact evaluation, effectively double claimed savings by reporting savings incorrectly. The initial claim used the engineering-based forecasted savings (the correct approach), and the true-up claim used the full meter-based normalized savings (incorrect approach). Summing the two lines should adjust the initial claim to the final meter-based result. With two full savings claims entered, rather than a delta, summing substantially over-claimed final savings.

Double true-up: One project was trued-up twice, resulting in over-adjusting the initial claimed savings. In this case, the post-performance true-up was applied correctly after the performance period, but then repeated a second time the following year. This also resulted in too large of a savings claim.

Projects claimed but not installed: Two gas projects included in the evaluation were claimed but the PA reported that they were never installed or trued-up. These projects have been zeroed out through the evaluation.

Inaccurate savings claimed: One steam project claimed therms savings in the tracking database that were more than double the savings reported in the project documentation. The reason for the over-claimed savings is unknown. This resulted in a large savings correction.

Recommendations

- Existing NMEC reporting guidance[18] is clear that initial claims should be made in the year of installation and trued-up the following year with a positive or negative value that, when summed with the initial claim, equals the final weather-normalized estimate of savings. All claims should follow this structure.
- The PAs should develop data accuracy checks that assure total final claimed savings (the sum of preliminary and trued-up claims) are consistent with final weather-normalized savings estimates.
- All NMEC projects must be trued up during the first quarter of the second year after installation. PAs should review all initial site-level NMEC claims to ensure they are trued-up on schedule.

[18] This is explained in reporting guidance published by Energy Division as NMEC Reporting Guidance 04242020.pdf that was distributed to the PAs.

Project documentation was varied and inconsistent, which made it difficult to identify the final project characteristics and results as well as the reasoning behind key project decisions.

There was substantial variation in the type and thoroughness of the project documentation provided. Some projects had relatively clear documentation that explained what had been planned for the project, what was done for the project, and why anything changed. Other documentation was very difficult to follow and did not provide any reasoning for why substantial changes were made during implementation or the performance period modeling. This lack of clear documentation required additional data requests, increased review time during the evaluation, and increased the likelihood of misunderstanding the reasoning behind some project decisions.

Most projects reviewed during the evaluation had insufficient documentation to explain why measure-level Measure application types (MATs)[19] and effective useful life (EUL), were selected. Unlike an NMEC project's savings, which are meter-based, the measures' EUL, which indicates how long the first-year savings will persist, must be based on measure life studies and other documentation as with non-meter-based custom projects. As a result, the EUL needs to be careful reviewed by evaluators as the resulting lifetime savings are important for cost-effectiveness and total system benefit calculations. The lack of clear MAT and EUL documentation for many projects made this essential part of the evaluation more inefficient, time-consuming and, potentially, inaccurate.

Recommendations

- The PAs should provide an explanation of why each measure-level MAT was assigned. At a minimum, the explanation should specify the type of equipment involved, such as lighting, heating, ventilation, air conditioning, refrigeration, or water heating and whether the measure involves installing equipment in a new building or new area of an existing building or in an existing building. The explanation should also indicate if the measure involves: a) replacing existing equipment with new energy efficient equipment, or b) adding new equipment to existing equipment, or c) repairing or refurbishing existing equipment, or d) changing settings in an existing control system. This clear explanation will help the evaluation team establish the appropriate MAT for each measure.
- Measure-life documentation should include a description of the measure, EUL of the measure and it's respective DEER EUL ID to explain why particular measure lives are assigned from DEER.

Regression-based modeling is the core of NMEC methods, and projects do not consistently provide transparent, well-documented models following standard practices.

We identified multiple types of issues with the way regression models were specified or structured. These included using novel and inappropriate variable combinations, using different model specifications for the baseline and performance models, models not well aligned with the onsite project activities, and unexplained changes in model structure. This is not unexpected for a programmatic approach still under development. However, for NMEC to evolve into a program approach that requires a light-touch evaluation, a greater level of consistency is required.

In addition, the pandemic put stress on basic site-level NMEC methods. Site-level NMEC methods measure change in consumption between two periods and define the difference as savings. COVID had substantial, variable impacts on energy consumption that were difficult to separate from program-motivated changes. Many of the COVID-related challenges may become moot under typical conditions. For example, occupancy measures used to address COVID-related interruptions were novel additions to models and may prove unnecessary in the future when occupancy changes are limited.

[19] For more detailed definitions of each MAT, see: https://www.caltf.org/measure-application-types-1

Recommendations

- Continued communication between the CPUC and PAs will guide the basic expectations for acceptable modeling practices and essential documentation to reduce uncertainty and project delays. This may be accomplished through rulebook updates, separate NMEC PFS/M&V template development, NMEC PCG discussions, and additional guidance documentation.
- Wherever possible, PAs should follow standard model structures (e.g. linear changepoint models or LBNL Time of week and temperature models[20]) and provide engineering-based explanations for deviations to simplify the review process.
- The PAs should ensure that baseline model specification is set before project installation and applied consistently in the post period to comply with the NMEC Rulebook.

The maintenance plans provided varied substantially in terms of detail and completeness.

Behavioral, Retro-commissioning, and Operational (BRO)[21] measures were noted as important options for NMEC projects in early policy guidance. To extend the measure life of BRO measures to three years, the NMEC Rulebook states that "participant or project owners must commit to a repair and maintenance plan for a minimum of three years via a signed customer agreement under which the repair and maintenance activities will continue."[22] Eight of the projects reviewed as part of the impact evaluation included BRO[23] measures. The Rulebook states that maintenance plans should include "continuous feedback," "Detailed documentation," "a detailed data tracking plan," and should include training.[24] However, the maintenance plans developed for the evaluated NMEC projects varied widely in their adherence to these guidelines. The two refrigerated warehouse projects did include detailed plans with clear data tracking plans but did not provide evidence that the plans were being followed. The large tech projects only provided an email from the customer stating, "we plan to have this program extended long term – there is no end [in] sight so keeping up with a 3+ year program is exactly what we want to do." Without the actual maintenance plan, we had no inkling whether the maintenance and repair measures were maintained and providing savings.

Recommendation

- PAs should provide maintenance plans that meet NMEC Rulebook requirements so that the BRO EUL can remain at three years.
- The CPUC should consider amending BRO EUL rules so that BRO measures without maintenance plans receive a one-year EUL, capped at verified savings of the 12-month performance period.
- Energy Division should facilitate the development of a maintenance plan template that is in-line with BRO measure program maintenance plan requirements.

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[20] The time of week and temperature model (TOWT) was developed initially by Lawrence Berkeley laboratory. Mathieu, Johanna L., Phillip Price, Sila Kiliccote, Mary Ann Piette. 2011. "Quantifying changes in building electricity use, with application to Demand Response." IEEE Transactions on Smart Grid 2:507- 518.

[21] BRO measures include information or education programs that influence energy-related practices (behavioral), activities and installations that restore equipment performance (retro-commissioning), as well as measures that improve the efficient operation of installed equipment (operational). BRO measures are assigned a three-year EUL.

[22] CPUC. "Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption-Version 2.0." P. 10. cpuc.ca.gov, January 7, 2020. https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/n/6442463694-nmec-rulebook2-0.pdf

[23] BRO measures include information or education programs that influence energy-related practices (behavioral), activities and installations that restore equipment performance (retro-commissioning), as well as measures that improve the efficient operation of installed equipment (operational). BRO measures are assigned a three-year EUL.

[24] CPUC. "Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption-Version 2.0." P. 10. cpuc.ca.gov, January 7, 2020. https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/n/6442463694-nmec-rulebook2-0.pdf

PAs did not address multiple key issues identified through Energy Division's Project Review process.

Site-specific NMEC projects go through a Project Review that is similar to the custom Project Review (CPR) process. However, a stark difference between CPR and NMEC Project Reviews is that the NMEC Project Review is advisory only, and not binding. The PA may choose to continue with project implementation regardless of the recommendations made following the NMEC Project Review process. The NMEC Project Review "does not restrict or delay project development or constitute an approval of related energy savings claims."[25] Although the NMEC Project Reviews are advisory, the NMEC Rulebook[26] states that these reviews should "be referenced during EM&V[27] activities to assess how Commission feedback was incorporated."

Four out of the 20 projects included in the impact evaluation had been selected for Project Review prior to project installation. Of the four projects, two did not address key issues identified during the Project Review. Additionally, one project did not follow the requested Early Opinion.[28] Issues that were not addressed despite being highlighted in Project Review recommendations include an overlooked cogeneration system and mis-specified EULs. The lack of attention to these highlighted issues led to artificially increased and extended claimed savings. The overlooked cogeneration system reduced savings by 13% at what was the largest kWh saving project in the evaluation sample. The project for which an Early Opinion was requested installed a gas line in order to switch from electric to gas heating. The final savings ignored the increased gas use (from zero) and did not follow the Early Opinion guidance. With the inclusion of the gas consumption, expected savings did not occur and the project increased the overall consumption of energy at the site.

Recommendations

- The PAs should address issues identified through the NMEC Project Review process and should document the reasons for making changes within the final savings report to improve project quality.
- CPUC should consider making NMEC Project Reviews more than advisory so that issues are more likely to be addressed during the project implementation which will help PAs achieve more accurate savings claims.

1.5.3 Process findings and recommendations

Participants indicated high levels of satisfaction with the program, driven by the programs' technical support and incentives.

When asked to rate program satisfaction on a scale of zero to 10, where zero is completely dissatisfied and 10 is completely satisfied, respondents gave an average rating of 8.1 which indicates a high level of satisfaction.

Table 1-7. Program satisfaction

Metric	By respondents (n=13)	By sites (n=62)
Average Satisfaction	8.1	8.5
% Promoters (≥8)	80%	94%
% Detractors (≤3)	7%	2%

Eighty percent of respondents, representing 94% of sites, were "promoters," providing a rating of 8 or above. In an open-ended question about the strengths of the program, respondents indicated that their satisfaction was driven by the technical support and incentives provided by the program. Three respondents elaborated on the value of technical support

25 CPUC. "Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption-Version 2.0." January 7, 2020. https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/n/6442463694-nmec-rulebook2-0.pdf.

26 Ibid.

27 Evaluation, measurement, and verification

28 Early Opinion reviews allow the PAs to request clarification from CPUC staff of custom project related CPUC policies or rules before submitting a project.

provided by the program, indicating that the embedded engineering and technical support and the data shared were particularly helpful.

Only one respondent was a detractor, providing a rating of 3 or less. This respondent indicated their dissatisfaction was driven by the administrative burden required for participation, inconsistent messaging about what qualifies for participation, and long delays throughout the project. At the time of the interview, they had not yet received their incentives, saying, “we're waiting years to get the incentive.” This participant started their project before 2022.

While nearly half of respondents had no suggestions for program improvements, those that did most frequently recommended streamlining the program and reducing administrative burden.

Twenty percent of respondents, representing 34% of sites, suggested shortening the delays for CPR review approval (Table 1-8). One said, “when projects go in for submission there are long delays between when we submit to when its approved and therefore, we can’t implement it…Savings are sitting on the table while we're waiting.” Twenty percent of respondents, representing 8% of sites, also suggested reducing the admin burden. One said, “[Reduce] admin burden, paperwork, or duplication of effort. [We have] too many people doing the same thing, sending the same data to multiple people and repeated requests for information from the program.” Request for information could come from either implementer or PA and could reflect information needs of implementer, PA, Project Reviewers or evaluators.

Table 1-8. Suggestions for program improvements

Improvement	Percent of respondents	Percent of sites
Shorten delays for approval	20%	34%
Make incentives tied to particular measures	7%	22%
Reduce admin burden	20%	8%
Provide information on cost of technical assistance, though it was free	7%	8%
Reduce disconnect between utility staff and NMEC on what qualifies	13%	5%
Increase incentives	13%	3%
No suggestions	47%	31%

Recommendation

Improve alignment between program implementers, PA staff, and evaluators on program evaluation and qualification requirements. Increasing clarity on data requirements among all parties and streamlining the process of data sharing across parties can reduce duplicative work and confusion. Follow-on work led by ED can facilitate this process.

1.5.4 Overarching NMEC findings and recommendations

Site-level NMEC shows possibility to address “stranded potential” savings but is also being applied in a much wider range of projects.

Our evaluation included multiple projects that may have addressed “stranded” savings, which is described in the March 2016 AB802 Technical Analysis[29] as follows.

29 https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/a/11189-ab802-technical-analysis.pdf

> "Stranded potential exists because a subset of customers maintains certain types of equipment well beyond the equipment's expected useful life. Long lived measures exist for two reasons:
>
> 1. The equipment is repairable and customers have been repairing the equipment rather than replacing the equipment when it fails (examples include boilers and chillers). …
>
> 2. There is no catastrophic system failure that triggers the customer to repair or replace the entire system (examples include insulation and commercial lighting fixtures)"

Stranded savings have the potential to offer dramatic savings where out-of-date or poorly commissioned systems that fit the above criteria would legitimately take advantage of NMEC's existing conditions baseline. In contrast, there are other NMEC projects that appear to have chosen NMEC as a path to claim greater savings than would be available via alternative paths.

During interviews with participating customers, multiple respondents indicated that they considered both Custom and NMEC offerings when making decisions on how to implement projects and chose the offering that made the most sense for them. They said that Custom offerings were typically chosen when the project scope included discrete measures with developed evaluation methods, and NMEC was chosen when the project contained a more holistic approach that covered multiple building systems, or where the project included behavioral, retro-commissioning and/or operational measures ("BROs"). This comparison indicates a consideration, and ultimate choice, of the NMEC approach for reasons that may not embrace the full purpose of measuring savings from the existing conditions baseline to access stranded potential.

Recommendation

Consider, as part of future studies,

- Assessing the volume of stranded savings potential. The 2019 Energy Efficiency Potential and Goals Study by Navigant/Guidehouse identified below code energy efficiency potential as reflecting "additional claimable impacts allowed after the passing of AB802" and should represent the target population for NMEC programs.
- An exploration of PA and implementer efforts to identify and target "stranded potential" buildings for NMEC projects.

NMEC intends to move savings risk away from the ratepayer to the PAs, implementers, and participants. While the PAs and implementers who engage in NMEC are aware of the risks, the PAs must manage the additional risk with participants carefully.

Site-level NMEC calculates savings from an existing conditions baseline. Upgraded systems need to be functional in the baseline for improvements in the performance period to appear as savings. Program implementers that fail to perform basic functional testing on systems to be upgraded may implement projects that will not provide the participant the expected reward under an NMEC approach. For example, one evaluated project had a 77% reduction from engineering-based forecasted savings to meter-based realized savings. The engineering-based forecasted savings made assumptions about how the old equipment had been functioning which were not supported by the meter-based model. The old equipment had been functioning at a small fraction of its capacity, which immediately became clear based on the deficiency report provided after the participant interview, showing that one of the two compressors was down. The new system is efficient but uses more energy than the existing system at partial capacity which was likely not meeting the functional needs of the space. The participant had not been made aware of the existing system's limitations nor its implications on the building's potential energy savings. The PAs and implementers are in a position to manage their own added risk under NMEC, but the participant may not be.

Recommendation

To protect participants, the implementer should ensure that equipment is operational and meets the functional needs of the building and that the 12 months of pre-installation data is an actual representation of baseline energy usage with functional equipment. A simple functional check by the implementer on the existing equipment during the investigation phase could eliminate this risk without adding additional burden on the participants.

2 INTRODUCTION

This report presents key findings of the site-level normalized metered energy consumption (NMEC) impact and net-to-gross evaluation on behalf of the California Public Utilities Commission (CPUC). NMEC is a set of statistical tools and approaches that estimate the energy consumption impact of energy efficiency programs by comparing pre- and post-intervention meter data. While most other energy efficiency programs claim final savings based on deemed[30] or calculated results, NMEC programs calculate and claim final savings based on measured impacts at the meter. This evaluation focuses on site-level NMEC projects where savings are estimated at the individual commercial site level. The impact evaluation provides savings estimates for site-level NMEC projects with initial claims[31] in program years (PY) 2020 or 2021 that were trued-up in PY2020, PY2021, or PY2022. The net-to-gross (NTG)[32] evaluation provides program attribution for site-level NMEC projects with initial claims in PY2020–PY2022.

2.1 Background

Over the last decade, the CPUC and the California Program Administrators (PAs) have been working to develop whole-building measurement and verification (M&V) program pathways to achieve deep savings in commercial buildings.

- In 2012, the CPUC requested that its regulated investor-owned utilities (IOUs) develop energy efficiency programs to encourage more comprehensive commercial building retrofits (Decision 12-05-015, 2012).[33]
- In 2015, the governor signed California Assembly Bill 802, which directed the CPUC to allow savings claims using a NMEC methodology (AB 802 Williams 2015).[34]
- In May 2019, the Commercial Whole Building Demonstration Joint Study was released. This study was an evaluation of a 12-building demonstration program and developed recommendations for future NMEC programs.[35]
- In December 2019, the Lawrence Berkeley National Laboratory (LBNL) Option C Technical Guidelines were published, which showed how to use NMEC methods to calculate energy and demand savings for site-level NMEC projects.[36]
- In 2020, the CPUC released an updated "Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption" (referred to as the NMEC rulebook).[37]
- In 2023, the CPUC released a draft revised NMEC rulebook that is currently going through the comment process.[38]

The NMEC evaluation was initially scoped as part of the PY2020–2021 Commercial, Industrial, and Agriculture Custom Projects (CIAC) Work Plan issued in May 2022. DNV completed a review of the tracking data and had multiple discussions with the California Public Utilities Commission (CPUC) and the program administrators (PAs) to better understand how site-level NMEC projects are claimed. Our review and discussions with the PAs revealed that some of the initial claims had been awaiting true-ups and were not part of the relevant tracking claims. DNV worked with the CPUC to separate the site-level

[30] Deemed refers to researched, vetted, and predictable savings for EE technologies and services with well-established properties. This contrasts with custom savings for EE technologies and services that require unique calculations and do not use predefined values.

[31] Site-level NMEC projects typically have two claims, with the initial claim occurring at the time of installation and the true-up claim occurring following the 12-month performance period.

[32] Net savings are changes in energy use attributable to a particular energy efficiency program and consider savings from participants who would not have purchased energy-efficient technologies without the program. Savings attributable to participants who would have purchased energy-efficient technologies with or without the program influence are excluded from net savings. These participants whom the program did not influence are considered free riders.

[33] "Decision 12-05-015," calmac.org. 5/18/12. https://www.calmac.org/events/Decision_12-05-15.pdf.

[34] California Legislative Information, "AB-802 Energy efficiency, Assembly Bill No. 802, Chapter 50," leginfo.legislature.ca.gov., 10/8/2015. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB802

[35] California Public Utilities Commission, Pacific Gas and Electric Company, "Commercial Whole Building Demonstration Joint Study Report," calmac.org, 5/1/19. https://www.calmac.org/publications/Commercial_Whole_Building_Joint_Study_ID_PGE0431.01.pdf

[36] Ibid

[37] CPUC, "Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption," January 7, 2020, https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/n/6442463694-nmec-rulebook2-0.pdf

[38] See Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption version 2.1,: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M520/K881/520881077.PDF

NMEC evaluation from the CIAC evaluation. The site-level NMEC evaluation began with an Evaluability Study, which investigated project characteristics and identified which projects were ready to be evaluated.

The Evaluability Study identified 42 projects ready for impact evaluation and 52 projects ready for NTG evaluation from the PY2020 and PY2021 claims. Given the timing of the evaluation and in the interest of broadening the population included in the evaluation, we looked at the site-level NMEC projects included in the PY2022 tracking data to identify any projects that could potentially be added to the evaluations.

The Evaluability Study and this impact and net-to-gross evaluation are the first comprehensive site-level NMEC evaluations since the NMEC pathway expanded beyond the pilot phase. The only other evaluation that has partially touched on site-level NMEC to date was “PY2018–2019 California Statewide On-Bill Financing Impact Evaluation”[39] written by Opinion Dynamics and published in 2022. That report focused only on the On-Bill Financing (OBF) Program, which was primarily a population NMEC program, but did have some projects that were assessed via site-level NMEC. DNV considered the findings in that report as we assessed the wider site-level NMEC programs.

The impact evaluation covers site-level NMEC projects with initial claims[40] in program years (PY) 2020 or 2021 that were trued-up in PY2020, PY2021, or PY2022. The net-to-gross evaluation covers site-level NMEC projects with initial claims in PY2020 – PY2022.

2.2 Evaluation objectives

For this evaluation, we estimated the gross[41] and net savings of site-level NMEC programs leveraging each site’s embedded performance measurements and assessed the application of NMEC program requirements. We determined the programs’ application of NMEC requirements by referring to the Rulebook for Programs and Projects Based on NMEC,[42] which includes the CPUC’s specific requirements for NMEC programs and measurement and verification (M&V) plans.

The objectives of this evaluation were to:

- Estimate gross kWh and therm savings for site-level NMEC projects with initial claims in PY2020-PY2021.
- Estimate net kWh and therm savings for site-level NMEC projects with initial claims in PY2020-PY2022.
- Assess the methods used by implementers to estimate meter-based savings.
- Provide timely feedback to the CPUC, program administrators (PAs),[43] and other stakeholders to facilitate timely program improvements and support future program design efforts.
- Provide meaningful and actionable recommendations to improve program performance in delivering energy efficiency savings.

2.3 Evaluated programs

The site-level NMEC pathway is offered as part of multiple programs that serve commercial or commercial-like buildings. There were six programs with site-level NMEC initial claims in PY2020-PY2021 that are included in the site-level NMEC gross savings evaluation described in Table 2-1. There are an additional four programs with claims in PY2022 that are included in the net-to-gross evaluation described in Table 2-2.

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[39] Report Template v2017.0521 (energydataweb.com)

[40] Site-level NMEC projects typically have two claims, with the initial claim occurring at the time of installation and the true-up claim occurring following the 12-month performance period.

[41] Gross savings are a measure of change in energy use due to energy efficiency programs, regardless of why customers participated.

[42] CPUC. “Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption-Version 2.0.” January 7, 2020. https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/n/6442463694-nmec-rulebook2-0.pdf.

[43] A program administrator is an entity tasked with the functions of portfolio management of energy efficiency programs and program choice.

In the California Energy Data and Reporting System (CEDARS) tracking database, each NMEC project makes two claims, one at the time of project installation and one approximately 12 months later following the performance period. For this impact evaluation, we only included programs with initial claims made in PY2020-PY2021. Some claims initially listed as site-level NMEC were later removed based on information provided by the PAs that showed that the projects were not site-level NMEC.[44]

Table 2-1. Programs included in the gross evaluation

PA	Program ID	Program name	Description
	PGE_IND_003	Manufacturing and Food Processing Efficiency Program/Industrial Systems Optimization Program (ISOP)	The ISOP program targets industrial manufacturing and food process customers and focuses on mechanical systems and behavioral, retro-commissioning, and operational (BRO) measures.
	PGE21011	Commercial Calculated Incentives	The Commercial Calculated Incentives program provides technical assistance and incentive support for commercial projects requiring custom calculations or whole-building NMEC methodologies.
PG&E	PGE2110012	University of California/ California State University (UC/CSU)	The UC/CSU program offers incentives for retrofit projects, monitoring-based commissioning, and training for campus energy managers.
SCE	SCE-13-L-003I	Public Sector Performance-Based Retrofit HOPPs	The Public Sector HOPPs program targets public sector buildings with stranded savings due to improvement delays or indefinite equipment repairs.
SCG	SCG3809[45]	Commercial Energy Management Technology for Lodging (CEMTL) Program	The CEMTL program targets small and medium commercial lodging buildings and seeks to provide savings opportunities that encompass the whole building rather than individual rooms.
SoCalREN	SCR-PUBL-B3	Public Agency Metered Savings Program	The Public Agency Metered Savings Program targets public sector stranded savings.

Table 2-2. Additional programs included in the net-to-gross evaluation

PA	Program ID	Program name	Description
	PGE_Com_001	Grocery Efficiency Program (CoolSave)	CoolSave is an NMEC-specific program that targets grocery stores and offers both comprehensive retrofits and retro-commissioning.
	PGE_Com_002	Laboratory Performance Efficiency Program (Smart Labs)	Smart Labs is an NMEC-specific program targeting laboratories for ventilation, other retrofits, and BRO measures.
PG&E	PGE_Com_003	Commercial Efficiency Program	The Commercial Efficiency Program is open to the entire commercial segment and offers site-level NMEC, population NMEC, custom, and deemed delivery channels.
SCG	SCG3910	Nonresidential Calculated Incentives	The Nonresidential Calculated Incentives program is a core program for projects

[44] Projects include those from San Diego Gas & Electric's (SDG&E) Facility Assessment Services Program, High Opportunity Program and Projects' (HOPPs) Building Retro-Commissioning Program, Strategic Energy Management (SEM) Program, and from Pacific Gas and Electric's (PG&E) On-Bill Financing Program.

3 METHODOLOGY

This section documents the methods DNV used, including the planned sample design, achieved sample sizes, gross savings, measurement and verification (M&V) activities, net savings approach, and final results expansion procedures. We followed International Performance Measurement and Verification Protocol (IPMVP) and the California Evaluation Protocol throughout the execution of the evaluation.

3.1 Sample designs

The Site-Level NMEC Sampling Memo for PY2020 and PY2021, issued to the CPUC on August 2023, provides details of the proposed sample design for both the gross and net site-level NMEC evaluations.

The gross population includes all evaluable projects, which means that the project savings have been finalized and the project has been trued-up in the tracking data. As identified in the site-level NMEC evaluability report, there were two customers with more than 10 sites in PY2020 and PY2021. For these two customers, we sampled a portion of their projects, as the project groups largely followed the same approaches. Table 3-1 shows the population counts, sample target, and final sample achieved for key analysis dimensions. The population of projects includes a large tech participant with 19 projects and a school district with 14 projects. We attempted a census for all projects that were trued up or for which a final savings report was provided, except for the large tech company and the school district, which had many participating sites. Overall, 88% of projects in the sample design were recruited.

Table 3-1. Gross sample coverage by PA

Group	Population (N)	Sample design quota	Final sample (n)	% of sample complete
PG&E	25	12	9	75%
SCE	14	3	3	100%
SCG	2	2	2	100%
SoCalREN	8	8	8	100%
Total	49	25	22	88%

The NTG population includes all projects with initial claims in PY2020–PY2022. We were able to include more projects within the NTG population as the project decision making should have occurred by the time the initial claim is made, as the initial claims should be made after project installation is complete.[46] Additionally, completing interviews closer to the time of decision making improved project recall and reduced the likelihood of decision maker turnover–related issues impacting the evaluation.

We attempted a census of the NTG population. Table 3-2 shows the net sample design population, sample target, and sampled sites. Of the 68 surveyed projects, 22 of those were also part of the final gross sample (i.e., embedded).

Table 3-2. Net sample coverage by PA

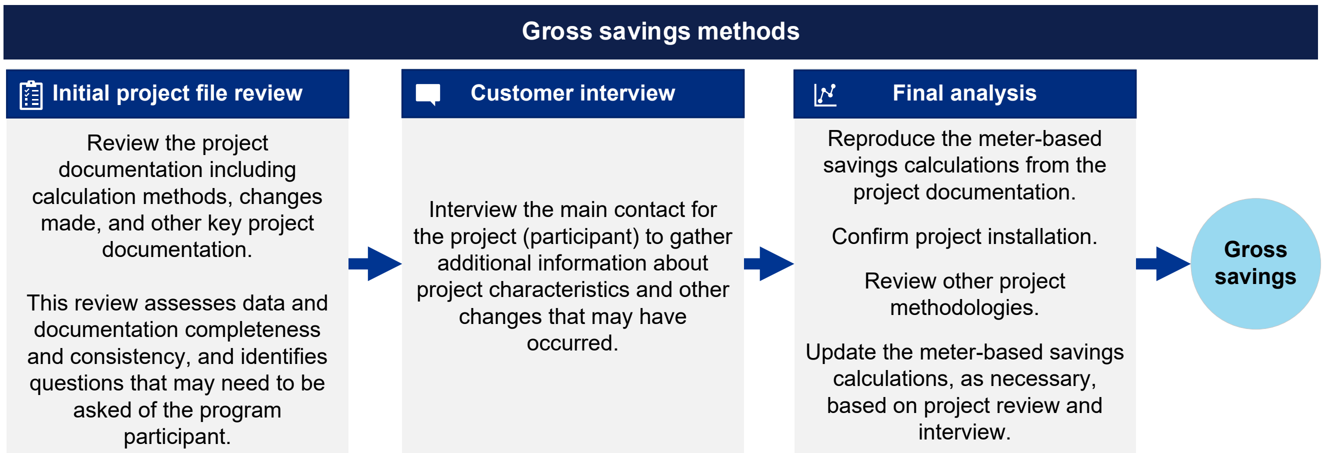
PA	Population (N)	Sample design quota	Final sample (n)	% of sample complete
PG&E	44	44	35	80%
SCE	15	15	15	100%
SCG	3	3	2	67%
SoCalREN	15	15	15	100%
Total	77	77	67	87%

46 Energy Division Staff Guidance: NMEC Reporting. April 24, 2020.

3.2 Gross savings methods

Figure 3-1 summarizes the key steps of the gross savings evaluation. Each step is further described in the following sections.

Figure 3-1. Gross savings methodology



3.2.1 Initial project file review

During the initial review of project files, DNV engineers and analysts used a modified version of the Custom Core Template (CCT) to validate key project information such as project eligibility, installed measures, measure application type (MAT) and effective useful life (EUL), engineering methods, key project dates, fuel switching, non-IOU fuel sources, and non-routine events (NREs).

- **Installed measures**: We reviewed measure documentation to determine whether we had sufficient information regarding which planned measures were implemented and when installation occurred. Some planned measures were not installed, or the scope changed between planning and implementation. This discrepancy would require further validation through the participant interview and might affect the savings.
- **Measure-level MAT**: MATs are important for determining EUL. We reviewed documentation regarding the MATs assigned by the PAs, identified any documentation that may support a particular MAT assignment, and prepared questions to confirm MAT assignment, particularly when attempting to verify whether a measure was accelerated by the program.
- **Measure-level EUL**: Verifying the measure-level EUL is important as it is the basis of the savings-weighted project EUL used to calculate the project lifetime savings. We reviewed the measure-level EULs provided in the documentation and looked for information regarding the sources.
- **Engineering-based savings estimates**: We confirmed the presence and general reasonableness of the provided engineering-based savings estimates. In cases where projects had multiple different EULs, the engineering-based savings estimates were examined more closely, as they are used to calculate the savings weighted EUL.
- **Project dates:** We reviewed project documentation to determine key project dates such as project implementation start and end and the dates of identified non-routine events (NRE). These dates are important for identifying any overlap between installation and the baseline or performance period models and for addressing any NREs. We noted dates to collect or confirm with participants during interviews.
- **Non-IOU fuel sources:** We reviewed project documentation for onsite generation. Onsite generation could impact the NMEC models if the generation is on the same meter as the participating building. Additionally, savings need to be less than the energy imported from the grid.

- **Non-routine events (NREs):** We reviewed the project documentation regarding identified NREs, discussions of other activities occurring at the site such as space repurpose, and energy use plots to identify any potential additional NREs.
- **Project Review dispositions:** For projects that went through CPUC Project Review, we reviewed project dispositions.
- **Other:** We also looked for other less common situations such as fuel switching and Early Opinions.

3.2.2 Customer interview

The customer interview aims to confirm the installation and operation of the proposed measures, key project dates, onsite generation, NREs, facility operation changes, occupancy patterns, and the effects of COVID-19. For replacement measures, we collected information about the pre-existing equipment conditions and the program influence to evaluate the MAT. If necessary, we followed up with the participant and the PA with additional data requests.

3.2.3 Final analysis

The final analysis includes an engineering and policy review and a model review. The engineering and policy review involved modifying the projects based on the customer interview and additional data provided. This section focuses on the model review approach.

The evaluation model review included both model replication and model validation. Model replication involved reproducing the models and savings results within the code, spreadsheets, or other tools provided in the project documentation. Model validation involved independently reproducing the models and savings results outside of the provided documentation and modifying the models as necessary to more closely align with modeling best practices and CPUC guidance.

3.2.3.1 Model replication

In general, we replicated four steps for each model: the baseline model, the performance model, normalization of baseline and performance consumption, and calculation of normalized savings. We considered a replication to be successful by achieving the same goodness of fit statistics for both baseline and performance models, fractional savings uncertainty (FSU) for the baseline model, total normalized savings, normalized savings fraction, and normalized FSU.

3.2.3.2 Model validation

The purpose of validation was to identify discrepancies between the way the PAs modeled their data, and standard modeling practices and CPUC guidelines that could produce biased estimates of savings. For each change we made during validation, we documented the discrepancy and estimated the savings impact.

Figure 3-2. Model validation

Model Validation

Engineering basis	Non-routine events	Normalization
• Does the model align with engineering principles for how a site's energy consumption would be expected to correlate with the included variables? • Do the baseline and performance period model structures align? • Do the normalized models and savings align with how savings are expected to be achieved?	• Are there any short-term spikes or drops in energy usage? • Are there any long-term consistent changes that do not align with project expectations? • Are the non-routine adjustments used appropriate?	• Was the appropriate typical weather data used (such as CALEE 2018)? • Were performance period values used to normalize non-weather variables?

Engineering basis: We reviewed all dependent and independent variables in the model for appropriateness. At minimum, we expected each model to use consumption as the dependent variable and actual outdoor temperature as an independent variable. For any other independent variables, we considered whether the PA provided sufficient justification for including the variables and whether the site's energy consumption would be expected to correlate with the additional variables under engineering principles. We also checked that both baseline and performance models included the same dependent and independent variables, as this is crucial for valid model comparison and savings estimation. Finally, we considered if any essential variables or additional data were left out of the models and requested that data from the participant where possible.

We assessed how the model parameter estimates changed from baseline to performance periods. Parameter estimates represent how the building consumption changes in response to changes in the associated independent variable and should be consistent with engineering principles. For example, if an installed measure would reduce how much consumption changes when outdoor temperature changes, we would expect the performance model's temperature parameter estimates to be smaller and of less statistical significance than those of the baseline model. Any parameter estimates that did not align with expected engineering-based outcomes suggested that some unknown influence on energy consumption was captured by those parameters.

Non-routine events: We assessed error and model fit plots to investigate the presence of NREs. It is important to properly account for NREs, as they represent abnormal changes in building consumption that can severely bias models if not properly accounted for. We looked for short-term spikes or drops, long-term consistent changes, and trends in energy consumption over time. If any were found, we confirmed whether the PA properly accounted for them, generally by removing data coinciding with short-term NREs from the model or including indicator variables in the model during the longer-term NREs. We also checked whether NREs were appropriately accounted for in the normalization step.

Normalization: When reviewing normalization, we assessed whether standard guidance was followed. For temperature normalization, we confirmed that an appropriate Typical Meteorological Year (TMY) data set was used. We also checked that the bounds of temperature values in the chosen TMY data did not exceed 10% of the temperature bounds from either the baseline or performance period model. For other variables, standard practice is to use performance period values if the bounds of the baseline model's values do not exceed 10% of the bounds of the performance period. In cases where this does not hold, it is acceptable to use the baseline period's data. Any other set of values is considered non-standard and would require justification to be used.

3.2.4 COVID-19 impacts

All the projects reviewed in this evaluation overlapped with the COVID-19 shutdowns of 2020 and 2021. The COVID pandemic impacted energy usage substantially, particularly in certain building types like schools. The impacts from COVID were long lasting, variable, and posed continued modeling challenges. Projects used various occupancy variables, shifted baseline or performance period models, shortened models, and other approaches to attempt to produce reasonable normalized savings estimates. Recognizing the difficulties of launching a meter-based program into a pandemic, this evaluation has focused on the reasonableness of the efforts to address COVID-19 impacts. We anticipate seeing fewer occupancy variables, re-baselining efforts, and other adjustments to future NMEC models as the impacts of COVID-19 lessen.

3.3 Net savings methods

DNV interviewers completed NTG in-depth interviews with participant decision makers for projects with initial claims in PY2020, PY2021, and PY2022. Nearly all the PY2020 and PY2021 projects sampled for NTG were also sampled for gross evaluation. Projects with initial claims in PY2022 were only included in the NTG sample.

Figure 3-3. Net savings methods

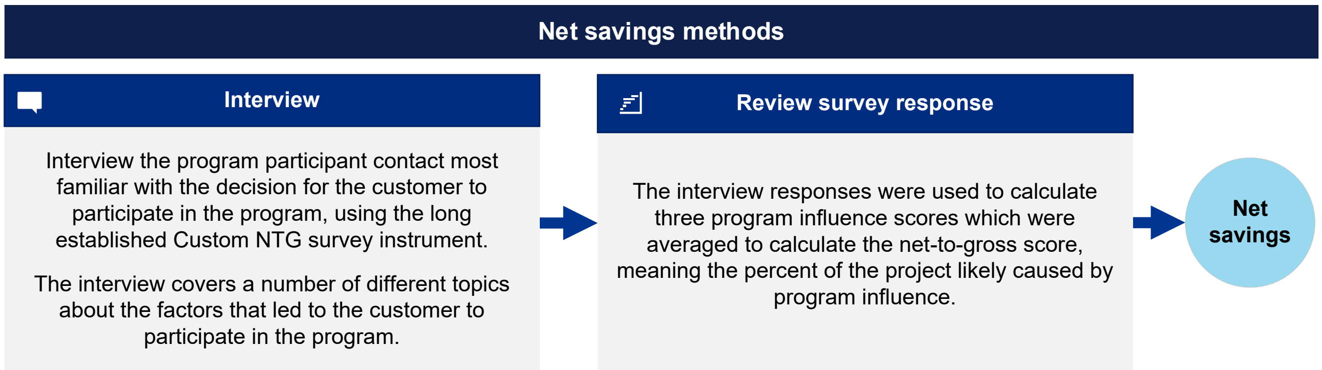


Table 3-3 presents the three program attribution indexes used to calculate the net-to-gross ratio for each site. The methodology matches the approach used over the last few years in the Group D CIAC Custom program evaluations. It attempts to measure program and non-program influence based on interviews with project decision makers. In addition to questions relevant to the methodology in Table 3-3, interviews included questions on project scopes, program processes, program satisfaction, and firmographics.

Table 3-3. NTGR scoring methodology

Score	Description	Calculation
Program attribution index 1 (PAI_1)	• This score reflects the relative program influence compared to both program and non-program factors that may have influenced decision making. • Each program influence (PI) or nonprogram influence (NPI) are rated using a 0-to-10 scale, where 0 meant "Not at all important" and 10 meant "Extremely important."	$PAI_1 = 10 * \frac{PI_{max}}{PI_{max} + NPI_{max}}$
Program attribution index 2 (PAI_2)	• This score captures the perceived importance of the program factors relative to nonprogram factors in the decision to implement the energy-efficient project. • Decision makers divvied up ten "points" between program factors collectively and non-program factors collectively. PAI_2 is the number of points given to program factors collectively. • If a respondent indicated in an earlier question that the decision to implement the project was made before learning of the program incentives, PAI_2 was cut in half.	If project decision made **after** learning about incentives: $PAI_2 = PI_{Collectively}$ If project decision made **before** learning about incentives: $PAI_2 = \frac{PI_{Collectively}}{2}$
Program attribution index 3 (PAI_3)	• PAI_3 provides information regarding program influence on project efficiency levels and timing. • This score captures what the project decision makers said was the likelihood that they would have installed the same efficiency equipment if the program had not been available.	$PAI_3 = 10 - Max(E, T)$
Customer-level net-to-gross ratio (NTGR)	• The NTGR is calculated as the average of the three program attribution index scores.	$NTGR_{cust} = \frac{Average(PAI_1, PAI_2, PAI_3)}{10}$

4 RESULTS

This section presents findings related to gross and net savings by key reporting dimensions. It includes a discussion of the reasons for differences in gross savings claims versus evaluated results. In addition, we include an examination of the reliability, sensitivity, and drivers of the NTGR, which measures the program's influence on decisions to implement efficiency measures.

4.1 Gross electricity savings and realization rates

Table 4-1 presents the gross electricity realization rates and savings results by PA. Claimed savings are the savings claimed by the PAs in the CEDARS tracking database. Documented savings are the savings reported in project final savings reports. As the claimed savings often diverged from the documented savings due to data entry errors, we report savings from both the tracking database and project documentation. Verified savings are the savings resulting from this evaluation. The gross realization rate (GRR) compares the verified savings with the savings claimed in the tracking data (Claimed). The documented realization rate (DRR) compares the savings verified through the evaluation with the savings provided in the project documentation.

Table 4-1. Gross electricity savings

Program administrator	Claimed	Documented	Verified	GRR	RP%*	DRR	RP%*
First-year savings							
PG&E	7,994,128	8,626,651	6,373,719	79.7%	±9.0%	79.6%	±10.0%
SCE	1,398,331	410,386	387,058	27.7%	±0.0%	105.3%	±0.0%
SoCalREN	1,011,894	971,737	794,944	78.6%	±19.0%	81.8%	±18.0%
Statewide	**10,404,353**	**10,008,774**	**7,373,565**	**70.9%**	**±8.0%**	**81.2%**	**±9.0%**
Lifecycle savings							
PG&E	41,979,642	48,743,814	34,406,514	82.0%	±15.0%	84.1%	±13.0%
SCE	16,021,861	4,718,557	4,468,497	27.9%	±0.0%	105.2%	±0.0%
SoCalREN	12,752,149	12,248,112	9,867,613	77.4%	±19.0%	80.6%	±19.0%
Statewide	**70,753,652**	**65,710,483**	**46,414,396**	**65.6%**	**±9.0%**	**85.2%**	**±11.0%**

*Relative precision at the 90% confidence level.

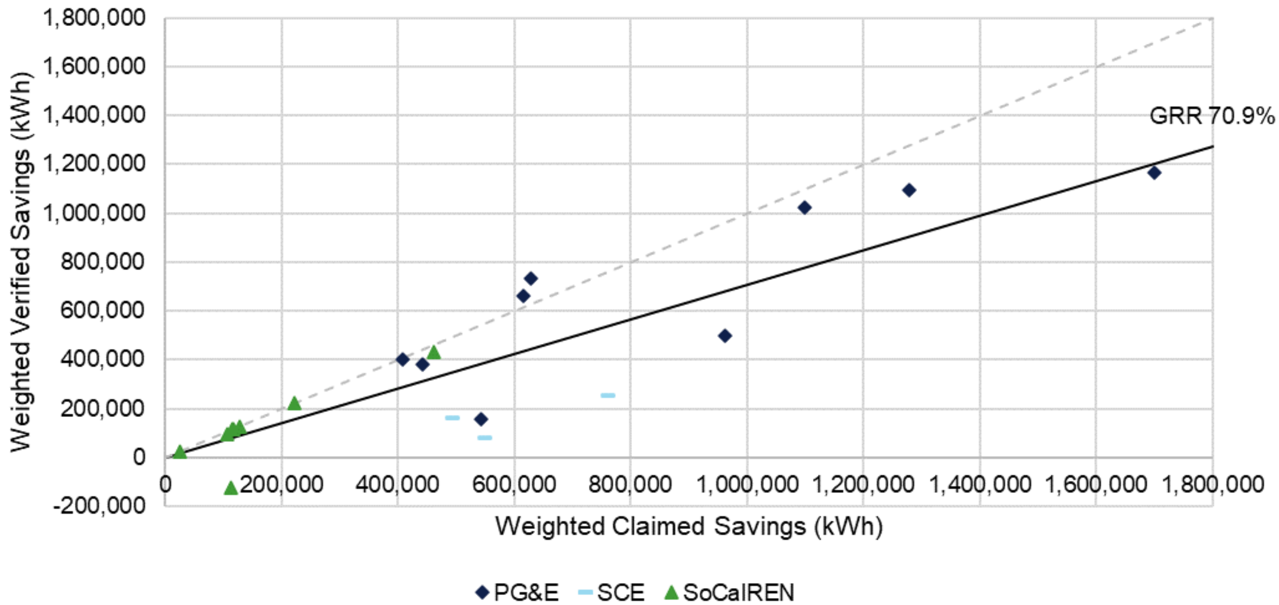
PG&E's GRR and DRR are relatively similar because the final savings claims (sum of initial and true-up claims) mostly matched the documented savings. SCE's GRR and DRR are very different due to an issue with how the projects were claimed; the initial claimed savings were based on the engineering-based forecast savings and the true-up claims were based on the full meter-based savings estimate rather than a positive or negative savings delta to adjust the initial claim. SoCalREN's GRR and DRR are relatively similar. The difference is primarily driven by a project that was trued up twice, resulting in an overclaim.

Overall, both the GRR and the DRR are significantly higher than what is typically seen in the CIAC evaluation. The PY2020-2021 Custom and Savings by Design electric first-year GRR was 59%, while the lifecycle GRR was 48%.[47] If the tracking data issues can be resolved, the future GRRs are expected to be closer to the DRR. It is important to note that these realization rates are for the first large-scale site-level NMEC projects. Additionally, these projects were all disrupted by the COVID-19 pandemic in various ways that made modeling efforts much more challenging.

[47] https://pda.energydataweb.com/api/downloads/2816/CIAC%202020-2021%20Evaluation%20Final%20Report%20-%20Revised.pdf

Figure 4-1 compares the weighted claimed savings and weighted verified savings. The diagonal dashed line indicates where each sample point would be plotted if the project realized 100% of the claimed savings. The points below the dashed line achieved less verified savings than claimed savings while the points above the dashed line achieved greater verified savings than claimed savings. Two out of the 20 projects with electricity savings had realization rates greater than 100%, six projects had realization rates between 95-100%, and five projects had realization rates below 50%.

Figure 4-1. Weighted first year electric energy savings scatterplot

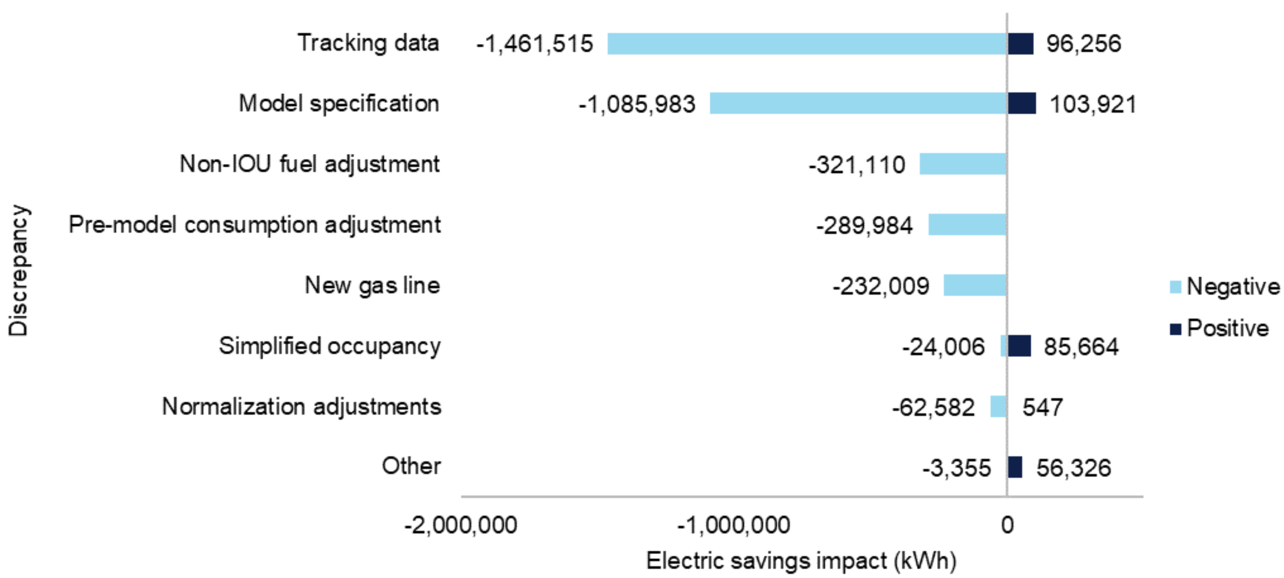


The following sub-sections present an analysis of the discrepancies between claimed and verified first year gross savings for the sampled projects. Table 4-2 summarizes the types of discrepancies identified. Figure 4-2 shows the savings impacts of each type of discrepancy.

Table 4-2. Savings discrepancy factors

Discrepancy factor	Description
Tracking data	Differences attributed to incorrect adjustments or unexplained changes to savings that occurred between completion of the analysis and entry into the PA tracking system.
Model specification	Differences attributed to using a different set of independent variables.
Non-IOU fuel adjustment	Changes due to adding onsite fuel to the modeling approach, including fuel cell and solar electricity generation, and correctly applying the non-IOU fuel savings credit limit.
Simplified occupancy	Changes due to removing the time-of-week and temperature (TOWT)[48] occupied/ unoccupied split when an occupancy variable is already included in the model, or the participant provided information indicating that the split is not necessary or to make baseline and performance models consistent.
Normalization adjustments	Differences due to using performance period values to normalize non-weather model inputs.
New gas line	Differences due to the addition of a new gas line that was not accounted for.
Pre-model consumption adjustment	Differences due to not removing non-building energy, which was based on a poorly documented pre-model engineering calculation, from metered consumption.
Other	Differences that cannot be attributed to other categories due to their unique nature.

Figure 4-2. Summary of first year kWh savings discrepancy factors by sum of savings impact



4.1.1 Tracking data

The largest savings discrepancies are due to differences between the tracking data and the project-specific final savings reports. Some of these issues were identified as part of the Evaluability Study,[49] while others are new issues that occurred

48 TOWT is a standard regression model approach whereby fuel consumption is modeled against temperature included as a spline and a set of time-of-week indicator variables, generally at daily or hourly level. May be split into occupied and unoccupied models and other variables may also be included.

49 DNV. "Site-Level NMEC Evaluability Study, Program Years 2020-2021." calmac.org. 12.07.2023, https://www.calmac.org/publications/Site-Specific_NMEC_Evaluability_Study_Report_-_Final.pdf.

with the incorporation of the PY2022 tracking data. The Evaluability Study found that each PA claimed savings in a different way and most PAs were not claiming savings as expected based on the NMEC reporting guidelines. Additionally, we identified data entry errors and projects that should have been trued-up but had not been yet.

Double claims: The Evaluability Study examined 14 SCE projects that were completed for the same school district. As part of the Evaluability Study, we found that these projects claimed the full forecast savings as the initial claim and the full normalized savings as the true-up claim. We sampled three of these sites as part of the gross savings evaluation. Given that the verified savings were less than the forecasted savings, the resulting realization rate was closer to 30%.

Double true-up: One SoCalREN project with an initial claim in 2020 was trued up in both 2021 and 2022. We confirmed that the second true-up claim was accidental. Two PG&E projects and one SoCalREN project had unexplained tracking data discrepancies. One PG&E project was not trued-up but was included here because the claim for this project did not follow PG&E's typical approach of claiming both the initial and true-up claim in the same program year. One additional project had a very small savings discrepancy, likely due to rounding.

4.1.2 Model specification

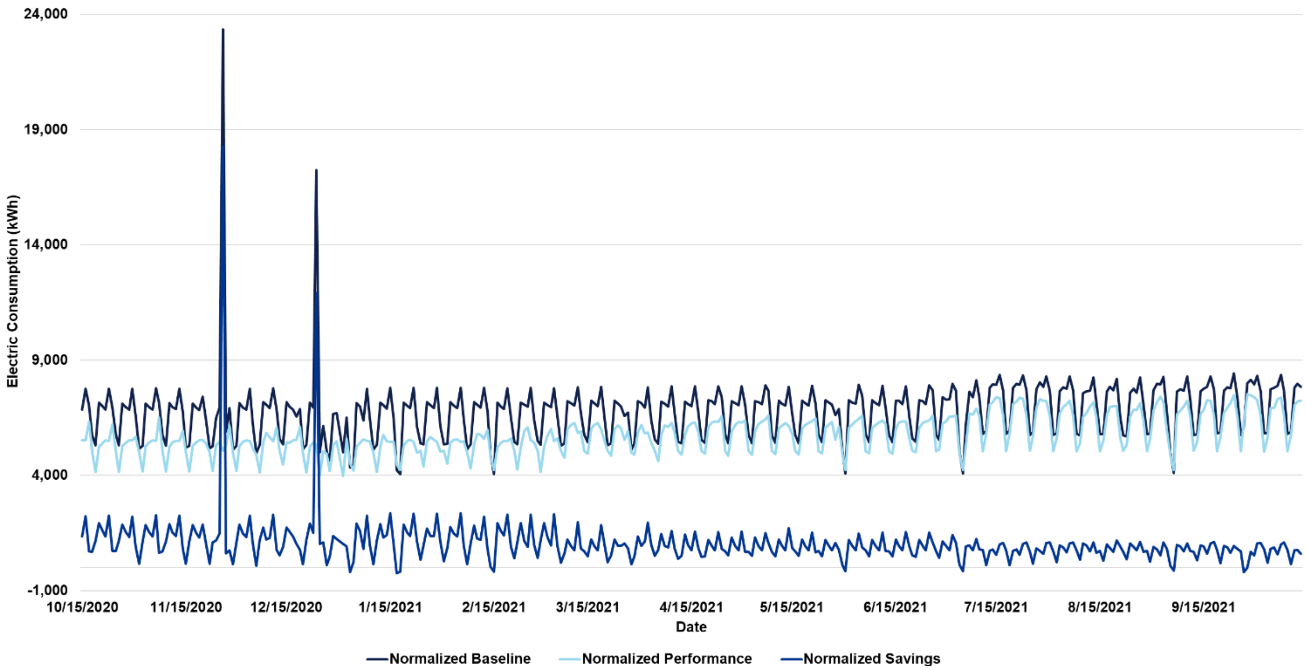
We identified model specification issues pertaining to inconsistent baseline and performance period models (two projects) and using an interaction between temperature and occupancy when defining the TOWT spline[50] (six projects).

Inconsistent model specifications: To effectively normalize energy usage across the baseline and performance periods, the model pairs need to use consistent specifications. One project only included holiday indicator variables in the performance period model. We added holiday indicator variables to the baseline model which resulted in a decrease in project savings. Another project for a refrigerated warehouse included pounds of product received as a variable in the baseline model but did not include it in the performance period. We added the pounds of product received variable to the performance period model, resulting in a decrease in savings.

Temperature and occupancy spline: The six large tech projects reviewed all used an interaction between temperature and occupancy when defining the TOWT spline. This specification is problematic because temperature and occupancy were not also included in the model separately, which would confirm a strong relationship to energy consumption. Further, occupancy and temperature are not reasonably expected to be correlated with one another, nor should they require the kind of flexibility of a temperature spline. Removing the interaction in the spline and replacing it with a temperature-based spline and including occupancy as a separate variable reduced savings for five projects and increased savings for one. One site demonstrates a problem with using this kind of interaction. As shown in Figure 4-3, when baseline and performance periods were normalized with the original model, two days showed dramatic spikes in normalized baseline usage and normalized savings that are far outside the bounds of the rest of the normalized period. This is indicative of an unstable, over-fit model. In the PA's code, when total actual savings, as opposed to normalized savings, were calculated, these spikes were removed, which suggests that the PA recognized such spikes are outliers and should not be included in the total savings. However, these spikes were not removed from the normalized savings. When the interaction was removed during evaluation, these spikes were no longer present.

[50] A spline is a model that is a collection of lines with different slopes that change at defined points (nodes), allowing for more flexible response to the given independent variable than a constant linear relationship.

Figure 4-3. Normalized daily baseline and performance consumption and savings for one site



4.1.3 Non-IOU fuel adjustments

DNV adjusted the modeling approach for two sites to account for onsite generation. A third project also had onsite generation, but it was appropriately accounted for in the models. When modeling energy usage at a site with onsite generation, projects are expected to add the onsite generation data to grid imports to calculate the total energy consumption at the site, rather than using the net-metering data from their IOU alone. For two sites, the onsite generation was not added to the net energy consumption variable. Once this was corrected and savings were estimated using models of total energy consumption, the project savings were reviewed to ensure that savings did not exceed grid imports.

Fuel cell: For one site, a fuel cell was added during the performance period. The fuel cell was originally identified through the CPUC Project Review disposition and still was not accounted for in the model. DNV requested the fuel cell electricity generation data and adjusted the model which resulted in a decrease in savings.

Non-IOU fuel analysis: Another site with onsite solar used two different baseline models: 1) a model for electricity imported from their IOU (net-metered consumption), and 2) a model of the electricity consumed at the site. Then, the normalized savings calculated from the second baseline model and the performance model were compared to the normalized consumption from the first baseline model. The PA capped savings to the first model's normalized electricity imports. Modeling electricity imports when onsite generation is present is not advised, as imports vary based on both consumption and onsite generation and temperature is typically not expected to be consistently correlated with the imports. Consequently, we modified the approach to use a model for electricity consumption and then compared the normalized savings with the actual imports following CPUC guidance.[51] This change resulted in a decrease in savings.

[51] CPUC. "Energy Efficiency Savings Eligibility at Sites with non-IOU Supplied Energy Sources — Guidance Document, Version 1.1." November 6, 2015. https://www.cpuc.ca.gov/~/-/media/cpuc-website/divisions/energy-division/documents/energy-efficiency/custom-projects-review-guidance-documents/savings-at-sites-with-non-iou-fuel-sources---guidance-doc.pdf

4.1.4 Pre-model consumption adjustment

A refrigerated warehouse project attempted to remove the electricity used for lowering the temperature of goods, which is considered an industrial process, from the actual electricity usage prior to estimating the models. This approach had the effect of preventing the normalization of the industrial process as it used actual production values for both the baseline and performance periods. Since the production increased during the performance period and relied on poorly documented and un-replicable engineering calculations, this had the effect of lowering the performance period electricity usage going into the models and effectively doubled project savings. This is not a meter-based savings estimate. To correct this, DNV included the industrial process consumption in the modeled consumption and re-estimated the model. This change had the effect of lowering savings.

4.1.5 New gas line

One project installed a new gas line in order to switch from electric heating to a gas boiler. The PA requested an Early Opinion regarding how to handle fuel switching within NMEC. The Early Opinion was provided, but the PA did not implement the guidance, which stated both fuels needed to be accounted for in the savings calculations and that the fuel substitution test needed to be applied at the project level. As the gas line was installed due to the program participation, we weather-normalized the gas energy usage during the performance period, converted the gas energy usage to electricity terms, and then removed the resulting value from the electricity savings. These modifications resulted in negative savings, indicating that the project increased energy usage overall. CPUC fuel substitution guidance requires that incented projects result in an overall reduction in source energy use,[52] which this project did not achieve.

4.1.6 Simplified occupancy

Many projects included occupancy variables in consumption models in an attempt to adjust for the disruptive occupancy and energy consumption shifts caused by the COVID-19 pandemic. Additionally, the TOWT model, used by most evaluated projects, has the ability to apply a schedule-based occupied and unoccupied split in the model. This allows different weather-related trends during regular business days and off days. The modeling package decides whether a split should be applied across baseline and performance periods or not. In the presence of the occupancy variable, there appeared to be model-overfitting evident by vastly different occupancy parameter estimates in the baseline versus performance periods, offset by very different temperature trends. Simplifying the models to include a single temperature spline facilitated a consistent weather normalization while letting the occupancy variable capture more important occupancy changes over time. This simplified the models and gave them greater consistency across sites. Given the variability of occupancy over time due to COVID-19, including an occupancy variable rather than relying on the TOWT occupied/ unoccupied split is a more effective way to control for the experienced occupancy changes. Both approaches should be considered within the particular context and usage patterns of a site to determine whether either is appropriate. We identified many instances where the occupancy adjustments did not align with how the site was used, and/ or where two occupancy adjustment approaches were used rather than one approach.

Occupancy variables and occupancy split included in the model: Seven projects included both an occupancy variable and used the TOWT occupied/unoccupied split. Five of the seven projects had occupied/unoccupied splits that were inconsistent between baseline and performance models. DNV removed the occupied/unoccupied split, resulting in increased savings for four projects and decreased savings for three projects.

Schools with occupancy splits not aligned with school schedule: Three projects involving lighting installation in schools used the TOWT occupied/unoccupied split, but the split did not reflect the actual operating conditions at the schools. During

[52] CPUC. “Fuel Substitution Technical Guidance for Energy Efficiency, Version 1.1” October 31, 2019. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/building-decarb/fuel-substitution-technical-guide-v11.docx

the interview, the participant reported they operate on a typical school week schedule. The buildings are occupied primarily Monday through Friday and less so on Saturday and Sunday. However, the occupied/unoccupied split assigned different combinations of days to the operating modes and the assignments were not consistent between baseline and performance periods. For example, one school had Wednesday through Saturday assigned as occupied and Sunday through Tuesday assigned as unoccupied in the baseline period. In the performance period, however, Tuesday through Saturday were assigned as occupied, and only Sunday and Monday were assigned as unoccupied. The TOWT models already had day-of-week indicators that were sufficient to model the day-of-week dependent baseload occupancy patterns, suggesting the occupancy mode split was capturing some other variation than different weather trend on the weekends. The simpler models maintain consistency across sites while changing results minimally (the normalized savings changed by no more than 2% for each school).

Office buildings with occupancy splits not aligned with business schedule: Three additional projects involved efficiency improvements at office buildings. Similar to the schools, the participant reported the buildings operate on a typical business week schedule, with Monday through Friday having high occupancy and Saturday and Sunday having reduced occupancy. However, the TOWT model's occupied/unoccupied split did not reflect this operating schedule. Again, when the split was removed during evaluation, annual electric savings changed by no more than 4%.

Parking structures with occupancy splits not aligned with 7-day week operation: Five parking structure projects also had occupied/unoccupied splits that did not align with how the sites were used. The parking structures operate seven days a week, and energy consumption is not correlated with occupancy, so any occupancy-based split in the data does not reflect actual operating conditions. We removed the occupied/unoccupied split for these projects, resulting in a decrease in savings for three projects and an increase in savings for two projects.

4.1.7 Normalization adjustments

DNV adjusted the way non-weather variables were normalized for two projects. We applied the IPMVP Option C guidance which says that the performance period conditions should be used for normalization.[53] Both projects were refrigerated warehouses that used mass of product received as an independent variable. One project used the average pounds of product received across the baseline and performance period. Instead, we used the performance period pounds received to normalize energy usage. This resulted in a decrease in savings. The other project used a three-year day-of-week average shipping rate to normalized energy usage. Instead, DNV used the performance period shipping amounts. This resulted in a small increase in savings.

4.2 Gross demand savings and realization rates

While all projects claimed electric savings, only half also claimed demand savings. As discussed in the Evaluability Study, demand savings require hourly models, which often pose challenges in meeting goodness-of-fit requirements. Since electric savings are nearly always modeled with daily savings, two separate models are needed to claim both electric and demand savings. This is likely the main reason only half of the projects claimed demand savings. In the future, electric savings may be based on a single electric claim using aggregated hourly savings valued at hourly total system benefit (TSB), which may provide an opportunity to consolidate electric and demand savings estimates into a single model.

Table 4-3 presents the gross demand realization rates and savings results by PA. Similar to the electric savings, we report GRRs and DRRs, as the claimed savings diverged from the documented savings due to data entry errors for several projects. The PY2020-2021 GRR was 90.3%, while the DRR was 84.0%.

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[53] International Performance Measurement and Verification Protocol: Concepts and Options for Determining Energy and Water Savings; Volume I: Revised March 2002 (nrel.gov) https://www.nrel.gov/docs/fy02osti/31505.pdf Pg 30-31

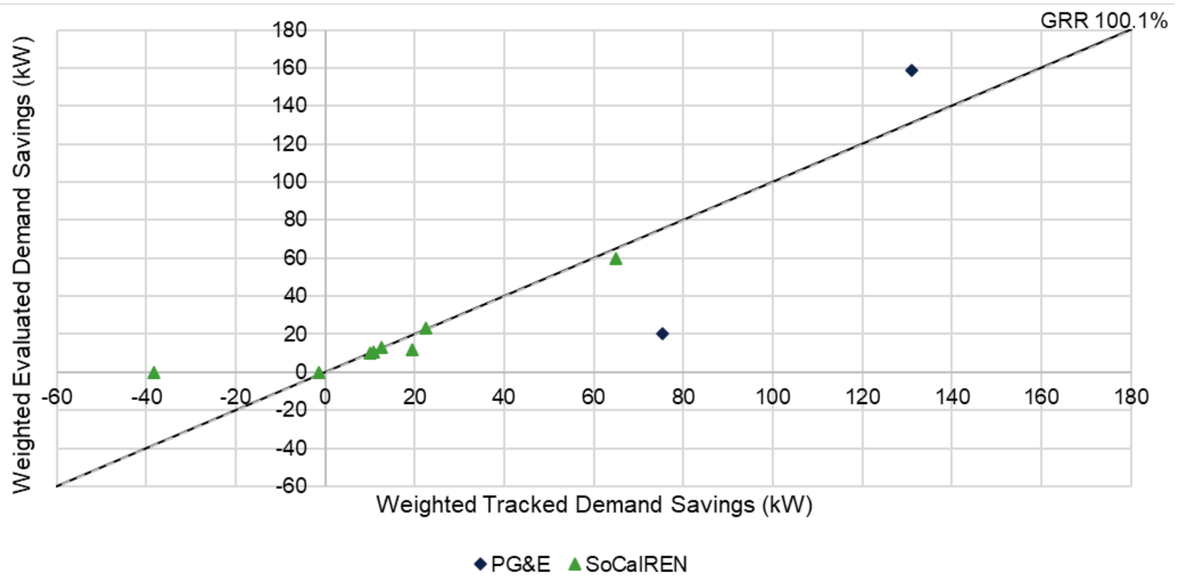
Table 4-3. Gross demand (kW) savings

Program administrator	Claimed	Documented	Verified	GRR	RP%*	DRR	RP%*
PG&E	64.3	390.1	55.8	86.8%	±63.0%	73.8%	±56.0%
SoCalREN	79.2	68.8	100.9	127.4%	±35.0%	146.6%	±33.0%
Statewide	**143.5**	**458.9**	**143.6**	**100.1%**	**±41.0%**	**93.0%**	**±41.0%**

*Relative precision at the 90% confidence level.

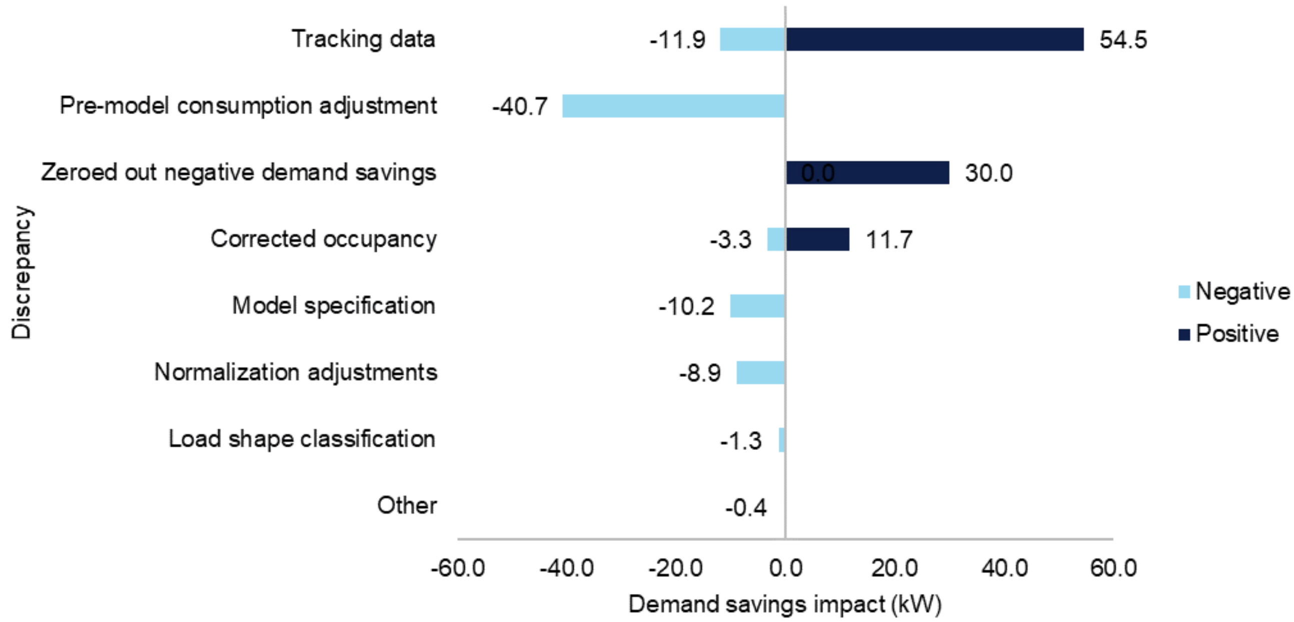
Figure 4-4 compares the weighted claimed savings to weighted verified savings. The diagonal dashed line indicates where each sample point would be plotted if the project realized 100% of the claimed savings. The points below the dashed line achieved less verified savings than claimed savings while the points above the dashed line achieved greater verified savings than claimed savings. Four out of the 10 projects with demand savings had realization rate greater than 100%, two projects had realization rates between 95-100%, and three projects had a realization rate below 50%.

Figure 4-4. Weighted demand savings scatterplot



All identified demand discrepancies fell into the same categories as for the electric energy savings (see Table 4-2). Figure 4-5 shows the savings impacts of each type of demand discrepancy.

Figure 4-5. Summary of first year kW savings discrepancy factors by project count and savings



For eight projects, discrepancies changed demand savings in the same direction as the associated project's electric savings, although some were to a greater relative degree. These included two projects with discrepancies between tracked and reported savings, five projects that had the occupied/unoccupied data split removed, and one project with an adjustment for COVID impacts that was modified. The higher relative change in demand savings was unsurprising, as demand savings are much smaller in magnitude than annual electric savings, and small absolute changes can translate into large relative changes. Additionally, demand savings are based on only 15 extreme condition hours out of 8,760 total hours on which the model is based, and thus are more susceptible to the random variation inherent in the model.

Only one project included a discrepancy that impacted kW savings and not kWh savings. This site was a refrigerated warehouse that did not use a model to estimate demand savings. Instead, the PA used a tool known as the SEM-NMEC Demand Savings Calculator. Inputs to calculate demand savings include the annual electric savings estimate, a parameter based on the PA, and a parameter based on the load shape building classification. While the tool is currently under review and results at site level may not be accurate, no other tool was available for this purpose and DNV engineers determined it was appropriate to use to calculate demand savings in this context. Engineers also determined that the load shape building classification was incorrectly set to "Industrial Process" and should have been "Commercial Refrigeration." Applying this change decreased demand savings slightly.

Two sites, a parking garage and an office building, claimed negative demand savings. It became apparent during evaluation that these negative savings were a result of background fluctuations in the hourly model rather than an engineering-based effect of the installed measures. Therefore, we zeroed out the demand savings. In general, *PAs should not claim negative demand savings unless it is a feasible outcome of the project supported by engineering principles rather than model errors that are not different from zero*.

4.3 Gross natural gas savings and realization rates

As discussed in the Evaluability Study,[54] several projects initially forecasted gas savings and fit gas models at the initial claims stage but abandoned the gas model after the performance period and final savings were calculated. In most cases, the gas models did not meet minimum goodness-of-fit requirements. In some cases, no reason was provided for why the gas model was abandoned. The evaluation sample included only three projects that claimed gas savings.

Table 4-4 presents the gas GRRs and savings results by PA. Similar to the electric savings, we report GRRs and DRRs, as the claimed savings diverged from the documented savings due to data entry errors for all projects. The PY2020-2021 first-year GRR was 34.6%, while the lifecycle GRR was 28.6%. If the tracking data issues can be resolved, the future GRRs are expected to look more similar to the DRR, which was 103.2% for first-year and lifecycle savings.

Table 4-4. Gross natural gas savings

Program administrator	Claimed	Documented	Verified	GRR	RP%*	DRR	RP%*
First-year savings							
PG&E	104,280	26,645	37,301	35.8%	±0.0%	103.2%	±0.0%
SCG	4,951	0	0	0.0%	±0.0%	NA	NA
Statewide	**109,232**	**26,645**	**37,761**	**34.6%**	**±0.0%**	**103.2%**	**±0.0%**
Lifecycle savings							
PG&E	1,590,733	436,896	454,472	28.6%	±0.0%	103.2%	±0.0%
SCG	50,261	0	0	0.0%	±0.0%	NA	NA
Statewide	**1,640,994**	**436,896**	**468,832**	**28.6%**	**±0.0%**	**103.2%**	**±0.0%**

*Relative precision at the 90% confidence level.

Two gas claims were for canceled projects, and their savings were zeroed out. The third project had two discrepancies due to documentation errors. One was an incorrect data entry in the tracking system, resulting in a large decrease in savings. The second discrepancy was comparatively small, due to a discrepancy between the replicated results estimated by running the PA's code and the project documentation. We made no changes to the PA's fiv-parameter change point model.

4.4 Net savings results and ratios

This section presents the net electric, demand, and gas savings verification results and net-to-gross ratios (NTGR) broken out by program administrator and year. The NTGR are in line with those of Custom which had a NTG of 42.7% in the 2020-2021 CIAC Impact Evaluation.[55] Additionally, the gas and electric NTGR are similar. Note for SCE and SoCalREN, sample sizes are small due to small levels of participation. While PG&E has a larger sample size, the relative precision implies a moderate level of uncertainty.

[54] DNV. "Site-Level NMEC Evaluability Study, Program Years 2020-2021." calmac.org. 12.07.2023, https://www.calmac.org/publications/Site-Specific_NMEC_Evaluability_Study_Report_-_Final.pdf.

[55] CPUC Group D CIAC 2020 -2021 Impact Evaluation. https://pda.energydataweb.com/api/downloads/2816/CIAC%202020-2021%20Evaluation%20Final%20Report%20-%20Revised.pdf Accessed February 2, 2024.

Table 4-5. Net savings results by PA

Program administrator	First-year net savings				Lifecycle net savings			
	Verified	Net	NTGR	RP%*	Verified	Net	NTGR	RP%*
				Energy (kWh)				
PG&E	12,427,824	6,179,114	49.7%	±16.0%	77,500,848	35,720,141	46.1%	±15.0%
SCE	1,821,339	686,645	37.7%	±42.0%	21,098,727	7,882,484	37.4%	±43.0%
SoCalREN	2,269,722	740,610	32.6%	±25.0%	24,846,998	7,695,115	31.0%	±26.0%
Statewide	**16,518,885**	**7,606,369**	**45.9%**	**±11.0%**	**123,446,573**	**51,297,740**	**41.1%**	**±12.0%**
				Demand (kW)				
PG&E	596	277	46.4%	±22.0%	NA			
SoCalREN	713	269	37.7%	±13.0%				
Statewide	**1,310**	**547**	**41.7%**	**±12.0%**				
				Natural gas (therms)				
Statewide	**10,187,469**	**4,732,079**	**46.5%**	**±86.0%**	**133**	**58**	**43.4%**	**±44.0%**

4.4.1 Program attribution index results

NTGRs are calculated using the approach that has been used in CIAC evaluations for the past nine years. The approach includes project scope, timing, and program and non-program influences to calculate the NTGR. We used this methodology because it is a well-established approach that has been used for nearly a decade for evaluating commercial programs. However, given that NMEC program influence is expected to come primarily through project timing and project scope, a methodology that is more aligned with these factors may be more appropriate in future evaluations. Aligning the methodology with this intent and the objective of unlocking stranded savings would offer a better representation of the programs' net impact.

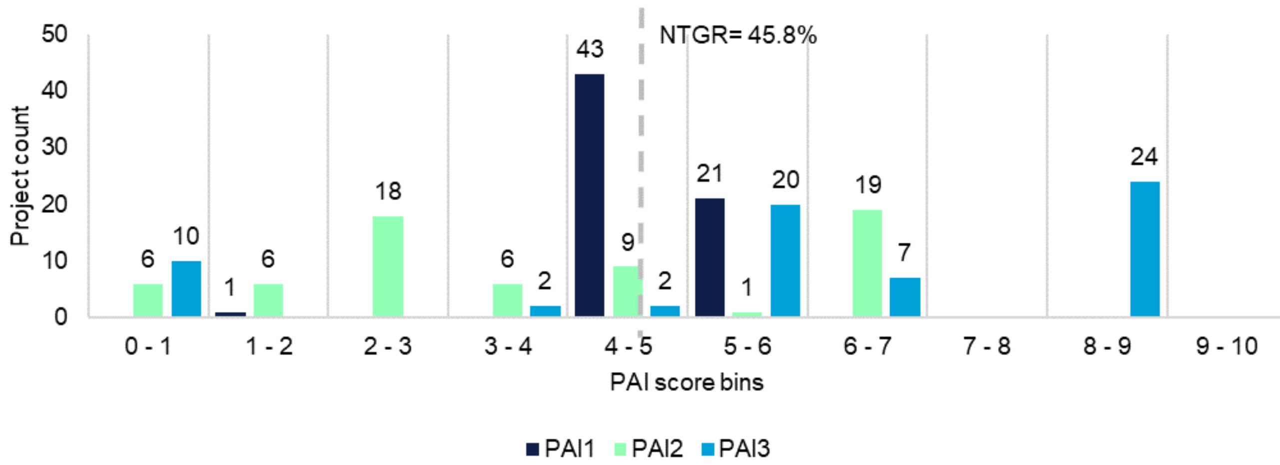
Table 4-6 describes the three program attribution indicators (PAI_1, PAI_2, and PAI_3) and shows the average score for each indicator.

Figure 4-6 shows the distribution of the three scores. PAI_3 is based on respondents' estimates of how the scope of projects and timing of projects would have been different if the program had not existed. The PAI_3 result is the highest result, well above five and more than 50% higher than the lowest indicator, PAI_2. The NTGR is calculated by averaging the three PAIs, resulting in a NTG score primarily based on influence ratings rather than the more direct timing and scope change measurements. The rest of this section shows the underlying data that went into the calculation of each PAI.

Table 4-6. Program attribution index (PAI) results

Program attribution index	Basis	Average
PAI_1	Respondents' ratings on the importance of individual program and non-program influences in their decision to implement a project	4.92
PAI_2	Respondents' rating on the importance of program influences collectively relative to the importance of non-program influences collectively on their decision to implement a project	4.04
PAI_3	Respondents' ratings for the likelihood they would have implemented a similar project scope on a similar timeline in the absence of the program.	6.29

Figure 4-6. Program attribution score distribution

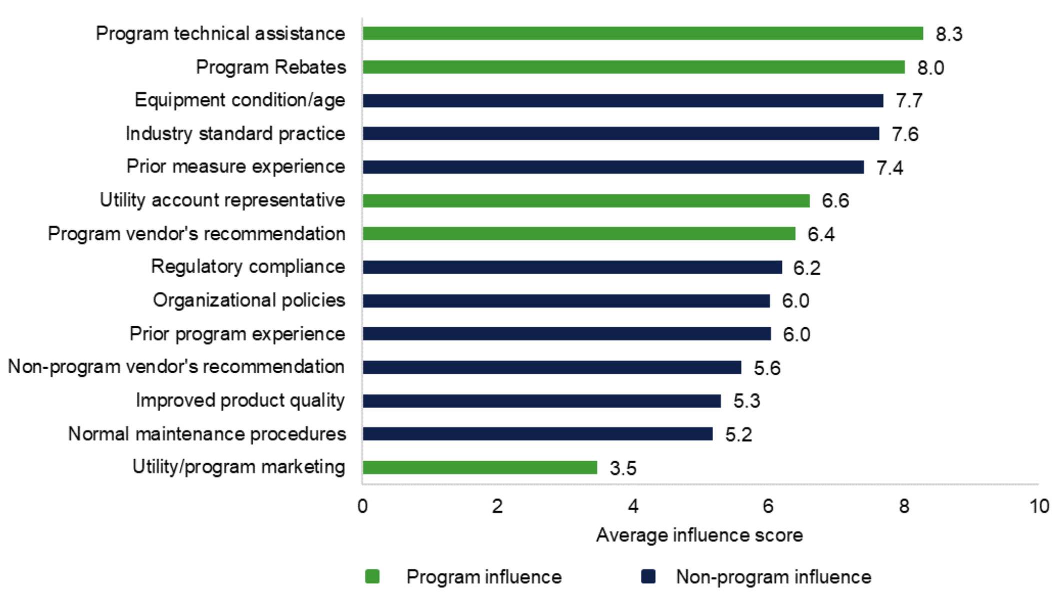


4.4.1.1 Program attribution index score 1 (PAI_1) individual influence ratings

As shown in Table 3-3, PAI_1 is calculated based on respondents' ratings of the importance of program and non-program influences. DNV asked respondents to provide a rating of how important various potential influences were on their decision to implement their project at the time that they did. Respondents provided a rating on 0-to-10 rating scale, where 0 means "Not at all important" and 10 means "Extremely important."

Figure 4-7 shows the average rating for each potential influence provided by respondents weighted by the number of sites associated with each respondent. Across all influences, both program and non-program, the program's technical assistance and rebates were the only influences to receive an average rating of 8 or above, signifying a high level of importance. The next three most important influences were all non-program: existing equipment's condition or age, industry standard practice, and prior experience with measures included in the project.

Figure 4-7. Influence ratings for program and non-program decision making factors*



*If respondents said an influence was "not applicable" their response rate treated as a rating of "0."

Figure 4-8 shows the PAI_1 rating for each site. Values are identical across sites for a single participant if the participant indicated that the decision-making process was the same for each site their organization put through the program. Most PAI_1 values are around 5. One respondent, who later expressed dissatisfaction with the program for not having received their incentives yet, had a PAI_1 less than 2. The way in which PAI_1 is calculated tends to result in scores near 5, as shown in Figure 4-9.

Figure 4-8. PAI_1 score distribution

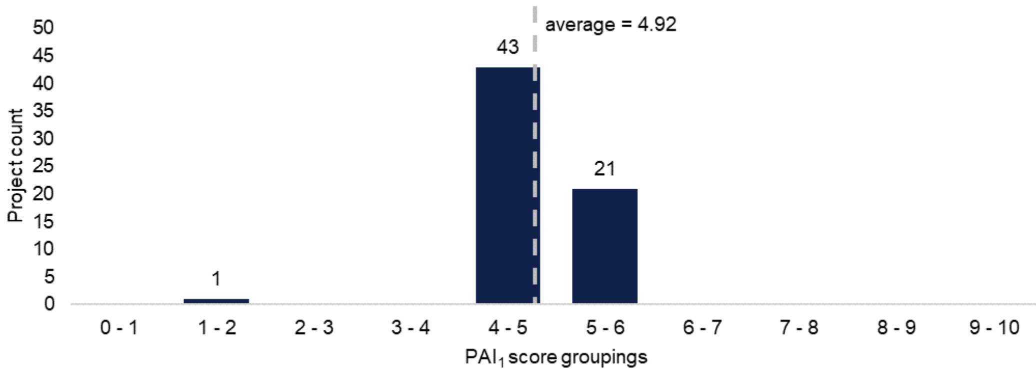


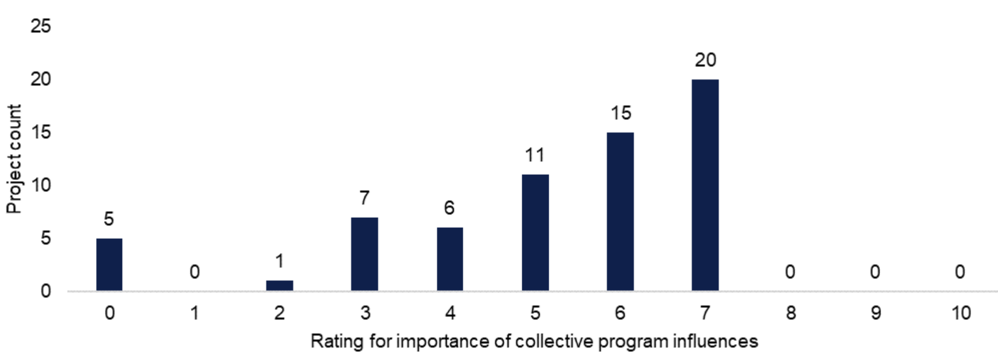
Figure 4-9. PAI_1 calculation examples

Example 1	Example 2	Example 3
PI_{max} = 10	PI_{max} = 10	PI_{max} = 4
NPI_{max} = 10	NPI_{max} = 5	NPI_{max} = 1
$PI_1 = 10 \times \frac{10}{10+10}$	$PI_1 = 10 \times \frac{10}{10+5}$	$PI_1 = 10 \times \frac{4}{4+1}$
PI_1 = 5	**PI_1 = 6.7**	**PI_1 = 8**

4.4.1.2 Program attribution index score 2 (PAI_2) program versus non-program collective influence ratings

PAI_2 uses information from the question asking respondents to divide up ten “points” between the program and non-program influences the respondent had identified (see Figure 4-7). PAI_2 is the sum of all the program influence “points” given by the respondent. If a respondent indicated in an earlier question that the decision to implement the project was made before learning of the program incentives, PAI_2 was cut in half. Figure 4-10 shows the distribution of respondents’ ratings of the relative importance of program influences.

Figure 4-10. Program influence distribution



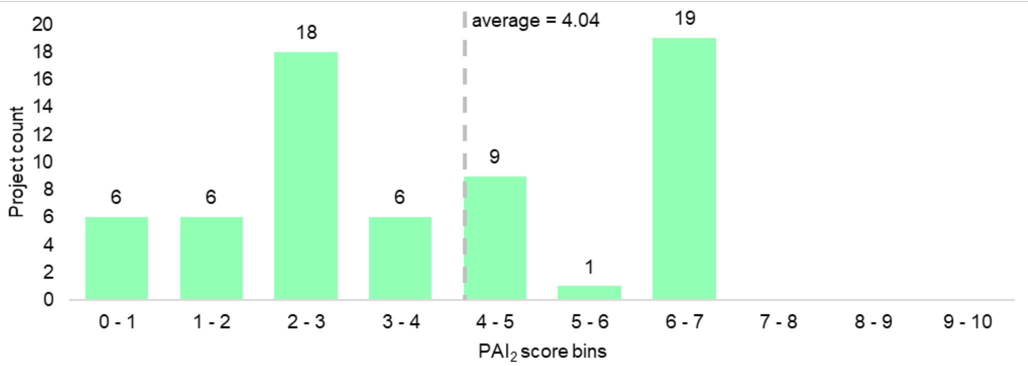
While respondents indicated that program influences were generally more important than non-program influences (scores above 5), 40% of the PAI_2 scores were cut in half based on decision making timing responses. As shown in Table 4-7, 40% of respondents said they made the decision to implement their project before beginning discussions with the implementor. While not stated specifically, it is possible that some respondents decided to implement their projects assuming they would have some type of program support before starting discussions with program implementors.

Table 4-7. Decision making timing compared with incentive and technical assistance timing

Was the decision to do this project made before or after you began discussions with [implementer] regarding the availability of incentives or technical assistance for this measure?	% of respondents	% of sites
Before	40%	37%
After	40%	54%
Don't Know	20%	9%

Figure 4-11 shows the PAI_2 rating by project. The PAI_2 ratings are lower than PAI_1 because PAI_2 includes a downwards adjustment for participants who indicated their decision to implement a project was made before beginning conversations with the program about incentives or technical support. Again, values are identical across sites for a single respondent if the respondent indicated that the decision-making process was the same for each site their organization put through the program.

Figure 4-11. PAI_2 score distribution

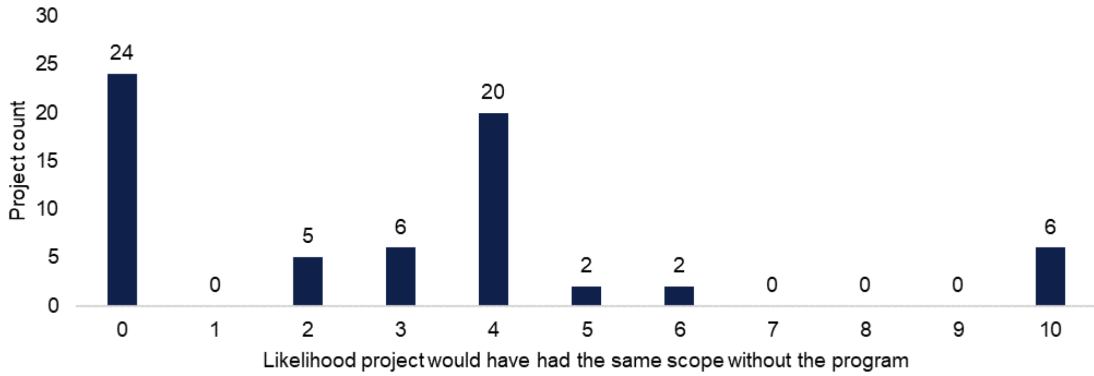


4.4.1.3 Program attribution index score 3 (PAI_3) program influence on project scope and timing

PAI_3 is calculated based on respondent's estimates for the program's influence on project scope and timing (see Table 3-3).

Figure 4-12 shows respondents' ratings by site for the likelihood their projects would have included the same scope in the absence of the program. Respondents were asked to provide a likelihood rating on a scale of 0 to 10 where 0 is "not at all likely" and 10 is "extremely likely." Fifty-four percent of projects provided a rating of 3 or below, indicating that the project scope would have been different without the program. Respondents were not specifically asked to elaborate on how the scope would have differed, but those who did provide an explanation indicated their project scope would have been smaller with less extensive energy efficiency improvements.

Figure 4-12. Likelihood project would have had the same scope without the program



Note: "0" = "Not at all likely" and "10" = "Extremely likely"

Respondents indicated that without the program it would have been "very unlikely" that they would have implemented their projects at the time as they did (Table 4-8). When asked about the likelihood that without the program they would have conducted their projects at the same time as they did, 47% of respondents representing 75% of sites said it was, "very unlikely." Only 20% of respondents, representing 15% of sites said it was "very likely" they would have implemented their project at the same time.

Table 4-8. Likelihood of implementing project at the same time without the program

If the program had not been available, what is the likelihood that you would have conducted the project at the same time as you did?	Percent of respondents	Percent of sites
Very likely	20%	15%
Somewhat likely	0%	0%
Neither likely or unlikely	13%	5%
Somewhat unlikely	20%	5%
Very unlikely	47%	75%

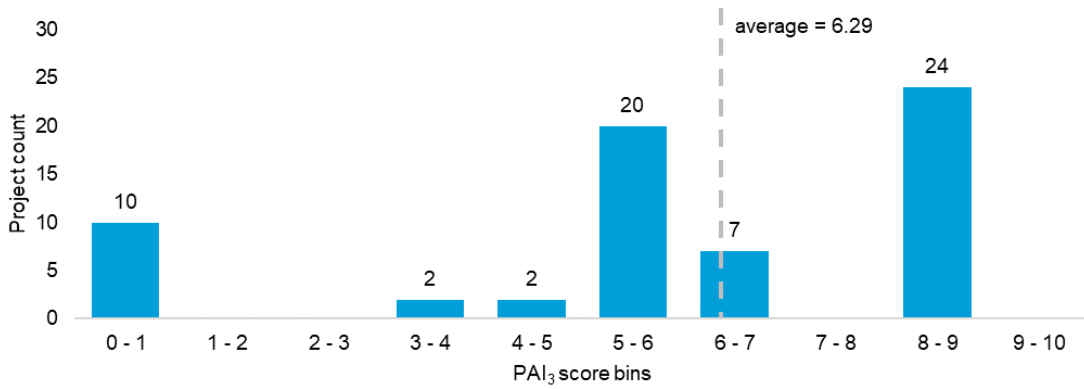
When asked a similar question that did not impact the NTG score about how much later they would have implemented their projects without the program, 33% of respondents, representing 23% of sites said they would never implemented the project (Table 4-9). Another 40% of respondents, representing 64% of sites, said they would have implemented their projects two or three years later than they did. Only 20% of respondents, representing 11% of sites, said they would have done that project at the same time or earlier.

Table 4-9. Whole project timing

Without the assistance received from the [program] (including any incentive funds, program information, energy audits, technical assistance, and any other support) would your organization have completed the whole project…	Percent of respondents	Percent of sites
About the same time or earlier than you did	20%	11%
At least a year later than you did	0%	0%
At least two years later than you did	13%	32%
At least 3 years later than you did	27%	32%
Or never	33%	23%
Or would the timing have varied by measure?	7%	2%

Figure 4-13 shows the PAI_3 score distribution. The PAI_3 values are more varied and the average score is greater than the values from PAI_1 and PAI_2.

Figure 4-13. PAI_3 score distribution



4.5 Participant satisfaction and program feedback

In addition to net-to-gross questions, the survey asked questions about program satisfaction, program strengths, and suggested areas for improvement.

Respondents indicated a high level of satisfaction with the program, driven by the programs' technical support and incentives. When asked, "on a scale of 0 - 10, where 0 is 'completely dissatisfied' and 10 is 'completely satisfied', how would you rate your overall satisfaction with the [program]," respondents gave an average rating above 8 (Table 4-10). Eighty percent of respondents, representing 94% of sites, were "promoters" providing a rating of 8 or above. Respondents indicated in an open-ended question about the strengths of the program, that their satisfaction was driven by the technical support and incentives provided by the program. This mirrors Table 4-11, which shows that respondents cited the program's technical support and incentives as the most important influences in their decision making processes. Three respondents elaborated on the value of technical support provided by the program:

- "The [program] representative helped review the technical aspects of the project so they were like our internal engineering staff."
- "The strength is the manpower they provide. The data they show you is super helpful. They show you the products…and the [potential] savings."
- "[The main strength is] the engineering and technical support that typical companies don't have in house."

Only one respondent was a detractor, providing a rating of 3 or less. These respondents indicated their dissatisfaction was driven by the administrative burden required for participation, inconsistent messaging about what qualifies for participation, and long delays throughout the project. At the time of the interview, they had not yet received their incentives saying, "we're waiting years to get the incentive." This participant started their project prior to 2022.

Table 4-10. Program satisfaction

Metric	By participants	By sites
Average satisfaction	8.1	8.5
% promoters (≥8)	80%	94%
% detractors (≤3)	7%	2%

Table 4-11. Program strengths

Strength	Percent of respondents	Percent of sites
Technical support	40%	68%
Incentives	33%	48%
Helps achieve energy efficiency	27%	42%
Data visualization of building systems and performance	20%	32%
Utility bill savings	20%	20%
Professional customer service	7%	8%
Connection to partners	7%	3%
Flexibility	7%	3%
GHG reductions	7%	2%
Nothing	7%	2%

While almost half of all respondents had no suggestions for improvements to the program, those that did have suggestions most frequently indicated wanting a more streamlined process. Twenty percent of respondents, representing 34% of sites suggested shortening the delays for approval (Table 4-12). One said, "when projects go in for submission there are long delays between when we submit to when its approved and therefore, we can't implement it…Savings are sitting on the table while we're waiting." Twenty percent of participants, representing 8% of sites, also suggested reducing the admin burden. One said, "[Reduce] admin burden, paperwork, or duplication of effort. [We have] too many people doing the same thing, sending the same data to multiple people and repeated requests for information from the program."

Table 4-12. Suggestions for program improvements

Improvement	Percent of participants	Percent of sites
Shorten delays for approval	20%	34%
Make incentives tied to particular measures	7%	22%
Reduce admin burden	20%	8%
Provide information on cost of technical assistance, though it was free	7%	8%
Reduce disconnect between utility staff and NMEC on what qualifies	13%	5%
Increase incentives	13%	3%
No suggestions	47%	31%

4.6 Measure application type (MAT)

Measure application types (MATs)[56] are an energy efficiency categorization related to the project type and context and are used to determine the appropriate approach for calculating effective useful life (EUL) and baseline for custom project measures. MAT designations are required for all custom projects as well as for site-level NMEC projects. For site-level NMEC projects, MATs are primarily used to determine the appropriate measure life.[57] Individual measures within site-level NMEC projects are assigned MATs that determine the appropriate measure-level EUL. Measure-level EULs are then averaged, on a weighted basis using measure-level engineering savings forecasts, to calculate the expected project EUL. The following custom project MATs are allowable in site-level NMEC projects:

[56] See Measure Application Types in Statewide Custom Project Guidance Document v1.4 at page 5, https://file.ac/OEr-2p-bk3A/

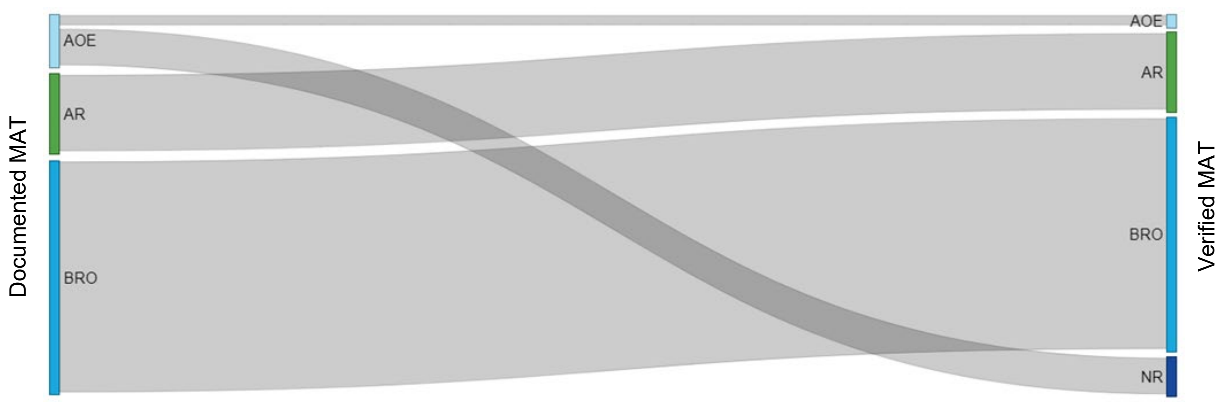
[57] Savings for all site-level NMEC projects are estimated using an existing condition baseline due to the performance-based approach, unlike custom projects, which use different baselines depending on the MAT.

- **Accelerated Replacement (AR):** Accelerated replacement means "the replacement of existing equipment that could and would remain operational without program intervention."[58] Replacement of "'operating equipment that when broken, non-functional, or unable to provide the intended service is typically repaired' can be classified as AR."[59] AR measures are assigned a measure-specific EUL.
- **Add-On Equipment (AOE):** Add-on equipment measures install "new equipment onto existing host equipment, improving the nominal efficiency of the host system."[60] AOE measures are assigned an EUL equal to the host equipment remaining useful life or the EUL of the measure.
- **Behavioral, Retro-commissioning, and Operational (BRO):** This group includes information or education programs that influence energy-related practices (behavioral), activities and installations that restore equipment performance (retro-commissioning), as well as measures that improve the efficient operation of installed equipment (operational). BRO measures are assigned a three-year EUL.
- **Building Weatherization (BW):** Building Weatherization involves in "non-mechanical building efficiency improvements such as windows, insulation, air sealing, and duct sealing."[61] BW measures are assigned a measure-specific EUL.
- **Normal Replacement (NR):** This group involves replacing existing equipment that has failed or no longer meets needs, or is planned to be replaced for reasons unrelated to the program. NR measures are assigned a measure-specific EUL.

4.6.1 Measure application type assessment

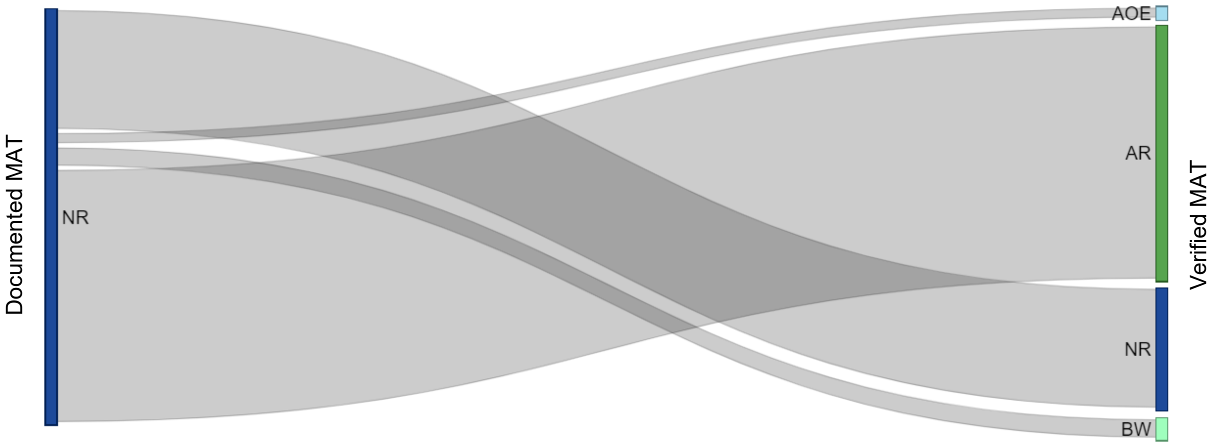
Only PG&E provided any evidence of effort in classifying measures appropriately into measure application types (MATs). SoCalREN (SCR) and SCE classified all measures as NR in their project applications, while PG&E classified measures as BRO, AR, and AOE. Figure 4-14 (PG&E) and Figure 4-15 (SCE & SCR) show the measure-level documented MAT on the left and the verified MAT on the right, weighted by savings. Relatively few of PG&E's measures were reclassified to a different MAT, while most of SCE and SCR's measures were reclassified to a MAT other than NR.

Figure 4-14. PG&E measure application type classification, weighted by forecasted savings



58 See Measure Application Types in Statewide Custom Project Guidance Document v1.4 at page 6, https://file.ac/OEr-2p-bk3A/
59 See Measure Application Types in Statewide Custom Project Guidance Document v1.4 at page 6, https://file.ac/OEr-2p-bk3A/
60 See Measure Application Types in Statewide Custom Project Guidance Document v1.4 at page 6, https://file.ac/OEr-2p-bk3A/
61 See Measure Application Types in Statewide Custom Project Guidance Document v1.4 at page 7, https://file.ac/OEr-2p-bk3A/

Figure 4-15. SCE and SCR measure application type classification, weighted by forecasted savings



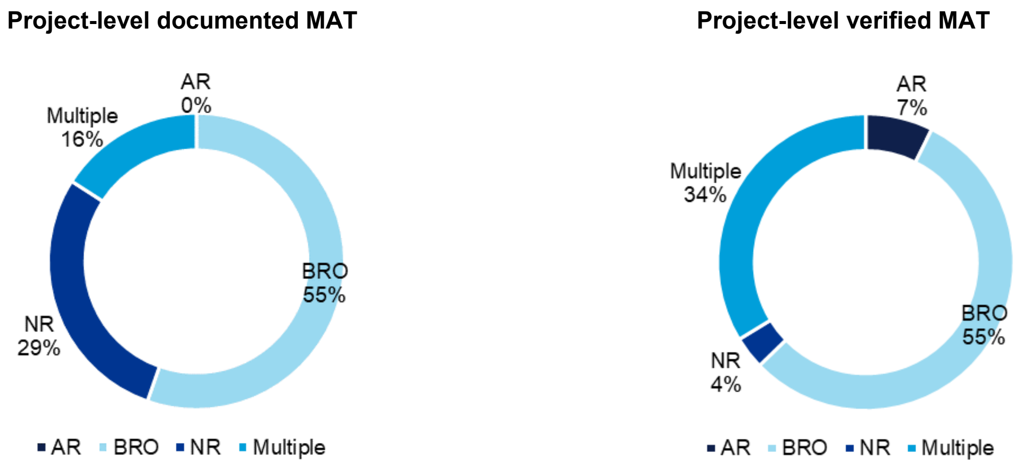
Of the 11 measures classified as NR in the project documentation, we confirmed for seven measures that the equipment replaced had still been functional. These projects generally did not provide evidence or reasoning substantiating the measures classification as NR.

Measures that are older than their assigned EUL are not automatically assigned to NR if the participant had intended to continue repairing or otherwise delay replacement. DNV reclassified seven of the measures from NR to AR based on the information gathered during customer interviews. The remaining four measures remain classified as NR. For these measures the participant confirmed that the existing lighting fixtures were no longer viable and needed to be replaced due to frequent repair or maintenance.

In one case (a PG&E project) a measure was reclassified from AOE to NR. The measure involved replacing doors in several refrigerated rooms. The customer indicated that the pre-existing doors had failed and needed to be replaced regardless of the program. They replaced the existing doors with standard doors, which is the same type of equipment that they would have likely used in the absence of the program.

Figure 4-16 shows the percent of electric verified savings by project-level MAT, which could include multiple measure-level MATs. The share of projects that were fully NR shrunk from 29% to 4% of verified savings while the share of projects with multiple MATs increased from 16% to 34%. Overall, BRO-only projects made up the largest share of project savings at 55%. Recommendations regarding MATs can be found in Section 5.2.

Figure 4-16. Percent of verified savings by project-level MAT



4.6.2 Normal replacement baseline

In the custom project context, MATs are used to select the appropriate baseline in addition to EULs. For NMEC projects, the approach forces the use of an existing conditions baseline for all projects regardless of MAT. The current NMEC rulebook says that "The Project M&V Plan must account for any normal replacement measures within the scope of the project."[62] The draft NMEC rulebook revisions, currently undergoing stakeholder review, calls for the adjustment of NR measure savings to remove below code savings.[63]. Since the NR MAT suggests that the existing equipment required replacement regardless of program intervention, this adjustment would remove the to-code savings that would have occurred in the absence of the program.

We reviewed how the proposed Rulebook change requiring an adjustment for below code savings associated with NR measures would have impacted the five projects with verified NR measures. For four of the projects, the pre-existing conditions exceeded minimum code requirements at the time and therefore would not have been adjusted under the draft rulebook. Savings for the remaining project would have been reduced by approximately a third because the standard practice by the time of retrofit exceeds the pre-existing condition, which would have been replaced even without the program.

4.7 Effective useful life (EUL)

The project effective useful life (EUL) is used to calculate the project lifecycle savings. The final savings for NMEC projects use a meter-based whole-building approach. There is nothing in the metering results that can inform the estimation of project EUL. In order to estimate a project-level EUL, EULs are assigned to the measures installed within the project according to MAT and are weighted by the forecast savings. Effective Useful Life is not verified or measured by NMEC M&V methods. Thus, it must be estimated using other information about the installed projects.

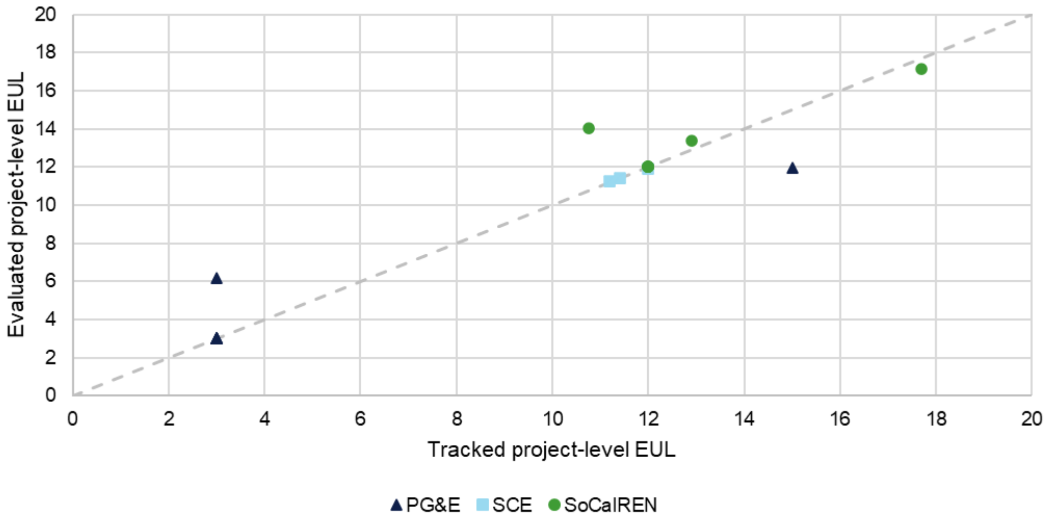
The comparison of tracked and evaluated project level EULs can be found in Figure 4-17. As the figure suggests, the tracked and evaluated project EULs align well for most projects, falling on or close to the grey dashed line. While the evaluation resulted in relatively few EUL modifications, it is important to note that project documentation generally did not

[62] CPUC. "Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption version 2.0." January 7, 2020. https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/n/6442463694-nmec-rulebook2-0.pdf page 14.

[63] See Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption version 2.1, page 7: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M520/K881/520881077.PDF

include sufficient information to justify the calculation of project level EUL. In many cases, EULs were hardcoded without any references indicating where the values came from or why they were appropriate. Including DEER IDs, for instance, could improve clarity.

Figure 4-17. Project-level effective useful life (EUL) scatterplot



Five projects had EUL discrepancies:

- A refrigerated warehouse project's EUL increased from 3 years to 6.2 years. This adjustment was made due to a MAT revision for one measure from AOE to NR, increasing the measure-level EUL from 3 years to 12 years.
- A campus building retrofit project's EUL decreased from 15 years to 12 years. DNV could not find any justification for the 15-year project-level EUL claimed. The CPUC Project Review disposition recommended a 13.5-year project-level EUL. Due to project changes made during the installation phase, the evaluated project EUL is 12 years.
- An office building retrofit project's EUL increased from 10.75 years to 14 years. The claimed EUL for an HVAC measure in the project was 5 years, which is not consistent with CPUC guidance. The measure EUL was adjusted to 15 years, increasing the project EUL.
- Another office building retrofit project's EUL increased from 12.9 years to 13.4 years. The project documentation did not support the 8 year EUL for the programmable thermostat, and so DNV used the DEER EUL of 11 years.
- A government office retrofit project's EUL decreased from 17.7 years to 17.13 years. Two measures with different MATs were bundled as one measure with a claimed EUL of 20 years. DNV evaluated the two measures individually and selected an EUL of 20 years for the BW measure and 15 years for the AR measure.

4.8 Project documentation

Clear and concise project documentation greatly impacts how efficient and thorough the project evaluation can be. Establishing clear expectations for the types of documentation needed may be able to reduce some of the administrative burden and duplicated efforts identified by participants during the interviews. In this section, we discuss the key documentation for NMEC projects.

4.8.1 Project feasibility study (PFS) and M&V plan

The PFS is written as part of the initial project scoping. It typically includes information about the site; a program influence narrative; the planned energy efficient activities and measures; measure-level MATs; the expected measure-level savings and EULs. Additionally, a project-level M&V plan is required, that defines the baseline model and the performance period model. The M&V plan often includes duplicate information from the PFS. A single document incorporating the information provided by both documents would be more efficient, and is recommended.

The NMEC rulebook says that project documentation during the application phase should include:

- "Estimates of energy savings and incentive payments"
- A "project M&V plan and demonstration of [the] feasibility of [the] NMEC analytical approach"
- Documentation of "methods and values used to develop [the] project EUL"
- "Planned adjustments for gross-realization rate (GRR) and net-to-gross (NTG) factors"[64]

All projects submitted M&V plans. Some of these M&V plans were embedded within the PFS and some were submitted as separate documents. Many of the M&V plans were generic, i.e., did not include information specific to the project. These generic M&V plans included extensive information about the types of M&V approaches that *could* be used but provided little to no information about the specific project approach. Providing informed site-specific plans is a critical component of the PFS and M&V plan submissions. Given that the baseline model needs to be set prior to the start of project implementation, this is a key area for improvement.

Baseline models are expected to be set during the project feasibility phase, as part of the screening process for determining whether the project is well suited for NMEC. Occasionally baseline models may need to be adjusted if project installation is delayed, as required by the NMEC rulebook. It is important that any changes to the baseline model are explained to make sure that the reasons for the changes are justifiable. For example, moving the baseline period closer to the start of the implementation period would generally be a reasonable adjustment whereas moving the baseline period to a time period that appears to show the greatest savings level would not be a reasonable adjustment.

All evaluated M&V plans included a description of baseline model variables; descriptions of non-routine events and related adjustments; and basic goodness of fit statistics. However, only five projects provided baseline model specification details, such as parameter estimates, p values, temperature spline node values, and occupied/unoccupied mode settings, in their M&V Plans. These values are essential to ensure replication efforts are successful and to fully assess whether the model reflects accurate engineering conditions at the site.

4.8.2 Maintenance plans

BRO measures generally rely on continued behavioral or maintenance activities to sustain savings. The NMEC rulebook requires participants with BRO measures to commit to at least a three-year maintenance plan.[65] Maintenance plans must include:

> "i) Continuous feedback for the building operator..., to sustain savings;
>
> ii) Detailed documentation of the operational interventions; and
>
> iii) A detailed data tracking plan pursuant to the signed repair and maintenance plan…"[66]

DNV reviewed eight projects with BRO measures. Two of these projects went through the ISOP program and the remaining six projects were implemented by a single large tech customer and went through PG&E's Commercial Calculated Incentives program.

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64 CPUC. "Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption version 2.0." January 7, 2020. https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/n/6442463694-nmec-rulebook2-0.pdf page 14.

65 Ibid.

66 Ibid., page 10.

The ISOP maintenance plans included a detailed list of parameters to monitor, a data tracking plan, a specified frequency for reviewing the data, and intervention plans if parameters deviate from the specified setpoints. These plans met the key requirements for a maintenance plan; however, the documentation did not provide any evidence that the plans were being followed.

The large tech projects provided an email indicating that the monitoring program would continue as the maintenance plan. While the program implemented for these projects is expected to provide continuous monitoring of the sites, as confirmed by the email chain, the documentation did not meet the requirements outlined in the NMEC rulebook. In future evaluations, projects with maintenance plans that do not meet the requirements the of NMEC rulebook may have an EUL capped at one year so that the EUL aligns with the one-year performance period where savings could be measured.

4.8.3 Final savings report

The final savings report is a key document that summarizes the final project, including any changes to the project throughout implementation, the performance period, and savings normalization. The NMEC rulebook states that the final savings report, referred to as the final M&V report in the NMEC rulebook, should include the following:

- "Documentation of "the activities carried out per the M&V Plan." [67]
- "Data collection (pre- and post- installation) adjustment models and all findings related to routine and non-routine events." [68]
- "First year and lifecycle savings claims, final avoided energy use and final normalized energy savings."[69]
- "Any deviations from the proposed M&V Plan should be documented and substantiated..."[70]
- The report "should reflect Commission staff review recommendations, if the project was selected for review."[71]

While all projects provided a final savings report with normalized savings estimates, very few provided a sufficient discussion of project implementation, deviations from the plans, changes at the site, a description and discussion of model specifications, and a discussion of savings results (particularly when the expected savings are not achieved). Clearly documenting how final savings are calculated is an essential part of NMEC projects and will be reviewed with greater scrutiny in future evaluations.

Non-routine events like significant changes in facility operation, occupancy pattern, space repurposes, and on-site generation can have significant impacts on savings estimate. However, this information was not tracked in a systematic way. Here are some examples of key information not consistently provided in the project documentation:

- **Changes made to address COVID-19 impacts:** All projects evaluated overlapped with the COVID-19 shutdowns. Projects used a variety of different ways to address the impacts, such as including occupancy variables or a COVID-19 indicator variable. How the facility operation and occupancy pattern were impacted by COVID-19 and how impacts changed over time was not clearly documented.
- **Non-IOU generation:** Multiple projects occurred at facilities with onsite, non-IOU generation that impacted both the metered energy usage and potentially impact eligibility if savings exceeded grid imports. However, project documentation did not address or acknowledge onsite generation for some sites (see Section 4.1.3) or did not sufficiently document the non-IOU generation and how it was addressed in the energy consumption analysis.

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[67] CPUC. "Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption version 2.0." January 7, 2020. https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/n/6442463694-nmec-rulebook2-0.pdf page 15

[68] Ibid., page 15

[69] Ibid., page 15

[70] Ibid., page 16

[71] Ibid., page 16

- **Removal of industrial energy usage:** For one of the refrigerated warehouses, the calculations made to remove non-building energy due to change in freezing capacity were not described in enough detail, nor were the variables input into the calculations explained. This led to lack of confidence in the adjustment method and removal of it during evaluation.
- **Changes in building use**: For one refrigerated warehouse retrofit, the project document suggested 3% of space was repurposed during the performance period from cooler to freezer. During the customer interview, we confirmed that 10% of the space was repurposed from cooler to freezer instead of 3%.

Additionally, projects that went through pre-installation project review by CPUC staff did not address the disposition items in the Final Savings Report, and in multiple cases, did not address key issues raised. This topic is further discussed in the next section.

4.9 Project review

The CPUC's Project Review process reviews a sample of projects with the goal of identifying any potential issues prior to project implementation. For site-level NMEC, projects selected for project review are typically reviewed prior to implementation and then reviewed again following the performance period. NMEC projects are typically selected for Project Review from the bi-monthly upload when incentives are greater than $100,000 and on an ad hoc basis. In addition to the project review process, PAs may request Early Opinions on policy issues that may impact their projects.

The NMEC rulebook states that "The Commission staff may select a sample of projects for review and input. Commission staff will provide feedback on the project and its documentation including but not limited to the Project M&V Plan, analytical methods, and data collection approaches proposed."[72] While the NMEC Project Reviews are advisory, the NMEC rulebook states that "The project M&V Report should reflect Commission staff review recommendations, if the project was selected for review."[73]

Four out of the 22 projects included in the gross evaluation had been selected for Project Review prior to project installation. Two of the projects addressed the issues raised in the review disposition. However, the other two projects did not address key disposition issues. Additionally, one project did not follow the guidance requested in the Early Opinion.

Fuel cell: One Project Review disposition identified a cogeneration system at the site that had not been addressed in the project models or a non-IOU fuel analysis. During the customer interview, we verified the existence of the fuel cell system, documented the operation dates which overlapped with the performance period, and requested fuel cell electricity generation. By not accounting for the fuel cell electricity generation, which reduced the amount of electricity imported from the grid, the project overclaimed savings. This project had the largest magnitude savings discrepancy of all of the projects evaluated.

Savings-weighted measure life: The Project Review disposition for this project recommended that different measure lives be used for some of the project components. The disposition recommended a savings-weighted measure life of 13.5 years. However, the tracking data claimed a life of 15 years. While there may be some measure changes or other modifications that could result in a different final measure life, the reasoning for using a different measure life was not provided.

New gas line: An additional project, which was not selected for Project Review, requested an Early Opinion regarding fuel switching in NMEC. However, the project ultimately did not follow the provided guidance. This project installed a new gas line when switching from electric to gas heating. The project did not account for the gas usage, which was increasing from

[72] CPUC. "Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption version 2.0." January 7, 2020. https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/n/6442463694-nmec-rulebook2-0.pdf page 14

[73] Ibid., page 16

zero in the baseline period. We took the new gas usage into account, which resulted in an overall increase in energy usage. See Section 4.1.5 for more details on this discrepancy.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Gross and net savings findings and recommendations

Site-level NMEC gross realization rates compared positively to other programs in CIAC.

Overall, both the site-level NMEC GRR and the DRR were significantly higher than what is typically seen for similar customers in other CIAC programs. For electric savings (kWh), site-level NMEC achieve a GRR of 71.5% that would have risen to 81.8% (DRR) if the savings claims had been made correctly by the PAs. Similarly, the program achieved lifecycle kWh savings GRR and DRR of 67.1% and 87.1%. The PY2020-2021 CIAC programs electric first-year GRR was 59%, while the lifecycle GRR was 48%.[74] Gas and kW results follow a similar pattern.

The net-to-gross interviews found substantial program influence on project scope and timing, but these factors account for only part of the current NTGR methodology.

NTGR methodology: The current methodology may not be well suited for measuring NMEC program influence. The well-established NTG methodology that has been used for many years for custom evaluations includes three equally weighted program attribution indicators. Two are based on rating program and non-program influences while only the third focuses on project scope and time. However, project timing and project scope are expected to be particularly important to NMEC program influence because of the objective of unlocking the stranded savings in buildings that are otherwise able to maintain and repair below-code systems. Aligning the methodology with this intent would offer a better representation of the programs' net impact.

Project scope: Respondents indicated that without the programs, they would likely have implemented a more limited project scope. When asked to rate the likelihood of completing the exact same project without the program on a ten-point scale, 53% of respondents gave a rating of 3 or less, indicating that it was unlikely that they would have completed the same scope without the program. For example, one respondent said, "We wouldn't have known about [the measures]. Their analysis helped us see what the change would be and without someone showing us that change we wouldn't have done it."

Project timing: Additionally, respondents indicated that without the program they would have implemented their projects multiple years later than they actually did or never have implemented them at all. When asked how much later they would have implemented their projects without the program, 33% of respondents, representing 23% of sites, said they would have never implemented the project (see Table 5-1). Another 40% of respondents, representing 64% of sites, said they would have implemented their projects two or three years later than they did. Only 20% of respondents, representing 11% of sites said they would have done that project at the same time or earlier.

[74] https://pda.energydataweb.com/api/downloads/2816/CIAC%202020-2021%20Evaluation%20Final%20Report%20-%20Revised.pdf

Table 5-1. Project timing

Without the assistance received from the program…would your organization have completed the whole project…	Percent of respondents	Percent of sites
About the same time or earlier than you did	20%	11%
At least a year later than you did	0%	0%
At least two years later than you did	13%	32%
At least three years later than you did	27%	32%
Or never	33%	23%
Or would the timing have varied by measure?	7%	2%

Recommendation

The CPUC should revisit the current NTGR methodology instrument and assess if the instrument and algorithm is in line with the actual NMEC program design and delivery. Opportunities for improvement include more timely NTG surveys, new questions to determine whether projects address stranded potential and to consider re-weighting current NTG algorithms to give more weight to project timing and scope.

5.2 Documentation findings and recommendations

Incorrectly entered savings claims in the tracking database system were the largest source of savings discrepancies.

The NMEC savings claim process is more complicated than the typical custom claim process to accommodate the final savings estimate calculated after performance period over a year after implementation. Engineering-based, forecasted savings are claimed the year the project is implemented. A year later, after the performance period, the meter-based normalized savings for the project are calculated. A true-up claim that represents the difference between the two values is entered into tracking the following year. The two claims should sum to the final meter-based savings estimate. The novel claims process for NMEC led to some reporting inaccuracies.

Double claimed projects: Thirteen projects, three of which were sampled in the impact evaluation, effectively double claimed savings by reporting savings incorrectly. The initial claim used the engineering-based forecasted savings (the correct approach), and the true-up claim used the full meter-based normalized savings (incorrect approach). Summing the two lines should adjust the initial claim to the final meter-based result. With two full savings claims entered, rather than a delta, summing substantially over-claimed final savings.

Double true-up: One project was trued-up twice, resulting in over-adjusting the initial claimed savings. In this case, the post-performance true-up was applied correctly after the performance period, but then repeated a second time the following year. This also resulted in too large of a savings claim.

Projects claimed but not installed: Two gas projects included in the evaluation were claimed but the PA reported that they were never installed or trued-up. These projects have been zeroed out through the evaluation.

Inaccurate savings claimed: One steam project claimed therms savings in the tracking database that were more than double the savings reported in the project documentation. The reason for the over-claimed savings is unknown. This resulted in a large savings correction.

Recommendations

- Existing NMEC reporting guidance[75] is clear that initial claims should be made in the year of installation and trued-up the following year with a positive or negative value that, when summed with the initial claim, equals the final weather-normalized estimate of savings. All claims should follow this structure.
- The PAs should develop data accuracy checks that assure total final claimed savings (the sum of preliminary and trued-up claims) are consistent with final weather-normalized savings estimates.
- All NMEC projects must be trued up during the first quarter of the second year after installation. PAs should review all initial site-level NMEC claims to ensure they are trued-up on schedule.

Project documentation was varied and inconsistent, which made it difficult to identify the final project characteristics and results as well as the reasoning behind key project decisions.

There was substantial variation in the type and thoroughness of the project documentation provided. Some projects had relatively clear documentation that explained what had been planned for the project, what was done for the project, and why anything changed. Other documentation was very difficult to follow and did not provide any reasoning for why substantial changes were made during implementation or the performance period modeling. This lack of clear documentation required additional data requests, increased review time during the evaluation, and increased the likelihood of misunderstanding the reasoning behind some project decisions.

Most projects reviewed during the evaluation had insufficient documentation to explain why measure-level Measure application types (MATs)[76] and effective useful life (EUL), were selected. Unlike an NMEC project's savings, which are meter-based, the measures' EUL, which indicates how long the first-year savings will persist, must be based on measure life studies and other documentation as with non-meter-based custom projects. As a result, the EUL needs to be careful reviewed by evaluators as the resulting lifetime savings are important for cost-effectiveness and total system benefit calculations. The lack of clear MAT and EUL documentation for many projects made this essential part of the evaluation more inefficient, time-consuming and, potentially, inaccurate.

Recommendations

- The PAs should provide an explanation of why each measure-level MAT was assigned. At a minimum, the explanation should specify the type of equipment involved, such as lighting, heating, ventilation, air conditioning, refrigeration, or water heating and whether the measure involves installing equipment in a new building or new area of an existing building or in an existing building. The explanation should also indicate if the measure involves: a) replacing existing equipment with new energy efficient equipment, or b) adding new equipment to existing equipment, or c) repairing or refurbishing existing equipment, or d) changing settings in an existing control system. This clear explanation will help the evaluation team establish the appropriate MAT for each measure.
- Measure-life documentation should include a description of the measure, EUL of the measure and it's respective DEER EUL ID to explain why particular measure lives are assigned from DEER.

Regression-based modeling is the core of NMEC methods, and projects do not consistently provide transparent, well-documented models following standard practices.

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[75] This is explained in reporting guidance published by Energy Division as NMEC Reporting Guidance 04242020.pdf that was distributed to the PAs.

[76] For more detailed definitions of each MAT, see: https://www.caltf.org/measure-application-types-1

We identified multiple types of issues with the way regression models were specified or structured. These included using novel and inappropriate variable combinations, using different model specifications for the baseline and performance models, models not well aligned with the onsite project activities, and unexplained changes in model structure. This is not unexpected for a programmatic approach still under development. However, for NMEC to evolve into a program approach that requires a light-touch evaluation, a greater level of consistency is required.

In addition, the pandemic put stress on basic site-level NMEC methods. Site-level NMEC methods measure change in consumption between two periods and define the difference as savings. COVID had substantial, variable impacts on energy consumption that were difficult to separate from program-motivated changes. Many of the COVID-related challenges may become moot under typical conditions. For example, occupancy measures used to address COVID-related interruptions were novel additions to models and may prove unnecessary in the future when occupancy changes are limited.

Recommendations

- Continued communication between the CPUC and PAs will guide the basic expectations for acceptable modeling practices and essential documentation to reduce uncertainty and project delays. This may be accomplished through rulebook updates, separate NMEC PFS/M&V template development, NMEC PCG discussions, and additional guidance documentation.
- Wherever possible, PAs should follow standard model structures (e.g. linear changepoint models or LBNL Time of week and temperature models[77]) and provide engineering-based explanations for deviations to simplify the review process.
- The PAs should ensure that baseline model specification is set before project installation and applied consistently in the post period to comply with the NMEC Rulebook.

The maintenance plans provided varied substantially in terms of detail and completeness.

Behavioral, Retro-commissioning, and Operational (BRO)[78] measures were noted as important options for NMEC projects in early policy guidance. To extend the measure life of BRO measures to three years, the NMEC Rulebook states that "participant or project owners must commit to a repair and maintenance plan for a minimum of three years via a signed customer agreement under which the repair and maintenance activities will continue."[79] Eight of the projects reviewed as part of the impact evaluation included BRO[80] measures. The Rulebook states that maintenance plans should include "continuous feedback," "Detailed documentation," "a detailed data tracking plan," and should include training.[81] However, the maintenance plans developed for the evaluated NMEC projects varied widely in their adherence to these guidelines. The two refrigerated warehouse projects did include detailed plans with clear data tracking plans but did not provide evidence that the plans were being followed. The large tech projects only provided an email from the customer stating, "we plan to have this program extended long term – there is no end [in] sight so keeping up with a 3+ year program is exactly what we

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[77] The time of week and temperature model (TOWT) was developed initially by Lawrence Berkeley laboratory. Mathieu, Johanna L., Phillip Price, Sila Kiliccote, Mary Ann Piette. 2011. "Quantifying changes in building electricity use, with application to Demand Response." IEEE Transactions on Smart Grid 2:507- 518.

[78] BRO measures include information or education programs that influence energy-related practices (behavioral), activities and installations that restore equipment performance (retro-commissioning), as well as measures that improve the efficient operation of installed equipment (operational). BRO measures are assigned a three-year EUL.

[79] CPUC. "Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption-Version 2.0." P. 10. cpuc.ca.gov, January 7, 2020. https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/n/6442463694-nmec-rulebook2-0.pdf

[80] BRO measures include information or education programs that influence energy-related practices (behavioral), activities and installations that restore equipment performance (retro-commissioning), as well as measures that improve the efficient operation of installed equipment (operational). BRO measures are assigned a three-year EUL.

[81] CPUC. "Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption-Version 2.0." P. 10. cpuc.ca.gov, January 7, 2020. https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/n/6442463694-nmec-rulebook2-0.pdf

want to do." Without the actual maintenance plan, we had no inkling whether the maintenance and repair measures were maintained and providing savings.

Recommendation

- PAs should provide maintenance plans that meet NMEC Rulebook requirements so that the BRO EUL can remain at three years.
- The CPUC should consider amending BRO EUL rules so that BRO measures without maintenance plans receive a one-year EUL, capped at verified savings of the 12-month performance period.
- Energy Division should facilitate the development of a maintenance plan template that is in-line with BRO measure program maintenance plan requirements.

PAs did not address multiple key issues identified through Energy Division's Project Review process.

Site-specific NMEC projects go through a Project Review that is similar to the custom Project Review (CPR) process. However, a stark difference between CPR and NMEC Project Reviews is that the NMEC Project Review is advisory only, and not binding. The PA may choose to continue with project implementation regardless of the recommendations made following the NMEC Project Review process. The NMEC Project Review "does not restrict or delay project development or constitute an approval of related energy savings claims."[82] Although the NMEC Project Reviews are advisory, the NMEC Rulebook[83] states that these reviews should "be referenced during EM&V[84] activities to assess how Commission feedback was incorporated."

Four out of the 20 projects included in the impact evaluation had been selected for Project Review prior to project installation. Of the four projects, two did not address key issues identified during the Project Review. Additionally, one project did not follow the requested Early Opinion.[85] Issues that were not addressed despite being highlighted in Project Review recommendations include an overlooked cogeneration system and mis-specified EULs. The lack of attention to these highlighted issues led to artificially increased and extended claimed savings. The overlooked cogeneration system reduced savings by 13% at what was the largest kWh saving project in the evaluation sample. The project for which an Early Opinion was requested installed a gas line in order to switch from electric to gas heating. The final savings ignored the increased gas use (from zero) and did not follow the Early Opinion guidance. With the inclusion of the gas consumption, expected savings did not occur and the project increased the overall consumption of energy at the site.

Recommendations

- The PAs should address issues identified through the NMEC Project Review process and should document the reasons for making changes within the final savings report to improve project quality.
- CPUC should consider making NMEC Project Reviews more than advisory so that issues are more likely to be addressed during the project implementation which will help PAs achieve more accurate savings claims.

[82] CPUC. "Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption-Version 2.0." January 7, 2020. https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/n/6442463694-nmec-rulebook2-0.pdf.

[83] Ibid.

[84] Evaluation, measurement, and verification

[85] Early Opinion reviews allow the PAs to request clarification from CPUC staff of custom project related CPUC policies or rules before submitting a project.

5.3 Process findings and recommendations

Participants indicated high levels of satisfaction with the program, driven by the programs' technical support and incentives.

When asked to rate program satisfaction on a scale of zero to 10, where zero is completely dissatisfied and 10 is completely satisfied, respondents gave an average rating of 8.1 which indicates a high level of satisfaction.

Table 5-2. Program satisfaction

Metric	By respondents (n=13)	By sites (n=62)
Average Satisfaction	8.1	8.5
% Promoters (≥8)	80%	94%
% Detractors (≤3)	7%	2%

Eighty percent of respondents, representing 94% of sites, were "promoters," providing a rating of 8 or above. In an open-ended question about the strengths of the program, respondents indicated that their satisfaction was driven by the technical support and incentives provided by the program. Three respondents elaborated on the value of technical support provided by the program, indicating that the embedded engineering and technical support and the data shared were particularly helpful.

Only one respondent was a detractor, providing a rating of 3 or less. This respondent indicated their dissatisfaction was driven by the administrative burden required for participation, inconsistent messaging about what qualifies for participation, and long delays throughout the project. At the time of the interview, they had not yet received their incentives, saying, "we're waiting years to get the incentive." This participant started their project before 2022.

While nearly half of respondents had no suggestions for program improvements, those that did most frequently recommended streamlining the program and reducing administrative burden.

Twenty percent of respondents, representing 34% of sites, suggested shortening the delays for CPR review approval (Table 5-3). One said, "when projects go in for submission there are long delays between when we submit to when its approved and therefore, we can't implement it…Savings are sitting on the table while we're waiting." Twenty percent of respondents, representing 8% of sites, also suggested reducing the admin burden. One said, "[Reduce] admin burden, paperwork, or duplication of effort. [We have] too many people doing the same thing, sending the same data to multiple people and repeated requests for information from the program." Request for information could come from either implementer or PA and could reflect information needs of implementer, PA, project reviewers or evaluators.

Table 5-3. Suggestions for program improvements

Improvement	Percent of respondents	Percent of sites
Shorten delays for approval	20%	34%
Make incentives tied to particular measures	7%	22%
Reduce admin burden	20%	8%
Provide information on cost of technical assistance, though it was free	7%	8%
Reduce disconnect between utility staff and NMEC on what qualifies	13%	5%
Increase incentives	13%	3%
No suggestions	47%	31%

Recommendation

Improve alignment between program implementers, PA staff, and evaluators on program evaluation and qualification requirements. Increasing clarity on data requirements among all parties and streamlining the process of data sharing across parties can reduce duplicative work and confusion. Follow-on work led by ED can facilitate this process.

5.4 Overarching NMEC findings and recommendations

Site-level NMEC shows possibility to address "stranded potential" savings but is also being applied in a much wider range of projects.

Our evaluation included multiple projects that may have addressed "stranded" savings, which is described in the March 2016 AB802 Technical Analysis[86] as follows.

> "Stranded potential exists because a subset of customers maintains certain types of equipment well beyond the equipment's expected useful life. Long lived measures exist for two reasons:
>
> 1. The equipment is repairable and customers have been repairing the equipment rather than replacing the equipment when it fails (examples include boilers and chillers). …
>
> 2. There is no catastrophic system failure that triggers the customer to repair or replace the entire system (examples include insulation and commercial lighting fixtures)"

Stranded savings have the potential to offer dramatic savings where out-of-date or poorly commissioned systems that fit the above criteria would legitimately take advantage of NMEC's existing conditions baseline. In contrast, there are other NMEC projects that appear to have chosen NMEC as a path to claim greater savings than would be available via alternative paths.

During interviews with participating customers, multiple respondents indicated that they considered both Custom and NMEC offerings when making decisions on how to implement projects and chose the offering that made the most sense for them. They said that Custom offerings were typically chosen when the project scope included discrete measures with developed evaluation methods, and NMEC was chosen when the project contained a more holistic approach that covered multiple building systems, or where the project included behavioral, retro-commissioning and/or operational measures ("BROs"). This comparison indicates a consideration, and ultimate choice, of the NMEC approach for reasons that may not embrace the full purpose of measuring savings from the existing conditions baseline to access stranded potential.

Recommendation

Consider, as part of future studies,

- Assessing the volume of stranded savings potential. The 2019 Energy Efficiency Potential and Goals Study by Navigant/Guidehouse identified below code energy efficiency potential as reflecting "additional claimable impacts allowed after the passing of AB802" and should represent the target population for NMEC programs.
- An exploration of PA and implementer efforts to identify and target "stranded potential" buildings for NMEC projects.

[86] https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/a/11189-ab802-technical-analysis.pdf

NMEC intends to move savings risk away from the ratepayer to the PAs, implementers, and participants. While the PAs and implementers who engage in NMEC are aware of the risks, the PAs must manage the additional risk with participants carefully.

Site-level NMEC calculates savings from an existing conditions baseline. Upgraded systems need to be functional in the baseline for improvements in the performance period to appear as savings. Program implementers that fail to perform basic functional testing on systems to be upgraded may implement projects that will not provide the participant the expected reward under an NMEC approach. For example, one evaluated project had a 77% reduction from engineering-based forecasted savings to meter-based realized savings. The engineering-based forecasted savings made assumptions about how the old equipment had been functioning which were not supported by the meter-based model. The old equipment had been functioning at a small fraction of its capacity, which immediately became clear based on the deficiency report provided after the participant interview, showing that one of the two compressors was down. The new system is efficient but uses more energy than the existing system at partial capacity which was likely not meeting the functional needs of the space. The participant had not been made aware of the existing system's limitations nor its implications on the building's potential energy savings. The PAs and implementers are in a position to manage their own added risk under NMEC, but the participant may not be.

Recommendation

To protect participants, the implementer should ensure that equipment is operational and meets the functional needs of the building and that the 12 months of pre-installation data is an actual representation of baseline energy usage with functional equipment. A simple functional check by the implementer on the existing equipment during the investigation phase could eliminate this risk without adding additional burden on the participants.

APPENDIX A. DETAILED GROSS REALIZATION RATES

Table A-1. Electric GRR by PA

PA	Projects	Customers	First year		Lifecycle	
			GRR	Relative precision	GRR	Relative precision
PG&E	9	6	79.7%	±9.0%	82.0%	±15.0%
SCE	3	1	27.7%	±0.0%	27.9%	±0.0%
SoCalREN	8	3	78.6%	±19.0%	77.4%	±19.0%
Total	**20**	**10**	**70.9%**	**±8.0%**	**65.6%**	**±9.0%**

Table A-2. Electric GRR by initial claim year

Initial claim year	Projects	Customers	First year		Lifecycle	
			GRR	Relative precision	GRR	Relative precision
2020	6	3	48.2%	±35.0%	52.2%	±38.0%
2021	13	7	81.6%	±7.0%	77.0%	±22.0%
2022	1	1	29.0%	±0.0%	29.0%	±0.0%
Total	**20**	**10**	**70.9%**	**±8.0%**	**65.6%**	**±9.0%**

Table A-3. Electric DRR by PA

PA	Projects	Customers	First year		Lifecycle	
			DRR	Relative precision	DRR	Relative precision
PG&E	9	6	79.6%	±10.0%	84.1%	±13.0%
SCE	3	1	105.3%	±0.0%	105.2%	±0.0%
SoCalREN	8	3	81.8%	±18.0%	80.6%	±19.0%
Total	**20**	**10**	**81.2%**	**±9.0%**	**85.2%**	**±11.0%**

Table A-4. Electric DRR by initial claim year

Initial claim year	Projects	Customers	First year		Lifecycle	
			DRR	Relative precision	DRR	Relative precision
2020	6	3	103.0%	±3.0%	109.4%	±2.0%
2021	13	7	81.9%	±7.0%	79.0%	±22.0%
2022	1	1	26.9%	±0.0%	26.9%	±0.0%
Total	**20**	**10**	**81.2%**	**±9.0%**	**85.2%**	**±11.0%**

Table A-5. Demand GRR by PA

PA	Projects	Customers	First year	
			GRR	Relative precision
PG&E	2	2	86.8%	±63.0%
SoCalREN	8	3	127.4%	±35.0%
Total	**10**	**5**	**100.1%**	**±41.0%**

Table A-6. Demand GRR by initial claim year

Initial claim year	Projects	Customers	First year GRR
2020	3	2	88.6%
2021	6	3	154.1%
2022	1	1	27.0%
Total	**10**	**5**	**100.1%**

Table A-7. Demand DRR by PA

PA	Projects	Customers	First year	
			DRR	Relative precision
PG&E	2	2	73.8%	±56.0%
SoCalREN	8	3	146.6%	±33.0%
Total	**10**	**5**	**93.0%**	**±41.0%**

Table A-8. Demand DRR by initial claim year

Initial claim year	Projects	Customers	First year	
			DRR	Relative precision
2020	3	2	101.1%	±1.0%
2021	6	3	123.8%	±58.0%
2022	1	1	25.0%	±0.0%
Total	**10**	**5**	**93.0%**	**±41.0%**

APPENDIX B. DETAILED NET-TO-GROSS RATIO RESULTS

Table B-1. Electricity NTGR by PA

			First year		Lifecycle	
PA	Projects	Customers	NTGR	Relative precision	NTGR	Relative precision
PG&E	35	11	49.7%	±20.0%	46.1%	±20.0%
SCE	15	2	37.7%	±53.0%	37.4%	±54.0%
SoCalREN	15	4	32.6%	±31.0%	31.0%	±32.0%
Total	**65**	**17**	**45.9%**	**±15.0%**	**41.1%**	**±15.0%**

Table B-2. Demand NTGR by PA

			First year	
PA	Projects	Customers	NTGR	Relative precision
PG&E	14	7	46.4%	±26.0%
SoCalREN	13	4	37.7%	±16.0%
Total	**27**	**11**	**41.7%**	**±14.0%**

Table B-3. Electricity NTGR by program year

			First year		Lifecycle	
PA	Projects	Customers	NTGR	Relative precision	NTGR	Relative precision
2020	18	4	34.7%	±40.0%	34.0%	±41.0%
2021	29	8	53.4%	±11.0%	45.8%	±20.0%
2022	18	7	42.6%	±21.0%	41.4%	±17.0%
Total	**65**	**17**	**45.9%**	**±15.0%**	**41.1%**	**±15.0%**

Table B-4. Demand NTGR by program year

			First year	
PA	Projects	Customers	NTGR	Relative precision
2020	3	2	25.2%	±36.0%
2021	7	4	34.9%	±32.0%
2022	17	6	43.5%	±16.0%
Total	**27**	**11**	**41.7%**	**±14.0%**

APPENDIX C. PROJECT DISCREPANCIES

Tables C-1 through C-3 present project-level results, including the project sample weight, claimed, documented, and verified first-year savings, GRR, DRR, and discrepancy descriptions. This table provides a complete list of discrepancies ordered by the size of the impact. Some of the listed discrepancies may be sizeable and others may be very small.

Table C-1. Project discrepancies resulting in adjusted first-year gross electric savings

PA	DNV ID	Initial claim ID	Weight	Claimed	Documented	Verified	GRR	DRR	Discrepancy descriptions
PG&E	DNV59	PGE-2022-SAVINGS ESTIMATE SITE SPECIFIC COMPREHENSIVE - 35348 13 = INDUSTRIAL REFRIGERATION	1.3	426,676	460,146	123,673	29%	27%	**Pre-model consumption adjustment:** Removed PA's correction for freezing energy due to inadequate and inconsistent documentation of method used; **Model specification:** Added pounds received variable to performance model to match baseline model; **Normalization adjustment:** Used performance period pounds received amount for normalization in place of PA's average of baseline and performance; **Tracking data:** PA reported results from Final Savings Report
	DNV15	PGE-2021-SAVINGS ESTIMATE SITE SPECIFIC COMPREHENSIVE - 10284 3 = COMMERCIAL HVAC	2.5	385,097	385,097	199,570	52%	52%	**Model specification:** Removed interaction between temperature and occupancy; **Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's unnecessary with an occupancy variable; **Other:** Results from replication; **Tracking data:** PA reported results from Final Savings Report

PA	DNV ID	Initial claim ID	Weight	Claimed	Documented	Verified	GRR	DRR	Discrepancy descriptions
	DNV14	PGE-2021-SAVINGS ESTIMATE SITE SPECIFIC COMPREHENSIVE - 10264 3 = COMMERCIAL HVAC	1.0	1,701,504	1,701,504	1,167,231	69%	69%	**Model specification:** Removed interaction between temperature and occupancy; **Non-IOU fuel adjustment:** Added fuel cell cogeneration kWh to utility kWh; **Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's unnecessary with an occupancy variable; **Tracking data:** PA reported results from Final Savings Report
	DNV23	PGE-2021-SAVINGS ESTIMATE SITE SPECIFIC COMPREHENSIVE - 10272 3 = COMMERCIAL HVAC	6.0	213,328	213,328	182,746	86%	86%	**Non-IOU fuel adjustment:** Used actual savings to adjust for solar generation rather than grid-only model comparison used by the PA; **Model specification:** Removed interaction between temperature and occupancy; **Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's unnecessary with an occupancy variable; **Tracking data:** PA reported results from Final Savings Report
	DNV17	PGE-2021-SAVINGS ESTIMATE SITE SPECIFIC COMPREHENSIVE - 10260 3 = COMMERCIAL HVAC	6.0	73,537	73,537	63,264	86%	86%	**Model specification:** Removed interaction between temperature and occupancy; **Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's unnecessary with an occupancy variable;

PA	DNV ID	Initial claim ID	Weight	Claimed	Documented	Verified	GRR	DRR	Discrepancy descriptions
									Tracking data: PA reported results from Final Savings Report
	DNV24	PGE-2021-SAVINGS ESTIMATE SITE SPECIFIC COMPREHENSIVE - 920 3 = COMMERCIAL HVAC	1.3	864,275	800,951	805,629	93%	101%	**Tracking data:** PA reported results from Final Savings Report; **Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's unnecessary given wifi connections variable
	DNV08	PGE-2021-SAVINGS ESTIMATE SITE SPECIFIC COMPREHENSIVE - 10277 3 = COMMERCIAL HVAC	1.0	408,914	408,914	403,616	99%	99%	**Model specification:** Removed interaction between temperature and occupancy; **Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's unnecessary with an occupancy variable; **Tracking data:** PA reported results from Final Savings Report
	DNV01	PGE-2021-SAVINGS ESTIMATE SITE SPECIFIC COMPREHENSIVE - 31700 4 = COMMERCIAL REFRIGERATION	1.3	482,903	525,063	520,664	108%	99%	**Tracking data:** PA reported results from Final Savings Report; **Model specification:** Added holiday variable to baseline model to match performance model; **Normalization adjustment:** Used performance period shipping amount for normalization in place of PA's 3-year day-of-week average

PA	DNV ID	Initial claim ID	Weight	Claimed	Documented	Verified	GRR	DRR	Discrepancy descriptions
	DNV10	PGE-2021-SAVINGS ESTIMATE SITE SPECIFIC COMPREHENSIVE - 10280 3 = COMMERCIAL HVAC	2.5	251,331	251,331	292,814	117%	117%	**Model specification:** Removed interaction between temperature and occupancy; **Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's unnecessary with an occupancy variable; **Tracking data:** PA reported results from Final Savings Report
SCE	DNV26	SCE-2020-Q1-0990002	4.7	117,713	15,987	17,136	15%	107%	**Tracking data:** PA reported results from Final Savings Report; **Other:** Applied baseline spline nodes to performance period to put models on the same support; **Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's overfitting for a school
	DNV33	SCE-2020-Q1-0990009	4.7	105,717	35,680	35,299	33%	99%	**Tracking data:** PA reported results from Final Savings Report; **Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's overfitting for a school; **Other:** Applied baseline spline nodes to performance period to put models on the same support
	DNV30	SCE-2020-Q1-0990006	4.7	163,140	49,943	54,564	33%	109%	**Tracking data:** PA reported results from Final Savings Report; **Other:** Applied baseline spline nodes to

PA	DNV ID	Initial claim ID	Weight	Claimed	Documented	Verified	GRR	DRR	Discrepancy descriptions
									performance period to put models on the same support; Simplified occupancy: Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's overfitting for a school; **Other:** Results from replication
SoCal REN	DNV47	SCR-2021-A0B0W00002QFFV0UAM	1.3	87,956	87,956	-97,129	-110%	-110%	**New gas line:** Added gas model to measure therm savings loss from boiler installation, PA did not account for this; **Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's unnecessary given customer-reported operating schedule; **Zeroed out negative demand savings:** PA claimed negative demand savings that were caused by hourly model background noise, not installed measures
	DNV43	SCR-2020-SCR-PUBL-B3-001	1.3	83,370	67,823	76,580	92%	113%	**Tracking data:** PA reported results from Final Savings Report; **Other:** Removed PA's COVID adjustment, customer said there was no COVID impact; **Other:** Shifted baseline period to 2/1/2019 - 1/31/2020 to be closer to installation; **Other:** Shifted performance period start date to 5/1/2020 to account for correct installation date; **Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied

PA	DNV ID	Initial claim ID	Weight	Claimed	Documented	Verified	GRR	DRR	Discrepancy descriptions
									split of data, as it's contrary to an engineering based model for a parking garage
	DNV45	SCR-2020-SCR-PUBL-B3-003	1.3	363,271	338,661	338,993	93%	100%	**Tracking data:** PA reported results from Final Savings Report; **Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's unnecessary given customer-reported operating schedule
	DNV48	SCR-2021-A0B0W00002SD56VUAS	1.3	18,791	18,791	18,443	98%	98%	**Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's contrary to an engineering-based model for a parking garage
	DNV50	SCR-2021-A0B0W00002SD56FUAC	1.3	92,635	92,635	92,356	100%	100%	**Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's contrary to an engineering-based model for a parking garage
	DNV44	SCR-2020-SCR-PUBL-B3-002	1.3	175,101	175,101	174,875	100%	100%	**Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's unnecessary given customer-reported operating schedule

PA	DNV ID	Initial claim ID	Weight	Claimed	Documented	Verified	GRR	DRR	Discrepancy descriptions
	DNV51	SCR-2021-A0B0W00002SD56KUAC	1.3	100,422	100,421	100,443	100%	100%	**Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's contrary to an engineering-based model for a parking garage; Tracking data: PA reported results from Final Savings Report
	DNV49	SCR-2021-A0B0W00002SD56AUAC	1.3	90,349	90,349	90,371	100%	100%	**Simplified occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's contrary to an engineering-based model for a parking garage

Table C-2. Project discrepancies resulting in adjusted first-year gross demand savings

PA	DNV ID	Initial claim ID	Weight	Claimed	Documented	Verified	GRR	DRR	Discrepancy descriptions
PG&E	DNV59	PGE-2022-SAVINGS ESTIMATE SITE SPECIFIC COMPREHENSIVE - 35348 13 = INDUSTRIAL REFRIGERATION	1	59	64	16	27%	25%	**Pre-model consumption adjustment:** Removed PA's correction for freezing energy due to inadequate and inconsistent documentation of method used; **Model specification:** Added pounds received variable to performance model to match baseline model; **Normalization adjustments:** Used performance period pounds received amount for normalization in place of PA's average of baseline and performance; **Tracking data:** PA reported results from Final Savings Report; **Load shape classification:** Changed site's load shape classification from Industrial Process to Commercial Refrigeration for kW savings calculation in SEM tool
	DNV24	PGE-2021-SAVINGS ESTIMATE SITE SPECIFIC COMPREHENSIVE - 920 3 = COMMERCIAL HVAC	1	103	127	125	121%	98%	**Tracking data:** PA reported results from Final Savings Report; **Corrected occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's unnecessary given wifi connections variable

PA	DNV ID	Initial claim ID	Weight	Claimed	Documented	Verified	GRR	DRR	Discrepancy descriptions
SoCal REN	DNV47	SCR-2021-A0B0W00002QFFV0UAM	1	-30	-30	0	0%	0%	**Zeroed out negative demand savings:** PA claimed negative demand savings that were caused by hourly model background noise, not installed measures; **Corrected occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's unnecessary given customer-reported operating schedule; **Tracking data:** PA reported results from Final Savings Report
	DNV48	SCR-2021-A0B0W00002SD56VUAS	1	-1	-1	0	0%	0%	**Zeroed out negative demand savings:** PA claimed negative demand savings that were caused by hourly model background noise, not installed measures; **Corrected occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's contrary to an engineering-based model for a parking garage; **Tracking data:** PA reported results from Final Savings Report

PA	DNV ID	Initial claim ID	Weight	Claimed	Documented	Verified	GRR	DRR	Discrepancy descriptions
	DNV43	SCR-2020-SCR-PUBL-B3-001	1	15	9	9	60%	97%	**Reported results:** PA reported results from Final Savings Report; **Other:** Shifted baseline period to 2/1/2019 - 1/31/2020 to be closer to installation; **Corrected occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's contrary to an engineering-based model for a parking garage; **Other:** Shifted performance period start date to 5/1/2020 to account for correct installation date
	DNV45	SCR-2020-SCR-PUBL-B3-003	1	51	47	47	92%	101%	**Corrected occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's unnecessary given customer-reported operating schedule; **Tracking data:** PA reported results from Final Savings Report
	DNV50	SCR-2021-A0B0W00002SD56FUAC	1	8	8	8	98%	98%	**Tracking data:** PA reported results from Final Savings Report; **Corrected occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's contrary to an engineering-based model for a parking garage

PA	DNV ID	Initial claim ID	Weight	Claimed	Documented	Verified	GRR	DRR	Discrepancy descriptions
	DNV49	SCR-2021-A0B0W00002SD56AUAC	1	8	8	8	98%	98%	**Tracking data:** PA reported results from Final Savings Report; **Corrected occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's contrary to an engineering-based model for a parking garage
	DNV44	SCR-2020-SCR-PUBL-B3-002	1	18	18	18	104%	104%	**Tracking data:** PA reported results from Final Savings Report; **Corrected occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's unnecessary given customer-reported operating schedule
	DNV51	SCR-2021-A0B0W00002SD56KUAC	1	10	10	10	105%	105%	**Tracking data:** PA reported results from Final Savings Report; **Corrected occupancy:** Removed nmecr algorithm automatic occupied/ unoccupied split of data, as it's contrary to an engineering-based model for a parking garage

Table C-3. Project discrepancies resulting in adjusted first-year gross gas savings

PA	DNV ID	Initial claim ID	Weight	Claimed	Documented	Verified	GRR	DRR	Discrepancy descriptions
PG&E	DNV24	PGE-2021-SAVINGS ESTIMATE SITE SPECIFIC COMPREHENSIVE - 920 3 = COMMERCIAL HVAC	1.0	111,228	38,558	39,791	36%	103%	**Tracking data:** PA reported results from Final Savings Report; **Other:** Results from replication
SCG	DNV41	SCG-2020-3809-12234368-2020001	1.0	3,560	0	0	0%	0%	Project not installed
	DNV42	SCG-2020-3809-12280626-2020002	1.0	1,392	0	0	0%	0%	Project not installed

APPENDIX D. STANDARD HIGH-LEVEL SAVINGS TABLES

These tables will be appended in the final PDF version of the report.

APPENDIX E. STANDARD PER-UNIT SAVINGS TABLES

APPENDIX F. SITE-LEVEL NMEC EVALUATION REPORT COMPILED STAKEHOLDER COMMENTS

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

Commenter	Comment	DNV Response
kW Engineering	Why wasn't each Site-Level NMEC Program's Cost-Effectiveness evaluated? This seems to be a major gap in this evaluation, which otherwise provided some very insightful and useful feedback. As we commented for the proposed updated NMEC Rulebook, we believe that Site-Level NMEC program offerings are not cost-effective and should provide the basis for a process evaluation to understand how Site-Level NMEC programs can meet the required California energy efficiency policy objectives without overburdening them with excessive requirements. a. In section 5.1, p. 46, the report does describe that SLNMEC projects are more comprehensive with customers installing more EEMs that they would without the program, but they also say that it takes too long, there are many delays, and there are a lot of callbacks for more information.	Evaluating program cost-effectiveness is not in the scope of the impact evaluation. However, we do recognize PAs concern and strongly recommend that PAs use the evaluation results to assess the cost-effectiveness of their programs.
kW Engineering	6. On p. 42 it is stated only 5 project M&V Plans were provided that provided baseline model specification details, citing parameter estimates, p values, temperature spline node value, and occ/unocc mode settings. We note these are not required per the NMEC Rulebook, nor are any analysis of the assumptions of regression (only model goodness of fit metrics are). However, this information is available in the provided R code for most of these projects and may be output with the proper statements.	The NMEC Rulebook does require that methods be transparent and documented. The NMEC Rulebook summarizes the CPUC requirements for NMEC programs and provides direction and guidance for implementing NMEC programs in California, but doesn't specify what documentation and information should be part of the project submittal package. It is the responsibility of the PAs to submit all required information to the evaluation team so that the ex ante savings could be replicated without any issues. It is cost prohibitive for the evaluation team to do extensive digging and perform some code modifications to determine which variables and model structure were used in the final model. Providing clear information about the variables used in the model and model structure is in alignment with Rulebook

Commenter	Comment	DNV Response
		requirements to set the model in advance and to provide transparent "data, methods and calculations."
PG&E	**Maintenance plans** Section 4.8.2 of the report states that "the ISOP maintenance plans included a detailed list of parameters to monitor, a data tracking plan, a specified frequency for reviewing the data, and intervention plans if parameters deviate from the specified setpoints. These plans met the key requirements for a maintenance plan; however, the documentation did not provide any evidence that the plans were being followed." The current NMEC Rulebook requires documentation to show that the customer committed to a maintenance plan for all BRO measures. It also requires the project developer to include training components in all repair and maintenance program offerings. However, investigation into how closely the maintenance plan was followed is beyond the requirements of the NMEC Rulebook, imposes unnecessary cost burden on the programs and negatively impacts the project developer/customer relations. Even if this is going to be added as a requirement in the future, its impact should be thoroughly discussed among the stakeholders in a statewide working group. Later in the same section, the report points out deficiencies in maintenance plans of projects for a large tech customer. PG&E agrees that there was room for improvement in the maintenance plans that were reviewed and approved in the first set of SLNMEC projects. Since then, PG&E has made great efforts to develop and expand on the maintenance plans and has made significant progress. ISOP maintenance plans that were cited in the previous paragraph are only a few examples of this effort.	The NMEC Rulebook does require "Continuous feedback for the building operator...to sustain savings", "detailed documentation of the operational interventions" and a "detailed data tracking plan pursuant to the signed repair and maintenance plan..." The evaluation was looking for evidence of these activities to substantiate that the maintenance plan was being implemented. The NMEC Rulebook requires that a signed three- year maintenance plan be in place prior to paying incentives for BRO measures. The evaluation did not seek to comment on maintenance plan timing outside of the NMEC Rulebook requirements.

Commenter	Comment	DNV Response
	In addition, PG&E would like to suggest that the maintenance plan should be a requirement at the post-install stage. While the current NMEC Rulebook is silent about when a maintenance plan should be filed and reviewed in project package, PG&E believes that requiring a maintenance plan at the pre-install stage would not be necessary. During the project development stage, the customers still are evaluating their options and putting together their financial plans for the project. At this stage, the project developers tend to propose a scope of work that would include all possible energy efficiency measures while some of the measures may be dropped later due to customer's limitations. Having the customers sign a maintenance plan at pre-install stage, when the customer is not committed enough to implement the entire project scope adds unnecessary burden. PG&E agrees that the post-install project package should include a maintenance plan for all BRO measures compliant with NMEC Rulebook.	
SDG&E	"PAs should provide maintenance plans that meet NMEC Rulebook requirements so that the BRO EUL can remain at three years. • The CPUC should consider amending BRO EUL rules so that BRO measures without maintenance plans receive a one-year EUL, capped at verified savings of the 12-month performance period. • Energy Division should facilitate the development of a maintenance plan template that is in-line with BRO measure program maintenance plan requirements." SDG&E disagrees with this recommendation and believe it is too vague to implement. Changing the EUL is punitive without reasoning and/or exceptions. Additionally, a "maintenance plan" for Behavior/Operational is not well enough defined to	Please see page 10 of the NMEC Rulebook, which states the following: "Behavioral, retrocommissioning, operational measures are permissible, including maintenance and repair, per compliance with these requirements: a. The program participant or project owners must commit to a repair and maintenance plan for a minimum of three years via a signed customer agreement under which the repair and maintenance activities will continue;[12] i) Continuous feedback for the building operator (or homeowner) must be provided, to sustain savings;[13] ii) Detailed documentation of the operational

Commenter	Comment	DNV Response
	implement in a meaningful way. SDG&E believes this needs greater discussion and broader language to be fully understood, and applied.	interventions;[14] and iii) A detailed data tracking plan pursuant to the signed repair and maintenance plan described above.[15] 4) Program Administrators (or for third-party programs, Implementers) shall include training components in all repair and maintenance program offerings in order to ensure participants understand the value of preventive maintenance and good operational practices.[16] This requirement should be carried out consistent with statutorily defined or Commission adopted workforce standards." The NMEC Rulebook cites the Assigned Commissioner and Administrative Law Judge's Ruling Regarding High Opportunity Energy Efficiency Programs or Projects (12/30/2015) Attachment A. The HOPPS ruling states that "During the claimable expected useful life (EUL) period, continuous feedback should be in place." If no maintenance plan is in place, the evaluation recommends capping EUL to align with the performance period where savings could be measured.
PG&E	**Functional check by program implementers** Section 1.5.4 suggests that “a simple functional check by the implementer on the existing equipment during the investigation phase could eliminate this risk without adding additional burden on the participants.” Since this may change how the site inspections are performed, it should be brought up and discussed in one of the statewide working group meetings and CPUC should collect feedback on it before making any changes in the current rules.	This recommendation is being made to protect participants. There was one project evaluated where the replaced equipment was not functioning and so the anticipated savings were not achieved.

Commenter	Comment	DNV Response
SDG&E	"To protect participants, the implementer should ensure that equipment is operational and meets the functional needs of the building and that the 12 months of pre-installation data is an actual representation of baseline energy usage with functional equipment. A simple functional check by the implementer on the existing equipment during the investigation phase could eliminate this risk without adding additional burden on the participants." SDG&E agrees with this recommendation, and will work with SW stakeholders to implement it in a consistant manner.	Thank you for your comment.
SCE	"Existing NMEC reporting guidance is clear that initial claims should be made in the year of installation and trued-up the following year with a positive or negative value that, when summed with the initial claim, equals the final weather normalized estimate of savings. All claims should follow this structure." • The Site-level NMEC Evaluation Report noted that thirteen projects double claimed savings by reporting savings incorrectly. SCE understands the situation and further corrected the claimed savings by filing the amended 2021 annual claims report “SOUTHERN CALIFORNIA EDISON COMPANY'S (U 338-E) AMENDED 2021 ANNUAL REPORT FOR ENERGY EFFICIENCY PROGRAMS” on February 23, 2023. • SCE notes that the same report was uploaded to the Documents module on CEDARS as well. SCE therefore disagrees with the evaluated GRR results and believes that the amended annual report should have been used to evaluate the GRR. • SCE requests that the evaluation team utilizes the amended claimed data for these projects for a proper evaluation of GRR and revise the results in the impact evaluation report. Thank you for the ability to comment on this important research effort.	Thank you for providing this additional context. This evaluation looked at PY2020-PY2022 claim data submitted to the CPUC via CEDARS and the project GRRs are calculated by comparing the evaluated savings to the claimed savings. It appears that the adjustments for these projects are in the PY2023 CEDARS tracking data. If that is the case, we plan to review the claims in the next evaluation cycle.

Commenter	Comment	DNV Response
kW Engineering	3. The three school projects from SCE were based on 3 months of reporting period data (it was SCE's first milestone at 3-months, the others are at 12 and 24 months of reporting period). Normalizing reporting period energy use based on a model with 3 months of reporting period data presents problems – generating normalized savings estimates for 12 months based on a reporting period model trained on 3 months can over- or under-estimate the actual savings. In this case the 3 months were all pre-covid and in winter months, meaning the reporting period model can potentially only predict low energy values and cause savings to be overestimated. Assuming the other Site-Level NMEC projects were based on 12 months of reporting period data, this would not be an apple-to-apples comparison.	We agree that a model based on 3 months of data is generally not sufficient. In this case, the performance period model was fit for 3-months by kW Engineering, likely due to COVID impacts at the schools. Then, the 3-month model was used to normalize for the 12-month period which was used for making the tracking data claims. While the NMEC Rulebook requires at least a 12-month performance period, these projects were allowed as an exception due to the extenuating circumstances of COVID. Additionally, there have been no additional claims made for a 12-month performance period or for a 24-month performance period. There may be a discrepancy between the models run and the way in which savings are being claimed.
kW Engineering	4. Section 4.1.6. p. 26 describes overfitting due to the TOWT algorithm's splitting of occupied/unoccupied points and determining a different temperature model for each set of points. It goes on to say that this feature, along with the use of occupancy variables, can cause overfitting. Isn't the TOWT's use of time-of-week indicator variables the cause of overfitting? The additional independent variables used in the TOWT algorithm can be indicator variables that designate a period of time of different operations, such as a school's vacation or summer periods, or they can be continuous variables representing occupancy effects as in cases addressing the low occupancy COVID periods. We agree removing the splitting function can reduce overfitting, but do not want readers to understand that this is in conflict with the additional indicator variable.	The intent of the report discussion is to point out that non-binary occupancy variables are intended to track occupancy on a much more informed basis than a simple regression-splitting approach and we don't understand the necessity of including the latter if occupancy is accounted for directly.

Commenter	Comment	DNV Response
kW Engineering	2. The draft report cites issues with the NTGR survey, citing that the survey should also address 'stranded potential' (section 4.4.1, p. 31) and be more aligned with factors relating to project timing and project scope. We believe the survey and its scoring should also consider performance risk, as it falls on implementers and participants in this pay for performance approach. **a.** The net savings results came up with 46% NTGRs for kWh and kW at a statewide level (p. 31). This is similar to CAIC NTGR results and is more of an issue with the survey and its scoring than reflective of a new program paradigm. We agree the NTGR survey should be updated. **b.** Section 3.3, p. 20 provides Table 3-3 which lists the NTGR scoring methodology. If there are many factors evaluated in the survey, there is high likelihood both PAImax and NPImax will each be 10, making the Program attribution index PAI1 score a 5 total. This seems to determine one third of the NTGR based on one program and one non-program factor and not consider the combination of all program and non program factors combined. **c.** Table 3-3 shows a distinction is made for Program attribution index 2 PAI2 that if the project decision was made before learning about incentives, the index is reduced by half. This seems excessive for cases when the program influenced the participant to implement the project sooner (as described in other sections of the report). **d.** E-5115 was put in effect in February 2011, so these evaluated projects weren't required to meet its requirements for program influence. Will subsequent evaluations include reviewing E-5115 program influence narratives and supporting evidence and determining the effectiveness of E-5115 requirements?	Thank you for your comment. Future evaluation may include reviewing E-5115 program influence information. The specific approach is not yet defined. Please look for the Site-level NMEC workplan which will be posted publicly this summer.

Commenter	Comment	DNV Response
SoCalREN	**The Net-to-Gross Methodology for NMEC Should Be Revisited** SoCalREN agrees with the draft report's assessment that "The current methodology may not be well suited for measuring NMEC program influence".[2] The draft report explains that the net-to-gross methodology used for custom evaluations includes three equally weighted program attribution indicators. The draft report notes that "project timing and project scope are expected to be particularly important to NMEC program influence because of the objective of unlocking the stranded savings in buildings that are otherwise able to maintain and repair below-code systems. Aligning the methodology with this intent would offer a better representation of the programs' net impact."[3] SoCalREN endorses the suggestion to give greater importance to project scope and project timing in evaluations. Such an adjustment would likely more accurately reflect the net-to-gross factors of projects, particularly those that have been categorized as repaired indefinitely.	Thank you for your comment.
SoCalREN	**Discrepancies Between the Draft Report and the Webinar Should be Addressed** SoCalREN notes that data for SoCalREN in the draft Report Table 1-5 "Net electric energy saving results by PA" does not align with slide 21 "Net Savings" presented at the April 24, 2024 webinar. SoCalREN requests that these discrepancies be corrected in the final report.	We have updated the report table.
PG&E	**Net-to-gross interviews** PG&E agrees that "the CPUC should revisit the current NTGR methodology instrument and assess if the instrument and algorithm is in line with the actual NMEC program design and delivery" and would like to offer help and cooperation in reevaluating the NTGR methodology to customize it to SLNMEC. We recommend factoring in the SLNMEC project timing and the risk associated with the meter-based nature of the projects when evaluating the program influence. By taking part in an EE project with no guaranteed incentive amount even after the installation of the measures as proposed, the customers	There will be opportunities for PAs to engage in-terms of providing comments and feedback on the updated NTG methods via the PDA platform.

Commenter	Comment	DNV Response
	are willing to take the risk that they would not have taken if the program did not have substantial technical influence.	
SoCalREN	SoCalREN thanks the California Public Utilities Commission (CPUC) and DNV for releasing the draft Site-Level NMEC Evaluation Draft Report for Program Years 2020-2022 for stakeholder feedback. Below are SoCalREN's comments on the draft report.	Thank you for your comments.
PG&E	PG&E Appreciates the California Public Utilities Commission (CPUC) and DNV for conducting the research and releasing the Site-Level NMEC Evaluation Draft Report for Program Years 2020-2022. Below are PG&E comments on the draft report.	Thank you for your comments.
SCE	SCE appreciates the opportunity to comment on this important research effort and looks forward to the final report and improving overall program performance.	Thank you for your comments.
SoCalREN	**Clarification On the Role and Timing of Advisory Dispositions** The draft evaluation states "Four out of the 22 projects included in the gross evaluation had been selected for Project Review prior to project installation. Two of the projects addressed the issues raised in the review disposition. However, the other two projects did not address key disposition issues."[1] During the webinar on April 24, 2024, the evaluation team clarified that advisory dispositions aim to prompt adjustments at the Installation Report Stage without causing delays in project approvals. Emphasizing the role and timing of advisory dispositions in the final report will help distinguish this process.	A key difference between custom and NMEC project reviews is that NMEC project reviews are advisory only. As such, projects may proceed prior to the project review which may increase the risk of not being able to implement all of the recommended changes. There may be other actions PAs could undertake to reduce this risk by taking proactive steps such as requesting early opinions or pointing out key areas for review prior to project implementation.

Commenter	Comment	DNV Response
PG&E	**Issues identified through Energy Division’s Project Review process** PG&E agrees that there should be a response to the CPR disposition in the post-install project package for all projects that receive a disposition. Perhaps this step could be added to the process as defined in the CPUC document, “Streamlining_Timelines_Per_SB1131”. PG&E identified this as a need and has made significant progress in that direction since the early years of SLNMEC program launch. In addition, PG&E discussed the Refrigerated Warehouse early opinion with CPUC review team and together decided to grandfather projects that were in the development stage when the Early Opinion was issued. PG&E makes sure that all projects that were developed after issuance of the Early Opinion follow this EO in its entirety. While PG&E works diligently with the project development team to address all deficiencies found in the CPR and includes them in a response to the disposition, we disagree with the recommendation to make NMEC Project Reviews more than advisory. This recommendation not only contradicts with SB1131, but also is a move in the reverse direction of what program participants suggested during the SLNMEC evaluations. As mentioned in Section 5.3 of this report, the respondents to the program improvement question most frequently recommended streamlining the program and reducing administrative burden. Making the dispositions more than advisory holds up the projects while they are under review by the CPR team and adds significantly to the timeline of SLNMEC projects beyond what it is currently. This would also contradict the recommendation at the end of the Section 1.5.3 of the same report.	Current rules do indicate that responses to dispositions should be included in the post-install package. The NMEC Rulebook says that "Final savings claims shall be substantiated by an M&V Report, consistent with the specifications in the Project M&V Plan. a. The project M&V Report should reflect Commission staff review recommendations, if the project was selected for review. b. Any deviations from the proposed M&V Plan should be documented and substantiated in the M&V Report." Please note that the recommendation in the report says the CPUC should consider making the "NMEC Project Reviews more than advisory..." Our recommendation of more than advisory does not intend to halt project implementation, but rather to ensure that the disposition recommendations are addressed as much as possible without withholding the project. Additionally, NMEC project reviews are not covered by the 30 day review period from SB1131. If future project packages show that Commission staff review recommendations are generally followed as the site-level NMEC programs further develop, this concern may be lessened.

Commenter	Comment	DNV Response
SDG&E	"The PAs should address issues identified through the NMEC Project Review process and should document the reasons for making changes within the final savings report to improve project quality. • CPUC should consider making NMEC Project Reviews more than advisory so that issues are more likely to be addressed during the project implementation which will help PAs achieve more accurate savings claims." SDG&E disagrees with this recommendation and believe it is too vague to implement. We have addressed this recommendation in our comments to the "draft rulebook" changes; submitted previously.	Noted. The first part of this recommendation clearly follows the existing NMEC Rulebook, which states that "Final savings claims shall be substantiated by an M&V Report, consistent with the specifications in the Project M&V Plan. a. The project M&V Report should reflect Commission staff review recommendations, if the project was selected for review. b. Any deviations from the proposed M&V Plan should be documented and substantiated in the M&V Report."
SDG&E	"Consider, as part of future studies, • Assessing the volume of stranded savings potential. The 2019 Energy Efficiency Potential and Goals Study by Navigant/Guidehouse identified below code energy efficiency potential as reflecting “additional claimable impacts allowed after the passing of AB802” and should represent the target population for NMEC programs. • An exploration of PA and implementer efforts to identify and target “stranded potential” buildings for NMEC projects." SDG&E agrees with this recommendation, and will work with SW stakeholders to implement it in a consistant manner.	Thank you for your comment.

Commenter	Comment	DNV Response
kW Engineering	5. Section 4.6.2, p. 40. Removing the to-code savings (as proposed in the report and in the proposed updated rulebook) can bias the savings. Engineering calculations are often high, so removing their estimates from the NMEC savings with a modeled approach can bias the final result. Despite AB 802 not requiring this NR adjustment, making this adjustment should only be done if the uncertainties of both the engineering estimate and the meter-based savings results are known. In other words, the quality of each savings result should be assessed before applying this requirement.	Noted. However, one possible motivation for a customer pursuing NMEC is that calculated savings which should reflect population means are expected to be lower than the site-specific savings due to higher HOU, etc. In this case, a deemed-savings based adjustment would in fact be too small. PG&E has acknowledged that they treat un-influenced measures as NREs where possible but if that measure occurs at the time of other NMEC measure installations, the NRE approach is not feasible. The intent of having the PA do the NR adjustment is precisely to have those most knowledgeable of the project estimate a reasonable value for to code savings and to explain that logic. Leaving that adjustment in the hands of evaluators risks a less site-specific consideration of those to-code savings. Additionally, IPMVP provides some guidance in quantifying NREs that could be followed by the implementers until further guidance is provided.

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