Industrial Systems Optimization Program (ISOP)

DRAFT Program-Level NMEC M&V Plan

*Pacific Gas & Electric Co.*

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# Background Information

## Document Purpose

ISOP – the Industrial System Optimization Program – is a third-party designed and implemented program selected through PG&E’s 2019 Solicitation process. ISOP uses an opt-in, single-point-of contact program delivery model for industrial, manufacturing and food processing customers to motivate energy savings through PG&E’s deemed, custom, normalized metered energy consumption (NMEC), and on-bill financing platforms (OBF).

ISOP NMEC projects will calculate savings using site-level NMEC methodology. Under this approach, NMEC methods used to determine savings for each project conform to site-specific conditions and savings drivers. NMEC methods are used to develop energy savings claims specific to a participating site.

CPUC and PG&E administrative guidance, including the CPUC NMEC Rulebook[[1]](#footnote-2) and PG&E Resource Savings Rulebook[[2]](#footnote-3), specify the following measure and verification (M&V) structure for NMEC savings claims:

* **Program-level M&V Plan.** A Program-level M&V Plan is required for each site-level M&V program. The program-level M&V plan is to be included in Implementation Plan filings and must address a list of topics specified in the NMEC Rulebook. *This document is the ISOP Program-level M&V Plan.*
* **Project-level M&V Plan.** NMEC-determined energy savings rely on a project-specific M&V plan, customized to the specific characteristics of the site and project. Each project-level M&V Plan shall include the proposed data collection, analysis methodologies, and documentation for an individual project, including project pre-screening, savings determination, and reporting. Project-level M&V plans will be submitted for each ISOP NMEC project. This document describes the requirements for project-level M&V Plans.

## NMEC Approach

The quantification of achieved energy and demand savings after the installation of Energy Efficiency Measures (EEMs) is based on the analysis of pre- and post-installation metered energy data. The savings methodology follows the established Option C Whole Building approach as documented in the International Performance Measurement and Verification Protocol (IPMVP).[[3]](#footnote-4) This M&V plan will apply to a variety of projects, each of which addresses different equipment, operating schedules, changes impacting energy use, metering and data resources, and levels of savings.

The site-level NMEC methodology has long been established in two well-known industry guidelines: IPVMP (Option C) and ASHRAE Guideline 14.[[4]](#footnote-5) The IPMVP describes best practices for different savings verification approaches while the ASHRAE Guideline 14 provides more detailed technical requirements. Because ISOP focuses on industrial facilities (see Section 4.10 for additional detail), this M&V Plan also draws on best practices described in the California SEM M&V Guide[[5]](#footnote-6) and Bonneville Power Associations Monitoring, Targeting & Reporting Guidelines (MT&R).[[6]](#footnote-7)

With the widespread availability of electric and natural gas energy use data measured in short-time intervals (e.g. sub-hourly, hourly, and daily) from advanced metering infrastructure (AMI) in the PG&E territory, and development of more accurate energy modeling algorithms, meter-based approaches have been employed in efficiency projects with great accuracy and success. The AMI data and advanced modeling algorithms have enabled more timely feedback on a facility’s energy use and savings achievements and have provided insight on the identification and treatment of non-routine events (NREs).

## ISOP M&V Plan Development

The ISOP M&V Plan was developed by Cascade Energy for PG&E with applicability solely limited to ISOP. The methodology and approach detailed in this plan draws heavily (and in many cases, incorporates directly) from the sources listed in the References Section, specially PG&E and SCE materials, California Strategic Energy Management (SEM) documents, Bonneville Power SEM documents, and NMEC Technical Guidance developed by LBNL for CPUC.

This plan may be updated in the event of revisions to key governing documents. In all cases, current versions of the CPUC NMEC Rulebook and related guidance shall apply.

# Project Timeline and Reporting

This section describes the general process of how individual projects will be accepted into ISOP, key milestones and approval steps, and what information must be provided in each project-level M&V plan and savings report.

## Eligibility Determination and Project Influence

Candidate sites will be screened for eligibility based in part on responsiveness to energy efficiency implementation, consistency of operations, and eligibility of proposed measures. ISOP engineers and coaches will coordinate with facility staff to identify measures, develop implementation plans, and estimate savings and incentives.

### Project Eligibility Criteria

Projects will be eligible for ISOP incentives using NMEC if they are currently allowable through the deemed and calculated energy efficiency programs, if they are other measures where the program documentation and program-level M&V Plan demonstrates that the savings and EUL forecasts are reasonable, or if they are behavioral, retro-commissioning, and operational (BRO) measures, including maintenance and repair. The following special cases are applicable, as specified in PG&E guidance[[7]](#footnote-8):

* **Commonly Replaced Equipment**. If a project will include savings associated with replacement of failed equipment with new equipment, a data-supported case that a given piece of equipment has a history of being repaired rather than replaced will be required or the project will be ineligible.
* **Repair of Non-Essential Component(s) of Equipment or Systems**. Non-essential components are those that, when failed or not operating as designed or optimally, only reduce efficiency and do not prevent the equipment from delivering the original service or function.
* **Fuel Substitution Measures**. Fuel substitution measures are eligible, but specific M&V and reporting issues will be addressed within the Project-Level M&V Plan.

### Maintenance Plan for BRO Projects

Per NMEC Rulebook guidance[[8]](#footnote-9), for all BRO projects, the program participant will 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. All interventions will be documented by ISOP staff.

## Project Time Periods

There are three time periods associated with each project: a baseline period, an implementation phase, and a performance monitoring and savings reporting phase. Savings will be determined as the normalized difference in energy consumption between the baseline period and the performance period.

### Baseline Period

The length of the baseline period shall be 12 consecutive months (1 year) to account for variations in operations and seasonality. The baseline period does not have to coincide with a calendar year. If valid adjustment models cannot be created and it is suspected that the 12-month baseline period is a limiting issue, a 24-month long baseline period may be used.

The customer and implementer shall work together to establish the start and end date of the baseline period so that it is as recent as practical at the time of the ISOP energy efficiency projects implementation.

### Implementation Period

The participant may proceed with measure installation only after receiving program approval. The participant must inform PG&E (via ISOP) when the energy efficiency measures (EEMs) have been installed. Either the participant or implementer may be responsible for verifying each installed measure.

### Performance Period

The Performance Period is sometimes referred to as the Reporting Period. The Performance Period begins following completion of all EEMs. The duration of the performance period must be at least 12 months, unless a shorter duration is considered sufficient by ISOP staff with PG&E’s explicit approval.

The first year savings energy savings, which will be the basis for participant incentives and ISOP savings claims, will be equal to the calculated energy savings during the 12 month Performance Period. For the purposes of reporting, the first year savings may in some cases be extrapolated based on a representative 90 day period of performance data within the first 5 months of the Performance Period, with a true-up following completion of the Performance Period.

The Performance Period may be extended in the event that additional EEMs were installed following the initial Implementation Period. The duration of the Performance Period would allow for at least 12 months of monitoring for each EEM.

## Documentation and Reporting

All participating facilities will complete pre-project and post-project reports as specified below:

### Project Application (Including Project Feasibility Study and Project-Level M&V Plan)

The Project Application will be submitted to PG&E with an opportunity for review and feedback by PG&E and CPUC reviewers prior to implementation of any measures.

Project Application will include:

1. **Project Feasibility Study.** The feasibility study will assess potential EEMs and provide information to meet the requirements set forth by the CPUC. The feasibility study shall include:
	* Site Pre-Screening Results, including assessment of site eligibility including assessment of condition of existing equipment and availability of at least 12 months of historic energy and weather data.
	* List of EEMs, including measure types (e.g. capital, BRO) and measure application type. Per NMEC Rulebook guidance, the Feasibility Study will identify any normal replacement EEMs within the scope.[[9]](#footnote-10) In the event that additional EEMs are identified for a participating facility following submission of the PFS, they may be added to the project, as long as they comply with PG&E and CPUC requirements. All completed EEMs will be documented in post-project reports (discussed in Section 2.3.2 and 2.3.3).
	* Forecast of energy savings and expected useful life (EUL) for each EEM. Savings forecasts will follow Rulebook guidance but will generally rely on engineering judgment and/or readily available data rather than data logging to establish approximate savings via bottom-up calculations. These estimates will not be the basis for savings claims, incentive offers, or performance payments.
	* Forecast of site total energy usage during baseline period and total savings during performance period. To assure savings are detectable above model noise, ISOP targets 10% or greater savings of baseline year electric and natural gas consumption. If lower than 10% savings are anticipated, the feasibility study will describe how the meter-based analysis may be used to quantify the savings at an acceptable certainty level, consistent with best practices described by ASHRAE Guideline 14 and other documented references.
	* Influence Documentation, as described in Section 4.5.
2. **Project-Level M&V Plan.** The M&V Plan will use a standard template (provided in Appendix 6.2) which includes the following information. As part of the Project-Level M&V, ISOP will also make available all raw data series and provide access to software tools (see 3.3.1) to provide transparency to reviewers.
	* Project Boundary, as described in Section 3.1.1.
	* Hypothesis Variables and Data Sources, as described in Section 3.1.3.
	* Baseline Data Report, including data excluded from the baseline (outliers) and treatment of NREs during the baseline period and expected during the performance period, as described in Section 3.2.
	* Baseline Model Details and Statistical Fitness Criteria, as described in Section 3.3.
	* Data Monitoring Plan, including sources of data, any anticipated NREs during the Performance Period, and anticipated NRE adjustments.

### Initial Savings Report

**Initial Savings Report.** As recommended in the CPUC Rulebook, the first savings report provides a snapshot of performance, including assessment of any NSEs identified to date. As described in Section 2.2.3, the Initial Savings Report may include an annualized 12 month savings estimate, to be used as the basis for preliminary savings claims and/or performance and incentive payments.

**Installation Verification Report**. The measure verification report will document the list of installed EEMs and also include cost information for each EEM. Full measure cost information (labor and materials) will be supported by receipts, contractor invoices, and the customer’s own labor and materials accounting system.

### First Year Savings and M&V Report

**Final Savings Report**. The final savings report will be delivered after twelve months of the Performance Period has been completed. The twelve-month savings report will include:

* Meter calibration requirements and documentation for data from any sub meters used,
* Identification of Baseline and Performance Periods
* Documentation of modeling algorithms used,
* Model goodness of fit metrics,
* Energy savings analysis, including documentation of any adjustments for NREs or concurrent incentive projects.
* Where applicable, true-up calculations for any preliminary annualized savings estimates provided in the Initial Savings Report.

### Second Year Savings and M&V Report

As part of multiyear participation in ISOP, some facilities may continue installing EEMs after the initial Implementation Period, per Section 2.2.3. In such cases, ISOP may elect to perform an additional 12 months of performance monitoring to document energy savings incremental to the initial claim.

In the event that additional EEMs are installed, per Section 2.2.3, additional Savings Reports may be provided to document savings specific to those EEMs, following the conclusion of the second 12 month period.

# Model Development and Savings Determination

There are five key steps associated with NMEC savings determination: facility characterization, baseline data preparation, baseline model development, monitoring performance, and energy savings claims.[[10]](#footnote-11)

## Facility Characterization

Facility Characterization details will be documented in the Project Feasibility Study.

### Facility Boundaries

A consistent project boundary must be used for the Baseline Period and Performance Period. The boundary must be configured in such a way that relevant energy and material inputs and outputs can be reliably measured throughout the project.

ISOP project boundaries may include either:

* **Whole Facility.** All systems and processes, and all energy usage (and generation, if applicable) at the facility, would be within the measurement boundary for the NMEC project. Energy usage would typically be measured by one or more utility meters.
* **Select Systems.** The boundary would delineate certain end-uses from others, allowing more focused efficiency efforts. Detailed documentation of energy end-uses and energy sources for specific systems including measurement/sub-metering locations would be required.

### Energy-Consuming Processes

Facility assessments and coordination with facility staff will allow development of a list of in-boundary energy-consuming processes. Energy audits and scoping conversations will be an important point of ISOP project influence and an important input for estimates of savings potential and measure cost-effectiveness.

### Determination of Independent Variables

Based on the system inventory and process characteristics, a hypothesis of likely energy drivers will be developed. Drivers may include, but will not be limited to:

* Ambient conditions (dry-bulb and wet-bulb temperatures);
* Facility operational modes (weekend/day) or occupancy levels;
* Production levels, including shipments to and from the facility;
* Other production-related variables such as raw material properties, etc.

Each hypothesis variable will be documented in the Feasibility Study along with the following criteria:

* **Data Source.** Meter or measurement type, accuracy, location and related relevant information (including serial numbers or account numbers for utility meters). If energy data from submeters is used, submeter types and accuracy will comply with NMEC Rulebook guidance.[[11]](#footnote-12)
* **Time Resolution of Data.** Energy and relevant variable data shall be collected at least monthly if not more frequently (e.g., weekly, daily, 15-minute interval). In general, more frequent data collection will be used if possible. Daily or weekly time interval data typically provide better insight into the process being modeled, and thus more accurate adjustment models may be created when compared to data of longer durations such as monthly data.
* **Statistical Significance.** In the process of variable selection, the model developer will face competing objectives: capture the full subset of statistically significant variables and provide the customer with a model that is simple and easy to maintain. No single selection criteria will provide the perfect solution, so the modeler must rely on his or her experience and engineering judgment.

## Baseline Data Preparation

Baseline data readiness details will be documented in the Project-Level M&V Plan. All data (in raw and cleaned forms) will be available for review by PG&E and CPUC staff.

### Specification of Baseline Period

Data for all hypothesis variables must be available for the entire duration of the Baseline Period. Per NMEC Rulebook[[12]](#footnote-13) guidance and as described in Section 2.2.1, the Baseline Period will satisfy the following requirements:

1. The Baseline Period must span no less than a 12-month period.
2. The baseline energy consumption shall be adjusted for non-routine events, as needed, as further described below in Section 3.2.2.
3. If the time between the end of the baseline period and the completion of implementation phase lasts more than 18 months, the project will be re-baselined to adjust for potential changes in coverage, normalization conditions, and consumption.

### Baseline Adjustments for Outlier Data

An initial review for outliers will be conducted by plotting each variable independently in a time series format. Apparently erroneous entries will be identified and flagged. Control limits of three standard deviations, ±3 sigma (σ), from the mean are often useful for identifying outliers in normally distributed data.

Missing or outlier data points will be reviewed with facility staff and verified or corrected if possible. If this is not possible, select data points may be removed from the data set (which is generally preferred to interpolation or estimation). All removed data points will be documented with supporting rationale in the Project-Level M&V Plan.

### Baseline Adjustments for Non-Routine Events (NREs)

Baseline data shall also be analyzed to determine the presence of unusual energy use patterns that may be caused by NREs. All suspected NREs should be confirmed with the participant and confirmed baseline period NREs must be documented in the pre-screen report, with a clear description of how their impacts will be addressed.

In keeping with PG&E’s guidance, NREs may be removed from the baseline data set only if they affect less than 25% of the data. If they affect more than 25% of the data, the facility may be ineligible.[[13]](#footnote-14)

The Project-Level M&V Plan will describe any NREs that occurred in the baseline period along with how they were treated, and any NREs anticipated during the performance period. Information on anticipated performance period NREs should be based on discussions with a knowledgeable representative of the participant, including type of NRE, its significance, anticipated time of occurrence, and duration. The project-level M&V Plan should describe how the NRE impacts will be quantified. The possibility of adding meters to help quantify NRE impacts should be considered.

## Baseline Model Development

Model equations and statistical fitness criteria will be documented in the Project-Level M&V Plan.

### Modeling Approach

In general, ISOP staff will seek to develop a single model to account for the energy usage of each facility. In special cases, a second model may be required to account for cases with distinct processes and operating modes that vary throughout the year (e.g. high and low production periods or extreme seasonal variation).

The model selection is not always simply based on the best statistics. The model is selected based on a combination of model statistics, ease of data acquisition, physical conditions at the site, and what makes intuitive sense to the facility operators.

ISOP will generally seek to develop a Linear Regression model based on a Forecast Normalization methodology to develop a model of baseline energy consumption that is applied to the Performance Period data to calculate adjusted baseline period energy consumption for comparison with observed (actual) reporting period energy consumption.

Model development is expected to be conducted in Cascade Energy’s SENSEI software platform[[14]](#footnote-15), which streamlines the process of testing candidate variables for statistical significance and comparing performance of hypothesis models. All hypothesis model variants, input and output data, resulting model coefficients, and model metrics will be documented and available for review.

### Statistical Criteria for Model Fitness

As specified in CPUC’s NMEC Technical Guidance[[15]](#footnote-16), the final model must meet the following criteria:

* Coefficient of Variation of the Root Mean Squared Error: 𝐶𝑉(𝑅𝑀𝑆𝐸) < 25%
* Net Mean Bias Error: 𝑁𝑀𝐵𝐸 < 0.5%
* Coefficient of Determination: 𝑅2 > 0.7 (recommendation only, not a criterion; lower values may be acceptable as long as low savings uncertainty is achieved)

In addition to the criteria listed above, models will be visually checked for validity, using a scatter plot comparing observed (actual) energy consumption versus calculated energy consumption using the model. The graph, and any other plots used for visual fitness assessment, will be included in the Project-Level M&V Plan.

## Monitoring Savings and Adjusting for Non-Routine Events (NREs)

### Monitoring Performance

During the Performance Period, data will be collected per the data collection plan. Performance data will be methodically reviewed to detect anomalous values and to ensure that the independent variables fall within the ranges specified for the model. For models with a single mode of operation, the generally acceptable values for each variable will be the maximum of ±3σ or the range used in the model.[[16]](#footnote-17) Outlier data will be reviewed with the customer and may be removed from the data series if determined to be erroneous. All excluded data will be documented in the Savings Report.

During the performance period, ISOP will maintain a list of all potentially relevant changes to the facility, including schedule changes, equipment installations, or production changes.

### NRE Adjustments

During the performance period, the most common method to identify NREs is through visual inspection of the metered energy use data. Time-series charts of energy use data may be used to identify shifts in energy use patterns that may be caused by NREs. If energy use data begins trending significantly outside expected values as determined by the model, an NRE may be present. ISOP staff’s professional judgement will be used to identify NREs, but a situation in which an independent variable departs its baseline mean by ±3σ will serve as a flag of a potential NRE.

Quantification of performance period NRE impacts will be documented in applicable Savings Reports. Methodologies to quantify NRE impacts include:

* Removing data from a short period of time the NRE occurred, developing a performance period model with the remaining data, and using it to quantify savings for the project. The NRE impact may be determined from the difference in actual energy use and the performance period model prediction during the time the NRE occurred.
* Using an indicator variable in the savings model for the time period when the NRE occurred. A simple indicator variable may be appropriate for an NRE that creates a constant addition or removal of energy. More sophisticated variables may be used when the NRE has variable energy use impacts.
* ISOP will be cite the BPA MT&R Guidelines for specific methodologies regarding implementation of Static Change Adjustments, Minor Process Adjustments, and/or Major Process Adjustments.[[17]](#footnote-18)

Any updates to the energy model used to calculate savings must be documented in the Project M&V Report.

## Finalizing Energy Savings Claims

### Calculation of Gross Savings

Energy savings within the project boundary will be calculated by applying the following equation:

*Energy Savings = Predicted Energy Use – Actual Energy Use ± Non-Routine Event Adjustments*

Where:

* Predicted Energy Use = energy consumption calculated for the performance period using the Baseline Model.
* Actual Energy Use = energy usage during the performance period as recorded by data sources specified in the M&V Plan.
* Non-Routine Event Adjustments = adjustments as described in the previous section.

### Adjustments for Other Incentivized Projects

If the end user is participating in other PG&E or Statewide program offerings, gross energy savings adjustments will be applied to gross savings results. Utility-approved project savings values associated with any projects will be used, prorated as necessary for the performance period.

PG&E’s Energy Insight platform will serve as the system of record for identifying possible concurrent incentive awards. ISOP Savings Reports will document the existence or absence of any concurrent projects.

### Reportable Savings

Savings claims will be reported with supporting documentation in the Final Savings Report. Depending on the specific mix of measures installed, an updated EUL value may be applicable. Per NMEC Rulebook[[18]](#footnote-19) guidance, reported savings will satisfy all applicable following requirements including:

1. Final savings claims will be filed only after the reporting period has ended and the M&V has been completed and finalized.
2. Final savings claims will be normalized by long term weather based upon the most up-to-date weather files. Weather and other normalizing adjustments will be applied to the baseline and performance period.
3. Final savings claims shall be substantiated by an M&V Report, consistent with the specifications in the Project-Level M&V Plan. All revisions to the M&V Plan as a result of PG&E and CPUC feedback, as well as other deviations from the proposed M&V Plan will be documented and substantiated in the M&V Report.
4. Final savings claims will reflect the same effective useful life, gross realization rate and net-to-gross used to adjust savings estimates.

# Specific NMEC Rulebook Topics

The subsections below address specific M&V Plan topics listed in Section II.1.A.1.a-m of the NMEC Rulebook (*Program-Level M&V Plans for Site-Level NMEC Programs*).

## Methodology, Analytical Methods, and Software Employed

See Chapter 3 above for detailed methodology description.

ISOP will rely on Cascade Energy’s SENSEI software for development and documentation of regression model and savings quantification. SENSEI licenses will be provided to any reviewer needing access. Use of SENSEI within ISOP is described in more detail in the Implementation Plan.

## Data Collection Plan

Analysis will incorporate data of several types:

* **Weather data** is integrated into SENSEI via a high-quality and gap-free feed aggregation service called DarkSky (<https://darksky.net/dev>). DarkSky takes data from multiple NOAA sources, including the NOAA Integrated Surface Database and converts the values into a regular hourly data stream for a specific location based on latitude and longitude. The aggregation uses an advanced algorithm that pulls data from multiple surrounding weather stations, giving greater weight to those that are closer in distance or more reliable in quality, while also accounting for geographic features. The result is a data stream with better accuracy and no gaps, even when a station goes offline. However, the data stream may not match any one weather station 100%, especially one that has significant gaps. The weather data in SENSEI is available for inspection and use by regulators and authorized utility staff.
* **Utility meter data**. Meter or service agreement numbers will be recorded for each utility data stream. Data will be captured from Green Button connect if possible.
* **Submetered energy data**. Participant-owned submeters must be identified and their accuracy specifications documented. Recent calibration documentation must be provided for meters that require periodic calibration. Minimum accuracy requirements must adhere to CPUC specifications. Meters undergoing in-situ calibration must describe the process and equipment used to calibrate the meter and how results were used to update meter readings.
* **Other customer data**, such as facility schedules, production levels, or occupancy. Data collection will be specific to the needs of each participating facility.

Sources of data and processes for collection will be documented in the Project-Level M&V Plan. The data plan will specify how often data will be collected and prepared for analysis and summarize any data quality issues identified and their resolution.

## Approach to Ensure Adequate Monitoring in Reporting Period

Project M&V Plans will describe how often energy use and independent variable data in the performance period will be collected and avoided energy use calculated. This activity is critical for three reasons:

1. To assure a participant’s sub meters continue to record data as expected. This is important for projects where a participant’s own energy metering systems are used. It is sometimes the case that these systems fail or encounter issues with data collection and archiving.
2. To assure savings are accumulating as expected, and
3. To periodically check for the presence of NREs, work with participants to determine their cause, and determine how to remove their impacts from the final savings analysis.

For each project, these factors are considered when determining the frequency of the savings progress reports. For example, projects with predictable buildings using reliable utility meter data may require savings progress to be checked every three to six months. Projects with customer-owned meters, potential NREs, and uncertain upfront savings estimates may need to check savings progress each month.

Monitoring shall include the collection of data for each dependent variable (energy use in kWh, therms, chilled and hot water BTUs, etc.) and independent variable (weather data, production rates, etc.) used in the baseline model. Following customer enrollment, PG&E meter data will be loaded into SENSEI using Green Button Connect in near-real-time if possible.

## Identifying and Adjusting for Non-Routine Events

Methodology details for addressing NREs in model results and savings reports are described in Section 3.4.2.

Given the breadth of sectors and facility sizes and types served by ISOP, NREs may take a wide variety of forms in different project. The following are examples of potential NREs:

* Changes in facility size,
* Changes in facility activity not affected by the energy efficiency measures (such as addition or removal of a data center),
* Addition of new equipment for safety/environmental purposes,
* Sustained increase or decrease in the observed level of an independent variable outside the range for which the baseline energy model was established.

Possible NREs will be identified through continuing monitoring of performance data as well as regular project check-ins with the customer. All NREs will be documented in the Project M&V Report. Standard thresholds will apply for identification of significant NREs and for possible updates to regression models (as specified in Section 3.4.2), ensuring that directionality is not biased specifically toward positive or negative adjustments.

## Determining Project Influence

Only projects which have been actively influenced by ISOP will be eligible for savings claims and incentives.

Project influence documentation will be consistent with custom program requirements, which will be described and supported by documentation within the Project Feasibility Study (see Section 2.3.1). The narrative will summarize the project developer's engagement and communications with the customer, the customer's decision-making criteria, and the project timeline, and will describe how the project was initiated, how the measure was identified, the alternative viable options that also meet the customer's needs, and the energy and non- energy benefits. Documentation, with time stamps if applicable, may include marketing materials, audits or site visit results, savings or financial calculations shown to customers, email correspondence, meeting minutes, customer internal policies or investment criteria, and/or relevant internal customer communications.[[19]](#footnote-20)

ISOP will use a net-to-gross (NTG) ratio of 0.95 for all NMEC projects per CPUC Resolution E-4952.

## Rationale for Confidence in Savings If Less than 10% of Baseline Consumption

Pre-screening will assess the project’s ability to detect a minimum 10% savings. After measures have been identified and their expected savings quantified, the uncertainty for the expected savings may be determined using the CVSE formula. To be detectable, the maximum allowable savings cannot be more than 50% at the 90% confidence level.

Use of interval data and advanced modeling methods means that even if fewer EEMs are installed or if they are not functioning as intended, savings at or below 5% may still be determined with reasonable accuracy and confidence.

## Incentive Structure

Where applicable, NMEC financial incentives will be calculated per the incentives rates specified in the ISOP Implementation Plan, including all applicable adders and subject to cost caps.

All incentives will be based on actual energy savings, as determined during the performance period and verified by the Savings Report. In addition, the ISOP program implementer will be eligible for performance-based payments calculated as a function of achieved energy savings.

## Costs, Energy Savings, and Expected Useful Life of Planned Measures

Each site-level NMEC project requires a list of EEMs with their estimated savings, measure costs, and EUL. This information will be provided in the Feasibility Study.

### Measure Costs

The full measure cost, as well as incremental cost if applicable, for each EEM will be estimated prior to implementation using any sources available, such as vendor quotes, market research, comparison to similar projects. Cost estimates for each EEM will be documented in the Feasibility Study and confirmed in the Installation Verification Report.

### Measure Energy Savings

Project energy savings will ultimately be determined at a project level through application of the regression model.

For the purposes of pre-project CPUC and PG&E review, savings forecasts may be derived from either of the following approaches, with key assumptions documented in the Feasibility Study:

* **Approved deemed values**, where deemed measures are applicable and applicable to existing conditions baseline.
* **Engineering or modeled estimates**, based on rated equipment usage, typical operational profiles, and engineering judgment, in alignment with NMEC Rulebook guidance.

### Measure Effective Useful Life (EUL)

EUL for each EEM will be specified prior to project implementation and documented in the Feasibility Study. EULs will be based on DEER, workpaper or other Commission adopted values, where available based on measure type.

* **BRO Projects:** Per PG&E guidance,[[20]](#footnote-21) behavioral measures in non-residential settings may use an EUL of up to two years, while retro-commissioning and operational measures are permitted to use an EUL of up to three years for ex ante savings claims.
* **Capital Projects**. A DEER EUL value will be used when applicable. If not, EULs based on technology type will be consistent with statewide custom program standards.

## Project-Level EUL Calculation

A weighted average EUL will be calculated by adding together the product of each EEM’s EUL multiplied by its expected savings, and dividing by the total expected savings. The forecast weighted average for all recommended EEMs will be included in the Feasibility Study based on forecast EEM savings, and the updated weighted average EUL for the EEMs actually installed and verified will be included in the Final Savings Report.

## Program Target Population and Eligibility

NMEC will only be used to calculate savings from eligible projects and facilities. In all cases, the current versions of the NMEC Rulebook, PG&E Resource Savings Rulebook, and other statewide policy guidance will apply.

Participation will be limited to eligible ISOP participating facilities, as classified by the NAICS codes listed in the Implementation Plan.

Eligibility will be assessed in the Feasibility Study. Projects will be specifically identified as one of the following types:

* **Commercial Facilities.** Existing commercial buildings are eligible for NMEC approaches per the 2020 NMEC Rulebook.[[21]](#footnote-22)
* **Industrial Building End Uses.** Per the 2020 NMEC Rulebook, “Site-level NMEC projects in industrial buildings are permissible, to the extent they are similar to one that would be carried out in a commercial building.” [[22]](#footnote-23) Projects which deal solely with commercial-like loads will be eligible for ISOP NMEC, and project boundaries will be clearly documented.
* **Industrial Process End Uses.** If future policy guidance expands site-level NMEC eligibility to industrial process loads, such projects will be eligible for ISOP at that time.

Potential participants will be subjected to additional qualitative eligibility screens based on influence, expected project cost-effectiveness, and likelihood of achieving 10% or greater energy savings.

## To-Code Savings Targeting

EEMs that capture To-Code (or To Standard Practice) savings will be a key focus of ISOP and eligible for NMEC savings calculations. One of ISOP’s basic objectives is to enroll participants in comprehensive efforts to identify and capture energy savings from underperforming equipment, which includes replacing operational existing equipment with newer, more efficient models. Apparently straight forward upgrades often go uncaptured indefinitely at large commercial and industrial sites due to barriers such as a customer’s lack of energy efficiency knowledge, reluctance to change the status quo, complex organizational structures, and competition for limited capital.

When To-Code EEMs are identified, the operability (or probability of repair) of existing equipment will be documented as described in Section 2.1.1 and consistent with PG&E guidance for Normal Replacement or Add-On Equipment measure application types.[[23]](#footnote-24)

All NMEC EEMs, including To-Code projects, will use an existing conditions baseline. Individual EEM savings estimates will not separately quantify to-code and above-code portions of savings.

## Copy of Bid M&V **Plan**

The following response was provided in the original ISOP bid, submitted to PG&E August 2, 2019, as a portion of the response to Q-35.[[24]](#footnote-25)

As SEM implementers for SCE/SoCalGas and SDG&E, we are well acquainted with data acquisition challenges for NMEC verification. We plan to connect our SENSEI software to PG&E’s Green Button portal, which will allow Cascade to automatically receive timely energy data for NMEC participants. Our SENSEI software also partners with a weather service that retrieves hourly dry bulb and relative humidity data based on latitude and longitude. Activity metrics such as cases received/shipped must be provided by the participant. We will provide simple forms for NMEC participants to send us their activity data, and motivated customers will have the opportunity to set up automated data transfer from their SCADA systems to our SENSEI platform for a hands-free approach.

Projected savings from NMEC projects generally range between 5% to 15% of baseline energy use. Cascade follows the ASHRAE 14-2014 fractional savings uncertainty (FSU) recommendation of no more than 50% uncertainty at a 68% confidence interval. The performance period can be lengthened as needed to achieve the ASHRAE recommendations, and sites with lower savings will need longer performance periods to see the savings through the noise. By extending the performance period appropriately, savings can be seen through the noise with acceptable confidence, even for facilities saving less than 10% of their baseline.

Each NMEC project requires a site-specific M&V plan consistent with the program M&V plan. We will develop a site-specific Baseline Determination and M&V Plan once a customer agrees to participate in an NMEC project. The plan includes a summary of all data required for the baseline regression model, data to be collected throughout the project, and the means of collecting such data.

The site-level M&V plan also provides a detailed description of the hypothesis regression model, including a description of and justification for each independent variable used in the regression model. We customize the energy analysis methodology on an individual project basis, ensuring it is consistent with CPUC and PG&E QA guidelines. Cascade staff will perform a site visit to visually confirm correct installation of energy-efficiency upgrades. This touch point is also an opportunity to discuss future projects and additional savings opportunities. The site-level M&V plan will also include a QA review process by a firm other than Cascade Energy.

Cascade adheres to PG&E, CPUC, ASHRAE, and IPMVP recommendations in determining model fitness. The regression model must ultimately yield statistically justified baseline energy use. Upon completion of all measures by the participant or the end of the implementation period (whichever occurs first), we input daily production and weather data into the baseline model throughout the 12- to 24-month performance period.[[25]](#footnote-26) Periodic reviews and NRE adjustments ensure the model is still valid. After the performance period, we then compare the predicted baseline energy use to the actual measured energy use for the same time period. The difference is the avoided energy use.

An M&V Report documents project energy savings and costs eligible for incentives. We document the energy-saving effects of any corresponding energy-efficiency projects (such as a custom project) and subtract it from the total achieved savings for the NMEC project. Where material costs are claimed, we perform on-site installation verification. If the final model changes materially from the hypothesis, an additional QA step would be required.

# References

1. “California Industrial SEM M&V Guide,” version 1.0. 2/8/2017. Sergio Dias Consulting for PG&E, SDG&E, SCE, and SCG. <https://neep.org/sites/default/files/CA_Industrial_SEM_MV_Guide_v1.0.pdf>
2. “ISOP Implementation Plan,” version 1.0. Cascade Energy. Finalized December 2020. To be published.
3. “MT&R Guidelines”, Revision 8.0. 11/15/2019. Energy Smart Industrial Energy Performance Tracking Team. Bonneville Power Administration. <https://www.bpa.gov/EE/Policy/IManual/Documents/MTR-Reference-Guide-Rev8.pdf>
4. “NMEC Rulebook,” version 2.0. Revised 1/7/2020. CPUC. <https://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442463694>
5. “Normalized Metered Energy Consumption Savings Procedures Manual,” version 1.01. Southern California Edison via ETCC. <https://www.etcc-ca.com/reports/normalized-metered-energy-consumption-savings-procedures-manual>
6. “PG&E M&V Requirements for Site-Level NMEC.” Revised 12/6/2019. <https://www.pge.com/pge_global/common/pdfs/save-energy-money/facility-improvements/custom-retrofit/PGE-Site-NMEC-MV-Requirements.pdf>. [Note: this document serves as the Program-Level M&V Plan for PG&E’s Public Sector NMEC and Commercial Whole Building NMEC offerings].
7. “PG&E Resource Savings Rulebook,” version 1.0. 3/27/2020. [https://www.pge.com/pge\_global/common/pdfs/for-our-business-partners/energy-efficiency-solicitations/PGE%20Platform%20Rulebook%20V1.0%20Final\_PC2%20(2).pdf](https://www.pge.com/pge_global/common/pdfs/for-our-business-partners/energy-efficiency-solicitations/PGE%20Platform%20Rulebook%20V1.0%20Final_PC2%20%282%29.pdf)
8. “Site-Level NMEC Technical Guidance,” version 2.0. Published 12/15/19. LBNL for CPUC. <https://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442463695>
9. “Superior Energy Performance Measurement and Verification Protocol for Industry.” Written under contract by The Regents of the University of California for the United States Department of Energy. March 8, 2017.

# Appendices

## Definitions and Acronyms

* **Baseline Period.** The baseline period is the 12-month period leading up to the energy efficiency intervention or retrofit.
* **Behavioral, Retrocommissioning, and Operations & Maintenance (BRO).** BRO is a measure application type category that includes measures that either restore or improve energy efficiency, and can be reasonably expected to produce multi-year savings.
* **Energy Efficiency Measure (EEM).** Energy using equipment, control system, or practice whose installation and/or implementation results in a reduction of energy purchased from the distribution utility (while maintaining a comparable or higher level of a specific service or to accomplish a specific amount of work).
* **Effective Useful Life (EUL).** An estimate of the median number of years that the EEMs installed under the program are still in place and operable.
* **Implementation Period.** The Implementation period is the period between the baseline period and the performance period. This period covers the time when the measures are installed, and the project construction is completed. The implementation period may also include time to adjust, fine-tune, or commission the measure as part of the construction process.
* **Industrial Systems Optimization Program (ISOP).** Third party designed and implemented program being offered to eligible PG&E industrial and commercial customers starting in 2021.
* **Measurement and Verification (M&V).** M&V is the process of using measurement to reliably determine actual savings created within an individual facility by an energy efficiency intervention. Savings cannot be directly measured, since they represent the absence of energy use. Instead, savings are determined by comparing measured use before and after implementation of a project, making appropriate adjustments for changes in conditions.
* **Net-to-Gross Ratio (NTG).** A ratio or percentage of net program impacts divided by gross or total impacts. Net-to-gross ratios are used to estimate and describe the free-ridership that may be occurring among energy efficiency program participant
* **Non-Routine Event (NRE)**. A non-routine event is an externally-driven (i.e. not related to the energy efficiency intervention) significant change affecting energy use in the baseline or the reporting period and therefore must be accounted for in savings estimations. Typical NREs include changes in facility size, changes in facility activity not affected by the energy efficiency measures (such as addition or removal of a data center) or other modifications to the facility or its operation that alter energy consumption patterns and are unrelated to the program intervention.
* **Normalized Mean Bias Erro**r (NMBE). NMBE refers to normalized mean bias error, which is the total error in the model expressed as a fraction of the total energy use, adjusted for the number of parameters in the model.
* **Normalized Metered Energy Consumption (NMEC).** NMEC is a method used to measure gross energy savings using metered energy consumption data to compare baseline and reporting period consumption under normal operating conditions. Normalization of energy consumption is achieved using adjustment models that account for routine events, and other adjustments to account for non-routine events so that consumption in baseline and reporting periods can be directly compared, as if all relevant variables were the same in the two periods. Normalized baseline period and/or performance period energy consumption are calculated using one or more adjustment models.
* **Performance Period.** The Performance Period is the period of time over which the savings from energy efficiency interventions and retrofits are measured. The reporting period immediately follows the implementation period.
* **Program Administrator (PA).** A PA can be any party that receives funding for and implements energy efficiency programs pursuant to PU Code Section 381. PAs currently include investor-owned utilities, community choice aggregators, and regional energy networks. PG&E is the PA for ISOP.
* **Reporting Period.** See Performance Period.
* **Retrocommissioning.** A systematic process of identifying and implementing operational and maintenance improvements to achieve the design intentions consistent with the current usage of a building. The process is designed to improve the performance of building subsystems as well as optimize the performance of the overall system. Retrocommissioning focuses on operations and maintenance improvements and diagnostic testing, although major repairs and equipment upgrades may be identified and recommended through the process. Minor repairs required to conduct diagnostic testing may also be implemented.
* **Strategic Energy Management (SEM)**. Strategic Energy Management is a holistic, whole-facility approach that focuses on business practice change from senior management through staff, affecting organizational culture to reduce energy waste and improve energy intensity. SEM emphasizes equipping and enabling plant management and staff to impact energy consumption through behavioral and operational change. While SEM does not emphasize a technical or project centric approach, SEM principles and objectives may support capital project implementation.48 “Strategic Energy Management” as used by the CPUC refers to specific, standalone programs designed by consultants to the investor owned utilities.

## Report Templates

*All report templates will be provided following submission of the first ISOP NMEC project.*

1. CPUC, “Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption”, version 2.0. Updated 1/7/2020. Available at <https://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442463694>. [↑](#footnote-ref-2)
2. PG&E, “PG&E Resource Savings Rulebook”, version 1.0. Updated 3/27/2020. Available at [https://www.pge.com/pge\_global/common/pdfs/for-our-business-partners/energy-efficiency-solicitations/PGE%20Platform%20Rulebook%20V1.0%20Final\_PC2%20(2).pdf](https://www.pge.com/pge_global/common/pdfs/for-our-business-partners/energy-efficiency-solicitations/PGE%20Platform%20Rulebook%20V1.0%20Final_PC2%20%282%29.pdf). [↑](#footnote-ref-3)
3. International Performance Measurement and Verification Protocol (IPMVP), Efficiency Valuation

Organization, [www.evo-world.org](http://www.evo-world.org). [↑](#footnote-ref-4)
4. American Society of Heating Refrigeration and Air-conditioning Engineers (ASHRAE) Guideline 14-2014 Measurement of Energy and Demand Savings. Available from [www.ashrae.org](http://www.ashrae.org). [↑](#footnote-ref-5)
5. “California Industrial SEM M&V Guide,” version 1.0. 2/8/2017. Sergio Dias Consulting for PG&E, SDG&E, SCE, and SCG. https://neep.org/sites/default/files/CA\_Industrial\_SEM\_MV\_Guide\_v1.0.pdf [↑](#footnote-ref-6)
6. “MT&R Guidelines”, Revision 8.0. 11/15/2019. Energy Smart Industrial Energy Performance Tracking Team. Bonneville Power Administration. https://www.bpa.gov/EE/Policy/IManual/Documents/MTR-Reference-Guide-Rev8.pdf [↑](#footnote-ref-7)
7. PG&E Resource Savings Rulebook, p72 [↑](#footnote-ref-8)
8. CPUC NMEC Rulebook, p10 [↑](#footnote-ref-9)
9. CPUC NMEC Rulebook, p14 [↑](#footnote-ref-10)
10. This structure draws heavily on best practices addressed by the referenced documents, including:

CPUC/LBNL NMEC Technical Guidance (Baseline Modeling Narrative, Baseline Model Goodness of Fit, Scenario Analysis of Uncertainty, Coverage Factor for Independent Variables, Treatment of NREs, and Savings Claims),

SEM M&V Guide (Facility Characterization, Establishing Time Periods, Energy Accounting, Energy Consumption Normalization, Creating and Validating Energy Models, and Calculating Savings),

MT&R Guidelines (Characterizing the Facility, Establishing Baseline Data Set, Developing a Baseline Model, Calculating Energy Savings, Adjustments for NREs, and Projecting Energy Savings). [↑](#footnote-ref-11)
11. Per the 2020 CPUC NMEC Rulebook (p19), electricity submeters must use Solid State True Root Mean

Square electric meter or watt transducers with +/- 0.5% accuracy. Gas submeters must be positive displacement type with +/- 2% accuracy. [↑](#footnote-ref-12)
12. CPUC NMEC Rulebook, p15. [↑](#footnote-ref-13)
13. PG&E Resource Savings Rulebook p70. [↑](#footnote-ref-14)
14. Additional information on SENSEI is available in the ISOP Implementation Plan. [↑](#footnote-ref-15)
15. LBNL/CPUC NMEC Technical Guidance, p7. [↑](#footnote-ref-16)
16. BPA MT&R Guidelines, p18. [↑](#footnote-ref-17)
17. BPA MT&R Guidelines, p23-25. [↑](#footnote-ref-18)
18. CPUC NMEC Rulebook, p16. [↑](#footnote-ref-19)
19. Adapted from R.09-11-014 EE Policy Manual v5 [↑](#footnote-ref-20)
20. PG&E Resource Savings Rulebook, p35. [↑](#footnote-ref-21)
21. CPUC NMEC Rulebook, p8. [↑](#footnote-ref-22)
22. CPUC NMEC Rulebook, p8. [↑](#footnote-ref-23)
23. PG&E Resource Savings Rulebook, p27-32. [↑](#footnote-ref-24)
24. ISOP Proposal to PG&E. Cascade Energy. 8/2/2019. [↑](#footnote-ref-25)
25. As defined in *PG&E Resource Savings Rulebook* v0.99c, Section 5.4.2.4 [↑](#footnote-ref-26)