DRAFT

M&V REQUIREMENTS FOR SITE-LEVEL NMEC

COOLSAVE

PREPARED FOR

PG&E

NOVEMBER 30, 2020

kW ENGINEERING

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1. Appropriateness of Meter-Based Platform

The grocery sector is a perfect application for whole-building measurement and verification (M&V) using hourly kilowatt (kW) and temperature data. Load shapes in this sector are very regular and well-correlated with ambient temperature and operating schedule. This combination yields predictable energy use, and minimizes errors in estimated energy use, and savings.

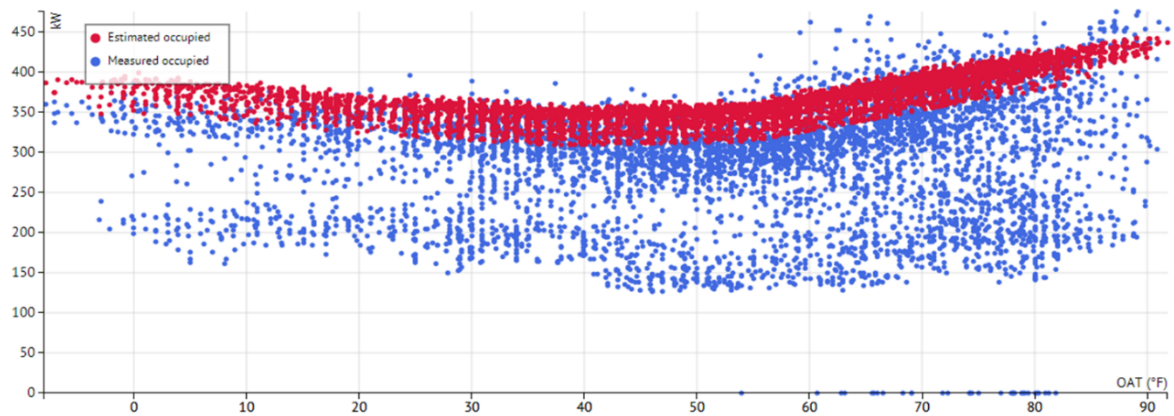

**Figure 1. Savings at a typical grocery site are shown above as the difference between forecasted (red) and measured (blue) points.
The drop in kW shows savings in the performance period.**

CoolSave uses a site-level approach for M&V. The site-level approach provides the following benefits:

- It aligns the interests of the program with those of the participant and PG&E.
- The approach allows the team to track savings for each site, ensuring proper measure commissioning and persistence. Site-level normalized metered energy consumption (NMEC) allows the program to more accurately track savings at the meter. If the program team fails to see realized savings, it can re-visit the site to determine why savings are not as expected and take corrective action. A population-based approach would not provide the site-level accuracy needed for diagnostic purposes. This improves the program's measure savings persistence, helps manage risk, provides better service to participants, and keeps the net to gross (NTG) ratio high.
- It utilizes data connectivity that has significant additional value to participants, such as case temperature monitoring and the opportunity for demand response.
- A site-level approach makes it possible to customize incentives to the savings expected and measured at the site.

2. Method

There are four phases to each project: a pre-screening phase, a project development and feasibility phase, an implementation phase, and a performance monitoring and savings reporting phase. These activities are illustrated within the backdrop of the meter-based savings analysis in Figure 2 below.

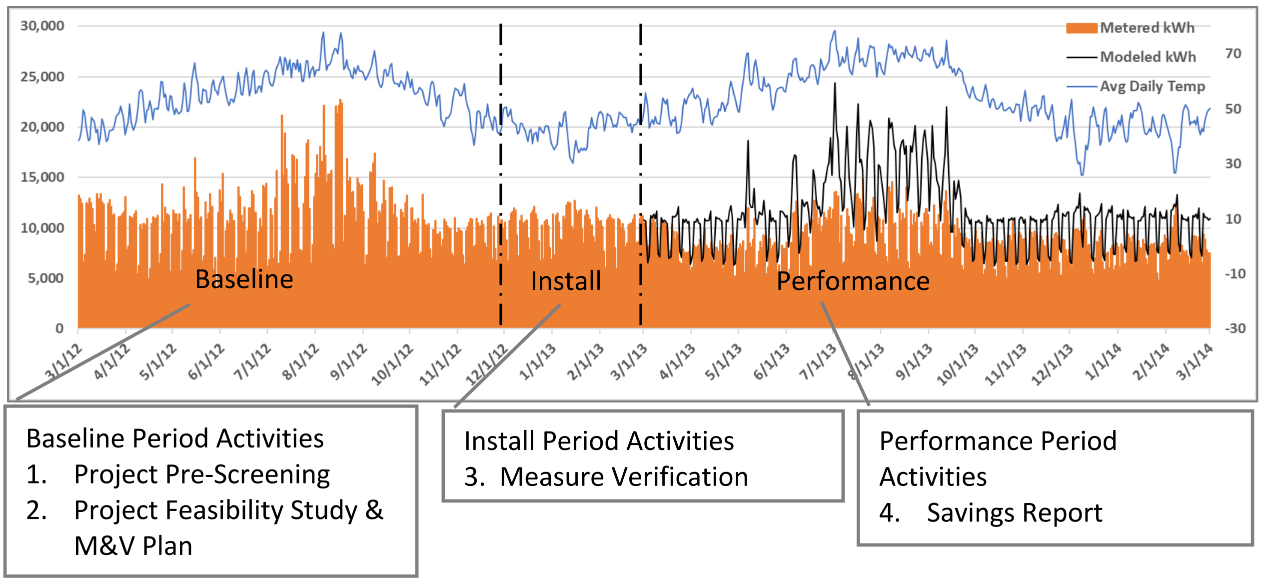

Figure 2. NMEC Project Process

Figure 2, above, outlines the activities taking place in the baseline, implementation, and performance phases of an individual project. It also shows how energy use is expected to decrease over the course of the project, and how energy savings are determined. During project screening, a project's baseline model is developed using energy use, schedule, and ambient temperature data from a year-long baseline period. This model is used to determine what the energy use would have been in the performance period absent the intervention; this quantity is referred to as adjusted baseline energy use and is represented by the black line in the chart. Both the baseline and performance models are applied to typical year weather data to determine normalized energy consumption. The difference between the normalized baseline use and the normalized energy use based on the performance period model gives the energy savings.

1. **Pre-screening**
   Each potential project is pre-screened for eligibility. The facility's condition is assessed to make sure it is not in need of major repairs and upgrades. Potential efficiency measures are identified and their potential for deep savings assessed (high level assessment, no detailed calculations). An energy model is developed from a year of energy use and temperature data and an assessment of building predictability is made. The potential for non-routine events (NREs) is assessed. The customer's desire to participate in a pay for performance approach is documented. The CoolSave team decides if the project is a good candidate for the NMEC platform according to criteria detailed subsequently in this document.

2. **Baseline/Pre-installation**
   The CoolSave team develops the project by identifying specific energy efficiency measures (EEMs) and estimating their savings. A feasibility study is completed to describe the savings measures,

how risks will be managed and how the program influenced the customer, and required program information is collected. A project-level M&V plan is developed that documents specifically how savings will be quantified for the project based on program requirements.

3. **Installation/Implementation/Verification**
Following acceptance of the project by PG&E, the customer proceeds to implement the project; the CoolSave team is available for technical assistance during implementation and will typically provide some level of commissioning. After substantial project completion, the CoolSave team verifies the installed measures and documents any variation from the original recommendations.

4. **Performance Monitoring and Savings Reporting**
During the performance phase, energy data is collected, achieved savings are determined, incentives are paid, and savings are reported.

Baseline Period

Project Pre-screening

Each potential project is pre-screened for eligibility. Project pre-screening will include a discussion with the building owner to assess equipment conditions, efficiency measure opportunities, level of interest in achieving deep savings, and capacity for incentives based on demonstrated savings. A year of energy use, weather, and other potentially influential variable data is collected and analyzed to determine whether an acceptable energy model may be developed that meets the eligibility requirements. These modeling criteria are:

- Coefficient of Variation of the Root Mean Squared Error: CV(RMSE)<25%
- Net Mean Bias Error: NMBE<0.5%
- Coefficient of Determination: R^2>0.7 (recommendation only, not a criterion)

The baseline year data will also be analyzed to determine the presence of unusual energy use patterns that may be caused by NREs. All suspected NREs will be investigated with assistance from the program participant. Any confirmed baseline period NREs will be documented, with a clear description of how their impacts on baseline energy use and/or savings will be addressed. Pre-screening documentation will be submitted as part of the Project Feasibility Study, which is described below.

Project Feasibility Study

The project feasibility (scoping) study provides an in-depth assessment of potential energy efficiency measures and provides information to meet the requirements set forth by the CPUC. Depending on the scope of the project, this step may include a detailed energy audit to identify and assess the cost-effectiveness and feasibility of EEMs. Much of the documentation required by CPUC's Rulebook for Programs and Projects Based on Normalized Metered Energy Consumption 2.0 (January 7, 2020) is included in the Project Feasibility Study requirements (other documentation is included in the project-level M&V Plan requirements, described below).

The feasibility study report will include:

- A description of the facility's baseline systems and equipment and their operations.
- Individual EEM descriptions, estimated savings, measure cost information, and cost-effectiveness calculations.
- CPUC-required documentation regarding measure categories (e.g., current condition of equipment).

- Individual measure effective useful life (EUL), and a savings-weighted average EUL for the measure package proposed.
- Capital measures as well as retro-commissioning (RCx) measures shall be clearly delineated.
- Documentation of the offering's influence on the participant's decision to participate and implement the project.
- Information on interventions that address stranded potential to demonstrate compliance with Decision 17-11-006[1] Ordering Paragraph 2 when targeting to-code savings.

The expected annual total savings for the recommended measures and the annual baseline period energy use for both electric and natural gas shall be reported. To assure savings are detectable above model typical variations (i.e. noise), the program targets 10% savings of baseline year electric and natural gas consumption. If savings lower than 10% are anticipated, the feasibility study will describe how the meter-based analysis may be used to quantify the savings at an acceptable level of certainty.

Project-Level M&V Plan

A project-level M&V Plan will be included with each project feasibility study. The M&V Plan will describe:

- A data collection plan documenting from where data is collected and how it is prepared for analysis.
- The building's utility meters or participant-owned submeters, including electric, natural gas, or energy delivered from a central plant (chilled or hot water and steam).
- Utility meter ID numbers.
- Description of systems and equipment.
- Documentation of how EEMs will be verified as installed and operating.
- Description of the modeling methods, algorithms, and software used to develop the building's baseline energy models (see *Modeling Methods and Savings Estimation Process* Section).
- The baseline energy model's goodness-of-fit (GOF) and accuracy metrics, showing how they meet program criteria.
- Assessment of expected savings uncertainty and how savings will be detectable at an acceptable level of certainty.
- Documentation of how baseline period NREs (if any) were identified and analyzed for the baseline period models.
- Documentation of measure-level and weighted average EULs based on best available information.
- Documentation of how anticipated NREs occurring in the installation and performance periods will be identified and impacts removed from the final savings estimation.
- Description of how savings will be documented and reported after the twelve-month performance period.
- Description of how all data and savings calculations used to determine the meter-based savings estimations will be made available.

Further information on modeling algorithms and data requirements are provided below in the section *Normalized Energy Savings*, below.

[1] CPUC NMEC Rulebook 2.0 document, p. 7

Installation/Implementation Period

Measure Verification Report

The duration of the installation period will be as needed but limited to conform to CPUC, PG&E and CoolSave program guidelines as applicable. The program team will work with the participant's project team to verify a completed project with commissioned EEMs and will notify PG&E when measures have been substantially installed. The program team will be responsible for verifying each installed measure, providing spot inspections for PG&E's engineers as requested. Measure verification requirements may vary depending on the type of measure. Trend data provides the most direct evidence of the improvements in systems and equipment energy performance due to the EEMs. Photographs, contractor invoices, and other cost information will also be collected.

A measure verification report will be sent after project completion has been verified by the program team; this will typically occur within 1-3 months. The report documents which measures were installed and how they were verified. The estimated annual electric and natural gas savings for each installed measure, as documented in the feasibility study, will be used to estimate the first incentive from the project.

The measure verification report will also include measure cost information. Full measure cost information (labor and materials) will be supported by receipts, contractor invoices, and the customers own labor and materials accounting system. Costs will be attributed to each measure based on information from the program participant and their installation providers as applicable.

Performance Period

Savings Report

The savings report will be delivered after twelve months of the reporting period has been completed. The savings report will describe the models used, document meter calibration requirements and data from any submeters used, identify the baseline period, describe modeling parameters (algorithms used, model goodness-of-fit metrics, etc.), and summarize energy savings analysis. Any NREs identified and treated as part of the analysis will be documented. Savings will be reported as normalized savings using CALEE2018 weather data. A model based on post-installation period energy use and conditions will be developed by our team for this purpose.

Demand savings will be determined using the Database for Energy Efficiency Resources (DEER) peak demand definitions, and documentation will be included in the savings report. Any deviations from planned M&V activities will be clearly identified and explained. The savings report will report claimed incentives and reported project costs. All data and information, spreadsheets or analysis code used to determine savings will be provided to PG&E, its consultants, and the CPUC for technical review and program evaluation. All documentation, data, and calculation tools will be provided with the savings report.

Modeling Methods and Savings Estimation Process

The savings analysis process begins with the development of a baseline period energy use model. Because the main influences on energy use in supermarkets are ambient temperature and building operation schedule, CoolSave's preferred modeling algorithm for electric savings is the time-of-week and temperature (TOWT) model developed by Lawrence Berkeley National Laboratory (LBNL). For natural gas savings, the approach that has shown the best agreement is a model correlating daily gas consumption with average temperature. The program team has converted these models to open source code and shared publicly for open review on github (here). LBNL's TOWT modeling algorithm accurately predicts building energy use for non-residential building types[2] and includes flexibility for improving model fit. Originally developed in 2011,[3] LBNL has modified it in a recently released version.[4]

"nmecr" is a measurement and verification practitioner's toolbox that builds upon the energy efficiency community's past efforts to model complex and nuanced building energy use profiles. While intended for use in the commercial and institutional sectors, its functions can be extended to model the energy use profile of industrial systems.

There are ten energy modeling algorithms available in nmecr:

- For use with hourly, daily, and monthly time interval data:
    - Simple Linear Regression with Outside Air Temperature
    - Three Parameter Linear Model (Cooling)
    - Three Parameter Linear Model (Heating)
    - Four Parameter Linear Model
    - Five Parameter Linear Model
- For use with hourly and daily time interval data:
    - Time-of-Week Model
    - Time-of-Week and Temperature (TOWT) Model - Preferred
- For use with monthly time interval data only:
    - Heating Degree Day Model
    - Cooling Degree Day Model
    - Heating & Cooling Degree Day Model

Normalized Energy Savings

The following methodology describes how normalized energy savings will be determined for participants in our program. It will be applied only to electric energy use for PG&E's customers as part of this program.

1. A TOWT regression model is fit to a baseline year of energy use and temperature data. Due to the extensive number of coefficients and data points used to develop the model, it may be impractical to provide the model and its coefficients in spreadsheets. The R or Python programming languages, which are open source and in the public domain, are more suitable environments.

2. The model is checked to assure its goodness-of-fit metrics are within acceptable limits and charts of model residuals are inspected to assure regression assumptions are met. The program's goodness-of-fit criteria are:

    a. Coefficient of Variation of the root mean squared error: CV(RMSE).

$$CV(RMSE) = \frac{\left(\frac{\sum_{i=1}^{n}\left(E_i - \hat{E}_i\right)^2}{(n-p)}\right)^{1/2}}{\bar{E}} < 25\%$$

[2] https://mvportal.evo-world.org/, see results for 'LBNL TOWT'
[3] Mathieu, J. L., P. N. Price, S. Silicate, and M. A. Piette. 2011. "Quantifying changes in building electricity use, with application to demand response." IEEE Transactions on Smart Grid, 2(3), pp. 507–518.
[4] LBNL GitHub RMV2.0, https://github.com/LBNL-ETA/RMV2.0.

b. Net Determination Bias Error: NDBE

$$NDBE = \sum_{i=1}^{n} (E_i - \hat{E}_i)/E < 0.005\%$$

c. The Coefficient of Determination, $R^2 = 1 - \frac{\frac{1}{n}\sum_i^n (E_i - \hat{E}_i)^2}{\sigma_E^2}$ will be checked to inform how well the dependent variable (temperature) explains the variation in the dependent variable (energy use), but it should not be used as an acceptance criterion.[5]

d. Savings Uncertainty for models with autocorrelation (models based on hourly and daily data) should be less than 50% at the 90% confidence level. The calculation will be made using the total expected savings from the feasibility study, or by assuming a minimum savings of 10% would be achieved. Savings Uncertainty is expressed as a fraction of actual savings using the formulation from ASHRAE Guideline 14:

$$U = \frac{\Delta E_{save,m}}{E_{save,m}} = t \cdot \frac{a \cdot CV\ (RMSE) \cdot \left[\frac{n}{n'}\left(1 + \frac{2}{n'}\right)\frac{1}{m}\right]^{\frac{1}{2}}}{F}$$

Where:

E_i is the measured energy use in any time interval, in energy units (kWh, therms, BTUs, etc.)

$\hat{E}_i$ is the model's predicted energy use in any time interval, in energy units

$\bar{E}$ is the average energy use over all the time intervals, in energy units

E is the total energy use over the training time period, in energy units

$E_{save,m}$ is the estimated energy savings over m time periods, in energy units

n is the number of data points in the training period

p is the number of parameters in the model

x_i is the value of the independent variable in any time interval

σ_E is the standard deviation of the distribution of energy use values

$\Delta E_{save,m}$ is the absolute precision of the savings estimate over m time periods, in energy units

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[5] "Why R^2 Doesn't Matter," https://evo-world.org/en/news-media/m-v-focus/868-m-v-focus-issue-5/1164-why-r2-doesn-t-matter

t is student's t-statistic for the specified confidence level and n-p degrees of freedom

α is calculated depending on the analysis time interval:

α = 1.26 for hourly interval data

α = -0.00024M^2 + 0.03535M + 1.00286 for daily interval data

α = -0.00022M^2 + 0.03306M + 0.94054 for monthly interval data

M is the number of months of reporting period data

CV(RMSE) is the coefficient of variation of the root mean squared error, defined above

n' is the number of data points in the model training period, corrected for autocorrelation

$$n' = n\frac{(1-\rho)}{(1+\rho)}$$

ρ is the autocorrelation coefficient at lag 1, which is the correlation of the model residuals $E_i - \hat{E}_i$ at time stamp *i* with their values at the previous time stamp, *i* – 1.

m is the number of data points in the performance period

F is the expected savings, expressed as a fraction of baseline energy use

Charts of the model residuals will be assessed to determine whether the residuals are normally distributed and have constant variance. Residuals are the differences (error) between the actual data and the models projected results for the same period. See Figure 3 below for an example of normally distributed residuals (roughly symmetric around zero). A significant bias in residuals indicates a model that lacks goodness of fit.

Should the fitted model fail to meet the GOF criteria, additional independent variables representing other key drivers of energy usage in the building may be added to improve model fit, or the modeling strategy may be adapted to model different operation modes separately. If the revised model fails to meet the GOF criteria, alternative modeling algorithms may be used. In all cases, the M&V Plan will include a clear description of how the model was developed. Pre-screening will be used to ensure that all participant sites may be modeled within acceptable technical limits.

When all criteria are met, the baseline model will be used for the project.

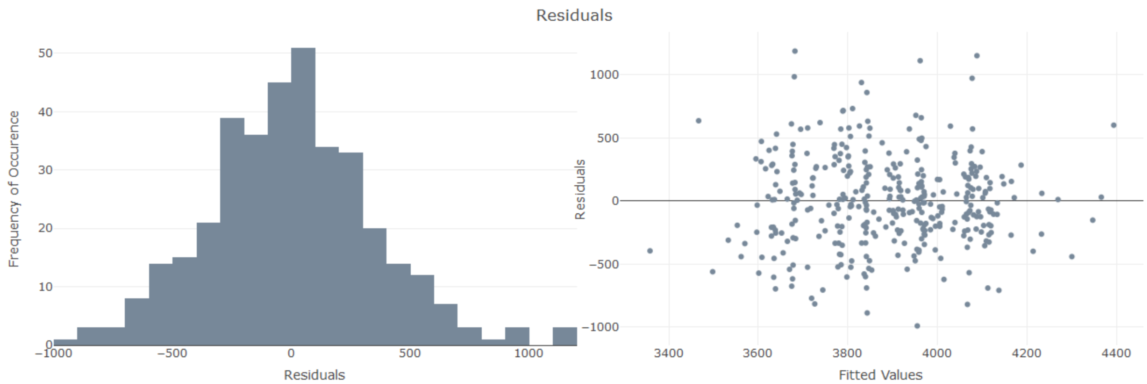

Figure 3. Residual Frequency and Scatter Plots

3. Data is collected for the 12-month period following installation of the measures. The data is prepared for analysis and adjusted to daily time intervals.

4. A TOWT regression model is fit to the performance period energy use and temperature data, the same goodness-of-fit metrics are checked, and chart of residuals are inspected to assure regression assumptions are met.

5. The building's climate zone weather data (CALEE2018) is used in both the baseline and performance period model to model adjusted baseline and performance energy use under normalized conditions.

6. The annual totals of normalized baseline and normalized performance period energy use are determined. Normalized savings are the difference between the normalized baseline and projected, normalized energy use for the performance period model as it is applied to typical weather.

Electric Peak Demand Savings

Demand savings will be determined using the DEER Peak Permanent Peak Demand Reduction calculation procedure, as documented in CPUC Resolution E-4952[6]. This procedure determines the average peak demand reduction between 4 pm and 9 pm over the three DEER peak period days defined for each climate zone. This calculation procedure requires that hourly baseline and performance period models are used. The procedure to develop the models based on hourly data are the same as for daily data described above. The goodness-of-fit criteria includes only the CV(RMSE) and NDBE metrics, and not the savings uncertainty, as this has been shown to be inaccurate for hourly data.

Avoided Energy Use

During the performance period, avoided energy use can be monitored by program staff. Periodically calculating and reviewing the avoided energy use provides a check that savings are accruing and an opportunity to detect NREs.

Avoided energy use is determined by inputting the performance period temperatures (and other independent variable values, if used) into the baseline energy model. This calculation produces the

[6] https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M232/K459/232459122.PDF

adjusted baseline energy use. The avoided energy use is the sum of the adjusted baseline predictions less the sum of the performance period energy use to that point in time. Results may be tabulated or charted with time series charts of the adjusted baseline and performance period usage data, or with a cumulative sum of savings chart.

Avoided energy use is a useful tool for monitoring during the performance period, but it will not be used for final energy savings calculations or for the final incentive payment calculation. Only normalized energy savings are used for final reporting.

3. Data

For energy interval data, the CoolSave team typically relies on the data collected by the utility at the utility-owned meter and made available online. The program team has infrastructure in place to collect this data automatically and import it into its cloud-based energy management platform. This done with the informed consent of the customer, using utility-provided data APIs such as Share My Data, where possible. Typically, this data is available with a roughly 24-hour time lag, although external events can impose longer delays at times.

The format of electricity data is a time-series of kWh values with a fixed interval, usually 15 minutes.

The format of gas data is a time-series of gas use values, usually hourly or daily. The unit of the gas data is usually therms, and if not, it is translated to therms when storing in the program platform.

Data Collection

Project-level M&V Plans will include a section on data collection and preparation that describes:

1. The source of both dependent and independent variable data to be used throughout the project duration, how data will be collected from each source, and how often.

   a. Utility data will be indicated by meter identification or service agreement identification number and sources named, such as utility account representative or via Share My Data. How the meters used in the analysis will be mapped to the customer accounts, premises, and measurement boundaries of the loads affected by the EEMs.

   b. If used, data from participant-owned or short-term meters will be identified and their accuracy specifications documented. Recent calibration documentation will be provided for meters that require periodic calibration. Minimum accuracy requirements will adhere to CPUC specifications. Meters undergoing in-situ calibration will describe the process and equipment used to calibrate the meter and how results were used to update meter readings.

   c. Weather station sources will be named and their distances from the project site listed. When alternate weather station data is used, a justification will be provided. When weather services are used, the name of the service and a description of how that service generates weather data for the building site will be included.

   d. If used, sources for other data will be named and a discussion of the reliability and accuracy of the data provided.

2. The anticipated format for all energy use and independent variable data and the parties responsible for providing the data.

3. How the implementer, PG&E, and participant will work together to ensure data is available throughout the project duration.

4. How often energy use and independent variable data will be collected and prepared for analysis.

5. What data quality issues were identified and how they were treated. Data quality issues include missing data – in small or large quantities, erroneous or outlier data, and repeated data values. The site-level M&V Plan will include a clear description of how the raw data was prepared for analysis.

Any submeter that the program team relies on for project data will meet the following requirements (per NMEC Rulebook, unless super-ceded by updated requirements). PG&E-owned electric and natural gas utility meters are assumed to meet the accuracy requirements; documentation, as such, will not be provided.

Energy Source	Meter Type	Minimum Accuracy
Electricity	Solid State True Root Mean Square electric meter or watt transducer	+/- 0.5% of reading including current transformer accuracy and corrections for installed conditions
Natural gas	Positive displacement	+/- 2% of reading
Chilled/hot water	Solid state Btu meter with temperature sensors and flow meter	● Temperature sensors: +/- 0.15°F from 32°F - 200°F ● Flow meter: +/- 2% of reading over expected flow range ● Calculator accuracy: +/- 0.1% at 30°F delta T
Steam	Solid state Btu meter with a vortex-shedding flow meter, and pressure and temperature sensors	+/- 2% of mass flow calculation

The requirements conform with the NMEC rulebook. If future versions of the rulebook update the requirements, the CoolSave team may choose to adopt the latest standard.

4. Monitoring

The CoolSave team has developed its own M&V software and published it as an open-source "R" model known as "nmecr" (github.com/kW-Labs/nmecr).

Weather and energy data are imported into the platform in close to real-time to allow for constantly updated savings calculations and insight into project performance over the performance period. This ongoing analysis also allows for continuous commissioning for persistence, and the detection of NREs, which can be investigated and incorporated into the model while the events are still recent.

The CoolSave team will provide one (1) energy savings report to PG&E after the 12-month performance period is complete that contains performance period savings estimates, details of the calculation methods, updated goodness-of-fit metrics, treatment approach for any NREs, and annual savings results. The savings reports will also include a narrative description of any changes to building operation or use that could affect project performance. Savings reports will also include a determination of peak demand savings from the most recent DEER peak period, if applicable.

The CoolSave team will be responsible for all M&V activities, software application and development, and ongoing, persistence monitoring.

Coverage Factor

According to ASHRAE Guideline 14, savings should be calculated “for all periods where independent variables are no more than 110% of the maximum and no less than 90% of the minimum values of the independent variables used in deriving the baseline model.”

For weather, coverage factor is determined by comparing the range of temperatures during the baseline and performance periods to the range of temperatures in the typical weather year used for calculating normalized savings. Because the baseline period covers a minimum of twelve months, it is expected that most project baselines will meet the coverage factor requirements.

The same is true for the performance period, once one year of performance data is available. Interim savings reports delivered in the first year of the project may fail to meet the coverage factor for weather, because the performance period won’t include all four seasons.

5. Expected Useful Life

Each site-level NMEC project requires a list of EEMs with their estimated savings, measure costs, and EUL. This informs the participant of the costs and benefits of different EEM options. The customer will select measures for implementation, with the requirement of 10% of baseline use or more in savings after implementation.

Because all savings are quantified from the existing conditions baseline, the individual EEM savings estimates need not quantify to-code and above-code portions of savings. Deemed savings estimates for specific EEMs may be used if their gross savings from existing conditions baselines are available. For each EEM, its full measure cost will be estimated and its EUL will be determined from standard measure tables (as in custom).

A weighted average EUL for the entire list of recommended EEMs will be determined. The 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. This information will be documented in the feasibility report.

After the implementation period, a list of installed EEMs, their expected savings, costs, and EULs will be reported. This may be a shorter list than that originally proposed and documented in the feasibility report. At the end of the twelve-month performance period, the final savings will be apportioned to each individual EEM, and a final weighted average EUL determined.

A weighted average EUL will be estimated for each installed and verified measure based on the measure's original expected savings estimate and the measure's EUL as determined above. The weighted average for all recommended EEMs will be reported in the feasibility study report, and the updated weighted average EUL for the installed and verified EEMs will be included in the savings report.

6. Anomalies / Non-routine Events

Non-routine events (NREs) can be short-term, long-term, or permanent changes in building energy use. They may be additions or removal of constant or variable loads. NREs occurring in the baseline period may be accounted for when developing the baseline model. Major occupancy changes, equipment maintenance, and addition of new equipment are typical examples of NREs.

Because they may occur at any time without the participant's or implementer's knowledge, NREs occurring in the post-installation period present risks to the final savings estimation, and if not sufficiently documented may bias the energy savings calculation. Savings progress reporting will be used in the performance period to identify and follow-up on any peculiar or unexpected behavior in the participant's energy use patterns and determine if an NRE has occurred.

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 will 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 will describe how the NRE impacts will be quantified. The possibility of adding meters to help quantify NRE impacts will be considered.

During the performance period, the most common method to identify NREs is through visual inspection of the metered energy use data. Even in sites where NREs are not anticipated, may be impacted by unforeseen events. Time-series charts of energy use data may be used to identify shifts in energy use patterns that may be caused by NREs. When a significant amount of performance period energy use data is available, a TOWT model may be developed. When the energy use data begins trending significantly outside expected values as determined by the model, an NRE may be present. Many other NRE detection algorithms, including automated ones, may be used. Each NRE approach will be described in the project-level Energy Savings Reports and final M&V reports.

Some NREs may have de minimis impact on expected or realized savings. If NRE's are determined to have an impact within the expected uncertainty in savings at the site, they will be considered de minimis and ignored in savings determinations.

Quantifying NREs

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

- Removing data from a short period of time during which 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 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.
- Custom calculation of NRE impacts may be used to account for the NRE using engineering models,

as used in custom projects. Due to the complexity of this approach, it is a measure of last resort to keep the program approach cost-effective.

NRE detection and impact quantification algorithms are the subject of ongoing research.

7. Influence and Assumptions

Influence

Project influence documentation will be consistent with other custom program requirements, described below.

A narrative and supporting evidence will be provided to document the actions performed by the program that induced the customer to implement, add scope to, enhance, or modify the energy efficiency project. The narrative will include a record of the CoolSave team'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 measures were identified, alternative viable options that may also meet the customer's needs, and the energy and non-energy benefits. Supporting evidence may include one or more of the following:

- Marketing materials, including website links, or other communication about program details. Marketing materials provide program details and allow program staff to intervene and promote efficiency measures.
- Audits or site visit results where energy efficiency opportunities are assessed. Site visits can illuminate additional opportunities and validate/quantify known opportunities.
- Energy savings and/or financial calculations for measures. Showing the value of savings and effects of incentives can motivate a customer to pursue a project they otherwise would not have in absence of program intervention.
- Email correspondence or meeting minutes with timestamps that discuss any of the above or that support the narrative.
- Customer decision-making policies such as corporate sustainability policy or investment criteria.
- Internal customer communications or communications with design team that discuss design alternatives, cost estimates, or the customer's decision-making process.

The CoolSave program will apply the net-to-gross (NTG) ratio of 0.95 per CPUC Resolution E-4952.

Other Assumptions

While the CoolSave program does not explicitly target to-code savings, some projects may have to-code components. One of the primary value propositions of the program is to reduce the implementation "hassles" for program participants through technical assistance with product specification and commissioning of new systems. Market research in the grocery sector indicates that many decisions about retrofit projects are made by customer staff who are charged with overseeing a large number of facilities and concurrent projects, including construction of new stores. New store development, from an opportunity cost perspective, will always outweigh the needs of retrofitting existing stores. The assistance provided by the program is designed to overcome this market barrier which stands in the way of equipment turnover in favor of more efficient models.

One example that will likely arise in the CoolSave Program is with area lighting retrofits. Participants in CoolSave may find it beneficial to perform LED area lighting retrofits that may include to-code lighting savings and may also include above-code components. For most of these buildings a “do nothing” approach with periodic lamp and ballast retrofits would be a viable, and code-compliant option. However, completing a more comprehensive LED upgrade would provide greater operational savings and a lower total cost of ownership. In these cases, the technical assistance and incentives offered by the program will help to motivate a greater share of the market to perform these retrofits.

Another potential measure that may be considered a “to-code” retrofit are refrigeration controls. Equipment that sits “back of the house” in grocery (such as compressors and controls that are not seen by customers) is often used for long, extended lifetimes well exceeding what is typically taken for standard EULs in energy efficiency programs. In these cases, some controls upgrades may be seen as “to-code” if they include new capabilities that are currently in Title 24 such as VFD condenser fan controls, floating head pressure controls and others. As above, retrofits of existing controls, while they offer cost savings, may not meet the participants’ cost-effectiveness criteria without incentives to move them to replace equipment that is otherwise functional, does not compromise product quality, and is not seen by their customers. Making these retrofits easier to complete, offering incentives, and making those incentives easy to obtain, are important criteria to motivate participants to act.

8. De Minimis Savings Justification

Pre-screening will assess the project’s ability to detect a minimum 10% savings based on ASHRAE’s fractional savings uncertainty formula. This formulation uses the baseline model CV(RMSE), the savings expressed as a fraction of baseline energy use (assumed to be 10%), the t-statistic for a confidence level of 90% (1.65), and the number of points in the baseline and performance periods respectively.

After measures have been identified and their expected savings quantified, the uncertainty for the expected savings may be determined using the same formula.

To be detectable, the maximum allowable savings uncertainty 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 down to levels of 4 – 5 % may still be determined with reasonable accuracy and confidence.

9. Customer Compensation, Incentives

Incentives will be offered to the customer for two primary reasons:

1. To motivate customers to complete comprehensive capital-investment projects
2. To enable customers to make low-cost improvements without hassle/interruption

The CapEx incentive will be a large incentive (relative to other custom options) to offer the most comprehensive retrofits possible. It will be staged in two payments, one following installation (60%), and one following a performance period, to ensure proper commissioning and persistence, and to “true-up” to metered performance. Final CapEx incentive payments will be normalized to typical year weather data.

The OpEx incentive (Implementation Assistance Incentive) is a relatively low-cost incentive to enable immediate project implementation for low-cost measures. During implementation of similar programs in

Chicago and New York, the CoolSave Team found that the hassle and paperwork of approving small OpEx expenditures often stood in the way of timely project implementation. Removing this roadblock is more than worth the additional program costs by removing administrative hurdles and bottlenecks from busy owners and operators.

The two incentives are summarized below:

Program Path	**OpEx Path – Low Cost**	**CapEx Path - Investment**
Services	Retro-commissioning 1-yr Remote Monitoring 1-yr Fault Detection	Project Scoping / Analysis Design Assistance Commissioning 1-yr Remote Monitoring 1-yr Fault Detection
Incentive	Implementation Assistance Incentive: Up to $2000 to cover labor and materials to support RCx	$0.12 / kWh incentive 60% post install 40% after 1-yr “true up” based on meter-based savings
Rationale	Experience with ComEd program showed that even small cost approvals stood in the way of progress. Offering small “low hassle” incentives overcame those hurdles.	This incentive level is enough to move the market to action. Making payment contingent on performance aligns customers interests with the program savings.