Guidehouse

Workplan for:

Energy Efficiency Savings Measurement, Estimation, Program Oversight, and Evaluation of the Group E Sectors

2021 Potential and Goals Study

Prepared for:

California Public Utilities Commission

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Contents

1. Overview

Guidehouse (formerly known as Navigant) is currently managing the CPUC Energy Efficiency Evaluation Contract for Group E Sectors: Potential and Goals and Industry and Market Studies (Group E). This contract consists of a variety of efforts that are all related to the process of forecasting energy efficiency savings including:

- Collecting data that informs forecasts
- Developing forecasts to inform the IOU energy efficiency (EE) goal setting process managed by the CPUC and the CEC IEPR process
- Coordinating with other forecasting related efforts at the CPUC (such as demand response and integrated resource planning)
- Exploring alternate methods of forecasting beyond those that have been historically used
- Providing forecasts in a format that can be useful for other state planning processes, program administrators, and program implementors

The CPUC has historically used the EE potential forecast to inform the goal setting process. The PG study itself does not set goals nor make recommendations regarding goal setting; this is a task for the CPUC. In October 2019 the CPUC held a set of workshops to solicit stakeholder feedback on improvements to the future of PG studies in California. As a result of the October 2019 workshop, CPUC staff are considering changes to this process. Upon reviewing stakeholder feedback and conferring with CPUC staff, Guidehouse developed this workplan to conduct a set of research efforts to support the CPUC goal setting process.

The 2021 PG study is more multi-faceted and complex relative to its predecessors to be able to better inform the various questions CPUC staff are considering. This workplan includes a set of research efforts with some occurring in parallel and some occurring in series. The various research activities and their interdependencies are juxtaposed against each other in Figure 1. The main activities are the following:

1. **EE Potential Forecast** – This is the core effort to forecast EE potential including developing a model and producing scenario results. This forecast will include emerging topics such as fuel substitution and integrating EE and demand response (DR) forecasts (see item 3 below). The study includes overhauling the adoption forecasting model based on feedback from stakeholders in the October workshops.
2. **Primary Data Collection** – There are two sets of research that will collect new data to feed as inputs into the EE potential forecast. Historically, the PG study did not collect any primary data and largely relied on secondary datasets and assumptions vetted with stakeholders. These research studies aim to fill key gaps identified by stakeholders in the October workshops.
    a. Market adoption characteristics

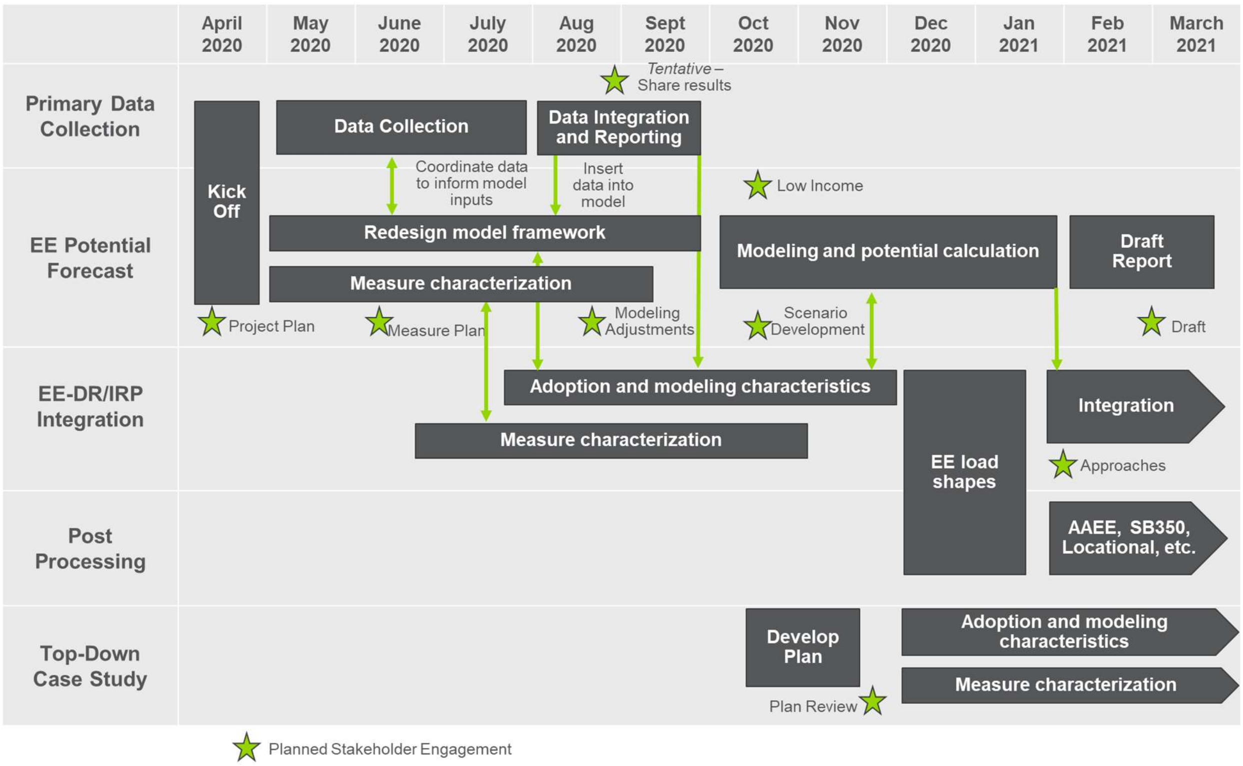
   b. Industrial and agricultural market characterization

3. **EE-DR/IRP Integration** – This activity will work towards integrating the EE forecast with DR forecast to be better coordinated. This topic was extensively covered during the October workshops with stakeholders expressing interest in understanding more the interdependencies. This also includes optimization of EE or coordinated EE/DR data integration into the CPUC's Integrated Resource Plan (IRP) process. The CPUC has sought stakeholder input on key IRP optimization role in the EE goals setting process.[1]
4. **Post Processing** – These are efforts to post process the results of the EE potential forecast to meet additional stakeholder needs beyond the CPUC's goal setting process. This includes developing hourly impact estimates, supporting the CEC's IEPR forecasting process, and considering locational disaggregation to inform a variety of stakeholders.
5. **Top-Down Forecasting Pilot –** This would explore forecasting EE potential using an alternate modelling approach from what has traditionally been used in the goal setting process. The impetus of this activity is stakeholder feedback from the October workshops. This effort is not fully scoped at this time.

Given the current (at time of writing of this workplan) situation with the COVID-19 pandemic, Guidehouse will work with CPUC staff to explore ways to accommodate this uncertain time with uncertainty analysis around key variables believed to be most impacted by the pandemic.

[1] Administrative Law Judge Valarie U. Kao's Ruling Inviting Responses to Potential and Goals Policy Questions. March 12, 2020. http://docs.cpuc.ca.gov/SearchRes.aspx?docformat=ALL&docid=329232450

Figure 1. Overall Study Framework

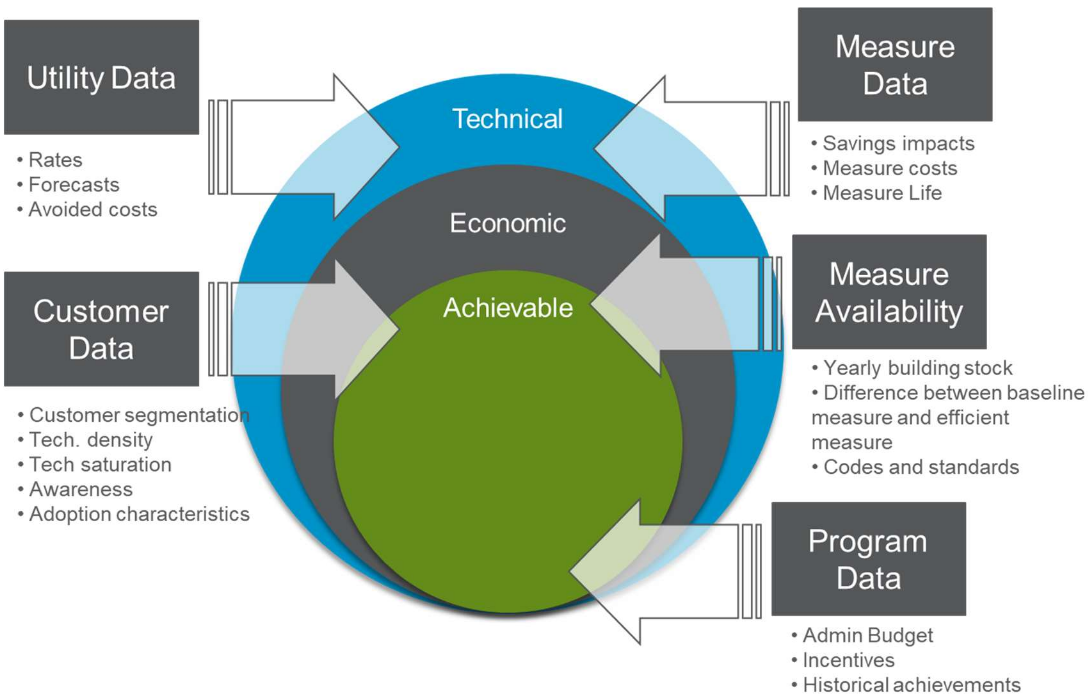


The remainder of this document describes these activities in more detail.

2. EE Potential Forecast

The EE potential forecast is a core activity that informs the CPUC's IOU goal setting process for 2021 and beyond. This activity will employ a range of analysis methods to meet the changing landscape of energy efficiency in the state of California. For this 2021 study, Guidehouse will develop a model to calculate technical, economic, and achievable potential across relevant sectors, building types and end uses. The 2021 study will improve upon past studies in terms of the measure characterization approach, the adoption modelling framework, and several added scope items related to non-traditional EE measures. Figure 2 illustrates the key inputs and the layers of the potential modelling approach.

Figure 2. Approach to Potential Analysis



The main tasks that will be carried out to develop this EE forecast are summarized below with additional detail in the following subsections.

1. **Task 1 – Model Infrastructure Redesign and Development**
   a. Update model forecasting algorithms
   b. Right-sizing model dimensionality
2. **Task 2 - Market and Baseline Characterization**
   a. Obtain market and baseline data. Data will inform total market size, saturation, energy sales, retail rates, avoided costs, etc.
   b. Integrate findings from primary data collection activities in the Market Studies

   c. Obtain additional data from existing secondary sources: CEC IEPR, CPUC Cost Effectiveness Tool, CA saturation studies, CA PA historic program achievements and spending

3. **Task 3 - Measure Characterization**
   a. Develop a list of measures to be considered in the potential study leveraging the 2019 P&G study and stakeholder input
   b. Prioritize and simplify measure list
   c. Characterize measures prioritizing CA-specific data sources such as DEER, evaluation studies and IOU Workpapers, Market Studies, leverage other sources where necessary
   d. Develop a database of measures to be used by the model
   e. Include appropriate accommodation of demand response co-benefits and fuel substitution (natural gas to electric) measures
4. **Task 4 - Technical Potential**
   a. Use the existing PG model framework to calculate technical potential
   b. Account for competing measures and develop instantaneous and annualized technical potential
5. **Task 5 - Economic Potential**
   a. Work with CPUC staff to determine appropriate cost effectiveness tests to apply
   b. Consider calculating based on simplified cost effectiveness metrics to limit program impacts for screening measures
   c. Use the existing P&G model framework developed by Guidehouse to calculate instantaneous and annualized economic potential
6. **Task 6 – Achievable Potential**
   a. Use PG model framework to calculate achievable potential
      i. Apply adoption characteristics using the economic potential based on market triggers
      ii. Use data obtained from the Market Studies as much as possible
   b. Calibrate base market potential using a combination of historic program activity and information obtained from the Market Studies
   c. Work with CPUC staff to develop scenarios beyond the base forecast to model/forecast
7. **Task 7 - Codes and Standards Potential**
   a. Using the existing PG model framework which replicates the ISSM methods, we will forecast C&S savings.

b. The team will review and scope potential C&S for inclusion in the study.

c. For the selected C&S, we will collect data and import to the ISSM framework and forecast savings

8. Task 8 - Low Income Potential

a. Develop a modelling approach based on the 2018 PG study and review with CPUC staff

b. Execute modelling approach

9. Task 9 - Reporting and Model Delivery

a. Develop draft deliverable and vet with stakeholder and CPUC staff

b. Revise deliverables based on feedback

c. Provide a model and web-based results viewer in addition to the written report

2.1 Task 1 – Model Infrastructure Redesign and Development

Stakeholder feedback from the October workshops indicated there is a need to overhaul some key structural and methodology components of the PG model. This work will begin upon project kick-off and will extend for several months. This is a critical step to setting up a modelling framework that achieves the ultimate needs of the CPUC and stakeholders. Model infrastructure redesign and development items that are being considered include:

- Revamping the algorithms used for adoption modelling to incorporate results of primary data collection described in section 3.1.
- Adding functionality to accommodate fuel substitution forecasting.
- Coordinating modelling efforts with the DR potential study (see box to the right) and additional details in section 4).[2]
- Right-sizing the dimensionality of the model reducing unnecessary complexity while adding additional details where it is useful.

Integrated modelling algorithm for EE-DR market adoption. The scope of this study is **not** to forecast both EE and DR potential, but rather capture the complementary impacts of DR programs on EE adoption and vice-a-versa. The previous EE and DR potential studies follow fundamentally different approaches to forecast program participation. The EE study used a customer decision logit model (based on energy and measure costs alone) coupled with a Bass diffusion model to simulate market adoption for energy efficient technologies and historic or proxy growth rates for behavioral programs. The DR Potential Study predicts participation in DR programs using an econometric customer propensity model. An integrated study would need to follow a joint EE-DR customer adoption framework that captures both EE and DR benefits to the customer and how that might influence customer adoption of technologies with co-benefits.

[2] Lawrence Berkeley National Lab (LBNL) developed the CPUC's most recent DR potential study.

Much of this development will happen in coordination with the following data collection tasks. For example, model right-sizing depends on the amount, quality, and granularity of input data available.

2.2 Task 2 – Market and Baseline Characterization

Market and baseline characterization refers to information about the size and characteristics of the population that forms the basis for the potential forecast. Much of this data already exists in an easy to use format, therefore this task is primarily compiling existing data from California specific data sources.

STEP 1: DEFINE SEGMENTS

Guidehouse will define residential, commercial, agricultural, industrial, mining and street lighting building segments and end uses to forecast savings potential for in this study. Guidehouse will use the 2019 Potential & Goals Study building type and end use lists, as a starting point for this study. There were a few lessons learned in the last study to include in this study:

- Non-residential sector definitions vary across CPUC and CEC products. Reconciliation was conducted at a high level.
- Measure characterization data for specific industrial sectors are lacking. The market building types segmentation should be reconsidered.
- Mining measure characterization is not priority due to the size of the segment, therefore, no changes in analysis
- Streetlighting measure characterization is not priority due to the size of the segment and limited remaining potential, therefore, market characterization can be aggregated or the segment could be removed entirely.

The end use characterization may be revisited based on specific measure characteristics and load shapes aggregated from the 2019 CEC load shape study.

Stakeholders have expressed interest in a study that considers locational dynamics and targeting based on market potential and reasonableness for savings. The consulting team must configure the market characterization to align with any approach. The location analysis can occur as a post processing set (see section 5.2). However, the target approach may be on a subset of climate zones, building types, or some other combination, this type of model build up will require appropriate planning of the market characterization.

STEP 2: IDENTIFY, COLLECT AND PRE-PROCESS NON-MEASURE SPECIFIC DATA

After identifying the relevant segments applicable to this potential study, the next step in this task is to develop macro-level model inputs that are not specific to any measure. Like the segmentation exercise in Step 1, Guidehouse will use the 2019 Potential & Goals Study global inputs, as shown in Table 1 and as a starting point for this study. Guidehouse will update these inputs based on latest updates to historic sources previously used and/or new sources as recommended by the CPUC and other relevant stakeholders.

Table 1. 2019 Potential & Goals Study Global Inputs

Global Input	Description	Sources
Retail Rates *($/kWh, $/therm)*	Forecast of energy costs to customers	CEC - Integrated Energy Policy Report (IEPR)
Sales Forecasts *(GWh, MW, and MM Therms)*	Forecast of energy sold to customers	CPUC - California Energy Consumption Database (ECDMS)
Building Stocks *(households, floor space, consumption)*	Forecast of building and/or sales growth	CEC – Requested from California Energy Commission
Avoided Costs	Forecast of avoided energy and capacity costs to utility	CPUC – Cost Effectiveness Tool
Historic Program Accomplishments	Historic program savings and spending, used for model calibration	CPUC – CEDAR Data; Interviews
Non-Incentive Program Costs		
Inflation Rate	Assumption: 2.3% assumption	Federal Reserve Bank of Philadelphia – Long-Term Inflation Forecasts
Discount Rate	Utility after-tax WACC Social discount rate	
Emissions Intensity and other Inputs	Electricity grid emissions intensity (hourly values); natural gas emissions; natural gas leakage; HFC emissions	Avoided Cost Calculator

2.3 Task 3 - Measure Characterization

Our overall measure characterization approach is to leverage our existing measure characterization database developed for the 2019 P&G study. We will review the measure list, determine if measures should be added (or removed), aggregated or simplified, and update the database with the most recent energy savings estimates, market saturation, and measure cost data available. As the California market matures and develops with both saturation of technologies, changing baselines, program interventions, and policies, the P&G study must evolve to consider the impacts on the characterized measures. The Industrial and Agriculture Market study will also provide input to this task filling a key data gap for these sectors.

IDENTIFY MEASURES AND DEVELOP LIST

The first step in the measure characterization process is to select a list of representative technologies to include in the potential study. Historically, the selection process entails identifying high impact technologies with significant savings opportunities across multiple end uses, as demonstrated through historic IOU program activity. Given the changes in the market and changing dynamics of the programs, we propose changes to the approach for the measure characterization. It is critical that the measures that have a meaningful impact on potential over the planning horizon be prioritized and selected appropriately. The potential study should capture emerging technologies as well as recent changes in how programs and measures are implemented.[3]

Updates will be made to right-sizing the measure list and granularity of measure characterization. The intent is to allow the study team's limited resources to scale the level of effort spent on different measures up or down based on the measure's importance. Efforts to right-size include considering:

1. Bundling or categorization of measures:
    a. Aggregating efficiency levels where additional granularity does not provide high value
    b. Bundle lower savings or niche measures into a single representative measure
    c. Typical groupings of measures in implementation, such as the whole upgrade program that tends to include the same 3-5 measures installed at once
2. How NMEC program impact measure characterization
3. Capture the high impact measures, while simplifying the low impact measure, by end use or another categorization
4. Targeting measures, such as climate zone and high/medium/low usage patterns to fully capture high potential impact
5. Program-based characterization
6. De-prioritizing effort on characterizing lighting measures as many have become standard practice baseline

[3] Changes include increased third party program penetration, removal of low cost lighting, LED lighting baseline, NMEC-based programs, and more.

There are two additional issues Guidehouse will account for in the process of measure selection:

- Guidehouse will identify EE measures that can provide joint EE and DR benefits. The work in this task will focus on characterizing co-benefits of affected measures and developing data to characterize DR benefits.
- Guidehouse will identify feasible fuel substitution measures (specifically measures that displace existing natural gas with added electricity consumption). The measure list already contains key measures that are candidates for fuel substitution, though additional measures will be considered. This study cycle will identify candidate measures and characterize data to enable modelling.

Characterizing DR co-benefits. Technologies with co-benefits are higher efficiency technologies with controls that make them good DR candidates. EE technologies could come with in-built controls and communication capabilities (e.g., smart water heater) that inherently make these suitable for DR, or they could be retrofitted with a control and communication on an existing energy efficient equipment (e.g., an aftermarket load control switch fitted to a water heater). Measure characterization will include quantification of these co-benefits.

Upon finalization of the measure list, Guidehouse will begin the measure characterization process. Guidehouse will source consumption, cost and other measure-specific data from primary data sources including but not limited to DEER, non-DEER workpapers, custom measure dispositions, EM&V results, emerging technologies programs, technical reference manuals and industrial energy assessments. Guidehouse will supplement these primary data sources with secondary data sources, such as potential studies performed in other jurisdictions across North America. Additional characterization is proposed through new market studies under the Group E contract. Table 2 shows data sources used in the 2019 Potential and Goals Study. Priority of sources may shift based on recency of source, CPUC staff direction, and stakeholder input.

Table 2. Example Measure Characterization Data Sources

Source Name	Description	Author
DEER (Database of Energy Efficient Resources)	Information from DEER updates for obtaining energy use and coincident peak demand for technologies, wherever available. Lighting energy can be calculated using the lighting calculator tool available at DEER.	CPUC
Workpapers	Characterizing technologies that are not included in DEER. Leverage the inventory of workpapers published by the California IOUs and catalogued/reviewed by the CPUC	IOUs and CPUC

Source Name	Description	Author
Industrial/Agricultural market characterization study	Primary data collected under the Group E contract on the industrial sector (see section 3.2)	Guidehouse/DNV GL
2025 California Demand Response Potential Study	Provides information on DR co-benefits for EE technologies that are DR enablers	LBNL
EM&V Reports	Impact and process reports may provide additional data to characterize markets and measures.	Third party evaluators and CA IOUs
CalTF eTRM	Online relational database for statewide deemed measures.	CalTF
CA IOU Emerging Technology Reports	Project/technology reports from the ETCC—a collaborative forum with IOUs and leading member organizations for characterization of emerging technologies.	Emerging Technology Coordinating Council (ETCC); IOUs
IOU Program Data	EEStats[4] and CEDARS database, in case energy use information was not available from the above-listed sources.	CPUC, IOUs
Non-California source examples: ○ Regional Technical Forum (RTF) Database	In cases where CA-specific sources are not available for energy use information, refer to the following sources: • Measure-level savings data from evaluated programs in the Pacific Northwest region, available through the RTF.	Northwest Power and Conservation Council (NPCC)
○ Guidehouse Potential Study Database	• Guidehouse's archive of characterized measure savings from potential studies and projects with other utilities.	Guidehouse

CHARACTERIZE TECHNOLOGIES

From Guidehouse's experience, most potential is driven through a limited number of technologies or measures currently available in the market or expected to be in the market at some point within the planning horizon. Guidehouse expects to source most measure-specific data from primary sources such as the DEER database and IOU workpapers.

Guidehouse will take a prioritized approach to measure characterization to ensure that measures with the largest impact on savings potential are allocated the appropriate level of resources. Higher impact measures typically receive more attention and scrutiny, while low impact measures initially receive a low impact review only.

[4] http://eestats.cpuc.ca.gov/Views/EEDataPortal.aspx

Each measure will be vetted and fully characterized for savings, costs, lifetime, and technical suitability. These measures will then be integrated into the model. Key measure characterization fields are expected to include:

- Measure descriptions and baseline assumptions;
- Energy savings (kWh, kW, Therms) including any refrigerant or natural gas leakage;
- Cost associated with the measure (equipment, operational);
- Lifetime of the measure (EUL and RUL);
- Applicability factors including initial energy efficiency (EE) market penetration, total measure saturation, density and technical suitability;
- Cross-measure interactive effects;
- Replacement type of measure; and
- Data sources.

Our measure characterization process will also involve assessing current and anticipated codes and standards as part of the baseline assessment, as well as declining cost trends for specific technologies.

CHARACTERIZING CUSTOMISED TECHNOLOGIES

The measure characterisation process outlined above works well for prescriptive types of measures that represent a piece of equipment. However, many energy efficiency opportunities are realised through customised solutions, that group different individual measures into packages and savings are in effect realised for the package. This is particularly applicable for larger commercial, industrial, and agricultural customers, including heterogeneous customers in the industrial sector where each customer’s energy profile is unique to that customer. It is also applicable to whole building packages either from existing program models or NMEC-based in the residential and commercial sectors.

Our approach builds from an end use perspective, where we identify specific end uses that are more aligned with custom measures. For example, for industrial and agricultural segments, we will focus our customised measure packages toward the process that is most dominant to that segment (e.g., motors, process heating, etc.). For commercial segments, the focus would be on HVAC equipment, HVAC controls, and lighting equipment/controls. For the potential study, we will incorporate our experience and assumptions about which sectors, segments, and end uses would be candidates for these customised measure groupings. We will then conduct a customer measure level savings and cost analysis that is separate from these types of analyses for prescriptive measures. Our market characterisation analysis will identify which portions of each of our segments / building types would be candidates for customised measures. Our outputs will show customised measures according to the various end use groupings that were identified at the outset (e.g., industry specific process, HVAC equipment, HVAC controls, lighting equipment/controls).

ADDRESS BEHAVIOR, OPERATIONAL AND RETRO COMMISSIONING (BROS) MEASURES

To estimate energy savings generated by behavioral interventions, Guidehouse will work with the CPUC and stakeholders to identify a representative list of behavior and activity-based measures. The measure list will remain the same as the 2019 study with the focus of this study being reviewing input data. The primary focus for updating inputs will be for Home Energy Report, Strategic Energy Management, and Retrocommissioning programs. Recent/current CPUC impact evaluations are expected to provide new data on these high impact BRO's measures.

For modelled measures, Guidehouse will develop key assumptions, including implementation plans and planned rollout assumptions. These assumptions will be used to define a unique participation forecast for each program. It is important to highlight that participation is a function of either customer adoption for opt-in programs and the number of customers that the utility wants to engage for opt-out programs. Engagement strategies for opt-out programs typically targets high-value customers first as these customers tend to result in the highest savings. Engagement often happens in waves and utilities may design the program as a means of experimenting with the effectiveness of different program elements. Some of the key assumptions include:

- A typical participation goal for the first year of implementation (or initial program saturation for existing programs)
- The percentage of residential, commercial, and industrial customers enrolled per year following the launch of the program
- The growth rate in participation over 5, 10, and 15 years

Additionally, we will consider collecting data on the following:

- Dynamic savings rates (future participants may save less than past participants)
- Opt-out rates and how they may change in the future

The methodology described above is subject to change depending on data availability and input from the CPUC and stakeholders.

2.4 Task 4 - Technical Potential

Technical potential is defined as the amount of energy savings that would be possible if the highest level of efficiency for all technically applicable opportunities to improve energy efficiency were taken, including retrofit measures, replace-on-burnout measures, and new construction measures. Guidehouse's PG model considers the following in forecasting technical potential:

- Technical potential assumes all eligible customers within a technology group adopt the highest level of efficiency available within the technology group, regardless of cost-effectiveness

- Technical potential represents the savings from converting all equipment that is at or below code to the highest level of efficiency within a technology group. Technical potential captures cross-measure interactive effects.
- Total technical potential is a sum of all individual technical potential within each technology group excluding whole building packages and BROs.
    - Whole building packages are excluded from the technical potential as doing so would be duplicative.
    - Technical potential for BROs are undefined in our model as there is limited data on the amount of savings could be achieved from programs that have 100% of eligible customers enrolled and how such high enrolment in multiple behavior programs interact with eachother.

Technical potential can be reported as both instantaneous and annualized potential, distinguished as follows:

- **Instantaneous:** Potential that is unconstrained by stock turnover in existing buildings in any given year.[5] This is the theoretical maximum savings possible from converting all equipment that is at or below code to the highest level of efficiency within a technology group.
- **Annualized:** Potential that is constrained by stock turnover in existing buildings. In any given year. This is the theoretical maximum savings possible from converting all equipment that is at or below code to the highest level of efficiency within a technology group upon burnout of the baseline technology.

The calculation of technical potential differs depending on the assumed measure replacement type, since technical potential is calculated on a per measure basis and includes estimates of savings per unit, measure density (e.g., quantity of measures per home), and total building stock in each service territory. As a starting point for illustrating how the technical potential calculation differs by replacement type, the replacement types considered in the 2019 Potential & Goals Study are described below.

EXISTING BUILDINGS

The PG model in its current form is set up to calculate technical potential for four replacement types in existing buildings:

- **Equipment**
    - **Replace on Burnout (ROB) –** New equipment needs to be installed to replace equipment that has reached the end of its useful life, has failed, and is no longer functional. Upon failure ROB equipment is generally not repaired by the customer and instead replaced with a new piece of equipment. Appliance standards are

[5] Includes buildings newly constructed in that same year

applicable to some types of ROB equipment and apply to all new purchases. An example of an ROB measure is the light bulb.

- **Accelerated Replacement –** Equipment that is beyond its EUL and is continuing to function in the market (likely because of repairs that a customer has conducted on the equipment to extend its life). The customer is not planning to replace the equipment on a "regular cycle" and thus programs are targeted at the customer to accelerate the equipment's replacement. Appliance standards are applicable to some types of Accelerated Repair equipment but only apply to new purchases (not the repair). Examples include measures such as boilers and chillers.

- **Retrofit**
  - **Retrofit Add-on –** New equipment being installed onto an existing system, either as an additional, integrated component or to replace a component of the existing system. In either case, the primary purpose of the add-on measure is to improve overall efficiency of the system. These measures are not able to operate on their own as stand-alone equipment and are not required for the operation of the existing equipment or building. Codes or standards may be applicable to some types of Retrofit Add-on measures by setting minimum efficiency levels of newly installed equipment; but the codes or standards do not require the measure to be installed. Examples include measures such as boiler controls, VFDs, and window film.
  - **Retrofit Replacement –** Measures that will be replaced not due to equipment failure but rather triggered by building renovation. These measures are those that are installed to replace previously existing equipment that has either not failed or is past the end of its EUL but is not compromising use of the building (such as insulation and water fixtures). Many of these installations are subject to building code but upgrades are not always required by code until a major building renovation (and even then, some may not be required).

Equation 1 shows the formula for calculating technical potential in existing buildings.

Equation 1. Technical Potential in Existing Buildings

Technical Potential, $_{\text{EXISTING BUILDINGS}}$ = Existing Building Stock $_{\text{YEAR}}$ (e.g., buildings[6]) X Measure Density (e.g., widgets/building) X Savings $_{\text{YEAR}}$ (e.g., m^3/widget) X Technical Suitability (dimensionless)

NEW CONSTRUCTION BUILDINGS

In a newly constructed building, equipment that is installed is always relative to code. New building stock is added to keep up with forecasted growth in total building stock and to replace existing stock that is demolished each year. Demolished (sometimes called replacement) stock

6 Units for building stock and measure densities may vary by measure and customer segment (e.g., 1,000 square meters (or feet) of building space, number of residential homes, customer-segment consumption/sales, etc.).

is calculated as a percentage of existing stock in each year. Equation 2 shows the formula for calculating technical potential in new buildings.

Equation 2. Technical Potential in New Buildings

Technical Potential, $_{NEW\ BUILDINGS}$ = New Building Stock $_{YEAR}$ (e.g., buildings[7]) X Measure Density (e.g., widgets/building) X Savings $_{YEAR}$ (e.g., m^3/widget) X Technical Suitability (dimensionless)

COMPETITION GROUPS

Guidehouse's modelling approach recognises that in some cases efficient technologies will compete against each other in the calculation of potential. The previous PG studies allowed for significant amounts of competition for many measures. In retrospect, this added unnecessary complexity to the model and data collection process. During measure characterization we will seek to aggregate high efficiency measures and reduce the amount of competition in our model. Where competition remains, this functionality to model will still be executed.

The study defines competition as efficient measures competing for the same installation (e.g. SEER 15 AC vs SEER 18 AC) as opposed to competing for the same savings (e.g., window A/C vs. split-system A/C) or for the same budget (e.g., lighting vs. water heating). General characteristics of competing technologies used to define the competition groups proposed for this study include:

- Competing efficient technologies share the same baseline technology characteristics, including baseline technology densities, costs, and consumption;
- The total (baseline plus efficient) maximum densities of competing efficient technologies are the same;
- Installation of competing technologies is mutually exclusive (i.e., installing one precludes installation of the others for that application); and
- Competing technologies share the same replacement type.

To address the overlapping nature of measures within a competition group, Guidehouse's analysis only selects one measure per competition group to include in the summation of technical potential across measures (i.e., at the end use, customer segment, sector, service territory, or total level). The measure with the largest savings potential in each competition group is used for calculating total technical potential of the competition group. This approach ensures double-counting is not present in the reported technical potential, though the technical potential for each individual measure is still calculated and reported.

[7] Units for building stock and measure densities may vary by measure and customer segment (e.g., 1,000 square meters (or feet) of building space, number of residential homes, customer-segment consumption/sales, etc.).

2.5 Task 5 - Economic Potential

Using the results of the technical potential analysis, the economic potential is calculated as the total energy efficiency potential available when limited to only cost-effective measures. All components of economic potential are a subset of technical potential. In addition to the above considerations in modeling technical potential, the following additional considerations are factored into our calculation of economic potential:

- Economic potential assumes all eligible customers within a technology group adopt the highest cost-effective level of efficiency available within the technology group. The most efficient technology within the group may not be cost effective.
- Various cost effectiveness tests and thresholds could be applied; thus, economic potential can vary by scenario.
- Since technical potential is undefined for BROs (discussed earlier in section 2.4), the economic potential for BROs is also undefined. However, the cost effectiveness test results of BROs interventions will be calculated and reported. C-E test results for BROs may subjectively inform scenario design.

Given the addition of fuel substitution measures, DR co-benefits, and integration with IRP, appropriate additional considerations may be needed. Such as:

- How to implement CPUC guidance on fuel substitution measures in regard to economic potential calculations in the PG study?[8]
- Do DR co-benefits get factored into the TRC (or other tests) as benefits?
- What (if any) alignment needs to happen with the IRP around this topic?

2.6 Task 6 - Achievable Potential

This section demonstrates our approach to calculating achievable potential, which is fundamentally more complex than the calculation of technical or economic potential. This section covers the following:

1. Potential modelling approach
2. Net-to-Gross ratios and free ridership
3. Cumulative savings
4. Scenario Analysis

ACHIEVABLE POTENTIAL MODELLING APPROACH

[8] https://www.cpuc.ca.gov/General.aspx?id=6442463306

Guidehouse's PG model employs a combination of customer willingness to adopt and market diffusion rates to simulate market adoption. A high-level summary of the algorithm is presented here. Three key steps are involved in simulating market adoption using Guidehouse's PG model:

1. Size population eligible to upgrade equipment in any given year
    a. The model sizes the annual, eligible population for measure-specific market adoption using building stock as a starting point.
    b. This eligible population for installation decisions is calculated based on replacement type, using either a measure's burnout rate, post-repair failure rate or number of retrofittable measures.
2. Calculate market share split amongst base and efficient measures for eligible population
    a. The model calculates the market share, or penetration of measures based on customer willingness to adopt the measure and the market's rate of diffusion for that measure.
3. Calculate savings attributable to utility program intervention
    a. The model calculates savings attributable to utility program intervention by multiplying the market adoption by the energy savings, relative to the appropriate baseline.
    b. In the case of discrete measures, the eligible population in step 1 is further constrained by the remaining stock available after accounting for whole building installations.

To properly define the energy efficiency resource that is available as part of the EE potential analysis, there must be a high level of confidence that the resource will be available in the required timeframe using tested programmatic and policy approaches. Once the achievable potential estimates are generated, a process of calibration is engaged to ensure that the band of uncertainty is mitigated. The EE potential modeling framework relies on several parameters that will inform development of projected measure adoption rates that will lead to the achievement of EE savings. Many of these parameters are based on rich datasets containing information about measure savings, measure cost and customer sensitivities. Data on parameters centering around the consumer's willingness to adopt and market diffusion are more uncertain and could be subject to contention.

Guidehouse plans to employ the stakeholder engagement process to collect input on these uncertain or contentious values. Once the initial achievable potential estimates are generated, Guidehouse will present the results to stakeholders and identify how changes to each of these uncertain parameters will affect the magnitude of the achievable potential. In a working session with stakeholders, we will provide context for each parameter and solicit their input to adjust these parameters. The goal of these parameters adjustments is to ultimately land on a calibrated set of EE achievable potentials. Stakeholder participants will have the opportunity to weigh in on various adjustments to these parameters. At the end of the process, we will land on achievable potential estimates that will inform our reference case for EE achievable potential.

NET-TO-GROSS RATIOS

Guidehouse's PG model is set up to calculate both gross and net savings attributable to IOU programs. Data and assumptions for net to gross values will be sources from DEER or other CPUC approved databases or documents.

CUMULATIVE SAVINGS

Guidehouse's PG model calculates both incremental and cumulative savings considering direction provided in commission adopted methods. Currently, the model is set up to calculate cumulative savings as the total energy efficiency program savings from measures installed since a "start year" and are still "active" in the current year. "Active" savings are calculated by accounting for:

- Decay of savings as measures reach the end of their useful lives
- Codes & standards that come into effect over time

The approach to quantifying decay is somewhat debatable. Past CPUC guidance has been to assume 50% of EE savings decay at the end of their EUL. Guidehouse used a modified, stakeholder vetted assumption in the last two potential studies that is based on the market adoption algorithms within the model. Essentially, customer re-enter the decision tree and make their purchase decision based solely on the technology performance and cost rather than experience. We will review this method to identify and implement possible improvements.

SCENARIO ANALYSIS

Guidehouse will develop combinations of economic and market achievable assessments to produce up to six scenarios of potential for goal-setting purposes. In previous studies, Guidehouse identified the variables presented in Table 3 as candidate parameters to vary across scenarios. Additional variables may emerge during the study process and will be considered.

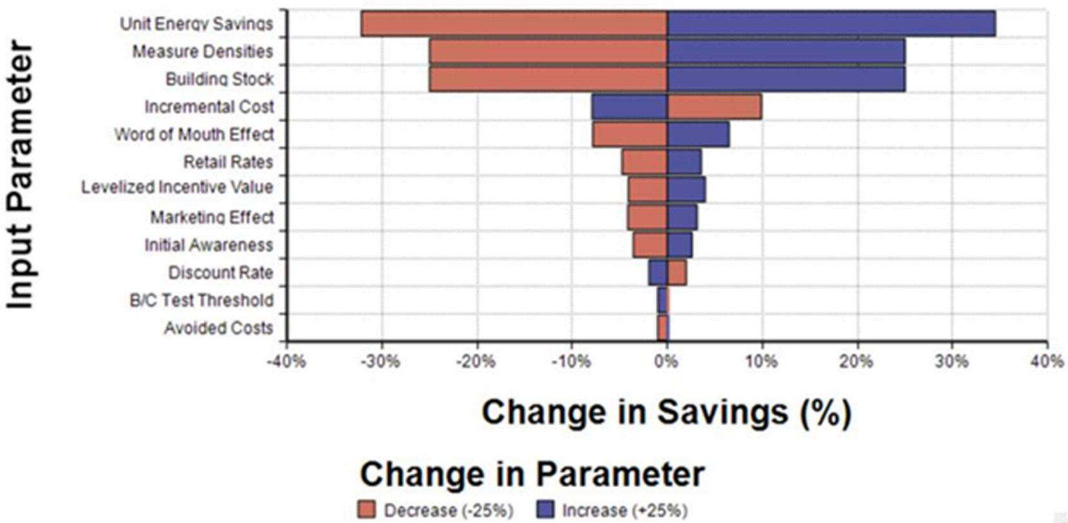
Table 3. Candidate Scenario Analysis Levers

Lever	Description	Potential Impact Applicability	
		Economic	Market
Building Stock Forecast	Typically sourced from the CEC's IEPR forecast, the building stock forecast can follow a range of pathways.	✔	✔
Avoided Cost Forecast	Avoided costs can be modified to include or exclude various components. For example, carbon pricing assumptions based into the avoided cost inputs can vary based on stakeholder interests.	✔ (depending on test)	✔
Measure-level Unit Energy Savings	The model is set up to test the effect of varying unit energy savings and costs by ±X% on potential results.	✔	✔
Measure-level Unit Costs		✔	✔
Cost-Effectiveness (C-E) Test	Different Cost-Effectiveness screening tests and/or thresholds yield different amounts of economic potential and cause the market potential model to incentivize different sets of measures.	✔	✔
C-E Measure Screening Threshold		✔	✔
Incentive Levels	Varying incentive levels will change both the cost-effectiveness of measures and their value proposition to customers.	✔ *	✔
Marketing & Outreach	Varying marketing and outreach levels impacts the rate at which technologies are adopted by customers.		✔
Retail Rate forecast	Typically sourced from the CEC's IEPR forecast, the retail rate forecast can follow a range of pathways. Each pathway can change the value proposition of measures to customers.	✔ (depending on test)	✔
Financing Programs	Financing programs help reduce the cost burden associated with efficient measure adoption.		✔

*Per the California Standard Practice Manual, incentives paid to free riders are a cost component in the TRC test.

Guidehouse's PG model contains a sensitivity analysis module that allows for parametric analysis. Model changes only one variable and tests the effect of that change on the results. All other variables are held constant. The model produces a Tornado diagram as part of these runs, which quickly illuminate the input assumptions to which results are most sensitive (see Figure 3).

Figure 3. Illustrative Tornado Diagram Showing Sensitivity of Total Savings.



Guidehouse will work with the CPUC to define the reference (or base) scenario for this study (i.e. screening test, avoided cost data, etc.). Guidehouse will calibrate the model using the settings in this reference scenario, and model alternate pathways for up to 3 additional scenarios. The three additional scenarios will be determined in conjunction with CPUC staff to make sure the results are most useful for policy decision making.

2.7 Task 7 - Codes and Standards Potential

Codes and Standards (C&S) impacts on energy efficiency potential are modeled two ways:

- C&S impacts the code baseline for IOU rebated measures; as C&S becomes more stringent in the future, above-code savings claimable by IOU programs decreases.
- IOUs can claim a portion of savings from C&S that come into effect through the IOU C&S advocacy programs. This component has historically been considered the “C&S Potential”. This task describes how we will calculate the C&S Potential. Impacts on rebate programs were described earlier in Task 2.

C&S Potential refers to the forecasted savings from current C&S, planned C&S, as well as a set of C&S that are reasonably expected to come into effect. Our study will calculate the C&S “Achievable” Potential in multiple formats, each for a different use:

- **Net C&S Savings** are the total energy savings estimated to be achieved from the updates to codes and standards since 2006. Net savings calculations account for naturally occurring market adoption (NOMAD) of code-compliant equipment and are used to inform demand forecasting, procurement planning, and tracking against greenhouse gas targets. This informs the CEC forecast (for AAEE and SB350 purposes).

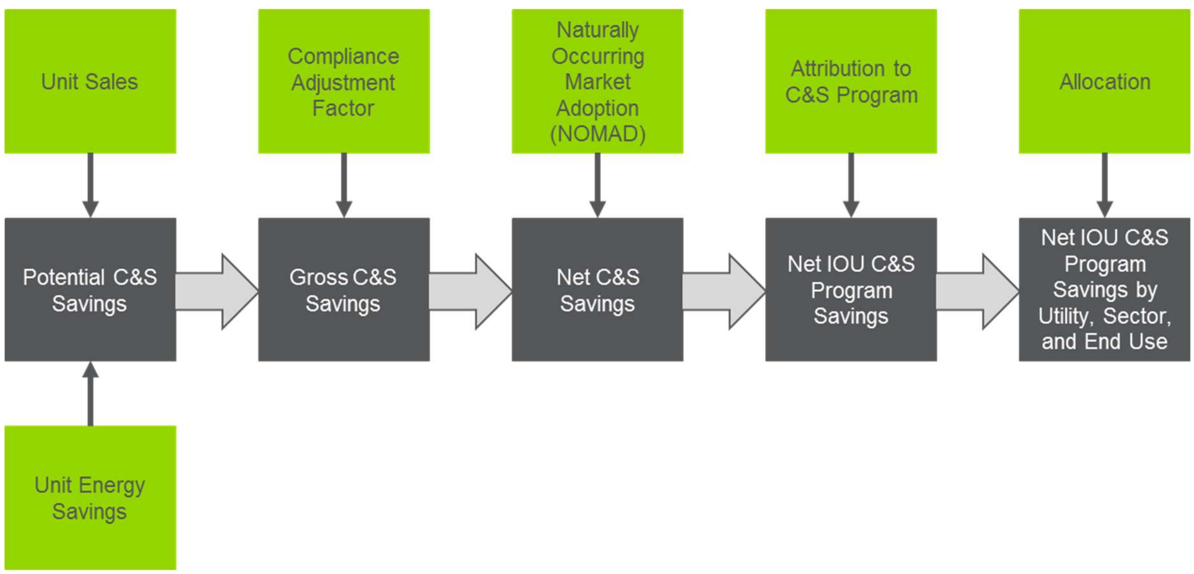
- **Net IOU C&S Program Savings** identifies the portion of the Net C&S Savings that can be attributed to the advocacy work of the IOU's C&S program. This result is used to inform the IOU program goals.

MODELLING METHOD TO DEVELOP SAVINGS ESTIMATES

Our model methodology for C&S savings is based on the Integrated Standards Savings Model (ISSM)[9] developed by Cadmus and DNV GL used by the CPUC in C&S program evaluation. We plan to continue use our existing ISSM based C&S model and update it to reflect any methodological changes in the latest approved ISSM.

The core process of calculating C&S Potential is illustrated in Figure 4.

Figure 4. C&S Savings Calculation Methodology



Incremental savings for C&S are the new savings generated in each year after the code compliance date due to upgrading older equipment or activity in the new construction market. Cumulative savings is the simple summation of incremental savings over time up until the entire market has turned over.[10] This is marked different from calculating cumulative savings for rebate programs which requires an estimate of decay (i.e. measures reverting to baseline after the EUL). In the realm of C&S, the baseline is the previous code or standard, thus there is no "reversion to the baseline" since consumers can't even purchase equipment at the old code or standard level.

SCOPING POTENTIAL STANDARDS AND DATA COLLECTION

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[9] Cadmus and DNV GL. *Integrated Standards Savings Model (ISSM).* 2017.

[10] For example, a standard that applies to an appliance that has a 7-year EUL will accrue incremental savings for 7 years at which point incremental savings from the retrofit market drops to 0. Savings remain from the new construction market after the 7 years unless the standard is subsumed by a more stringent standard and layering effects are removed.

The Guidehouse team will work with the EDPM, program managers and contractors, Commission staff and consultants to scope out a list of potential standards to be included in the C&S potential. Table 4 summarizes our approach and sources of information.

Table 4: Developing Potential C&S for Analysis

Potential C&S	Information Sources
C&S in effect that have been evaluated	Past CPUC evaluations will be used to develop the list of C&S to consider. These evaluations will also contain data in the ISSM input format for our team to leverage. We expect little need to collaborate with external team members other than confirming the latest evaluation data is being used.
C&S in effect that have not been evaluated	IOU C&S claims will be used to develop this list of C&S to consider. Our team will consult the IOU program managers and their contractors to obtain the list; it's possible these claims will have been submitted to CPUC staff. We expect these claims to contain data in the ISSM input format for our team to leverage.
Future C&S	We will to work closely with the Codes and Standards Program administrators, the CEC staff, Commission staff, and knowledgeable consultants to monitor code and standard development and adoption plans.

After compiling information from all these sources, we will develop a list of codes and standards that can be reasonably included in the potential study and estimate input parameters based on available secondary data.

PRODUCE SAVINGS RESULTS

As mentioned earlier, ISSM requires several inputs to calculate the gross and net savings estimates for individual standards. We will use available data sources to develop estimates of annual unit energy savings for each appliance standard and code change and combined code changes in Title 24.

Where gaps exist, we will research current appliance market sales and projections, construction projections, and trends and develop market size estimates over the forecast period. We will combine the unit savings and market size estimates to calculate the potential savings from each standard over the forecast period.

Compliance factors will need to be estimated for future C&S. For building codes, we use historical data at the building level by building type based on the proportion of projected energy savings achieved. For the appliance standards, we will review historical compliance rates for similar standards.

NOMAD factors will also need to be estimated for future C&S. We propose using estimates from prior evaluations in most cases with adjustments to shift the start year as appropriate.
Once all input values are generated this task will provide savings results with the following granularity:

- Yearly Incremental and Cumulative Savings
- Net Attributable Savings
- Net Savings
- IOU

- Sector
- C&S Measure
- End Use
- Applicable Hourly Load Shapes (see section 5.1)

2.8 Task 8 - Low Income Potential

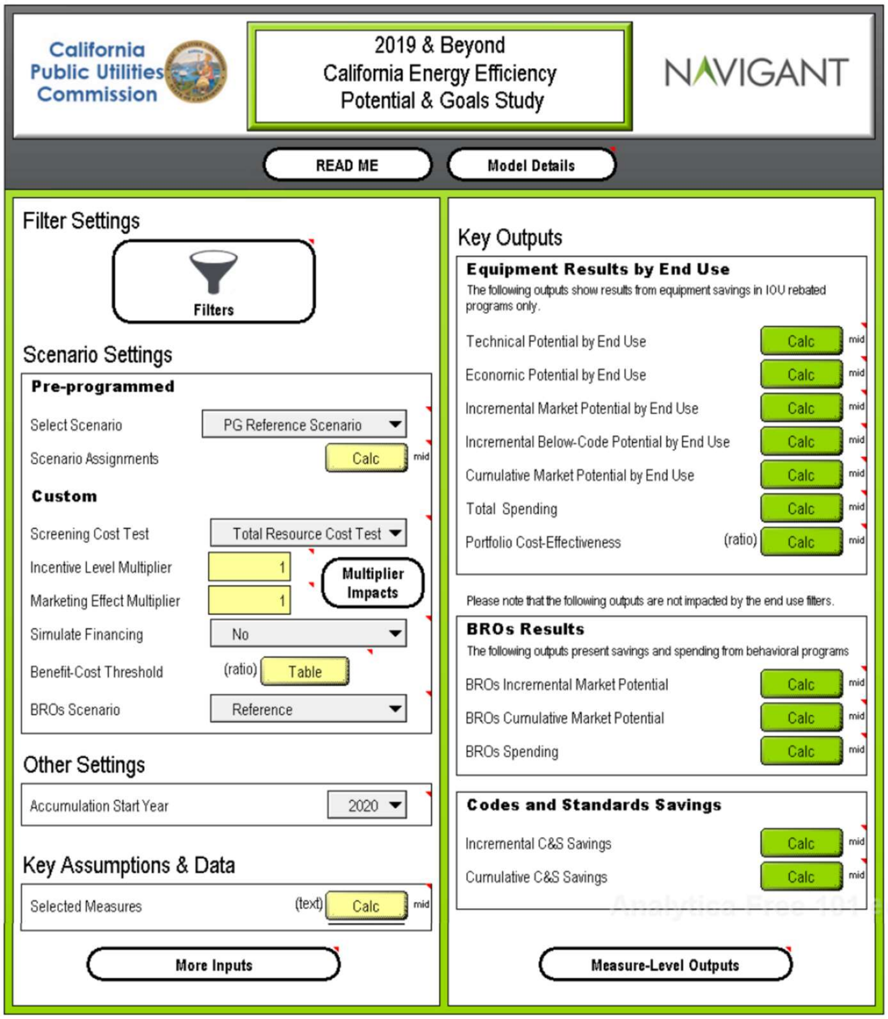
In this task, the Guidehouse team will forecast the Market Achievable potential from the low-income sector and programs. The 2019 PG study developed a new forecasting method relative to the 2018 PG study. This 2019 study approach was more complex and granular; however, these changes did not improve the results accuracy as was initially hypothesized. Therefore, this study will revert back to the method utilized by the 2018 PG study. The method is to request data from the IOUs on the number of expected program treatments and retreatments and apply estimated unit energy savings values (based on IOU reports or impact evaluations) to forecast market potential.

2.9 Task 9 - Reporting and Model Delivery

Guidehouse will prepare a draft report for internal and external review once draft results have been vetted. As has been historically done in the past, Guidehouse expects to publish this draft report, along with draft results and the draft model publicly through the appropriate CPUC channels. We will respond to feedback from external stakeholders and provide a final report.

In addition to a written report, this task will also provide a model and a results viewer similar to that one published with the 2019 PG study. Guidehouse's PG model is currently built using Analytica, a software platform developed by Lumina. Analytica is a software platform for data analytics, simulation, forecasting, and decision-support, widely used for applications in energy, environment, and economics. Figure 5 shows a screenshot of the model's graphical user interface. This interface contains several features that allow users to easily change inputs and scenario settings, run the model and view outputs.

Figure 5. Graphical User Interface of 2019 Potential & Goals Study Model



The model will be delivered to the CPUC as an executable file that does not require a license to run. Though users may need to install a free version of the Analytica Player software.

Furthermore, Guidehouse will train CPUC staff on use of the model. For this study, training will be adapted to the needs of CPUC staff and can consist of the following:

- Documents detailing the modelling methodology and approach;
- User guides describing how to import/export data, run the model, navigate through underlying model logic, change settings, and review results
- Training exercises (structured similarly to practice problems) providing trainees an opportunity to assess their comprehension and aid in knowledge retention.
- Topic-specific recorded webinars;

- In-person training sessions; and
- Technical support post model delivery up until the contract end period

3. Primary Data Collection

Per the stakeholder comments at the October workshop and Guidehouse experience with the PG study over the years, there is a clear understanding of specific data and information gaps regarding the California energy efficiency market. To date, the PG study largely relied on secondary data sets and filled gaps using assumptions vetted with stakeholders. For example, it leveraged non-California-based data to characterize the industrial and agricultural sectors and made assumptions based on prior program experience anchoring results based on historical data during the calibration process. This historical approach to calibration does not address future evolution of programs, products, and markets. Factors that contribute to the growing discrepancy between traditional potential study analysis assumptions and actual portfolio characteristics include:

- Historical programs relied heavily on widget-based incentives to meet portfolio goals
- Changes in the custom project review process and requirements for customer participation
- Changing baselines (e.g. wine tank insulation becoming industry standard practice, which potentially stalls further adoption) and rapidly evolving markets (e.g. changes in lighting standards and prices)
- Transition towards NMEC-based programs and portfolios mostly allocated to third parties, CCAs, and RENs versus IOU designed and implemented

As a result, Guidehouse identified two market research studies to collect primary data and information critical to the PG study approach:

- Market adoption research to capture decision-making factors and enable model updates to rely less on previous program achievements for calibration
- Industrial and agricultural sector market characterizations

These activities will develop updated inputs that feed into the EE potential forecast improving the foundation of its results. These two studies are described briefly below. Guidehouse has prepared individual Research plans for each of these studies to detail research questions and methods.

3.1 Market Adoption Research

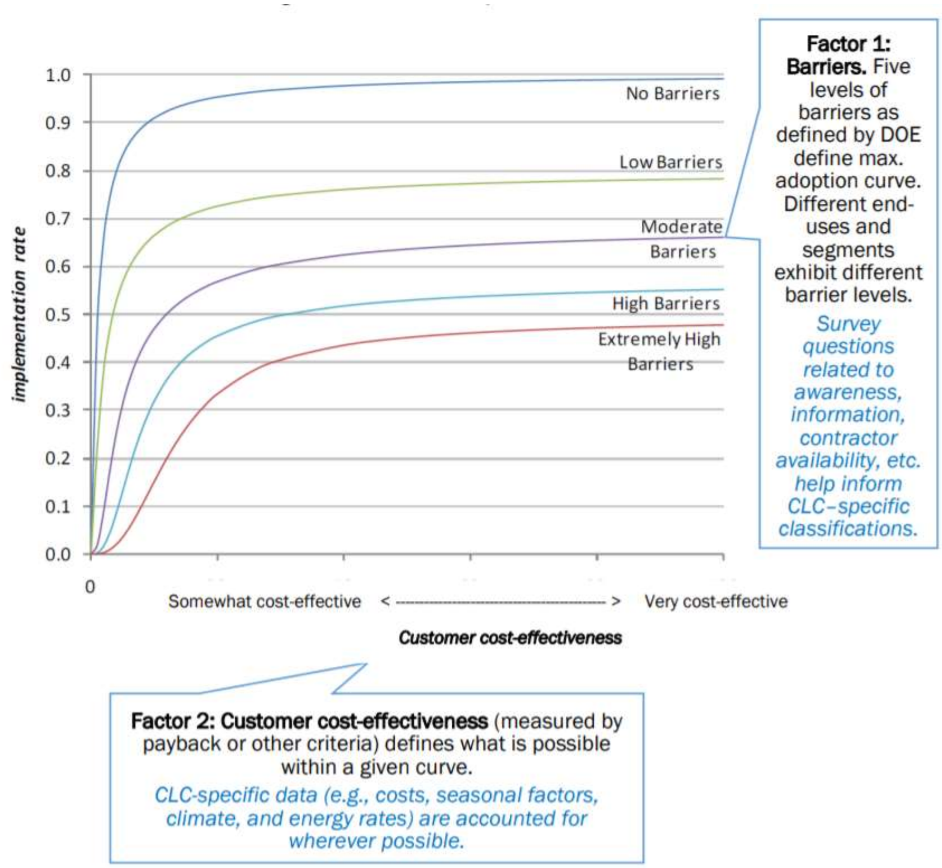
The market adoption study will gather data on adoption characteristics and customer segmentation in order to inform adoption mechanisms in the P&G study for three segments: residential, small commercial, and large commercial. This will provide data that can be used to revise and inform the core adoption algorithms within the EE potential model.

Historically, Guidehouse leveraged data from a Midwest utility to characterize customer adoption based solely on economic factors, namely the payback period of a technology. Not only does this analysis use data from several years ago (2014), it is also limited in scope and does not capture the complexities that influence customers’ decisions to implement energy efficiency projects. These complexities can encompass the characteristics of individual actors as well as external triggers that influence interest, awareness, and willingness to act. Factors that promote action include marketing messages, word-of-mouth, incentives, financial benefits, and intrinsic motivators. Additionally, this study will also capture factors that negatively impact adoption in each customer segment, for example, low awareness, high costs, limited technology availability, and high complexity, among others. The Guidehouse team proposes conducting adoption surveys to characterize the following parameters:

- Decision making factors
- Benefits of and barriers to adoption specific energy efficiency measures (such as fuel substitution)
- Existing penetration and saturation levels of specific technologies
- Role of incentives in energy efficiency adoption

The findings will provide updated saturation and penetration values for the targeted market segments for development of impact adoption curves. Figure 6 comes from the 2017 Cape Cod and Lighting Potential Study and shows an example of how market adoption study results were used in potential study modeling.

Figure 6. Example Market Adoption Curves



3.2 Industrial and Agricultural Market Characterization

This research will gather California-specific data and information on market penetration, saturation and market adoption characteristics within the industrial and agricultural sectors. This will provide data that can be used to revise and inform inputs to the EE potential model.

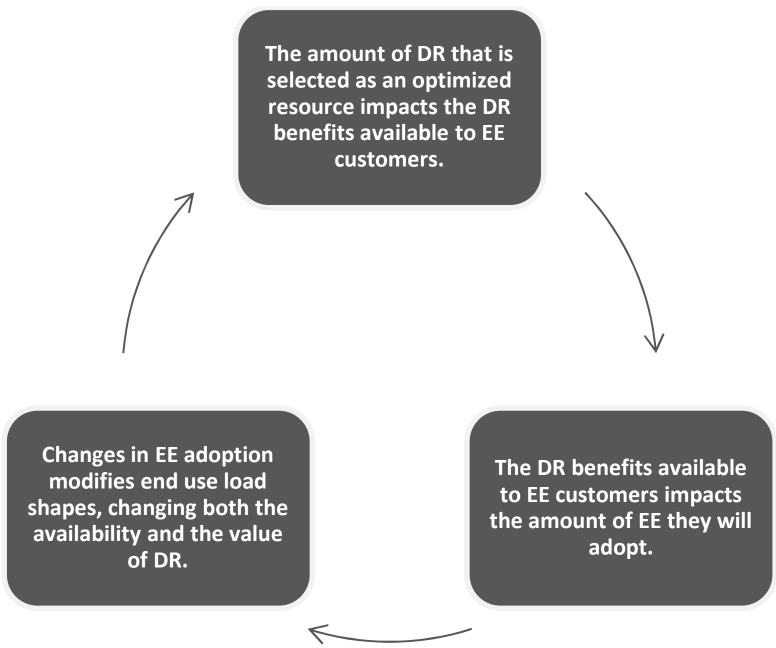
Historically the PG study relied on data from the U.S. Department of Energy's Industrial Assessment Center (IAC) Database. The IAC database provided past PG studies with insights on the current saturation of efficiency and practices in industry. Stakeholders have cautioned (including during the October 2019 workshops) that this dataset may not be representative of the California market.

This activity will target up to six of the most energy-intensive technologies or systems in each identified segment, identify those that may have the greatest potential for savings, and then interview experts to characterize the status of these technologies in the market. The study will use these interviews to estimate market penetration and willingness of customers to adopt technologies.

4. Energy Efficiency and Demand Response Integration, IRP Integration

Energy Efficiency business plan decision D.18-05-041 provides impetus to integrate both EE and DR forecasting efforts. Lawrence Berkeley National Lab (LBNL) developed the CPUC's most recent DR potential study. It is important to note that the amount of EE resource adopted by the market impacts the amount of remaining DR potential in the market. Similarly, to properly capture adoption of EE technologies in the EE market, assumptions must be made about the availability of DR programs/incentive and co-benefits that impact consumer decisions. This implies a feedback loop as illustrated in **Error! Reference source not found.** below.

Figure 7. EE-DR Adoption Feedback Loop



Because of this feedback loop, EE and DR potential studies must be connected so they can best inform integrated resource plan. Guidehouse in coordination with LBNL team identified three key areas to implement integrate the two potential studies. These three topics are discussed in more detail in other sections of this document as they relate to the broader efforts of EE potential forecasting and load shape analysis:

- Modeling algorithms (section 2.1)
- Measure characterization (section 2.3)
- Load shapes (section 5.1)

Historically, demand response was treated as an optimizable resource in the IRP while EE savings fed into the IRP model as a load modifier.[11] However, future integration is likely to consider alternate methods including treatment of EE as an optimizable resource (requiring the development of supply curves). the A logical avenue to integrated EE and DR forecasts is through the IRP model. Guidehouse is prepared to support integration into IRP by preparing supply curves and load modifier assumptions for both EE alone as well as a coordinated EE/DR forecast.

[11] Specifically, the forecast assumes that IOUs achieve their goals

5. Post Processing

5.1 Develop Hourly Impacts

Estimating the load impacts of EE on DR. As mentioned earlier in section 4, the amount of EE adopted impacts the amount and type of DR potential that remains. Hourly baseline energy demand is a key input to the DR potential study. This baseline demand needs to properly account for all EE measures that affect DR-responsive end-uses. Understanding this relationship requires coordination on load shape assumptions between the two studies.

Disaggregating savings forecasts to an hourly basis is a post processing step that applies to all sources of EE potential being forecasted. Hourly impacts are key input that informs the CEC's IEPR forecast, the IRP model, and efforts to integrate/coordinate EE and DR resources. Our process for hourly disaggregation will be as follows and detailed below.

- Step 1 – Identify End Uses of Concern
- Step 2 – Compile Load Shape Data
- Step 3 – Map Load Profiles to P&G study Measures
- Step 4 – Aggregate to End Use Load Shapes

In Step 1 we will identify end uses of concern. Our goal will be to address end uses that account for at least 95% of energy efficiency savings forecasts inclusive of Rebate Programs, C&S, and BROs.

In Step 2, Guidehouse will compile load shape data at the most granular level. We expect readily available load profiles are broken down by:

- Sector
- End Use (with some load shapes being specifically applicable to key measures)
- Climate Zone
- Building type (for some sectors)

Load shapes will be collected from existing secondary data and prioritized to be specific to California. We expect to leverage the following data sources (listed in order of priority):

1. **CEC's 2019 published study "California Investor-Owned Utility Electricity Load Shapes".** This CEC managed project published a database of load shapes currently being used by the CEC for load forecasting purposes.
2. **CPUC EM&V Group A Contract.** EM&V efforts on Group A which is scoped with developing load shapes based on M&V data.
3. **IOU Rate Class Load Data.** Each IOU reports actual, aggregate 8760 data for key rate classes in their service territory. These are only representative of net whole building energy usage as opposed to specific end uses.

4. **DEER.** DEER contains a set of load shapes that are used to inform peak energy savings as well as avoided cost calculations. We will review the latest DEER database to identify reliable load shape data.
5. **OpenEI.** OpenEI[12] is a public database containing hourly residential load profiles by end use and climate zone across the United States. It is based on building simulation models run with local water data.

In Step 3 we will map the collected load shapes to each P&G measure. In most cases this will be a one to many relationship (one load shape applies to many measures) often covering an entire end use. However, to the extent that specific measure-level load shapes are available (thus multiple load shapes apply to measures within the same end use) we will map and retain this level of granularity.

In Step 4 we will aggregate the measure level load shape data into End Uses. Load shape data will be made available in our results viewer and can be applied to our end use forecast of electricity savings to estimate hourly impacts.

5.2 Locational Forecasts

Historically the PG study has been able to disaggregate market potential savings to the climate zone level. Thus, as a default the 2021 study will meet this need. However, additional definitions of location and levels of disaggregation can be considered. This need was discussed during the October workshops; utilities mentioned they do not need locational EE forecasting for distribution resource planning purposes. Rather IOUs, CCAs, and other stakeholders are interested in understanding potential within various geopolitical regions to inform program planning and locational targeting. Thus, our plan is to address these needs.

5.2.1 Climate Zone Market Potential

California state agencies including the CEC have two sets of climate zones. CPUC managed datasets such as DEER, workpapers, and IOU program reporting use building climate zones (BCZs). There are 16 BCZs that disaggregate the state into regions with similar weather (i.e. climate). The CEC's forecasting climate zones (FCZ) used in IEPR and differ from the BCZ. FCZs are primarily "political boundaries" as they are based on utility service territory. The IOUs are further broken into smaller forecasting zones. Guidehouse has developed mappings that we can leverage to disaggregate market potential outputs to BCZ level results into FCZ level results for each sector.

[12] 8760 hourly load profile data for residential customers at the end-use level available at: http://en.openei.org/datasets/dataset/commercial-and-residential-hourly-load-profiles-for-all-tmy3-locations-in-the-united-states

5.2.2 Savings Potential to inform CCAs and RENs

During the October 2019 workshops, Community Choice Aggregators (CCAs) and Regional Energy Networks (RENs) expressed interest in obtaining more granular results from the study to inform their own program planning/targeting needs. CCA's specifically requested that savings the county level or some similar geopolitical boundary level would best support their needs. As such, this post processing efforts aims to disaggregate IOU territory savings to the level that is informative to CCAs and RENs.

This will require population, customer counts, and historic program activity and other similar data that characterizes the market and a more granular level than just the IOU service territory. Guidehouse will work with the CPUC, CCAs, RENs, and other relevant stakeholders to determine an appropriate methodology leveraging available data.

5.3 Support Development of CEC Forecasts

The California Energy Commission (CEC) provides a long-term forecast of energy consumption as part of the Integrated Energy Policy Report (IEPR), this forecast is referred to as the California Energy Demand (CED) Forecast.

The CED forecast is updated on a regular basis. In the process of updating the CED, the CEC first issues a baseline forecast which includes historic energy efficiency program and C&S impacts. It also includes some level of future energy efficiency: that which has been "committed". Committed efficiency savings reflect savings from initiatives that have been approved, finalized, and funded, whether already implemented or not.

However, there also exist additional savings from initiatives that are neither finalized nor funded but are reasonably expected to occur though either the IOU programs or C&S. These savings are referred to as achievable and are based on the CPUC bi-annual Potential and Goals Study. Often, a portion of the savings that are quantified in the P&G study are already incorporated in the CED baseline forecast, CEC staff need to estimate the portion of savings from CPUC potential study not accounted for in the baseline forecast. These nonoverlapping savings are referred to as Additional Achievable Energy Efficiency (AAEE) impacts. AAEE impacts include multiple scenarios that inform the CEC's tracking of savings towards the goals set forth in SB350 (i.e. doubling statewide EE savings by 2030).

Guidehouse has been supporting the CPUC and CEC in this coordination process since 2012 and we expect to follow a similar process for this study as in years past. This includes:

- Holding a series of kickoff and coordination meetings between CPUC, CEC and Guidehouse staff
- Developing a scenario framework that meets the specific needs of the CEC
- Producing scenario results at the level of detail/granularity as requested by the CEC
- Providing guidance on hourly impacts (leveraging load shapes) and locational impact at the climate zone level

- Delivering databases of relevant outputs
- Supporting stakeholder engagement activities

6. Top-Down Potential Study

The specific scope of this study is to be determined. However, per stakeholder input at the October workshop, there is interest to consider a potential study that is top-down based on macro-economic trends rather than bottom-up based on individual measures. During the October workshop stakeholders provided suggestions on how this might be accomplished.

The following are items this pilot study may consider:

- The top-down definition could be a policy driven approach in setting a target and modelling the path towards that target.
- This approach could also follow a consumption-based modelling method using metered data disaggregated to the end use level. One approach is to define existing and target end use intensities to quantify the potential
- How to link the findings from the market adoption study (discussed in section 3.1) to ensure any top down forecast still considers market behaviors.

This activity will be a separate a separate technical analysis conducted in parallel to the core Study.

7. Schedule and Stakeholder Engagement

Table 5 lists the schedule for the EE potential forecast. This detailed schedule is being provided as the goals setting process has certain regulatory requirements that must be met. A high-level schedule of other activities was illustrated earlier in Figure 1. Specific dates for EE-DR/IRP integration, post processing, and the top-down case study have not been finalized at this time.

Table 5: Schedule for EE Potential Forecast

Task	Milestone/Deliverable	Start Date	Completion Date
N/A	Scope Development	2/10/2020	4/15/2020
1	Develop Model Infrastructure (Align to Scope)	4/13/2020	7/1/2020
2	Collect Global Inputs/ Market Baseline	5/1/2020	9/1/2020
3	Characterize Measures	5/1/2020	9/15/2020
4	Develop Technical Potential	9/15/2020	10/15/2020
5	Develop Economic Potential	10/15/2020	11/1/2020
6	Develop Achievable Potential	10/15/2020	12/15/2020
7	C&S Potential	9/15/2020	11/15/2020
8	Low Income Potential	9/15/2020	12/15/2020
9	Reporting	9/1/2020	4/1/2021

Throughout the PG study Guidehouse plans to engage with stakeholder to collect feedback on key topics. Table 6 lays out our current plan for stakeholder engagement, these items were illustrated earlier in Figure 1. We may consider more opportunities for engagement with stakeholders; feedback on this matter may be sought via discussion and/or written feedback from stakeholders.

Table 6: Planned Stakeholder Engagement Topics

Stakeholder Meetings	Webinar or In Person
Work Plan	Webinar
Stakeholder input on **measure** priorities and characterization including fuel substitution & EE/DR	TBD
Stakeholder input on **modeling**: fuel substitution EE/DR, and EE adoption	TBD
Presentation of Low-Income approach and data needs	TBD
Draft findings from primary data collection studies	TBD
Discussion of EE/DR/IRP integration approaches	TBD
Stakeholder input on scenarios	TBD
Stakeholder input on locational post processing	TBD

Stakeholder input on scoping top-down study	TBD
Draft Results	TBD