Assessing Energy Efficiency Potential and Goals

Discussion Facilitation Document on Selected Topics

Working Document – For Stakeholder Discussion ONLY

Prepared for:

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Submitted by:
Navigant, a Guidehouse Company
101 California Street
Suite 4100
San Francisco, CA 94111

guidehouse.com

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INTRODUCTION

The California Public Utilities Commission (CPUC) has been developing estimates of energy and demand savings potential in the service territories of California's major investor-owned utilities (IOUs) for more than a decade. The estimates include technical, economic, and market potential forecasts for Pacific Gas and Electric (PG&E), Southern California Edison (SCE), San Diego Gas and Electric (SDG&E), and Southern California Gas (SCG). This Potential and Goals (PG) study supports multiple related efforts:

- Inform the CPUC as it proceeds to adopt goals and targets, providing guidance for IOU energy efficiency (EE) portfolios.
- Inform the California Energy Commission (CEC) to develop its forecast of additional achievable energy efficiency potential (AAEE) and SB350 target setting.
- Inform CPUC Integrated Resource Planning (IRP).
- Guide the IOUs in portfolio planning and the state's principal energy agencies in forecasting for procurement, including the planning efforts of the CPUC, CEC, and California Independent System Operator.
- Provide data to other entities such as third-party program implementers, CCAs, and RENs to inform their program planning efforts.

The CPUC PG study has been updated every 2 years in recent history with the latest updating being issued in 2019.[1] The 2019 Study (conducted by Navigant, a Guidehouse Company) was primarily an update of the 2017 Study due to a compressed project timeline. The 2019 study informed IOU goals for 2020 and beyond. If the CPUC were to follow a similar update cycle in the future, the next PG study would be the 2021 study that informs goals in 2022 and beyond.

Navigant, the current PG study contractor, has been working with CPUC staff to explore key topics that the next PG study should consider. Addressing these new topics in a future PG study will require updated methodologies and new types of data that have not been used in past CPUC PG studies.

Prior to selecting what enhancements are needed for a future PG study, discussion and input from the stakeholder community is needed. The topics in this document were selected by CPUC staff as issues for consideration.

This document is structured into individual sections that each discuss a specific topic. The topical discussions are meant to provide background on the issue and lay out methodological needs, data needs, and pose unanswered questions. This document is not meant to contain recommendations as to what the next PG study should do. Rather its purpose is to highlight outstanding questions and data gaps that need to be resolved for scoping the next PG study to meaningfully address these topics.

[1] 2019 Study report, results, model, and other support documentation is available at: https://www.cpuc.ca.gov/General.aspx?id=6442461220

1. Energy Efficiency and Demand Response Potential Integration

The Energy Efficiency business plan decision (D.18-05-041) agreed with the proposal Energy Division staff made under Energy Efficiency applications (A.17-01-013 et al.) and Demand Response applications (A.17-01-012 et al.) for the integration of the EE and DR potential studies to support analysis under the Integrated Resource Planning (IRP) process. According to D.18-05-041 at 34 (Section 2.4.2):

> *"The most straightforward portion of the staff proposal for limited energy efficiency and demand response integration is with respect to the idea of conducting a combined potential and goals study to look at both energy efficiency and demand response opportunities within the same customer base. No party has major objections to this idea and Commission staff are already working on a way to design such an integrated study. We expect that the next solicitation for consultant assistance in conducting the potential and goals study will include elements of energy efficiency and demand response potential in an integrated manner.''*

There are multiple areas in which EE and DR interact and could be integrated in a potential study. These include:

- Characterization of controls-based technologies (e.g., advanced lighting controls) have both EE savings and DR capabilities. Therefore, costs and benefits of these measures need to be assessed from a joint EE-DR perspective.

- Market adoption of these measures needs to represent both EE and DR savings and benefits that customers could potentially realize through adoption of these measures. EE influences the baseline load for DR. For example, the lighting loadshape after installing advanced lighting controls would determine the potential availability for DR at different hours from lighting controls.

EE-DR potential integration assumes added significance in the state's current electrification drive toward meeting climate goals. EE potential estimation is expected to include a growing portfolio of electric technologies from fuel substitution. This influences the system load and thereby increases the need for DR to provide grid services. Representation of DR impacts from these technologies and the interactive effects between EE-DR from these technologies would assume increasing importance as the portfolio of electrification technologies progressively grows over time.

Navigant has identified possible areas of EE-DR integration in future potential studies through modifications in existing approaches in current EE and DR potential studies and/or adopting new approaches (both in terms of input data development and modeling framework). This is to be used as a starting point and not a recommendation for a specific approach for the discussion regarding PG study methodology considerations for EE-DR integration.

The four broad areas that represent EE and DR interactions/overlaps and are relevant for an integrated potential study to consider are:

1. Modeling Framework for Integration of EE-DR Potential Estimates.
2. Technology Characterization.
3. Market Segmentation and Load Profile Development
4. Market Adoption Framework

The subsequent sections below outline the methodological considerations under each topic, lists key research questions that would need to be addressed and indicates the data required to support EE-DR potential integration modeling. Lastly, this abstract poses a set of policy questions on the EE-DR topic that need to be addressed for EE-DR potential integration.

1.1 Energy Efficiency and Demand Response Potential Integration Areas

1.1.1 Modeling Framework for Integration of EE-DR Potential Estimates

Currently, EE and DR potential estimates are developed using independent modeling frameworks for the two types of resources that do not incorporate the interactions between EE and DR. There are fundamental differences in the modeling framework and approach used to develop EE and DR potential estimates, which future integrated EE-DR potential studies need to address.

The key methodological considerations are briefly discussed below, followed by a list of research questions that an integrated EE-DR potential modeling framework would need to address.

Methodological Considerations
The EE potential estimation approach considers potential at three levels: technical, economic and market/achievable potential, which are based on industry standard definitions of these potential levels.[2] It first assesses the technical potential with highest savings measure/technologies, and moves on to assess economic or cost-effective potential for EE technologies using the California Standard Practice tests (primarily the TRC test but other such as mTRC, and PAC tests are possible), and finally applies market diffusion algorithms to forecast the market adoption of cost-effective technologies/measures based on stock turnover. The final output of the potential study is a market potential analysis, which calculates the energy efficiency savings that could be expected in response to specific levels of incentives and assumptions about existing CPUC policies, market influences, and barriers. Market potential is used to inform the utilities' energy efficiency goals, as determined by the CPUC.

The DR Potential Study, conducted by Lawrence Berkeley National Laboratory (LBNL)[3], followed a fundamentally different approach for potential estimation from the 2018 EE Potential and Goals Study. It does not follow the technical, economic, market potential framework as the EE study, and instead develops supply curves for DR that feed into the IRP model to determine cost-competitive DR with other supply side resources. The DR study uses customer end-use load profiles based on IOU-provided AMI data as a foundation and applies DR participation, costs, and unit impact assumptions to generate DR supply curves that feed into E3's RESOLVE model to determine cost-competitive DR with supply side resources.

The modeling framework for integrated EE-DR potential estimation would need to incorporate the different areas of EE-DR interactions/overlaps, which current studies do not consider. These areas of interactions fall under the three categories previously listed, which are - **technology characterization, market segmentation and load profile development, and market adoption framework**, and will be further described in this paper.

To date, the CPUC's IRP modeling efforts have considered energy efficiency (EE) as a "baseline resource"; i.e., a resource that is included in the model as an assumption with a set magnitude rather than being selected by the model as part of an optimal solution. In consideration of future updates to the IRP, the CPUC is considering integrating EE as a supply-side resource.[4] EE and DR potential estimates for

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[2] Navigant, 2019. *2019 Energy Efficiency Potential and Goals Study*, prepared for California Public Utilities Commission. Submitted by Navigant Consulting; July 1, 2019. ftp://ftp.cpuc.ca.gov/gopher-data/energy_division/EnergyEfficiency/DAWG/2019%20PG%20Study%20Report_Final%20Public_PDFA.pdf

[3] Lawrence Berkeley National Laboratory (LBNL), 2017. *2025 California Demand Response Potential Study. Charting California's Demand Response Future*. https://drrc.lbl.gov/publications/2025-california-demand-response

[4] Senate Bill (SB 350), also known as the Clean Energy and Pollution Reduction Act of 2015, mandates that the California Public Utilities Commission (CPUC) examine the future of California's energy procurement practices through an IRP process.

IRP purposes will need to represent the availability of these resources as supply curves in the IRP model from three distinct categories of technologies:

1. Technologies in the EE Potential Study that provide EE savings only (e.g., building envelope measures).
2. Technologies in the DR Potential Study that provide DR benefits only (e.g., Behind the Meter storage technologies).
3. Technologies that provide both EE and DR benefits, referred to as co-benefits (e.g., advanced lighting controls).

For IRP purposes, EE and DR supply curves can be developed for the first two categories, that represent hourly EE and DR resource availability and the associated levelized costs. For technologies with co-benefits, which is the third category listed above, there could be three possibilities for supply curves –

- Supply curves associated with adoption of the technology based on EE-considerations only, which represent EE resource availability from the technology at a certain levelized cost for EE only.
- Supply curves associated with adoption of the technology based on DR-considerations only, which represent the DR resource availability from the technology at a certain levelized cost for DR only.
- Supply curves associated with adoption of the technology based on joint EE-DR considerations, which represent combined availability of EE and DR at a certain levelized cost for joint EE-DR services.

The modeling framework for integrated EE-DR potential estimates will need to consider these possibilities.

Key research questions
The key research questions that need to be addressed for modeling EE-DR potential integration are:

a. What are the common modeling elements between EE and DR that an integrated study needs to consider?
b. What are the modeling areas in which integration is possible vs. areas which need separate treatment for EE and DR? What is a possible modeling framework to integrate EE and DR potential estimates?
c. What would be the data development approach for an integrated study that best leverages the common and different data sources that currently exist for the two potential studies?

1.1.2 Technology Characterization

One of the initial steps in considering EE-DR potential integration is to identify technologies/measures that provide joint EE-DR benefits (referred to as technologies with “co-benefits”) and characterize these from a joint EE-DR perspective. Technologies with co-benefits are primarily higher efficiency technologies with controls that make them good DR candidates. DR entails executing manual, semi-automated, or automated load control strategies on any of these technologies to provide Shift, Shed, Shape, and

Shimmy types of DR[5]. Table 1**Error! Reference source not found.** below lists a representative set of technologies with co-benefits.

Table 1. Representative List of Technologies with Co-Benefits by End Use

End-Use	Technology Groups with EE-DR Co-Benefits
HVAC	• HVAC controls, thermostats, energy management system (EMS). • Variable Air Volume (VAV) system • Variable Refrigerant Flow (VRF) system • Demand Controlled Ventilation (DCV) • HVAC Pump and Fan VFD • HVAC ECM (electronically commutated motors) • Electric space heating technologies (electric resistance and heat pumps) with controls.
Lighting	• Lighting controls o Standard controls o Zonal controls o Advanced lighting controls
Electric water heating	• Electric resistance water heater controls • Heat pump water heater controls
Pool Pumps	• Two-speed and variable speed pool pumps
Industrial Processes	• Process controls and optimization

The key methodological considerations for characterizing technologies with co-benefits are briefly discussed below, followed by a list of research questions that an integrated EE-DR potential study framework would need to address.

Methodological Considerations
Integration of EE-DR potential modeling would need to represent the interactions between EE and DR for technologies that provide co-benefits at the technology characterization step. This would involve a systematic process to identify technology groups and individual technologies with EE and DR benefits (referred to as co-benefits) included in the latest EE and DR potential studies, plus additional technologies that might need to be considered, and develop a common technology characterization framework that specifies the following characteristics:

- Energy use and DR impact estimates for technologies with co-benefits
- Upfront and recurring costs[6]

[5] These DR resource types are defined in the DR Potential Study. LBNL, 2017. "2025 California Demand Response Potential Study: Final Report on Phase 2 Results", submitted by Lawrence Berkeley National Lab; https://drrc.lbl.gov/publications/2025-california-demand-response

[6] A joint technology characterization framework will obviate the need to separately estimate the co-benefit percentages, which will be used to characterize cost-sharing between EE and DR.

- Equipment capital and installation costs
- One-time DR enablement costs
- Ongoing communication costs for DR
- Program administrative costs from both EE and DR perspectives
- Savings lifetime parameters
  - Expected Useful Life (EUL) of technology[7]
  - DR program life
  - Savings persistence
    - Event opt-outs
    - Control equipment failure
    - Customer attrition
- Market information
  - Density
  - Saturation
  - Applicability

Key research questions
The key research questions for potential integration under this area are:

a. Which measures in the 2019 EE Potential and Goals Study[8] are DR enablers and which DR technologies from the DR Potential Study[9] have EE co-benefits? Are there additional measures not considered by either study that should be considered?

b. How can the joint EE-DR benefits be incorporated during the technology characterization stage so that the overlaps are considered, and costs/savings are not double counted?

c. How do we define DR savings by different service types (Shed, Shift, Shape, and Shimmy) for technologies that can provide both EE and DR benefits?

d. To what extent will the specification of measure lifetimes need to be considered jointly for an integrated EE-DR study, recognizing that there are differences in how the technology/measure lifetime is characterized for EE and persistence in DR program participation for DR?

1.1.3 Market Segmentation and Load Profile Development

A key element for EE-DR potential integration is to develop a common approach for market segmentation and represent EE-DR interactions in the customer load profiles that form the foundation of the potential estimates. The latest EE and DR potential studies do not incorporate these considerations. Integration of the two studies would need to consider the methodological issues and research questions discussed below.

Methodological Considerations
An integrated EE-DR potential study would require a common basis for customer segmentation. The most recent DR Potential Study segmented customers by sector, size[10] (based on maximum demand values

[7] One may need to consider whether DR dispatch has any impact on the technology EUL

[8] Navigant, 2019. "2019 Energy Efficiency Potential and Goals Study", prepared for California Public Utilities Commission. Submitted by Navigant Consulting; July 1, 2019. ftp://ftp.cpuc.ca.gov/gopher-data/energy_division/EnergyEfficiency/DAWG/2019%20PG%20Study%20Report_Final%20Public_PDFA.pdf

[9] LBNL, 2017. "2025 California Demand Response Potential Study: Final Report on Phase 2 Results", submitted by Lawrence Berkeley National Lab; https://drrc.lbl.gov/publications/2025-california-demand-response

[10] Only applies to retail and office building types.

following customer rate codes), and by building type based on customer NAICS codes. The 2019 Potential and Goals Study segmented customers by sector and building type, but not by size. An integrated study needs to consider a common approach for customer segmentation so that the same set of load profiles can be used for both EE and DR potential estimation.

In terms of geographical disaggregation, the 2019 Potential and Goals Study presented potential by building climate zone[11] whereas the DR Potential Study built load profiles by Sub-LAP[12]. An integrated study would need to base both EE and DR potential estimates off a common load profiles foundation.

Another important consideration would be for future integrated EE-DR potential studies to consider differences in loadshapes pre- and post- installation of efficient technologies (with EE and DR co-benefits). To date, the load profiles used in both EE and DR potential studies are based on aggregate end-use shapes. This implies that the same loadshape (end-use shapes) is applied to base and efficient technologies within an end-use. However, this is unlikely to be valid for technologies with co-benefits where the efficient technology involves controls addition to optimize operations, which in turn changes the shape. Therefore, for these technologies, one needs to consider the pre- and post-efficient technology installation loadshapes separately to determine the EE savings shape. The post-control technology installation load profile, in turn, forms the baseline load profile for DR impact estimates.

Key research questions
The key research questions for potential integration under this area are:

a. How would current approaches for market segmentation in EE and DR potential studies need to be modified to accommodate EE-DR potential integration?
b. What would be a common load profile development approach that both EE and DR potential estimates could use as inputs and to what extent can this leverage available load profile databases[13]?
c. Keeping Integrated Resource Planning (IRP) requirements in mind, to what extent do EE savings need to reflect temporal variations by incorporating hourly load profiles and develop savings shapes from EE technologies?
d. How do changes to the baseline load profiles due to EE impacts affect DR potential?

1.1.4 Market Adoption Framework

The latest EE and DR potential studies follow fundamentally different approaches to forecast program participation. The EE study uses a Bass diffusion[14] approach to simulate market adoption for energy efficient technologies and historic or proxy growth rates for behavioral programs, whereas the DR Potential Study predicts participation in DR programs using an econometric customer propensity model[15].

[11] http://www.energy.ca.gov/maps/renewable/BuildingClimateZonesMap.pdf

[12] California's Independent System Operator (CAISO) has defined 23 Sub-Load Aggregation Points (Sub-LAPs), which are geographic areas that divide the electric grid. PG&E's service territory is divided into 16 Sub-LAPs; SCE's service territory is divided into 6 Sub-LAPs; and SDG&E's service territory consists of one Sub-LAP. Sub-LAPs are the common unit at which day ahead load forecasting is done and affect how loads can be aggregated into market bids. (Reference: 2025 California Demand Response Potential Study).

[13] For example, the recently published CEC report titled: "California Investor Owned Utility Electricity Load Shapes; April 2019, CEC" available at "https://ww2.energy.ca.gov/2019publications/CEC-500-2019-046/CEC-500-2019-046.pdf

[14] The Bass Diffusion approach to simulate market adoption of EE technologies is described in detail in the 2019 Potential and Goals study.

[15] The customer propensity model to forecast participation in DR programs under variations in DR program parameters is described in the 2025 DR Potential Study.

An integrated EE-DR potential modeling framework would need to address the methodological considerations and research questions presented below.

Methodological Considerations
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. A possible approach could be to modify the Bass diffusion approach (currently used in the 2019 Potential and Goals study) with a multi-choice logit decision model to represent the set of discrete customer choices available to customers for purchase of a technology with EE and DR co-benefits and predict customer adoption of these technologies. Market adoption model parameters are typically estimated by calibrating to historic program achievements. A joint EE-DR adoption framework would need to incorporate both EE and DR program data for calibration if such an approach were to be used. Other options to represent combined EE and DR value streams to the customer and model customer adoption accordingly for technologies that provide co-benefits, need further discussion.

Key research questions
The key research questions for potential integration under this area are:

a. What are the factors that influence customer decision making to adopt technologies from an EE-only, DR-only and combined EE-DR perspective for technologies that could provide both EE and DR benefits?
b. What type of framework could be used to model customer adoption in an integrated potential study that represents the influence of joint EE-DR benefits on customer adoption?

1.2 Data Needs

Data collection for EE and DR potential estimates can be streamlined in an integrated study. There are existing data inputs in each of the current EE and DR potential studies that can be leveraged in an integrated study. Some of the inputs can crossover from one study to the other to better enable an integrated study. The Navigant team also identified new data needs that will both facilitate an integrated study and improve the quality and accuracy of the EE and DR potential estimates.

Crossover Areas for Existing Data

There are three existing data categories that would need to be streamlined for an integrated study:

1. **Customer Demographic Data:** Demographic data includes building type, consumption data, and energy usage by unit. Each study has the specific needs:
    - **a.** DR Potential Study groups customers into clusters[16] using:
        - **i.** Customer demographic data, such as building type
        - **ii.** Energy usage per building type
        - **iii.** Rate class
    - **b.** EE Potential Study does not group customers any more than by building type

[16] A cluster is defined in the DR Potential Study as "a group of customers / sites that are assumed to be identical for the purposes of the analysis, with the same location classification, sector, building type, end-uses, enabling technology, and demographic profile, etc. Each cluster has a unique and specific time-series dataset for total load, end-use disaggregated load, and other site-specific time series data." The DR potential study included approximately 3,500 clusters to represent the customers in the services territories of PG&E, SCE and SDGE.

An integrated study could leverage this data for both EE and DR potential estimates and to define a common approach applicable to the combined study. For example, the rate class information from the customer demographic data can be used to segment customers by size when estimating both EE and DR potential. Another example would be to use this data to classify homes into solar and non-solar homes.

2. **Saturation Data:** Both the current EE and DR potential studies leverage sources like the California Residential Appliance Saturation Study (RASS), Commercial Saturation Survey (CSS and California Lighting and Appliance Saturation Survey (CLASS) to characterize market eligibility for savings. An integrated study should ensure that sources used to collect saturation data for both potential estimates are as consistent as possible.
3. **Load Shapes:** The DR Potential Study leveraged end use load shapes derived from AMI[17] data to produce DR potential estimates in the form of annual supply curves. Since an integrated study will aim to produce supply curves for both EE and DR savings using load shape data, load profile data collection efforts should be coordinated for both EE and DR measures so that the same foundation is used for developing both EE and DR supply curves to ensure the analysis addresses the potential additive benefit to the peak period.

New Data Needs

In addition to data inputs that are currently used for in the EE and DR potential studies, the following additional inputs need to be considered:

1. **Load Shapes:** In addition to using AMI infrastructure to collect data to create end use load profiles, the following improvements can be made, subject to the scope of an integrated study and the practicality of pursuing these improvements:
    a. Collecting data at the device or sensor level
    b. Sourcing real-time data from third parties
    c. Using building simulation tools to inform changes in load shapes over time
    d. Metering studies or laboratory tests to develop EE savings shapes
2. **EE Custom Projects:** More information should be collected for custom projects with bundled measure offerings as there are significant opportunities for EE and DR co-benefits through such projects.
3. **Geographic granularity:** A future, integrated study will have to streamline and refine the locational granularity at which potential estimates are developed. The EE Potential and Goals Study has historically estimated potential down to the climate zone level for the California Energy Commission's demand forecasting efforts. The DR Potential Study on the other hand estimated potential down to sub load aggregation points on the grid, referred to as Sub-LAPs[18].

[17] For the DR Potential Study analysis, the three California IOUs provided hourly or 15-minute energy use data for approximately 100,000 residential, 78,000 commercial, and 25,000 industrial customers in their service territories. LBNL used this data to predict customer end-use loads in each utility service territory.

[18] California's Independent System Operator (CAISO) has defined 23 Sub-Load Aggregation Points (Sub-LAPs), which are geographic areas that divide the electric grid. PG&E's service territory is divided into 16 Sub-LAPs; SCE's service territory is divided into 6 Sub-LAPs; and SDG&E's service territory consists of one Sub-LAP. Sub-LAPs are the common unit at which day ahead load forecasting is done and affect how loads can be aggregated into market bids.

4. **Non-Energy Benefits:** A future integrated potential study could be further enhanced by including non-energy benefits (NEBs) in the customer adoption model to better represent the value of energy efficiency and demand response technologies.
5. **Building Classification Data:** The DR potential study utilized NAICS codes to classify and segment buildings and develop load profiles by segment. However, the study used a limited number of customer segments[19], which can be further improved upon in future to represent additional segments. For the PG study, the building types are based on the those included in the CEC's IEPR forecast.
6. **Pilot Program Data:** There may be a need to conduct and collect data from pilot programs aimed at assessing the impact of dual incentives (EE and DR) on adoption. Pilot programs can also help inform the persistence of DR savings over the lifetime of a technology and/or program.

1.3 Policy Questions for Further Discussion

The broad policy topics that need to be further discussed within the EE-DR potential integration context are:

- Will an integrated EE-DR potential study be used to set EE goals?
    - Does consideration of EE as a supply-side resource for IRP affect this?
    - How can the findings from the EE-DR potential integration study be used to influence IDSM program funding and implementation and expand the number of technologies being considered under IDSM (currently only includes residential HVAC controls, non-residential HVAC controls, lighting controls)?
- How will cost-effectiveness of technologies that deliver joint EE-DR benefits be assessed? Will cost-effectiveness for these measures be based on the TRC test as is currently used for EE?
- How can co-benefit considerations from technologies that deliver both EE and DR benefits influence existing EE incentive levels and structures for these technologies?
- Are there coordination needs with CAISO proceedings for jointly considering EE and DR as supply side resources?

[19] For example, the DR potential study classified commercial customers into only offices, retail, refrigerated warehouses, and "other".

2. FUEL SUBSTITUTION

On August 1, 2019, the Commission decided to institute the Fuel Substitution Test (D.19-08-009) to replace the Three-Prong Test (D92-02-075). Within 90 days of this decision (late October), the Commission will issue technical guidelines for fuel substitution There are other efforts happening statewide on this topic including the building decarbonization working group.[20] Regardless of the pending guidelines and initiatives, the PG Study team opens the discussion regarding PG study methodology considerations for fuel substitution measures.

Fuel substitution (FS) is substituting one Commission-regulated fuel for another. Therefore, the analysis would show one fuel type increasing in use and the other decreasing in use. The two fuels the PG study had historically modeled were electricity and natural gas.

2.1 Key Methodological Considerations

The new fuel substitution test (FST) provides the following guidelines:[21]

- Measure must not increase total source energy consumption using the baseline comparison measure available utilizing the original fuel
- Measure must not increase forecasted carbon-dioxide-equivalent emissions

The discussion here ensures that any considerations keep in mind the FST decision.

The typical potential study analysis includes (at a high level) the following steps:

- Identify data availability, data gaps, and acceptable assumptions
- Criteria for measure list
- Measure list selection
- Measure characterization
- Modeling parameters
    - Cost-effectiveness screening (economic potential)
    - Adoption rates / adoption curves
    - Decision criteria for adoption
    - Modeling framework – in isolation with energy efficiency or part of a larger demand side resource pool

Measure List Selection and Technical Potential

The measure list will only include FS measures that meet the FST requirements.

The current FS measure list may at minimum include:

- Commercial
    - Space Heating
        - Ductless Mini Split Heat Pump (include multi-splits)
        - Packaged RTU HP - Air Source & Split System HP - Air Source
    - Water Heating
        - Tankless electric resistance water heater
        - Electric resistance water heater
        - Heat Pump Water Heater

[20] https://www.cpuc.ca.gov/BuildingDecarb/

[21] Specific implementation of the FST will be provided in the CPUC guidance, Draft Fuel Substitution Technical Guidance. https://pda.energydataweb.com/api/downloads/2299/Draft%20Fuel%20Substitution%20Technical%20Guidance%20091619.pdf

        - Pool heating equipment
    - Cooking Equipment

- Residential
    - Space Heating
        - Packaged/Split Heat Pump (various HSPF efficiencies)
        - Ductless Heat Pump
        - PTHP
    - Water Heating
        - Electric resistance water heater
        - Tankless resistance water heater
        - HPWH
        - Solar Water Heater
    - Cooking
        - Electric Stovetop (Resistance or Induction)
        - Electric Range (Resistance)
    - Laundry Equipment

- Agricultural (end use level characterization)
    - Process Heating/Waste Heat Recovery
    - Motor Drives

- Industrial (end use level characterization)
    - Process Heating

The final analyzed list should go under a selection process as to what is existing versus emerging potential. This may be considered via the technical potential analysis since there are important considerations in calculating the savings. For example, homes with gas wall heaters may not have the physical location or room for ducts to install a ducted heat pump. Additionally, the level of data and equipment stock for certain technologies may be limited.

Cost-Effectiveness Screening Test

The guidelines require the use of the Cost Effectiveness Tool (CET). An analysis of FS potential may rely on the 8,760 hourly nature of the technology's load shape and the respective CO2e grid emissions. Considerations for the cost-effectiveness may include:

- 8,760 hourly load shapes
- 8,760 hourly emissions factors
- Locational emission factors

Furthermore, there are additional benefits and risks associated with fuel substitution that may be considered for quantification into the analysis framework:

- Benefit - Improved indoor air quality
- Benefit - Higher demand response/flexible load potential
- Benefit – Reduced demand for natural gas and emissions from leaks
- Risk - Increased hydrofluorocarbon (HFCs) emissions
- Risk – Increased electric grid costs to meet rising demand

Program Influence, Adoption Rates and Calibration

Per the existing PG study, the model is calibrated to historical program participation. This data will be a challenge given there are no FS measures in current programs.

Traditionally programs must provide an incentive to a participant to claim savings. The PG study would need an assumption about what incentive or assistance is provided by programs. The incentive level setting process could be determined by the Btu savings, cost of TCO2e, measure cost, or other metric.

Key questions for to consider in this process are:

- What fraction of customers would opt for high efficiency gas rather than do FS?
- What is the natural market momentum to electrify absent ratepayer funded programs?

Modeling Framework

Currently, the framework in California is to consider the DERs in isolation. There is an isolated energy efficiency potential study. Demand response, distributed generation (including storage), and electric vehicles are analyzed under separate rulemakings. The full benefits of all these distributed energy resources are best realized and quantified in combination. Fuel substitution analysis can be best analyzed when considering the holistic impacts on the grid when considering other energy resources on the demand side. For example, if a home upgrades their panel to install a heat pump, there is an opportunity for electric vehicle charging, which then increases the customer's benefits to consider a solar PV installation. Furthermore, all of these aspects lead to an ability to be a flexible load. A potential study could consider the full spectrum of the loading order to value the resource appropriately. Considering fuel substitution in isolation of changing the equipment's energy source may undervalue the transition.

2.2 Outstanding Questions

- Are PA's piloting or designing FS programs that could provide data?
- Should the study consider electric to natural gas opportunities?
- Should there be a metric for technical potential that includes the FST requirement?
- In calculating customer adoption rates, should costs such as panel upgrade costs cost be considered?
- Should adoption rates be calculated based on the status quo approach for energy efficiency potential or use some other method? If so, what approach?
- For economic potential, what test is needed? Should a cost per MTCO2e be included? If so, at what threshold?
- Should the study/analysis assume an incentive cap of 50% of equipment cost for retrofits? Would this vary based on targeted electrification, disadvantaged communities, or other priorities? If paired with demand response, how does the incentive calculation change?

2.3 Data Needs

To calculate the potential for fuel substitution, the Navigant team ideally would like to have the following data points:

- Existing penetration levels of electric vs. gas equipment (heating, water heating, cooking, process heating)
- Technical suitability (applicability) of fuel substitution by technology
- Existing efficiency levels of installed equipment
- Measure and panel upgrade costs
- End use profiles of electric replacement technologies
- Adoption rates via adoption surveys or delphi panel
    - Geography
    - Rate class
    - Other (current pilot programs and other initiatives may provide insight on adoption rates and granularity of data)

2.4 Appendix: Order for the Fuel Substitution Test

The following text is from the Order as documented in the Decision Modifying The Energy Efficiency Three-Prong Test Related to Fuel.[22]

Fuel substitution measures must offer resource value and environmental benefits. Fuel substitution measures should reduce the need for energy supply without degrading environmental quality. A measure may be "deemed" (have pre-determined savings parameters) or "custom" (have unique savings parameters) and may also be contained within a custom project. To be considered for energy efficiency ratepayer funding for retrofit measures, a measure must meet the following requirements:

> *a. The measure must not increase total source energy consumption when compared with the baseline comparison measure available utilizing the original fuel, as currently defined by the baseline policies in D.16-08-019 and Resolution E-4939, Attachment A, and as may be revised by the Commission.*
>
> *b. The measure must not adversely impact the environment compared to the baseline measure utilizing the original fuel. This means that the use or operation of the measure must not increase forecasted carbon-dioxide-equivalent emissions.*

The baseline measure utilizing the original fuel, against which the fuel substitution measure is compared, must be the same for both items a and b above.

This test does not apply to new construction applications, but does apply to renovations of existing buildings. Program administrators proposing fuel substitution measures must provide all assumptions and calculations for review, utilizing the most recent versions of the Avoided Cost Calculator and the Cost-Effectiveness Tool available at the time the measure is proposed.

The costs and benefits of fuel substitution measures and programs shall be reflected in the cost-effectiveness analysis of the total portfolio of the program administrator sponsoring the measures. When a fuel substitution measure passes the Fuel Substitution Test, it shall be included in the cost-effectiveness analysis of the portfolio with a net-to-gross (NTG) ratio assumption of 1.0, until such time as evaluated NTG information is available, when the assumption shall be updated on

[22] http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M310/K159/310159146.PDF, California Public Utilities Commission, August 2019. Decision Modifying The Energy Efficiency Three-Prong Test Related to Fuel Substitution, 19-08-009.

3. LOCATIONAL ENERGY EFFICIENCY TARGETS

The current PG forecasts energy efficiency potential at the IOU territory level with capabilities to disaggregate to the climate zone level.

However, other studies and efforts in California may conduct analysis at a different level of granularity.

- Utility Distributed Resources Planning (DRP) occurs at a much more granular level than climate zones, but varies by utility, with the Grid Needs Assessment required by Decision 18-02-004 identifying projects down to the circuit segment.
- The California Energy Commission disaggregates energy efficiency forecasts at the building climate zone level (20 zones in California) and subsequently to the bus-bar level for planning purposes.
- The most recent DR Potential study[23] provides results at the sub-LAP level (23 zones throughout California).
- Work under the Integrated Resource Plan (IRP) and Integrated Distributed Energy Resources (IDER) proceedings may require energy efficiency data at a more local level in order to evaluate it in comparison to other distributed resource options.

Historically, energy efficiency programs have pursued the overall most effective way to reduce net load; given the discussions of localized grid value of load reductions however, there may be opportunities to create greater value in specific locations. This effort will support that decision by identifying localized valuation and determining the ability of energy efficiency programs to meet those needs. Meeting identified grid needs with energy efficiency can increase the total value provided by those resources by deferring or replacing conventional grid investments in constrained regions. Conversely, if a region isn't constrained, there would be no distribution or transmission deferral value to local load reductions. A key consideration is whether the energy efficiency contributions can be targeted confidently enough in exact locations such that specific localized needs can be met. Without a definitive potential analysis, is more challenging.

3.1 Key Methodological Considerations

Pivotal to this analysis is developing a framework for establishing the locational value of energy efficiency savings, obtaining data on locational value, disaggregating PA goals to local areas, and cross checking the ability for the local area to "absorb" that amount of energy efficiency (lest the target exceed the technical potential for the region). To execute such a framework, key issues need to be examined.

[23] Lawrence Berkeley National Laboratory (LBNL), 2017. *2025 California Demand Response Potential Study. Charting California's Demand Response Future.*
https://drrc.lbl.gov/publications/2025-california-demand-response

3.1.1 What is/are the Needs for Having Locational Disaggregation?

As this is a new effort in the PG study, a fundamental question should be asked: what will a locational analysis be used to inform? Understanding what CPUC proceedings and IOU planning processes need alignment to locational energy efficiency targets will inform the rigor of analysis required.

The following questions need to be answered:

- Should the goals be set at some location more granular than the IOU territory level?
- Will program planning staff at IOUs and implementers be using this data to target program participants?
- Will this information be used to inform grid planning activities by the CPUC, CEC, or other entities?
- Should locational target analysis be statewide or targeted to specific areas of need?

3.1.2 Definition of "Location"

Once the above understanding of what locational data will be used for, the next step will be to establish an appropriate definition of location that fits the need. The term "location" is colloquial and can be interpreted to mean a variety of levels of disaggregation. Historically the most granular definition of location in the PG study was the building climate zone level (16 zones throughout California). Recent further analysis is also examining the forecasting climate zone (20 zones throughout California). Building climate zones do not align in any way with utility infrastructure. Forecasting climate zones, on the other hand do align with utility infrastructure at a very high level. However, "locational" analysis could even be at a far more granular level than 20 zones throughout the state.[24]

Sources for locational definitions include:

- IOU DRPs, CEC IEPR, IRP and IDER proceeding documents
- Grid Needs Assessment requirements from Decision 18-02-004
- Interviews with experts at: IOUs, CEC, CAISO

We expect the following possible levels of granularity to be explored:

- Geopolitical boundaries
  - Building climate zones
  - County
  - Zip Code
- Grid-based definitions
  - Forecast Climate Zone
  - Transmission local capacity area sub-regions
  - Distribution substations

[24] For example, the DR potential analysis provides results at the sub-LAP level, 23 zones throughout California.

- o Individual feeders

Needs of feeders may be identified through the grid planning processes but would likely prove difficult to produce the targeted energy efficiency adoption necessary to meet needs that granular at a high degree of confidence in the time required to defer investments.

For the locational value of energy efficiency to be realized, the adoption of the resources must tie to a specific reduction in costs in the grid planning portfolio. This means the load reductions must be trusted and accepted by the distribution planning department in a timeframe that allows them to adapt the plan. This requires an important time granularity component to be included in assessing the value.

3.1.3 Modeling Methods

Technical Potential

The calculation of locational technical potential should not be a significant departure from previous calculations. For a given area, the building stock and existing saturation of efficient equipment should be taken into account to determine the total feasible load reduction. As individual grid needs have specific timing for the required load reduction, it will also be important to determine the technical potential for load reductions at different times. In general, potential study modeling methodologies can scale to whatever locational granularity is deemed best.

Market Potential

The market potential calculation and target setting for locational energy efficiency will be more complex, as achieving locational value will require close coordination with grid planning processes. Specific areas should be prioritized for incentives and higher targets with consideration for the locational value they provide, but that locational value has more strenuous requirements to achieve than in previous energy efficiency evaluations. Rather than simply receiving a $/kw value for reducing peak, the project must be tied to a specific grid upgrade and shown to have been able to replace it. This also means that the value of a particular location is subject to change based on updates to the forecasted load constraint that is driving the necessity of an upgrade. Because the value is tied to specific projects, the setting of targets and incentives that drive the market potential will need to carefully track the assessed locational value. Additional discussion of these concepts and what they imply at a granular level are described in the rest of this section.

Impacts of Locational Incentives

Currently, there is no policy on incentives for locational targeting of programs. If specific areas are identified that would be of greater use in reducing grid expenditures, equity concerns it would be important to consider equity concerns as different customers could then be provided different levels of incentives for the same results, particularly in the case where increased load from the very customers who stand to receive higher incentives is the driver for that increased value. To resolve this issue, the addition of a non-energy benefits factor for low-income and disadvantaged communities leveraging census income data and CalEnviroScreen[25] could be used.

[25] CalEnviroScreen identifies California communities by census tract that are disproportionately burdened by, and vulnerable to, multiple sources of pollution. https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30

3.2 Outstanding Questions

- If the study is meant to inform grid planning, should the study provide the confidence level required from grid planners of an energy efficiency program to replace planned wires investments? If so, what would be required to ensure this confidence will be achieved?
- When would an EE program need to achieve reductions relative to an upcoming grid constraint to have confidence in the deferment?
- Is there publicly available data at the level of granularity required for this analysis (see next section for discussion on data needs)?
- How should the P&G study incorporate developments from other proceedings like IDER and DRP?

3.3 Data Needs

To calculate locational targets for energy efficiency, the team ideally would like to have the following data points:

- Customer counts and historic energy consumption at the locational level (aggregated zip code level data is available publicly from IOUs)
- Historic energy efficiency adoption at the locational level (zip code level data is available from CPUC public sources)
- Regional/locational technology saturation to inform remaining technical potential calculations (potentially available from California saturation studies)
- AMI data request through the Energy Data Request Program (established by CPUC Decision 14-05-016) will be considered. Though there is a chance this particular use of the data may not fall within the eligibility of the program or provide sufficient baseline data needed for the potential analysis.
- Locational avoided cost of energy (including timing)
- Locational avoided cost of capacity (including timing)
- Locational non-energy considerations (CalEnviroScreen, census data)
- Grid Needs Assessment to inform the locational avoided cost of energy and capacity

4. REN & CCA DISAGGREGATION

On November 8, 2012, the Commission decided (D.12-11-015) to grant program administration status and to allocate budgets to Regional Energy Networks (RENs) and Community Choice Aggregators (CCAs).[26] RENs and CCAs are intended to perform activities generally not undertaken by IOU programs and to pursue technologies and customer segments underrepresented by IOU programs.[27] On June 5, 2018 the Commission decided (D.18-05-041) that RENs and CCAs must file Joint Cooperation Memos (JCMs) to help eliminate redundancies in activities and segments and to demonstrate compliance with review criteria. JCMs articulate how PAs operating in overlapping territories plan to divide and share program activities.

This abstract is intended to facilitate initial conversations about the methodological considerations of forecasting energy savings associated with Regional Energy Network (REN) and Community Choice Aggregator (CCA) efficiency programs. The potential use cases of a future PG study and model and outputs should drive requirements. To better understand the potential use cases, the following should be undertaken:

- Establish purpose and use cases-
- Summarize alternate approaches that leverage the current PG model framework as well as new modeling frameworks
- Choose approach that best meets use requirements and CPUC policy objectives

The RENs and CCAs have expressed interest in having potential study data in a form more useful to them than what is currently available from the existing PG study.[28] The expressed use cases for potential estimates are to help:

- Identify program design opportunities (e.g., hard to reach customers, technologies with large remaining potential, under adopted technologies, underperforming market segments or geographies)
- Forecast near term program impacts to help these program administrators establish goals for annual business plans.

The forecasting model used to establish IOU program goals and targets may not be easily adapted to establish goals for CCAs and RENs for the following reasons:

- IOU centered model is largely agnostic of program delivery mechanism
  - IOU territory, building type, and climate zone have been the fundamental dimensions in previous potential studies
  - Should a future model include PAs as the dimension instead of IOUs? Or should RENs/CCAs become a separate dimension (or subset of IOUs)?

[26] At the time, there was only one CCA, Marin Clean Energy.

[27] RENs are generally not allowed to duplicate other PA programs in their territory, except when they target hard to reach (HTR) customers. RENs are also not required to pass cost effectiveness test. CCAs on the other hand are required to be cost effective. CCAs that "apply to administer" programs may be permitted to duplicate other PA programs in their territory. However, CCAs that "elect to administer" programs cannot duplicate other PA activities.

[28] This initial use case language was drafted following an October 8, 2019 informal call including staff from ED, RENs, CCAs, and Navigant.

  - The current PG model assumes mutual exclusivity between IOU service territories and is not set up for overlapping territories where two PA's provide programs for the same fuel type (electric vs. gas) for the same set of customers.
- The existing PG study model architecture a methodology is largely driven by incentive-based programs
  - Is this an appropriate starting point for RENs/CCAs?
  - Should a more customized/specific perspective of REN/CCA programs be taken?
  - Consider alternate approach for market transformation, financing, and other models.

This abstract and associated discussion is intended to help identify and resolve forecasting methodology issues. The future of REN and CCA policy is not under consideration here. For the purposes of this effort, we will proceed with the assumption of "on the books" policy and will focus on the method considerations that would best capture today's state of REN and CCA activities. The ALJ is expected to issue a proposed decision this year following request for comments on "The Future of RENs." Some methodological options may depend on future policy changes and CPUC decisions.

4.1 Key Methodological Considerations

There are several methodological considerations, but for this discussion, the focus will be on the topic of overlapping service areas.

The Commission has established RENs to perform "activities that utilities cannot or do not intend to undertake," "pilot activities where there is no current utility program offering," and "activities in hard to reach markets." (D.12-11-015) While these criteria minimize redundancy in program activities within service areas, there still remains the possibility that separate and unique activities across REN, CCA, third party, and IOU programs promote the same adoption of an efficient technology.[29] Independent analyses of the programs operating within a service area could result in double counting of program adoptions. Integrated analysis of PAs operating in an overlapping territory can better ensure no double counting, but still requires assumptions about attribution. Assumptions can vary for differentiating by geography, program delivery, overlap, customer types, etc. So a method should be established and agreed upon upfront to minimize double counting program benefits and specify attribution assumptions.

- Option 1: Separate, parallel analyses with post-hoc integration
- Option 2: Separate, prioritized sequential analyses with the results of each reducing the potential for the next (e.g., existing approaches to IOU savings for codes and standards, low income, whole home forecasts)
- Option 3: Integrated analysis of a compendium of factors leading to efficient technology adoption with post-hoc attribution (informed by a delphi panel or model sensitivity analysis)
- Option 4: Treat metrics for RENs and CCAs as gross (of IOU programs) not requiring integration with IOU program metrics (e.g., could apply predetermined factor that attributes activities to the entity and remove overlap that would be updated for subsequent cycles after evaluation)

[29] Especially in the cases of programs targeting hard to reach customers or using alternate delivery mechanisms.

4.2 Outstanding Questions

- Is there data that forecasts CCA customer base into the future (expansion of existing CCAs and creation of new CCAs with defined population forecasts)?
- Do we approach forecasting RENs and CCAs as we have with IOU programs?
    - Bottom up by measure/technology vs top down by existing portfolio achievements /plans? (technology vs portfolio basis)
    - Need an estimate for each REN and CCA?
- Would it be sufficient to estimate CCA/REN savings by extrapolating relevant IOU 'average' savings against selected scaling factors? Scaling could be conducted based on:
    - Based on consumption or population disaggregation factors
    - Based on evaluated parameters
    - Based on budget
    - Other?
- Do goals from RENs and CCAs require the same forecasting horizon as IOUs (i.e. a 10-year forecast though most attention is paid to the first 2 years for program budget planning)
- Is CCA/REN forecast 'potential' intended to identify the maximum impact of programs that might exist within these business models? Or is it intended to estimate the near-term impacts of current plans without consideration of scaling planned activities within or beyond currently targeted territories, demographics, etc.?
    - Early conversations indicate that these are meant to be near term for each REN to address their specific goals and jurisdictions rather than applying new mechanisms across the full model
- Since most of the programs (especially for RENs) are non-resource based or alternative models like direct install, is there data available to model customer adoption metrics appropriately?
    - May vary by program type such as direct install, financing, workforce development
- Do we only consider evaluated savings to calibrate forecasts or are reported/claimed savings reasonable to use?
    - This issue occurs for IOU goals as well, but different requirements for CCA/REN goals may allow for a different approach
    - Differences in available data and evaluation requirements/methods/budgets might not yet yield sufficiently precise ex post or NTG estimates for CCAs or RENs.
- Does overlap between RENs and IOUs need an additional attribution component? Could the REN savings be considered as spillover for IOU savings?
- How can a forecast built on data today withstand the rapidly evolving CCA market? For example:
    - Existing CCA territories without current ratepayer funded EE programs add programs in the future
    - New CCAs are formed
    - Fuel substitution (across program administrators)
    - Statewide IOU programs are formed and seek out savings across all PAs

4.3 Data Needs

It is still early to establish specific data needs without knowing the answers to the above questions. However, key data can still be collected that would inform any method:

- Territory definition – what is available or missing
  - Number of CCAs
  - Specific geographic building stock and consumption and forecasts
  - Definition of "hard to reach" and quantification of the amount of each REN/CCA jurisdiction that is considered hard to reach
- Determine and summarize the offering matrix of PA, technology, program type, and services, and segments
- Identify target markets and understand if technology saturation data specific to regions/target markets is even available
- Understand costs of the existing REN/CCA programs (incentive, non-incentive, dollar per unit energy claimed)

4.4 Appendix: Reviewed Documents and Links

4.4.1 CPUC Decisions

D12-11-015: Formal establishment of RENs including purpose and criteria for REN activities.
http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M034/K299/34299795.PDF

D16-08-019: Conclusions of Law for RENs (starting p.98)
https://docs.wixstatic.com/ugd/0c9650_9afbd868952646bba5ea5b687499fd4b.pdf

D18-05-041: Establishes requirement for JCMs (p.122)
http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M215/K706/215706139.PDF

4.4.2 Joint Cooperation Memos

JCMs describe differences in program offerings by sector (all 2019)

BayREN & PG&E Joint cooperation memo
https://www.pge.com/pge_global/common/pdfs/for-our-business-partners/energy-efficiency-solicitations/BayREN_PGE_Joint_Cooperation_Memo.pdf

SoCalREN & SCE Joint Cooperation memo
https://socalren.com/sites/default/files/JCM_2019_-_SCE_SCG_SoCalREN.pdf

3C-REN & SCG/SCE/PG&E Joint cooperation memo
https://vcportal.ventura.org/CEO/energy/AL5478_et_al.pdf

4.4.3 Other Document Links

Presentation at 10th Annual Statewide EE Forum (2019)
RENs: Lessons Learned & the Future of EE

http://californiaseec.org/wp-content/uploads/2019/07/SEEC_-RENs-Best-Practices-and-Lessons-Learned_FINAL.pdf

REN Pilot preliminary findings (2015)
http://eecoordinator.info/wp-content/uploads/2016/08/Stag-Webinar-Slides-July-28-2015-_-REN-Value-and-Effectiveness.pptx

5. INDUSTRIAL AND AGRICULTURAL SECTORS

Per stakeholder comments on the 2019 PG study, there is a concern that the existing market data and program potential analysis anchoring on historical program data results in poor representation of the industrial and agriculture sector savings potential. The discussion here will mostly focus on the industrial sector which is 15% of the electricity and 38% of the natural gas consumption, based on the 2017 IEPR demand forecast. Most of the issues are also applicable to agricultural.

The foundation of on-the-record stakeholder concerns seem to be related to the availability of robust market data and the assumptions built into the modeling approach. Furthermore, there is interest to understand if incentives or other programmatic mechanisms are the main influences on these sectors adoption of energy efficiency. For example, providing technical assistance via a continuous improvement framework may impact a facility in a more aggressive manner than an incentive that covers a low percentage of the full cost of equipment or the customer's annual utility bill.

Additionally, the one may be able to extract lessons learned in other market adoption frameworks from across the country. Their studies' data and modeling methods may be applicable to California.

5.1 Key Methodological Considerations

Measure and Market Characterization

Existing baseline data leverages a nationwide database of the DOE Industrial Assessment Center (IAC)[30] to develop percent savings assumptions. This value is an aggregated assumption across all industrial sites, by segment, who have been recommended the specific measure (which is rolled up to the end use level). Therefore, built into this value is an assumption of the baseline and existing saturation levels across the industrial segments.

The following are several issues with the existing data sources:

- **Issue 1:** California has industry practice standards (ISP) and decades of EE programs. The DOE IAC data applicability to California is questionable.
- **Issue 2:** Applying IAC data assumes uniformity across industrial facility/company size.
- **Issue 3:** Does the IAC data meet the needs of a robust estimate of industrial and agricultural potential?

There are other data points of interest for characterizing the industrial and agricultural sectors. There are some anecdotal statements from implementers and program managers that the ISPs are not prevalent and may be slowing down market adoption. Furthermore, the low participation rates of the industrial sector within programs may indicate natural occurring energy efficiency or a lack of investment in energy efficiency. There may be other barriers such as the custom review process. Understanding the baseline will provide perspective on these other considerations.

Program Influence, Adoption Rates and Calibration

Current modelling approach provides flexibility in disaggregating the potential savings achieved by deemed, custom, behavioral, and emerging technologies. The deemed approach follows a bass-diffusion model, and the custom model follows an extrapolation of existing program accomplishments. The

[30] https://energy.gov/eere/amo/industrial-assessment-centers-iacs

historical program data provides the foundation for calibrating future savings potential. In these two cases, the model is rooted on historical program data. For the behavioral programs, the PG study assumes a specific program rollout plan that is rooted on the retro-commissioning program impacts to date. For emerging technology, the PG study assumes a certain level of adoption. Based on the existing framework, the following are a set of identified issues:

- **Issue 1:** Are the existing program models and regulatory framework sufficiently capturing the market potential?
- **Issue 2:** Does the market adoption mechanism vary for different program delivery models?
- **Issue 3:** Are there other market sensitivities that are not currently modeled that can impact market and program adoption?
- **Issue 4:** Are the cost-sensitivities (payback period) appropriate for all segments within the sector?
- **Issue 5:** What are the drivers to market adoption in these sectors? Costs? Mandates? Competition?
- **Issue 6:** Is the bass diffusion model the right method for calculating potential for the larger facilities?

5.2 Outstanding Questions

- Is there sufficient baseline data of the sectors to calculate a true technical potential? If no, what are the proposed data sources available for use?
- Should potential for industrial and agriculture sectors be a true market potential or utility program potential?
- If true market potential should be produced and stakeholders argue that true market potential is larger than utility program accomplishments how would such a model be calibrated?
- Will a market characterization study provide sufficient integrity to the analysis and confidence in varying goals accordingly?
- How disaggregated should the data be and at what definition?
    - Size of facility (<200 kW, 200kW- 1MW, etc.)
    - Segment (chemical, food processing, forestry, etc.)
    - Other?

5.3 Data Needs

To calculate the market potential for the industrial and agricultural sector, the Navigant team ideally would like to have the following data points:

- Existing density, penetration levels of high efficiency equipment and processes

- Existing efficiency levels of installed equipment
- Measure costs
- Adoption rates via adoption surveys or Delphi panel
- Calibration data if calculating market (vs. program) potential

6. STATEWIDE AND THIRD-PARTY PROGRAMS

The current regulatory framework requires the IOUs to work on two new levels of program delivery – statewide programming and outsourcing a high percentage of the portfolio program savings to third party program implementers. The existing potential study does not model the impacts of this change. The 2019 PG was very much a widget/measure level analysis with a focus on a per IOU characterization. While it was inclusive of all sectors and technologies, it did not disaggregate results to individual programs nor did it distinguish between program delivery mechanism (upstream, mid-stream, downstream, third party, etc.).

Current understanding is that upcoming third-party resource programs will have a mechanism for energy savings allocations across the utilities. The total impact from statewide energy efficiency programs will be allocated to individual utilities. Load share-based allocation of statewide savings may result in more or fewer savings being attributed to the prime utility sponsoring the third-party program. The review and approval process for the ABAL will require flexibility in the assumptions due to adopted goals, available measures, and timing of solicitations being completed across the state.

The PG study's bottom up forecast is based on technologies and market status in each IOU territory. Allocation of statewide savings based on load is an accounting exercise, not a precise estimate of where and by whom savings occur. Therefore, with the new framework, there will need to be an established approach to ensure the proper IOU-level goal setting either independent or dependent on the delivery channel.

Furthermore, stakeholders have asked about the impact of program effectiveness when switching to third party implementation. Will there be a transition period where participation is low? Will third parties "ramp up" in program effectiveness being able to ultimately deliver savings more effectively than individual IOUs? When these questions were brought up during the 2019 PG study, the Navigant and CPUC response was generally: "it's unclear, we need data". Since the rollout of third party implementation is ongoing, it is not likely that performance data will be available for the next update of the PG study.

6.1 Outstanding Questions

- There are certain assumptions of the existing market conditions that do not necessarily vary by IOU territory. If a program delivery channel is focused on certain geographic areas or a patchwork of a delivery is distributed throughout the territories that may change over time, then how does the PG study address these variances?
- Should it be possible for the PG model to stratify by different slices and wedges of the population?
- How should potential (and goal setting) for nascent program models be assessed?
- Can there be separate goals for the IOU core, IOU statewide, and IOU third party programs and how can the PG study feed into this segmented approach?
- Is there reason to believe or data to show that third party programs deliver more or less savings per dollar than comparable utility programs?

6.2 Data Needs

Potentially a new set of data or program data going forward will be required to provide input to future studies. Future statewide implementers should consider tracking data to understand where savings are occurring and compare to the load-based allocation approach to inform future potential studies.

7. BROS FORECASTING

The 2019 PG study defined behavior-based initiatives as those providing information about energy use and conservation actions rather than financial incentives, equipment, or services. Savings from Behavior, Retrocommissioning and Operational efficiency (BROs) are modeled as incremental impacts of behavior and operational changes beyond equipment changes. The 2019 PG study showed higher BROs savings than the previous PG study and also showed BROs being a larger share of utility program savings (share significantly increased due to reductions in equipment-based rebate programs). Some stakeholders raised issues not addressed by the 2019 study and are discussed further here.

Most of the IOUs have significantly increased the size of their home energy report (HER) programs in the two years since 2017, which was the last program-year evaluated. As a result, one stakeholder commented that program attrition as well as the characteristics of remaining un-treated customers may slow the growth of future HERs programs. The stakeholder specifically commented:

> *"HER penetration over time is a function not only of program growth (e.g. adding customers to the program), but also of program attrition, which occurs as customers move out of their homes or otherwise opt out of the program. While intentional opt-outs are so low as to be almost negligible, attrition through customer churn is significant and can act as a substantial damper on growth once penetration rates become relatively high, as "refill" cohorts must be added to the program in order to backfill those lost to attrition. If refill cohorts are not added to the program, the overall savings from the program will attenuate as less households receive the treatment."*

Furthermore, SDG&E raised a cautionary flag that mandatory TOU rates across all residential customers and increased penetration of other DERs (solar and battery storage) may diminish the savings that can be achieved by HERs programs.

7.1 Outstanding Questions

- Is there data showing that the HERs programs are reaching a saturation point or plateau in IOU programs?
- Are past evaluations of BROs savings still an accurate basis from which to forecast future savings (for example, should the model account for impacts from changing to TOU rates, are the remaining untreated homes different from previously treated homes)?
- Do CCAs implement HER programs or are CCA customers still included in IOU treatment and control groups for HERs?
- How do we break the cycle of stakeholders wanting CA-specific data to inform BROs measure forecasts when program administrators are not piloting and evaluating new BROs measures? What will help stakeholder be more comfortable with any BROs forecast that includes measures beyond HERs?

8. RESEARCH AND DATA PRIORITIES

The PG study modeling effort requires a wealth of data. The quality of the data varies by type and source. The following table outlines the full data set of either the status quo PG study or a new method. Specific data requirements are provided in the other sections of this document. Each input characteristic has different levels of rigor and impact of the overall savings potential.

Data	Source	Quality	Issues
Building stock forecast	CEC IEPR	High quality based on years of experience and stakeholder input. Broken down by sector, building type, and IOU	What is included or not in each sector? Can this data be more disaggregated to a locational level (or at least include CCA territories)?
Avoided costs	Developed by CPUC	Not applicable to change from EE proceedings	Is there sufficient hourly avoided cost data? Does it meet sufficient valuation of carbon abatement? Is locational based data available and reasonable for locational valuation? Is it applicable to other demand side impacts, such as DR?
Retail rates	Developed by IOU rate cases and summarized/forecasted by IEPR	Not applicable to change from EE proceedings	Can the future study include rate structure impacts from time dependent pricing?
End use level data	RASS and CEUS provide disaggregation to end use for Res and Com sectors.	Primary data collection or building modeling but based on dated data from more than 10 years ago	Aside from new survey data, is the Res/Com data sufficient? For Ind/Ag, what are other available data sources?

Data	Source	Quality	Issues
Measure characteristics – deemed savings	DEER, CPUC-approved workpapers	Regarded as the standard with detailed stakeholder review process and ex post evaluation.	Will the next DEER and round of CPUC approved workpapers include fuel substitution measures and EE/DR opportunities? Is measure level (widget-based) analysis the best approach for a PG study? What if the PG study bundles measures (i.e. – more than one measure per project) or forecasts at the measure category level?
Measure characteristics – non-deemed savings	Custom program reported and evaluated data. For Ind/Ag, also leverage DOE IAC data.	Large data set from multiple program years and verification studies.	Does it cover any untapped potential of better and implementation of custom measures? Does it address NMEC-based project savings potential?
Measure characteristics – costs	Measure cost studies, workpapers, and DEER. For AIMS, use program reported costs.	Primary data collection based on information collected in 2012 and published in 2013; Program reported costs	Is the data relevant? Is there program reported data that is higher quality? Does the program reported data include incremental or full costs?
Measure characteristics – measure life	DEER	Based on mostly engineering judgement and secondary data sources	Is there a need to address different values especially for NMEC, measure category analysis, etc?
Measure characteristics - Saturation and density data	CLASS, CSS, RASS and CEUS, CEC data and DOE IAC data	California-based primary data collection but based on dated data from more than 7 years ago; except for Ind based on national data	If specific program and measure level impacts quantified at a segment level, then the value of high-quality data increases.

Data	Source	Quality	Issues
Calibration data	Historical program data	Highly dependent on historical program achievements	The definition of market potential drives the specific need for calibration inputs. What is the definition of market potential?

8.1 Outstanding Questions

- Each input characteristic has different levels of rigor and impact of the overall savings potential. How would we prioritize the importance of each input value for ensuring more accurate results and addressing other future PG study objectives?
- Would a sensitivity analysis of the input parameters for the savings potential matter on a per measure or portfolio basis?
- Would the sensitivity of the cost-effectiveness matter?
- Key questions to consider when vetting data include:
  - Age of source
  - Data source – i.e. secondary data or primary data collection
  - Existing size of uncertainty
  - Ease of data collection
  - Level of portfolio importance

APPENDIX A. BACKGROUND INFORMATION ON THE POTENTIAL AND GOALS STUDY

This Appendix provides an overview of the 2019 PG Study. The full report, model, input databases, and outputs can be found on the California Public Utilities Commission (CPUC) website.[31] This Appendix is largely material copied and modified from the 2019 PG Study final report from the introduction and executive summary sections.

A.1 Context of the Potential and Goals Study

Navigant and its partners (collectively known as the Navigant team), prepared the 2019 Potential and Goals Study (or 2019 Study) for the CPUC. The purpose of this study is to develop estimates of energy and demand savings potential in the service territories of California's major investor-owned utilities (IOUs) during the post-2019 energy efficiency (EE) rolling portfolio planning cycle. The 2019 Study includes results for Pacific Gas and Electric (PG&E), Southern California Edison (SCE), San Diego Gas and Electric (SDG&E), and Southern California Gas (SCG). A key component of the 2019 Study is the Potential and Goals Model (PG Model), which provides a single platform in which to conduct robust quantitative scenario analysis that reflects the complex interactions among various inputs and policy drivers.

The 2019 Study is primarily an update of the 2017 Study.[32] The 2019 Study had a compressed timeline relative to past CPUC Potential and Goals (PG) studies; as such, the opportunities to update methodologies, add measures, and deeply engage stakeholders was limited.

The 2019 Study supports multiple related efforts:

- Inform the CPUC as it proceeds to adopt goals and targets, providing guidance for the next IOU EE portfolios. The potential model is a framework that facilitates the stakeholder process. The model helps build consensus for goals by soliciting agreement on inputs, methods, and model results.
- Inform strategic contributions to SB350 targets. The California Energy Commission (CEC) has historically used the PG study to develop its forecast of additional achievable energy efficiency potential (AAEE). SB350 targets a doubling of the AAEE by 2030.
- Inform Integrated Resource Planning (IRP). In late 2017 and early 2018, Navigant supported CPUC staff in examining methods to integrate EE procurement practices into the IRP optimization process. Those efforts leveraged outputs from the 2017 Study to develop input to the IRP model.
- Guide the IOUs in portfolio planning and the state's principal energy agencies in forecasting for procurement, including the planning efforts of the CPUC, CEC, and California Independent System Operator (CAISO). Although the model cannot be the sole source of data for IOU program planning activities, it can provide critical guidance for the IOUs as they develop their plans for the 2020 and beyond portfolio planning period.

The study period spans from 2020 to 2030 based on the direction provided by the CPUC and focuses on current and potential drivers of energy savings in IOU service areas. Analysis of EE savings in publicly owned utility service territories is not part of the scope of this effort.

[31] https://www.cpuc.ca.gov/General.aspx?id=6442461220

[32] Navigant, *Energy Efficiency Potential and Goals Study for 2018 and Beyond*, September 2017.

This study forecasts the potential energy savings from the EE programs and C&S across all customer sectors: residential, low income, commercial, agricultural, industrial, mining, and street lighting. This study does not set IOU goals, nor does it make a recommendation as to how to set goals. Rather, it informs the CPUC's goal setting process.

A.2 Types of Potential

Consistent with the 2017 Study and common industry practice, the 2019 Study forecasts EE potential at four levels:

- **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 EE were taken, including retrofit, replace on burnout, and new construction measures. Technical potential in existing buildings represents the immediate replacement of applicable equipment-based technologies regardless of the remaining useful life of the existing measure. Technical potential in new construction buildings represents installation of highest level of efficiency at the time of construction. Technical potential is undefined for codes and standards (C&S), whole building, and behavior, retrocommissioning, and operational efficiency (BROs) programs.
- **Economic potential:** Using the results of the technical potential analysis, the economic potential is calculated as the total EE potential available when limited to only cost-effective measures.[33] All components of economic potential are a subset of technical potential. Economic potential may be a fraction of technical potential as the economic screen is applied separately to new construction vs. existing buildings.
- **Market potential:** The market potential analysis calculates the EE savings that could be expected in response to specific levels of incentives and assumptions about existing CPUC policies, market influences, and barriers. Some studies also refer to this as achievable potential. Market potential is used to inform the utilities' EE goals, as determined by the CPUC. Market potential has historically been used by the CPUC to inform the goal setting process.
- **Below code potential** is a subset of the market potential. These savings are defined as the opportunities for EE that program administrators can claim through accelerated replacement programs. These savings reflect additional claimable impacts allowed after the passing of AB802.

Many variables drive the calculation of market potential. These include assumptions about the way efficient products and services are marketed and delivered, the level of customer awareness of EE, and customer willingness to install efficient equipment or operate equipment in ways that are more efficient. The Navigant team used the best available current market knowledge to calibrate market potential for voluntary rebate programs.

A.3 Modeling Methods

Table 2**Error! Reference source not found.** summarizes the modeling approach for each source of savings. Each approach is discussed in more detail in chapter 2 of the 2019 PG study report.

[33] The model default is to use the total resource cost (TRC) test as defined by the California Standard Practice Manual. The TRC threshold for what constitutes a cost-effective measure varies by scenario.

Table 2. Overview of Modeling and Calibration Approach

Savings Source	Modeling Approach	Calibration Approach	Methodology Change Relative to 2017 Study?
Rebated technologies	Bass diffusion forecast competes below code, at code, and above code technologies against each other.	Calibrated to historic program spending.	No
Whole building packages	Bass diffusion forecast competes below code, at code, and above code technologies against each other.	Calibrated to historic program spending.	No
Industrial/Agriculture custom measures and emerging technologies	Trend forecast based on recent IOU custom project savings in these sectors. Emerging technologies can ramp up the trend in the future.	Forecast is anchored in IOU program history and thus inherently calibrated to current market conditions.	No
Behavioral, retro-commissioning, and operational measures	Interventions are limited to the applicable customers and markets and assumptions for reasonable penetration rates.	Starting penetration rates are based on current penetration rates.	No
Codes &Standards	Model replicates the algorithms of the CPUC's Integrated Standards Savings Model (ISSM).	Calibration not needed as evaluated results are used.	No
Financing	Financing is applied to rebated technologies and whole building approaches. Bass diffusion forecast changes due to reduced upfront barriers and increased consumer adoption.	No program data available for calibration.	No
Residential low income	Bass diffusion forecast competes below code, at code, and above code technologies against each other.	Calibrated to historic low income program accomplishments.	Yes

A.4 Scenarios

The 2019 Study considers multiple scenarios to explore how EE potential might change based on a number of alternative assumptions about policies, measures, and market response. This study considers scenarios primarily built around policies and program decisions that are within the sphere of influence of the CPUC and its stakeholders collectively. Table 3 summarizes the various scenarios considered for the 2019 Study.

Table 3. Scenarios for EE Market Potential

Lever	Reference	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Cost-Effectiveness (C-E) Test	TRC	TRC	TRC	TRC	TRC
C-E Measure Screening Threshold	1.0 for all measures	0.85 for all measures	1.25 for all measures	1.0 for all measures	0.85 for all measures
Incentive Levels	Capped at 50%*	Capped at 50%*	Capped at 50%*	Capped at 50%*	Capped at 75%**
Marketing and Outreach	Default calibrated value	Default calibrated value	Default calibrated value	Increased marketing strength	Increased marketing strength
Behavior, Retrocommissioning, and Operational (BRO)s Program Assumptions	Reference	Reference	Reference	Aggressive	Aggressive
Financing Programs	No modeled impacts	No modeled impacts	No modeled impacts	No modeled impacts	IOU financing programs broadly available to res and com customers

*Incentives are set based on a $/kWh and $/therm basis consistent with existing IOU programs; incentives are capped at 50% of incremental cost.
**Incentives are assumed to be 1.5 times higher than what current IOU programs are offering on a $/kWh and $/therm basis, capped at 75% of incremental cost.

A.5 Changes from Previous Study

While the 2019 Study framework mirrors past PG studies, several changes were implemented for this study that result in substantially different results than observed from these previous efforts. Table 4. highlights the key changes implemented for the 2019 Study with an indication as to what directional impact each change had on the overall results.

Table 4. Key Changes Relative to 2017 Study

Category	Update Relative to Previous Study	Directional Impact	
Baseline Policy	Deemed non-residential lighting standard practice baseline to be LED.[34] . CPUC staff directed the PG team to assume LEDs are baseline in the residential sector as well.	↓	Cuts savings significantly by approximately 225 GWh across all IOUs.
BROs Measures	Updated data and one measure added (online audits).	↑	Increases savings specifically from home energy reports (HERs), and strategic energy management (SEM).
DEER/ Workpapers	Used DEER 2020 (previously DEER 2017).	↓	Decreases savings and potential due to updating the majority of weather-sensitive measures.
Custom Programs	Used 2 more years of program data for calibration (2015-2017).	↓	Shows a downward trend over time versus the previous, flat trend.
Low Income Programs	Leveraged recently published evaluations for the Energy Savings Assistance (ESA) Program to update model inputs.	↓	Shows actual program savings are far less than claimed savings. Incorporating the ESA evaluation reduced low income program potential.
Cost-Effectiveness	Used 2019 avoided costs with approved greenhouse gas (GHG) adder.	↓	Decreases in avoided costs due to updates to GHG adder, decreases C-E results in the 2020-2030 range.
Cost-Effectiveness	Varied TRC threshold by scenario whereas previous study did not.	↓	Offera more stringent interpretations of C-E threshold across scenarios.
Rebate Program Measures	Added new measures including smart connected power strips and connected LEDs.	↑	Increases residential savings potential but not enough to backfill loss of LED savings.

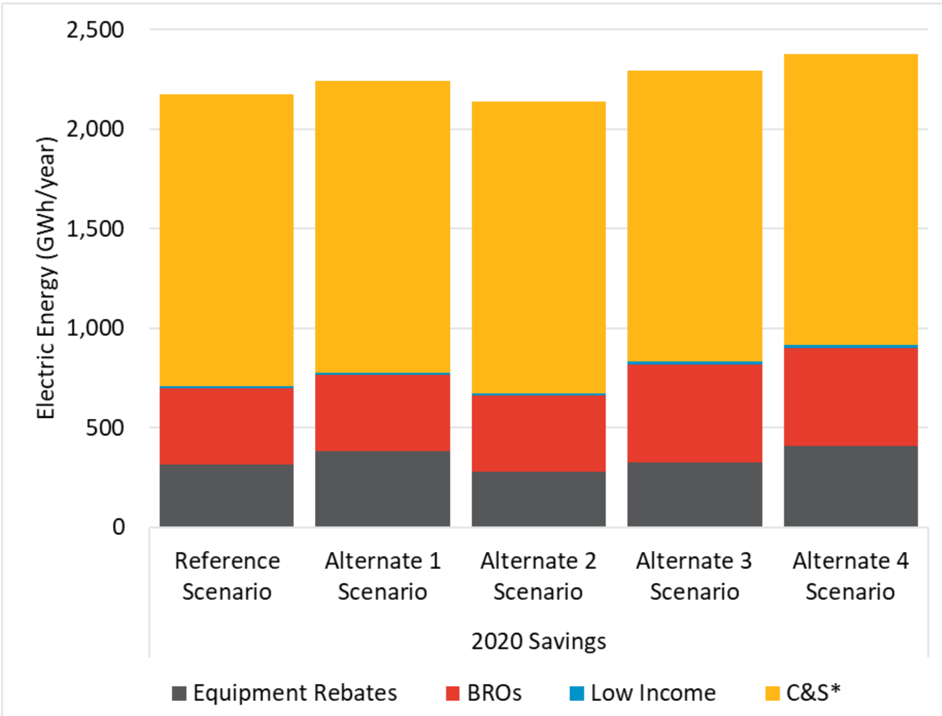
A.6 Results

A.6.1 Total Electric Market Potential

[34] Database for Energy Efficient Resources (DEER) Resolution E-4952

Figure 1 shows the total 2020 (first year) electric market potential for each type of EE program delivery approach.[35] The figure illustrates the magnitude of market potential for each EE program type for each of the five scenarios listed in Table 2.

Figure 1. 2020 Net Statewide Incremental[36] Electric Savings by Scenario



*Includes interactive effects

Some notable takeaways from the electric results include the following:

- The overall electric savings are approximately 6% lower than the total savings observed from the previous PG study. While the total is relatively comparable, there is a significant shift in savings from equipment rebate programs to BROs programs and C&S.
- Savings from equipment rebate programs dropped about 45% relative to the previous PG study. This drop is primarily driven by the loss of nearly 225 GWh of lighting savings due to CPUC baseline policy changes.
- It is important to note that while a significant amount of lighting savings is no longer represented in the rebate program potential estimates, they are not lost. Rather, lighting savings are captured through codes and standards and through naturally occurring EE (the latter of which was not quantified as part of this study or claimable by IOU programs.)
- Savings from BROs programs increased approximately 30% in 2020 relative to the previous PG study. This increase is mainly driven by revised data on HERs and the addition of online audits.

[35] Note that this study categorizes the following EE program areas: equipment rebates; behavior, retrocommissioning, and operational efficiency (BROs); low income; and codes and standards (C&S).

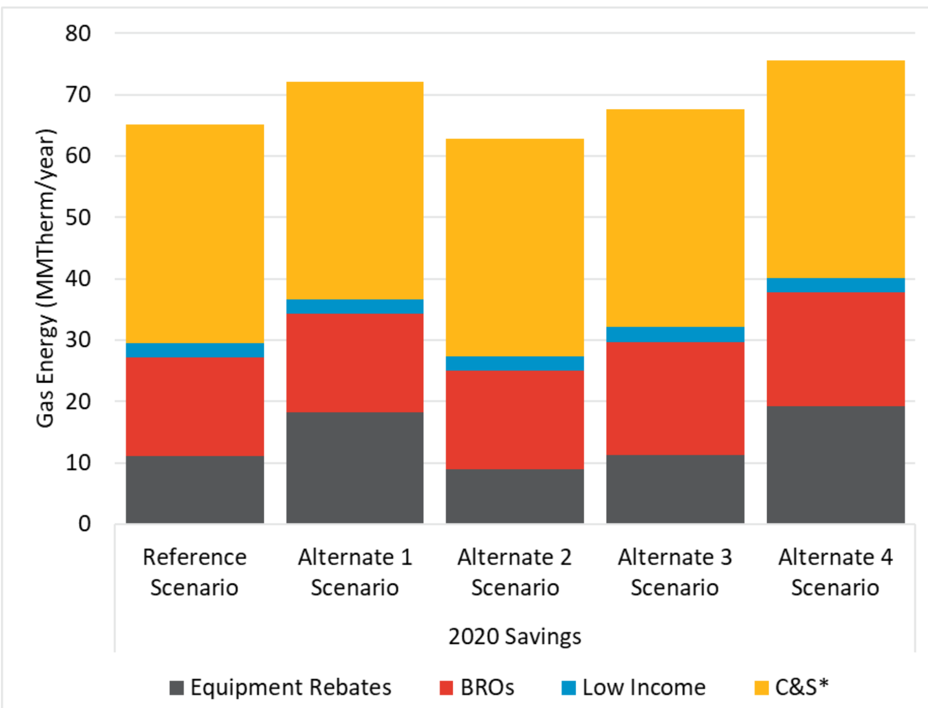
[36] Incremental savings represent the annual energy and demand savings achieved by the set of programs and measures in the first year that the measure is implemented. It does not consider the additional savings that the measure will produce over the life of the equipment. A view of incremental savings is necessary to understand what additional savings an individual year of EE programs will produce. This has historically been the basis for IOU program goals.

- Consistent with past PG studies, the largest contributor to savings comes from C&S programs. It should be noted that C&S advocacy efforts have historically been provided as a separate goal from incentive programs.
- The Alternative 4 scenario appears to yield the highest electric savings potential. This scenario assumes the most permissive C-E threshold at 0.85 for all measures and highly ambitious efforts aimed at increasing customer uptake of various EE programs. These efforts include high rebate amounts, stepped-up marketing and outreach efforts, aggressive BROs interventions, and innovative financing approaches targeted to the residential and commercials sectors.

A.6.2 Total Gas Market Potential

Figure 2 shows the total 2020 (first year) gas market potential for each type of EE program delivery approach. The figure illustrates the magnitude of market potential for each EE program type for each of the five scenarios listed in Table 2.

Figure 2. 2020 Net Statewide Incremental Gas Savings by Scenario



*Includes interactive effects

Some notable takeaways from the gas results include the following:

- The overall gas savings are substantially lower than the total savings observed from the previous PG study. Reductions are seen in virtually every program category, except BROs.
- Savings from equipment rebate programs dropped more than 20% relative to the previous PG study. The reductions for equipment rebate programs are primarily driven by updated data on IOU-claimable savings.

- Savings from BROs programs increased approximately 12% in 2020 relative to the previous PG study. This increase is mainly driven by revised data on SEM programs.
- Consistent with past PG studies, the largest contributor to savings comes from C&S programs. It should be noted that C&S advocacy efforts have historically been provided as a separate goal from incentive programs.
- The Alternate 4 scenario appears to yield the highest gas savings potential. This scenario assumes the most permissive C-E threshold at 0.85 for all measures and highly ambitious efforts aimed at increasing customer uptake of various EE programs. These efforts include high rebate amounts, stepped-up marketing and outreach efforts, aggressive BROs interventions, and innovative financing approaches targeted to the residential and commercials sectors.

A.7 Study Products

Aside from the written report, the following supporting deliverables are available to the public via the CPUC's website:[37]

- **2019 PG Results Explorer:** A web-based tool that allows readers to dynamically explore the results of the study, including all five scenarios. Available at: https://bit.ly/2019-CA-Energy-Efficiency-PG-Study
- **2019 PG MICS:** A spreadsheet version of the Measure Input Characterization System documenting all final values for all rebated technologies forecast in the model.
- **2019 PG BROs Inputs:** A spreadsheet version of all measure-level inputs for BROs measures.
- **2019 PG Measure Level Results Database:** A spreadsheet of technical, economic, and market potential for each measure in each sector, end use, and utility. The database also includes measure level C&S results.
- **2019 PG Model File:** An Analytica-based file that contains the PG Model used to create the results of this study.
- **2019 PG Model Users Guide:** Document that helps advanced users who want to open and run the PG Model file in Analytica.

[37] https://www.cpuc.ca.gov/General.aspx?id=6442461220