Guidehouse

Memorandum

To: **Coby Rudolph, Genesis Tang, Jason Symonds, Kapil Kulkarni, CPUC**

From: **Karen Maoz and Amul Sathe**

Date: **October 1, 2020**

Re: **Low Income Potential Analysis Scope**

Background

The 2021 Potential and Goals Study (2021 PG Study) forecasts the energy efficiency potential from a variety of sectors including the low income (LI) sector. The original scope for the LI sector in the study was documented in the 2021 PG study workplan as follows:

> *"…this study will revert back to the method utilized by the 2018 PG study. The method is to request data from the IOUs on the number of expected program treatments and retreatments and apply estimated unit energy savings values (based on IOU reports or impact evaluations) to forecast market potential."*

CPUC staff have discussed with the Guidehouse team that the results of the original scope will not sufficiently inform the CPUC's LI proceeding. CPUC staff and Guidehouse discussed a more detailed and granular scope of work to assess the potential from the Energy Savings Assistance (ESA) Program. Our proposed revised scope is outlined in this memo.

Overview of Scope

Our revised scope will include the following:

- **Measure Selection and Characterization**
  - A list of measure will be selected based on:
    - Current ESA programs
    - Proposed ESA measures in the IOU ESA/CARE applications, Staff Proposal, and Party testimony
    - Limited additional measures
  - Selected measures will be characterized using existing data sources
- **Technical Potential Analysis**
  - Represents the remaining untapped potential based on data from the most recent, 2019 residential appliance saturation study (2019 RASS)[1] relevant to California low-income households

[1] The RASS is pending publication. https://www.energy.ca.gov/data-reports/surveys/2019-residental-appliance-saturation-study

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  - Quantifies both annual and cumulative technical potential for all measures characterized
  - Accounts for relevant factors including building type (SF and MF), ownership (rent vs own), and climate zone
- **Achievable Potential Analysis**
  - Represents the potential that is achievable through LI program intervention
  - Uses an appropriate (based on budget and data availability) forecasting methodology for the LI sector that considers historical program treatments and uptake of measures, as well as forward looking analysis for how new measures might penetrate the low-income sector
  - Quantifies both annual and cumulative achievable potential at the measure level
- **Program Budget Analysis**
  - Calculates the measure costs and program expenditures associated with both the technical and achievable potential

The rest of this memo discusses the methodology for these tasks.

Methodology

Task 1: Measure Selection and Characterization

Guidehouse will work with CPUC staff to identify a list of measures to include in this analysis. For the purposes of keeping this study within a reasonable budget, we will limit (with a few necessary exceptions) our measure list to include only one "representative measure" for a unique installation. By example, we will model the measure "High Efficiency Clothes Washer" as opposed to multiple measure options for different clothes washer efficiencies and different types of washers (top loading, front loading, combo washer dryer, etc.).[2]

Our measure list will include:

- Batch 1: Current ESA program measures (a list of which can be found in Appendix A)[3]
- Batch 2: Proposed ESA measures in the IOU ESA/CARE applications, Staff Proposal, and Party testimony
- Batch 3: Up to 5 additional measures informed by ED staff and stakeholders/parties

Guidehouse will work with CPUC to finalize the list in batches before proceeding to collect data on each measure. For example, we expect to finalize Batch 1 in the above list first and subsequently Batch 2 and 3.

Once a batch of measure has been finalized, Guidehouse will proceed with collecting data and characterizing measures. Measure characterization will include the following:

- Measure name
- Annual unit energy impact (kWh, kW, Therms)

[2] The "representative measure" approach is largely consistent with the main EE potential study. Adding measures that compete for the same installation highly complicates the market adoption forecasting methods.
[3] Sources from the monthly and annual reports on the Low-Income Oversight Board (LIOB) website: http://liob.cpuc.ca.gov/Pages/monthlyAnnualReport.html

- Measure expense as defined in the annual IOU ESA reports[4]
- Effective useful life (EUL)
- Measure applicability – any restrictions on program eligibility by building type or climate zone

We expect to leverage the following data sources for this effort:

- Batch 1
  - Guidehouse expects the IOUs to maintain a comprehensive database of all current ESA measures and their savings, costs, EUL and applicability. We will submit a data request to the IOUs requesting this information.
  - If such data is unavailable, we will default to using data contained in the IOU's monthly and annual ESA program reports (for costs and savings) and DEER/workpapers (for EUL).
- Batch 2
  - Guidehouse expects the IOUs to have developed estimates and assumptions for savings, costs, EUL and applicability for new measures being proposed in the ESA program.
  - We will review substantiation provided by the IOUs or submit a data request to the IOUs if this information is not already public.
  - If such data is unavailable for proposed measures, we will discuss the appropriate path forward with CPUC staff so as to not overly burden the budget. Guidehouse's budget is limited in its ability to support original, detailed engineering analysis, cost analysis or building simulation modeling to fill gaps. Thus, assumptions or existing California secondary sources may be warranted.
- Batch 3
  - Guidehouse does not expect CPUC or IOUs staff to have significant measure information for these measures, though we will request if any such information is available.
  - In the absence of data, Guidehouse will develop preliminary estimates based on DEER, eTRM, workpapers, or professional judgement. As with Batch 2, Guidehouse's budget is limited in its ability to support original analysis to fill gaps. Thus, assumptions or existing California secondary sources may be warranted.

Final measure data will be complied in an excel spreadsheet.

Task 2: Market and Program Data Collection

Measure data collected in Task 1 will not be sufficient to define the future potential in the LI sector. We will need to collect additional data on the LI market and past ESA programs.

Building Stock

The analysis will need to define the size and segmentation of the building stock within each IOU service territory as well as a 10-year forecast for building stock. We propose to leverage the existing CEC IEPR building stock forecasts and apply factors to disaggregate the low income sector.

The CEC provides a forecast of the total number of single family (SF) and multifamily (MF) homes in each IOU territory. Mobile homes (MH) are embedded into these totals. We proposed to take data

[4] Guidehouse is interpreting expense represents the sum of equipment and installation cost.

from this forecast and supplement with following information/assumptions based on existing secondary data sources:

- This analysis will only cover existing LI homes and not the new construction market. Therefore, we only need the existing stock of homes and the CEC's assumptions about demolition rates for retiring buildings. These homes are the target for potential analysis.
- We will collect data on what fraction of the total residential building stock in each IOU territory and climate zone that is low income. Such disaggregation methods have been followed in past CPUC PG studies and recently completed work Guidehouse has conducted for the CEC in support of SB350 forecasting.
- We will collect information from existing sources (such as the IOU monthly and annual ESA reports and the CPUC's Low Income Needs Assessment reports) that will allow us to break out Fraction of homes in each building type that are rented vs. owned

Measure Density/Saturation

Density and efficiency technology saturation are two essential inputs specific to individual technologies that describe the state of the market.

- **Density** is a measure of the number of units per building. The model will use density information to determine the number of technology units in the market. Density can be expressed as the following (for example): units/home, bulbs/home, fixtures/1,000 square feet, tons of cooling/1,000 square feet, etc.
- **Efficiency Technology Saturation** is the fraction of the density that already has the efficient technology installed and thus is not a target for the ESA program to replace.

The 2021 PG Study plans to mine data from the forthcoming Residential Appliance Saturation Survey being published by the CEC to estimate these values. If such information is not available, older vintages of saturation studies will be used and adjusted in an attempt to reflect current saturations. Adjustments (if necessary) would be based on historic program participation in ESA

Past ESA Program Activity

Data on the past ESA program activity (up to 10 historic years) will be collected from the IOU's annual reports provided to the CPUC. For programs as a whole we will collect the following by utility:

- Total equipment costs
- Total non-equipment costs (including implementation costs)

Because the measures offered in ESA have changed over time, we will only focus on collecting historic measure level data for current ESA program measures (for example historic savings and installations of CFLs will not be collected/examined). For individual measures we will collect the following data:

- Number of installations
- Energy impact (kWh, kW, Therms)

Task 3: Technical Potential Analysis

Technical potential is defined as the amount of energy savings that would be possible if the highest level of efficiency for all technically applicable opportunities to improve energy efficiency were taken. Technical potential can be reported as both instantaneous and annualized potential, distinguished as follows:

- **Instantaneous:** Potential that is unconstrained by stock turnover in any given year. This is the theoretical maximum savings possible from converting all equipment that is at or below code to high efficiency.
- **Annualized:** Potential that is constrained by stock turnover. In any given year, this is the theoretical maximum savings possible from converting all equipment that is at or below code to high efficiency upon burnout of the baseline technology. Annual stock turnover is assumed to be the inverse of EUL.[5]

Equation 1 shows the general formula for calculating instantaneous technical potential.

Equation 1. Technical Potential

Technical Potential = Existing Building Stock $_{YEAR}$ (e.g., homes) X Measure Density (e.g., widgets/home) X (1 Efficiency Technology Saturation) -X Unit Energy Impact $_{YEAR}$ (e.g., kWh/widget) X Technical Suitability (dimensionless)

The technical suitability factor is a catch-all adjustment that can be used to reflect situations where there is reason to believe the density is not reflective of the opportunity. It is typically set to 1.0 but on rare occasions it can be adjusted lower. For example, if density data is only available for the number of windows per home but it does not specify those that are on the first floor, a technical suitability factor may be need.[6]

We propose to conduct this task at the following level of granularity: IOU, building type, and measure. Once the analysis is complete, we will post process the data to further disaggregate results into climate zones and ownership types. Disaggregation will be conducted using the current ratios of population falling into each climate zone and ownership type.

Task 4: Achievable Potential Analysis

For the achievable potential analysis, Guidehouse will use a stock turnover-based model that consider both the technology EUL and ESA program guidelines for when equipment is eligible for replacement and various adoption curves. Given that the ESA programs deliver measures at no cost to participants, there are other barriers for consideration including hassle factor, not understanding the benefits, and others. As such, Guidehouse proposes the following approach:

- Develop 3-5 prototypical adoption curves (see additional details below)
    - Curves are independent of building type, ownership type, and climate zone
- Map measures to the appropriate adoption curves using the following considerations
    - Ease of implementation (e.g. advanced power strip or LED light bulb)
    - Aesthetics or need landlord approval (e.g. refrigerator)
    - Intrusive (e.g. insulation, HVAC equipment)
    - Historic program uptake

[5] Annual stock burnouts = 1 / EUL
[6] The ESA Installation Standards state the following criteria as “non-feasible” for window replacement: “Window is above the first floor of a structure and installation will present unsafe working conditions”

- Apply curves in the model to forecast market adoption (units)
- Multiply adoption (units) by unit energy impact to arrive at achievable potential

Guidehouse will develop prototypical adoption curves based on two possible sources:

- Reviewing average rates of adoption from past ESA program measures. Historic annual data can be plotted to reveal average trends in different types of measures (easy to implement vs. intrusive installation)
- Using Guidehouse staff professional judgement on reasonable adoption curves informed by our decade of potential study experience

We propose to conduct this task at the following level of granularity: IOU, building type, and measure. Once the analysis is complete, we will post process the data to further disaggregate results into climate zones[7] and ownership types. Disaggregation will be conducted using the current ratios of population falling into each climate zone and ownership type.

Given that the disaggregation will occur outside of the adoption modeling framework, capturing the "ease of installment" impact is in aggregate for all building types and ownership types. That is to say although installation rates in the real world vary by building type and ownership type, we are unsure that such data exists to dive this deep and our budget does not allow for such a deep dive. Our aggregate results will still be valid as the aggregate forecast is calibrated to the aggregate historical market activity. Specific details of the calibration process will be addressed as program and measure data collection is completed. Such disaggregation could be explored in future updates to the LI potential with larger budget and access to deeper data.

Guidehouse proposes up to two additional adoption scenarios (for a total of three) which apply factors to adjust the base adoption curves developed for this study. These scenarios will be developed in coordination with CPUC staff as program and policy levers.

Task 5: Program Budget Analysis

Program budget will be broken down into two components each with separate estimates:

<u>Equipment Expenses</u>

We will calculate Equipment Expenses by multiplying the number of annual adoptions of each technology by their deemed equipment expense. This can be calculated for both the annual technical potential and the achievable potential.

<u>Program Costs</u>

Program costs represents the sum of the following:

- Implementation
- Training Center
- Inspections
- Marketing and Outreach
- Statewide Marketing Education and Outreach

[7] Note certain measures are not eligible in every climate zone.

- Measurement and Evaluation Studies
- Regulatory Compliance
- General Administration
- CPUC Energy Division

The forecast of program costs can be conducted in one of two ways:

- Assume all program costs scale proportionally with equipment costs (based on scaling ratios from historic program years)
- Assume a portion of the program costs are fixed and do not change over time while the remainder scales proportionally with equipment costs.

Program costs can be calculated for both the annual technical potential and the achievable potential.

Task 6: Reporting and Deliverables

Guidehouse will provide a model file suitable for public release, a spreadsheet database of results, and a written document that outlines our methodology and summarized our findings. The written document may be a chapter within the 2021 PG Study report.

Task 7: Stakeholder Engagement

As directed by CPUC staff, Guidehouse will engage stakeholders in communicating methodology, assumptions, and results of this analysis.

Timeline

- Technical potential draft (for internal CPUC use) – December 1, 2020
- Market potential draft - February 2020
- Reporting - March 2020 (aligns with the broader PG study)

Appendix A: Current ESA Program Measures

Appliances
High Efficiency Clothes Washer
Refrigerators
Microwaves
Freezers
Domestic Hot Water
Other Hot Water
Tank and Pipe Insulation
Water Heater Repair/Replacement
Thermostat-controlled Shower Valves
Combined Showerhead/TSV
Heat Pump Water Heater
Tub Diverter/ Tub Spout
Enclosure
Air Sealing / Envelope
Attic Insulation
HVAC
Furnace Repair/Replacement
Room A/C Replacement
Central A/C replacement
Heat Pump Replacement
Evaporative Coolers
Duct Testing and Sealing
Energy Efficient Fan Control
Prescriptive Duct Sealing
Central A/C Tune up
Smart Thermostat
A/C Time Delay
High Efficiency Forced Air Unit (HE FAU)
Blower Motor Retrofit
Maintenance
Furnace Clean and Tune
Lighting
Lighting (Occupancy Sensor)
LED Reflector Downlight Retrofit Kits
LED Diffuse A-Lamps
LED Reflector Bulbs (BR)
LED Torchieres
LED Exterior Hardwired Fixtures
LED Interior Hardwired Fixtures
Miscellaneous
Pool Pumps
Smart Power Strips - Tier 1
New - Smart Power Strips - Tier 2

Source: 2020 ESA July Monthly report from PG&E – ESA Table 2