Cal TF Technical Position Paper No. 12: Review of the Energy Savings Assistance Program Saving Estimation Methods

January 23, 2020

Background

The California Public Utilities Commission (CPUC) has directed the investor-owned utilities' (IOUs) Energy Savings Assistance (ESA) programs to use deemed savings values for program planning and reporting. The following is an excerpt from CPUC Decision 17-12-009:

> *"…we have become increasingly aware that our continued reliance on billing analyses may have limitations. Recognizing these limitations, as well as similarities among measures in both the ESA program and mainstream direct install EE offerings, beginning in 2018, the ESA Program will utilize deemed savings values for all program measures, in alignment with mainstream EE program activity…we encourage our next impact evaluation and 2017 EE Potential Study to examine applying DEER values to the 2017 ESA Program Year's installation figures."* (Page 234)

In this same decision, the CPUC also directed the IOUs to work with the California Technical Forum (Cal TF) to develop deemed savings values for the ESA program:

> *"We direct the IOUs to coordinate with the California Technical forum to recommend prospective savings values and revisions to its EM&V methodologies for the low-income program." (Page 405)*

Prior CPUC directives have been to derive measure savings values from ESA impact evaluations[1] so this new direction is a departure from past practices. The ESA impact evaluations have historically used whole house billing analysis which is a reasonable evaluation approach for a residential program that installs bundles of measures, each with small energy savings. The drawback of using a whole house billing analysis is that it does not produce reliable measure-level savings estimates for all ESA measures.

In response to this CPUC directive, the Cal TF formed a Low Income (LI) Subcommittee to develop a response to the CPUC's directive. The LI Subcommittee was made up of Cal TF members with a background in low income markets and energy efficiency programs, and IOU staff who support the ESA programs (including both program staff and members of the evaluation and engineering support teams). The National Resources Defense Council (NRDC) also participated. CPUC staff participated on many of the subcommittee calls as an observer. The LI Subcommittee members are listed in Appendix 1.

Subcommittee Objectives

The original objectives of the LI Subcommittee were to 1) recommend prospective deemed savings values for the measures of the statewide ESA program administered by the IOUs, and 2) recommend any necessary revisions to the EM&V methodologies upon which the ex ante values of the ESA deemed measures are based. These recommendations would be delivered via a Cal TF technical position paper (TPP).

[1] "The IOUs are to use the most current energy savings estimates as determined in the Final Report of the Load Impact Evaluation for the applicable program cycle, unless directed otherwise by the Commission. For measures not reflected in the Load Impact Evaluation, those energy savings can be derived from DEER, engineering calculations, etc. as appropriate." D.14-08-030

Revised Objectives

After the Cal TF staff reviewed the ESA measures and measure definitions, it became clear that the effort required to further develop ESA ex ante savings values for each of the IOUs' ESA measures was much greater and more complicated and costly than originally anticipated. Therefore, the first LI subcommittee objective was modified to outline recommendations for developing deemed savings values[2] for the ESA program. This is a logical first step, given that the approach and requirements should be reviewed and agreed on by the major stakeholders prior to expending the time and resources to calculate the savings values. Because the low income and energy efficiency programs use different funding sources, any subsequent work to develop reliable ex ante savings values will require separate dedicated funding from low income funds as low income measure development cannot be funded from energy efficiency funds.

Description of ESA Program

The Statewide ESA Program (formerly known as the Low Income Energy Efficiency (LIEE) Program) provides qualified residential utility customers with energy-saving improvements at no charge. Program services include energy education, an in-home energy assessment, and installation of one or more qualifying (or feasible) measures that are identified during an in-home assessment. ESA is implemented by the four California IOUs: Pacific Gas & Electric Company (PG&E), Southern California Edison (SCE), Southern California Gas Company (SCG), and San Diego Gas and Electric Company (SDG&E).[3] The CPUC defines the program budget and maintains an oversight role.

Eligible participants must meet the program's income guidelines, which are the same as those for CARE, the California Alternative Rates for Energy Program, and live in a house, mobile home or apartment that is at least five years old. Measures must also be feasible, based on an on-site home assessment.

All program measures/upgrades are directly installed by qualified program installers. The types of measures/upgrades the ESA program provides are:

- Weatherization
    - Caulking, weather-stripping, attic insulation, minor home repairs
- HVAC
    - Furnaces, room air conditioners (AC), some central AC, evaporative coolers
- Hot water measures
    - Hot water heaters, showerheads, faucet aerators, others
- Appliances
    - Washing machines, refrigerators
- Lighting
    - LED bulbs and fixtures
- Other

[2] For the purposes of this discussion, we define "deemed" to be ex ante savings estimates that are drawn from DEER or are estimated using engineering calculations or simulation modeling.

[3] ESA program services are also provided by Southwest Gas Corporation, Liberty Utilities, Golden State Water Company/Bear Valley Electric, PacifiCorp, and Alpine Natural Gas Operating Company. However, these providers are regulated by a separate proceeding than the IOU ESA implementers.

- Smart strips, others

Prior to 2020, the goals of ESA were to provide 100% of all eligible and willing customers the opportunity to participate in ESA by 2020, improve the health, safety, and comfort (non-energy benefits) of ESA customers, and produce cost-effective longer-term energy savings in income-eligible households that provide a reliable energy resource for California.[4]

The program underwent three important changes beginning in program year 2017 when the following were eliminated:

- Three Measure Minimum Rule (3MM): a minimum energy savings threshold had to be met if only two measures are installed. Otherwise, at least three measure had to be installed;
- The Go-Back Rule was a "freeze" on re-treating households that had received ESA services since 2002; and
- Measure caps that limit the number of measures deployed at a location.

Differences between ESA and Mainstream Energy Efficiency

There are a number of important differences between the ESA program and mainstream energy efficiency (EE) programs that must be considered when recommending savings estimate methods using DEER or other sources of previously approved deemed values:

- While the objective of mainstream EE program is to save energy, the ESA program is expected to fulfill multiple objectives. In addition to being "an energy resource by delivering increasingly cost-effective and longer term savings"[5] the ESA program is designed to reduce the "energy bills of eligible customers, and to improve the quality of health, comfort, and safety.[6] These additional "quality of life" objectives can result in unique changes in energy use in homes treated through the ESA program as compared to the mainstream EE program. For example, when an old, inefficient piece of equipment is replaced with a higher efficiency unit, energy use may increase after the installation of the efficient equipment when consumers realize they can be comfortable for a reasonable cost.
- While customers participating in both mainstream EE and ESA programs seek energy (and bill) savings, the motivations and outcomes for low income customers are also different in ways that can be expected to change energy use (driven in large part by customer behavior or the condition/efficiency of the equipment being replaced):
    - Participation in most mainstream EE programs is "opt in": customers elect to participate, customers select the measures to be installed, and customers bear (at least some of) the cost of the measures; and
    - Participation in the ESA program is "opt out": customers are targeted by the IOUs to participate, the IOUs' third-party implementers apply program rules to select the measures to be installed (and in certain cases systems and appliances to be repaired), and customers bear none of the cost of participation.

[4] California Public Utility Code Sections 382(e), 386(a)(3), 900, 2790, and the California Energy Efficiency Strategic Plan (CAEESP), adopted in D.10-09-047. Southern California Edison. 2014. Energy Savings Assistance (ESA) Program Plan and Budget Proposal for the 2015–2017 Program Cycle. California Public Utilities Commission (CPUC) Internal Audit Unit, Energy Savings Assistance (ESA) Program, October 2017.

[5] California Energy Efficiency Strategic Plan January 2011 Update. Pg. 24

[6] California Public Utilities Commission (CPUC). Decision 17-12-009. Pg. 2.

- Low income savings are measured from the existing baseline, whereas the baseline for mainstream EE programs is generally either code or industry standard practice;[7]
- The efficiency of equipment installed via the ESA program does not need to be at the same high levels as the mainstream program. The rationale is that the ESA upgrades represent a significant improvement in efficiency over the existing equipment that they are replacing and still likely provide significant energy savings and/or meaningful health comfort and safety benefits to the participant. In addition, the program is funding (and the cost effectiveness calculation supporting) the full cost of the installation, not just an incremental cost as is the case with the mainstream program and does not need to bear the potentially significant additional incremental cost of even higher efficiency equipment, which allows the program to treat more customers; and
- Some ESA measures, such as furnaces and air conditioning units, may replace non-working equipment or poorly functioning equipment that is never or rarely used. In other instances, measures may be added when there is no existing equipment (e.g., evaporative cooler, room AC). Therefore, some ESA installations result in an increase in energy usage.

Energy usage patterns and other aspects of low-income households may differ from the general population and, therefore, the assumptions related to the operation of equipment (such as hours of use) used for mainstream deemed savings values may not be appropriate. At this time, there is little primary research available to validate the extent to which these assumptions apply to different groups of ESA participants, leading to uncertainty whether one-size-fits-all deemed measure values, as are used for mainstream EE measures, are appropriate. Energy use patterns in low-income households may differ from the general population due to the following reasons:

- Some participants may use the inefficient or poorly working equipment less before program treatment because the cost to operate inefficient or poorly working equipment is high. Conversely, some participants may use the new equipment more after program treatment because the cost to run more efficient equipment is lower, the equipment functions better, is safer, or because the program replaced nonworking equipment;[8]
- Participants that have new equipment as a result of program participation (rather than replaced equipment) are likely to use it;
- A larger proportion of low-income customers are seniors and/or disabled than in the mainstream EE program population and therefore their "occupied" hours are likely higher;
- Building stock is frequently older, in poorer condition, and appliances are more frequently purchased on the secondary market; and
- Appliances in use by ESA-eligible households are frequently repaired rather than replaced which results in a different baseline for ESA eligible households.

The ESA program is administered under different regulatory requirements/constraints than mainstream EE program:

[7] However, use of an existing baseline is allowed for accelerated replacement deemed measures in the mainstream programs.

[8] This is commonly referred to as the "rebound effect" and is applicable to mainstream EE programs as well.)

- With respect to the cost effectiveness test, measure costs are total costs of direct installation contractors with no cost to the participant (whereas the mainstream EE programs use the incremental cost between the standard efficiency and high efficiency equipment, in most cases). These costs are known with certainty to the ESA administrators and do not need to be estimated;
- Low-income savings are determined based upon existing equipment baseline, not on code requirements;
- Free ridership is not estimated and net-to-gross values are not applicable to ESA savings, because it is assumed that, absent the program, these measures would not be installed;
- Gross savings installation adjustment (GSIA) is not applicable because all equipment is installed by the ESA implementers;
- Planning/reporting measure savings values have historically been determined from program impact evaluations where:
    - There is a single savings value for each measure type and IOU; and
    - Measure savings are not distinguished by efficiency level/tier or vintage.
- The goals of the ESA program extend beyond energy savings and the ESA cost effectiveness test accounts for both the energy benefits and non-energy benefits (NEBs).

Cal TF Staff Review

Cal TF staff conducted the following research to inform this TPP.

Literature Review

Cal TF staff reviewed the following documents or the sections pertaining to the ESA program, as applicable:

- *Statewide Energy Savings Assistance Program 2017-2020 Policy and Procedures Manual*.
- *Energy Savings Assistance Program. California Installation Standards.* Prepared by Richard Heath and Associates for the California IOUs. March 2018.
- California Public Utilities Commission (CPUC). 2014. Decision 14-08-030. Phase II Decision on the Large Investor-Owned Utilities' 2012-2014 Energy Savings Assistance (ESA) Program and California Alternative Rates for Energy (CARE) Program Applications.
- California Public Utilities Commission (CPUC). 2017. Decision 17-12-009. Decision Resolving Petitions for Modification of Decision 16-11-022.
- Evergreen Economics. 2013. *PY2011 Energy Savings Assistance Program Impact Evaluation Final Report*. August 30.
- DNV GL. 2019. *DRAFT Energy Savings Assistance (ESA) Program Impact Evaluation Program years 2015-2017*. March 29.
- DNV GL. 2019. *Energy Savings Assistance (ESA) Program Impact Evaluation Program years 2015-2017*. April 26.
- DNV GL. 2019. "2015-2017 ESA Impact Eval Results – Phase 2 – FINAL – April 26 Public Posting.xlsx."

ESA Measure Mapping

Cal TF staff investigated whether there was an existing saving value in the mainstream program for any of the ESA measures. Specifically, the Cal TF staff determined whether the ESA measure type was in any of the following sources:

- Statewide consolidated measures
- IOU workpapers (active or retired)
- POU Technical Reference Manual
- Database for Energy Efficiency Resources (DEER)

The measure mapping is presented in Appendix 2. The mapping revealed that there are existing sources upon which to base ESA measure estimates for all measures except the following:

- Furnace clean and tune
- Minor home repairs
- Water heater blanket
- Torchiere (LED)
- LED night lights
- Second refrigerators
- Microwaves

Conclusions

The following sections summarize the findings and conclusions related to the ESA program in response to the CPUC directives in Decision 17-12-009.

Establishing Prospective Deemed Savings Values

Given that the ESA program measures are similar technologies to those offered in the mainstream program, it is reasonable to develop deemed savings using similar methods as the mainstream EE program. Per Cal TF staff's mapping of ESA measures to mainstream program savings value sources[9], there are existing workpapers or other sources for most of the ESA measures. However, to understand which method is likely to produce more reliable measure ex ante savings estimates or estimates that result in a higher or more consistent realization rates, additional analysis should be conducted.

If a deemed approach to developing ex ante savings estimates is pursued, there are a number of modifications that must be made to make the estimates applicable to the low-income population that are outlined in the following sections. First, because the measure definitions for the mainstream EE measures do not align with the ESA program measure definitions (for both the base and measure cases) some adjustments would need to be made. For instance, as mentioned previously, the ESA program claims energy savings estimated from the participant's existing equipment whereas, DEER and the mainstream program estimate a measure's energy savings from the code-required or industry standard practice baseline efficiency. Similarly, the installed equipment does not necessarily align as some measures within the ESA program do not require that the same level of efficient equipment be installed as in the mainstream programs (as is the case with furnaces). However, the underlying savings methodology of the DEER (and workpaper) estimates are valid, and it is possible to scale the base and/or

[9] As presented in Appendix 2: Measure Mapping.

measure case efficiency levels for the DEER (and workpaper) values to match the efficiency values of the ESA measures. This conforms to the methodology required by the CPUC for developing deemed measures for the mainstream program:

> *For non-DEER measures, the IOUs are instructed to use DEER values as starting points and/or apply the DEER methodologies for estimating the non-DEER parameter value for cases in which any of the specific parameters of an IOU installation differ from the assumptions that form the basis of a DEER measure.*[10]

Furthermore, some ESA measure definitions do not align exactly with the mainstream program and would need to be modified. For instance, "furnace repair/replacement" will need to be split into two measures: "furnace repair" and "furnace replacement." Similarly, "water heater repair/replacement" would need to be split into "water heater repair" and "water heater replacement."[11]

Lastly, given that the pre- and post-usage patterns of low-income participants may be different than mainstream participants, the input values for operating hours/usage may need to be adjusted. For some measures, this may require using different hours of use values in the base case and measure case calculations.

Revisions to EM&V Methodologies

Several of the recommendations below will serve to improve the measure level estimates and realization rates. Although whole house billing analysis is still an appropriate evaluation method for ESA bundled measures, past evaluations have not produced consistent results at the measure level. Using site specific data gathered through the program implementers, whether used to develop population level estimates applicable to low income or on a site by site basis using a hybrid approach, could result in more accurate ex ante estimates. Documenting the working condition of replaced equipment will allow the evaluators to scope evaluation methods and develop stratification approaches that will also result in higher realization rates and provide meaningful evaluation findings. The recommendation to conduct research into negative savings can be included in the scope of future ESA impact evaluations.

Recommendations

The Cal TF makes the following recommendations related to developing ex ante savings estimates for the ESA program. Furthermore, several of the recommendations below will support and improve the ESA evaluations, including mining the program data to improve the estimates and conducting research into negative savings.

Mine Program Data

The IOUs should leverage the information gathered from the ESA participant sites to inform energy savings estimates. Appliance and HVAC system information are collected by the ESA outreach workers during the initial interviews.[12] Using site-specific data from the ESA participants (rather than using

[10] California Public Utilities Commission (CPUC). Energy Division. 2013. *Energy Efficiency Policy Manual Version 5.* Page 30.

[11] Repair measures are allowed through the mainstream EE programs as BRO (behavioral, retrocommissioning, and operational) measures so there may be information and/or data to support the development of these savings estimates.

[12] *Statewide Energy Savings Assistance Program 2017-2020 Cycle Policy and Procedures Manual*. Page 33.

population level data) will allow for the development of measure level savings estimates that are more accurate for the low-income population.

The data that would be useful to inform deemed estimates for low income customers are described in the sections below. If any of these data points are not already collected by the ESA outreach workers during the initial interviews, the utilities should confirm whether they are collected through subsequent site visits, such as the measure installation or through the quality control inspections. For any data not currently collected, the utilities should assess the resources and cost to add the collection of these data points through the existing channels, as the collection of additional could have significant cost implications for the program. The utilities should ensure that the ESA Policies and Procedures Manual includes data collection and quality control protocols to support accurate collection of these data points.

Specific data on removed/base case equipment. The efficiency level and capacity of the equipment that is removed can be used to calculate measure energy savings with a more accurate baseline than using a population average. The IOUs should capture manufacturer, model number, capacity, and manufacture date, where available. The IOUs report that some information on the existing equipment is captured by the implementers and documented in the program data bases, but these practices should be standardized for all ESA program administrators. This applies to measures that replace existing equipment, such as furnaces, air conditioning units, water heaters, and refrigerators.

Working condition of old units. Replacement of poorly working or rarely used equipment is a likely cause of (or contributor to) negative savings values for specific measures. ESA outreach workers should document and report the working condition of the existing equipment so that the savings can be correctly estimated. There is a hypothesis that negative savings may be the result of installers replacing non-working equipment which is only allowed in very specific circumstances. The ESA program administrators should create clear rules around the replacement of non-working equipment and require that the ESA outreach workers capture and report the existing conditions. Similar to the recommendation, above, this applies to measures that replace existing equipment, especially furnaces, air conditioning units, water heaters, and refrigerators.

Information on equipment use. Data/information on participant's use of the equipment would greatly inform the energy savings estimates and shed light on how/if usage by low income households differs from mainstream EE participants. Information gathered should be specific to usage patterns of the old, removed equipment and usage of the new equipment in order to understand how the usage may have changed with the new equipment and whether there may not be realized energy savings due to an increase in equipment utilization. Since it is often difficult for participants to accurately estimate the hours of equipment use, the IOUs may want to consider gathering information that is a proxy for equipment use, such as number of occupants in the household. When possible, end use metering is a very reliable method for determining equipment use but can be expensive and complex.

Developing baseline or other values for deemed measure estimates requires a body of data with a sufficient number of observations across the variables of interest. Building up this body of data for the ESA program deemed measures will take time, so in order to estimate baseline values applicable to the low-income population in the interim, Cal TF recommends the use of the Residential Appliance Saturation Survey (RASS) to determine the mix of equipment type within each climate zone or IOU service territory. An updated RASS is expected to be released in the first half of 2020 and is expected to have good coverage of low-income households.

Conduct Further Investigation into Negative Savings

One very important issue to understand is the reason(s) for negative savings for some measures. The 2015-2017 ESA Impact Evaluation found negative savings values for furnace repair/replacement (gas) and room AC measures (electric).[13] There could be a variety of contributors to negative savings, including the installation of measures that replace non-functioning, poorly functioning/unused, or improperly installed equipment or highly inefficient existing equipment that was expensive to run could yield a significant rebound effect from an increase in usage of the new equipment.

The program and/or impact evaluation data should be reviewed to understand what proportion of these installations show negative savings and what other characteristics they share. For instance, for the furnace repair/replacement participants, the savings for participants who had their furnaces repaired versus replaced should be reviewed to see if there are clear trends. Similarly, program records for room AC sites should be reviewed to see how many of them replaced non-working units compared to how many replaced units 15 years or older. The program installation standards for room AC measures implies that if the existing unit is non-operational, then it can be replaced through the program.[14]

Measure Standardization

To the extent they have not already done so, the IOUs should consider standardizing the ESA measure definitions so they are consistent across the state. The ESA program has a standard set of eligible measures, but for some measures, each IOU defines the efficiency levels or tier cut offs differently. Table 1 below provides an example of this: SCE and SDG&E have slightly different refrigerator sizes and offerings.

Table 1. SDG&E and SCE ESA Refrigerator Sizes

SDG&E Refrigerator Sizes	SCE Refrigerator Sizes
15 cf Refrigerator	10 cf Refrigerator
17 cf Refrigerator	15 cf Refrigerator
18 cf Refrigerator	18 cf Refrigerator
21 cf Refrigerator	21 cf Refrigerator
23 cf Side-by-Side	22 cf Side-by-Side
26 cf Side-by-Side	19 cf Bottom Freezer Refrigerator

Aligning the measure definitions across the IOUs would greatly reduce the amount of work required to scale the mainstream measures to the ESA measure definitions. The Cal TF and IOUs recently standardized the measure definitions across the state for the mainstream EE program in the statewide consolidated measures that will be used by all IOUs starting in 2020. Prior to this, the individual IOU workpapers had non-uniform measure definitions, tier levels and efficiency requirements. The primary benefit of standardizing the measures for the mainstream EE program was to simplify program design,

[13] DNV GL. 2019. *Energy Savings Assistance (ESA) Program Impact Evaluation Program years 2015-2017*. April 26. Pages 45 and 52. Furnace maintenance, microwaves, duct test and seal, smart fan delay, and smart power strip also had negative savings.

[14] The ESA *California Installation Standards* (dated March 2018) indicate that for Window/Wall Air Conditioning and Heat Pump Replacement, Section 1. Feasibility Criteria, 1.1 indicates that the installation is not feasible if a "Unit is already present and operational, and is less than 15 years old." (Page 22-A).

administration, and reporting for program implementers operating across IOU service territories. ESA implementation contractors would realize this same benefit.

Conduct a Pilot to Assess the Benefits/Drawbacks of Different Approaches to Estimating Deemed Savings

To better determine the most appropriate or reliable method for estimating deemed savings for ESA, the IOUs may want to undertake a pilot on three to five measures[15] to consolidate the measure definitions across the ESA program administrators and scale the mainstream DEER values or workpaper base case and measure case to align with the ESA measure definitions. This would allow the ESA program administrators to understand how this approach for developing deemed savings estimates compares with the current method and what the program realization rate would have been had the program ex ante values been based on the adapted DEER or workpaper values. It will also provide insight into the level of effort and resources required to use this approach to establish deemed savings values for the remaining ESA measures.

The pilot should also compare the relative advantages and drawbacks of using billing analysis or engineering estimates (via DEER or workpapers) to develop ex ante deemed values for ESA measures. This analysis should go beyond estimating the accuracy or robustness of these estimates and include other considerations such as ease and cost to execute. Each of these methods have their advantages and drawbacks; some of these are presented in the table below as an illustration.

[15] The pilot measures should be selected to provide meaningful insights into the benefits and drawbacks of using deemed savings estimates for the ESA programs. This should include measures that currently yield non-intuitive evaluation findings, negative energy savings, or those with a high contribution to the program savings.

Advantages & Drawbacks of Deemed Estimates Versus Billing Analysis	
Ex Ante Estimates Using Billing Analysis	
Advantages	Drawbacks
There is a history of ESA study results from previous program cycles which could be used to identify trends over time. However, this may not be the possible in the near term given that recent evaluations used different methods. Billing analysis can typically provide reliable findings/values at the household level. Billing analysis uses actual pre- and post-retrofit energy usage and weather data, as opposed to simulated data. Allows use of a nonparticipant control group to control for exogenous changes. Methodologies and available data for billing analysis have evolved considerably, and will continue to evolve (e.g., NMEC; hourly data; etc.) making this an increasingly fruitful option. Analysis can be done on a premise basis.	Applying whole-billing analysis approaches to estimate measure-level savings when savings are too small to measure with statistical significance is challenging. For the ESA program, total expected household-level savings as a percent of overall household usage can be small compared to the natural variation across households. At the measure level these savings are significantly smaller. Estimates not available for new measures. Measures must be installed, and the program evaluation conducted to develop estimates using whole house billing analysis. Historically, the ESA billing analysis methodologies have changed over time making direct comparisons to previous results difficult. Aggregated results do not allow analysis of which measures are producing negative savings (increases in energy usage). Identifying which measures are producing energy gains and analyzing why the gains are occurring (a) can inform the program design rules to help limit measure installations that will increase energy gains, or alternatively (b) will allow development of program rationale that justifies limited energy gains (such as replacing a non-working appliance with a working appliance).
Ex Ante Estimates Using Consolidated WP/DEER	
Advantages	Drawbacks
Aligns with mainstream program approach. Approved calculation methodologies are available for most ESA measures based on previously developed DEER or workpaper measures. Can calculate specific values based on climate zone. Can be developed for new measures in advance (where measures must be installed and in place for a year before billing analysis can estimate savings).	Existing inputs/parameters need to be reviewed and possibly modified to be applicable to low income customers. There may not be sufficient supporting data to modify inputs/parameters to be applicable to low income customers without additional research and/or data collection through program implementation, which can be very costly to the program.

One output of this pilot to develop deemed savings estimates should be to identify the source of the workpaper inputs or DEER value assumptions and determine whether savings estimates would be improved by finding sources that are specific to low income households. ESA program data on base case equipment and customer usage should be leveraged to the extent possible. In some cases, there may be existing studies that support different input values or assumptions more appropriate to low income households and in other cases, primary research may be required.

Consider a Hybrid Approach to Developing Deemed Estimates

One of the recommendations made by a Cal TF member on the LI Subcommittee was to explore the possibility of using a hybrid approach to developing ESA program deemed savings estimates. The ESA program is in a unique position to leverage/pilot the use of hybrid measures in California. A hybrid measure is a measure with savings estimated using an engineering calculation or workpaper, but with a variable or variables that use site-specific data to calculate the savings. This is a hybrid of fully deemed estimates (that are calculated with all population-based estimates) and custom measures (that are calculated based entirely on site-specific calculations and inputs) where the calculation methodology is agreed to in advance, some inputs are based on population estimates, but the key drivers of savings are based on site-specific inputs. Hybrid measures leverage the benefits of both deemed and custom approaches in that they are simple to use and the methodology is known and agreed to in advance, but the estimates are more accurate because they are based on the site's actual characteristics.

The hybrid approach may be a good option for some of the measures in the ESA program. Because the ESA program is a direct installation program, the program implementers can verify and gather site specific information that can be used in the hybrid calculations. This overcomes one of the biggest draw backs of using completely deemed measures for ESA – there is acknowledgement that the low-income population differs from the mainstream EE programs but there is not recent or definitive studies or documentation to quantify these differences.

Hybrid measures may require changes to the current ESA implementation, depending on data and information the ESA implementers currently gather, and the number and types of information selected as inputs to the hybrid measures.

The hybrid approach is not recommended for all ESA measures. Hybrid measures are only recommended for measures where it is reasonable to gather site-specific data/information for the key drivers of energy savings and for measures with a large enough contribution to the program portfolio to merit the additional effort. For the ESA program, these would likely be equipment replacement measures (like central and room AC, heat pumps, and water heaters replacements). The range of variation in the input values for other measures, such as lighting or insulation measures, is unlikely to be great enough to merit the collection of site-specific data.

Summary and Next Steps

To summarize, it is reasonable to develop deemed savings using similar methods as the mainstream EE program given that the ESA program measures are similar technologies to those offered in the mainstream program. However, a number of modifications would need to be made to make the estimates applicable to the low-income population. These include scaling the base and/or measure case efficiency levels for the DEER (and workpaper) values to match the efficiency values of the ESA measures and adjusting the input values for operating hours/usage (and possibly other parameters) to be

applicable to the low-income population. To understand which method is likely to produce more reliable measure ex ante savings estimates or estimates that result in a higher or more consistent realization rates, additional analysis should be conducted.

Cal TF makes the following recommendations related to developing reliable ex ante savings estimates for the ESA program:

- Mine the ESA program data to use to develop measure level savings estimates that are applicable to the low-income population;
- Conduct further investigation into the negative savings for some measures to understand the contributing factors;
- Standardize the ESA measure definitions so they are consistent across the state;
- Conduct a pilot to assess the benefits and drawbacks of different approaches to estimating deemed savings to determine the most appropriate or reliable method for estimating deemed savings for ESA; and
- Consider a hybrid approach to developing deemed estimates that uses an engineering calculation or workpaper with a variable or variables that use site-specific data to calculate the savings.

It should be noted that there were a number of suggested modifications to the final TPP by subcommittee members that we were not able to incorporate, including a request to add a recommendation for the CPUC to order the IOUs to conduct the recommended pilot and another to revise the TPP to focus more on the objective around evaluation methods.

In closing, Cal TF staff appreciated the opportunity to work with the LI Subcommittee participants to prepare this document in response to the direction in CPUC Decision 17-12-009 related to the ESA program. Cal TF would welcome the opportunity to work with the utilities if they move forward on any of the recommendations in this paper.

Appendix 1: LI Subcommittee Members

The following individuals were identified to participate on the Low Income Subcommittee, however, not all of the individuals were active participants.

Table 2. LI Subcommittee Members

Subcommittee:	Low Income Subcommittee
Champion:	Jennifer Barnes, Cal TF Staff
Subcommittee Members: Cal TF Members	Pierre Landry, Retired Southern California Edison Tom Eckhart, UCONs Larry Kotewa, Elevate Energy Sepi Shahinfard, Cadmus Group Armen Saiyan, Los Angeles Department of Water and Power
Subcommittee Members: Non-TF Members	Brenda Gettig, San Diego Gas & Electric Loan Nguyen, Southern California Gas Company Alok Singh, Southern California Edison Greg Buchler, Southern California Edison Carol Edwards, Southern California Edison Shahana Samiullah, Southern California Edison Sunil Maheshwari, Southern California Edison Randy Kwok, Pacific Gas and Electric Company Brian Smith, Pacific Gas and Electric Company Iris Cheung, Pacific Gas and Electric Company Tim Melloch, Cal TF Staff Alison LaBonte, California Public Utilities Commission Sarah Lerhaupt, California Public Utilities Commission Jeremiah Valera, Los Angeles Department of Water and Power Luke Sun, Los Angeles Department of Water and Power Mohit Chhabra, National Resources Defense Council

Appendix 2: Measure Mapping

To understand the availability of mainstream measures for use by the ESA program, Cal TF Staff mapped the ESA measures to the following sources:

- Statewide consolidated measure
- IOU workpaper
- POU Technical Reference Manual
- DEER

Table 3 provides a list of historical ESA Program measures, some of which are no longer offered. Not all of the measures listed are or have been offered by all utilities. The highlighted measures were listed in the 2018 Eligible Measure List in the ESA Policy & Procedures Manual but do not have an associated statewide or IOU workpaper.

Table 3. ESA to Mainstream Portfolio Measure Mapping

Eligible Measures (2018 Policy & Procedures Manual)	Source for Deemed Value/Calculated Savings Estimate			
	SW Consolidated Measure?	IOU Workpaper(s)?	POU TRM?	Measure in DEER?
HVAC				
Gas Furnace Repair/Replace	SWHC031-01		Y 15.1	Res-GasFurnace-AFUE95 Res-GasFurnace-AFUE97
High Efficiency Furnace Repair/Replace	SWHC031-01		Y, 15.1	Res-GasFurnace-AFUE95 Res-GasFurnace-AFUE97
FAU Standing Pilot Light Conversion	SWHC002-01		N	No
Room A/C Replacement	SWAP007-01		Y, 9.2	

Eligible Measures (2018 Policy & Procedures Manual)	Source for Deemed Value/Calculated Savings Estimate			
	SW Consolidated Measure?	IOU Workpaper(s)?	POU TRM?	Measure in DEER?
Central A/C Replacement	N	PGECOHVC166R3 (11/23/16) SCE13HC062R1 (1/22/15)	Y, 9.1	RE-HV-ResAC-lt45kBtuh-15S RE-HV-ResAC-lt45kBtuh-16S RE-HV-ResAC-lt45kBtuh-17S RE-HV-ResAC-lt45kBtuh-18S RE-HV-ResEvapAC-lt45kBtuh-17p4S RE-HV-ResAC-45to65kBtuh-15S RE-HV-ResAC-45to65kBtuh-16S RE-HV-ResAC-45to65kBtuh-17S RE-HV-ResAC-45to65kBtuh-18S RE-HV-ResEvapAC-45to65kBtuh-17p4S RE-HV-ResHP-15p0S-8p7H RE-HV-ResHP-16p0S-9p0H RE-HV-ResHP-17p0S-9p4H RE-HV-ResHP-18p0S-9p7H
Central Heat Pump Replacement	N	PGECOHVC166R3 (11/23/16) SCE13HC062R1 (1/22/15)	N	
A/C Time Delay	N	WPSDGEEREHC0024R3(12/20/18) SCE17HC052R0	N	
Energy Efficient Fan Control	SWHC029-01		N	
Duct Sealing	SWSV001-01		Y, 9.4	Res-DuctSeal-MedToLow-wtd Res-DuctSeal-HighToLow-wtd
Prescriptive Duct Sealing	SWSV001-01?		N	
Evaporative Coolers		SCE17HC017 SCE17HC013 SCE17HC026.1	N	D03-405
Evaporative Coolers (Installation) *	~~SWHC033,34,35~~		~~N~~	D03-405
Maintenance				
Furnace Clean and Tune	N	N	N	
Central A/C Tune-up/Services	SWSV006,07,08,09		Y, 9.5	
Evaporative Cooler Maintenance*	N		N	
Enclosure				
Air Sealing / Envelope	N	SCE17MI005 (10/19/17)	Y, 12.6	
Attic Insulation	N	WPSDGEREHC1066R0 (12/22/17)	Y, 12.1	
Minor Home Repairs	N	N		
Domestic Hot Water				

Eligible Measures (2018 Policy & Procedures Manual)	Source for Deemed Value/Calculated Savings Estimate			
	SW Consolidated Measure?	IOU Workpaper(s)?	POU TRM?	Measure in DEER?
Faucet Aerator	SWWH001-01		Y, 15.5	No
Low Flow Shower Head	SWWH002-01		Y, 15.4	No
Water Heater Repair/Replacement	SWWH012-01		Y, 15.3	
Heat Pump Water Heater	SWWH014-01		Y, 11.3	RE-WtrHt-SmlStrg-HP-lte12kW-rep30G-3p24EF RE-WtrHt-SmlStrg-HP-lte12kW-rep30G-3p50EF RE-WtrHt-SmlStrg-HP-lte12kW-rep40G-3p24EF RE-WtrHt-SmlStrg-HP-lte12kW-rep40G-3p50EF RE-WtrHt-SmlStrg-HP-lte12kW-rep50G-3p24EF RE-WtrHt-SmlStrg-HP-lte12kW-rep50G-3p50EF RE-WtrHt-SmlStrg-HP-lte12kW-rep60G-3p50EF RE-WtrHt-SmlStrg-HP-lte12kW-rep75G-3p50EF
Water Heater Blanket	N	N	N	
Water Heater Pipe Insulation	N	SCE17MI005R0 (10/19/17)	Y, 15.2	
Thermostatic Shower Valve*	SWWH003-01		N	No
Combined Showerhead/TSV	SWWH003-01		N	No
Tub Diverter/ Tub Spout*	SWWH023-01		N	No
Thermostatic Tub Spout*	N		~~N~~	-
Thermostat-controlled Shower Valve*	SWWH003-01		~~N~~	No
Lighting				
Compact Fluorescent Lights (CFL)*	N		N	-
Interior Hard wired CFL fixtures*	N		N	-
Exterior Hard wired CFL fixtures*	N		N	-
Torchiere (CFL)*	N		N	-
Vacancy Sensor	N	SCE17LG020R2 (12/2/16)	N	
LED A-Lamps	N	PGECOLTG165R6 (4/30/18) SCE17LG133R2 (7/1/18)	Y, 10.1	

Eligible Measures (2018 Policy & Procedures Manual)	Source for Deemed Value/Calculated Savings Estimate			
	SW Consolidated Measure?	IOU Workpaper(s)?	POU TRM?	Measure in DEER?
LED Reflector Bulb	N	PGECOLTF141R9 (4/25/18) SCE17LG127R2 (5/1/18)	Y, 10.1	
LED Reflector Downlight Retrofit Kits	N	PGECOLTG175R4 (8/10/17) WPSDGENRLG0107 (7/1/18)	Y, 10.1	
Interior Hard wired LED fixtures	N	SCE17LG103R2 (10/22/18) PGECOLTG139R10 (8/10/17)	N	
Exterior Hard wired LED fixtures	N	SCE13LG108R3 (9/22/15) SCE17LG119R1 (10/17/18)	N	
Torchiere (LED)	N	N	N	
LED Night Lights	N	N	N	
LED Diffuse Bulb (60W Replacement)*	?		~~?~~	-
Appliances				
Refrigerators	SWAP001-01		Y, 11.1	Yes (SW WP scaled the DEER savings)
Second Refrigerators	N	N	N	
High Efficiency Clothes Washer	SWAP004-01		Y, 11.5	RB-Appl-EffCW-med-Tier1-Top RB-Appl-EffCW-med-Tier2-Top RB-Appl-EffCW-med-Tier1-Front RB-Appl-EffCW-med-Tier2-Front RB-Appl-EffCW-med-Tier3-Front
Microwaves	N	N	N	
Miscellaneous				
Pool Pumps	SWRE002-01		Y, 13.2	
Tier 1 Smart Power Strips	N	SCE13CS002R3 (1/25/16) PGECOALL101R5 (2/11/16)	Y, 13.1	
Tier 2 Advanced Power Strips	SWAP010-01		N	

* Measure had been previously offered in the ESA Program but were not in the 2018 Eligible Measure List in the Policy & Procedure Manual