

California Air Resources Board

Quantification Methodology

Department of Community Services and Development

Low-Income Weatherization Program:
Single-Family Energy Efficiency and Solar Photovoltaics
Multi-Family Energy Efficiency and Renewables

California Climate Investments



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Section A. Introduction

California Climate Investments is a statewide initiative that puts billions of Cap-and-Trade dollars to work facilitating greenhouse gas (GHG) emission reductions; strengthening the economy; improving public health and the environment; and providing benefits to residents of disadvantaged communities, low-income communities, and low-income households, collectively referred to as “priority populations.” Where applicable and to the extent feasible, California Climate Investments must maximize economic, environmental, and public health co-benefits to the State.

The California Air Resources Board (CARB) is responsible for providing guidance on estimating the GHG emission reductions and co-benefits from projects receiving monies from the Greenhouse Gas Reduction Fund (GGRF). This guidance includes quantification methodologies, co-benefit assessment methodologies, and benefits calculator tools. CARB develops these methodologies and tools based on the project activities eligible for funding by each administering agency, as reflected in the program expenditure records available at: www.arb.ca.gov/cci-expenditurerecords.

For the Department of Community Services and Development’s (CSD) Low-Income Weatherization Program (LIWP), CARB staff developed this LIWP Quantification Methodology to provide guidance for estimating the GHG emission reductions and selected co-benefits of each proposed project activity. This methodology uses calculations to estimate GHG emission reductions from displacing fossil fuel-generated electricity with rooftop solar electricity, and reducing energy use due to energy efficiency measures installed by LIWP projects.

The LIWP Benefits Calculator Tool automates methods described in this document, provides a link to a step-by-step user guide, and outlines documentation requirements. CSD and service providers will use the LIWP Benefits Calculator Tool to estimate the total project GHG emission reductions and co-benefits as well as the total project GHG emission reductions per dollar of GGRF requested and implemented for reporting purposes. The LIWP Benefits Calculator Tool is available for download at: <http://www.arb.ca.gov/cci-resources>.

Using many of the same inputs required to estimate GHG emission reductions, the LIWP Benefits Calculator Tool estimates the following co-benefits and key variables from LIWP projects:

- Select criteria and toxic air pollutant reductions over the quantification period (in pounds (lbs)), including nitrogen oxide (NO_x), reactive organic gases (ROG), and fine particulate matter less than 2.5 micrometers (PM_{2.5});
- Total energy savings over the quantification period (in kWh and therms);
- Total energy cost savings over the quantification period (in \$);
- Total renewable electricity generation over the quantification period (in kWh); and

- Total water savings over the quantification period (in gallons).

Key variables are project characteristics that contribute to a project's GHG emission reductions and signal an additional benefit (e.g., renewable energy generated). CSD and service providers will also use the Climate Adaptation Co-benefit Assessment Methodology, which was not incorporated into the LIWP Benefits Calculator Tool. All CARB co-benefit assessment methodologies are available at: www.arb.ca.gov/cci-cobenefits.

Methodology Development

CARB and CSD developed this Quantification Methodology consistent with the guiding principles of California Climate Investments, including ensuring transparency and accountability.¹ CARB and CSD developed this LIWP Quantification Methodology to be used to estimate the outcomes of proposed projects, inform project selection, and track results of funded projects. The implementing principles ensure that the methodology would:

- Apply at the project-level;
- Provide uniform methods to be applied statewide, and be accessible by CSD and all service providers;
- Use existing and proven tools and methods;
- Use project-level data, where available and appropriate; and
- Result in GHG emission reduction estimates that are conservative and supported by empirical literature.

CARB assessed peer-reviewed literature and tools and consulted with experts, as needed, to determine methods appropriate for the LIWP project activities. CARB also consulted with CSD to determine project-level inputs available. The methods were developed to provide estimates that are as accurate as possible with data readily available at the project level.

CARB released the Draft LIWP Quantification Methodology and Benefits Calculator Tool for public comment in December of 2018. This Final LIWP Quantification Methodology and accompanying LIWP Benefits Calculator Tool have been updated to address public comments, where appropriate, and for consistency with updates to the LIWP Guidelines.

In addition, the University of California, Berkeley, in collaboration with CARB, developed assessment methodologies for a variety of co-benefits such as providing cost savings, lessening the impacts and effects of climate change, and strengthening community engagement. As they become available, co-benefit assessment methodologies are posted at: www.arb.ca.gov/cci-cobenefits.

¹ California Air Resources Board. www.arb.ca.gov/cci-fundingguidelines

² Greenhouse Gas Quantification Methodology for the Department of Community Services and Development Low-

Tools

The LIWP Benefits Calculator Tool relies on energy savings estimates from energy saving measures, appliance upgrades, and solar photovoltaic (PV) installations. CSD estimates project-specific energy savings based on the individual measures installed in a home using a number of publicly available data sources. The tables in Section C list the data sources used for individual measures that are not calculated using the home audit software below (see Section B for more information). CSD's service providers use the following tools for conducting home energy audits and solar PV estimates:

Home energy audit software approved by the California Energy Commission, or approved by Energy Upgrade California, is used by CSD's service providers to estimate energy savings for various energy efficiency measures available under LIWP. Service providers currently use Snugg Pro and EnergyPro to create a "whole building" analysis of the energy performance of dwellings and identify opportunities for energy efficiency improvements. These software packages determine the dwelling energy load and estimate energy consumption from existing dwelling characteristics such as the dwellings size, thermal boundary, location, number of occupants, and equipment. They generate a whole-building estimate of energy savings from all selected efficiency measures. These tools are used statewide, subject to regular updates to incorporate new information, and based on publicly available information. They can be accessed at: <https://snuggpro.com/> and <http://www.energysoft.com/>.

The National Renewable Energy Laboratory (NREL) PVWatts® Calculator is a web-based tool that estimates the electricity production of a grid-connected roof- or ground-mounted solar PV system based on simple inputs. PVWatts calculates estimated values for the proposed system's monthly and annual electricity production. The tool is used statewide, publicly available, subject to regular updates to incorporate new information, free of charge, and available to anyone with internet access. The tool can be accessed at: <http://pvwatts.nrel.gov/>.

In addition to the tools above and data sources listed in Section C, the LIWP Benefits Calculator Tool relies on CARB-developed emission factors. CARB has established a single repository for emission factors used in CARB benefits calculator tools, referred to as the California Climate Investments Quantification Methodology Emission Factor Database, available at: <http://www.arb.ca.gov/cc-resources>. The Database Documentation explains how emission factors used in CARB benefits calculator tools are developed and updated.

CSD and their service providers will use the LIWP Benefits Calculator Tool to estimate the GHG emission reductions and co-benefits of proposed and implemented projects. The LIWP Benefits Calculator Tool can be downloaded from: <http://www.arb.ca.gov/cc-resources>.

Updates

CARB staff periodically review each quantification methodology and benefits calculator tool to evaluate their effectiveness and update methodologies to make them more robust, user-friendly, and appropriate to the projects being quantified. CARB updated the LIWP Quantification Methodology from the previous versions² to enhance the analysis and provide additional clarity. The changes include:

- Specification of Snugg Pro and EnergyPro software as the tools CSD service providers use to estimate energy savings for measures that vary based on dwelling-specific characteristics;
- Creation of a new LIWP Benefits Calculator Tool for CSD to use in reporting energy savings, energy generation, GHG reductions and co-benefits for LIWP projects; and
- Addition of a link to a step-by-step User Guide.

² Greenhouse Gas Quantification Methodology for the Department of Community Services and Development Low-Income Weatherization Program Single-Family Energy Efficiency & Solar Photovoltaics, November 14, 2016.

https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/csd_liwp_finalqm_15-16.pdf

Greenhouse Gas Quantification Methodology for the Department of Community Services and Development Low-Income Weatherization Program Large Multi-Family, January 7, 2016.

<https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/liwp-lmfqm-final.pdf>

Section B. Methods

The following section provides details on the methods supporting emission reductions in the LIWP Benefits Calculator Tool.

Project Activities

CSD developed two project activities that meet the objectives of LIWP and for which there are methods to quantify GHG emission reductions.³ Other project features may be eligible for funding under LIWP; however, each project requesting GGRF funding must include at least one of the following:

- Energy Efficiency Measures
- Solar PV Installation

General Approach

Methods used in the LIWP Benefits Calculator Tool for estimating the GHG emission reductions and air pollutant emission co-benefits by activity type are provided in this section. The Database Documentation explains how emission factors used in CARB benefits calculator tools are developed and updated.

These methods account for fossil fuel energy that is displaced or reduced by energy efficiency measures and solar PV energy generation. In general, the GHG emission reductions are estimated in the LIWP Benefits Calculator Tool using the approaches in Table 1. The LIWP Benefits Calculator Tool also estimates air pollutant emission co-benefits and key variables using many of the same inputs used to estimate GHG emission reductions.

Table 1. General Approach to Quantification by Project Activity

Energy Efficiency
<i>Emission reductions = Estimated energy savings from measures installed * emission factor</i>
Solar PV
<i>Emission reductions = Estimated solar energy generation * emission factor</i>

³ CSD program guidelines are found at: <http://www.csd.ca.gov/Resources/ProgramGuidelines>

A. Emission Reductions from Energy Efficiency

Both the GHG emission reductions and air pollutant emission reductions from Energy Efficiency are estimated as the difference between the baseline and project scenarios using Equation 1.

Equation 1: Emission Reductions from Energy Efficiency

$$Emission\ Reductions = \left(\sum S_{electricity} \times EUL \right) \times EF_{electricity} + \left(\sum S_{NG} \times EUL \right) \times EF_{NG}$$

Where,		Units
$S_{electricity}$	= Estimated annual energy savings for each measure	kWh per year
EUL	= Effective useful life for each energy efficiency measure installed, or their weighted average	years
$EF_{electricity}$	= Emission factor for electricity	MTCO ₂ e per kWh; lbs per kWh
S_{NG}	= Estimated annual fuel savings for each measure	therms per year
EF_{NG}	= Emission factor for fuel	MTCO ₂ e per therm; lbs per therm

B. Solar Water Heaters

GHG emission reductions from Solar Water Heaters are estimated as the difference between the baseline and project scenarios using Equation 2.

Equation 2: Emission Reductions from Solar Water Heaters

$$Emission\ Reductions = \left[\sum_{n=1}^{25} [1 - (n)(R_{degradation})] \right] (GHG_{per\ system}) \times SWH_{total}$$

Where,		Units
n	= Any given year	
25	= Estimated useful life of solar PV systems ⁴	years
$R_{degradation}$	= Rate of system degradation (0.5)	% per year
$GHG_{per\ system}$	= GHG emission reduction per system derived from CSI Thermal Calculator	MTCO ₂ e
SWH_{total}	= Number of SWH systems to be installed	

C. Emission Reductions from Solar PV Generation

Both the GHG emission reductions and air pollutant emission reductions from Solar PV Generation are estimated as the difference between the baseline and project scenarios using Equation 3.

Equation 3: Emission Reductions from Solar PV Generation

$$Emission\ Reductions = \sum_{n=1}^{30} (1 - R_{degradation})^{n-1} (PV_{production}) (EF_{electricity})$$

Where,		Units
<i>n</i>	= Any given year	
30	= Estimated useful life of solar PV systems ⁴	years
<i>R</i> _{degradation}	= Rate of system degradation (0.5)	% per year
<i>PV</i> _{production}	= Annual electricity generated based on PVWatts Calculator	kWh per year
<i>EF</i> _{electricity}	= Emission factor for electricity	MTCO _{2e} per kWh; lbs per kWh

Estimates for Proposed Projects

Energy efficiency project GHG emission reduction estimates are used for comparing proposals from potential LIWP service providers and are based on the projected number of dwellings served and the average annual energy savings achieved per dwelling. The average per dwelling energy savings value is an estimate developed by CSD based on historical average energy savings of over 3,000 projects implemented during 2017 and 2018. It includes average savings for a variety of measures installed in a sample dwelling across varying climate zones and heating fuels used in a dwelling. CSD will use the LIWP Benefits Calculator Tool with the statewide historical averages in Table 2 to evaluate proposed projects.

Table 2. Average Annual Reductions from Energy Efficiency Measures

Dwelling Type	Annual Reduction in kWh	Annual Reduction in therms
Single-Family	1,104 per dwelling	68.0 per dwelling
Multi-Family	1,300 per dwelling	66.5 per dwelling
Single-Family within the 12 county area for Farmworker Housing projects	1,170 per dwelling	73.0 per dwelling

Estimates for Implemented Projects

LIWP service providers conduct a home energy assessment to generate a list of recommended measures that can improve the energy efficiency of the dwelling. LIWP service providers use audit software like Snugg Pro or EnergyPro to determine the estimated savings from measures whose performance is dependent on the conditions of the individual home. For measures with well-known and consistent performance not dependent on individual dwelling characteristics, deemed energy savings are calculated by multiplying the number of installed measures by a deemed savings value per measure, using the data sources listed in Section C.

CSD will compile information from LIWP service providers on implemented projects, and use the LIWP Benefits Calculator Tool to estimate GHG reductions for reporting. Project energy savings will vary by dwelling due to variations in dwelling type, location, and the number and types of measures installed. LIWP service providers will estimate energy savings and energy generation based on the individual characteristics of a dwelling using audit software like Snugg Pro or EnergyPro, deemed savings estimates, and PVWatts. For all installed measures funded by GGRF, LIWP service providers submit periodic reports that document dwelling specific characteristics such as location data, heating fuel type, and details on each installed measure. CSD uses this data to identify climate-zone-specific energy savings for each dwelling.

Section C. References – Measure Energy Savings

CSD uses a variety of sources to estimate the energy savings of all available measures. The databases and sources listed below contain deemed savings and effective useful life values for a variety of measures. Deemed savings values are evaluations of the historical energy savings achieved by simpler efficiency measures with well-known and consistent performance not dependent on individual dwelling characteristics.

Table 3. Reference Sources for Energy Savings

Reference Source	Website
Database for Energy Efficient Resources (DEER)	http://www.deeresources.com/
Non-DEER measure work papers and CPUC dispositions	http://www.deeresources.com/index.php/non-deer-workpapers
CMUA Energy Efficiency Technical Reference Manual and associated spreadsheets	http://cmua.org/energy-efficiency-technical-resource-manual-2016/
Energy Savings Assistance Program	http://www.calmac.org/ http://eestats.cpuc.ca.gov/
CalTF approved work papers	http://www.caltf.org/approved-measures/

Table 4. Measures Estimated Using Audit Software

Ceiling Insulation	Clothes Dryer Replacement
Cool Roof	Duct Insulation
Duct Replacement or Sealing	Electric Oven/Range
Floor Insulation	Heat Pump Water Heater
Heating and Cooling Source Replacements	Pipe Insulation*
Pool Pump*	Radiant Barrier
Wall Insulation	Water Heater Replacement (or Boiler Replacement*)
Window Replacement	

* Measures Restricted to Multi-family Properties

Table 5. Data Sources for Individual Deemed Measures

Note that the applicability of the sources below are based on dwelling type.

LIWP Measure	Energy Savings Reference
Hot Water Flow Faucet Restrictor, Low Flow Showerhead / Hand-Held Low Flow Showerhead	Water-Energy Grant Program GHG Calculator (latest version for FY 2015-16). Found at: https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/quantification.htm OR Workpaper Disposition for Water Fixtures California Public Utilities Commission, Energy Division (March 2013) / No workpaper ID. Found at: http://www.deeresources.net/workpapers
LED Light Bulbs and Fixtures	CMUA Technical Reference Manual (TRM), June 9, 2016 and associated TRM spreadsheet – TRM204_residential-LED_v3-15-2016.xlsx. Found at: http://cmua.org/energy-efficiency-technical-resource-manual-2016/ OR Energy savings quantified using energy audit tool.
LED Night Lights	SCE work paper, SCE13LG029 LED, Electroluminescent plug-in night lights, August 25, 2012. Measure Name: 0.3 Watt Night Light LED replacing Incandescent Night Light. Found at: http://www.deeresources.com/index.php/non-deer-workpapers
Vacancy Sensor	PG&E Energy Savings Assistance (ESA) Program Annual Report for Program Year 2015, May 1, 2014. ESAP Table 9. Found at: http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M164/K883/164883950.PDF
Tier 2 Advanced Power Strips	Savings Estimation Technical Reference Manual for the California Utilities Association, June 09, 2016; TRM503_Tier-2-APS_v3-15-2016. Found at: http://cmua.org/energy-efficiency-technical-resource-manual-2016/
Thermostatic Shower Valve and Showerhead	Disposition for Water Fixtures, California Public Utilities Commission, Energy Division, February 22, 2013. Found at: http://www.deeresources.com/index.php/non-deer-workpapers Water-Energy Grant Program GHG Calculator (latest version for FY 2015-16). Found at: https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/quantification.htm
High Efficiency Clothes Washer	Water-Energy Grant Program GHG Calculator (latest version for FY 2015-16). Found at: https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/quantification.htm OR PGE: High Efficiency Clothes Washers Multifamily / Workpaper ID: PGECOAPP127R2. Found at: PGE: High Efficiency Clothes Washers Multifamily / Workpaper ID: PGECOAPP127R2
Ceiling Fan	Savings Estimation Technical Reference Manual for the California Utilities Association, June 09, 2016; TRM206_residential-ceiling-fans_v2-18-2014. Found at: http://cmua.org/energy-efficiency-technical-resource-manual-2016/
Ceiling Insulation	DEER Database READI v.2.5.1 (Current Ex Ante data) options:

	<p>include Non-DEER data; 1/1/2013 - 1/1/2021. Measure IDs RB-BS-Ceillns-R0-R30, RB-BS-Ceillns-R0-R38, RB-BS-Ceillns-VintR-AddR11, RB-BS-Ceillns-VintR-AddR19, RB-BS-Ceillns-VintR-AddR30. Found at: http://www.deeresources.com/index.php/deer-versions/readi</p> <p>OR Energy savings quantified using energy audit tool.</p>
Electronically Commutated Motor (ECM) Blower Motor	<p>Workpaper disposition for Residential HVAC Quality Maintenance CPUC May 2, 2013. Found at: http://www.deeresources.com/index.php/non-deer-workpapers</p> <p>OR Energy savings quantified using energy audit tool.</p>
Efficient Fan Controller	<p>Workpaper PGE3PHVC150 R0 Enhanced Time Delay. Found at: http://www.deeresources.com/index.php/non-deer-workpapers</p>
Exterior Security Light (w/ Photocell and Motion Sensor)	<p>DEER Database READI v.2.5.1 (Current Ex Ante data) options: include Non-DEER data; 1/1/2013 - 1/1/2021. Measure ID R-OutDD-CFLfixt-20w-ext(20w)-dWP50. Found at: http://www.deeresources.com/.</p>
Freezer Replacement	<p>DEER Database READI v.2.5.1 (Current Ex Ante data) options: include Non-DEER data; 1/1/2013 - 1/1/2021. Measure ID: RE-Frzz-Wtd-Tier1. Found at: http://www.deeresources.com/.</p>
Infiltration Reduction	<p>PY2011 Energy Savings Assistance Program Impact Evaluation Final Report, Study ID:SDG0273.01 August 30, 2013. Found at: http://www.energyefficiencycouncil.org/policy-activity/cpuc/studies</p> <p>OR Energy savings quantified using energy audit tool.³⁵</p>
Refrigerant Charge w/Coil Cleaning	<p>Savings Estimation Technical Reference Manual for the California Utilities Association, June 09, 2016; TRM224_residential_HVAC-tune-up_refrigeration-charge_V3-15-2016 and TRM226_residential_HVAC-tune-up_coil-cleaning_3-15-2016. Found at: http://cmua.org/energy-efficiency-technical-resource-manual-2016/</p> <p>OR Workpaper Disposition for Refrigerant Charge Verification California Public Utilities Commission, Energy Division (March 2013). Found at: www.deeresources.net/workpapers</p>
Refrigerator Replacement	<p>DEER Database READI v.2.5.1 (Current Ex Ante data) options: include Non-DEER data; 1/1/2013 - 1/1/2021. Measure ID: RE-Appl-ESRefg-TMLrg-697kWh-452kWh, RE-Appl-ESRefg-TMMed-652kWh-399kWh. Found at: http://www.deeresources.com/.</p>
Smart Thermostat	<p>PG&E Short Form Work Paper PGECOHC167 Revision 1. Residential Smart Communicating Thermostat. Oct 27, 2017. Found at: http://www.deeresources.com/index.php/non-deer-workpapers</p>
Wall Insulation	<p>"DEER for 2014 Code Update" database, released in November of 2013. RB-BS-BlowInIns-R0-R13. Found at: http://www.deeresources.com/</p>
Water Heater Blanket	<p>Evaluation, Measurement, and Verification Report for the Moderate Income Comprehensive Attic Insulation Program #1082-04, Study ID:BOE0001.01. June 12, 2008. Found at: http://www.calmac.org/publications/BO_MICAP_1082_04_EMV_FIN</p>

	AL Report BOE000101.pdf
Whole House Fans	CMUA Technical Reference Manual (TRM), June 9, 2016 and associated TRM spreadsheet – TRM202_whole-house-fan_v2-18-2014.xlsx. Found at: http://cmua.org/energy-efficiency-technical-resource-manual-2016/
Solar PV	National Renewable Energy Laboratory PVWatts Calculator. Found at: http://pvwatts.nrel.gov/
Solar Water Heating	CSI Thermal Program Incentive Calculator for Standard-300 Systems. Found at: https://www.csithermal.com/calculator/

Table 5 continued, Measures Restricted to Multi-family Properties

LIWP Measure	Energy Savings Reference
Domestic Hot Water Recirculation System Upgrades - Demand Control (from no control to demand control)	Workpaper Disposition for On-Demand Pump Control for Central Domestic Hot Water Systems California Public Utilities Commission, Energy Division (March 2013). Found at: http://www.deeresources.net/workpapers OR Energy savings quantified using energy audit tool.
Domestic Hot Water Recirculation System Upgrades - Temperature Control	SCG: Demand-Controlled Set-back DHW Thermostat Controller Replacement of an Existing DHW Constant-Temperature Controller (Multifamily Residential) / No workpaper ID. Found at: www.deeresources.net/workpapers OR Energy savings quantified using energy audit tool.
Pool Cover	Workpaper Disposition for Commercial Pool Covers. Found at: www.deeresources.net/workpapers OR Energy savings quantified using energy audit tool.
Pool Heater	PGE: Commercial Pool Heaters / Workpaper ID PGECOPRO105. Found at: www.deeresources.net/workpapers OR Energy savings quantified using energy audit tool.
Vending Machine Controller	SDGE: Vending Machine Controller / WorkPaper ID: WPSDGENRCS0001. Found at: www.deeresources.net/workpapers OR Energy savings quantified using energy audit tool.

Table 6. Data Sources for Snugg Pro

Reference Source	Website
Typical Meteorological Year (TMY) by the National Renewable Energy Laboratory	https://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/
30 Year Weather Normals by the National Climatic Data Center (NCDC)	https://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/climate-normals/1981-2010-normals-data
Current Weather data by NCDC Quality Controlled Data	https://www.ncdc.noaa.gov/crn/qcdatasets.html
Regional and age specific default housing characteristics (NREL and LBL)	http://www.homeenergysaver.lbl.gov/consumer/documentation
National emissions per kWh database by utility (eGrid, EIA, EPA, CARMA)	https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid https://www.eia.gov/electricity/data.php
National city/state/zip cross-referencing	https://catalog.data.gov/dataset/zip-codes-zipcodes
IECC 2006 standards based on climate zone (IECC)	https://www.iccsafe.org/errata-central/
Natural gas, fuel oil, and propane price by state (EIA)	https://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm https://www.eia.gov/petroleum/heatingoilpropane/#itn-tabs-1
Electricity prices by utility (EIA + geo-referencing)	https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a
National database of improvement costs and specifications (National Residential Efficiency Measures Database, NREL)	https://remdb.nrel.gov/
Regional comparable average home energy consumption (Residential Energy Consumption Survey, RECS)	https://www.eia.gov/consumption/residential/data/2015/index.php?view=consumption
EnergyStar certified appliance tables (EnergyStar)	https://www.energystar.gov/productfinder/

Table 7. Data Sources for EnergyPro

Reference Source	Website
2016 Building Energy Efficiency Standards (CEC-400-2015-037-CMF, June 2015)	https://www.energy.ca.gov/title24/2016standards/
Reference Appendices for the 2016 Building Energy Efficiency Standards (CEC-400-2015-038-CMF, June 2015)	https://www.energy.ca.gov/2015publications/CEC-400-2015-038/
Residential Compliance Manual (CEC-400-2015-032-CMF, November 2015)	https://www.energy.ca.gov/2015publications/CEC-400-2015-032/
Residential Alternative Calculation Methods (ACM) Reference Manual (CEC-400-2015-024-CMFREV, 2008 and Revised June 2016)	https://www.energy.ca.gov/2015publications/CEC-400-2015-024/ https://www.energy.ca.gov/title24/2008standards/
Department of Energy (DOE) EnergyPlus Program	https://energyplus.net/
ASHRAE Publications (ASHRAE Handbook of Fundamentals, ASHRAE 90.1 Performance Compliance, etc.)	https://www.ashrae.org/technical-resources/ashrae-handbook