CALIFORNIA DEPARTMENT OF COMMUNITY SERVICES & DEVELOPMENT (CSD) LOW INCOME WEATHERIZATION PROGRAM (LIWP) TECHNICAL REFERENCE MANUAL

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CSD LIWP Technical Reference Manual

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CSD LIWP Technical Reference Manual

1. OVERVIEW

The California Department of Community Services and Development (CSD) has developed this Technical Reference Manual to support energy savings and carbon reduction claims for measures installed in their Low-Income Weatherization Program (LIWP). With program oversight and direction provided by the California Air Resource Board (ARB), CSD and a network of LIWP Providers install energy efficient measures into the homes of income qualifying customers located in disadvantaged communities (DACs) with the goal of reducing energy use and greenhouse gas (GHG) emissions.

2. ENERGY SAVING METHODOLOGY

Energy savings for measures installed in CSD programs are included in this document and categorized by weather sensitive vs. non-weather sensitive measures. Applicable assumptions, units for energy savings, and the reference for energy savings are listed for each measure. A deemed savings approach is used to quantify most measure savings in this document. This is an approach which uses industry standards and data from relevant sources and/or studies to calculate average savings for commonly-installed measures. These references, and how they were applied to the measures, are described further in the following sections. A select set of measures are justified by energy audits. When an energy audit is used, estimated energy savings are taken from the audit results.

2.1 REFERENCES FOR ENERGY SAVINGS

Several references were used when compiling deemed savings for measures. These are described below.

Database for Energy Efficient Resources (DEER)

The Database for Energy Efficient Resources (DEER) contains information on selected energy-efficient technologies and measures. The database provides estimates of the energy-savings potential for these technologies in residential and nonresidential applications. DEER is developed by the California Public Utilities Commission (CPUC) with funding provided by California ratepayers. Versions of the DEER used in this manual include DEER 2005, DEER 2011, and DEER 2014.

http://www.deeresources.com/

Investor-Owned Utility (IOU) Workpapers

Following decision D.12-05-015, OP 143 states that the IOUs "shall utilize Database for Energy Efficient Resources (DEER) assumptions, methods, and data in the development of non-DEER values whenever appropriate, and shall follow Commission Staff direction relating to the determination of appropriate application of DEER to non-DEER values". However, there are measures that are not included in the DEER or outside of the measure parameters. In these cases, IOUs have created workpapers which document methodology and measure savings.

California Public Utilities Commission (CPUC) Workpaper Dispositions

Pursuant to Decision (D.) 12-11-015 OP 44, Commission staff selected a subset of the IOU workpapers to review for appropriate application of DEER or non-DEER values. Dispositions from these reviews are available which list the updates required for the current IOU workpaper and/or DEER. Commission dispositions are understood to have information on current acceptable measure information including energy savings. Energy savings from dispositions supersede any savings values located in DEER or in IOU workpapers.

http://www.deeresources.com/index.php/non-deer-workpapers/non-deer-work-paper-values-13-14

Energy Savings Assistance (ESA) Program

The IOUs operate the ESA Program. This is a ratepayer-funded program with the objective of helping income-qualified utility customers reduce their energy costs and energy consumption, while recognizing customer health, safety, and comfort benefits. The ESA Program is monitored and evaluated by the CPUC. LIWP and ESA have many similar measures; therefore, past Program Annual reports and Impact Evaluations were reviewed for energy savings.

California Municipal Utilities Association Technical Reference Manual

The California Municipal Utilities Association Technical Reference Manual provides the methods, formulas, and default assumption used for estimating energy savings and peak demand impacts from energy efficiency measures and projects installed by California's publicly owned utilities.

http://cmua.org/energy-efficiency-technical-reference-manual

2.2 QUANTIFICATION OF CARBON REDUCTION

While it is well known that combustion of fossil fuels releases carbon dioxide, methane and nitrous oxide into the atmosphere, the extent to which this occurs varies geographically depending on many factors, such as electric power plant fuel and power plant efficiency, among others. This section summarizes the GHG emission factors and calculations used to convert electric and gas energy savings into GHG emission reduction as applicable to LIWP.

2.2.1 GHG Emission Factors

Intending to utilize emission factors representative of California's energy use, ARB developed emission factors, which includes both total in-state generation and imported electricity emissions (Metric Tons of Carbon Dioxide equivalent [$MTCO_2e$]). Currently, this is the most up-to-date estimate and will be used in calculations. These emission factors are shown in Table 1. For additional information on how these rates were calculated, refer to the Greenhouse Gas Quantification Methodology for the Department of Community Services and Development Low-Income Weatherization Program Single-Family Energy Efficiency and Solar Photovoltaics FY 2015-2016 document that can be found on the following

webpage:
https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/quantification.htm

Table 1: Emission Factors

Fuel Type	Emission Rate	Units
Electricity	0.000303	MTCO2e per kWh
Natural Gas	0.00531	MTCO2e per therm
	0.0531	MTCO2e per mmBtu
Kerosene	0.0755	MTCO2e per mmBtu
Propane	0.0615	MTCO2e per mmBtu
Fuel Oil	0.0742	MTCO2e per mmBtu

2.2.2 Other Fuel Types

Although natural gas is the primary heating fuel used in California, CSD expects to encounter various heating fuel types during delivery of LIWP. These fuels may include propane, fuel oil and kerosene.

Since the predominant heating fuel in California is natural gas, DEER and utility workpapers only focus on natural gas savings. However, combustion fuel energy savings can be determined for every heating fuel based on the assumption that combustion appliance efficiency is equal for each of the heating fuels considered. Using this assumption, CSD will assume that for every 100 kBtu of natural gas savings documented in a workpaper or DEER, this equates to 100 kBtu of propane, fuel oil or kerosene savings.

2.2.3 Carbon Reduction Conversion

Each measure resulting in energy or gas savings will have a calculated carbon reduction counterpart. This carbon reduction value will be calculated using the following equation and be tracked by $MTCO_2e$ offset.

$$\left(Savings_E \times Emission_E\right) + \left(Savings_G \times Emission_G\right) = MTCO_2e$$

Where:

Savings $_E$ = Estimated annual electricity savings
Emission $_E$ = Emission factor for electricity ($MTCO_2e$ per kWh)
Savings $_G$ = Estimated annual gas savings
Emission $_G$ = Emission factor for gas ($MTCO_2e$ per therm)

Each installed measure will be assigned a $MTCO_2e$ reduction value. CSD will track all installed measures and corresponding $MTCO_2e$ reduction values for reporting purposes. Examples demonstrating the conversion process are included below:

Example #1: An interior LED bulb, replacing a 75W incandescent, is installed in a single family home.

Electric savings can be found in the body of this Technical Reference Manual. Savings are as follows:

	kWh	therms
LED Bulb- 75W equivalent	19.9	0

The total MTCO is calculated using the following equation:

$$(19.9\ kWh \times 0.000303\ MTCO_2e/kWh) + (0\ therms \times 0.00531\ MTCO_2e/therm)$$
$$= 0.00603\ MTCO_2e$$

Example #2: Wall insulation in a single family dwelling located in climate zone 11. 1,200 square feet of insulation is installed and the home has natural gas heat.

Electric and gas savings can be found in the attached Savings Reference Workbook. Savings are as follows:

	kWh	therms
Wall Insulation- CZ 11 (per sqft)	0.419	0.131
Wall Insulation- CZ 11 (1,200 sqft)*	502.8	3.72

*To obtain total savings, multiply the total square feet of installed insulation by the per square foot savings.

The total MTCO is calculated using the following equation:

$$(502.8\ kWh \times 0.000303\ MTCO_2e/kWh) + (3.72\ therms \times 0.00531\ MTCO_2e/therm)$$
$$= 0.1746\ MTCO_2e$$

3. NON-WEATHER SENSITIVE RESIDENTIAL MEASURES

Non-weather sensitive measures are measures which are location independent and do not rely on the location specific climate (average heating degree days (HDD) or cooling degree days (CDD)) for measure savings. These measures will have equal savings in all homes with equivalent dwelling types in which they are installed.

The following measures are considered non-weather sensitive:

- Advanced power strips
- Ceiling fans
- Hot water flow restrictors
- LED bulbs
- LED night light
- Vacancy sensor
- Refrigerator replacement
- Water heater blanket

3.1 ADVANCED POWER STRIPS (TIER 2)

Measure Name	Tier 2 Audio-Visual Advanced Power Strips (T-2 AV APS)
Assumptions	**BASELINE DESCRIPTION** Preexisting standard power strip without a control mechanism, which is controlled with a single manual switch, or no power strip. **EFFICIENT CASE DESCRIPTION** Tier 2 Audio-Visual Advanced Power Strip with usage sensing, advanced power analysis and algorithm control capabilities. **ESTIMATED USEFUL LIFE** Useful life is assumed to be identical to plug control occupancy sensor measure. **UNIT ENERGY SAVINGS** Applicable to single family, mobile home and multi-family residential dwellings.
Unit Energy Savings	212 kWh per power strip[1]
Estimated Useful Life (EUL)	5 years[1]
References	[1]Savings Estimation Technical Reference Manual for the California Utilities Association, June 09, 2016; TRM503_Tier-2-APS_v3-15-2016.xlsx. Found at:http://cmua.org/energy-efficiency-technical-resource-manual-2016/

3.2 CEILING FANS

Measure Name	Ceiling Fans
Assumptions	**BASELINE DESCRIPTION** Standard efficiency ceiling fan with incandescent lamps. **EFFICIENT CASE DESCRIPTION** Replacement with ENERGY STAR® qualified ceiling fan and high-efficacy lighting. **UNIT ENERGY SAVINGS** Applicable to single family, mobile home and multi-family residential dwellings.
Unit Energy Savings	151 kWh per ceiling fan[1]
Estimated Useful Life (EUL)	10 years[1]
References	[1]Savings Estimation Technical Reference Manual for the California Utilities Association, June 09, 2016; TRM206_residential-ceiling-fans_v2-18-2014.xlsx. Found at: http://cmua.org/energy-efficiency-technical-resource-manual-2016/

3.3 HOT WATER FLOW RESTRICTORS

Installation or retrofit of a hot water flow restrictor reduces total water flow and introduces air into the stream. The reduction in flow reduces the load on a home's hot water heating system.

3.3.1 Faucet Restrictor

Measure Name	Faucet Restrictor
Assumptions	**BASELINE DESCRIPTION** Faucet with a rated flow of 2.2 gpm or higher. **EFFICIENT CASE DESCRIPTION** Faucet aerator reducing flow to 1.8 gpm or less for kitchen applications and to 1.2 gpm or less for bathroom applications.
Unit Energy Savings	Energy savings per faucet restrictor based on existing water heater fuel type and application[1] **ELECTRIC WATER HEATER** Bathroom – 285 kWh Kitchen – 353.3 kWh

	GAS WATER HEATER Bathroom – 15.4 therms Kitchen – 19.1 therms
Estimated Useful Life (EUL)	10 years[2]
References	[1]Water-Energy Grant Program GHG Calculator. Found at: https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/quantification.htm [2]DEER2014-EUL-table-update_2014-02-05

3.3.2 Low-Flow Showerhead

Fixed showerheads are mounted to the wall of the shower. The angle of the shower head can be adjusted to direct the water in the most comfortable position.

Hand-held showerheads have a flexible hose that allows removing the showerhead from the bracket on the showerarm, allowing the user to shower sitting down or in any position.

Measure Name	Low Flow Showerhead/ Hand-Held Low Flow Showerhead
Assumptions	**BASELINE DESCRIPTION** Existing showerhead with a flow rate 2.5 gpm or higher. **EFFICIENT CASE DESCRIPTION** Replacement with showerhead that reduces flow rate to 2.0 gpm or lower.
Unit Energy Savings	Energy savings per showerhead based on existing water heater fuel type.[1] **ELECTRIC WATER HEATER** 379.8 kWh **GAS WATER HEATER** 20.5 therms
Estimated Useful Life (EUL)	10 years[2]
References	[1]Water-Energy Grant Program GHG Calculator. Found at: https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/quantification.htm [2]DEER2014-EUL-table-update_2014-02-05

3.3.3 Thermostatic Shower Valve

A thermostatic shower valve is located just before the showerhead (can be a separate device, or integrated into the showerhead as a "combination" unit, addressed in Section 3.3.4 below). When the shower is turned on, water flows freely through the valve until it reaches a preset temperature (usually 99ºF) and is activated. The valve then restricts the water to a trickle (0.2 gpm or less), until a reset mechanism is manually engaged to

return the showerhead to its normal flow rate. The valve saves water by reducing flow to a trickle (instead of flowing at 1.5 gpm) from the time the shower water gets hot until someone actually gets in and takes a shower.

Measure Name	Thermostatic Shower Valve
Assumptions	**BASELINE DESCRIPTION** No thermostatic shower valve present. **EFFICIENT CASE DESCRIPTION** Thermostatic shower valve installed on the showerarm. **UNIT ENERGY SAVINGS** Mobile home savings based on multi-family dwelling savings.
Unit Energy Savings	Energy savings per valve based on existing water heater fuel type and dwelling type[1] **ELECTRIC WATER HEATER** Single family homes - 45.1 kWh Multi-family homes - 50.1 kWh Mobile homes – 50.1 kWh **GAS WATER HEATER** Single family homes - 2.0 therms Multi-family homes - 2.2 therms Mobile homes – 2.2 therms
Estimated Useful Life (EUL)	10 years[2]
References	[1]Disposition for Water Fixtures, California Public Utilities Commission, Energy Division, February 22, 2013. Found at: http://www.deeresources.com/index.php/non-deer-workpapers [2]PGE work paper PGECODHW113, Revised August 22, 2012.

3.3.4 Thermostatic Shower Valve and Showerhead Combination

Measure Name	Thermostatic Valve and Showerhead
Assumptions	**BASELINE DESCRIPTION** Showerhead with a water flow rate of 2.5 gpm or higher. **EFFICIENT CASE DESCRIPTION** Installation of showerhead with integrated thermostatic shower valve with a maximum total water flow of 1.5 gpm. **UNIT ENERGY SAVINGS** Mobile home savings based on multi-family dwelling savings.

	Measure savings for the thermostatic shower valve and showerhead as stand-alone measures are combined for this measure.
Unit Energy Savings	Energy savings per valve and showerhead based on existing water heater fuel type and dwelling type[1] **ELECTRIC WATER HEATER** Single family homes – 211.6 kWh Multi-family homes – 236 kWh Mobile homes – 236 kWh **GAS WATER HEATER** Single family homes – 9.5 therms Multi-family homes – 10.6 therms Mobile homes – 10.6 therms
Estimated Useful Life (EUL)	10 years[2]
References	[1]Disposition for Water Fixtures, California Public Utilities Commission, Energy Division, February 22, 2013. Found at: http://www.deeresources.com/index.php/non-deer-workpapers [2]PGE work paper PGECODHW113, Revised August 22, 2012.

3.4 LED BULBS

Measure Name	LED Bulbs
Assumptions	**BASELINE DESCRIPTION** Incandescent or halogen lamps used more than 2 hours per day. **EFFICIENT CASE DESCRIPTION** Replacement of existing bulbs with high-efficiency LED bulbs in interior and exterior fixtures. **UNIT ENERGY SAVINGS** Energy savings averaged across all climate zones. Applicable to all residential dwelling types.
Unit Energy Savings	Energy Savings per lamp.[1] Interior LED replacing 40W equivalent – 12.5 kWh Interior LED replacing 60 W equivalent – 18.2 kWh Interior LED replacing 75 W equivalent – 19.9 kWh Interior LED replacing 100 W equivalent – 28.4 kWh Exterior LED replacing 40 W equivalent – 27 kWh Exterior LED replacing 60 W equivalent – 39 kWh Exterior LED replacing 75 W equivalent – 43 kWh

	Exterior LED replacing 100 W equivalent – 62 kWh
Estimated Useful Life (EUL)	15 years[1]
References	[1]Savings Estimation Technical Reference Manual for the California Utilities Association, June 09, 2016; TRM204_residential-LED_v3-15-2016.xlsx. Found at:http://cmua.org/energy-efficiency-technical-resource-manual-2016/

3.5 LED NIGHT LIGHTS

Measure Name	LED Night Lights
Assumptions	**BASELINE DESCRIPTION** Incandescent night light. **EFFICIENT CASE DESCRIPTION** Replacement by a maximum 0.5 W LED night light, with integrated photocell control. **ENERGY SAVINGS** Energy savings averaged across all climate zones for each dwelling type.
Unit Energy Savings	Energy savings per night light based on dwelling type[1] Single family – 29.0 kWh Multi-family – 28.8 kWh Mobile home – 31.6 kWh
Estimated Useful Life (EUL)	16 years[2]
References	[1]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 [2]DEER2014-EUL-table-update_2014-02-05

3.6 VACANCY SENSOR

A vacancy sensor switch is a manual-on/automatic-off electronic device that turns off unneeded lights. The sensor switch is manually turned on when someone enters a room. It then detects lack of occupancy, and it automatically turns off the light fixture(s) after the room is vacated.

Measure Name	Vacancy Sensors
Assumptions	**BASELINE DESCRIPTION**

	No vacancy sensor installed on the lighting system. **EFFICIENT CASE DESCRIPTION** A vacancy sensor is installed to replace the manual on/off light switch in intermittently occupied locations. **UNIT ENERGY SAVINGS** Applicable to single family, mobile home and multi-family residential dwellings.
Unit Energy Savings	39.9 kWh per sensor[1]
Estimated Useful Life (EUL)	8 years[2]
References	[1]PG&E Energy Savings Assistance (ESA) Program Annual Report for Program Year 2013, May 1, 2014. ESAP Table 9. Found at: http://www.liob.org/docs/PGE%202014%20(PY%202013)%20ESA%20&%20CARE%20Annual%20Report.pdf [2]DEER2014-EUL-table-update_2014-02-05

3.7 REFRIGERATOR REPLACEMENT

Replacement of an older, energy-wasting primary refrigerator with an energy-efficient new refrigerator.

Measure Name	Refrigerator Replacement
Assumptions	**BASELINE DESCRIPTION** Refrigerator manufactured in 1998 or before. **EFFICIENT CASE DESCRIPTION** Replacement with a basic ENERGY STAR® qualified refrigerator or refrigerator meeting CEC energy efficiency standards, maximum 23 cu. ft. capacity. **UNIT ENERGY SAVINGS** Applicable to single family, mobile home and multi-family residential dwellings.
Unit Energy Savings	705 kWh each[1]
Estimated Useful Life (EUL)	14 years[2]
References	[1]PG&E Energy Savings Assistance (ESA) Program Annual Report for Program Year 2013, May 1, 2014. ESAP Table 9. Found at: http://www.liob.org/docs/PGE%202014%20(PY%202013)%20ESA%20&%20CARE%20Annual%20Report.pdf [2]DEER2014-EUL-table-update_2014-02-05

3.8 WATER HEATER BLANKET

A water heater blanket is “external” insulation installed on a water heater tank to supplement the internal R-value of tank walls (also the top of an electric unit), in order to reduce standby loss and decrease recovery time during the heating process.

Measure Name	Water Heater Blanket
Assumptions	**BASELINE DESCRIPTION** Existing water heater tank with no (or ineffective) external insulation and internal R-value of ≤R-12 (gas) or ≤R-15 (electric). **EFFICIENT CASE DESCRIPTION** Installation of an ≥R-6 water heater insulating blanket. **UNIT ENERGY SAVINGS** Applicable to single family, mobile home and multi-family residential dwellings.
Unit Energy Savings	Energy savings per blanket based on existing water heater fuel type and dwelling type[1] **ELECTRIC WATER HEATER** 242 kWh **GAS WATER HEATER** 12 therms
Estimated Useful Life (EUL)	15 years[2]
References	[1]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_FINAL_Report_BOE000101.pdf [2]PGE Work Paper PGECOPRO103, Tank Insulation, Revision 4, August 29, 2012.

4. WEATHER SENSITIVE RESIDENTIAL MEASURES

Weather sensitive measures are location or climate zone dependent. These measures will have different savings values dependent on the location of the home in which they are installed. Some measures require justification by energy audit before they may be installed.

The following measures are considered weather sensitive:

- Ceiling insulation
- Duct repair and replacement
- ECM blower motor
- Efficient fan controller, “Enhanced Time Delay”
- Floor insulation
- HVAC replacement
- Refrigerant charge and coil cleaning
- Smart thermostat
- Solar PV
- Solar water heating
- Wall insulation
- Water heater replacement
- Whole house fan
- Window replacement

4.1 CEILING INSULATION

Measure Name	Ceiling Insulation (R-11, R-19, R-30, R-38)
Assumptions	**BASELINE DESCRIPTION** Pre-existing ceiling insulation based on vintage of home or no ceiling insulation present. **EFFICIENT CASE DESCRIPTION** Ceiling insulation is brought up to a total of R-30 or R-38, depending on climate zone (preexisting + added insulation). ***Must be justified by energy audit when there is pre-existing ceiling insulation.***
Unit Energy Savings	Energy savings dependent on climate zone and dwelling type. Savings reported per square foot of installed insulation.[1] Savings must be quantified by energy audit when

	there is pre-existing insulation. Refer to attached spreadsheet for savings values. *Tab-Ceiling Insulation Tables*
Estimated Useful Life (EUL)	20 years[2]
References	[1]"DEER for 2014 Code Update" database, released in November of 2013. RB-BS-CeilIns-R0-R30, RB-BS-CeilIns-R0-R38. Found at: http://www.deeresources.com/ [2]DEER2014-EUL-table-update_2014-02-05

4.2 DUCT REPAIR AND REPLACEMENT (DUCT TEST AND SEAL)

Repairing and replacing ducts reduces air leakage into unconditioned spaces, such as the attic space and under-floor crawl space, thereby reducing the amount of time the HVAC system must operate to keep the home comfortable. Conducting leakage tests determines the amount of existing duct leakage, whether it is feasible to perform sealing work, the amount of leakage reduction achieved, and whether the system complies with the minimum tightness specifications.

Measure Name	Duct Repair and Replacement
Assumptions	**BASELINE DESCRIPTION/EFFICIENT CASE DESCRIPTION** As modeled in energy audit. ***Must be justified by energy audit***
Unit Energy Savings	Energy savings quantified using energy audit tool.
Estimated Useful Life (EUL)	18 years[1]
References	[1]DEER2014-EUL-table-update_2014-02-05

4.3 ELECTRONICALLY COMMUTATED MOTOR (ECM) BLOWER MOTOR

In a central HVAC system, the “blower motor” powers the fan that moves the air through the ducts. This measure will replace a less efficient blower motor with a more efficient one. The replacement motor affects HVAC energy consumption in a few different ways. First, the more efficient motor uses less power to circulate the air through the ducts, thereby saving energy. Second, because the motor uses less energy, it generates less heat, which in turn reduces the home’s cooling load in the summer. Lastly, because the motor uses less energy, it generates less heat, which in turn increases the homes heating load in the winter. This is the reason for negative gas savings.

Measure Name	ECM Blower Motor
Assumptions	**BASELINE DESCRIPTION** Existing, functional air conditioning and heating system with

	less efficient blower motor. **EFFICIENT CASE DESCRIPTION** Installation of more efficient blower motor. **UNIT ENERGY SAVINGS** Applicable to only single family dwellings with air conditioning.
Unit Energy Savings	Energy savings is dependent on climate zone and dwelling type. Savings reported per motor.[1] Refer to attached spreadsheet for savings values. *Tab-ECM Blower Motor*
Estimated Useful Life (EUL)	10 years[1]
References	[1]Workpaper disposition for Residential HVAC Quality Maintenance CPUC May 2, 2013. Found at: http://www.deeresources.com/index.php/non-deer-workpapers

4.4 EFFICIENT FAN CONTROLLER, "ENHANCED TIME DELAY"

Air conditioners are designed to cool the air and remove moisture for the air they are cooling. In California's dry climates, moisture removal is not needed because humidity is low. The enhanced time delay relay "tunes" the air conditioner to cool the air more efficiently by not removing the moisture. The enhanced time delay relay saves energy by continuing to run the blower motor after the air conditioning compressor turns off at the end of the cooling cycle. This saves energy in various ways: 1) Pushes the cold air out of the ducts and into the home, 2) Continues to cool the air by evaporative cooling of the moisture that has condensed on the evaporator coil during the cooling cycle.

Measure Name	Efficient Fan Controller, "Enhanced Time Delay"
Assumptions	**BASELINE DESCRIPTION** Existing, functional air conditioning system with ducts. No time delay present. **EFFICIENT CASE DESCRIPTION** Installation of time delay on air conditioner.
Unit Energy Savings	Energy savings is dependent on climate zone, dwelling type and existing motor type. Savings reported per motor.[1] Refer to attached spreadsheet for savings values. *Tab-Efficient Fan Controller*
Estimated Useful Life (EUL)	10 years[1]
References	[1] Workpaper PGE3PHVC150 R0 Enhanced Time Delay

4.5 FLOOR INSULATION

Measure Name	Floor Insulation
Assumptions	**BASELINE DESCRIPTION/EFFICIENT CASE DESCRIPTION** As modeled in energy audit. ***Must be justified by energy audit***
Unit Energy Savings	Energy savings quantified using energy audit tool.
Estimated Useful Life (EUL)	20 years[1]
References	[1]DEER2014-EUL-table-update_2014-02-05

4.6 HVAC REPLACEMENT

Measure Name	Includes: Central Cooling Replacement, Central Heating Replacement and Package Unit Replacement
Assumptions	**BASELINE DESCRIPTION/EFFICIENT CASE DESCRIPTION** As modeled in energy audit. ***Must be justified by energy audit***
Unit Energy Savings	Energy savings quantified using energy audit tool.
Estimated Useful Life (EUL)	Central Cooling Replacement: 15 years[1] Central Heating Replacement: 20 years[1] Package Unit Replacement: 15 years[1]
References	[1]DEER2014-EUL-table-update_2014-02-05

4.7 REFRIGERANT CHARGE AND COIL CLEANING

Refrigerant charge correction and coil cleaning for residential & non-residential, air-cooled, direct expansion, air conditioning, and heat pump units.

Measure Name	Refrigerant Charge and Coil Cleaning
Assumptions	**BASELINE DESCRIPTION** AC/heat pump unit not correctly charged based on manufacturer's recommendations. **EFFICIENT CASE DESCRIPTION** Properly charged air-cooled, direct expansion, air conditioning, or heat pump unit.

	UNIT ENERGY SAVINGS Measure savings includes both savings for refrigerant charge and coil cleaning.
Unit Energy Savings	Energy Savings dependent on Climate Zone and tons of unit capacity. Savings reported per cap-ton.[1] Refer to attached spreadsheet for savings values. *Tab-Refrigerant Charge +CC.*
Estimated Useful Life (EUL)	5 years[1]
References	[1] Savings Estimation Technical Reference Manual for the California Utilities Association, June 09, 2016; TRM224_residential_HVAC-tune-up_refrigeration-charge_V3-15-2016.xlsx and TRM226_residential-HVAC-tune-up_coil-cleaning_3-15-2016.xlsx. Found at: http://cmua.org/energy-efficiency-technical-resource-manual-2016/

4.8 SMART THERMOSTAT

Measure Name	Smart Thermostat
Assumptions	**BASELINE DESCRIPTION** A nonprogrammable thermostat or a programmable thermostat where: 1. Sensors are out of calibration, OR 2. Thermostat is used primarily in manual by-pass mode, OR 3. Control settings are not user-friendly, OR 4. There is a high level of user dissatisfaction that results in poor use of the thermostat. **EFFICIENT CASE DESCRIPTION** Web-enabled programmable thermostat. **UNIT ENERGY SAVINGS** Savings are calculated assuming the averaged conditioned area of a home to be 1,500 square feet.
Unit Energy Savings	Energy Savings dependent on Climate Zone.[1] Refer to attached spreadsheet for savings values. *Tab-Smart Thermostat.*
Estimated Useful Life (EUL)	11 years[1]
References	[1] Savings Estimation Technical Reference Manual for the California Utilities Association, June 09, 2016; TRM501_web-enabled-programmable-thermostats-residential_3-15-2016.xlsx. Found at:

	http://cmua.org/energy-efficiency-technical-resource-manual-2016/

4.9 SOLAR PV

Measure Name	Solar PV
Assumptions	**BASELINE DESCRIPTION** Residential dwelling without solar PV. **EFFICIENT CASE DESCRIPTION** Residential dwelling with a functional solar PV system.
Unit Energy Savings	Energy savings will be quantified on a case-by-case basis using the tool PVWatts or equivalent.[1]
Estimated Useful Life (EUL)	30 years[2]
References	[1] Life Cycle Greenhouse Gas Emissions from Solar Photovoltaics, NREL fact sheet. Available online at: http://www.nrel.gov/docs/fy13osti/56487.pdf. Accessed on September 12, 2016. [2]CPUC California Solar Initiative 2010 Impact Evaluation Report

4.10 SOLAR WATER HEATING

Measure Name	Solar Water Heating
Assumptions	**BASELINE DESCRIPTION** Existing natural gas water heater without solar water heating. **EFFICIENT CASE DESCRIPTION** Functioning solar water heater in conjunction with existing natural gas water heater.
Unit Energy Savings	Energy Savings dependent on Climate Zone. Refer to attached spreadsheet for savings values. *Tab-Solar Water Heating.*
Estimated Useful Life (EUL)	25 years[2]
References	[1]CSI Thermal Program Incentive Calculator for Standard-300 Systems. Found at: https://www.csithermal.com/calculator/ [2]California Solar Initiative Thermal Program Handbook Rev 18.1.0. Found at: http://www.gosolarcalifornia.ca.gov/documents/CSI-Thermal_Handbook.pdf

4.11 WALL INSULATION

Insulating an existing structure to specified levels. Walls must be uninsulated, and must be pressure-filled to achieve a minimum of R-13 insulation.

Measure Name	Wall Insulation
Assumptions	**BASELINE DESCRIPTION** No insulation. **EFFICIENT CASE DESCRIPTION** Blown-in wall insulation of R-13. **UNIT ENERGY SAVINGS** Measure is only applicable to single family and multi-family dwellings.
Unit Energy Savings	Energy Savings dependent on Climate Zone. Savings reported per square foot of installed insulation.[1] Refer to attached spreadsheet for savings values. *Tab-Wall Insulation Tables.*
Estimated Useful Life (EUL)	20 years[2]
References	[1]"DEER for 2014 Code Update" database, released in November of 2013. RB-BS-BlowInIns-R0-R13. Found at: http://www.deeresources.com/ [2]DEER2014-EUL-table-update_2014-02-05

4.12 WATER HEATER REPLACEMENT

Measure Name	Water Heater Replacement – Electric or Gas
Assumptions	**BASELINE DESCRIPTION/EFFICIENT CASE DESCRIPTION** As modeled in energy audit. ***Must be justified by energy audit***
Unit Energy Savings	Energy savings quantified using energy audit tool.
Estimated Useful Life (EUL)	13 years Electric Water Heater[1] 11 years Gas Water Heater[1]
References	[1]DEER2014-EUL-table-update_2014-02-05.

4.13 WHOLE HOUSE FAN

Measure Name	Whole House Fan
Assumptions	**BASELINE DESCRIPTION** An air-conditioned home with no central whole house fan. **EFFICIENT CASE DESCRIPTION** Whole house fan permanently installed.
Unit Energy Savings	Energy Savings dependent on Climate Zone. Refer to attached spreadsheet for savings values. *Tab-Whole House Fan.*
Estimated Useful Life (EUL)	20 years[1]
References	[1] Savings Estimation Technical Reference Manual for the California Utilities Association, June 09, 2016; TRM202_whole-house-fan_v2-18-2014.xlsx. Found at: http://cmua.org/energy-efficiency-technical-resource-manual-2016/

4.14 WINDOW REPLACEMENT

Measure Name	Window Replacement
Assumptions	**BASELINE DESCRIPTION/EFFICIENT CASE DESCRIPTION** As modeled in energy audit. ***Must be justified by energy audit***
Unit Energy Savings	Energy savings quantified using energy audit tool.
Estimated Useful Life (EUL)	20 years[1]
References	[1]DEER2014-EUL-table-update_2014-02-05

5. INFILTRATION MEASURES

Infiltration measures are grouped together as a whole. If any or all of these measures are installed the group's energy savings will be applied.

Infiltration measures include:

- Caulking
- Cover plate gaskets
- Door repair
- Glass replacement
- Minor envelope repair
- Weatherstripping
- Window repair

Measure Name	Infiltration Reduction
Assumptions	**BASELINE DESCRIPTION** Home requires one or more of the measures included in the infiltration group. **EFFICIENT CASE DESCRIPTION** Any or all infiltration group measures are installed. **UNIT ENERGY SAVINGS** Deemed energy savings averaged across all climate zones and utility study findings. Climate zones without cited savings are given zero savings.[1]
Unit Energy Savings	Options for savings quantification: 1. **Deemed:** Energy Savings per household[1]. Refer to attached spreadsheet for savings values. *Tab-Infiltration Group Tables* 2. **Audit:** Energy savings quantified using energy audit tool.
Estimated Useful Life (EUL)	15 years[2]
References	[1]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 [2]DEER2014-EUL-table-update_2014-02-05

6. ATTACHMENTS

LIWP TRM Savings Reference Workboo