SERVICE & DOMESTIC HOT WATER

FAUCET AERATOR, RESIDENTIAL

SWWH001-02

CONTENTS

MEASURE NAME

Faucet Aerator and Flow Restriction Valves, Residential

STATEWIDE MEASURE ID

SWWH001-02

TECHNOLOGY SUMMARY

This measure is defined as the installation of a low-flow faucet aerator or flow control valves (FCV) on a residential lavatory or kitchen sink faucet. T

An aerator is an add-on device that is installed at the faucet outlet to reduce the flow rate of water. The aerator reduces the water exiting a faucet by mixing it with air; a screen is used to introduce air into the water stream, dividing a single stream of water into many tiny streams. Since there is less space for the water to flow through, the flow rate of the water exiting the faucet is reduced.[1]

A flow control valve (FCV) acts as a converging-diverging section with a throat in which the flow area is reduced to impede full flow of incoming water while retaining pressure. Flow control valves for faucet water line inlets must be installed in pairs, one in the cold line and one in the hot line.

A faucet aerator or FCV is a water-efficient fixture addition that helps residential customers reduce hot water use and save energy.

MEASURE CASE DESCRIPTION

The measure case is defined as a low-flow faucet aerator or FCVs installed on a lavatory or kitchen faucet in a residential building. The measure offerings, shown below, are based upon flow rate (gallons per minute, gpm). Savings are calculated for water heating fuel type, faucet type, flow rate, and building type (single family, multifamily, and double-wide mobile home), and for each California climate zone. For FCV measures, the flow rate indicates the combined flow of cold and hot inlet lines.

Measure Case Specification

DHW Fuel Type	Faucet Type	Single Family Flow Rate (gpm)	Multifamily or Mobile Home Flow Rate (gpm)
Gas	Lavatory Sink	0.5	0.5
		1.0	1.0
		1.2	1.2
	Kitchen Sink	1.5	1.5

[1] Umesh, V. and Sitaram, N. 2014. "Hydraulic Performance of Faucet Aerator as Water Saving Device and Suggestions for its Improvements." International Journal of Research in Engineering and Technology, Volume 3 (Issue 7).

DHW Fuel Type	Faucet Type	Single Family Flow Rate (gpm)	Multifamily or Mobile Home Flow Rate (gpm)
Electric	Lavatory Sink	0.5	0.5
		1.0	1.0
		1.2	1.2
	Kitchen Sink	1.5	1.5

Measure Offerings

Statewide Measure Offering ID	Measure Offering Description
SWWH001A	Faucet, Kitchen Aerator, 1.5 gpm, gas, AOE
SWWH001B	Faucet, Lavatory Aerator, 1.2 gpm, gas, AOE
SWWH001C	Faucet, Lavatory Aerator, 1.0 gpm, gas, AOE
SWWH001D	Faucet, Lavatory Aerator, 0.5 gpm, gas, AOE
SWWH001E	Faucet, Kitchen Aerator, 1.5 gpm, electric, AOE
SWWH001F	Faucet, Lavatory Aerator, 1.2 gpm, electric, AOE
SWWH001G	Faucet, Lavatory Aerator, 1.0 gpm, electric, AOE
SWWH001H	Faucet, Lavatory Aerator, 0.5 gpm, electric, AOE
SWWH001I	Faucet, Kitchen Aerator, 1.5 gpm, gas, AR
SWWH001J	Faucet, Lavatory Aerator, 1.2 gpm, gas, AR
SWWH001K	Faucet, Lavatory Aerator, 1.0 gpm, gas, AR
SWWH001L	Faucet, Lavatory Aerator, 0.5 gpm, gas, AR
SWWH001M	Faucet, Kitchen Aerator, 1.5 gpm, electric, AR
SWWH001N	Faucet, Lavatory Aerator, 1.2 gpm, electric, AR
SWWH001O	Faucet, Lavatory Aerator, 1.0 gpm, electric, AR
SWWH001P	Faucet, Lavatory Aerator, 0.5 gpm, electric, AR
SWWH001Q	Faucet, Kitchen Flow Control Valve, 1.5 gpm, gas, AOE
SWWH001R	Faucet, Lavatory Flow Control Valve, 1.2 gpm, gas, AOE
SWWH001S	Faucet, Lavatory Flow Control Valve, 1.0 gpm, gas, AOE
SWWH001T	Faucet, Lavatory Flow Control Valve, 0.5 gpm, gas, AOE
SWWH001U	Faucet, Kitchen Flow Control Valve, 1.5 gpm, electric, AOE
SWWH001V	Faucet, Lavatory Flow Control Valve, 1.2 gpm, electric, AOE
SWWH001W	Faucet, Lavatory Flow Control Valve, 1.0 gpm, electric, AOE
SWWH001X	Faucet, Lavatory Flow Control Valve, 0.5 gpm, electric, AOE

BASE CASE DESCRIPTION

The base case for an *add-on equipment installation* is defined as an existing residential lavatory faucet or kitchen faucet without an aerator or flow control valve (FCV) installed, with a flow rate of 2.2 gpm. This designated base case flow rate represents the existing condition and was derived from data from the Sempra Energy Utilities (San Diego Gas and Electric and the Southern California Gas Company) 2009 field survey.[2] This flow rate is also adopted for the first baseline period an *accelerated replacement installation*. The baseline flow rates for the second baseline period of an *accelerated replacement installation* is equal to the flow rate stipulated by code.

Base Case Specification - Lavatory Sink

Installation Type	Single Family Flow Rate (gpm)	Multifamily or Mobile Home Flow Rate (gpm)	Source
Add-on equipment	2.2	2.2	Sempra Energy Utilities (SEU). 2012. "SEU 2009 ASW Data REDACTED.xlsx".
Accelerated replacement – 1st baseline (existing condition)	2.2	2.2	
Accelerated replacement – 2nd baseline	1.2	1.2	California Energy Commission (CEC). 2017. *2016 Appliance Efficiency Regulations.* CEC-400-2017-002. Section 1605.3(h). Table H-3.

Base Case Specification - Kitchen Sink

Installation Type	Single Family Flow Rate (gpm)	Multifamily or Mobile Home Flow Rate (gpm)	Source
Add-on equipment	2.2	2.2	Sempra Energy Utilities (SEU). 2012. "SEU 2009 ASW Data REDACTED.xlsx".
Accelerated replacement – 1st baseline (existing condition)	2.2	2.2	
Accelerated replacement – 2nd baseline	1.8	1.8	California Energy Commission (CEC). 2017. *2016 Appliance Efficiency Regulations.* CEC-400-2017-002. Section 1605.3(h). Table H-3.

CODE REQUIREMENTS

This measure is governed by the California Appliance Efficiency Regulations (Title 20)[3] standards, which stipulates the maximum flow rates for kitchen and lavatory faucets.

Prior Applicable State and Federal Codes and Standards

Code	Applicable Code Reference	Effective Date
CA Appliance Efficiency Regulations – Title 20 (2016)	Section 1605.3(h) Table H-3	See following table.
CA Building Energy Efficiency Standards – Title 24	Not applicable.	n/a
Federal Standards	Not applicable.	n/a

[2] Sempra Energy Utilities (SEU). 2012. "SEU 2009 ASW Data REDACTED.xlsx".

[3] California Energy Commission (CEC). 2017. *2016 Appliance Efficiency Regulations.* CEC-400-2017-002. Section 1605.3(h). Table H-3.

California Title 20 Standards for Plumbing Fittings and Fixtures

Regulated Water Appliance	Regulation (Pre Sept. 1, 2015)	Effective Date			
		Sept. 1, 2015	Jan. 1, 2016	July 1, 2016	July 1, 2018
Lavatory Faucet and Aerator	2.2 gpm @60 psi	1.5 gpm @ 60 psi	-	1.2 gpm @60 psi	-
Kitchen (Sink) Faucet	2.2 gpm @60 psi	-	1.8 gpm, optional temporary flow of 2.2 gpm @60 psi	-	-

NORMALIZING UNIT

Per aerator (each).

PROGRAM REQUIREMENTS

Measure Implementation Eligibility

All combinations of measure application type, delivery type, and sector that are established for this measure are specified below. Measure application type is a categorization based on the circumstances and timing of the measure installation; each measure application type is distinguished by its baseline determination, cost basis, eligibility, and documentation requirements. Delivery type is the broad categorization of the delivery channel through which the market intervention strategy (financial incentives or other services) is targeted. This table also designates the broad market sector(s) that are applicable for this measure.

Note that some of the implementation combinations below may not be allowed for some measure offerings by all program administrators.

Implementation Eligibility

Measure Application Type	Delivery Type	Sector
Add-on equipment	DnDeemDI	Res
Add-on equipment	UpDeemed	Res
Add-on equipment	DnDeemed	Res
Accelerated replacement	DnDeemDI	Res

For *accelerated replacement* application types, this measure adopts the program-level "Preponderance of Evidence Assessment" described in Version 2.0 of the Accelerated Replacement Using Preponderance of Evidence report developed by the utilities and stakeholders to provide guidance for the California programs ("POEV 2.0", see Section 7)[4]. "Continued viability" and "program influence" must be demonstrated as the evidence of accelerated replacement.

[4] Track 1 Working Group. 2016. Accelerated Replacement Using Preponderance of Evidence. Version 2.0. December 7.

To demonstrate the viability of the pre-existing system or to show that the program is replacing equipment that is "installed and operating," the customer must be approached by a direct install implementer. Additionally, the program must obtain and provide additional documentation, including (but not limited to) the following:

- Targeted segment of the market or customers
- Customer/site information
- Make/model of pre-existing equipment and/or
- Performance/flowrate measurements of pre-existing equipment, and/or
- Photograph of pre-existing equipment in place and operating

Program influence evidence can be demonstrated through one of the three alternatives listed in Section 7.3 of POEV 2.0. This measure establishes the program-level evidence of program influence by adopting the net-to-gross (NTG) ratio from prior program evaluation results.

Specific documentation requirements will be determined by the program administrator and will be specified in the program implementation plan.

Eligible Products

The existing faucet must have a flow rate of at least 2.2 gpm.

The low-flow faucet aerator and flow control valve (FCV) must be installed on an existing faucet with a flow rate that complies with the Measure Case Specification.

For FCV, combined water flow rate must meet the measure flow requirements. FCV make, model number and flow rate must be included with a copy of the invoice

For *accelerated replacement application types*, the retrofit faucet must have an existing faucet aerator.

For *all other application types*, the faucet must not have an aerator installed.

Eligible Building Types

Eligible building types include all existing residential buildings of any vintage with a natural gas or electric water heater, including single family, multifamily, and double-wide mobile homes.

Eligible Climate Zones

The measure is applicable in all California climate zones.

PROGRAM EXCLUSIONS

The measure is not applicable to new faucets that meet or exceed the 2016 California Appliance Efficiency Regulations (Title 20) code requirement of 1.2 gpm flow rate for lavatory faucet and 1.8 gpm flow rate for kitchen faucet.

DATA COLLECTION REQUIREMENTS

Data collection requirements are to be determined.

USE CATEGORY

Service & Domestic Hot Water

ELECTRIC SAVINGS (kWh)

The electric unit energy savings (UES) is derived from the gas UES, the ratio of the recovery efficiency of a gas water heater to that an electric water heater, and a therm-to-kWh conversion factor.

$$UES_{kWh} = UES_{therms} \times \frac{EFF_{gas}}{EFF_{elec}} \times \frac{100{,}000\ kWh}{3{,}413\ Btu}$$

$UES_{kWh} =$	*Annual electric unit energy savings (kWh/year)*
$UES_{therms} =$	*Annual gas unit energy savings (therms/year)*
$EFF_{gas} =$	*Minimum water heater efficiency (recovery efficiency), gas*
$EFF_{elec} =$	*Minimum water heater efficiency (recovery efficiency), electric*

Refer to Gas Savings for the derivation of the gas UES. All other inputs used for this calculation are specified below.

Electric UES Inputs

Energy Savings Inputs / Constants	Value	Source
Gas Unit Energy Savings (therms)	Varies by CZ	See Gas Savings section.
Gas Water Heater Min. Efficiency (recovery efficiency)	0.77	Southern California Gas Company (SCG). 2010. "Gas Fired Storage Water Heater Extract from CEC Appliance Data 07.07.2010.xlsx." California Public Utilities Commission (CPUC), Energy Division. 2010. *Non-DEER Measure Review Template: PGECODHW113 – Low Flow Showerhead and Thermostatic Shower Restriction Valve.* April 27.
Electric Water Heater Min. Efficiency (recovery efficiency)	0.98	California Energy Commission (CEC). 2014. *2014 Appliance Efficiency Regulations.* CEC-400-2014-009-CMF. Section 1604.

Recovery Efficiency: To convert the water heating load to electric energy use at the water heater, the recovery efficiency (RE) is used. Recovery efficiency is a measure of how efficiently the heat from the energy source is transferred to the water (the ratio of energy output used to heat the water divided by energy input).

PEAK ELECTRIC DEMAND REDUCTION (kW)

Peak electrical demand reduction calculation is a function of the electric unit energy savings (UES), a peak period usage factor, and the operating hours per year. The peak period usage factor (PPUF) – similar in concept to a coincident demand factor (CDF) – reflects the percent of hot water usage during the designated peak demand period.

$$kW_{reduction} = \frac{UES_{kWh} \times PPUF}{(DAYS \times PEAKHRS)}$$

UES_{kWh} =	*Annual electric unit energy savings (kWh/year)*
PPUF =	*Peak period usage factor*
DAYS =	*Operating days per year*
PEAKHRS =	*Peak hours per day*

Peak Demand Reduction Inputs

Parameter	Value	Source
Peak Period Usage Factor (PPUF)	0.37	Southern California Edison (SCE). 2019. "Water Heater - Electric Peak Usage Factor adjustment to new TOU.xlsx"
Operating days per year	365	Professional judgement.
Peak hours per day	5	California Public Utilities Commission (CPUC). 2018. *Resolution E-4952.* October 11. OP 1.

GAS SAVINGS (THERMS)

The gas unit energy savings (UES) of this measure is based upon the estimated decrease in hot water usage as a result of the installation of a low-flow aerator. The gas UES for a flow control valve (FCV) is the same as a low-flow aerator.

Calculation of Water Usage and Water Savings

The estimation of base case and measure case water usage and the UES calculation replicated the approach presented in the "Workpaper Disposition for Water Fixtures" issued by the California Public Utilities Commission (CPUC) in 2013[5] to the extent possible. Deviations from the 2013 CPUC disposition that were necessary for accuracy and consistency include the following:

- Climate zone adjustment factors in 2013 CPUC disposition were not used, but rather updated to be consistent climate zone groundwater temperatures developed for the Title 24 2013 weather data.
- The 2013 CPUC disposition recommended 25 gpd based upon the NREL study for the DOE Building America analysis. The 25 gpd value is used directly for installations with 2.25 gpm code baseline, but split between kitchen (54.8%, 13.7 gpd) and lavatory (45.2%, 11.3 gpd) for 2.9 aerators/household = 3.9 gpd/aerator). This breakdown for lavatories is more conservative than the disposition since the disposition uses two aerators/household, rather than 2.9.

[5] California Public Utilities Commission (CPUC), Energy Division. 2013. "Workpaper Disposition for Water Fixtures." February 22.

- The adjustment in the disposition from 59% energy factor to 77% recovery efficiency rate was not necessary since the original calculations in the 2009 field survey data also used 77%. This measure analysis utilizes a 77% recovery efficiency rate to be consistent with the direction of the disposition.

Water savings was calculated as the difference between the baseline and measure case usage. Water usage (baseline or measure case) is a function of the flow rate, number of faucets per household, and assumed operating time.

$$WS = WU_{base} - WU_{measure}$$

$$WU = \frac{FlowRate \times Min \times Days}{N}$$

$WS =$	*Annual water savings (gal/year)*
$WU =$	*Annual water use (gal/year), for base or measure case*
$FlowRate =$	*Water volume flow rate (gpm), for base or measure case*
$Min =$	*Faucet average operating time (min/day)*
$Days =$	*Faucet days of operation (days/year)*
$N =$	*Number of faucets per household, SF or MF*

The inputs to the base case and measure case water usage calculation are specified and explained below. Note that this measure is applicable for single family, multifamily, and mobile home installations. Due to lack of data on mobile home water usage, particularly at the fixture type level (showerhead, faucet), the mobile home water usage and savings calculations adopt the more conservative multifamily values.

Base Case Water Usage Inputs

Single Family				
Parameter	Units	Kitchen	Lavatory	Source
Base Case Flow Rate	gpm	2.2	2.2	Sempra Energy Utilities (SEU). 2012. "SEU 2009 ASW Data REDACTED.xlsx".
Average Faucet Use Time	min/day	6.08	5.02	*(calculated)*
Flow Rate for All Sink Faucets	gpd	13.40	11.04	Sempra Energy Utilities (SEU). 2012. "SEU 2009 ASW Data REDACTED.xlsx". Hendron, R. and C. Engebrecht. 2010. *Building America Research Benchmark Definition: Updated December 2009.* National Renewable Energy Laboratory. NREL/TP-550-47246.

Multifamily / Mobile Home				
Parameter	**Units**	**Kitchen**	**Lavatory**	**Source**
Base Case Flow Rate	gpm	2.2	2.2	Sempra Energy Utilities (SEU). 2012. "SEU 2009 ASW Data REDACTED.xlsx".
Average Faucet Use Time	min/day	5.07	4.18	*(calculated)*
Flow Rate for All Sink Faucets	gpd	11.20	9.20	Sempra Energy Utilities (SEU). 2012. "SEU 2009 ASW Data REDACTED.xlsx". Hendron, R. and C. Engebrecht. 2010. *Building America Research Benchmark Definition: Updated December 2009.* National Renewable Energy Laboratory. NREL/TP-550-47246.

Measure Case Water Usage Inputs

Single Family						
Parameter	**Units**	**Kitchen**	**Lavatory**			**Source**
Measure Case Flow Rate	gpm	1.5	0.5	1.0	1.2	-
Average Faucet Use Time	min/day	6.08	5.02	5.02	5.02	*(calculated)*
Multifamily / Mobile Home						
Parameter	**Units**	**Kitchen**	**Lavatory**			**Source**
Measure Case Flow Rate	gpm	1.5	0.5	1.0	1.2	-
Average Faucet Use Time	min/day	5.07	4.18	4.18	4.18	*(calculated)*

Average Faucet Use Time. The estimated total water usage of all faucets in the household (gallons per day, gpd) was drawn from the Building America Research study conducted by the National Renewable Energy Laboratory (NREL).[6] To derive water usage by faucet type, data from the Sempra Energy Utilities (San Diego Gas and Electric and the Southern California Gas Company) 2009 field survey[7] was used to apportion the usage between kitchens and lavatories for both single-family and multifamily residences. The portion of total sink water usage is specified in the table below.

[6] Hendron, R. and C. Engebrecht. 2010. *Building America Research Benchmark Definition: Updated December 2009.* National Renewable Energy Laboratory. NREL/TP-550-47246.

[7] Sempra Energy Utilities (SEU). 2012. "SEU 2009 ASW Data REDACTED.xlsx".

Sink Water Usage Breakdown and Number of Faucets per Household, by Aerator Application

Parameter	Kitchen	Lavatory	Source
Portion of Total Sink Water Usage	0.55	0.45	Sempra Energy Utilities (SEU). 2012. "SEU 2009 ASW Data REDACTED.xlsx".
Number of Faucets per Household	1.0	2.9	Sempra Energy Utilities (SEU). 2012. "SEU 2009 ASW Data REDACTED.xlsx". California Public Utilities Commission (CPUC), Energy Division. 2013. "Workpaper Disposition for Water Fixtures." February 22.

Number of Faucets per Household. The number of faucets per household (specified in the previous table) were derived from survey results for SCG and SDG&E utilized in calculations included in the 2013 CPUC disposition. The survey data specified the number of lavatories and kitchens in a household. There was no breakdown between single-family and multifamily residence types in the survey data; thus, identical values for the number of kitchen and lavatory faucet aerators are used for all residence types.

Water Usage per Day. The water usage (gallons per day) for each faucet type was divided by the appropriate base case flow rate to derive the average minutes average per day of expected faucet use. This methodology estimates faucet use time in minutes per day that is constant and varies only by building type. The assumption of the minutes per day that a faucet is used does not change between the base case and measure case means that a reduction in the faucet flow rate will reduce water usage.

Water Use Assumptions, by Building Type

Parameter	Single Family	Multifamily / Mobile Home	Source
Water usage @ 2.25 gpm (gal/day)	25.0	20.8	Hendron, R. and C. Engebrecht. 2010. *Building America Research Benchmark Definition: Updated December 2009.* National Renewable Energy Laboratory. NREL/TP-550-47246.
Water usage @ 2.20 gpm (gal/day)	24.4	20.4	
Annual operating days (days/yr)	365	365	Assumption based on professional judgement

Calculation of Gas Unit Energy Savings

The gas unit energy savings (UES) of this measure is based upon the estimated decrease in hot water usage as a result of the installation of a low-flow aerator. The calculation of gas UES is represented below, followed by an explanation of the inputs used for this calculation.

$$UES_{therms} = \left[\frac{WS \times Cp \times WaterWeight \times \left(\frac{1\ therm}{100{,}000\ Btu}\right)(T_{mixed} - T_{ground})}{EFF_{gas}}\right]$$

$UES_{therms} =$	*Annual gas unit energy savings (therms/year)*
$WS =$	*Annual water savings (gal/year)*
$Cp =$	*Specific heat capacity of water (Btu/lb/°F), fixed constant*
$WaterWeight =$	*Weight of water (lb/gal), fixed constant*
$T_{mixed} =$	*Mixed water temperature, at faucet (°F)*
$T_{ground} =$	*Make-up groundwater temperature, varies by climate zone (°F)*
$EFF_{gas} =$	*Water heater efficiency, gas*

Recovery Efficiency: To convert the water heating load to electric energy use at the water heater, the recovery efficiency (RE) is used. Recovery efficiency is a measure of how efficiently the heat from the energy source is transferred to the water (the ratio of energy output used to heat the water divided by energy input).

Gas UES Inputs

Parameter	Value	Source
Specific Heat Capacity of Water (Btu/lb/°F)	1	Fixed constant
Water Weight (lb/gal)	8.34	Fixed constant
Average Make-up (Groundwater) Water Temperature (°F)	*Varies by climate zone*	Comparison-of-Ground-Temperatures.xlsx
Mixed Water Temperature @ Faucet (°F)	106	Sempra Energy Utilities (SEU). 2012. "SEU 2009 ASW Data REDACTED.xlsx".
Gas Water Heater Min. Efficiency (recovery efficiency)	0.77	Southern California Gas Company (SCG). 2010. "Gas Fired Storage Water Heater Extract from CEC Appliance Data 07.07.2010.xlsx." California Public Utilities Commission (CPUC), Energy Division. 2010. *Non-DEER Measure Review Template: PGECODHW113 – Low Flow Showerhead and Thermstatic Shower Restriction Valve.* April 27.

Make-up (Groundwater) Water Temperatures by Climate Zone

Climate Zone	Make-up (Groundwater) Temperature (°F)	Source
CZ 1	51.4	Reeves, P. (Consultant to California Public Utilities Commission, Energy Division). 2013. "Comparison-of-Ground-Temperatures-v2_byPaulReeves.xlsx."
CZ 2	57.3	
CZ 3	57.1	
CZ 4	59.5	
CZ 5	55.8	
CZ 6	61.8	
CZ 7	62.6	
CZ 8	63.7	
CZ 9	63.8	
CZ 10	64.2	
CZ 11	63.2	
CZ 12	60.9	
CZ 13	64.1	
CZ 14	62.7	
CZ 15	75.5	
CZ 16	51.8	

LIFE CYCLE

Effective Useful Life (EUL) is an estimate of the median number of years that a measure installed through a program is still in place and operable. Remaining Useful Life (RUL) is an estimate of the median number of years that a technology or piece of equipment replaced or altered by an energy efficiency program would have remained in service and operational had the program intervention not caused the replacement or alteration.

As per Resolution E-4807, the California Public Utilities Commission (CPUC) defined the EUL of add-on equipment as the minimum of the EUL of the measure itself and the RUL of the host equipment.[8] The methodology to calculate the RUL conforms with Version 5 of the Energy Efficiency Policy Manual, which recommends "one-third of the effective useful life in DEER as the remaining useful life until further study results are available to establish more accurate values." This approach provides a reasonable RUL estimate without the requiring any prior knowledge about the age of the equipment being replaced.[9] The RUL of the host equipment (which is a faucet for this particular measure) is therefore calculated as one-third of the EUL of a faucet.

The EUL and RUL established for this low-flow aerator measure are specified below. The EUL of the aerator and the RUL of the host faucet are adopted for this measure.

Effective Useful Life and Remaining Useful Life

Parameter	Gas	Electric	Source
EUL (yrs) – aerator	10.00	10.00	California Public Utilities Commission (CPUC), Energy Division. 2014. "DEER2014-EUL-table-update_2014-02-05.xlsx"
EUL (yrs) – host faucet	20.00	20.00	National Association of Home Builders (NAHB) / Bank of America Home Equity. 2007. *Study of Life Expectancy of Home Components.* Prepared by the Economics Group of NAHB. Page 9. Glacier Bay. (n.d.) "Glacier Bay Faucets 20-year Limited Warranty."
RUL (yrs) – host faucet	6.67	6.67	California Public Utilities Commission (CPUC). 2016. *Resolution E-4807.* December 16. Page 13.

BASE CASE MATERIAL COST ($/UNIT)

For *add-on equipment measure applications*, the base case assumes that the existing faucet is not equipped with an aerator. Therefore, the base case cost is equal to $0.

Base case material costs for *accelerated replacement installations* are equal to $0 in the first baseline period. Material cost for the second baseline period were drawn directly from the Database for Energy Efficient Resources (DEER) 2008 measure cost documentation.[10]

[8] California Public Utilities Commission (CPUC). 2016. *Resolution E-4807*. December 16. Page 13.

[9] KEMA, Inc. 2008. "Summary of EUL-RUL Analysis for the April 2008 Update to DEER." Memorandum submitted to Itron, Inc.

[10] California Public Utilities Commission (CPUC). 2008. "Revised DEER Measure Cost Summary (05_30_2008) Revised (06_02_2008).xlsx." See "Res – Shwrhd & Aerators" tab.

MEASURE CASE MATERIAL COST ($/UNIT)

The measure case material cost *all application types* of a low-flow faucet aerator was calculated as the average of (proprietary) negotiated costs from four third-party contractors that implemented this measure in 2017.[11]

Faucet flow control valves (FCVs) are sold in pairs for a price of $25.00, this price will be used for material cost for faucet applications as the measure must be installed in pairs.

BASE CASE LABOR COST ($/UNIT)

For *add-on equipment measure applications*, the base case assumes that the existing faucet is not equipped with an aerator or flow control valves (FCVs). Therefore, the base case labor installation cost is equal to $0.

Base case labor costs for *accelerated replacement applications* are equal to $0 in the first baseline period. The labor cost for the second baseline period were calculated as the average of (proprietary) negotiated costs from four third-party contractors that implement this measure in 2017.[12]

MEASURE CASE LABOR COST ($/UNIT)

The labor cost for *all application types* to install a low-flow faucet aerator was calculated as the average of (proprietary) negotiated costs from four third-party contractors that implement this measure in 2017.[13]

Installation of flow control valves (FCVs) in residential faucets adopts the labor cost of low-flow showerhead from DEER cost data [14], at $16.74 per fixture. However, the installer will have to work on the cold and hot water lines, and the labor cost will be multiplied by a factor of 2, for total labor cost of $33.48 ($16.74 x 2).

NET-TO-GROSS (NTG)

The net-to-gross (NTG) ratio represents the portion of gross impacts that are determined to be directly attributed to a specific program intervention The NTG ratio for direct installations was specified in the Workpaper Disposition for Water Fixtures disposition issued by the Energy Division of the California Public Utilities Commission (CPUC) in 2013. The NTG ratio for all other delivery channels is based upon the average of all NTG ratios for all evaluated 2006 – 2008 residential programs, as documented in the 2011 DEER Update Study conducted by Itron, Inc. This sector average NTG (“default NTG”) is applicable to all energy efficiency measures that have been offered through residential sector programs for more than two years and for which impact evaluation results are not available.

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[11] This data is proprietary and documentation is not available.

[12] This data is proprietary and documentation is not available.

[13] This data is proprietary and documentation is not available.

[14] California Public Utilities Commission (CPUC). 2008. “Revised DEER Measure Cost Summary (05_30_2008) Revised (06_02_2008).xlsx.”

Net-to-Gross Ratios

Parameter	Gas	Electric	Source
NTG – Residential, direct install only	0.59	0.59	California Public Utilities Commission (CPUC), Energy Division. 2013. "Workpaper Disposition for Water Fixtures." February 22. Page 6. Itron, Inc. 2011. *DEER Database 2011 Update Documentation.* Prepared for the California Public Utilities Commission. Table 13-4
NTG – Residential default, non-direct install	0.55	0.55	California Public Utilities Commission (CPUC), Energy Division. 2013. "Workpaper Disposition for Water Fixtures." February 22. Page 6. Itron, Inc. 2011. *DEER Database 2011 Update Documentation.* Prepared for the California Public Utilities Commission. Page 15-4 Table 15-3.

In conformance with Resolution E-4952, an adjustment factor is applied to the "above-code" NTG ratio specified above to the "below-code" savings of an *accelerated replacement installation*.

Net-to-Gross Ratio Adjustment Factor for Accelerated Replacement

Parameter	Value	Source
NTG adjustment factor	0.75	California Public Utilities Commission (CPUC). 2018. *Resolution E-4952.* October 11. Op 1. Pp 58 – 59.

GROSS SAVINGS INSTALLATION ADJUSTMENT (GSIA)

The gross savings installation adjustment (GSIA) rate represents the ratio of the number of verified installations of the measure to the number of claimed installations reported by the utility. This factor varies by end use, sector, technology, application, and delivery method. These values are based upon the "Workpaper Disposition for Water Fixtures" issued by the California Public Utilities Commission (CPUC) in 2013.

Gross Savings Installation Adjustment Rates

Parameter	Gas	Electric	Source
GSIA	0.665	0.665	California Public Utilities Commission (CPUC), Energy Division. 2013. "Workpaper Disposition for Water Fixtures." February 22. Page 6. The Cadmus Group, Inc. 2010. *Residential Retrofit High Impact Measure Evaluation Report*. Prepared for the California Public Utilities Commission Energy Division.

NON-ENERGY IMPACTS

Non-energy impacts that result from the installation of a low-flow aerator is the reduction of water usage. The calculation of water savings is explained in the Gas Savings section.

DEER DIFFERENCES ANALYSIS

The table below summarizes the inputs and methods that are and are not based upon the Database for Energy Efficient Resources (DEER).

DEER Difference Summary

DEER Item	Comment
Modified DEER methodology	No
Scaled DEER measure	No
DEER Base Case	No
DEER Measure Case	No
DEER Building Types	No
DEER Operating Hours	No
DEER eQUEST Prototypes	No
DEER Version	DEER 2017, READI v2.4.7
Reason for Deviation from DEER	DEER contained similar measures which have since been removed.
DEER Measure IDs Used	n/a
NTG	Source: DEER 2014, 2016 and 2013 CPUC disposition. The NTG value of 0.59 is associated with NTG ID: *Res-mDHWaerator,* the value of 0.55 is associated with NTG ID: *Res-Default>2*
GSIA	Source: DEER 2011. The GSIA value of 0.665 is associated with ID: *Res-LowF-FA-All*
EUL/RUL	Source: DEER 2014. The EUL ID for the aerator measure is *WtrHt-WH-Aertr.*

REVISION HISTORY

Measure Characterization Revision History

Revision Number	Revision Complete Date	Primary Author, Title, Organization	Revision Summary and Rationale for Revision Effective Date and Approved By
01	03/31/2018	Jennifer Holmes Cal TF Staff	Draft of consolidated text for this statewide measure is based upon: Workpaper WPSCGREWH120618 Revision 3 (December 31, 2015) Consensus reached among Cal TF members.
	1/30/2019	Jennifer Holmes Cal TF Staff	Incorporated AR from: PGECODHW125, Revision 7 (December 26, 2018) Revisions for submittal of version 01
02	6/12/2019	Chan Paek SoCalGas	Added flow control valve (FCV) measures
	03/23/2021	Soe K Hla PG&E	Adopted all remaining measures for PG&E Added AOE DnDeemed to Implementation Eligibility Table Fixed incorrect EUL ID and ElecImpactProfile ID in EAD Replaced incorrect Dataspec and Coversheet from the previous upload.