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WATER HEATING

LOW-FLOW SHOWERHEAD, COMMERCIAL

SWWH020-03

CONTENTS

MEASURE NAME

Low-Flow Showerhead or Flow Control Valves, Commercial

STATEWIDE MEASURE ID

SWWH020-03

TECHNOLOGY SUMMARY

Installation of a low-flow showerhead or flow control valves (FCV) in a commercial facility will reduce water consumption and save energy associated with water heating. Many commercial buildings – particularly hotels, motels, educational facilities, fitness centers, small/large office buildings, recreation centers, and others can benefit from reducing flowrates or replacing existing water fixtures, and specifically, showerheads with low-flow fixtures or FCV's. The economics from such improvement is cost effective. By reducing the flow rate, commercial showers will reduce the hot water use and result in both water and energy and savings.

Flow Control Valves act as a converging-diverging section with a throat in which the flow area is reduced to impede full flow while retaining pressure. The reduction in flow rate offsets the amount of hot water used, in effect the energy demand by the water heating source is reduced. A flow control valves operate and conserve energy in the same manner as a low-flow showerhead but is applied upstream from fixture point.

MEASURE CASE DESCRIPTION

This measure is defined as the replacement of an existing showerhead with a low-flow showerhead or installing a flow control valve upstream from the fixture in a commercial facility. Measure case flow rates for either the installation of an efficient showerhead or flow control valves are specified below. The measure offerings for the low-flow showerhead and flow-control valve (and therefore energy savings) vary by flow rate (gpm), as well as household type (single family, multifamily, or mobile home), climate zone, and installation type. Measure offerings are listed below.

Measure Case Specification

Measure Offering	Max. Qualifying Flow Rate (gpm)
Low-flow Showerhead	1.80
	1.50
Flow Control Valves	1.50

BASE CASE DESCRIPTION

The base case for this measure is defined as the existing condition flowrate for the first baseline period and the stipulated code flowrate for the second baseline (see Code Requirements). The existing condition baseline was derived from flow-rate data collected by Blackstone at five hotel/motel properties in Southern California.

Base Case Specification

Base Case Scenario	Flow Rate (gpm)	Source
Existing Condition – 1st baseline	2.25	Southern California Gas Company (SCG). 2016. "Att.-C_WPSCGNRWH170412A-Rev01_Com_LFSH_Sample of Data Collected at Hotels.xlsx"
Code/Standard – 2nd baseline	1.80	California Energy Commission (CEC). 2017. *2016 Appliance Efficiency Regulations*. CEC-400-2017-002. Section 1605.3.

CODE REQUIREMENTS

Applicable state and federal codes and standards for showerheads are specified below. The low-flow showerhead maximum flow rate was originally mandated by the Energy Policy Act of 1992.[1] The California Appliance Efficiency Regulations (Title 20)[2] effective in 1994 met the federal code and have exceeded it in subsequent updates.

Applicable State and Federal Codes and Standards

Code	Applicable Code Reference	Effective Date
CA Appliance Efficiency Regulations – Title 20 (2016)	Section 1605.3, Table H-5: The maximum flow rate of a showerhead shall not be greater than 2.5 gpm at 80 psi.	Units manufactured on or after January 1, 1994 and prior to July 1, 2016.
	Section 1605.3, Table H-5: The maximum flow rate of a showerhead shall not be greater than 2.0 gpm at 80 psi.	Units manufactured on or after July 1, 2016 and prior to July 1, 2018.
	Section 1605.3, Table H-5: The maximum flow rate of a showerhead shall not be greater than 1.8 gpm at 80 psi.	Units manufactured on or after July 1, 2018.
CA Building Energy Efficiency Standards – Title 24	Not applicable.	n/a
Federal Standards - Energy Policy Act of 1992	Not applicable, exceeded by Title 20.	n/a

NORMALIZING UNIT

Each, per fixture.

[1] H.R.776 – 102nd Congress. Energy Policy Act of 1992. Pub. L. No. 102-106, Stat. 2776.

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

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
Accelerated replacement	DnDeemDI	Com
Add-On Equipment	DnDeemDI	Com

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).[3]. "Continued viability" and "program influence" must be demonstrated as the evidence of accelerated replacement.

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

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

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.

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

Eligible Products

The measure for the installation of low flow showerheads is applicable for the *accelerated replacement* of the existing showerhead of 2.5 gpm flow rate or greater with a low-flow showerhead of 1.8 gpm or lower flow rate. The installed low-flow showerhead shall meet the requirements of test procedure ANSI/ASME A112.18.1-2000, Section 5.5

The measure for the installation of flow control valves is applicable for the *add-on equipment* onto an existing showerhead with the flow rate of 2.5 gpm or greater, reducing the flow rate to 1.5 gpm or lower.

The facility must have natural gas as the water heating source fuel.

Make and model number must be included with a copy of the invoice.

Eligible Building Types and Vintages

This measure is applicable for all existing commercial building types. Note however, that savings for this measure are based upon shower water use data and assumptions for lodging and schools.

Eligible Climate Zones

This measure is applicable in all California climate zones.

PROGRAM EXCLUSIONS

This measure is excluded from newly constructed buildings, additions to existing buildings, and alterations to existing buildings.

DATA COLLECTION REQUIREMENTS

The savings calculations for this measure utilized ex ante data for only hotels and schools. Due to lack of data, the savings for installations in educational facilities are applied to all commercial building types. Further testing data (several lodging facilities and different commercial building categories), in addition to a measurement and verification (M&V) plan may improve the verification of measurable savings for a more robust and representative sample of commercial building types. The plan can vary in depth and scope, and can include spot measurements, monitoring of fixtures use, and/or utility bill analysis.

USE CATEGORY

Service & Domestic Hot Water

ELECTRIC SAVINGS (KWH)

Not applicable.

PEAK ELECTRIC DEMAND REDUCTION (KW)

Not applicable.

GAS SAVINGS (THERMS)

Fundamentally, the gas unit energy savings (UES) from the installation of a low-flow showerhead or flow control valve is due to the reduction of hot water usage. The gas UES calculation, therefore, includes calculations of 1) water consumption and 2) unit energy consumption (UEC) associated with hot water usage with showerheads with the base case and measure case flow rates.

The water and gas consumption calculations are based on standard engineering methodologies, as documented for this measure by CLEAResult in 2016.[4] The data utilized to determine water and gas consumption from using hot water for showers were drawn from multiple studies. In particular, data from water conservation programs, published studies, and assumptions provided in technical references were utilized to calculate the average consumption of water per shower per year. The gas unit energy consumption and savings are a function of the calculated water savings per year. The water and gas consumption calculations are presented below.

Although one or more showers may be present in some offices, manufacturing buildings, etc., the gas savings of this measure were calculated for educational and lodging facilities as a placeholder for all commercial building types.

Water Savings Calculations

Water Savings Calculation for Lodging Applications

Lodging Case 1. Data drawn from a 2000 study conducted for the American Water Works Association (AWWA)[5] were utilized to determine the average water consumption from showers in individual hotel/motel rooms. Water consumption in five hotels was metered over a short-term period at either a whole-building level or sub-metered by room and then disaggregated to determine consumption at multiple end uses. The data was extrapolated to derive annual end use water consumption. For these calculations, each guest room is assumed to have one shower. Because occupancy rates and occupants per room vary, the data from the study were normalized using the weighted occupancy rate during testing and occupants per room to determine the annual water consumption per occupant.

$$Annual\ Water\ Consumption\ Per\ Occupant = \frac{Per\ Shower\ Consumption_{avg}}{OccRate_{wtd}\ \times OccPerRoom_{wtd}}$$

[4] CLEAResult. *2016. Savings Calculations for Commercial Showerhead – Baseline Water and Gas Consumption Estimates for Commercial Hot Water Applications.*

Southern California Gas Company (SCG). 2016. "WPSCGNRWH170412A-Rev01_Com_LFSH_Energy Savings Data and Calculations.xlsx."

[5] Dzieglelewski, B., J. Kiefer, E Opitz, G. Porter, G. Lantz, et. al. 2000. *Commercial and Institutional End Uses of Water.* Prepared for the American Water Works Association. Denver, CO: American Water Works Association (AWWA) Research Foundation.

$$\frac{12{,}207\ Gallons}{0.82 \times 1.87 \frac{Occupant}{Room}} = 7{,}938 \frac{Gallons}{Occupant}$$

Additional data was utilized to account for regional average of occupancy rate and national average of occupants per room to find the annual average consumption per shower. A study by PKF Consulting published in 2015[6] evaluated the Southern California lodging industry for the years from 2010-2015 and forecasted occupancy rates for the year 2016. The study shows that Los Angeles County represents 42% of the total market evaluated within the study and had an 80.0% occupancy rate in 2013, then 81.2% and 81.6% for 2014 and 2015, respectively. This shows that the occupancy rate is slightly rising over the years and has been for all evaluated years. The forecasted occupancy rate was projected to slightly drop by 0.1% in 2016. This projection of a slight drop may be an indication that occupancy rates will begin to decrease as historical data shows that fluctuation in lodging occupancy rates occur over time. Due to the possibility that the market is on the rise and rates may be at its peak, a weighted average for occupancy rate over the five years of data provided by PKF Consulting was calculated. This average rate was found to be 73.17%, which covers the following Southern California counties or areas: Los Angeles, San Diego, Orange County, Santa Barbara, Ventura, Coachella Valley, the Inland Empire, San Luis Obispo, and Southern California Coastal areas. For the purposes of the calculations for this measure, the weighted average of 73.17% occupancy rate was adopted to calculate all lodging related water and gas savings.[7]

The equation below represents the calculation to normalize annual water consumption per shower, assuming the number of showers identified in the study equals the number of guest rooms.

$$U_{hospitalit} = Annual\ Consumption\ Per\ Occupant \times OccRate_{Region} \times OccPerRoom_{Natl}$$

$$7{,}938 \frac{Gallons}{Occupant} \times 73.17\% \times 1.4 \frac{Occupants}{Room} = 8{,}131 \frac{Gallons}{Shower/yr}$$

The post-retrofit annual usage per shower was calculated using the post and existing flow rates:

$$8{,}131 \frac{Gallons}{Shower/yr} \times \frac{1.50\ gpm\ measure}{2.25\ gpm\ base} = 5{,}420 \frac{Gallons}{Shower/yr}$$

Lodging Case 2. Additional data from the *Potential for Urban Water Conservation in California* study conducted by the Pacific Institute[8] were utilized for an alternate calculation of water usage, based upon the typical shower length and the above occupancy data. The annual water consumption calculation is represented below, using an average shower time per occupant per day.

$$U_{hospitalit} = t \times V_{Base\ existing} \times 365 \times OccRate_{Region}$$

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[6] PKF Consulting USA. 2015. "Southern California Lodging Forecast."

[7] Southern California Gas Company (SCG). 2016. "WPSCGNRWH170412A-Rev01_Com_LFSH_Energy Savings Data and Calculations.xlsx."

[8] Gleick, P., D. Haasz, C. Henges-Jeck., V. Srinivasan, G. Wolff, K. Cushing, et al. (Pacific Institute). 2003. *Waste Not, Want Not: The Potential for Urban Water Conservation in California*. Appendix D; Table D-7 Page 5.

$$16.2\ \frac{Minutes}{Room\ (shower) \times Day} \times 2.25\frac{Gallons}{Minute} \times 365\frac{Day}{Year} \times 73.17\% = 9{,}734\ \frac{Gallons}{Shower}$$

The post-retrofit annual consumption per shower (W_{post2}) was calculated using the post and existing flow rates:

$$9{,}734\ \frac{Gallons}{Shower} \times \frac{1.5\ gpm\ post\ flowrate}{2.25\ gpm\ existing\ flowrate} = 6{,}489\ \frac{Gallons}{Shower}$$

Data and Assumptions for Lodging

Parameter	Description	Value	Source
$OccRate_{Region}$	Regional lodging occupancy rate	73.2%	PKF Consulting USA. 2015. "Southern California Lodging Forecast."
$OccPerRoom_{Natl}$	National lodging avg. # of guests per room	1.4	Dziegleleswki, B., J. Kiefer, E Opitz, G. Porter, G. Lantz, et. al. 2000. *Commercial and Institutional End Uses of Water.* Prepared for the American Water Works Association. Denver, CO: American Water Works Association (AWWA) Research Foundation. Page 82.
Days	Operating days per year (days)	365	Professional judgement.
Lodging Case 1			
V_{volume}	Annual metered shower water consumption (five hotels) (gal/yr)	11,731,000	Dziegleleswki, B., J. Kiefer, E Opitz, G. Porter, G. Lantz, et. al. 2000. *Commercial and Institutional End Uses of Water.* Prepared for the American Water Works Association. Denver, CO: American Water Works Association (AWWA) Research Foundation.
$N_{showers}$	Total number of showers (showers)	961	
$OccRate_{wtd}$	Weighted occupancy rate during testing	0.82	
$OccPerRoom_{wtd}$	Average occupants per room	1.87	
$W_{baseline\ Avg}$	Base case water consumption per shower	12,207	
$W_{baseline\ Avg}$	Base case water consumption, normalized from the national avg. rate (gal/shower/yr)	8,131	
$E_{therm\ baseline\ Avg}$	Base case gas consumption per shower per year (Therms/yr)	35.38	
Lodging Case 2			
t_{shower}	Shower minutes per occupant per day (min/shower)	16.2	PKF Consulting USA. 2015. "Southern California Lodging Forecast." Dziegleleswki, B., J. Kiefer, E Opitz, G. Porter, G. Lantz, et. al. 2000. *Commercial and Institutional End Uses of Water.* Prepared for the American Water Works Association. Denver, CO: American Water Works Association (AWWA) Research Foundation.
$W_{baseline\ Avg}$	Base case water consumption per shower per year (gal/yr)	9,734	Gleick, P., D. Haasz, C. Henges-Jeck., V. Srinivasan, G. Wolff, K. Cushing, et al. (Pacific Institute). 2003. *Waste*

Parameter	Description	Value	Source
$E_{therm\ baseline\ Avg}$	Base case gas consumption per shower per year (Therms/yr)	42.35	*Not, Want Not: The Potential for Urban Water Conservation in California*. Appendix D; Table D-7 Page 5.

Schools Water Savings Calculation

The calculation below includes the parameters for the calculation of the annual average water usage for showers in schools. Water consumption data were logged and bills were reviewed for four schools, the inputs and assumptions are specified in the table below.

The average baseline water usage for individual showers was calculated as:

$$\frac{258{,}000\ Gallons}{59\ Showers} = 4{,}373\frac{Gallons}{Year}$$

The post-retrofit annual usage per shower was calculated using the measure and baseline flow rates:

$$4{,}373\ \frac{Gallons}{Shower} \times \frac{1.50\ gpm\ measure\ flowrate}{2.25\ gpm\ base\ flowrate} = 2{,}915\ \frac{Gallons}{Shower}$$

Inputs and Assumptions for Schools

Parameter	Description	Value	Source
$OccRate_{Regionl}$	Total annual metered shower water consumption (gal)	258,000	Dziegleleski, B., J. Kiefer, E Opitz, G. Porter, G. Lantz, et. al. 2000. *Commercial and Institutional End Uses of Water.* Prepared for the American Water Works Association. Denver, CO: American Water Works Association (AWWA) Research Foundation.
$OccPerSchool_{Natl}$	Total number of showers	59	
Days	Operating days per year (days)	220	
$t_{shower\text{-}yr}$	Annual shower utilization (min/yr)	1,944	CLEAResult. 2016. *Savings Calculations for Commercial Showerhead – Baseline Water and Gas Consumption Estimates for Commercial Hot Water Applications.*

Annual Water Usage Per Shower

Showerhead Flow Rate (gpm)	Water Usage (gallons per showerhead per year)	
	Lodging	School
2.25	8,932	4,373
1.50	5,955	2,915
1.80	7,146	3,498

Annual Water Savings Per Shower (1st baseline)

Showerhead Flow Rate (gpm)	Water Savings (gallons per showerhead per year)	
	Lodging	School
1.50	2,977	1,458
1.80	1,786	875

Energy Savings Calculation

The annual gas UES is a function of the water saved, the temperature differential between the groundwater and mixed water temperatures, and the efficiency of the commercial gas water heater. The parameters, assumptions and conversion factors of this calculation are specified and explained below.

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

$UES_{therms} =$	*Annual gas unit energy savings (therms/year)*
$WS =$	*Water savings*
$Cp =$	*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)*
$T_{ground} =$	*Supply water(groundwater) temperature, (°F)*
$EFF_{gas} =$	*Water heater efficiency, gas (thermal efficiency)*

Inputs and Assumptions

Description	Value	Source
Existing showerhead water flow (gpm)	2.25	Southern California Gas Company (SCG). 2016. “Att.-C_WPSCGNRWH170412A-Rev01_Com_LFSH_Sample of Data Collected at Hotels.xlsx”
Base case showerhead water flow (gpm)	2.00	California Energy Commission (CEC). 2017. *2016 Appliance Efficiency Regulations*. CEC-400-2017-002. Section 1605.3.
Base case showerhead water flow (gpm)	1.80	
Water Heater Thermal Efficiency (gas)	83%	California Public Utilities Commission (CPUC), Energy Division. 2020. "DEER-WaterHeater-Calculator-v4.2.xlsm." Updated September 17, 2020. Itron, Inc. and ERS, Inc. 2016. “2014 Nonresidential Downstream Deemed ESPI Pipe Insulation Impact Evaluation Report.” Prepared for the California Public Utilities Commission. Itron, Inc. and ERS, Inc. 2017. 2015 Nonresidential Downstream Deemed ESPI Pipe Insulation Impact Evaluation Report. Prepared for the California Public Utilities Commission.
Post flow rate (gpm)	1.50	*(measure case gpm)*
Mixed water temperature (°F)	106 °F	California Public Utilities Commission (CPUC), Energy Division. 2013. “2013-2014_DHWFixtureMeasures_Disposition-1March2013.xls.” February 22. See “Annexe_Low_FlowShowerHeads_gas” tab.
Supply water (groundwater) temperature	Varies by climate zone	See below.
Density of water (lb / gal)	8.34	*Fixed constant.*
Specific heat of water (Btu/lb-°F)	1.0	*Fixed constant.*

Make-Up (Groundwater) Temperature. Make-up water(groundwater) temperature was derived from data collected from a field survey conducted for the Sempra Energy Utilities (San Diego Gas and Electric and the Southern California Gas Company) in 2009.[9]

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	

Mixed Water Temperature. The mixed water temperature was determined from physical water temperature measurements recorded in the Water Saver Solutions and the Blackstone Research Solutions studies.

Water Heater Thermal Efficiency. The efficiency of a gas water heater was derived from data extracted from the California Energy Commission Water Heater Calculatorv4.1 in 2020. The average thermal efficiencies for all baseline water heater technologies was used and compared to the deemed pipe insulation evaluation conducted by Itron, Inc.

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.

The RUL is only applicable to the first baseline period for a retrofit or accelerated replacement measure with an applicable code baseline. 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

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

remaining useful life until further study results are available to establish more accurate values."[10] This approach provides an RUL estimate without the requiring any a priori knowledge about the age of the equipment being replaced.[11]

The EUL and RUL specified for this measure are specified below. The EUL of the residential sector showerhead measure is adopted for this commercial sector measure; showerheads are subject to similar operating conditions, regardless of flow rate. Thus, it is expected that all low-flow showerheads have approximately the same EUL. The first baseline period savings utilizes the RUL period of 1/3 of the useful life. The second period savings utilizes the value of the EUL less the RUL.

Effective Useful Life and Remaining Useful Life

Parameter	Value	Source
EUL – showerhead	10.00	California Public Utilities Commission (CPUC). 2014. "DEER2014-EUL-table-update_2014-02-05.xlsx."
RUL =1/3 EUL (1st baseline)	3.33	California Public Utilities Commission (CPUC), Energy Division. 2013. *Energy Efficiency Policy Manual Version 5*. Page 32.
EUL less the RUL (2nd baseline)	6.67	

BASE CASE MATERIAL COST ($/UNIT)

The base case material cost for a 2.5 gpm showerhead was drawn from the Database of Energy Efficient Resources and is used for the 2nd baseline period for *accelerated replacement* installations. Base case material costs for *accelerated replacement and add-on equipment installations* are equal to $0 in the first baseline period.

MEASURE CASE MATERIAL COST ($/UNIT)

The measure case material cost for a low-flow showerhead (< 2.0 gpm) showerhead was directly from the Database for Energy Efficient Resources (DEER) 2008 measure cost documentation.[12]

The measure case material cost of all flow control valve flow rates and all installation types were drawn from their original workpapers from SoCalGas, WPSCGCCWH180504A-R0. The cost from these workpapers stem from research done through existing distributors and manufacturers.

[10] California Public Utilities Commission (CPUC), Energy Division. 2013. *Energy Efficiency Policy Manual Version 5*. Page 32.

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

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

BASE CASE LABOR COST ($/UNIT)

Insofar as the low-flow showerhead components are fundamentally the same as a base case fixture, the installation costs for the base and measure case fixtures are assumed to be equal. See Measure Case Labor Cost.

MEASURE CASE LABOR COST ($/UNIT)

The installation cost per shower head was drawn from the Database of Energy Efficient Resources (DEER). Insofar as the low-flow showerhead components are fundamentally the same as a base case fixture, the installation costs for the base and measure case fixtures are assumed to be equal. The measure case labor costs for the installation of flow control valves is assumed to be equal to that of the installation of the showerhead.

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. These NTG values are based upon the average of all NTG ratios for all evaluated 2006 – 2008 commercial, industrial, and agriculture programs, as documented in the 2011 DEER Update Study conducted by Itron, Inc. These sector average NTGs ("default NTGs") are applicable to all energy efficiency measures that have been offered through commercial, industrial, and agriculture sector programs for more than two years and for which impact evaluation results are not available.

Net-to-Gross Ratios

Parameter	Electric	Gas	Source
NTG – Commercial	0.60	0.60	Itron, Inc. 2011. *DEER Database 2011 Update Documentation.* Prepared for the California Public Utilities Commission. Page ES-8 Table ES-9 and Page 15-4 Table 15-3.

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. This GSIA rate is the current "default" rate specified for measures for which an alternative GSIA has not been estimated and approved.

Gross Savings Installation Adjustment

Parameter	Value	Source
GSIA	1.0	California Public Utilities Commission (CPUC), Energy Division. 2013. *Energy Efficiency Policy Manual Version 5*. Page 31.

NON-ENERGY BENEFITS

The water savings that result from the replacement of a standard base case showerhead with a low-flow showerhead represent the non-energy benefits quantified for this measure. See Gas Savings for the water savings calculation methodology and explanation of data sources and inputs.

DEER DIFFERENCES ANALYSIS

This section provides a summary of DEER-based inputs and methods, and the rationale for inputs and methods that are not DEER-based.

DEER Difference Summary

DEER Item	Comment / Used for Workpaper
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	No
Reason for Deviation from DEER	DEER does not contain this measure for the commercial sector.
DEER Measure IDs Used	n/a
NTG	Source: DEER. The NTG of is associated with NTG ID: Com-*Default>2yrs*
GSIA	Source: DEER. The GSIA of 1.0 is associated with GSIA ID: *Def-GSIA*
EUL/RUL	Source: DEER. The value of 10 years is associated with EUL ID: *WtrHt-WH-Shrhd*.

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: WPSCGNRWH170412A Revision 1 (December 21, 2017) Consensus reached among Cal TF members.
	01/31/2019	Jennifer Holmes Cal TF Staff	Revisions for submittal of version 01.
02	06/14/2019	Jennifer Holmes (Cal TF Staff) / Matthew Mendoza (SCG)	Addition of 1.5 gpm flow control valve measure
03	10/7/2020	Anders Danryd SoCalGas	Updated water heater thermal efficiency to match baseline technologies in “Water Heater Calculator v4.2” per E-5082
	11/20/2020	Anders Danryd SoCalGas	Removed NTG Adjustment factor