

PUBLIC UTILITIES COMMISSION

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SAN FRANCISCO, CA 94102-3298



April 12, 2017

Advice Letter 5084-A

Ronald van der Leeden
Director, Regulatory Affairs
Southern California Gas
555 W. Fifth Street, GT14D6
Los Angeles, CA 90013-1011

**Subject: Supplement – Notification of Updated Energy Savings Assistance
(ESA) Program Thermostatic Tub Spout Measure Savings**

Dear Mr. van der Leeden:

Advice Letter 5084-A is effective as of January 27, 2017.

Sincerely,

A handwritten signature in cursive script that reads "Edward Randolph".

Edward Randolph
Director, Energy Division



Ronald van der Leeden
Director
Regulatory Affairs

555 W. Fifth Street, GT14D6
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March 9, 2017

Advice No. 5084-A
(U 904 G)

Public Utilities Commission of the State of California

Subject: Supplement - Notification of Updated Energy Savings Assistance (ESA) Program Thermostatic Tub Spout Measure Savings

Purpose

Southern California Gas Company (SoCalGas) hereby notifies the California Public Utilities Commission (Commission) of updated savings relating to the Thermostatic Tub Spout (TTS) Measure in the ESA Program.

This supplemental filing replaces in its entirety Advice No. 5084, Notification of Updated ESA TTS Measure Savings, filed on January 27, 2017. The purpose of this Advice Letter is to provide information on the cost-effectiveness of the TTS Measure.

Discussion

On November 18, 2014, SoCalGas filed Application (A.) 14-11-011 seeking approval of the TTS Measure in the ESA Program in efforts to increase both energy and water savings. On November 21, 2016, the Commission issued Decision (D.) 16-11-022 which approved the “deployment of thermostatic tub spouts in the ESA Program as they become commercially available in 2016 and are consistent with the projected savings in SoCalGas’ application.”¹

In A.14-11-011, SoCalGas had indicated that the TTS Measure was expected to achieve 2,135,197 first year therm savings each for 2016 and 2017.² On April 25, 2016, SoCalGas submitted Workpaper SWWH001v00, *Auto-Diverting Tub Spout with Thermostatic Shut-Off Valve*, in the Energy Efficiency Rolling Portfolio Rulemaking (R.13-11-005) in support of SoCalGas’ Residential Deemed Energy Efficiency

¹ See D.16-11-022 at pp. 145-146; and Conclusion of Law 47.

² Prepared Direct Testimony of Mark Aguirre and Hugh Yao November 18, 2014, at p. 107 and Exhibit 2: ESA Program Measures & Associated First Year Therm Savings.

programs. The Workpaper, included as Attachment A, provided new information regarding the total savings the TTS Measure is expected to achieve. In Table 1 below, and as further described in the Workpaper, SoCalGas provides new energy savings findings per unit for the TTS installation scenarios under SoCalGas' ESA Program.³

Table 1: ESA Thermostatic Tub Spout Savings Per Unit

Climate Zone	Housing Type	Tub Spout Therm Savings Per installation
4	SF	8.63
4	MF	9.63
4	MH	8.63
5	SF	9.30
5	MF	10.38
5	MH	9.30
6	SF	8.21
6	MF	9.17
6	MH	8.21
8	SF	7.84
8	MF	8.76
8	MH	7.84
9	SF	7.83
9	MF	8.75
9	MH	7.83
10	SF	7.78
10	MF	8.70
10	MH	7.78
13	SF	7.83
13	MF	8.77
13	MH	7.83
14	SF	8.09
14	MF	9.07
14	MH	8.09
15	SF	5.76
15	MF	6.49
15	MH	5.76

³ See Workpaper, Attachment A, p. 22.

16	SF	10.09
16	MF	11.28
16	MH	10.09

In total, SoCalGas projects installation of 384,959 tub spouts saving a total of 3,006,364 first-year therms over 2017-2020, based on the treated unit goals adopted in D.16-11-022 as shown in Table 2 below.

Table 2: Thermostatic Tub Spout Projected Energy Savings 2017-2020

	2017	2018	2019	2020	TOTAL
Treated Unit Goal	110,000	115,500	121,275	127,339	474,114
Tub Spout Installations	89,315	93,781	98,470	103,393	384,959
Projected Expenditures	\$9,187,834	\$9,859,465	\$10,582,262	\$11,353,625	\$40,983,186
First Year Therm Savings	709,689	745,176	782,434	769,064	3,006,364
Lifecycle Therm Savings	7,096,890	7,451,760	7,824,340	7,690,640	30,063,640

As estimated in the Workpaper⁴, the TTS provides less energy savings than projected in A.14-11-011. Nevertheless, the resulting cost effectiveness calculations remain consistent with SoCalGas' inclusion of TTS in its ESA portfolio. Specifically, with the exception of climate zone 15, TTS has a cost effectiveness above 1.0 as measured by the ESACET test for all climate zones and housing types. For the Resource TRC test, TTS is above the portfolio average 0.36 for all climate zones and housing types. Please see Attachment B for complete ESACET and Resource TRC calculation results.⁵ Incorporating the TTS in the SoCalGas ESA portfolio, as opposed to leaving it out, raises both the total Resource TRC and the total ESACET result as shown in Table 3.

Table 3: SoCalGas Cost Effectiveness 2017 Portfolio Comparison

Errata Filing		Using New Tub Spout Savings		Taking Tub spouts out of portfolio (Quantity = 0)	
ESACET	Resource TRC	ESACET	Resource TRC	ESACET	Resource TRC
0.90	0.58	0.79	0.41	0.77	0.36

⁴ The Workpaper contains unit installed cost estimates relevant to another program; these do not apply to ESA.

⁵ Advice Letter to be filed March 31, 2017.

In order to demonstrate the impact on the portfolio of the TTS and the change in that measure's savings, cost effectiveness results provided in this table are presented based on the parameters used for year 2017 of SoCalGas' Errata Application Filing. Between the "Errata Filing" and "Using New Tub Spout Savings" scenarios shown, only the TTS savings are varied demonstrating the impact of that adjustment on the portfolio. In the "Taking Tub Spouts Out" scenario, the TTS is removed demonstrating that the measure remains a net benefit to portfolio cost effectiveness.

The TTS Measure remains an important part of SoCalGas' ESA Program measure portfolio and one of the most substantial contributors to therm savings. The energy savings provided in the Workpaper, while lower than the figures presented in SoCalGas' Application, are consistent with SoCalGas' recommendation that this measure be included in SoCalGas' 2017-2020 measure mix. In addition, the measure provides significant water savings, and offers cost effectiveness metrics that compare favorably to the balance of SoCalGas' portfolio.

SoCalGas plans to begin installing tub spouts in first quarter 2017.

Protests

Anyone may protest this Advice Letter to the Commission. The protest must state the grounds upon which it is based, including such items as financial and service impact, and should be submitted expeditiously. Pursuant to discussions held with Energy Division, SoCalGas hereby requests that the protest must be made in writing and received by March 14, 2017, which is five days from the filing of this Advice Letter. There is no restriction on who may file a protest. The address for mailing or delivering a protest to the Commission is:

CPUC Energy Division
Attn: Tariff Unit
505 Van Ness Avenue
San Francisco, CA 94102

Copies of the protest should also be sent via e-mail to the attention of Energy Division Tariff Unit (EDTariffUnit@cpuc.ca.gov). A copy of the protest should also be sent via both e-mail and facsimile to the address shown below on the same date it is mailed or delivered to the Commission.

Attn: Ray B. Ortiz
Tariff Manager - GT14D6
555 West Fifth Street
Los Angeles, CA 90013-1011
Facsimile No. (213) 244-4957
E-mail: ROrtiz@SempraUtilities.com

Effective Date

SoCalGas believes this Advice Letter is subject to Energy Division disposition and, at the direction of Energy Division, should be classified as Tier 1 (effective pending disposition) pursuant to General Order (GO) 96-B. Therefore, SoCalGas respectfully requests that this Advice Letter become effective on January 27, 2017, which is the date requested on Advice No. 5084.

Notice

A copy of this Advice Letter is being sent SoCalGas' GO 96-B service list and the Commission's service list in A.14-11-007. Address change requests to the GO 96-B should be directed by electronic mail to tariffs@socalgas.com or call 213-244-3387. For changes to all other service lists, please contact the Commission's Process Office at 415-703-2021 or by electronic mail at Process_Office@cpuc.ca.gov.

Ronald van der Leeden
Director - Regulatory Affairs

Attachments

CALIFORNIA PUBLIC UTILITIES COMMISSION

ADVICE LETTER FILING SUMMARY ENERGY UTILITY

MUST BE COMPLETED BY UTILITY (Attach additional pages as needed)

Company name/CPUC Utility No. **SOUTHERN CALIFORNIA GAS COMPANY (U 904G)**

Utility type:

ELC

GAS

PLC

HEAT

WATER

Contact Person: Ray B. Ortiz

Phone #: (213) 244-3837

E-mail: ROrtiz@semprautilities.com

EXPLANATION OF UTILITY TYPE

ELC = Electric

GAS = Gas

PLC = Pipeline

HEAT = Heat

WATER = Water

(Date Filed/ Received Stamp by CPUC)

Advice Letter (AL) #: 5084-A

Subject of AL: Supplement - Notification of Updated Energy Savings Assistance (ESA) Program
Thermostatic Tub Spout Measure Savings

Keywords (choose from CPUC listing): Energy Efficiency

AL filing type: Monthly Quarterly Annual One-Time Other

If AL filed in compliance with a Commission order, indicate relevant Decision/Resolution #:

None

Does AL replace a withdrawn or rejected AL? If so, identify the prior AL No

Summarize differences between the AL and the prior withdrawn or rejected AL¹: N/A

Does AL request confidential treatment? If so, provide explanation: No

Resolution Required? Yes No

Tier Designation: 1 2 3

Requested effective date: 1/27/17

No. of tariff sheets: 0

Estimated system annual revenue effect (%): N/A

Estimated system average rate effect (%): N/A

When rates are affected by AL, include attachment in AL showing average rate effects on customer classes (residential, small commercial, large C/I, agricultural, lighting).

Tariff schedules affected: N/A

Service affected and changes proposed¹: N/A

Pending advice letters that revise the same tariff sheets: N/A

Protests and all other correspondence regarding this AL are due no later than 20 days after the date of this filing, unless otherwise authorized by the Commission, and shall be sent to:

CPUC, Energy Division

Attention: Tariff Unit

505 Van Ness Ave.,

San Francisco, CA 94102

EDTariffUnit@cpuc.ca.gov

Southern California Gas Company

Attention: Ray B. Ortiz

555 West 5th Street, GT14D6

Los Angeles, CA 90013-1011

ROrtiz@semprautilities.com

Tariffs@socalgas.com

¹ Discuss in AL if more space is needed.

ATTACHMENT A

Advice No. 5084-A

Workpaper SWWH001v00

Auto-Diverting Tub Spout with Thermostatic Shut-off Valve

- Tub Spout Calculations (Attachment A to Workpaper SWWH001v00)
- Tub Spout and Showerhead Cost Data (Attachment B to Workpaper SWWH001v00)

Workpaper SWWH001v00

Revision #0

Southern California Gas Company

Auto-Diverting Tub Spout with Thermostatic Shut-off Valve

April 25, 2016

AT-A-GLANCE SUMMARY

Measure Codes	ShwFLr005, ShwFLr006	ShwFLr007, ShwFLr008
Measure Description	The Auto-diverting tub spout (5.0 gpm) with thermostatic shut-off valve purges cold water through tub spout until the water raises to 95° F. The water is then diverted to the showerhead at a trickle until full flow (1.5 gpm) is activated via the pull cord.	The Auto-diverting tub spout (5.0 gpm) with thermostatic shut-off valve purges cold water through tub spout until the water raises to 95° F. The water is then diverted to the showerhead at a trickle until full flow (1.5 gpm) is activated via the pull cord.
Base Case Description	5.0 gpm tub spout with a 2.0 gpm showerhead combo	5.0 gpm tub spout with a 1.8 gpm showerhead combo
Units	Each	Each
Energy Savings	Refer to Excel Saving Calculation Attachment A	Refer to Excel Saving Calculation Attachment A
Full Measure Cost (\$/unit)	\$119.99	\$119.99
Incremental Measure Cost (\$/unit)	\$94.00	\$91.38
Effective Useful Life	10 years (DEER EUL ID: WtrHt-WH-Shrhd)	10 years (DEER EUL ID: WtrHt-WH-Shrhd)
Measure Installation Type	New Construction (NEW/NC), Replace on Burnout (ROB)	Early Retirement (ER)
Net-to-Gross Ratio	0.7 (DEER NTGR ID: All-Default<=2yrs) 0.85 (DEER NTGR ID : Res-Default-HTR-di)	0.7 (DEER NTGR ID: All-Default<=2yrs) 0.85 (DEER NTGR ID : Res-Default-HTR-di)
Important Comments	Calculated water savings for single family and multi-family are 1806.95 and 2017.62 gallons per year respectively. This Workpaper has a complementary Ex Ante Database dataset that will be provided in a separate submission to the California Public Utilities Commission (CPUC).	Calculated water savings for single family and multi-family are 1806.95 and 2017.62 gallons per year respectively. This Workpaper has a complementary Ex Ante Database dataset that will be provided in a separate submission to the California Public Utilities Commission (CPUC).

REVISION HISTORY

Rev	Date	Author	Summary of Changes
0	04/25/16	Miguel Urrea (SCG)	<ul style="list-style-type: none">Initial Release

COMMISSION STAFF AND CAL TF COMMENTS

Rev	Party	Submittal Date	Comment Date	Comments	WP Developer Response

Cal TF website: <http://www.caltf.org/>

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SECTION 1. GENERAL MEASURE & BASELINE DATA

1.1 MEASURE DESCRIPTION & BACKGROUND

For users intending to save energy and water during showers this measure offers a unique option, not until recently, available in the market. The Auto-diverting Tub Spout (ADTS) with thermostatic shut-off valve (TSV) replaces tub spouts and showerheads in the residential market with shower-bathtub combos (62% of all showers¹). With behavioral waste continuing to be a significant problem² during shower warm-ups along with leaky tub spouts³ new technologies are needed. This measure saves energy and water by reducing shower warm-up waste, replaces leaky tub spouts, and lowering the showerhead flowrate. Mobile home savings are the same as single-family home savings and will not have a separate energy impact profile. NEW and ROB measures types will use code baseline from 2016 – 2.0 gpm showerhead. ER measure type will use code baseline from 2018 – 1.8 gpm due to the RUL of 3 years.

Table 1 -Base, Standard, and Measure Cases

Case	Description of Typical Scenario
Measure	Auto-diverting Tub Spout (5.0 gpm) with thermostatic shut-off valve and 1.5 gpm showerhead
Existing Condition	5.0 gpm tub spout with a 2.25 gpm showerhead
Code/Standard (2016)	5.0 gpm tub spout with a 2.0 gpm showerhead
Code/Standard (2018)	5.0 gpm tub spout with a 1.8 gpm showerhead
Industry Standard Practice	N/A

Table 2 -Measures and Codes

Measure Codes				Measure Name
SCG	SDG&E	SCE	PG&E	
ShwFLr005				Auto-diverting Tub Spout with thermostatic shut-off valve Showerhead (1.5 gpm) –Gas
ShwFLr006				Auto-diverting Tub Spout with thermostatic shut-off valve Showerhead (1.5 gpm) –Electric
ShwFLr007				Auto-diverting Tub Spout with thermostatic shut-off valve Showerhead (1.5 gpm) –Gas
ShwFLr008				Auto-diverting Tub Spout with thermostatic shut-off valve Showerhead (1.5 gpm) –Electric

Describe requirements for these measures, including:

- Eligibility requirements:** Water heating source using natural gas or electricity distributed by IOU. The measure cannot be applied where tankless water heaters are used. Instantaneous tankless water heaters may have different effect on savings with thermostatic shut-off valves. Not compatible with showers containing a wall mounted diverter
- Implementation and installation requirements:** Measures presented in this Workpaper apply to single-family, mobile, and multi-family residential households.

¹ Residential End Uses of Water (Mayer, 1999).

² Disaggregating Residential Shower Warm-Up Waste (Sherman, 2014).

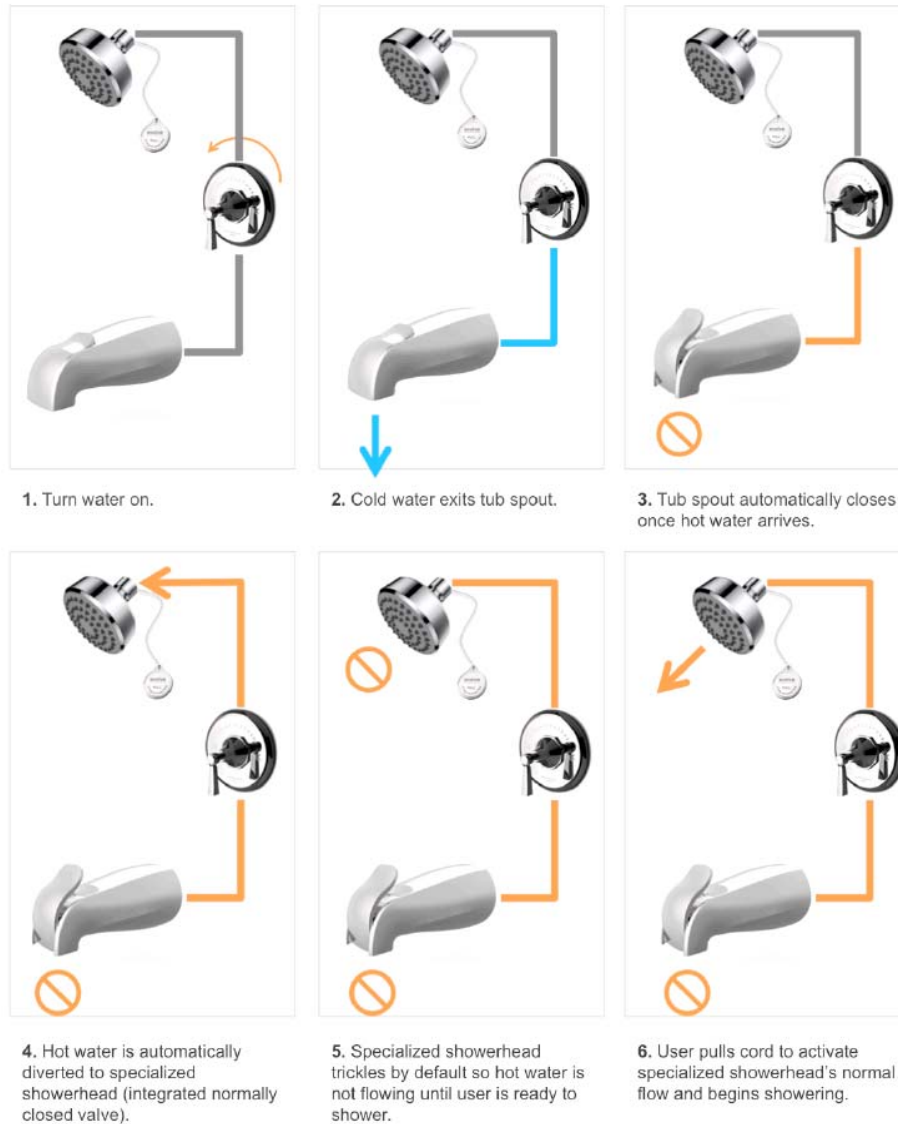
³ Leaking Shower Diversers (Taitem Engineering, 2011).

- **Other program restrictions and guidelines:** Make and model number must be included with a copy of the purchase receipt. Product must be certified by International Association of Plumbing and Mechanical Officials (IAPMO).

1.2 TECHNICAL DESCRIPTION

The ATDS with TSV helps to reduce structural waste, diminish behavioral waste to a trickle, stop tub spout leak, and lowers the showerhead flow rate to 1.5 gpm. These benefits are realized through the use of a flow diverter and TSV within the tub spout that detects when water reaches 95° F. The technology purges the cold water in the shower piping through the spout causing faster hot water arrival water with less water (structural waste)². Once the hot water arrives, the diverter changes the flow direction to the showerhead where the water flow is reduced to a trickle with no tub spout leak. Then the user simply pulls the lanyard on the showerhead to open the valve and allow normal water flow.

Figure 1 - How the ADTS System Works



1.3 INSTALLATION TYPES AND DELIVERY MECHANISMS

The Tub Spout will be offered as a direct install and as a downstream rebate. These delivery channels were selected to deliver the Tub Spout since they are the same as current low flow showerhead program.

Table 3 - Installation Type Descriptions

Installation Type	Savings		Life	
	1 st Baseline (BL)	2 nd BL	1 st BL	2 nd BL
Replace on Burnout (ROB)	Above Code or Standard	N/A	EUL	N/A
New Construction (NEW/NC)	Above Code or Standard	N/A	EUL	N/A
Retrofit or Early Replacement (RET/ER)	Above Customer Existing	Above Code or Standard	RUL	EUL-RUL

A delivery mechanism is a delivery method paired with an incentive method. Delivery mechanisms are used by programs to obtain program participation and energy savings.

Table 4 - Delivery Method Descriptions

Delivery Method	Description
Financial Support	The program motivates customers, through financial incentives such as rebates or low interest loans, to implement energy efficient measures or projects.
New Construction	The program offers financial incentives and/or design assistance to customers involved with new building construction. This is intended is to motivate customer to exceed Title 24 building energy efficiency requirements (residential or nonresidential).

Table 5 - Incentive Method Descriptions

Incentive Method	Description
Direct Install	The program implements energy efficiency measures for qualifying customers, at no cost to the customer.
Down-Stream Incentive	The customer installs qualifying energy efficient equipment and submits an incentive application to the utility program. Upon application approval, the utility program pays an incentive to the customer. Such an incentive may be deemed or customized.

1.4 MEASURE PARAMETERS

1.4.1 DEER Data

There are currently no DEER measures that apply to this type of technology.

Table 6 - DEER Difference Summary

DEER Item	Used for Workpaper?
Modified DEER methodology	No
Scaled DEER measure	No
DEER Base Case	No
DEER Measure Case	No
DEER Building Types	Yes
DEER Operating Hours	No
DEER eQUEST Prototypes	No
DEER Version	DEER 2016
Reason for Deviation from DEER	DEER does not contain this type of measure.
DEER Measure IDs Used	N/A

Net-to-Gross Ratio

The NTG values were obtained using the DEER READI tool⁴. The relevant NTG values for the measures in this Workpaper are in the table below. This is a new technology that varies from the standard low flow showerhead and thermostatic shut-off valve.

Table 7 -NTGR ID

NTGR ID	Description	Sector	BldgType	Measure Delivery	NTGR
All-Default <=2yrs	All other EEM with no evaluated NTGR; new technology in program for 2 or fewer years	All	Any	Any	0.7
Res-Default- HTR-di	All other EEM with no evaluated NTGR; direct install hard-to-reach only.	Res	Any	DirInstall	0.85

*Direct install measures that are not hard-to-reach will use the default NTG value.

Spillage Rate

Spillage rates are not tracked in Workpapers; they are tracked in an external document which will be supplied to the Commission Staff.

Installation Rate

The GSIA ID for low flow showerheads with flow restrictor valve and without flow restrictor valve is the closest technology description to the ADTS with TSV. Neither of the GSIA IDs are applicable to this Workpaper because of the forced tub spout warm-up and the type of installation required for this technology. The default GSIA ID is used. The GSIA values were obtained using the DEER READI tool⁴. The relevant IR values for the measures in this Workpaper are in the table below.

Table 8 -GSIA ID

GSIA ID	Description	Sector	BldgType	ProgDelivID	GSIAValue
Def-GSIA	Default GSIA values	Any	Any	Any	1

Effective and Remaining Useful Life

The EUL and RUL values were obtained using the DEER READI tool⁴. DEER defines the RUL as 1/3 of the EUL value. The RUL value is only applicable to the first baseline period for an RET measure with an applicable code baseline. The DEER effective useful life for low-flow showerheads was employed as the technologies are subjected to very similar conditions and would be expected to have approximately the same EUL of 10 years⁵. The relevant EUL and RUL values for the measures in this Workpaper are in the table below.

Table 9 -EUL ID

EUL ID	Description	Sector	UseCategory	EUL (Years)	RUL (Years)
WtrHt-WH- Shrhd	Low-Flow Showerhead	Res	SHW	10	3.3

⁴ (Remote Ex-Ante Database Interface, 2015).

⁵ Tub Spout Flow-Reduction Systems Test (Hsia, 2015).

1.4.2 Codes and Standards Analysis

Table 10 - Code Summary

Code	Reference	Effective Dates
Title 20 (2014) ⁶	Section 1605.3	July 1, 2016

Table 11 - Standards for Showerheads

Appliance	Maximum Flow Rate		
	Manufactured on or after January 1, 1994 and prior to July 1, 2016	Manufactured on or after July 1, 2016 and prior to July 1, 2018	Manufactured on or after July 1, 2018
Showerheads	2.5 gpm at 80 psi	2.0 gpm at 80 psi	1.8 gpm at 80 psi

*Taken from Title 20 Section 1605.3 Table H-5

1.5 EM&V, MARKET POTENTIAL, AND OTHER STUDIES – BASE CASE AND MEASURE CASE INFORMATION

In order to establish savings, conservative values were chosen.

1.5.1 Disaggregating Residential Shower Warm-Up Waste (Sherman 2014)

An Understanding and Quantification of Behavioral Waste Based On Data from Lawrence Berkeley National Lab

Type	Analysis of shower water waste data
Author	Troy Sherman of Evolve Technologies LLC
Completion Date	August 2014
Time Frame	2013 to 2014
Market Covered	Single Family
Techniques Used	1,057 Survey respondents and 19 homes monitored throughout California
Relevance/Impacts	This study quantifies structural waste and behavioral waste time frames due to shower warm-ups in single family homes. The data and findings from this study help establish the base case consumption and water savings for this Workpaper.
Concerns (Survey Techniques, # of respondents, etc...)	The flow rate average of the dedicated showers and tub/shower combos participating in the study was 1.79 gpm. This average is significantly below the typical 2.2 gpm flow rates cited in multiple REUW studies. The lower average flow rates indicate the study's participants are likely more conservation oriented than average and, as a result, could be producing less total warm-up waste than typical. Data does not take multi-family residents into consideration, but is used in Workpaper as best available data.

1.5.2 Evaluation of Potential Best Management Practices – Residential Hot Water Distribution (Koeller 2007)

An analysis of the waste of water that occurs in a typical household between the times the tap/fixture is turned on and desired useful hot water arrives.

⁶ Water Appliance Amendments (California Energy Commission, 2016).

Type	Research on structural water waste
Author	John Koeller of Koeller and Company
Completion Date	October 2006
Time Frame	2005
Market Covered	Single Family and multi-family
Techniques Used	Laboratory tests
Relevance/Impacts	This study quantifies structural waste in terms of water in pipe (100 ft. of pipe). The study focuses on how various flow rates affect structural waste.
Concerns (Survey Techniques, # of respondents, etc...)	No concerns

1.5.3 Taitem Tech Tip – Leaking Shower Diverters (Taitem 2011)

Diverter valves with leaks in shower mode waste both water and energy.

Type	Research on leaking shower diverters
Author	Taitem Engineering
Completion Date	2011
Time Frame	2011
Market Covered	Single Family and multi-family
Techniques Used	Survey of 130 apartment and houses with 120 bath/shower units w/ diverters
Relevance/Impacts	Study found that 34% of the diverters leaked more than 0.1 gallons per minute (gpm) with the average at 0.8 gpm.
Concerns (Survey Techniques, # of respondents, etc...)	No concerns

1.5.4 Residential End Uses of Water (REUW 1999)

Study designed to provide specific data on the end uses of water in single-family residential settings across the country.

Type	Study on single family end use of water
Author	Peter W. Mayer and William B. DeOreo of Aquacraft, Inc.
Completion Date	1999
Time Frame	1996 to 1997
Market Covered	Single Family
Techniques Used	Survey of 5,000 households and detailed end use study of 1,200 households.
Relevance/Impacts	Mean shower volume is 17.2 gallons
Concerns (Survey Techniques, # of respondents, etc...)	No concerns

1.5.5 SEU Survey conducted by ASW (ASW 2009)

Data from various residential water measurements and household questionnaire responses from Feb to May 2009

Type	Survey on residential water use
Author	ASW
Completion Date	2009
Time Frame	February to May 2009
Market Covered	Single Family
Techniques Used	Survey of 249 households.
Relevance/Impacts	Mean number of showerheads in single family household is 2.01. Pre-existing showerheads flow rate is 2.25 gpm.
Concerns (Survey Techniques, # of respondents, etc...)	No concerns

1.5.6 The End Use of Hot Water in Single Family Homes from Flow Trace Analysis (Aquacraft 2000)

Single family hot water use study.

Type	Study on single family end use of hot water
Author	Peter W. Mayer and William B. DeOreo of Aquacraft, Inc.
Completion Date	2000
Time Frame	October 1999 – 14 days
Market Covered	Single Family
Techniques Used	Survey and measurements of 10 Seattle homes.
Relevance/Impacts	Water trace data from ten single family homes in Seattle (Aquacraft, Inc., 2000) showed that the mean shower duration is 7.4 minutes. Another measurement study of residential end use of water by AWWA Research Foundation (REUW 1999) shows the similar data, a median of 7.2 minutes and a mean of 8.2 minutes, for shower duration. Shower duration of 7.4 minutes, along with other assumptions used in this Workpaper, results in more realistic baseline shower water consumption that is equivalent to about 33% of the total domestic hot water consumption
Concerns (Survey Techniques, # of respondents, etc...)	Low sample size.

1.6 DATA QUALITY AND FUTURE DATA NEEDS

There is currently no single study which is recognized as a statewide acceptable report on the use of hot water in tub/shower combos for single family and multi-family units. The studies listed above are the best available data. Further research is needed both in the area of hot water usage in tub/shower combos (including warm-up practices) and current pre-existing conditions for both tub spout and

showerhead. Due to the recent and upcoming code changes for showerhead flow rates in combination with the current drought in California the pre-existing showerhead flow rates should be revisited.

SECTION 2. CALCULATION METHODOLOGY

2.1 METHODOLOGY

SoCal Gas completed three steps to estimate ex ante energy savings:

1. Establish Base Case Water Usage:
 - Structural waste (time hot water takes to reach the water fixture)
 - percentages of showerhead warm up versus tub spout warm up
 - Behavioral waste (time user takes to enter shower minus structural waste time)
 - Percentages of tub spout warm up while multitasking
 - Tub spout leak percentage and rate
 - Shower time and water usage
 - Showerhead and tub spout flow rate
 - Showers mixed daily water usage - single family and multi-family
 - Showers per day - single families and multi-family
2. Calculate Water Savings due to:
 - Forced tub spout warm-up
 - Removal of behavioral waste
 - Removal of tub spout leak
 - Reduction in Showerhead flow rate
3. Convert Water Savings to Energy Savings:
 - Convert water savings to therm savings
 - Convert therm savings to kWh savings
 - Calculate kW savings from kWh savings

2.2 CALCULATIONS

The energy saved comes from four different pieces. First part from structural waste, second from behavioral waste, third from leaky tub spout, and the fourth from reduced water flow during shower. Calculations resulted in similar findings as found in “Auto-Diverting Tub Spout System with ShowerStart TSV⁷.”

2.2.1 Data, Assumptions, and Conversion Factors

The table below summarizes the base case assumptions and data derived from studies.

⁷ (Sherman, Auto-Diverting Tub Spout System with ShowerStart TSV, 2015).

Table 12 - Base Case Parameters and Assumptions

Variable	Description	Base Case	Source
(ShFr)	Showerhead Flow Rate =	2 gpm	Title 20 (2015) Section 1605.3
(TFr)	Tub Spout Flow Rate =	5 gpm ¹	
(C ₁)	Seconds to Minutes =	60 sec/min	
(SFMDW - 2.25 gpm)	Single Family Mixed Daily Water for Showers =	28.01 gal/day	Dispositon - For 2.25 gpm
(MFMDW - 2.25 gpm)	Multifamily Mixed Daily Water for Showers =	23.34 gal/day	Dispositon - For 2.25 gpm
(ShWu)	% of Showerhead Warm-up =	60% %	Sherman 2014, pg 8
(TsWu)	% of Tub Spout Warm-up =	40% %	Sherman 2014, pg 5
(SP)	Showerhead Warm-up pipe water purged =	130% %	Koeller 2007, pg 44-45
(TsWuPWt)	Tub Spout Warm-up pipe water purged =	106% %	Koeller 2007, pg 44-45
(BWt)	Behavioral Waste (Time) =	47 sec/shower	Sherman 2014, pg 11
(BWp)	Behavioral Waste (% of Warm-up Waste) =	59% %	Sherman 2014, pg 11
(TMWu)	Tub Multitasking Warmup =	58% %	Sherman 2014 - pg 5
(TsIP)	Tub Spout Leak (Percentage) =	34% %	Taitem 2011 - pg 2
(TsIR)	Tub Spout Leak (Rate) =	0.8 gpm	Taitem 2011 - pg 2
(TShWuPr)	Total Shower Water Usage Pre-existing =	17.2 gal/shower	REUWS 1999 - pg 102 Table 5.6
(SFSh)	Single Family Showerheads =	2.01 showerheads	ASW study
(MFSH)	Multifamily Showerheads =	1.5 showerheads	US Census
(Sht)	Shower Time =	7.4 min	Aquacraft, Inc., 2000 - pg 8

Showerhead Flow Rate

With previous established 2.25 gpm in preexisting condition⁸ and the recent code update to 2.0 gpm,⁶ it was decided to use code as the current code baseline and 1.8 gpm for early retirement code baseline due to the 3 year RUL period.

Tub Spout Flow Rates

With limited studies on tub spout flow rates a market assessment shows significant spouts available above 5 gpm. Since 5 gpm is the flow rate of the ADTS, it was chosen as the baseline flow rate so no savings would be derived from the tub spout flow rate alone.

⁸ SEU Survey Conducted by ASW (ASW, 2009).

Mixed Daily Water for Showers

The 2013-2014 domestic hot water fixture disposition⁹ set the mixed daily water for shower usage with a 2.25 gpm showerhead. The ratio of the values 2.25 gpm over 2.0 gpm showerhead were used to calculate the baseline mixed daily water usage. Mixed daily water usage is used to calculate the number of showers taken per day.

Structural Waste

In tub/shower combos the user has the option to purge the cold water via the showerhead or the tub spout. Tub spout warm-ups are found to save both time and energy when compared to showerhead warm-ups due to the faster gpm¹⁰. Tub spout warm-ups are found to occur during 40% of the time in tub/shower combos². Structural waste time is calculated by subtracting out the behavioral waste time from the total warm-up waste time.

Behavioral Waste

From the time when the water reaches desired temperature until the user gets in the shower. Because of the faster warm-up with a tub spout it is more likely that the user will sit near the tub to wait for hot water before entering the shower. This does not always occur and 58% of users initiating a tub spout warm-ups were found to multitask during warm-up². Behavioral waste time varies, and as such, a conservative value was taken².

Weighted Average Showerheads per Household

The survey data from SEU territories⁸ was averaged to be 2.01 showerheads per single family household. Acquired data from the U.S. Census Bureau¹¹ was used to calculate the weighted average showerheads per household for the multi-family residences. The data for number of bathrooms per household for new construction of multi-family units between the years 1978-2014 was used. After the weighted average was calculated, the result was rounded up to the nearest tenth. Savings are conservative since rounding this number up results in lower savings. The calculations are shown in the appendix.

Shower duration

Water trace data from ten single family homes in Seattle (Aquacraft, Inc., 2000)¹² showed that the mean shower duration is 7.4 minutes. Another measurement study of residential end use of water by AWWA Research Foundation (REUW 1999)¹ shows the similar data, a median of 7.2 minutes and a mean of 8.2 minutes, for shower duration. Shower duration of 7.4 minutes, along with other assumptions used in this Workpaper, results in more realistic baseline shower water consumption that is equivalent to about 33% of the total domestic hot water consumption.

Showerhead Temperature

For low flow showerheads, the outlet water heater temperature is assumed to be 106°F to account for tempering of the hot water with cold water to establish full shower flow, as obtained from the ASW survey study in SEU territories. Hot water does not comprise the entire shower flow, so evaluating a smaller water heater temperature rise limits the water heater energy attributable to entire shower flow.

⁹ Water Fixture Disposition (CPUC, 2013).

¹⁰ Residential Hot Water Distribution (Koeller & Klein, 2007).

¹¹ Bathrooms (US Census, 2014).

¹² The End Use of Hot Water in Single Family Homes from Flow Trace Analysis (Mayer & DeOreo, 2000).

The water temperature entering the heater varies with climate zones according to the 2013 Title 24¹³ weather data.

Gas Water Heater Efficiencies

To convert the water heating load to energy use at the water heater, the recovery efficiency (RE) is used. A weighted value of 0.813 is derived from the current CEC maintained Title 20 Appliance Database¹⁴ (downloaded on March 25, 2016) of natural-gas fired, storage-type water heaters without limit to the listed EF. An RE of 0.98 is used for Electric Water heaters, taken from 2013-2014 Water Fixture Disposition⁹.

2.2.2 Establish Base Case Water Usage

Base case water usage is broken into three parts: structural, behavioral, and shower usage.

Structural Usage

(StWt)	Structural Waste (Time) = BWt / BWp - BWt =	33 sec/Warm-up
(TslStw)	Tub Spout Leak during Structural Waste Time StWt / C1 * TslR =	0.440 gal/Warm-up
(ShStw)	Shower Structure Waste = StWt / C1 * ShFr =	1.10 gal/Warm-up
(WtP)	Amount of Water in Pipe = ShStw / SP =	0.85 gal
(TsStw)	Tub Structure Waste = WtP * TsWuPWt =	0.89 gal/Warm-up
(WStwTslW)	Weighted Structural Waste w/ Tub Spout Leak Weighted= (ShStw + TslStw * TslP) * ShWu + TsStw * TsWu =	1.11 gal/Warm-up

Behavioral Usage

(TsBwP)	Tub Spout Behavioral Waste (Percentage) = TMWu * TsWu =	23% %
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¹³ (2013 Building Energy Efficiency Standards, 2013).

¹⁴ (California Energy Commission Appliance Efficiency Database, 2016).

(TslBw) Tub Spout Leak during Behavioral Waste
 $BWt / C_1 * TslR =$ 0.627 gal/Warm-up

(ShBw) Shower Behavioral Waste =
 $BWt / C_1 * ShFr =$ 1.57 gal/Warm-up

(TsBw) Tub Behavioral Waste =
 $BWt / C_1 * TSFr =$ 3.92 gal/Warm-up

(WBwTslW) Weighted Behavioral Waste w/ Tub Spout Leak Weighted=
 $(ShBw + TslBw * TslP) * ShWu + TsBw * Bwp =$ 1.98 gal/Warm-up

Shower Usage

(ASht) Actual Shower Time =
 $Sht - (StWt + BWt) / C_1 =$ 6.07 min

(AShtWuTslW) Actual Shower Time Water Usage W/ Tub Spout Leak Weighted=
 $ASht * (ShFr + TslR * TslP) =$ 13.78 gal/shower

2.2.3 Calculating Water Savings

Water savings come from the forced tub spout warm-up, removal of behavioral waste, removal of tub spout leak, and reduction in showerhead flow rate.

Forced Tub Spout Warm-up

(TsStw) Tub Structure Waste =
 $WtP * TsWuPWt =$ 0.89 gal/Warm-up

(WStwTslW) Weighted Structural Waste w/ Tub Spout Leak Weighted=
 $(ShStw + TslStw * TslP) * ShWu + TsStw * TsWu =$ 1.11 gal/Warm-up

(StWtrS) Structural Water Savings =
 $WStwTslW - TsStw =$ 0.21 gal/Warm-up

Removal of Behavioral Waste

(WBwTslW) Weighted Behavioral Waste w/ Tub Spout Leak Weighted=
 $(ShBw + TslBw * TslP) * ShWu + TsBw * Bwp =$ 1.98 gal/Warm-up

(BWtrS) Behavioral Water Savings =
 $WBwTslW - 0 =$ 1.98 gal/Warm-up

Removal of Tub Spout Leak and Reduction in Showerhead Flow Rate

A 2.0 gpm Showerhead flowrate is used in the base case (AShtWuTslW) formula and 1.5 in the proposed case (AShtWuP) formula.

(AShtWuTslW) Actual Shower Time Water Usage W/ Tub Spout Leak Weighted=
 $Asht * (ShFr + TslR * TslP) =$ 13.78 gal/shower

(AShtWuP) Actual Shower Time Water Usage W/out Tub Spout Leak =
 $Asht * ShFr =$ 9.10 gal/shower

(ShtWtrS) Shower Time Water Savings =
 $AShtWuTslW - AShtWuP =$ 4.68 gal/shower

Total Shower Water Savings

(TShWtrS) Total Shower Water Savings w/ Tub Spout Leak Weighted=
 $StWtrS + BWtrS + ShtWtrS$ 6.87 gal/shower

Annual Single Family Water Savings

(SFMDW – 2.0 gpm) Single Family Mixed Daily Water =
24.90 gal/day

(SFSpD) SF Showers per Day - Showerhead =
 $SFMDW / (TShWuPr * SFSh) =$ 0.72 showers/day

(SFWtrS) SF Water Savings =
 $TShWtrS * SFSpD * 365 \text{ days/year} =$ 1806.95 gal/year

Annual Multi-family Water Savings

(MFMDW – 2.0 gpm) Multi-family Mixed Daily Water =
20.75 gal/day

(MFSpD) MF Showers per Day - Showerhead =
 $MFMDW / (TShWuPr * MFSh) =$ 0.80 showers/day

(MFWtrS) MF Water Savings =
 $TShWtrS * MFSpD * 365 \text{ days/year} =$ 2017.62 gal/year

2.3.4 Convert Water to Energy Savings

Water to Gas Savings

The natural gas savings is equal to the energy required to raise the volume of water saved from ground water temperature to the water temperature at the showerhead. The values and equation used to make the conversion is shown below.

$$E_{\text{therm saved}} = \left[\frac{(W_{\text{savings}} * \rho * C_p * (T_{\text{out}} - T_{\text{in}})_{\text{water heater}})}{RE_{\text{Gas}} * C_{\text{volume}}} \right] * \left[\frac{1 \text{ Therm}}{100,000 \text{ BTU}} \right]$$

where,

- $W_{\text{savings}} = \text{Water Savings}$
- $\rho = 62.37 \frac{\text{lbm}}{\text{ft}^3}$; Water Density at 60 °F
- $C_p = 1 \frac{\text{btu}}{\text{lbm} \cdot \text{F}}$; Water Specific Heat at 60 °F
- $T_{\text{out}} = 106 \text{ °F}$; Water Temp at Showerhead
- $T_{\text{in}} = \text{Climate Zone Specific; Cold Water Temperature}$
- $RE_{\text{Gas}} = 0.813$; Recovery Efficiency
- $C_{\text{volume}} = 7.5 \frac{\text{gal}}{\text{ft}^3}$; Gallons to Cubic Feet Conversion

Water to Electric Savings

The Electric savings (kWh) is equal to the energy required to raise the volume of water saved from ground water temperature to the water temperature at the showerhead. The power consumption (kW) is defined by the percentage of the daily hot water consumed during peak period.

$$E_{\text{kWh saved}} = \left[\frac{(W_{\text{savings}} * \rho * C_p * (T_{\text{out}} - T_{\text{in}})_{\text{water heater}})}{RE_{\text{Elec}} * C_{\text{volume}} * C_{\text{kWh}}} \right] = \left[\frac{E_{\text{therm saved}} * RE_{\text{Gas}}}{RE_{\text{Elec}} * C_{\text{kWh}}} \right] * \left[\frac{100,000 \text{ BTU}}{1 \text{ Therm}} \right]$$

where,

- $RE_{\text{Elec}} = 0.98$; Recovery Efficiency
- $C_{\text{kWh}} = 3412 \frac{\text{btu}}{\text{kWh}}$; kWh to btu Conversion

$$E_{\text{kWh saved}} = \left[\frac{E_{\text{kWh saved}} * E_{\text{pp}}}{365 \text{ days/year} * 3} \right]$$

where,

- $E_{\text{pp}} = 0.11$; Percentage of daily DHW energy consumption during peak period

SECTION 3. LOAD SHAPES

Load shapes are used for portfolio lifecycle cost analysis. A load shape indicates the distribution of a measure's energy savings over one year. A load shape is a set of fractions summing to unity, with one fraction per hour (or other time period). Multiplying a savings value by the load shape value for any particular hour yields the energy savings for that particular hour.

The ideal load shape for net benefits estimates would represent the difference between the base case and measure case. The closest load shapes that are applicable to the measures in this Workpaper are listed in the table below.

Table 13 - Building Types and Load Shapes

Building Type	Load Shape	E3 Alternate Building Type
Residential Mobile Home - Double-Wide	Residential	HeatPump_WtrHt-RC
Residential Multi-family	Residential	HeatPump_WtrHt-RC
Residential Single Family	Residential	HeatPump_WtrHt-RC

SECTION 4. COSTS

4.1 BASE CASE COST

Available DEER cost data for low flow showerheads comes from DEER 2008 and the 2010-2012 Measure Cost Study (MCS). MCS was used for labor/installation cost data, but since no GPM was listed for the showerhead a vendor cost study was performed for showerhead and tub spout cost. Cost data can be found in Attachment B.

Table 14 - Base Case Cost

Measure Code	Product Description	Equipment Cost	Labor/Installation Cost	Maintenance/Other Cost	Total Base Case Cost
ShwFLr005, ShwFLr006	2.0 GPM Showerhead	\$38.62	\$15.67		\$54.29
ShwFLr007, ShwFLr008	1.8 GPM Showerhead	\$41.23	\$15.67		\$56.91
ShwFLr005, ShwFLr006, ShwFLr007, ShwFLr008	5.0 GPM Tub Spout with Diverter	\$28.03	\$15.67		\$43.70
ShwFLr005, ShwFLr006	Showerhead and Tub Spout with Diverter	\$66.65	\$31.34		\$97.99
ShwFLr007, ShwFLr008	Showerhead and Tub Spout with Diverter	\$69.27	\$31.34		\$100.61

4.2 MEASURE CASE COST

There is no available cost data for this measure. Labor/installation cost was taken from discussion with contractors and equipment cost came from manufacturer.

Table 15 - Measure Case Cost

Measure Code	Product Description	Equipment Cost	Labor/Installation Cost	Maintenance/Other Cost	Total Base Case Cost
ShwFLr005, ShwFLr006, ShwFLr007, ShwFLr008	ADTS w/single-function 1.5 gpm Showerhead & All Quick Connect Mounts	\$119.99	\$72.00		\$191.99

4.3 FULL AND INCREMENTAL MEASURE COST

Table 16 - Full and Incremental Measure Cost Equations

Installation Type	Incremental Measure Cost	Full Measure Cost	
		1 st Baseline	2 nd Baseline
ROB	$(MEC + MLC) - (BEC + BLC)$	$(MEC + MLC) - (BEC + BLC)$	N/A
NEW/NC			
RET/ER	$(MEC + MLC) - (BEC + BLC)$	MEC + MLC	$(MEC + MLC) - (BEC + BLC)$
REF	$(MEC + MLC) - (BEC + BLC)$	MEC + MLC	N/A
REA	MEC + MLC	MEC + MLC	N/A

MEC = Measure Equipment Cost; MLC = Measure Labor Cost
 BEC = Base Case Equipment Cost; BLC = Base Case Labor Cost

Table 17 - Full and Incremental Costs

Measure Code	Installation Type	Incremental Measure Cost	Full Measure Cost	
			1 st Baseline	2 nd Baseline
ShwFLr005, ShwFLr006,	ROB/NC	\$94.00	\$94.00	N/A
ShwFLr007, ShwFLr008	ER	\$91.38	\$191.99	\$91.38

ATTACHMENTS

Attachment A – Tub Spout Calculations



Tub_Spout_Calculati
ons_Rev0.xlsx

Attachment B – Tub Spout and Showerhead Cost Data



Tub_Spout_Showerh
eads_Cost_Data.xlsx

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Tub Spout Calculations
(Attachment A to Workpaper SWWH001v00)

Measure Summary Table

Measure ID	Measure Name	Category	Priority	Start Date	End Date	Status	Progress (%)	Responsible	Cost (\$)	Benefit (\$)	Risk	Notes
M001	Implement new software system	IT	High	2023-01-01	2023-03-31	Completed	100	J. Smith	150,000	200,000	Low	Project completed ahead of schedule.
M002	Upgrade server infrastructure	IT	Medium	2023-02-01	2023-04-30	In Progress	75	A. Johnson	80,000	120,000	Medium	Minor delays due to hardware procurement.
M003	Develop new mobile app	IT	High	2023-03-01	2023-06-30	In Progress	60	S. Lee	200,000	300,000	Medium	Scope creep identified, need to re-evaluate requirements.
M004	Conduct employee training	HR	Low	2023-01-15	2023-02-15	Completed	100	M. Garcia	20,000	50,000	Low	All staff successfully trained.
M005	Review and update policies	HR	Low	2023-02-01	2023-03-31	In Progress	40	K. Brown	10,000	30,000	Low	Legal review pending for some sections.
M006	Optimize office space	Facilities	Medium	2023-03-15	2023-05-31	In Progress	50	D. White	60,000	80,000	Medium	Vendor selection in progress.
M007	Implement security audit	IT	High	2023-04-01	2023-04-30	Completed	100	R. Black	30,000	40,000	Low	No critical vulnerabilities found.
M008	Launch new marketing campaign	Marketing	High	2023-05-01	2023-07-31	In Progress	30	L. Green	120,000	180,000	Medium	Target audience research ongoing.
M009	Improve customer service	Customer Support	Medium	2023-06-01	2023-08-31	In Progress	20	N. King	50,000	70,000	Low	Staffing levels being reviewed.
M010	Upgrade financial reporting system	Finance	High	2023-07-01	2023-09-30	In Progress	10	P. Queen	90,000	130,000	Medium	Integration with existing systems complex.
M011	Develop strategic plan	Strategy	High	2023-08-01	2023-10-31	In Progress	5	Q. Ross	40,000	60,000	Low	Market analysis phase complete.
M012	Implement sustainability initiatives	Operations	Medium	2023-09-01	2023-11-30	In Progress	0	R. Taylor	70,000	100,000	Medium	Initial assessment phase.
M013	Review annual budget	Finance	High	2023-10-01	2023-10-31	In Progress	0	S. White	20,000	30,000	Low	Final review meeting scheduled.
M014	Conduct year-end performance review	HR	High	2023-11-01	2023-12-31	In Progress	0	T. Black	30,000	40,000	Low	Review process initiated.
M015	Plan for next fiscal year	Finance	High	2023-12-01	2024-01-31	In Progress	0	U. Green	50,000	70,000	Low	Market trends being analyzed.

ED Water Consumption

	Temp	C0	C1	C2
Sinks	105	12.5	4.16	0
Bath	105	3.5	1.17	0
Shower	105	14	4.67	0
Dishwasher	Tank	5	0	0
Clotheswasher	Tank	7.5	2.5	0

Building Type	Code	# Bedrms
Single-Family	23	3
Multi-Family	24	2
Mobile Home	26	2

Daily Water Usage : DEER Assumptions

	Single-Family	Multi-Family
Sinks	25.0	20.8
Bath	7.0	5.8
Shower	28.0	23.3

Daily Water Usage : SCG/SDGE Survey

Kitchen Sink	43
Lavatory Sink	36
Total Sinks	79
Shower	86

Ratio DEER/SCG/SDGE

	Single-Family	Multi-Family
Sinks	0.32	0.26
Shower	0.33	0.27

Low Flow Showerheads Savings

Baseline Calculation		Ratio	SF Code	SF Avg	Adjusted SF Avg	Ratio SF 2.2	Ratio SF 1.8	Ratio MF Code	MF Avg	Adjusted MF	Ratio MF 2.2	Ratio MF 1.8		
Baseline Flow rate	2.50	2.25		2.25	2.20	1.80		2.50	2.25	2.25	2.20	1.80	gpm	SF = Single Family
Average shower time	7.4	7.4		7.4				7.4	7.4	7.4			min	MF = Multi Family
Number of showers taken per day per household	2.79	2.79		2.79				2.22	2.22	2.22			Showers/household/day	Cold temp See Weighted Averages
Throttling factor	0.9	0.9		0.9				0.9	0.9	0.9			days/year	Show er water temp 106
Number of showerheads per household	365	365		365				365	365	365			days/year	Hot temp 130
Baseline Water consumption	2.01	2.01		2.01				1.50	1.50	1.50			showerhead/household	
Mixed water daily use for shower	5652	5062		5062				6310	8095	5679			Gallons / showerhead / year	
Hot water daily use for shower	19.6	26.3		26.3				16.3	33.3	23.3			Gallons / household / day	
Measure Calculation				SF 1.6 gpm	Adjusted SF 1.6	SF 1.7 gpm	MF 1.5 gpm	MF 1.6 gpm	Adjusted MF 1.6	MF 1.7 gpm				
Low Flow rate	1.5	1.6		1.6			1.5	1.6	1.6	1.7	gpm			
Average shower time	7.4	7.4		7.4			7.4	7.4	7.4	7.4	min			
Number of showers taken per day per household	2.79	2.79		2.79			2.22	2.22	2.22	2.22	Showers/household/day			
Throttling factor	0.9	0.9		0.9			0.9	0.9	0.9	0.9	days/year			
Number of showerheads per household	2.01	2.01		2.01			1.50	1.50	1.50	1.50	showerhead/household			
Measure Water consumption	3391	5399		3617			3843	3786	5756	4039			Gallons / showerhead / year	
Mixed water daily use for shower	18.7	29.7		19.9			21.2	15.6	23.7	16.6			Gallons / showerhead / day	
Hot water daily use for shower	11.8	18.7		12.5			13.3	9.8	14.9	10.5			Gallons / household / day	
Annual Water Savings Summary		SF			MF									
		1.5 gpm	1.6 gpm	1.7 gpm	1.5 gpm	1.6 gpm	1.7 gpm							
3085 .5 gpm Baseline Ratio of 2.25	2261	2035	1808	2524	2272	2019	Gallons / showerhead / year							
2570 2.25 gpm Baseline Avg	1695	1469	1243	1893	1641	1388	Gallons / showerhead / year							
2.2 gpm Baseline Ratio of 2.25	1582	1356	1130	1767	1515	1262								
1.8 gpm Baseline Ratio of 2.25	678	452	226	757	505	252								
Unit = gallons per showerhead per year														
Water volume conversion	7.481	Water density @ 60°F	62.37	Cp of water	1.0	Cold water temperature	See Weighted Ave	water temp @ showerhead	106	Water heater min. efficiency	0.77	SF		
gal / ft³		lbm / ft³		btu / lbm / °F		°F		°F				CZ2010 Weather Files (weather files for 2013 Title-24)		
											Weighted Average			
Therms Saved		SF			MF									
Baseline Fed - 2.50 gpm		1.5 gpm	1.6 gpm	1.7 gpm	1.5 gpm	1.6 gpm	1.7 gpm							
1	13.37	12.0	10.7	14.9	13.4	11.9					CZ01	51.4		
2	11.94	10.7	9.6	13.3	12.0	10.7					CZ02	57.2		
3	11.99	10.8	9.6	13.4	12.0	10.7					CZ03	57.0		
4	11.40	10.3	9.1	12.7	11.5	10.2					CZ04	59.4		
5	12.29	11.1	9.8	13.7	12.3	11.0					CZ05	55.8		
6	10.84	9.8	8.7	12.1	10.9	9.7					CZ06	61.7		
7	10.64	9.6	8.5	11.9	10.7	9.5					CZ07	62.5		
8	10.36	9.3	8.3	11.6	10.4	9.3					CZ08	63.7		
9	10.34	9.3	8.3	11.6	10.4	9.3					CZ09	63.7		
10	10.27	9.2	8.2	11.5	10.3	9.2					CZ10	64.0		
11	10.56	9.5	8.4	11.8	10.7	9.5					CZ11	62.8		
12	11.1	10.0	8.9	12.4	11.2	9.9					CZ12	60.7		
13	10.3	9.3	8.3	11.6	10.4	9.3					CZ13	63.8		
14	10.7	9.6	8.6	12.0	10.8	9.6					CZ14	62.3		
15	7.6	6.8	6.1	8.6	7.7	6.9					CZ15	74.9		
16	13.3	12.0	10.7	14.9	13.4	11.9					CZ16	51.6		
											MF			
											CZ2010 Weather Files (weather files for 2013 Title-24)			
											Weighted Average			
Baseline SCG - 2.25 gpm		1.5 gpm	1.6 gpm	1.7 gpm	1.5 gpm	1.6 gpm	1.7 gpm							
1	10.0	8.7	7.4	11.2	9.7	8.2					CZ01	51.4		
2	9.0	7.8	6.6	10.0	8.7	7.3					CZ02	57.2		
3	9.0	7.8	6.6	10.0	8.7	7.4					CZ03	57.0		
4	8.5	7.4	6.3	9.5	8.3	7.0					CZ04	59.4		
5	9.2	8.0	6.8	10.3	8.9	7.5					CZ05	55.8		
6	8.1	7.0	6.0	9.1	7.9	6.7					CZ06	61.7		
7	8.0	6.9	5.9	8.9	7.7	6.5					CZ07	62.5		
8	7.8	6.7	5.7	8.7	7.5	6.4					CZ08	63.7		
9	7.8	6.7	5.7	8.7	7.5	6.4					CZ09	63.7		
10	7.7	6.7	5.6	8.6	7.5	6.3					CZ10	64.0		
11	7.9	6.9	5.8	8.9	7.7	6.5					CZ11	62.7		
12	8.3	7.2	6.1	9.3	8.1	6.8					CZ12	60.6		
13	7.8	6.7	5.7	8.7	7.5	6.4					CZ13	63.6		
14	8.0	6.9	5.9	9.0	7.8	6.6					CZ14	62.1		
15	5.7	4.9	4.2	6.4	5.6	4.7					CZ15	74.6		
16	10.0	8.7	7.3	11.2	9.7	8.2					CZ16	51.5		
Baseline SCG - 2.2 gpm		1.5 gpm	1.6 gpm	1.7 gpm	1.5 gpm	1.6 gpm	1.7 gpm							
1	9.4	8.0	6.7	10.5	9.0	7.5								
2	8.4	7.2	6.0	9.3	8.0	6.7								
3	8.4	7.2	6.0	9.4	8.0	6.7								
4	8.0	6.8	5.7	8.9	7.6	6.4								
5	8.6	7.4	6.1	9.6	8.2	6.9								
6	7.6	6.5	5.4	8.5	7.3	6.1								
7	7.5	6.4	5.3	8.3	7.1	5.9								
8	7.3	6.2	5.2	8.1	6.9	5.8								
9	7.2	6.2	5.2	8.1	6.9	5.8								
10	7.2	6.2	5.1	8.0	6.9	5.7								
11	7.4	6.3	5.3	8.3	7.1	5.9								
12	7.8	6.6	5.5	8.7	7.4	6.2								
13	7.2	6.2	5.2	8.1	7.0	5.8								
14	7.5	6.4	5.3	8.4	7.2	6.0								
15	5.3	4.6	3.8	6.0	5.1	4.3								
16	9.3	8.0	6.7	10.4	8.9	7.4								
Baseline SCG - 1.8 gpm		1.5 gpm	1.6 gpm	1.7 gpm	1.5 gpm	1.6 gpm	1.7 gpm							
1	4.0	2.7	1.3	4.5	3.0	1.5								
2	3.6	2.4	1.2	4.0	2.7	1.3								
3	3.6	2.4	1.2	4.0	2.7	1.3								
4	3.4	2.3	1.1	3.8	2.5	1.3								
5	3.7	2.5	1.2	4.1	2.7	1.4								
6	3.3	2.2	1.1	3.6	2.4	1.2								
7	3.2	2.1	1.1	3.6	2.4	1.2								
8	3.1	2.1	1.0	3.5	2.3	1.2								
9	3.1	2.1	1.0	3.5	2.3	1.2								
10	3.1	2.1	1.0	3.4	2.3	1.1								
11	3.2	2.1	1.1	3.6	2.4	1.2								
12	3.3	2.2	1.1	3.7	2.5	1.2								
13	3.1	2.1	1.0	3.5	2.3	1.2								
14	3.2	2.1	1.1	3.6	2.4	1.2								
15	2.3	1.5	0.8	2.6	1.7	0.9								
16	4.0	2.7	1.3	4.5	3.0	1.5								
Unit = therms/year														

Mixed Daily Water Calculator

*From Disposition	Baseline Calculation	SF Code	SF Avg	Adjusted SF Avg	MF Code	MF Avg	Adjusted MF Avg		SF = Single Family
	Baseline Flow rate	2.50	2.25	2.25	2.50	2.25	2.25	gpm	MF = Multi Family
	Average shower time	7.4	7.4	7.4	7.4	7.4	7.4	min	
Number of showers taken per day per household		2.79	2.79	2.79	2.22	2.22	2.22	Showers/household/day	Cold temp 65
	Throttling factor	0.9	0.9	0.9	0.9	0.9	0.9	-	Show water temp 106
	days/year	365	365	365	365	365	365	days/year	Hot temp 130
Number of showerheads per household		2.01	2.01	2.01	1.50	1.50	1.50	showerhead/household	
Baseline Water consumption		8436	7592	5086	8994	8095	5679	Gallons / showerhead / year	
	Mixed water daily use for shower	46.5	41.8	28.0	37.0	33.3	23.3	Gallons / household / day	
	Hot water daily use for shower	29.3	26.3	17.6	23.3	21.0	14.7		
	Measure Calculation	SF 1.5 gpm	SF 1.6 gpm	Adjusted SF 1.6	SF 1.7 gpm	MF 1.5 gpm	MF 1.6 gpm	Adjusted MF 1.6	MF 1.7 gpm
	Low Flow rate	1.5	1.6	1.6	1.7	1.5	1.6	1.6	1.7
	Average shower time	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Number of showers taken per day per household		2.79	2.79	2.79	2.79	2.22	2.22	2.22	2.22
	Throttling factor	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
	days/year	365	365	365	365	365	365	365	365
Number of showerheads per household		2.01	2.01	2.01	2.01	1.50	1.50	1.50	1.50
Measure Water consumption		3391	5399	3617	3843	3786	5756	4039	4291
	Mixed water daily use for shower	18.7	29.7	19.9	21.2	15.6	23.7	16.6	17.6
	Hot water daily use for shower	11.8	18.7	12.5	13.3	9.8	14.9	10.5	11.1
	Annual Consumption and GPM adjustment								
	flow rate (GPM)	SF (Gal/day)	MF (Gal/day)	Annual SF Volume(Gal)	Annual MF Volume(Gal)				
	2.50	31.12	25.93	5652	6310				
	2.25	28.01	23.34	5086	5679				
	2.00	24.90	20.75	4521	5048				
	1.80	22.41	18.67	4069	4544				
	1.70	21.16	17.63	3843	4291				
	1.60	19.92	16.60	3617	4039				
	1.50	18.67	15.56	3391	3786				
	1.25	15.56	12.97	2826	3155				
	1.00	12.45	10.37	2261	2524				

SF Weather Data

CZ2010 Weather Files (weather files for 2013 Title-24)															
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave	Weighted Average	
CZ01	49.5	48.7	48.6	49.0	50.5	52.0	53.2	54.0	54.1	53.4	52.2	50.8	51.4	51.4	0.0
CZ02	53.7	52.3	52.1	52.8	55.6	58.4	60.8	62.3	62.5	61.2	58.9	56.2	57.3	57.2	0.1
CZ03	54.5	53.4	53.3	53.8	55.8	57.8	59.6	60.7	60.8	59.9	58.2	56.2	57.1	57.0	0.0
CZ04	55.7	54.1	54.0	54.8	57.7	60.7	63.3	64.9	65.0	63.7	61.2	58.3	59.5	59.4	0.1
CZ05	53.6	52.7	52.7	53.1	54.8	56.5	58.0	58.9	59.0	58.2	56.8	55.1	55.8	55.8	0.0
CZ06	58.9	57.8	57.7	58.2	60.4	62.6	64.5	65.7	65.8	64.9	63.0	60.9	61.8	61.7	0.0
CZ07	60.2	59.3	59.2	59.7	61.5	63.2	64.8	65.8	65.9	65.1	63.5	61.8	62.6	62.5	0.0
CZ08	60.7	59.5	59.4	59.9	62.3	64.7	66.7	68.0	68.1	67.0	65.1	62.8	63.7	63.7	0.1
CZ09	60.2	58.7	58.6	59.3	62.1	64.9	67.4	68.9	69.1	67.8	65.4	62.7	63.8	63.7	0.1
CZ10	59.9	58.2	58.0	58.9	62.2	65.5	68.3	70.1	70.3	68.8	66.0	62.8	64.1	64.0	0.1
CZ11	55.8	52.8	52.6	54.0	59.8	65.5	70.5	73.6	73.9	71.3	66.5	60.9	63.2	62.8	0.3
CZ12	55.6	53.5	53.3	54.3	58.4	62.5	66.1	68.3	68.5	66.7	63.2	59.3	60.9	60.7	0.2
CZ13	57.0	54.0	53.8	55.2	60.8	66.3	71.1	74.2	74.5	72.0	67.3	61.9	64.1	63.8	0.3
CZ14	55.2	52.2	51.9	53.4	59.2	65.0	70.0	73.2	73.5	70.9	66.0	60.4	62.7	62.3	0.3
CZ15	68.4	65.5	65.3	66.6	72.2	77.7	82.4	85.5	85.7	83.3	78.6	73.3	75.5	74.9	0.5
CZ16	45.3	42.7	42.4	43.7	48.7	53.8	58.1	60.9	61.1	58.9	54.6	49.8	51.8	51.6	0.2

MF Weather Data

CZ2010 Weather Files (weather files for 2013 Title-24)															
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave	Weighted Average	
CZ01	49.5	48.7	48.6	49.0	50.5	52.0	53.2	54.0	54.1	53.4	52.2	50.8	51.4	51.4	
CZ02	53.7	52.3	52.1	52.8	55.6	58.4	60.8	62.3	62.5	61.2	58.9	56.2	57.3	57.2	
CZ03	54.5	53.4	53.3	53.8	55.8	57.8	59.6	60.7	60.8	59.9	58.2	56.2	57.1	57.0	
CZ04	55.7	54.1	54.0	54.8	57.7	60.7	63.3	64.9	65.0	63.7	61.2	58.3	59.5	59.4	
CZ05	53.6	52.7	52.7	53.1	54.8	56.5	58.0	58.9	59.0	58.2	56.8	55.1	55.8	55.8	
CZ06	58.9	57.8	57.7	58.2	60.4	62.6	64.5	65.7	65.8	64.9	63.0	60.9	61.8	61.7	
CZ07	60.2	59.3	59.2	59.7	61.5	63.2	64.8	65.8	65.9	65.1	63.5	61.8	62.6	62.5	
CZ08	60.7	59.5	59.4	59.9	62.3	64.7	66.7	68.0	68.1	67.0	65.1	62.8	63.7	63.7	
CZ09	60.2	58.7	58.6	59.3	62.1	64.9	67.4	68.9	69.1	67.8	65.4	62.7	63.8	63.7	
CZ10	59.9	58.2	58.0	58.9	62.2	65.5	68.3	70.1	70.3	68.8	66.0	62.8	64.1	64.0	
CZ11	55.8	52.8	52.6	54.0	59.8	65.5	70.5	73.6	73.9	71.3	66.5	60.9	63.2	62.7	
CZ12	55.6	53.5	53.3	54.3	58.4	62.5	66.1	68.3	68.5	66.7	63.2	59.3	60.9	60.6	
CZ13	57.0	54.0	53.8	55.2	60.8	66.3	71.1	74.2	74.5	72.0	67.3	61.9	64.1	63.6	
CZ14	55.2	52.2	51.9	53.4	59.2	65.0	70.0	73.2	73.5	70.9	66.0	60.4	62.7	62.1	
CZ15	68.4	65.5	65.3	66.6	72.2	77.7	82.4	85.5	85.7	83.3	78.6	73.3	75.5	74.6	
CZ16	45.3	42.7	42.4	43.7	48.7	53.8	58.1	60.9	61.1	58.9	54.6	49.8	51.8	51.5	

Tub Spout and Showerhead Cost Data
(Attachment B to Workpaper SWWH001v00)

Auto-diverting Tub Spout with thermostatic shut-off valve

Recommendations for 2016 Workpaper

Base Case Cost

Measure Code	Product Description	Equipment Cost	Labor/ Installation Cost	Maintenance/ Other Cost	Total Base Case Cost
ShwFLr005, ShwFLr006	2.0 GPM Showerhead	\$ 38.62	\$ 15.67		\$ 54.29
ShwFLr007, ShwFLr008	1.8 GPM Showerhead	\$ 41.23	\$ 15.67		\$ 56.91
ShwFLr005, ShwFLr006, ShwFLr007, ShwFLr008	5.0 GPM Tub Spout with Diverter	\$ 28.03	\$ 15.67		\$ 43.70
ShwFLr005, ShwFLr006	Showerhead and Tub Spout with Diverter	\$ 66.65	\$ 31.34		\$ 97.99
ShwFLr007, ShwFLr008	Showerhead and Tub Spout with Diverter	\$ 69.27	\$ 31.34		\$ 100.61

*assuming same cost for tub spout installation as showerhead installation

Measure Case Cost

Measure Code	Product Description	Equipment Cost	Labor/ Installation Cost	Maintenance/ Other Cost	Total Base Case Cost
ShwFLr005, ShwFLr006, ShwFLr007, ShwFLr008	ADTS w/single-function 1.5 gpm Showerhead & All Quick Connect Mounts	\$ 119.99	\$ 72.00		\$ 191.99

Incremental Measure Cost

Measure Code	Installation Type	Incremental Measure Cost	Full Measure Cost	
			1 st Baseline	2 nd Baseline
ShwFLr005, ShwFLr006,	ROB/NC	\$ 94.00	\$ 94.00	N/A
ShwFLr007, ShwFLr008	ER	\$ 91.38	\$ 191.99	\$ 91.38

Auto-diverting Tub Spout with thermostatic shut-off valve

From discussions with contractors and manufacture

Measure Code	Units	Material Cost	Labor Cost	Total Cost	Source
ShwFLr005, ShwFLr006, ShwFLr007, ShwFLr008	Each	\$ 119.99	\$ 72.00	\$ 191.99	http://thinkevolve.com/shop/tub-spout-system-showerhead/

*Updated 3/31/2016

**Full cost table from manufacturer is available upon request

2016 TS W Diverter Pivot Table

Row Labels	Column Labels	Jan-00	Grand Total
Base			
Average of Price per unit	\$	28.03	\$ 28.03
Count of Model		33	33
Total Average of Price per unit	\$	28.03	\$ 28.03
Total Count of Model		33	33

2016 TS W Diverter Database

Manufacturer	Series	Model	GPM	Category	Price per unit	Source	Comments
Deleted	Deleted	E531D-1F	5	Base	\$ 8.91	http://www.homedepot.com/	
Deleted	Deleted	RP17453	5	Base	\$ 21.14	http://www.homedepot.com/	
Deleted	Deleted	972-362PK2	5	Base	\$ 30.40	http://www.homedepot.com/	
Deleted	Deleted	RP5836	5	Base	\$ 20.77	http://www.homedepot.com/	
Deleted	Deleted	RP34357RB	5	Base	\$ 51.66	http://www.homedepot.com/	
Deleted	Deleted	K-10281-4-CP	5	Base	\$ 25.65	http://www.homedepot.com/	
Deleted	Deleted	179101	5	Base	\$ 62.00	http://www.homedepot.com/	
Deleted	Deleted	RP5834	5	Base	\$ 23.95	http://www.homedepot.com/	
Deleted	Deleted	RP17454PB	5	Base	\$ 67.17	http://www.homedepot.com/	
Deleted	Deleted	9D0034230X	5	Base	\$ 18.80	http://www.homedepot.com/	
Deleted	Deleted	10319	5	Base	\$ 27.98	http://www.homedepot.com/	
Deleted	Deleted	58253	5	Base	\$ 20.97	http://www.homedepot.com/	
Deleted	Deleted	10766	5	Base	\$ 17.50	http://www.homedepot.com/	
Deleted	Deleted	K-10280-4-CP	5	Base	\$ 25.65	http://www.homedepot.com/	
Deleted	Deleted	RP17453SS	5	Base	\$ 47.51	http://www.homedepot.com/	
Deleted	Deleted	022635-0020A	5	Base	\$ 14.95	http://www.homedepot.com/	
Deleted	Deleted	K-10281-4A-CP	5	Base	\$ 27.41	http://www.homedepot.com/	
Deleted	Deleted	RP5834	5	Base	\$ 25.99	http://www.lowes.com/	
Deleted	Deleted	88052	5	Base	\$ 12.99	http://www.lowes.com/	
Deleted	Deleted	SW2103	5	Base	\$ 22.98	http://www.lowes.com/	
Deleted	Deleted	88703X	5	Base	\$ 16.99	http://www.lowes.com/	
Deleted	Deleted	RP72565RB	5	Base	\$ 45.51	http://www.lowes.com/	
Deleted	Deleted	80765	5	Base	\$ 11.48	http://www.lowes.com/	
Deleted	Deleted	15136-PB	5	Base	\$ 24.49	http://www.lowes.com/	
Deleted	Deleted	10281-4-BN	5	Base	\$ 39.68	http://www.lowes.com/	
Deleted	Deleted	8888730.224	5	Base	\$ 37.54	http://www.lowes.com/	
Deleted	Deleted	SWD0205 D	5	Base	\$ 29.99	http://www.lowes.com/	
Deleted	Deleted	SWD0422 D	5	Base	\$ 18.99	http://www.lowes.com/	
Deleted	Deleted	10317	5	Base	\$ 27.99	http://www.lowes.com/	
Deleted	Deleted	89249	5	Base	\$ 21.99	http://www.lowes.com/	
Deleted	Deleted	185-S-CP	5	Base	\$ 32.03	http://www.lowes.com/	
Deleted	Deleted	10316	5	Base	\$ 24.99	http://www.lowes.com/	
Deleted	Deleted	SW2101	5	Base	\$ 18.98	http://www.lowes.com/	

2016 Showerhead Pivot Table

Row Labels	Column Labels	2	1.75	Grand Total
Code 2016				
Average of Price per unit	\$	38.62	\$	38.62
Count of Model		35		35
Code 2018				
Average of Price per unit			\$41.23	\$ 41.23
Count of Model			14	14
Total Average of Price per unit	\$	38.62	\$41.23	\$ 39.36
Total Count of Model		35	14	49

2016 Showerhead Database

Manufacturer	Series	Model	GPM	Category	Price per unit	Source	Comments
Deleted	Deleted	TAV-529T		2 Code 2016	\$ 20.98	http://www.homedepot.com/	
Deleted	Deleted	75356SN		2 Code 2016	\$ 59.98	http://www.homedepot.com/	
Deleted	Deleted	015-WSTD2C		2 Code 2016	\$ 20.98	http://www.homedepot.com/	
Deleted	Deleted	23045		2 Code 2016	\$ 31.48	http://www.homedepot.com/	
Deleted	Deleted	ASW-673T		2 Code 2016	\$ 54.98	http://www.homedepot.com/	
Deleted	Deleted	75554		2 Code 2016	\$ 29.38	http://www.homedepot.com/	
Deleted	Deleted	015-WSTD3K		2 Code 2016	\$ 31.48	http://www.homedepot.com/	
Deleted	Deleted	SM-623CGT		2 Code 2016	\$ 17.98	http://www.homedepot.com/	
Deleted	Deleted	58208-0101		2 Code 2016	\$ 36.73	http://www.homedepot.com/	
Deleted	Deleted	21530		2 Code 2016	\$ 49.98	http://www.homedepot.com/	
Deleted	Deleted	YAT-933T		2 Code 2016	\$ 27.28	http://www.homedepot.com/	
Deleted	Deleted	75357OB		2 Code 2016	\$ 41.98	http://www.homedepot.com/	
Deleted	Deleted	75174		2 Code 2016	\$ 47.23	http://www.homedepot.com/	
Deleted	Deleted	ASK-733T		2 Code 2016	\$ 36.73	http://www.homedepot.com/	
Deleted	Deleted	K-R75563-BN		2 Code 2016	\$ 36.73	http://www.homedepot.com/	
Deleted	Deleted	TAV-523T		2 Code 2016	\$ 18.98	http://www.homedepot.com/	
Deleted	Deleted	75251		2 Code 2016	\$ 29.98	http://www.homedepot.com/	
Deleted	Deleted	26313SRN		2 Code 2016	\$ 41.98	http://www.homedepot.com/	
Deleted	Deleted	015-WSVNKK		2 Code 2016	\$ 41.98	http://www.homedepot.com/	
Deleted	Deleted	43268		2 Code 2016	\$ 59.98	http://www.lowes.com/	
Deleted	Deleted	81568		2 Code 2016	\$ 29.98	http://www.lowes.com/	
Deleted	Deleted	75569		2 Code 2016	\$ 34.98	http://www.lowes.com/	
Deleted	Deleted	1660.717.002		2 Code 2016	\$ 36.44	http://www.lowes.com/	
Deleted	Deleted	75569SN		2 Code 2016	\$ 39.98	http://www.lowes.com/	
Deleted	Deleted	S-2252-E2-BP		2 Code 2016	\$ 63.98	http://www.lowes.com/	
Deleted	Deleted	49267		2 Code 2016	\$ 54.98	http://www.lowes.com/	
Deleted	Deleted	D460047RB		2 Code 2016	\$ 48.04	http://www.lowes.com/	
Deleted	Deleted	75762SN		2 Code 2016	\$ 29.98	http://www.lowes.com/	
Deleted	Deleted	R14519-CP		2 Code 2016	\$ 38.98	http://www.lowes.com/	
Deleted	Deleted	D460029BR		2 Code 2016	\$ 51.17	http://www.lowes.com/	
Deleted	Deleted	S-2007-BN-E2		2 Code 2016	\$ 48.75	http://www.lowes.com/	
Deleted	Deleted	D460047BN		2 Code 2016	\$ 43.86	http://www.lowes.com/	
Deleted	Deleted	DK131A5		2 Code 2016	\$ 22.18	http://www.lowes.com/	
Deleted	Deleted	52634-SS20-PK		2 Code 2016	\$ 39.98	http://www.lowes.com/	
Deleted	Deleted	72425-CP		2 Code 2016	\$ 31.50	http://www.lowes.com/	
Deleted	Deleted	6307EPORB		1.75 Code 2018	\$ 54.18	http://www.homedepot.com/	
Deleted	Deleted	6303EPORB		1.75 Code 2018	\$ 46.54	http://www.homedepot.com/	
Deleted	Deleted	6303EP		1.75 Code 2018	\$ 28.69	http://www.homedepot.com/	
Deleted	Deleted	6300EP		1.75 Code 2018	\$ 19.18	http://www.homedepot.com/	
Deleted	Deleted	Mar-45		1.75 Code 2018	\$ 29.74	http://www.homedepot.com/	
Deleted	Deleted	#####		1.75 Code 2018	\$ 29.99	http://www.homedepot.com/	
Deleted	Deleted	A501ORB		1.75 Code 2018	\$ 87.78	http://www.lowes.com/	
Deleted	Deleted	May-44		1.75 Code 2018	\$ 24.98	http://www.lowes.com/	
Deleted	Deleted	A501CG		1.75 Code 2018	\$ 60.98	http://www.lowes.com/	
Deleted	Deleted	Nov-63		1.75 Code 2018	\$ 26.98	http://www.lowes.com/	
Deleted	Deleted	Mar-21		1.75 Code 2018	\$ 64.53	http://www.lowes.com/	
Deleted	Deleted	6300EP		1.75 Code 2018	\$ 28.05	http://www.lowes.com/	
Deleted	Deleted	6304EP		1.75 Code 2018	\$ 31.27	http://www.lowes.com/	
Deleted	Deleted	D460057BN		1.75 Code 2018	\$ 44.39	http://www.lowes.com/	

Cost Case Reporting Table

Cost Case Reporting Table										Incremental Cost Reporting Table													
Cost Case Description	Cost Case ID	Program Delivery Strategy	Material Cost	Installation Man Hours - Material	Installation Labor Cost (Material)	Installation Man Hours - Labor	Installation Labor Cost (Labor)	Climate Labor Material	Climate Labor Labor	Normalizing Unit	Program Delivery Strategy	Material Cost	Measure Material Cost	Base Case - Code/Standard Cost Case ID	Base Case - Code/Standard Material Cost	Base Case - Code/Standard Incremental Material Cost	Base Case - Market Average Cost Case ID	Base Case - Market Average Material Cost	Base Case - Market Average Incremental Material Cost	Base Case - Customer Average Cost Case ID	Base Case - Customer Average Material Cost	Base Case - Customer Average Incremental Material Cost	
Facet America - 1.5 gal/minute	FR0410R07PM	Dispatch/Non-Dispatch/Reliable/Incentive	\$5.54	\$0.33	\$0.33	780	780	0.25	0.25	Unit	Dispatch/Non-Dispatch/Reliable/Incentive	\$5.54	0.25	Facet America - 2.2 gal/minute	\$5.14	\$1.10	None specified	None	None	None	Facet America	\$5.14	\$0.50
Low Flow Showerhead - 0.25 gal/minute	FR0410R07PM	Dispatch/Non-Dispatch/Reliable/Incentive	\$22.22	\$0.30	\$16.74	780	780	0.50	0.50	Unit	Dispatch/Non-Dispatch/Reliable/Incentive	\$22.22	0.50	Facet America - 2.2 gal/minute	\$1.74	\$2.00	None specified	None	None	None	Facet America	\$1.74	\$0.50
Facet America - 1.5 gal/minute	FR0410R07PM	Dispatch/Non-Dispatch/Reliable/Incentive	\$5.54	\$0.33	\$0.33	780	780	0.25	0.25	Unit	Dispatch/Non-Dispatch/Reliable/Incentive	\$5.54	0.25	Dispatch/Non-Dispatch/Reliable/Incentive	\$4.18	\$1.46	None specified	None	None	None	Dispatch/Non-Dispatch/Reliable/Incentive	\$4.18	\$0.25
Low Flow Showerhead - 2.5 gal/minute	FR0410R07PM	Dispatch/Non-Dispatch/Reliable/Incentive	\$23.22	\$0.30	\$16.74	780	780	0.50	0.50	Unit	Dispatch/Non-Dispatch/Reliable/Incentive	\$23.22	0.50	Dispatch/Non-Dispatch/Reliable/Incentive	\$23.22	\$0.00	None specified	None	None	None	Dispatch/Non-Dispatch/Reliable/Incentive	\$23.22	\$0.00
Code Standard - showerhead - 2.5 gal/minute	None	Dispatch/Non-Dispatch/Reliable/Incentive	\$14.22	\$0.30	\$16.74	780	780	0.50	0.50	Unit	Dispatch/Non-Dispatch/Reliable/Incentive	\$14.22	0.50	Dispatch/Non-Dispatch/Reliable/Incentive	\$14.22	\$0.00	None specified	None	None	None	Dispatch/Non-Dispatch/Reliable/Incentive	\$14.22	\$0.00
Code Standard - Facet America - 2.2 gal/minute	None	Dispatch/Non-Dispatch/Reliable/Incentive	\$3.74	\$0.30	\$16.74	780	780	0.50	0.50	Unit	Dispatch/Non-Dispatch/Reliable/Incentive	\$3.74	0.50	Dispatch/Non-Dispatch/Reliable/Incentive	\$3.74	\$0.00	None specified	None	None	None	Dispatch/Non-Dispatch/Reliable/Incentive	\$3.74	\$0.00
Labor Base Wage Rate Table										Agency													
Reference	Sector	Measure Category	Measure Subcategory	Program Delivery Strategy	Base Labor Rate																		
0.00001	Residential	Domestic 180 Hours	Water Conservation	Non-Dispatch/Non-Dispatch/Reliable/Incentive	\$18																		
Climate Multiplier Table (N/A)																							
Climate Zone	Reference City	Material	Installation																				
1	Denver	0.95	1.13																				
2	San Diego	1.00	1.00																				
3	San Francisco	1.00	1.00																				
4	San Jose	1.00	1.00																				
5	San Luis Obispo	0.95	1.07																				
6	San Mateo	1.00	1.00																				
7	San Diego	1.00	1.00																				
8	San Jose	0.95	1.07																				
9	San Antonio	1.00	1.00																				
10	Atlanta	1.00	1.00																				
11	Chicago	1.00	1.00																				
12	San Antonio	1.00	1.00																				
13	San Antonio	1.00	1.00																				
14	Atlanta	0.95	1.00																				
15	San Diego	0.95	1.07																				
16	Atlanta	0.95	1.00																				
	Average	0.95	1.00																				