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APPLIANCE & PLUG LOADS
CLOTHES WASHER, RESIDENTIAL
SWAP004-01

CONTENTS

MEASURE NAME

Clothes Washer, Residential

STATEWIDE MEASURE ID

SWAP004-01

TECHNOLOGY SUMMARY

This measure pertains to ENERGY STAR-certified residential clothes washers. A significant amount of the energy used for clothes washing is used for heating the water, thus machines that use less water are typically more energy efficient. Horizontal-axis (front loading) clothes washers tumble clothes through a smaller pool of water than conventional vertical-axis (top loading) models, saving up to 50% of energy consumed in the washing process. High-efficiency machines also have more efficient motors that spin clothes two to three times faster than the conventional machines. Thus, more water is removed from the clothes, which reduces the energy required to dry them.

The following terms are useful to understand the ENERGY STAR clothes washer measure:

- The **capacity** is the entire volume measured in cubic feet which a dry-clothes load could occupy within the clothes container during washer operation.
- The **energy consumption per cycle** is equal to the sum of the washing machine electrical energy consumption, the hot water heater energy consumption, and the dryer energy consumption.
- The **integrated modified energy factor (IMEF)** and **modified energy factor (MEF)** indicate how many cubic feet of laundry can be washed and dried with one (1) kWh of electricity. The higher the number, the greater the efficiency. The efficiency requirements for residential clothes washer models are based upon IMEF.
- The **integrated water factor (IWF)** is the number of gallons needed for each cubic foot of capacity. A lower number indicates lower water consumption and therefore represents more efficient use of the water.

MEASURE CASE DESCRIPTION

This measure is defined as a clothes washer that meets the minimum criteria of ENERGY STAR Version 8.0 or the ENERGY STAR Most Efficient 2018.[1] The following table provides the minimum integrated modified energy factor (IMEF) / modified energy factor (MEF) and the maximum integrated water factor (IWF) for the measure offerings defined for this measure. Savings were calculated for each applicable building type and for each investor-owned utility service area for each measure offering.

Measure Case Specification

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[1] ENERGY STAR. 2018. "ENERGY STAR® Program Requirements Product Specification for Clothes Washers - Eligibility Criteria Version 8.0." Effective February 5, 2018.

ENERGY STAR. 2018. "ENERGY STAR Most Efficient Recognition Criteria: Clothes Washers." Effective January 2018.

Tier	Measure Offering	Applicable Building Types	Min. Integrated Modified Energy Factor (IMEF)	Min. Modified Energy Factor (MEF J2)	Max. Integrated Water Factor (IWF)
ENERGY STAR Residential	Top-Loading > 2.5 cubic feet	Single family Mobile home Multifamily (in unit) Multifamily (common)	2.06	n/a	4.3
	Front-Loading > 2.5 cubic feet		2.76	n/a	3.2
ENERGY STAR Most Efficient Residential	Top-Loading > 2.5 cubic feet	Single family Mobile home Multifamily (in unit) Multifamily (common)	2.92	n/a	3.2
	Front-Loading > 2.5 cubic feet				

BASE CASE DESCRIPTION

The base case technology for this measure is a top-loading or front-loading residential clothes washer that meets the federal and Title 20 California Appliance Efficiency Regulations (see Code Requirements).

CODE REQUIREMENTS

Applicable state and federal codes and standards for clothes washers are denoted and further explained below.

Applicable State and Federal Codes and Standards

Code	Applicable Code Reference	Effective Date
CA Appliance Efficiency Regulations – Title 20 (2017)	Section 1605.1, Table P-2: Standards for Residential Clothes Washers	March 7, 2015
Federal Standards	Code of Federal Regulations, 10 CFR 430.32(g)(3)	March 7, 2015
	Code of Federal Regulations, 10 CFR 431.156	January 1, 2018
CA Building Energy Efficiency Standards – Title 24	None.	n/a

California Appliance Efficiency Regulations (Title 20). The 2017 California Appliance Efficiency Regulations (Title 20)[2] requires that all residential clothes washers manufactured on or after the effective dates meet the minimum efficiency requirements for the integrated modified energy factor (IMEF) and the integrated water factor (IWF). Title 20 minimum standards for residential clothes washers follow U.S. Department of Energy (DOE) federal minimum efficiency requirements.

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[2] California Energy Commission (CEC). 2014. *2014 Appliance Efficiency Regulations.* CEC-400-2014-009-CMF.

DOE Federal Standards. Clothes washers fall under federal DOE Energy Regulations.[3] , shown in the following tables. Note that federal standards match the requirements cited in Title 20.

Federal and State Minimum Efficiency Requirements for ENERGY STAR Clothes Washers – Residential

Residential Clothes Washers	Clothes Container Compartment Capacity (ft^3)	Min. Integrated Modified Energy Factor (IMEF)	Max. Integrated Water Factor (IWF)
Compact Top-Loading Clothes Washers	< 1.6 ft^3	1.15	12.0
Standard Top-Loading Clothes Washers	≥ 1.6 ft^3	1.57	6.5
Compact Front-Loading Clothes Washers	< 1.6 ft^3	1.13	8.3
Standard Front-loading Clothes Washers	≥ 1.6 ft^3	1.84	4.7

NORMALIZING UNIT

Each

PROGRAM REQUIREMENTS

Measure Implementation Eligibility

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

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

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[3] Code of Federal Regulations at 10 CFR 430.32 (g)(3).

Code of Federal Regulations at 10 CFR 431, Subpart I.

Implementation Eligibility

Measure Application Type	Delivery Type	Sector
New construction	UpDeemed	Res
New construction	DnDeemed	Res
New construction	DnDeemDI	Res
Normal replacement	UpDeemed	Res
Normal replacement	DnDeemed	Res
Normal replacement	DnDeemDI	Res

Eligible Products

This measure is defined as a clothes washer that meets minimum criteria of ENERGY STAR Version 8.0 or the ENERGY STAR Most Efficient 2018.[4] Eligible product information for each measure offering is described below.

Energy Efficiency Requirements for Clothes Washers

Measure Offering	Requirements
ENERGY STAR Residential Clothes Washer > 2.5 cubic feet	— Must be an ENERGY STAR-qualified top-loading or front-loading model. — The clothes container volume must be > 2.5 and ≤ 6.0 cubic feet. — Top-loading models must have an Integrated Modified Energy Factor (IMEF) ≥ 2.06 and an Integrated Water Factor (IWF) ≤ 4.3. — Front-loading models must have IMEF ≥ 2.76 and an IWF ≤ 3.2. — Qualified machines that satisfy the ENERGY STAR Connected criteria are allowed an IMEF 5% lower than the minimum qualifying standard.
ENERGY STAR Most Efficient Clothes Washer	— Must be an ENERGY STAR Most Efficient model that is a top-loading or front-loading residential model. — The clothes container volume must be ≥ 1.6 and ≤ 6.0 cubic feet. — Models > 2.5 cubic feet must have an IMEF ≥ 2.92 and an IWF ≤ 3.2.

Eligible Building Types

Eligible building types include residential single family and double-wide mobile homes, and in-unit multifamily residences; as well as multifamily common area laundry.

Eligible Climate Zones

The measure is applicable in all California climate zones.

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[4] ENERGY STAR. 2018. "ENERGY STAR® Program Requirements Product Specification for Clothes Washers - Eligibility Criteria Version 8.0." Effective February 5, 2018. Page 3.

ENERGY STAR. 2018. "ENERGY STAR Most Efficient Recognition Criteria: Clothes Washers." Effective January 2018.

PROGRAM EXCLUSIONS

The following products are not eligible for the ENERGY STAR Most Efficient Clothes Washer (> 2.5 cubic feet):

- Configurations other than a front-loading or top-loading design.
- Clothes washer with capacity ≤ 2.5 cubic feet.
- Combination washer-dryers and residential clothes washers with a heated drying functionality.
- Compact washers ≤ 1.6 cubic feet.
- Commercial clothes washers

DATA COLLECTION REQUIREMENTS

Data collection requirements are to be determined.

USE CATEGORY

Appliance and plug loads (AppPlug)

ELECTRIC SAVINGS (kWh)

The methodology to derive unit energy savings (UES) of an ENERGY STAR clothes washer is dependent upon the product tier/measure offering. The UES of residential clothes washers were drawn from the Database of Energy Efficient Resources (DEER) were calculated as a function of the energy requirements of the washing machine itself, and the energy requirements of the water heater and clothes dryer.

Tier	Measure Offering	Statewide Measure Offering ID	Energy Impact Measure ID	DEER Version
ENERGY STAR – Residential	Top-Loading	SWAP004G (Dwelling) SWAP004H (Common)	RB-Appl-EffCW-med-Tier1-Top	DEER 2020
	Front-Loading > 2.5 ft^3	SWAP004A (Dwelling) SWAP004B (Common)	RB-Appl-EffCW-med-Tier2-Front	DEER 2020
ENERGY STAR Most Efficient (ESME) – Residential	Top-Loading > 2.5 ft^3	SWAP004I (Dwelling) SWAP004J (Common)	Scaled from: RB-Appl-EffCW-med-Tier3-Front	DEER 2020
	Front-Loading > 2.5 ft^3	SWAP004C (Dwelling) SWAP004D (Common)	RB-Appl-EffCW-med-Tier3-Front	DEER 2020

Residential Clothes Washers – DEER-Based Unit Energy Savings

The measure offerings for which the values were drawn directly from DEER 2020 are specified below. The DEER Measure IDs in this table are only applicable to residential clothes washers installed in single-family, domestic mobile home, and in-unit multifamily residences.

Clothes Washer DEER Measure IDs

Tier	Measure Offering	DEER Measure ID	Min. Integrated Modified Energy Factor (IMEF)	Max. Integrated Water Factor (IWF)
ENERGY STAR – Residential	ENERGY STAR Top-Loading	RB-Appl-EffCW-med-Tier1-Top	2.06	4.3
	ENERGY STAR Front-Loading > 2.5 ft^3	RB-Appl-EffCW-med-Tier2-Front	2.76	3.2
ENERGY STAR Most Efficient (ESME) – Residential	Top-Loading > 2.5 ft^3	Scaled from RB-Appl-EffCW-med-Tier3-Front	2.92	3.2
	Front-Loading > 2.5 ft^3	RB-Appl-EffCW-med-Tier3-Front		

The UES of an ENERGY STAR Most Efficient top-loading clothes washer (2.92 IMEF) is scaled from the top-loading "Tier 3" measure in DEER (2.76 IMEF).

$$UES_{2.92\ IMEF} = UES_{2.76\ IMEF}\ \frac{\left(\frac{1}{IMEF_{base}} - \frac{1}{2.92}\right)}{\left(\frac{1}{IMEF_{base}} - \frac{1}{2.76}\right)}$$

The UES of a residential ENERGY STAR clothes washer installed in multifamily common area are based upon the DEER savings values corresponding to the DEER Measure IDs in the previous table. However, the savings are scaled proportionally to reflect the increase in wash cycles per year in a multifamily common area compared to residential use. The scaling factors shown below are derived from the number of wash cycles per year specified in the U.S. Department of Energy (DOE) Technical Support Documents (TSDs) for residential clothes washers.

Scaling Factors for Unit Energy Savings of Residential Clothes Washer

Building Type	Wash Cycles per Year	Scaling Factor	Source for Cycles per Year
Single Family	295	-	U.S. Department of Energy (DOE). 2012. *Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Clothes Washers.* Prepared by Navigant Consulting, Inc. and Ernest Orlando Lawrence Berkeley National Laboratory. Chapter 7, page 7-6.
Multifamily	1,095	3.71	U.S. Department of Energy (DOE). 2014. *Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Clothes Washers.* Prepared by Navigant Consulting, Inc. and Lawrence Berkeley National Laboratory. Chapter 7, page 7-6.

Saturation of Electric Water Heating and Electric Dryers. The energy use estimates from the DOE TSD assume the use of an electric water heater and an electric dryer. Thus, the calculated UEC must account for the saturation of electric hot water heating and electric dryers in California.

In 2009, the California Energy Commission administered the Residential Appliance Saturation Study (RASS)[5] across the service territories of the large investor-owned utilities (IOUs). The survey requested households to provide information on appliances, equipment, and general consumption patterns. Data collection was completed in early 2010.

The 2009 RASS data was analyzed to estimate the residential electric and gas water heater and dryer saturations for residential homes in California. Note that this analysis used the residential saturations from RASS for commercial washers installed in multifamily common areas washers because no other comparable source was available for those applications.

Residential Dryer and Water Heater Saturations, by Utility Service Area and Fuel Type

IOU Service Area	Gas Dryer w/ Gas Water Heating	Gas Dryer w/ Elec Water Heating	Electric Dryer w/ Gas Water Heating	Electric Dryer w/ Electric Water Heating
PG&E	40.2%	0.2%	57.9%	1.6%
SCE	71.7%	0.4%	21.3%	6.6%
SDG&E	66.4%	0.9%	31.3%	1.4%
SCG	78.0%	0.4%	20.8%	0.7%

Interactive Effects Multiplier. The interactive effects multipliers were drawn from DEER. Because interactive effects factors specific to clothes washers were not available, the HVAC interactive effects factors for screw-in lamps were applied to the clothes washer measure savings. The interactive effects factors were selected for "IOU territory" (weighted by climate zone) and the "Existing" building vintage. The factors for the utilities were used for the appropriate service territory. The "small office" building type was used for the multifamily common area measures.

PEAK ELECTRIC DEMAND REDUCTION (KW)

Residential Clothes Washers – DEER-based Peak Demand Reduction

As with electric energy savings, the peak demand reduction of residential ENERGY STAR clothes washers was drawn directly from the Database of Energy Efficient Resources (DEER). The measure offerings for which the values were drawn directly from DEER are specified below. The DEER Measure IDs in this table are only applicable to residential clothes washers installed in single-family, domestic mobile home, and in-unit multifamily residences.

Clothes Washer DEER Measure IDs

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[5] KEMA, Inc. 2010. *2009 California Residential Appliance Saturation Survey. Volume 2: Results.* Prepared for the California Energy Commission. CC-200-2010-004.

Tier	Measure Offering	DEER Measure ID	Min. Integrated Modified Energy Factor (IMEF)	Max. Integrated Water Factor (IWF)
ENERGY STAR – Residential	ENERGY STAR Top-Loading	RB-Appl-EffCW-med-Tier1-Top	2.06	4.3
	ENERGY STAR Front-Loading > 2.5 ft^3	RB-Appl-EffCW-med-Tier2-Front	2.76	3.2
ENERGY STAR Most Efficient (ESME) – Residential	Top-Loading > 2.5 ft^3	Scaled from RB-Appl-EffCW-med-Tier3-Front	2.92	3.2
	Front-Loading > 2.5 ft^3	RB-Appl-EffCW-med-Tier3-Front		

Coincident Demand Factor. The coincident demand factor (CDF) was drawn from the U.S. DOE Office of Energy Efficiency and Renewable Energy Building Analysis Spreadsheets developed as companion resources for the House Simulation Protocols. The Building America Existing Homes spreadsheet provides the set of standard operating conditions—including hourly and monthly profiles for occupancy, lighting, appliances, and miscellaneous electric loads developed by Building America to objectively compare energy use before and after a retrofit.

Peak Demand Reduction Inputs

End Use	CDF	Source
Multifamily Common Area	0.067	U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy. 2010. Building America Analysis Spreadsheets. "B10 Analysis - Existing Homes 2011.01.26.xlsm." See "Pre-Retrofit Normalized Hourly Profiles (Common Areas)" on the "Hourly Profiles" tab. Last modified December 17, 2010.

Interactive Effects. The interactive effects multipliers were pulled from the Database for Energy Efficient Resources (DEER) 2016. Because interactive effects specific to clothes washers were not available, the HVAC interactive effects factors for compact fluorescent lamps were applied to the clothes washer measure savings. The interactive effect factors were selected for "IOU territory" (weighted by climate zone) and the "Existing" building vintage. The factors for the utilities were used for the appropriate service territory. The "small office" building type was used for the multifamily common area measures.

GAS SAVINGS (THERMS)

The natural gas unit energy savings (UES) of an efficient clothes washer is based solely on the energy savings associated with reduced gas hot water heater and gas dryer energy consumption that will result from the installation of a high-efficiency clothes washer. The approaches to estimate the gas UES for residential clothes washers are summarized below.

Residential Clothes Washers – DEER-Based Unit Energy Savings

As with electric energy savings, the gas UES of residential ENERGY STAR clothes washers was drawn directly from the Database of Energy Efficient Resources (DEER). The measure offerings for which the values were drawn directly from DEER 2018 are specified below. The DEER Measure IDs in this table are

only applicable to residential clothes washers installed in single-family, domestic mobile home, and in-unit multifamily residences.

Clothes Washer DEER Measure IDs

Tier	Measure Offering	DEER Measure ID	Min. Integrated Modified Energy Factor (IMEF)	Max. Integrated Water Factor (IWF)
ENERGY STAR – Residential	ENERGY STAR Top-Loading	RB-Appl-EffCW-med-Tier1-Top	2.06	4.3
	ENERGY STAR Front-Loading > 2.5 ft^3	RB-Appl-EffCW-med-Tier2-Front	2.76	3.2
ENERGY STAR Most Efficient (ESME) – Residential	Top-Loading > 2.5 ft^3	Scaled from RB-Appl-EffCW-med-Tier3-Front	2.92	3.2
	Front-Loading > 2.5 ft^3	RB-Appl-EffCW-med-Tier3-Front		

Electric (kWh) to Gas (therm) Conversion. The energy use estimates taken from the U.S. Department of Energy (DOE) Technical Support Documents (TSDs) assume the use of an electric dryer and electric hot water heater. Because the energy usage is expressed exclusively in kWh, the dryer and water heater energy use values were converted to therms for the domestic hot water and dryer combinations that include gas as a fuel source.

Gas Correction Factors. Gas energy savings estimates were developed for the following domestic hot water and dryer combinations: electric water heat / electric dryer, gas water heat / electric dryer and gas water heat / gas dryer. According to the 2009 RASS, 0% of California IOU customers have electric water heat / gas dryer combinations in their homes. RASS distributions are considered separately for PG&E, SCE, SCG, and SDG&E customers. Because gas dryers and gas water heaters have a lower energy factor than electric dryers and electric water heaters, correction factors must be applied to facilities with gas dryers and/or gas water heating.

The gas water heater (or gas dryer) correction factor is a ratio of the efficiency of an electric storage water heater (or electric dryer) to the efficiency of a gas storage water heater (or gas dryer).

Gas Correction Factors

Factor	Value	Source
Gas Dryer Correction Factor	1.120	U.S. Department of Energy (DOE). 2012. *Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Clothes Washers.* Prepared by Navigant Consulting, Inc. and Ernest Orlando Lawrence Berkeley National Laboratory.
Efficiency of electric water heater	1.000	
Efficiency of gas water heater	0.750	
Gas Water Heater Correction Factor	1.333	

Interactive Effects. The interactive effects multipliers were pulled from DEER 2016. Because interactive effects factors specific to clothes washers were not available, the gas HVAC interactive effects factors for compact fluorescent lamps were applied to the clothes washer measure savings. The interactive effect factors were selected for "IOU territory" (weighted by climate zone) and the "Existing" building vintage. The factors for the utilities were used for the appropriate service territory. The "small office" building type was used for the multifamily common area measures.

See the Electric Savings for an explanation of the remaining parameters in the calculation.

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 EUL specified for high-efficiency clothes washers are presented below. Insofar as the clothes washer measure is not add-on equipment, the RUL is not applicable.

Effective Useful Life and Remaining Useful Life

Parameter	ENERGY STAR Residential Top- and Front Loading, > 2.5 ft³	ENERGY STAR Most Efficient Clothes Washer, > 2.5 ft³	Source
EUL (yrs)	11.0	11.0	California Public Utilities Commission (CPUC). 2014. "DEER2014-EUL-table-update_2014-02-05.xlsx."
RUL (yrs)	n/a	n/a	-

BASE CASE MATERIAL COST ($/UNIT)

Residential Clothes Washers

The base case material cost for equipment *delivered via direct install* is equal to $0.

The estimation of the base case material cost for *all other delivery types* was estimated with regression analysis of model data obtained by Energy Solutions, under contract with PG&E in November 2016, to determine the incremental measure cost (IMC) of a high efficiency residential clothes washer. A web scraping tool collected data on cost and other product attributes of clothes washers from five major retailers; washer models were matched to the ENERGY STAR qualified product list (QPL),[6] the California Energy Commission (CEC) Modernized Appliance Efficiency Database System (MAEDBS),[7] and the U.S. Department of Energy (DOE) Compliance Certification Database – all accessed in 2016.[8] Using a multiple regression analysis, the study team identified the incremental cost of the measure features that improve efficiency (represented by the IMEF value).

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[6] https://www.energystar.gov/productfinder/product/certified-clothes-washers/results

[7] https://cacertappliances.energy.ca.gov/Pages/ApplianceSearch.aspx

[8] https://www.regulations.doe.gov/certification-data/CCMS-79223002113.html#q=Product_Group_s%3A%22Clothes%20Washers%20-%20Residential%22

MEASURE CASE MATERIAL COST ($/UNIT)

Residential Clothes Washers

The estimation of the material cost for *all delivery types* was estimated with regression analysis of model data obtained by Energy Solutions, under contract with PG&E in November 2016, to determine the incremental measure cost (IMC) of a high efficiency residential clothes washer. A web scraping tool collected data on cost and other product attributes of clothes washers from five major retailers; washer models were matched to the ENERGY STAR qualified product list (QPL),[9] the California Energy Commission (CEC) Modernized Appliance Efficiency Database System (MAEDBS),[10] and the U.S. Department of Energy (DOE) Compliance Certification Database – all accessed in 2016.[11] Using a multiple regression analysis, the study team identified the incremental cost of the measure features that improve efficiency (represented by the IMEF value).

Note that at the time of this analysis (November 2016), the ENERGY STAR specification was different from the current ENERGY STAR specification (2018). However, the minimum IMEF requirements remained consistent. The mapping from the prior and current ENERGY STAR specifications is as follows:

Front-Loaders:

IMEF ≥ 2.76: 2016 ENERGY STAR Most Efficient = 2018 ENERGY STAR

IMEF ≥ 2.72: 2016 CEE Tier 3 = 2018 ENERGY STAR Most Efficient

Top-Loaders:

IMEF ≥ 2.06: 2016 ENERGY STAR = 2018 ENERGY STAR

IMEF ≥ 2.76: 2016 CEE Tier 3 = 2018 ENERGY STAR Most Efficient

For consistency, this measure will refer to the 2018 ENERGY STAR specifications.

The IMC was derived using the multiple regression analysis shown using data from five major retailer websites:

$$Log(Price) = \beta_0 + \beta_1 IMEF + \beta_2 IMEF[Attribute_2] \ldots + \beta_n IMEF[Attribute_n] + \varepsilon$$

The resulting regression coefficient for IMEF is 0.49. The IMC is calculated as:

$$IMC = Cost_{base} * exp(\beta_{IMEF} * \Delta IMEF) - Cost_{base}$$

$Cost_{base}$ = Base case cost ($)

$\Delta IMEF$ = Difference between the average IMEF of ENERGY STAR only models and the average IMEF of non-ENERGY STAR models.

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[9] https://www.energystar.gov/productfinder/product/certified-clothes-washers/results

[10] https://cacertappliances.energy.ca.gov/Pages/ApplianceSearch.aspx

[11] https://www.regulations.doe.gov/certification-data/CCMS-79223002113.html#q=Product_Group_s%3A%22Clothes%20Washers%20-%20Residential%22

Due to different market characteristics between front-loading and top-loading clothes washers, a separate IMC analysis was conducted for each type.

BASE CASE LABOR COST ($/UNIT)

The base case labor cost for equipment *delivered via direct install* is equal to $0.

For *all other delivery types*, it is assumed the participant would have purchased a standard efficiency clothes washer absent the program. As such, the labor cost is assumed to be the same for both base case and measure case scenarios and the incremental labor cost is equal to $0.

MEASURE CASE LABOR COST ($/UNIT)

For *all other delivery types*, it is assumed the participant would have purchased a standard efficiency clothes washer absent the program. As such, the labor cost is assumed to be the same for both base case and measure case scenarios and the incremental labor cost is equal to $0.

NET-TO-GROSS (NTG)

The net to gross (NTG) ratio represents the portion of gross impacts that are determined to be directly attributed to a specific program intervention. The NTG established for residential clothes washers is applicable for all units with a modified energy factor (MEF) that exceeds the ENERGY STAR qualification by 10

Net-to-Gross Ratios

Parameter	ENERGY STAR Residential Top- and Front Loading > 2.5 cubic feet	ENERGY STAR Most Efficient Clothes Washer, > 2.5 cubic feet	Source
NTG – residential units with MEF ≥ 10% above ENERGY STAR	0.31	0.31	Itron, Inc. 2011. *DEER Database 2011 Update Documentation.* Prepared for the California Public Utilities Commission. Page 14-5 Table 14-3.

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 Rates

Parameter	ENERGY STAR Residential Top- and Front Loading, >2.5 cubic feet	ENERGY STAR Most Efficient Clothes Washer, >2.5 cubic feet	Source
GSIA	1.0	1.0	California Public Utilities Commission (CPUC), Energy Division. 2013. *Energy Efficiency Policy Manual Version 5*. Page 31.

NON-ENERGY IMPACTS

The non-energy impacts associated with a high-efficiency clothes washer is the reduction in water use. The water savings for this measure were derived only for the residential models that meet the ENERGY STAR Most Efficient specification. This includes ENERGY STAR Most Efficient models installed in single family and in-unit multifamily residences, as well as residential clothes washers installed in multifamily common areas.

The water savings for the residential ENERGY STAR Most Efficient clothes washers were calculated with the Water Energy Nexus Calculator (WEN Calculator version 1.05), a calculator designed to calculate the embedded energy in water and the avoided capacity cost associated with water savings.[12] The "Environmental Benefits" module within the WEN Calculator calculates reduced water use from secondary data of existing environmental benefits models.

DEER DIFFERENCES ANALYSIS

This section provides a summary of inputs and methods that are adopted from the Database of Energy Efficient Resources (DEER), and the rationale for inputs and methods that are not DEER-based.

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[12] California Public Utilities Commission (CPUC). 2015. *Decision 15-09-023 in the Order Instituting Rulemaking into Policies to Promote a Partnership Framework between Investor Owned Utilities and the Water Sector to Promote Water-Energy Nexus Programs (R.13-12-011).* Issued September 25, 2015.

DEER Difference Summary

DEER Item	Comment
Modified DEER methodology	Yes
Scaled DEER measure	Yes
DEER Base Case	Yes
DEER Measure Case	Yes
DEER Building Types	Yes
DEER Operating Hours	Yes
DEER eQUEST Prototypes	No
DEER Version	DEER 2016 READi v2.3.0
DEER Measure IDs Used	RB-Appl-EffCW-med-Tier1-Top RB-Appl-EffCW-med-Tier2-Top RB-Appl-EffCW-med-Tier1-Front RB-Appl-EffCW-med-Tier2-Front RB-Appl-EffCW-med-Tier3-Front
NTG	Source: DEER 2011. The value of 0.31 is associated with NTG ID: *Res-sAll-mCW*
GSIA	Source: DEER. The value of 1.0 is associated with GSIA ID: *Def-GSIA* The value of 1.0 is associated with GSIA ID: *Res-CW-PGE*
EUL/RUL	Source: DEER. The value of 11 years is associated with EUL IDs: *ComLau-EffCW and Appl-Eff-CW*

REVISION HISTORY

Measure Characterization Revision History

Revision Number	Date	Primary Author, Title, Organization	Revision Summary and Rationale for Revision Effective Date and Approved By
01	02/28/2018	Jennifer Holmes Cal TF Staff	Draft of consolidated text for this statewide measure is based upon: PGECOAPP127, Revision 4 (December 18, 2017) PGECOAPP127, Revision 3 (January 13, 2017) Consensus reached among Cal TF members.
	12/31/2018	Jennifer Holmes Cal TF Staff	Revisions for submittal of Version 01
	07/02/2019	Ayad Al-Shaikh, Cal TF Staff	Update DEER Table.