

1.7 ENERGY STAR Clothes Washer

Algorithms

$$\begin{aligned} & \text{Customer kWh} \\ & = \left( \left( \frac{Cap \times N}{IMEF_{Base}} \right) \times \left( CW_{Base} + \frac{DHW_{Base} \times \% ElectricDHW}{R_{Eff}} + (DryBase \times \%ElecDry) \right) \right) \\ & - \left( \left( \frac{Cap \times N}{IMEF_{EE}} \right) \times \left( CW_{EE} + \frac{DHW_{EE} \times \% ElectricDHW}{R_{Eff}} + (DryEE \times \%ElecDry) \right) \right) \end{aligned}$$

$$\text{Customer Coincident kW} = \frac{\text{Customer kWh}}{\text{Hours}} \times \text{Coincidence Factor}$$

$$\begin{aligned} & \text{Customer Dth} \\ & = \left( \left( \frac{Cap \times N}{IMEF_{Base}} \right) \times \left( \frac{DHW_{Base} \times (1 - \% ElectricDHW)}{R_{Eff}} + DryBase \times (1 - \%ElecDry) \right) \right) \\ & - \left( \left( \frac{Cap \times N}{IMEF_{EE}} \right) \times \left( \frac{DHW_{EE} \times (1 - \% ElectricDHW)}{R_{Eff}} + DryEE \times (1 - \%ElecDry) \right) \right) \times 0.003412 \end{aligned}$$

$$\text{Non-Energy O\&M} = Cap \times N \times (IWF_{Base} - IWF_{EE}) \times \text{Water-Sewer-Rate}$$

Variables

Cap	3.45	Clothes washer drum capacity (ft <sup>3</sup> ). If unknown, assume 3.45ft <sup>3</sup> (Reference 1)
IMEF <sub>Base</sub>	Table 1.7.1	Integrated Modified Energy Factor for Federal Minimum equipment (ft <sup>3</sup> /kWh/cycle) (Reference 1)
IMEF <sub>EE</sub>	Table 1.7.1	Difference in cost between the standard equipment and the more efficient equipment
N	Table 1.7.1	Annual number of loads (Reference 1)
CW <sub>Base</sub>	7%	Percentage of total energy consumption for clothes washer operation for baseline equipment (Reference 1)
CW <sub>EE</sub>	6%	Percentage of total energy consumption for clothes washer operation for EnergyStar equipment (Reference 1)
DHW <sub>Base</sub>	33%	Percentage of total energy consumption for water heating for baseline equipment (Reference 1)
DHW <sub>EE</sub>	31%	Percentage of total energy consumption for water heating for EnergyStar equipment (Reference 1)
%Electric <sub>DHW</sub>	Table 1.7.2	Percent of domestic hot water savings assumed to be electric (Reference 1)
DryBase	59%	Percent of total energy consumption for dryer operation in baseline case.
DryEE	62%	Percent of total energy consumption for dryer operation in efficient case.
%ElecDry	See Table 1.2.7	Percent of dryer operation assumed to be electric.
IWF <sub>Base</sub>	See Table 1.1.7	Baseline Integrated Water Factor (Gal / cycle / cu.ft. ) for a standard clothes washer with a capacity of 1.6 cu.ft. or greater
IWF <sub>EE</sub>	See Table 1.1.7	EnergyStar Integrated Water Factor (Gal / cycle / cu.ft. ) for a clothes washer with a capacity of 1.6 cu.ft. or greater
Water-Sewer-Rate	\$0.008797	Water rate + Sewer rate per saved gallon of water.
Conversion Factor	0.0034120	convert kWh to Dtherms (factor is Dth/kWh)
Incremental Cost	\$50.00	Incremental Cost for EnergyStar Top Loading Clothes Washer
Incremental Cost	\$190.00	Incremental Cost for EnergyStar Front Loading Clothes Washer
R <sub>Eff</sub>	Table 1.7.2	Recovery efficiency (Reference 1)
Coincidence Factor	Table 1.7.1	Coincidence Factor (Reference 1)
Hours	Table 1.7.1	Annual Hours of Use (Reference 1)
Lifetime	11	Measured Lifetime (Reference 1)

Provided by Product Vendor or Customer

M&V Verified

Quantity of ENERGY STAR Clothes Washers Installed	Yes	
ENERGY STAR Clothes Washer Water Heater Fuel Type	Yes	Provide the Water Heater fuel type for the clothes washer's hot water; Electric or Natural Gas.
ENERGY STAR Clothes Washer-Sector	Yes	
Clothes Dryer Fuel Type	Yes	Provide the Clothes Dryer's fuel type; Electric or Natural Gas

Table 1.1.7 Sector-Breakout Clothes Washer Efficiency and Operational Information

Sector	Unit Type	IMEF <sub>Base</sub>	IMEF <sub>EE</sub>	N	Hours	Coincidence	IWF <sub>Base</sub>	IWF <sub>EE</sub>
Single-Family	Top and Front-Load-Average	1.64	2.24	258	258	3.8%		
	Top Loading	1.84	2.76	258	258	3.8%	6.5	4.3
	Front Loading	1.57	2.06	258	258	3.8%	4.7	3.7
Multi-Family	Commercial Front Load	2.00	2.20	1244	1244	4.5%		

Table 1.7.2 Washer Fuel Type by Factor

Fuel Type	%Electric <sub>DHW</sub>	R <sub>Eff</sub>	%ElecDry
Electric	100%	98%	100%
Gas	0%	78%	0%

References:

1. State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs Version 3.1 January 20, 2020
2. 2008 Database for Energy Efficient Resources, Version 2008.2.05, EUL/RUL Values, October 10, 2008.
3. Weighted average of 258 clothes washer cycles per year (based on 2015 Residential Energy Consumption Survey (RECS) national sample survey of housing appliances section, West North Central Region. nups4/www.eld.gov/Lurisumpuun/residential/data/2015/hc/phpi

DEEMED SAVINGS TECHNICAL ASSUMPTIONS

4. 10 CFR Parts 429 and 430 [Docket Number EERE-2008—BT—STD— 0019] RIN 1904—AB90 Energy Conservation Program: Energy Conservation Standards
5. The percentage of total energy consumption that is used for the machine, heating the hot water or by the dryer is different depending on the efficiency of the unit.
6. The percentage of total (gas and electric fuel types) water heating units that are electric calculated from 2015 Residential Energy Consumption Survey (RECS) data. <https://www.2ia.gov/consumption/residential/data/2015/hc/php/hc8.7.phr> Fuel used by main water heater section.
7. The percentage of total (gas and electric fuel types) dryer units that are electric calculated from 2015 Residential Energy Consumption Survey (RECS) data.
8. To account for the different efficiency of electric and Natural Gas hot water heaters (gas water heater): recovery efficiencies ranging from 0.74 to 0.85 (0.78)
9. Calculated from Itron eShapes, 8,760 hourly data by end-use for Missouri, as provided by Ameren. Reference is from Illinois Technical Reference Manual June
10. Clothes Washer Program Requirements Version 7.0.  
<https://www.energystar.gov/certified-products/sites/products/uploads/files/ENERGY%20STAR%20Final%20Version%207%20Clothes>
11. Clothes Washer Program Requirements Version 8.0.
12. ENERGY STAR Calculator. [https://www.energystar.gov/sites/default/files/asset/document/appliance\\_calculator.xlsx](https://www.energystar.gov/sites/default/files/asset/document/appliance_calculator.xlsx)
13. Based on the average clothes washer volume of all units that pass the new Federal Standard on the California Energy Commission (CEC) database of Clothes
14. Department of Energy. Energy Efficiency Program for certain commercial and industrial equipment
15. Department of Energy: Energy Savings Potential and RD&D Opportunities for Commercial Building Appliances Report. 2009.
16. 2015 Residential Energy Consumption Survey (RECS) Data
17. California Public Utilities District. Res Retro HIM Evaluation Report. Weighted by quantity of each efficiency level from MESP SPECTRUM. Reference it from

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