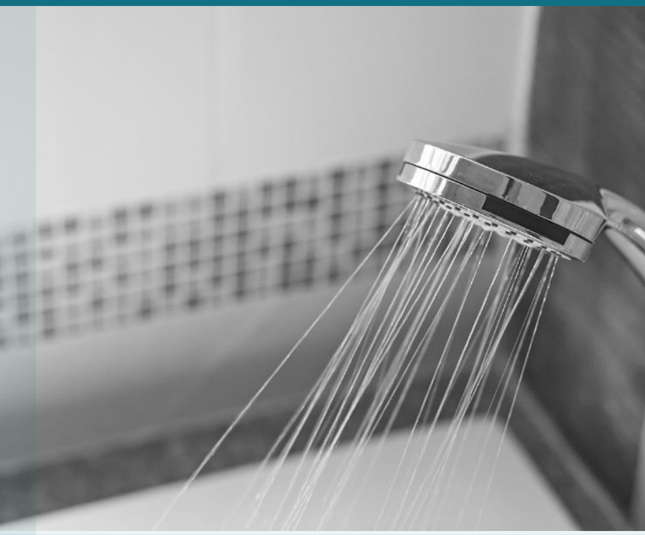
W-4. Require Low-Flow Water Fixtures



GHG Mitigation Potential

Potentially small reduction in GHG emissions from indoor water use

Co-Benefits (icon key on pg. 34)

Climate Resilience

Using low-flow water fixtures conserves water resources, which will become more strained under climate change.

Health and Equity Considerations

Low-flow and high-efficiency water fixtures can help to reduce water utility bill costs for project residents.

Measure Description

This measure requires use of low-flow or high-efficiency water fixtures in residential and non-residential buildings. Low-flow and high-efficiency fixtures may include toilets, urinals, showerheads, faucets, clothes washers, and dishwashers. These fixtures use less water than their traditional counterparts and, therefore, reduce energy and indirect GHG emissions that result from sourcing and transporting fresh water.

Scale of Application

Project/Site

Implementation Requirements

Install low-flow or high-efficiency fixtures that exceed state standards in any of the following: toilets, urinals, showerheads, faucets, clothes washers, and dishwashers.

Cost Considerations

Low-flow water fixtures tend to be slightly more expensive to purchase and install than less efficient models; however, these costs are almost immediately offset by large savings in water and energy consumption.

Expanded Mitigation Options

Install low-flow or high-efficiency water fixtures that perform better than the minimum efficiency standard established by ENERGY STAR, reducing the associated energy use and GHG emissions.

GHG Reduction Formula

$$A1 = \sum \left(D1 \times Ez \times \frac{Fz-Gz}{Fz} \right) \text{ or } = \sum (D1 \times Hz)$$ (Water savings)

$$A2 = \frac{A1}{D1} \text{ or } = \frac{D1-D2}{D1}$$ (Percent emissions reduction)

$$B = A1 \times I \times (J + K)$$ (Energy savings)

$$C = B \times L \times M \times N$$ (Emissions reduction)

GHG Calculation Variables

ID	Variable	Value	Unit	Source
Output				
A1	Indoor water savings with low-flow fixtures	[ ]	AF	calculated
A2	% reduction in indoor water, energy, and GHG emissions with low-flow fixtures	[ ]	%	calculated
B	Energy savings with low-flow fixtures	[ ]	kWh	calculated
C	GHG reduction with low-flow fixtures	[ ]	MT CO_2e	calculated
User Inputs				
D1	Existing indoor water use	[ ]	gal	user input
D2	Mitigated indoor water use	[ ]	gal	user input (if known)
Hz	% savings of water for end use z	1–100	%	user input (if known)
Constants, Assumptions, and Available Defaults				
Ez	% of indoor water used for end use z	Table W-4.1 Table W-4.2	%	Pacific Institute 2003 and Water Research Foundation 2016
Fz	Current state standard water flow rate for end use z	Table W-4.3 Table W-4.4	variable units	EnergyStar 2021a, 2021b, 2021c, 2021d and CA Green Building Code
Gz	Reduced flow rate for end use z	Table W-4.3 Table W-4.4	variable units	EnergyStar 2021a, 2021b, 2021c, 2021d and CA Green Building Code
I	Conversion from gal to AF	3.07×10^{-6}	AF per gal	conversion

ID	Variable	Value	Unit	Source
J	Electricity for municipally provided water	Table W-1.1	kWh per AF	CPUC 2016
K	Electricity required for wastewater treatment following municipal use	418	kWh per AF	CPUC 2016
L	Conversion from kWh to MWh	0.001	MWh per kWh	conversion
M	Carbon intensity of local electricity provider	Tables E-4.3 and E-4.4	lb CO_2e per MWh	CA Utilities 2021
N	Conversion from lb to MT	0.000454	MT per lb	conversion
z	End use or type of fixture	N/A	-	-

Further explanation of key variables:

- (Ez) – For residential uses, the percentages of indoor water that is typically used for the most common end uses are shown in Table W-4.1 in Appendix C. For non-residential uses, the percentages of total and indoor water that is typically used for the most common end uses are shown in Table W-4.2 in Appendix C. To calculate the water savings for this measure relative to total or indoor use, the user should multiply the savings rate from a given fixture (e.g., kitchen faucet) by the percentage of water that is used in kitchen faucets for a typical residential or non-residential use.
- (Fz) – The current (2019) California Plumbing Code water use flow rates for common fixtures are provided in Table W-4.3 (for residential uses) and Table W-4.4 (for non-residential uses) in Appendix C. The user can use a specific existing flow rate if the flow rate for the end use or fixture differs from the 2019 code.
- (Gz) – The reduced water use flow rate for common fixtures in provided in Table W-4.3 (for residential uses) and Table W-4.4 (for non-residential uses). These reduced rates assume implementation of voluntary measures from the 2019 California Green Building Code or EnergyStar certification, which goes beyond the current (2019) California Plumbing Code. The user can use a specific reduced flow rate if the flow rate for the end use or fixture differs from the rates shown in Tables W-4.3 or W-4.4.
- (Hz) – This variable is the percent water savings from using a fixture with improved water efficiency, relative to the existing rate for that fixture. If the user knows what the percent savings is for their fixtures, the equation above with variable Hz can be used.
- (J) – The water energy-intensity factors are derived from the most recent version of the CPUC Water Energy Calculator and are provided in Table W-1.1 in Appendix C (CPUC 2016). The energy intensity factors assume that all water is treated to potable standards and rely upon region-wide average values for DWR's 10 hydrologic regions.
- (K) – For this measure, water conservation would affect indoor water consumption. Because indoor water is sent to wastewater treatment plants, it is necessary to account for the energy that would be avoided at the wastewater treatment plant. The value of 418 kWh/AF is based on the CPUC Water Energy Calculator (CPUC 2016).
- (M) – GHG intensity factors for major utilities in California are provided in Tables E-4.3 and E-4.4 in Appendix C. If the project study area is not serviced by the listed electricity provider, or the user is able to provide a project-specific value, the user should replace these defaults in the electricity consumption GHG calculation formula.

GHG Calculation Caps or Maximums

None.

Example GHG Reduction Quantification

The user reduces GHG emissions from water-related electricity by requiring low-flow fixtures. In this example, the project is a non-residential office use located in Central Coast hydrologic region with a total indoor water demand of 10 million gal per year (D1). The user is proposing to upgrade the toilets and bathroom faucets per the 2019 California Green Building Code Voluntary Measures. Accordingly, the following assumptions are obtained from Tables W-4.2 and W-4.4 in Appendix C:

- Percent of indoor water used for toilets (Ez) = 48 percent.
- Percent of indoor water used for bathroom faucets (Ez) = 3 percent.
- Current state standard water flow rate for toilets (Fz) = 1.28 gal per flush.
- Current state standard water flow rate for toilets (Fz) = 0.5 gal per minute.
- Reduced water flow rate for toilets (Fz) = 1.12 gal per flush.
- Reduced water flow rate for toilets (Fz) = 0.35 gal per minute.

The project is in the San Francisco Bay hydrologic region, the electricity provider is My Choice Energy (MCE), and the analysis year is 2026. The carbon intensity of electricity is therefore 184 lb CO_2e per MWh (G).

$$A1 = \left[\left(10\times10^{6}\ \textbf{gal} \times 48\%(\text{toilet}) \times \frac{1.28(\text{toilet}) - 1.12(\text{toilet})}{1.28(\text{toilet})}\right) + \left(10\times10^{6}\ \textbf{gal} \times 3\%(\text{bathroom faucet}) \times \frac{0.5(\text{bathroom faucet}) - 0.35(\text{bathroom faucet})}{0.5(\text{bathroom faucet})}\right)\right] = 690{,}000\ \text{gal}$$

$$A2 = \frac{690{,}000\ \text{gal}}{10\times10^{6}\ \textbf{gal}} = 7\%$$

$$B = 690{,}000\ \text{gal} \times \left(3.07\times10^{-6}\,\frac{\text{AF}}{\text{gal}}\right) \times \left(695\,\frac{\text{kWh}}{\text{AF}} + 418\,\frac{\text{kWh}}{\text{AF}}\right) = 2{,}358\ \text{kWh}$$

$$C = 2{,}358\ \text{kWh} \times 0.001\,\frac{\text{MWh}}{\text{kWh}} \times 184\,\frac{\text{lb } CO_2e}{\text{MWh}} \times 0.000454\,\frac{\text{MT}}{\text{lb}} = 0.2\ \text{MT } CO_2e$$

Quantified Co-Benefits

Energy and Fuel Savings

Energy savings (B) are derived in the steps above that are necessary to quantify GHG reductions.

Water Conservation

Water savings (A1) are derived in the steps above that are necessary to quantify GHG reductions.

Sources

- California Plumbing Code. 2019 (CA Code). *Chapter 15 Alternate Water Sources for Nonpotable Applications.* https://up.codes/viewer/california/ca-plumbing-code-2019/chapter/15/alternate-water-sources-for-nonpotable-applications#15. Accessed: January 2021.
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