W-2. Use Grey Water

GHG Mitigation Potential

Potentially small reduction in GHG emissions from outdoor water use

Co-Benefits (icon key on pg. 34)

Climate Resilience

Using grey water conserves water resources, which will become more strained under climate change, and provides a backup water source should extreme events disrupt current sources. This could also reduce costs associated with obtaining fresh potable water from distant sources.

Health and Equity Considerations

The project should provide appropriate education on grey water for project residents and employees.

Measure Description

This measure requires the use of grey water for outdoor uses. *Grey water* is water from sinks, showers, tubs, and washing machines that has not contacted biological pathogens. Grey water offsets freshwater that would need to be extracted or sourced for the same demand, resulting in water and GHG emissions savings. The energy associated with grey water use is essentially negligible as it is used on site for a second time and does not require major pumping equipment or further treatment.

Scale of Application

Project/Site

Implementation Requirements

Grey water should only be used for non-potable applications, such as landscaping and other outdoor uses, because grey water does not undergo water treatment before being used for the second time.

Cost Considerations

Initial costs of altering the plumbing of a property to use grey water will vary with the property type; however, all applications will have costs associated with installing water collection, storage, and distribution infrastructure. These costs would be offset by reductions in freshwater use, as well as reduce energy requirements for water treatment and waste management.

Expanded Mitigation Options

For grey water sourced from sinks, it is best practice not to use water with greasy and oily substances, such as runoff from kitchen sinks with leftover oils, meat scraps, and dairy products.

GHG Reduction Formula

$A1 = (\mathbf{D} \times E + \mathbf{D} \times F) \times G \times H$ (Water savings, if not known by user)

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

$C1 = B \times L \times M \times N$ (Emissions reduction)

$C2 = \mathbf{A2}$ (Percent emissions reduction)

GHG Calculation Variables

ID	Variable	Value	Unit	Source
Output				
A1	Outdoor water savings from using grey water	[ ]	AF	calculated
B	Energy savings from using grey water	[ ]	kWh	calculated
C1	GHG reduction from using grey water	[ ]	MT CO_2e	calculated
C2	% GHG reduction from outdoor water use	[ ]	%	calculated
User Inputs				
A2	Percentage of water from grey water sources (relative to total outdoor water demand)	[ ]	%	user input
D	Number of residents in homes with grey water systems	[ ]	occupants	user input
Constants, Assumptions, and Available Defaults				
E	Gal per day per occupant from showers, bathtubs, and lavatories	25	gal per day per occupant	CA Code 2019
F	Gal per day per occupant for laundry	15	gal per day per occupant	CA Code 2019
G	Days per year	365	days per year	conversion
H	Conversion from gal to AF	3.07×10^{-6}	AF per gal	conversion
I	Electricity required for municipally provided water	Table W-1.1	kWh per AF	CPUC 2016
J	Electricity required for wastewater treatment following municipal use	418	kWh per AF	CPUC 2016
K	Fraction of electricity for grey water	0	kWh per AF	assumption
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

Further explanation of key variables:

- (A1) – If the user knows how much grey water will be used for their project, that amount should be used to determine GHG reductions. If it is not known, however, the formula for A1 can be used to estimate the volume of grey water at residential uses, based on the 2019 California Plumbing Code.
- (I, K, 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 rely on region-wide average values for DWR's 10 hydrologic regions. Because grey water is reused on site, it avoids energy after initial water consumption for at least once use cycle (i.e., wastewater treatment and extraction, conveyance, pre-treatment, and distribution energy for an equivalent volume of water).
- (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 (i.e., for the future year in which the grey water system would be established), 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 using grey water for non-potable uses in place of fresh water. In this example, the project in the South Coast hydrologic region and includes 300 residents. These residents would produce about 13.4 AF of water, which the user has determined is equal to 20 percent of the project's total water demand (A2). The electricity provider for the project area is City of Riverside and the analysis year is 2024. The carbon intensity of electricity is therefore 789 lb CO_2e per MWh (L).

$$A1 = \left(\mathbf{300} \times 25\frac{\text{gal}}{\text{day}\cdot\text{resident}} + \mathbf{300} \times 15\frac{\text{gal}}{\text{day}\cdot\text{resident}}\right) \times 365\frac{\text{days}}{\text{year}} \times \left(3.07\times10^{-6}\frac{\text{AF}}{\text{gal}}\right) = 13.4\text{ AF}$$

$$B = 13.4\text{ AF} \times \left(\left(1{,}898\frac{\text{kWh}}{\text{AF}} + 418\frac{\text{kWh}}{\text{AF}}\right) - 0\frac{\text{kWh}}{\text{AF}}\right) = 31{,}034\text{ kWh}$$

$$C1 = 31{,}034\text{ kWh} \times 0.001\frac{\text{MWh}}{\text{kWh}} \times 789\frac{\text{lb } CO_2e}{\text{MWh}} \times 0.000454\frac{\text{MT}}{\text{lb}} = 11.1\text{ MT } CO_2e$$

$$C2 = \mathbf{20\%}$$

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

This measure would not necessarily change water consumption, but it would result in conservation of fresh water sources by using grey water. This quantity of freshwater savings is equal to the amount of grey water (A1).

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.
- California Public Utilities Commission (CPUC). 2016. Water-Energy Calculator–Draft Version 1.05. Available: *https://www.cpuc.ca.gov/nexus_calculator/.* Accessed: January 2021.
- California Utilities. 2021. Excel database of GHG emission factors for delivered electricity, provided to the Sacramento Metropolitan Air Quality Management District and ICF. January through March 2021.