W-5. Design Water-Efficient Landscapes

GHG Mitigation Potential

Potentially small reduction in GHG emissions from outdoor water use

Co-Benefits (icon key on pg. 34)

Climate Resilience

Designing water-efficient landscapes conserves water resources, which will become more strained under climate change. In addition, native landscaping can help to support biodiversity and pollinators.

Health and Equity Considerations

Water-efficient landscaping can lower utility costs for project residents, and reduce pesticide and fertilizer run-off, which can affect water quality.

Measure Description

This measure requires the use of landscapes that are water efficient, with lower water demands than required by the DWR 2015 Model Water Efficient Landscape Ordinance (MWELO) (California Code of Regulations [C.C.R.], Title 23, Division 2, Chapter 2.7). Designing water-efficient landscapes for a project site or throughout a community reduces water consumption and thus the corresponding energy and indirect GHG emissions that result from sourcing and transporting fresh water.

Scale of Application

Project/Site and Plan/Community

Implementation Requirements

Relative to the maximum allowable water use under the MWELO, users can achieve water savings by reducing lawn sizes, planting vegetation with minimal water needs (e.g., California native species), choosing vegetation appropriate for the climate of the project site or community, or choosing complementary plants that have similar water needs or that can provide shade and/or water to each other.

Cost Considerations

Water-efficient landscapes save money not only through reduced requirements for irrigation, but also require fewer inputs like fertilizer and pesticides and less use of landscaping equipment. Depending on the area of the landscape and the cost of designing it for water efficiency, these cost savings usually recoup the cost of installation and design.

Expanded Mitigation Options

Pair with Measure W-6 for increased outdoor water conservation and GHG reductions. Encourage application of biochar to improve soil quality and enhance carbon sequestration. Incorporate low-impact development practices in the landscape and surrounding area.

GHG Reduction Formula

$A1 = ([(D \times E) + ((1 - D) \times F)] - (\frac{G}{H} \times E)) \times I \times J$ (Water savings)

$A2 = 1 - A1/[((D \times E) + ((1 - D) \times F)) \times I \times J]$ (Percent emissions reduction)

$B = A1 \times K \times L$ (Energy savings)

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

GHG Calculation Variables

ID	Variable	Value	Unit	Source
Output				
A1	Outdoor water savings with water-efficient landscapes	[ ]	gal	Calculated
A2	% reduction in outdoor water, energy & GHG emissions with water-efficient landscapes	[ ]	%	Calculated
B	Energy savings with water-efficient landscapes	[ ]	kWh	Calculated
C	GHG reduction with water-efficient landscapes	[ ]	MT CO_2e	Calculated
User Inputs				
D	Evapotranspiration adjustment factor for maximum allowable water use	0.55 or 0.45	unitless	user input
E	Landscape area	[ ]	sf	user input
F	Special landscape area	[ ]	sf	user input
Constants, Assumptions, and Available Defaults				
G	Plant factor	0 to 1.0	unitless	UC Davis 2021a
H	Irrigation efficiency	0.75 or 0.81	unitless	23 C.C.R. Appendix A
I	Evapotranspiration rate	[ ]	Inches per year	23 C.C.R. Appendix A
J	Conversion from acre-inches/acre to gal/sf	0.62	(gal per sf) per (acre-inch per acre)	conversion
K	Conversion from gal to AF	3.07×10^{-6}	AF per gal	conversion
L	Electricity for municipally provided water	Table W-1.1	kWh per AF	CPUC 2016
M	Conversion from kWh to MWh	0.001	MWh per kWh	conversion

ID	Variable	Value	Unit	Source
N	Carbon intensity of local electricity provider	Tables E-4.3 and E-4.4	lb CO_2e per MWh	CA Utilities 2021
O	Conversion from lb to MT	0.000454	MT per lb	conversion

Further explanation of key variables:

- (A1) – The methodology for calculating water reductions is based on the MWELO. It combines calculations for maximum allowable water use (known as MAWA per the MWELO) and estimated total water use (known as ETWU per the MWELO) into one formula for quantifying water savings.
- (D) – The evapotranspiration adjustment factor for maximum allowable water use is dependent on the project or land use type and is 0.55 for residential uses and 0.45 for non-residential uses.
- (F) – Special landscape area is an area of the landscape dedicated solely to edible plants, recreational areas, areas irrigated with recycled water, or water features using recycled water.
- (G) – In the calculation for water savings, the plant factor is the primary determinant of the magnitude of water savings. The plant factor should be taken from the University of California Davis' Water Use Classification of Landscape Species (WUCOLS) or other professional associations that are approved by DWR. The plant factor ranges from 0 to 0.1 for very low water plants; 0.1 to 0.3 for low water plants; from 0.4 to 0.6 for moderate water use plants; and from 0.7 to 1.0 for high water use plants. The water demands of a particular plant species can vary, depending on the region where the project is located. The region categorizations and plant factors can be found from the WUCOLS plant database (UC Davis 2021a, 2021b).
- (H) – The irrigation efficiency factor depends on the type of irrigation that will be used for the landscape and is 0.75 for spray head irrigation and 0.81 for drip irrigation.
- (I) – The evapotranspiration rate corresponding to the user's location affects how much water savings are achieved. Users can look-up location-dependent evapotranspiration rates from Appendix A of the MWELO (23 C.C.R. Appendix A).
- (L) – 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.
- (N) – 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 water efficient landscaping. In this example, the project is a residential use in Crescent City (North Coast hydrologic region). As a residential project, the evapotranspiration adjustment factor is 0.55 (D). Per MWELO, the evapotranspiration rate for Crescent City is 27.7 inches per year (I). The project includes a landscaped area of 1,500 sf (E), which will be landscaped with coyote mint (a low water use plant with plant factor equal to 0.1 [G]) and irrigated with a drip system (H). The project does not include special landscaping area (F). The electricity provider for the project area is PacificCorp, and the analysis year is 2022. The carbon intensity of electricity is, therefore, 1,228 lb CO_2e per MWh (N).

$$A1 = ([(\mathbf{0.55} \times \mathbf{1{,}500\ sf}) + ((1 - \mathbf{0.55}) \times \mathbf{0\ sf})] - (\frac{0.1}{0.81} \times \mathbf{1{,}500\ sf})) \times 27.7\frac{\text{inch}}{\text{yr}} \times 0.62\frac{\left(\frac{\text{gal}}{\text{sf}}\right)}{\left(\frac{\text{acre·in}}{\text{acre}}\right)} = 10{,}988\ \frac{\text{gal}}{\text{yr}}$$

$$A2 = 1 - 10{,}988\frac{\text{gal}}{\text{yr}}/[((\mathbf{0.55} \times \mathbf{1{,}500\ sf}) + ((1 - \mathbf{0.55}) \times \mathbf{0\ sf})) \times 27.7\frac{\text{inch}}{\text{yr}} \times 0.62\frac{\frac{\text{gal}}{\text{sf}}}{\frac{\text{acre·inch}}{\text{acre}}}] = 22\%$$

$$B = 10{,}988\frac{\text{gal}}{\text{yr}} \times \left(3.07\times10^{-6}\frac{\text{AF}}{\text{gal}}\right) \times 362\frac{\text{kWh}}{\text{AF}} = 12\frac{\text{kWh}}{\text{yr}}$$

$$C = 12\frac{\text{kWh}}{\text{yr}} \times 0.001\frac{\text{MWh}}{\text{kWh}} \times 1{,}228\ \frac{\text{lb } CO_2e}{\text{MWh}} \times 0.000454\frac{\text{MT}}{\text{lb}} = 0.007\frac{\text{MT } CO_2e}{\text{yr}}$$

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 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.
- University of California, Davis (UC Davis). 2021a. *WUCOLS IV Water Use Classification of Landscape Species*. Plant Search Database. Available: https://ucanr.edu/sites/WUCOLS/Plant_Search/. Accessed: January 2021.
- University of California, Davis (UC Davis). 2021b. *WUCOLS IV Water Use Classification of Landscape Species*. Regions. Available: https://ucanr.edu/sites/WUCOLS/WUCOLS_IV_User_Manual/Regions/. Accessed: January 2021.