W-6. Reduce Turf in Landscapes and Lawns

GHG Mitigation Potential

Large

Potentially large reduction in GHG emissions from outdoor water use

Co-Benefits (icon key on pg. 34)

Climate Resilience

Reducing turf conserves water resources, which will become more strained under climate change.

Health and Equity Considerations

Turf is often used for play. For residential or school projects, include play opportunities, build additional public parks nearby, and/or increase access to existing parks or playgrounds. However, turf often requires use of fertilizer (which can be derived from fossil fuels) and herbicides, both of which can affect water quality, and the removal of turf can reduce runoff effects.

Measure Description

This measure would remove or avoid turf grass. Turf grass (i.e., lawn grass) has relatively high-water needs compared to most other types of vegetation. Lowering landscaping water demands by reducing turf size would reduce water consumption and thus the corresponding energy and indirect GHG emissions that result from sourcing and transporting fresh water. Water agencies in California have instituted turf removal programs that provide rebates for residents who reduce the turf area at their homes.

Scale of Application

Project/Site

Implementation Requirements

See measure description.

Cost Considerations

Turf maintenance in landscape and lawns has always been significantly more expensive than a lawn filled with hardier species that are native to the region. As turf requires constant input to be maintained, the cost of transitioning turf to a more sustainable landscape is relatively inexpensive, and both a short- and long-term cost savings may be realized.

Expanded Mitigation Options

Additional GHG emissions savings may be achieved through reduced fertilizer use. The methods to calculate these reductions are not included in the quantification method.

GHG Reduction Formula

$A1 = D \times E \times F \times G \times H$ (Water savings)

$A2 = \frac{F}{I}$ (Percent emissions reduction)

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

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

GHG Calculation Variables

ID	Variable	Value	Unit	Source
Output				
A1	Outdoor water savings from turf reduction	[ ]	gal	calculated
A2	% reduction in GHG emissions from outdoor water use	[ ]	%	calculated
B	Energy savings from turf reduction	[ ]	kWh	calculated
C	GHG emissions reduction from turf reduction	[ ]	MT CO_2e	calculated
User Inputs				
F	Area of turf to be removed	[ ]	sf	user input
I	Total turf area	[ ]	sf	user input
Constants, Assumptions, and Available Defaults				
D	Crop coefficient	0.6 or 0.8 (cool- or warm-season grasses)	unitless	UC Davis 2021a, 2021b
E	Evapotranspiration rate	[ ]	inches per year	MWELO
G	Conversion factor acre-inches/acre to gal/sf	0.62	(gal per sf) per (acre-inch per acre)	conversion
H	Days per year	365	days per year	conversion
J	Conversion from gal to AF	3.07×10^{-6}	AF per gal	conversion
K	Electricity required for municipally provided water	Table W-1.1	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

Further explanation of key variables:

- (D) – The crop coefficient for turf grasses is represented by two values, one for cool-season grasses (0.6) and one for warm-season grasses (0.8).
- (E) – 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 CCR Appendix A).
- (H) – 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.
- (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 reducing turf grass. In this example, the project is in Lancaster (South Coast hydrologic region), which has evapotranspiration rate of 44.2 inches per day (E). The project will remove 800 sf of turf (F) with warm-season grasses (D). The project's entire turf area is 1,200 sf (I). The electricity provider for the project is Lancaster Choice Energy, and the analysis year is 2022. The carbon intensity of electricity is, therefore, 600 lb CO_2e per MWh (M).

$$A1 = 0.8 \times 44.2 \frac{\text{inch}}{\text{yr}} \times \mathbf{800\ sf} \times 0.62 \frac{\left(\frac{\text{gal}}{\text{sf}}\right)}{\frac{\text{acre}\cdot\text{inch}}{\text{acre}}} = 17{,}539 \frac{\text{gal}}{\text{yr}}$$

$$A2 = \frac{\mathbf{800\ sf}}{\mathbf{1{,}200\ sf}} = 67\%$$

$$B = 17{,}539\ \text{gal} \times \left(3.07\times10^{-6} \frac{\text{AF}}{\text{gal}}\right) \times 1{,}898 \frac{\text{kWh}}{\text{AF}} = 102\ \text{kWh}$$

$$C = 102\ \text{kWh} \times 0.001 \frac{\text{MWh}}{\text{kWh}} \times 600 \frac{\text{lb } CO_2e}{\text{MWh}} \times 0.000454 \frac{\text{MT}}{\text{lb}} = 0.03\ \text{MT } CO_2e$$

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 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. *Turfgrass Crop Coefficients*. Available: https://ucanr.edu/sites/UrbanHort/Water_Use_of_Turfgrass_and_Landscape_Plant_Materials/Turfgrass_Crop_Coefficients_Kc/. Accessed: January 2021.
- University of California, Davis (UC Davis). 2021b. *Water Requirements for Turfgrasses*. Available: https://ucanr.edu/sites/WUCOLS/Water_Requirements_for_Turfgrasses/. Accessed: January 2021.