S-1. Institute or Extend Recycling Services

GHG Mitigation Potential

Potentially small reduction in GHG emissions from waste management pathways

Co-Benefits (icon key on pg. 34)

Climate Resilience

Recycling can reduce upstream material extraction and product manufacturing, preserving resources and reducing energy use.

Health and Equity Considerations

Any new recycling facilities should not be constructed near vulnerable or underserved communities.

Measure Description

This measure will institute or extend recycling services to reduce the volume of landfilled waste. Decomposition of certain types of landfilled waste produces CH_4. Increasing waste diversion from landfills therefore reduces GHG emissions. The recycling process generates some emissions, but also reduces upstream emissions from the manufacturing and production of new raw materials and goods.

Scale of Application

Project/Site and Plan/Community

Implementation Requirements

See measure description.

Cost Considerations

Expanding recycling services generates costs of collection, processing, and management of the materials to be recycled, and can include the construction of new facilities to process a certain type of material, or transportation for the materials to reach a plant that can accommodate them. However, expanded recycling also reduces costs associated with new material production, waste processing, landfill management, pollution control, and waste-stream GHG emissions.

Expanded Mitigation Options

Waste reduction is as important, if not more so, as waste diversion. Work with building tenants to audit waste streams to identify opportunities for material reduction. For example, organizations may reduce single-use disposal at large events (e.g., concerts) and venues (e.g., stadiums) through partnerships with organizations that provide reusable cups and dishes.

GHG Reduction Formula

$A = [E1 \text{ or } E2] \times D$

$B_Z = A \times F_Z$

$C = \text{Input } B_Z \text{ into U.S. EPA WARM}$

GHG Calculation Variables

ID	Variable	Value	Unit	Source
Output				
A	Waste disposed by building type	[ ]	tons	calculated
B	Waste disposed by material type	[ ]	tons	calculated
C	GHG reduction from recycling vs. landfilling waste	[ ]	MT CO_2e	calculated using U.S. EPA WARM
User Inputs				
D	Population	[ ]	resident or employee	user input
Constants, Assumptions, and Available Defaults				
E1	Annual residential waste disposal rates by location	Table S-1.1	tons per resident per year	CalRecycle n.d.(a)
E2	Annual statewide non-residential waste disposal rates by business type	Table S-1.2	tons per employee per year	CalRecycle n.d.(b)
F	Percentage of material z in waste stream	Table S-1.3	%	CalRecycle n.d.(c), 2020
z	Material type (e.g., glass)	N/A	-	-

Further explanation of key variables:

- (C) – U.S. EPA's (2020) Waste Reduction Model (WARM) calculates GHG emissions associated with various waste management practices, including recycling and landfilling. To estimate the GHG benefit of recycling over landfilling, users input the tonnage of waste by material type into the Tons Landfilled column under the "baseline" scenario. The user then inputs the tonnage of waste by material type into the Tons Recycled column under the "alternative management" scenario. If a material type cannot be recycled, the used should input the tonnage for that material into the Tons Landfilled column under the alternative management scenario. The model calculates emissions under the baseline and alternative management scenarios of manufacturing, transportation, and end-of-life landfilling or recycling of waste and shows the net GHG savings in MT CO_2e.
- (E1) – Annual solid waste disposal rates for multi-family and single-family homes are provided in Table S-1.1 in Appendix C, *Emission Factors and Data Tables*.
- (E2) – Annual non-residential waste disposal rates by business type are provided in Table S-1.2 in Appendix C.

- (F) – The composition of disposed waste by material type for residential and non-residential buildings is provided in Table S-1.3 in Appendix C.

GHG Calculation Caps or Maximums

None.

Example GHG Reduction Quantification

The user reduces GHG emissions by diverting waste from a landfill to a recycling center. In this example, the project is an Arts, Entertainment, & Recreation business with 100 employees (D).

$$A = 1.94 \frac{\text{tons}}{\text{yr·employee}} \times 100 \text{ employees} = 194 \frac{\text{tons}}{\text{yr}}$$

$$B_{paper} = 194 \frac{\text{tons}}{\text{yr}} \times 21\% = 40.7 \frac{\text{tons}}{\text{yr}}$$

$$B_{glass} = 194 \frac{\text{tons}}{\text{yr}} \times 3\% = 5.8 \frac{\text{tons}}{\text{yr}}$$

$$B_{metals} = 194 \frac{\text{tons}}{\text{yr}} \times 2\% = 3.9 \frac{\text{tons}}{\text{yr}}$$

$$B_{plastic} = 194 \frac{\text{tons}}{\text{yr}} \times 14\% = 27.2 \frac{\text{tons}}{\text{yr}}$$

$$B_{food} = 194 \frac{\text{tons}}{\text{yr}} \times 34\% = 66.0 \frac{\text{tons}}{\text{yr}}$$

$$B_{yard\ trimmings} = 194 \frac{\text{tons}}{\text{yr}} \times 12\% = 23.3 \frac{\text{tons}}{\text{yr}}$$

$$B_{mixed\ organics} = 194 \frac{\text{tons}}{\text{yr}} \times 6\% = 11.6 \frac{\text{tons}}{\text{yr}}$$

$$B_{carpet} = 194 \frac{\text{tons}}{\text{yr}} \times 1\% = 1.9 \frac{\text{tons}}{\text{yr}}$$

$$B_{concrete} = 194 \frac{\text{tons}}{\text{yr}} \times 2\% = 3.9 \frac{\text{tons}}{\text{yr}}$$

$$B_{dimensonal\ lumber} = 194 \frac{\text{tons}}{\text{yr}} \times 1\% = 1.9 \frac{\text{tons}}{\text{yr}}$$

$$B_{fly\ ash} = 194 \frac{\text{tons}}{\text{yr}} \times 1\% = 1.9 \frac{\text{tons}}{\text{yr}}$$

The user inputs the tons of waste by material type (B) into U.S. EPA's WARM in the Tons Landfilled column. The project will recycle all paper (B_{paper}), glass (B_{glass}), and plastic ($B_{plastic}$),

which is assumed in the alternative management scenario. Based on WARM, the project would mitigate up to 202 MT CO_2e by diverting its waste from a landfill to a recycling facility.

Quantified Co-Benefits

None.

Sources

- CalRecycle. n.d.(a) *Residential Waste Stream by Material Type*. Available: https://www2.calrecycle.ca.gov/WasteCharacterization/ResidentialStreams. Accessed: April 2021.
- CalRecycle. n.d.(b) *Disposal and Diversions Rates for Business Groups*. Available https://www2.calrecycle.ca.gov/WasteCharacterization/BusinessGroupRates. Accessed: January 2021.
- CalRecycle. n.d.(c) *Business Group Waste Stream Calculator*. Available https://www2.calrecycle.ca.gov/WasteCharacterization/BusinessGroupCalculator. Accessed: January 2021.
- CalRecycle. 2020. *2018 Facility-Based Characterization of Solid Waste in California*. Available https://www2.calrecycle.ca.gov/WasteCharacterization/Study. Accessed: January 2021.
- U.S. Environmental Protection Agency (U.S. EPA). 2020. *Waste Reduction Model (WARM), Version 15*. Available: https://www.epa.gov/warm. Accessed: January 2021.