American Carbon Registry
AT WINROCK INTERNATIONAL

CALCULATOR TOOL USER GUIDE FOR THE QUANTIFICATION AND REGISTRATION OF ENVIRONMENTAL IMPACTS OF GREEN FINANCE FOR

DIVERSION OF ORGANIC WASTE FOR ANAEROBIC DIGESTION PROJECTS

VERSION 1.1

July 2021

WINROCK INTERNATIONAL

CALCULATOR TOOL USER GUIDE FOR THE QUANTIFICATION AND REGISTRATION OF ENVIRONMENTAL IMPACTS OF GREEN FINANCE FOR DIVERSION OF ORGANIC WASTE FOR ANAEROBIC DIGESTION PROJECTS

VERSION 1.1
July 2021

American Carbon Registry®

WASHINGTON DC OFFICE
c/o Winrock International
2451 Crystal Drive, Suite 700
Arlington, Virginia 22202 USA
ph +1 703 302 6500

ACRcapitalmarkets@winrock.org
www.winrock.org/ms/acr-capital-markets

ABOUT AMERICAN CARBON REGISTRY® (ACR)

ACR is a scientific standards body for the creation of environmental assets. This includes tradable assets like carbon offset credits issued by ACR Environmental Markets and the quantification of environmental attributes of financial instruments by ACR Capital Markets. We complement decades of expertise in the development of market-making standards and project measurement methodologies with operational expertise in the verification, registration, issuance, retirement, and reporting of environmental claims.

ACRONYMS

ACR	American Carbon Registry
CNG	Compressed natural gas
CO_2e	Carbon dioxide equivalent
CUSIP	Committee on Uniform Securities Identification Procedures
DME	Dimethyl ether
EPA	United States Environmental Protection Agency
GHG	Greenhouse gas
ISIN	International Securities Identification Number
kg	Kilogram
KPI	Key performance indicator
LFG	Landfill gas
LNG	Liquified natural gas
MJ	Megajoule
MT	Metric ton
NSPS	New Source Performance Standard
RNG	Renewable natural gas
scf	Standard cubic feet

CONTENTS

FIGURES

1 INTRODUCTION

The American Carbon Registry (ACR) developed methods to quantify environmental key performance indicators (KPIs) for bond-funded activities related to the diversion of organic waste for anaerobic digestion. The Methodology calculates a project's Carbon Return and applies benchmarks to assess a project's impact relative to investments in the same category. The Methodology quantifies the following environmental benefits:

- Greenhouse gas (GHG) emission reductions
- Bioenergy and/or biofuel generation
- Landfill diversion
- Compost or digestate production

The Methodology is a technical document that includes project eligibility data requirements, quantification approach, and project data requirements. To make these methods accessible to issuers, ACR created an accompanying Calculator Tool that embeds the methods and equations found in the Methodology. **This User Guide is a supplement to the Methodology and provides instructions on how to use the Calculator Tool.**

The Methodology for the Quantification and Registration of Environmental Impacts of Green Finance for Diversion of Organic Waste for Anaerobic Digestion Projects and the accompanying Calculator Tool are available at www.winrock.org/ms/acr-capital-markets. The online Calculator Tool is password protected. Email ACRcapitalmarkets@winrock.org to request access.

2 CALCULATOR TOOL INPUTS

The Methodology relies on project-specific data to assess the environmental impacts of a diversion of organic waste for anaerobic digestion project. Users will input these data into the Calculator Tool. This Chapter defines the inputs used for quantifying the KPIs and guides users on making appropriate selections in the Calculator Tool. Project data fall into six categories and are detailed in the sections below.

2.1 GENERAL PROJECT INFORMATION

- **Bond issuer:** Entity issuing the bond (i.e., city, state, county, other government entity, or corporation)
- **CUSIP number:** Nine character alphanumeric code serving as a unique identifier for bonds registered in North America
- **ISIN:** Twelve character alphanumeric code serving as a unique identifier for bonds outside of North America, if applicable
- **Bond name:** Bond name as used in bond official statement
- **Project name:** Project name funded with bond proceeds
- **Contact person (name, title):** Contact person responsible for completing or responding to inquiries related to issuer's use of the Methodology and Calculator Tool
- **Contact email:** Email address for the contact person identified
- **Contact phone:** Phone number for the contact person identified
- **Total bond financing for the diversion of organic waste for anaerobic digestion project (in U.S. dollars):** Amount of money from the bond used for the project
- **Total project cost (in U.S. dollars):** Amount of money from all sources required for the project

2.2 LANDFILL INFORMATION

- **Location of landfill from which material is diverted (state):** Select the state where the landfill is located from the dropdown menu.
- **Existence of a landfill gas (LFG) capture system at the landfill from which material is diverted:** Select "Yes" or "No" from the dropdown menu to indicate whether the landfill from which material is diverted has an LFG capture system. A collection system may be passive or active and is typically composed of a series of gas collection wells placed throughout the landfill to help control odors, minimize emissions, and increase safety. Many landfills install gas capture systems to comply with regulatory requirements.

If no, proceed to Anaerobic Digester Information. If yes, proceed to the next field.

- **Moisture conditions:** Select the moisture conditions that most accurately describe the average conditions at the landfill from the dropdown menu:
  - Dry: <20 inches of precipitation/year
  - Moderate: 20-40 inches of precipitation/year
  - Wet: >40 inches of precipitation/year
  - Bioreactor: Water is added until the moisture content reaches 40 percent moisture on a wet weight basis
- **Gas collection efficiency:** The LFG collection efficiency will vary throughout the life of the landfill. Select the gas collection efficiency that most accurately describes system from the dropdown menu:
  - Worst-case gas collection: Years 0-4: 0%; Years 5-9: 50%; Years 10-14: 75%; Years 15 to 1 year before final cover: 82.5%; Final Cover: 90%

    This scenario represents a landfill that is in compliance with the U.S. EPA's New Source Performance Standard (NSPS).
  - Typical operation: Years 0-1: 0%; Years 2-4: 50%; Years 5-14: 75%; Years 15 to 1 year before final cover: 82.5%; Final Cover: 90%

    This scenario represents the average U.S. landfill, although every landfill is unique.
  - Aggressive gas collection: Years 0: 0%; Years 0.5-2: 50%; Years 3-14: 75%; Years 15 to 1 year before final cover: 82.5%; Final Cover: 90%

    This scenario includes landfills where the operator is aggressive in gas collection relative to a typical landfill. Bioreactor landfills, which are operated to accelerate decomposition, are assumed to collect gas aggressively.
  - California regulatory collection: Years 0: 0%; Year 1: 50%; Years 2-7: 80%; Years 8 to 1 year before final cover: 85%; Final Cover: 90%

    This scenario represents compliance with California's regulatory requirements.
- **Primary end-use for gas:** Select "Gas is recovered for energy" or "Gas is flared" from the dropdown menu to indicate the primary way that collected LFG is used or destructed.
- **Percentage of gas sent to primary end-use:** Enter the percent of LFG sent for the primary end-use.

If 100%, proceed to Anaerobic Digester Information. If less than 100%, proceed to the next field.

- **Secondary end-use for gas:** Select "Gas is recovered for energy" or "Gas is flared" from the dropdown menu to indicate the secondary way that collected LFG is used or destructed.
- **Percentage of gas sent to secondary end-use:** Enter the percent of LFG sent for the secondary end-use.

2.3 ANAEROBIC DIGESTER INFORMATION

- **Project operational life (years):** The Methodology assumes (and Calculator Tool defaults to) an operational life of 25 years for an organic waste diversion for anaerobic digestion project. Individual project operational lives may vary. If entering a different operational life, project proponents must substantiate the alternative project duration with documentation (i.e., equipment manufacturer specifications, operator's project performance record, or organic waste processing contracts).
- **Duration of initial start-up period prior to full operation (years):** Enter the number of years expected prior to the facility operating at full capacity when the quantity of diverted material may be lower.
- **Anaerobic digester operation type:** Select the type of anaerobic digester operation from the dropdown menu:
  - **Wet mesophilic digester with curing of digestate to produce compost:** A digester that typically operates between 20° and 40°C and is designed to process pumpable slurries. These digesters cannot accept yard waste. Digestate solids undergo and aerobic composting treatment before land application resulting in the stabilization of organics in the finished compost.
  - **Wet mesophilic digester without curing of digestate:** A digester that typically operates between 20° and 40°C and is designed to process pumpable slurries. These digesters cannot accept yard waste. Digestate solids are directly applied to land.
  - **Dry mesophilic digester with curing of digestate to produce compost:** A digester that typically operates between 20° and 40°C and is designed to process materials with a solids content between 25 and 40% and process solid substrates without the addition of water. These digesters can accept food and yard waste. Digestate solids undergo and aerobic composting treatment before land application resulting in the stabilization of organics in the finished compost.
  - **Dry mesophilic digester without curing of digestate:** A digester that typically operates between 20° and 40°C and is designed to process materials with a solids content between 25 and 40% and process solid substrates without the addition of water. These digesters can accept food and yard waste. Digestate solids are directly applied to land.
- **Type of bioenergy or biofuel produced:** Select the type of bioenergy or biofuel from the dropdown menu:
  - **Electricity for export to grid:** Biogas is combusted on-site to produce electricity (e.g., via an internal combustion engine) and surplus is exported to regional grid.
  - **Natural gas for pipeline injection:** Biogas is refined, compressed, and renewable natural gas is injected into a utility pipeline.
  - **Vehicle fuel (RNG):** Biogas is refined, compressed, and the renewable natural gas is used as vehicle fuel in the form of compressed natural gas (CNG) or liquified natural gas (LNG).

- **Vehicle fuel (hydrogen):** Biogas is refined, compressed, and converted to hydrogen fuel cells.
- **Vehicle fuel (DME):** Biogas is converted to methanol and synthesized into dymethyl ether.

- **Quantity of bioenergy or biofuel produced annually:** The type of bioenergy or biofuel and associated unit displayed depend on the selection in the previous field. Enter the annual quantity of bioenergy or biofuel produced for the appropriate bioenergy or biofuel type:
  - **Electricity for export to grid:** Annual net surplus electricity to grid (kWh/year).
  - **Natural gas for pipeline injection:** Annual pipeline injection (scf/year)
  - **Vehicle fuel (RNG):** Annual RNG production (scf/year)
  - **Vehicle fuel (hydrogen):** Annual hydrogen fuel production (kg/year)
  - **Vehicle fuel (DME):** Annual DME production (gallons/year)

2.4 DIVERTED MATERIAL INFORMATION

- **Quantity of organic material diverted from a landfill and sent to anaerobic digester.** Each category is split between the quantity of material diverted during the initial start-up period and the quantity of material diverted during the remainder of the operational life.
  - **Mixed organics (short tons/year):** Mixed food and yard waste, default weighted as 53 percent food waste and 47 percent yard waste.

If the composition of diverted waste is unknown, enter the annual quantity of diverted organic material as mixed organics and proceed to Quantity of Residual Material Initially Diverted but Later Recycled or Otherwise Utilized by Project.

If the composition of diverted waste is known, enter the quantities, by waste type:

- **Food waste (short tons/year):** Uneaten food from residences, commercial establishments such as grocery stores and restaurants, institutional sources such as school cafeterias, and industrial sources such as factory lunchrooms.

  The U.S. EPA has not yet analyzed differences in GHG emissions by food waste type in the anaerobic digestion pathway. Therefore, the emission factors are the same for each food waste type
- **Yard waste (short tons/year):** Yard trimmings from residential, institutional, and commercial sources, default weighted as 50 percent grass, 25 percent leaves, and 25 percent tree and brush trimmings.

- **Quantity of residual material initially diverted but later recycled or otherwise utilized (short tons/year):** Material initially diverted but later sent to a facility for recycling or other utilization.
- **Quantity of residual material initially diverted but later landfilled by project (short tons/year):** Material initially diverted but later sent back to a landfill.

2.5 DIGESTATE / FINSIHED COMPOST INFORMATION

- **Percent of digestate or compost used distributed for land application during total operational life (%):** Enter the percent of the digestate or finished compost that will be land applied.

2.6 TRANSPORTATION INFORMATION

- **Average distance traveled to transport diverted waste from curb to digester facility (miles):** Select the distance range that most accurately reflects the average distance traveled to transport diverted waste from curb collection to the anaerobic digester facility:
  - ≤50 miles
  - 51-100 miles
  - 101-150 miles
  - 151-200 miles
  - >200 miles

If the average distance is unknown, leave blank and proceed to the next field.

- **Average distance traveled to transport waste from curb to landfill (miles):** Select the distance range that most accurately reflects the average distance traveled to transport waste from curb collection to the landfill:
  - ≤50 miles
  - 51-100 miles
  - 101-150 miles
  - 151-200 miles
  - >200 miles

If the average distance is unknown, leave blank and proceed to the next field.

- **Average distance traveled to transport residual material from digester facility to landfill or other facility (miles):** Select the distance range that most accurately reflects the average distance traveled to transport residual material:
  - ≤50 miles
  - 51-100 miles
  - 101-150 miles
  - 151-200 miles
  - >200 miles

If the average distance is unknown, leave blank.

- **Average distance traveled to transport digestate/compost from digester facility to application site (miles):** Select the distance range that most accurately reflects the average distance traveled to transport digestate or compost:
  - ≤50 miles
  - 51-100 miles
  - 101-150 miles
  - 151-200 miles
  - >200 miles

If the average distance is unknown, leave blank.

- **Alternative fuel solid waste collection vehicles:** Select "Yes" or "No" from the dropdown menu to indicate whether the diverted or residual material is transported in alternative fuel vehicles.

If no, proceed to results page. If yes, proceed to the next field.

- **Percentage of fleet biodiesel**: Enter the percent of the waste collection vehicle fleet that is fueled with biodiesel.
- **Percentage of fleet CNG**: Enter the percent of the waste collection vehicle fleet that is fueled with CNG.
- **Percentage of fleet RNG**: Enter the percent of the waste collection vehicle fleet that is fueled with RNG.
- **Percentage of fleet hydrogen**: Enter the percent of the waste collection vehicle fleet that is fueled with hydrogen.
- **Percentage of fleet electric**: Enter the percent of the waste collection vehicle fleet that is fueled with electricity.

3 CALCULATOR TOOL OUTPUTS

After entering the project data inputs into the Calculator Tool, the resulting KPIs are displayed as outputs, pictured below.

Figure 1: Image of Calculator Tool Outputs

KEY PERFORMANCE INDICATOR	TOTAL	PRO-RATED (IF APPLICABLE)	REPRESENTATIVE YEAR	UNIT	SUSTAINABLE DEVELOPMENT GOAL
GHG Impact from Project Operations				Metric tons carbon dioxide equivalent ($MTCO_2e$) emission reductions	
Primary GHG Impact from Project Operations				$MTCO_2e$ emission reductions	
Potential Secondary GHG Impact from Project Operations				$MTCO_2e$ emission reductions	
Carbon Return			N/A	$MTCO_2e$ emission reductions/$1,000 bond financing/years of project operation	
GHG Cost Effectiveness			N/A	$MTCO_2e$ emission reductions/$1,000 bond financing	
Social Cost of Carbon Benefit				$ (thousands)	
Project GHG Impact Compared to Benchmark		N/A		$MTCO_2e$ compared to benchmark	
Project GHG Impact Compared to Benchmark		N/A		% relative to benchmark	
Surplus Electricity Produced				Megawatt hour (MWh)	
Surplus Bioenergy or Biofuel Produced (including electricity)				Gigajoule (GJ)	
Surplus Bioenergy or Biofuel Produced per Dollar Invested			N/A	GJ/$1,000 bond financing	
GJ Compared to Benchmark				GJ compared to benchmark	
Project Bioenergy or Biofuel Production Compared to Benchmark				% relative to benchmark	
Net Organic Material Diverted from Landfills				short tons	
Net Material Diverted from Landfills				short tons	
Net Material Diverted Per Dollar Invested			N/A	short tons/$1,000 bond financing	
Digestate Produced				short tons	
Digestate Produced Per Dollar Invested			N/A	short tons/$1,000 bond financing	
Compost Produced				short tons	
Compost Produced Per Dollar Invested			N/A	short tons/$1,000 bond financing	