Abstract

This is an organic waste composting project based in the state of Massachusetts in the USA that composted residual and commercial food waste, diverting the food waste from local landfills. By diverting the waste, this project was able to reduce greenhouse gas emissions, which would have occurred during the anaerobic decay process associated with food waste decomposition in landfills.

Project Description (PD)

Basic Information	
ID of project	Identification of the project in the registry
Project name	Black Earth 2022 OWC
Project proponent	One Earth Fund Inc.
Representative	Gordon Hilbun, CEO, Gordon.hilbun@oneearth.us
Statement by the project proponent	The One Earth Fund Inc. and all accompanying documentation provided.
Pre-registration date	2023.10.15
Date of version	2025
Methodology(ies) applied and version number	☐ No ☒ Yes, 2013 CAR Organic Waste Composting V1.1
Criteria for validation	☒ ISO 14064-2 ☒ Applied methodology, 2013 CAR Organic Waste Composting V1.1 ☐ Other, please specify.
Host country(ies)	USA
Host country approval	☒ Yes ☐ No
Sectoral scope of project activity	13 - Waste handling and disposal

Multiple project activities	☐ Yes ☒ No
Methodology(ies) applied and version number	2013 CAR Organic Waste Composting V1.1
Type (CDR, avoidance, hybrid)	☐ CDR ☒ Avoidance ☐ Hybrid
MRV cycle:	Annual
Estimated annual average GHG emission mitigation (t CO2-e)	6000

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1. Project description

1.1 Purpose, objectives, and general description of the project

This project is for organic waste composting of residential and commercial food waste that would have been deposited in a landfill resulting in greenhouse gas emissions created by anaerobic decay in landfill environments.

- Black Earth 2022 OWC
- Food waste was being discarded with normal municipal trash collection and dumping.
- Weight scales and electronic records accounting and monitoring.
- Limited to project facilities.
- Waste collection and distribution to landfills.
- 6,000 metric tons.

1.2 Project type and sectoral scope

Sectoral scope	13 - Waste handling and disposal
Project type	Organic Waste Composting resulting in GHG emission avoidance

1.3 Project

☐ Single location/area or installation

☒ Bundled project (multiple locations/areas or installations)

☐ Grouped project (locations/areas or installations added post validation)

☐ Bundled and grouped project.

1.3.1 Eligibility criteria for grouped project

Not Applicable

1.4 Location

Site 1	
Address	1062 Edmans Rd. Framingham, MA. 01701
County/province	Middlesex County
Country	USA
Region	North America
Geographic location	
Latitude	42.3292
Longitude	-71.4818
Map link	https://earth.google.com/57c9c839-fbfb-4458-a566-c94c3a49edf7

Site 2	
Address	600 Cow Pond Brook Rd. Groton, MA 01450
County/province	Middlesex County
Country	USA
Region	North America

Geographic location	
Latitude	42.6233
Longitude	-71.5007
Map link	https://earth.google.com/50c0b2fd-1f3b-45a4-9384-775aa4b64170
Site 3	
Address	197 School St. Manchester-by-the-Sea, Massachusetts, 01944
County/province	Essex County
Country	USA
Region	North America
Geographic location	
Latitude	42.5941
Longitude	-70.7661
Map link	https://earth.google.com/56e306b7-511d-477a-82fa-e2202250521c

1.5 Conditions prior to implementation

Facilities were lawncare waste sites prior to converting to composting facilities.

1.6 Technology applied

- Facilities are windrow and forced aeration facilities.
- Standard material handling equipment (forklifts, front-end loaders, etc.)

- Mixed material shredders
- Annually calibrated heavy vehicle sized weight scales
- Dump and pickup trucks
- Forced air floor systems
- The total capacity for all facilities is 21 tons per day.

1.7 Roles and responsibilities

1.7.1 Project proponent(s)

Organization Name	One Earth Fund
Role in the project	Project Owner
Contact person	Gordon Hilbun
Title	CEO
Address	520 W Ponce De Leon Ave #573, Decatur, GA, 30030 USA
Telephone	+01 678.562.5006
Email	Gordon.hilbun@oneearth.us

1.7.2 Others involved in the project

Organization name	Black Earth Compost
Role in the project	Facility Owner
Contact person	Conor Miller
Title	CEO
Address	197 School Street, Manchester, MA 01944

Telephone	+01-978-290-4610
Email	conor@blackearthcompost.com

1.8 Chronological plan/implementation

1. Start date: 2021.12.01
2. 2021.12.01- 2022.11.30
3. 2022.12.01
4. Annual monitoring and reporting for trailing twelve-month project lifetime.
5. Verification and validation to begin on 15 January

1.9 Eligibility

This project meets additionality requirements under both the CAR OWC Protocol 2013 v1.1 and the CDM ASM0022 for GHG reduction through approved composting processes. The two additionality tests that are applicable under both CAR and CDM protocols are for both Performance Standards and Legal Requirements. This project will be audited using the ISO 14064 standard to ensure compliance with ISO standards.

1. This project meets the performance test because the organic waste collected for composting operations would otherwise be deposited in landfills.
2. This project meets the legal requirements test because it would not otherwise have occurred due to federal, state, or local regulations or other legally binding mandates for disposal of prescribed quantities of food waste.

1.10 Funding

Funding is all through private donations to One Earth Fund, which is a 501(c)3 non-profit charity based in the USA.

1.11 Ownership

One Earth Fund Inc. is the project owner and the legal representative of the facility owner, Black Earth Compost, LLC.

1.12 Other certifications

Not Applicable to this project.

1.13 Double counting, issuance and claiming

This project was registered under both the Climate Action Reserve and Verra Registries. The CAR Project IDs are (1) 1682, (2) 1732, and (3) 1733. The Verra Registry is Project ID # 4608. This project was approved by both registries, but these projects have been canceled in those registries by the project proponent once this project was accepted by Carbonmark.

1.13.1 Other registration and double issuance

This project was registered with the Climate Action Reserve, Verra Registry, and the International Carbon Registry, but the project developer removed it from all these registries due to project administrative backlogs at both registries. The Climate Action Reserve, Verra Registry, and the International Carbon Registry all accepted this project as a viable project under the CAR OWC Protocol 2013 v1.1 ("the methodology).

Is the project registered or intends to be registered with another GHG program?

☐ Yes, (provide evidence on how double issuance will be prevented)

☒ No

Has the project been rejected by another GHG program

☐ Yes

☒ No

GHG program	Climate Action Reserve
Project ID	(1) 1682, (2) 1732, and (3) 1733
Link	https://thereserve2.apx.com/mymodule/mypage.asp
Status	Selecting Verification Body
GHG program	Verra Registry
Project ID	4608
Link	https://registry.verra.org/myModule/reg/ProjectInfo.asp?action=update&id1=4608&p=1
Status	Pipeline listing requested (under development)

1.13.2 Double claiming and other instruments

Are the project activities also included in a GHG emissions trading program or subject to binding emission limit?

☐ Yes

☒ No

Has the project activity applied for, received, or is planning to receive instruments from another GHG-related environmental crediting system, e.g. IREC or Guarantees of Origin.

☐ Yes

☒ No

Do project activities affect GHG emissions accounted for within a value chain (goods/service, i.e. scope 3 emissions and the project proponent or Authorized representative a buyer or a seller of such goods/services?

☐ Yes

☒ No

1.14 Other benefits

- A summary description of project activities that result in sustainable development goals (SDG) contributions (i.e., technologies/measures implemented, activity location).
- An explanation of how project activities will result in expected contributions.
- A description of how the project contributes to achieving any nationally stated sustainable development priorities, including any provisions for monitoring and reporting.
- In the table below provide information on contribution for each SDG.

Identification of SDG contributions Please provide information on SDGs the projects impact and how the project achieves them.			
SDG target	Indicator (text from the SDG indicator)	Net impact (activities to increase or decrease)	Contributions
1. No poverty			
1.1			
1.2			
...			
2. Zero hunger			
2.1			

2.2			
...			
3. Good health and well-being			
4. Quality education			
5. Gender equality			
6. Clean water and sanitation			
7. Affordable and clean energy			
8. Decent work and economic growth			
9. Industry, innovation, and infrastructure			

10. Reduced inequalities				
11. Sustainable cities and communities				
12. Responsible consumption and production	12.3.1 (a) Food loss index and (b) food waste index	Decrease food waste by ~8000MTs and decrease emissions from food waste by ~7000MTs.	We will directly contribute to the 2030 goal, to halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses	
13. Climate action				
14. Life below water				
15. Life on land				
16. Peace, justice, and strong institutions				
17. Partnership for the goals				

1.15 Host country attestation

Provide information if the project has obtained a letter of assurance and authorization from the host country or countries where the GHG emission mitigations occur. The letter may be provided in Appendix.

☐ Host country attestation

☒ No host country attestation (not required for this project type)

1.16 Additional information

Provide additional relevant legislative, technical, economic, sectoral, social, environmental, geographic, site-specific, and other information relevant to the project's eligibility, net GHG emission mitigations, or quantification of the project's net GHG emission mitigations.

1.16.1 Confidential/sensitive information

All project data relevant to project registration, verification, validation, and registration will be made publicly available.

2. Crediting

2.1 Project start date

State the start date of the project activity in the format of dd/mm/yyyy.

Project start date	12/01/2021

2.2 Expected operational lifetime or termination date

12 months

2.3 Crediting period

Crediting period for the project in years.

Start date of crediting	12/01/2022
Crediting period	☐ Five years, renewable twice. ☒ Ten years, fixed. ☐ Fifteen years, renewable twice (CDR only). ☐ Other, provide information on how that conforms with CAR requirements.

2.4 Calander year of crediting

Calendar year of crediting (2022)	Estimated GHG emission mitigations (t CO2-e)
Baseline emissions 01 December 2021 to 30 November 2022	3,995.69
Total estimated GHG emission mitigations during the crediting period (t CO2-e)	2,864.83
Total number of years (yrs)	10

Calendar year of crediting (2023)	Estimated GHG emission mitigations (t CO2-e)
01 January 2022 to 30 November 2023	4,146.72
Total estimated GHG emission mitigations during the crediting period (t CO2-e)	2,973.02
Total number of years (yrs)	10

3. Safeguards

3.1 Statutory requirements

The Massachusetts State Department of Environmental Protection bans the disposal of food and other organic wastes from businesses and institutions that generate more than 1,000 pounds of waste per week. This project meets these requirements by only collecting waste from eligible entities and, therefore, qualifies under the additionality requirements for both CAR and CDM methodologies.

3.2 Potential negative environmental and socio-economic impacts

The project utilizes facilities already existing and staffed by local community members. The project facilities are also already permitted by the local government authorities.

3.3 Consultation with interested parties and communications

All participants in the composting program agree to the terms of service for the facility owner before being approved to participate in the program. These agreements are maintained by the facility owner and can be audited by the verification/ validation auditor.

3.3.1 Stakeholders and consultation

Complete the table and copy/paste to add other stakeholders.

Stakeholder	Composting Facility
Legal rights	All facilities are owned by the facility owner under the local laws and as an entity under the Secretary of the Commonwealth of Massachusetts.
Diversity	Project proponent works in direct collaboration with the stakeholder, who has direct inputs into the project.
Location	Not applicable
Effects	The project directly benefits the stakeholder and local community.
Date of consultation	01/10/2021
Stakeholder engagement	Recurring meetings and work sessions, at a minimum monthly interactions.

Consultation	The stakeholder is consistently updated on project progress, and since the stakeholder is responsible for all data inputs, has full visibility on the projects progression and execution.
Stakeholder input	The stakeholder has been involved with all aspects of the project since conceptualization and through execution.
Free prior informed consent	Project proponent and Stakeholder have written and verbal agreements for all project activities.
Conclusion	The stakeholder has agreed to all terms and desires to expand more projects.
Ongoing consultation	Monthly project management meetings, with intermittent checkpoints.

1.1.1 Public comments

Comments received	Action taken
None to date.	

1.2 Environmental impact assessment

Environmental impact studies have been conducted on all facilities as required by local regulatory authorities and will be verified by auditors during verification and validation audits.

1.3 Risk assessment

Identify risks that could substantially affect the project's GHG emissions mitigations and/or impacts on stakeholders and the environment. Describe any measures and steps taken due to risk assessment to mitigate risk

	Risks identified	Mitigation measures
Risk 1	Receipt of non-qualified food waste	Inspection of food waste during receipt and processing. All non-food waste is rejected when found.
Risk 2	Failure to compost food waste	Continual inspection of compost piles and outputs to ensure composting in compliance with methodology.

1.3.1 Additional information on risk management

Facilities are all monitored by local environmental compliance agencies for full waste disposal compliance, beyond just the composting operations. These reports will be audited during the verification and validation process.

2. Methodology

Please provide details in the following sections if a methodology is applied to the project.

2.1 Reference to applied methodology and applied tools

Title, version, and reference number) of:

- Selected methodology.
- Any other methodologies or methodological tools to which the selected methodology refers to.
- Link to the applicable website to referenced methodologies and methodological tools.

Type (methodology, tool, module)	Reference ID	Version	Title
Methodology	OWC	1.1	Organic Waste Composting Project Protocol Version 1.1, July 2013
Methodology	ACM0022	0.3.0	Alternative waste treatment processes

2.2 Applicability of methodology

Methodology ID	Applicability condition	Justification
CAR OWC v1.1 section 3.4.1	Only projects that divert and compost eligible feedstocks are deemed to exceed common practice and, therefore, eligible for registration under this protocol. Based on the performance standard research results, food waste and co-mingled non-	Project is an organic waste composting facility that only accepts qualified

	recyclable food soiled paper waste are the sole composting feedstocks deemed eligible per this protocol.	food waste as per the methodology.

2.3 Deviation from applied methodology

There have been no required deviations identified.

Methodology ID	Requirement	Deviation	Justification

2.4 Other Information relating to methodology application

The project proponent is currently working with CAR to update the emissions calculations for the methodology that currently need to be updated.

3. Additionality

In compliance with Section 3.4.1 and 3.4.2 of the methodology, this project meets both the regulatory and performance standards necessary to meet additionality requirements. The state of Massachusetts's legal requirements for food waste disposal do not apply to this project. This project also meets all performance standards required for effectively composting qualified food waste.

3.1 Level 1 - ISO 14064-2 GHG emissions additionality

This project meets additionality requirements relevant to baseline emissions because it directly addresses SSR 6 and 7 for GHG Assessment Boundaries required by the methodology in Section 4.

3.2 Level 2a – Statutory additionality

As delineated in Section 3.4.2 of the methodology, there are no federal or state regulations currently in place that obligate waste source producers to divert waste to an aerobic composting facility. Massachusetts requires that food waste over 1000 pounds by source be composted, but this project meets the requirement for statutory additionality by only collecting food waste under 1000 pounds per contributing source.

3.3 Level 2b – Non-enforcement additionality

Not applicable to the project, as enforcement is maintained and recorded by local authorities.

3.4 Level 3 – Technology, institutional, common practice additionality

This project increases the throughput capacity for organic waste composting in a multi-state region of the northeastern United States. By increasing the capacity to process waste throughput, the activities of this project will reduce the amount of food waste disposed of in landfills and directly reduce landfill emissions.

3.5 Level 4a – Financial additionality I

The financial proceeds from this project are the primary economic driver, allowing for the expansion of throughput outlined in Section 3.4 above.

3.6 Level 4b – Financial additionality II

Not applicable to this project.

3.7 Level 5 – Policy additionality

Currently, the host country has no defined national climate change objectives, so policy additionality is not applicable to this project.

4. Baseline scenario

GHG emission reductions from a composting project are quantified by comparing actual project emissions to the calculated baseline emissions. Baseline emissions are an estimate of the GHG emissions from sources within the GHG Assessment Boundary (see Section 4) that would have occurred in the absence of the project. Project emissions are actual GHG emissions that occur at sources within the GHG Assessment Boundary as a result of the project. Project emissions must be subtracted from the baseline emissions to quantify the project's total net GHG emission reductions (Equation 5.1). GHG emission reductions must be quantified and verified on at least an annual basis. Project developers may choose to quantify and verify GHG emission reductions on a more frequent basis if they desire. The length of time over which GHG emission reductions are periodically quantified and verified is called the "reporting period."

This project meets the justification requirements for baseline scenario emissions reduction by composting approved food waste through the specific process requirements outlined in the Performance Standard Test section of the methodology. Since the project has to meet the rigorous requirements outlined the Performance Standard Test, there is de minimus risk of baseline scenario deviations.

The project also fulfills the additionality requirements since prior to the project's initiation, residential and small commercial food waste was sent to landfills. Currently, there are no viable alternatives to this project since food waste at scale has no other disposal options except for landfilling.

This project is applicable to the GHG Assessment Boundary by addressing SSRs 6 and 7, as described in Section 4 of the methodology. Project data captures all relevant information necessary to calculate the

emissions mitigation impact of the project; this data includes: (1) approved food waste received, (2) facility emissions, (3) material handling equipment emissions (4) Weight scale calibration dates.

Data tables can be shared upon request and will be provided as part of the verification and validation report.

5. Project boundary

This project is in compliance with Section 4.1 of the methodology, which outlines the requirements for SSRs 6 and 7.

SSR	Source Description	Gas	Included (I) or Excluded (E)	Quantification Method	Justification/Explanation
6. Waste Mixing, Pre-Processing, and Transport	Emissions resulting from the use of fossil fuels or grid delivered electricity for pre-processing equipment used for processing/mixing eligible waste materials	CO_2	I	Baseline: N/A Project: Estimated using fossil fuel use or electricity use data and appropriate emission factors	Depending on the specifics of project waste pre-processing practices, increases in GHG emissions from this source could be significant. In cases where multiple facilities are engaged in a single compost process, fossil fuel emissions from transport between such facilities shall be included.
		CH_4	E	N/A	Excluded, as this emission source is assumed to be very small.
		N_2O	E	N/A	Excluded, as this emission source is assumed to be very small.
7. Aerobic	Emissions resulting from the	CO_2	Fossil: I Biogenic: E	Baseline: N/A Project: Estimated using fossil fuel use or electricity use data and appropriate emission factors	Project CO2 emissions resulting from onsite fossil fuel use and/or grid delivered electricity may be significant. In cases where multiple facilities are engaged in a single compost process, fossil fuel emissions from transport between such facilities shall be included.
					Biogenic CO2 emissions from aerobic processing are excluded.

Composting and Transport	composting process, including active composting and curing of eligible waste at project facilities	CH_4	I	Baseline: N/A Project: Estimated using emission factors adjusted for project-specific composting practices	Project CH4 emissions depend on the type of composting as well as the management of the composting process. Projects are required to account for emissions based on project- specific composting practices.
		N_2O	I	Baseline: N/A Project: Estimated using emission factors adjusted for project-specific composting practices	Project N2O emissions depend on the type of composting as well as the management of the composting process. Projects are required to account for potential emissions based on project-specific composting practices.

Table 2 Identification of GHG SSRs

Identification of relevant GHG SSRs

Please identify all GHG SSRs relevant to the baseline and the project and label accordingly. The GHGs shall be assessed, and justification for any inclusion or exclusion shall be provided

SSR		Controlled/ related/ affected	GHGs	Included/ excluded	Justification/ explanation	Coordinates
Baseline	Sink 1		CO2			
	Sink 1		CH4			
	Sink 1		CO2			
	Reservoir 3		CO2			
	Sink 6	Related	CO2	Included	As per methodology	42.3292, -71.4818
	Sink 6	Related	CH4	Excluded	As per methodology	42.3292, -71.4818

Project	Sink 6	Related	N2O	Excluded	As per methodology	42.3292, -71.4818
	Sink 6	Related	CO2	Included	As per methodology	42.6233, -71.5007
	Sink 6	Related	CH4	Excluded	As per methodology	42.6233, -71.5007
	Sink 6	Related	N2O	Excluded	As per methodology	42.6233, -71.5007
	Sink 6	Related	CO2	Included	As per methodology	42.5941, -70.7661
	Sink 6	Related	CH4	Excluded	As per methodology	42.5941, -70.7661
	Sink 6	Related	N2O	Excluded	As per methodology	42.5941, -70.7661
	Sink 7	Related	CO2	Included	As per methodology	42.3292, -71.4818
	Sink 7	Related	CH4	Included	As per methodology	42.3292, -71.4818
	Sink 7	Related	N2O	Included	As per methodology	42.3292, -71.4818
	Sink 7	Related	CO2	Included	As per methodology	42.6233, -71.5007
	Sink 7	Related	CH4	Included	As per methodology	42.6233, -71.5007
	Sink 7	Related	N2O	Included	As per methodology	42.6233, -71.5007
	Sink 7	Related	CO2	Included	As per methodology	42.5941, -70.7661
	Sink 7	Related	CH4	Included	As per methodology	42.5941, -70.7661
	Sink 7	Related	N2O	Included	As per methodology	42.5941, -70.7661

6. Quantification of GHG emission mitigations

In the following section, procedures for quantifying the baseline project emissions shall be provided, followed by a procedure for quantification of leakage emissions (affected SSRs). Net GHG emissions mitigation shall be forecasted annually, taking into account baseline and project emissions and leakage.

6.1 Criteria and procedures for quantification

Total baseline emissions for the reporting period are estimated by calculating and summing the emissions from all relevant baseline SSRs that are included in the GHG assessment boundary.
As indicated in Table 4.1 of the methodology, total baseline emissions are equivalent to the emissions of methane that would have occurred had eligible food and food-soiled paper waste streams been disposed of at an MSW landfill (SSR 4).

The baseline calculation assumes that the quantity of eligible food and soiled paper waste that is composted by the project would otherwise have been disposed of at a landfill or waste

incineration plant in the absence of the project. While the majority of non-recovered organic MSW in the U.S. is disposed of at landfills, and a small percentage of waste is also incinerated at Waste to Energy (WTE) facilities. Organic wastes that are landfilled will degrade primarily under anaerobic conditions and will release methane to the atmosphere, whereas waste that is combusted will produce insignificant emissions of methane to the atmosphere. The baseline calculation for eligible food waste streams assumes that the food waste is landfilled. However, the baseline methane emissions are adjusted to reflect that some of the waste would have gone to WTE facilities. The percentage of food and soiled paper waste that is assumed to be incinerated in the baseline is equal to the waste incineration rate for the U.S. state where the project is located, as specified in Table A.4 of Appendix A of the methodology.

6.1.1 Baseline emissions (Equation 5.2, 5.3, and 5.4 of the methodology)

Equation 5.2. Calculating Baseline Methane Emissions for Food Waste Streams

$$BE = \sum_{S} BE_{CH_4,S}$$

Where,

			Units
BE	=	Total sum of the baseline emissions during the reporting period	$MTCO_2e$
$BE_{CH4,S}$	=	Baseline methane emissions from composted waste stream 'S' during the reporting period	$MTCO_2e$

$$BE_{CH_4,S} = BE_{FW,S} + BE_{SP,S}$$

Where,

$BE_{FW,S}$	=	Baseline methane emissions from the food waste component of eligible waste stream 'S' that is composted during the reporting period	$MTCO_2e$
$BE_{SP,S}$	=	Baseline methane emissions from the soiled paper component of eligible waste stream 'S' that is composted during the reporting period	$MTCO_2e$

Equation 5.3. Baseline Methane Emissions from Eligible Food Waste, by Waste Stream

$$BE_{FW,S} = 0.9 \times W_{FW,S} \times (1 - WTE_S) \times 128 \times \rho \times FE_{FW,S} \times 21$$

Where,

			Units
$BE_{FW,S}$	=	Baseline methane emissions from the food waste component of eligible waste stream 'S' that is composted during the reporting period	$MTCO_2e$
0.9	=	Model correction factor to account for model and waste composition uncertainties related to waste composition and waste characteristics[22]	fraction
$W_{FW,S}$	=	Aggregated weight of eligible food waste (measured on a wet basis) from eligible waste stream 'S' that is composted by the project during the reporting period. See Section 5.1.1 for guidance on determining the weight of eligible food waste	MT food waste (wet weight)
WTE_S	=	Fraction of waste from eligible waste stream 'S' that would have been incinerated at a Waste to Energy plant in lieu of being landfilled. This fraction is equal to the state-specific fraction of total generated waste that is incinerated. Referenced by waste origination State from Table A.4 in Appendix A	fraction
128	=	Methane potential of food waste (measured on a wet basis) from eligible waste stream 'S'. Projects must use this value for all food waste streams[23]	m^3CH_4/MT food waste (wet weight)
ρ	=	Density of methane, equal to **0.000674**	$MTCH_4/m^3$
$FE_{FW,S}$	=	Fraction of methane generated from eligible waste stream 'S' that is emitted to the atmosphere over a ten year time horizon, as calculated using the First Order Decay function. The fraction emitted to the atmosphere is a function of the decay rates of food waste, the landfill gas collection assumptions (see Box 5.1), and the amount of methane generated that is oxidized in the cover soil	fraction
21	=	Global warming potential of methane	$MTCO_2e$ / $MTCH_4$

Equation 5.3. (Continued)

$$FE_{FW,S} = \sum_{x=1}^{10}\left[e^{-k_{FW,S}(x-1)} \times \left(1 - e^{-k_{FW,S}}\right) \times \left(1 - \left(GC_S \times LCE_x\right)\right)\right] \times (1 - 0.1)$$

Where,			Units
e	=	Mathematical constant, approximately equal to 2.71828	
$k_{FW,S}$	=	Decay rate for eligible food waste stream 'S'. The decay rate is a function of the climatological characteristics of the region where the waste is landfilled. Referenced from Table A.2 by waste origination county climate category, which is referenced from Figure A.2	yr^{-1}
x	=	Placeholder for the iterative calculation. The FOD equation calculates emissions out over a period of ten years (x = 1 to 10) following the year in which the waste is initially diverted to the compost operation. The ten year calculation is summed and applied to the total baseline emissions for the current reporting period	
GC_S	=	Gas collection factor for eligible waste stream 'S'. The gas collection factor is equal to the fraction of waste disposed at landfills utilizing gas collection for the state from which the waste stream 'S' originates. Referenced by state from Table A.3 in Appendix A	fraction
LCE_x	=	Fraction of methane that would be captured and destroyed by LFG collection systems in the year x, starting with the year that the waste is diverted to the project (x =1) and ending with year x = 10. All projects shall use a value of '**0.0**' for the first two years of calculated waste decay (x=1 to 2), a value of '**0.5**' for the third year (x=3), a value of '**0.75**' for years 4 to 7 (x=4 to 7), and a value of '**0.95**' for the remaining years of decay until the end of the calculation period (x =8 to 10). See Box 5.1 for a discussion of LCE assumptions[24]	fraction
0.1	=	Factor for the oxidation of methane by cover soil bacteria[25]	fraction

Equation 5.4. Baseline Methane Emissions from Eligible Soiled Paper Waste, by Waste Stream

$$BE_{SP,S} = 0.9 \times W_{SP,S} \times (1 - WTE_S) \times 310 \times \rho \times FE_{SP,S} \times 21$$

Where,			Units
$BE_{SP,S}$	=	Baseline methane emissions from the soiled paper component of eligible waste stream 'S' that is composted during the reporting period	$MTCO_2e$
0.9	=	Model correction factor to account for model and waste composition uncertainties related to waste composition and waste characteristics[26]	fraction
$W_{SP,S}$	=	Aggregated weight of eligible soiled paper waste (measured on a wet basis) from eligible waste stream 'S' that is composted by the project during the reporting period. See Section 5.1.1 for guidance on determining the weight of eligible food waste	MT soiled paper (wet weight)
WTE_S	=	Fraction of waste from eligible waste stream 'S' that would have been incinerated at a Waste to Energy plant in lieu of being landfilled. This fraction is equal to the state-specific fraction of total generated waste that is incinerated. Referenced by waste origination State from Table A.4 in Appendix A	fraction
310	=	Methane potential of soiled paper waste (measured on a wet basis) from eligible waste stream 'S'. Projects must use this value for all soiled paper waste streams[27]	m^3CH_4/MT food waste (wet weight)
ρ	=	Density of methane, equal to **0.000674**	$MTCH_4/m^3$
$FE_{SP,S}$	=	Fraction of methane generated from eligible waste stream 'S' that is emitted to the atmosphere over a ten year time horizon, as calculated using the First Order Decay function. The fraction emitted to the atmosphere is a function of the decay rates of soiled paper waste, the landfill gas collection assumptions (see Box 5.1), and the amount of methane generated that is oxidized in the cover soil	fraction
21	=	Global warming potential of methane	$MTCO_2e$ / $MTCH_4$

6.1.2 Project emissions (Equation 5.8 of the methodology)

$$PE = PE_{CO_2} + PE_{CH_4,C} + PE_{N_2O,C}$$

Where,			Units
PE	=	Total project emissions for the reporting period, from all SSRs within the GHG Assessment Boundary	$MTCO_2e$
PE_{CO2}	=	Project carbon dioxide emissions for the reporting period from fossil fuel and grid electricity sources included in the GHG Assessment Boundary (SSR 6, 7)	$MTCO_2e$
$PE_{CH4,C}$	=	Project methane emissions for the reporting period from the composting of eligible waste (SSR 7)	$MTCO_2e$
$PE_{N2O,C}$	=	Project nitrous oxide emissions for the reporting period from the composting of eligible waste (SSR 7)	$MTCO_2e$

6.1.3 Project Emissions (Equation 5.10 of the Methodology)

$$PE_{CH_4,C} = \sum_T [W_{C,T} \times EF_{CH_4,T}]$$

Where,			Units
$PE_{CH4,C}$	=	Total project emissions of CH_4 from the composting of eligible wastes at the project operation	$MTCO_2e$
$W_{C,T}$	=	Aggregated weight of eligible food and soiled paper waste from all eligible waste streams composted during the reporting period in composting system category 'T'	MT
$EF_{CH4,T}$	=	Methane emission factor for the composting treatment system category 'T', taken from Table 5.2	$MTCO_2e$/MT eligible waste

$$W_{C,T} = (W_{FW} + W_{SP}) \times F_{EW,T}$$

Where,			Units
W_{FW}	=	Aggregated weight of eligible food waste from all eligible waste streams composted during the reporting period at the operation (measured on a wet basis)	MT food waste
W_{SP}	=	Aggregated weight of eligible soiled paper waste from all eligible waste streams composted during the reporting period at the operation (measured on a wet basis)	MT soiled paper waste
$F_{EW,T}$	=	Fraction of eligible waste that is treated in each composting system category 'T' during the reporting period	fraction

6.2 Quantification of Net-GHG emissions and/or removals

GHG emission reductions from a composting project are quantified by comparing actual project emissions to the calculated baseline emissions. Baseline emissions are an estimate of the GHG emissions from sources within the GHG Assessment Boundary (see Section 4) that would have occurred in the absence of the project. Project emissions are actual GHG emissions that occur at sources within the GHG Assessment Boundary as a result of the project. Project emissions must be subtracted from the baseline emissions to quantify the project's total net GHG emission reductions (Equation 5.1 above). GHG emission reductions must be quantified and verified on at least an annual basis. Project developers may choose to quantify and verify GHG emission reductions on a more frequent basis if they desire. The length of time over which GHG emission reductions are periodically quantified and verified is called the "reporting period."

All data sheets with access to calculation formulas will be provided to verification entities and Carbonmark by request.

Net GHG Emission Mitigations are calculated as follows:

ER=BE-PE

Where:

ER	=	Total emission reductions for the reporting period	$MTCO_2e$
BE	=	Total baseline emissions for the reporting period, from all SSRs in the GHG Assessment Boundary (as calculated in Section 5.1)	$MTCO_2e$
PE	=	Total project emissions for the reporting period, from all SSRs in the GHG Assessment Boundary (as calculated in Section 5.2)	$MTCO_2e$

Table 2: Aggregated GHG Emission Mitigations

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage (tCO_2e)	Estimated net GHG emission mitigations (tCO_2e)
Year 1	4210.61	1,345.78	0	2,864.83
Year 2	4369.76	1,396.74	0	2,973.02
Total	8,580.37	2,742.52	0	5,837.85

6.3 Risk assessment for permanence

Due to organic waste composting producing a clearly defined output based on a measurable input that is produced within a ten-week process, the risk of future CO2 reductions or reversals is immaterial. The monitoring plan in Section 10.1 provides details to ensure project emissions reductions are significantly restricted. The main risk to this project is regulatory risk if an operating permit was temporarily suspended or revoked, which would not affect prior credits, only ex-ante credits, which are not applicable for this project.

Permanence risk (%)	<1%

7. Management of data quality

Best Management Practices as defined in Section 2.2 of the methodology, were utilized for this project. As part of the verification/ validation process (VVP) the following information was verified.
Receipt of waste

- Waste pre-processing, including storage, handling, and mixing
- Movement and handling of waste onsite
- Composting activities, including formation of piles, operation of aeration and leachate collection systems, turning of windrows, and other activities that are necessary for, or related to, the composting of eligible waste.
- Movement, handling, and storage of finished compost onsite
- Movement, handling, and storage of leachate
- Measurement and documentation of project parameters, including BMPs
- Other operations at the compost facility/facilities that are necessary for the activities listed above.

Data management is through permission-restricted Google Drive and Google Sheets that can be exported to MS Excel (.xlsx) or Adobe Acrobat (.pdf) for VVP use or for Carbonmark and buyer compliance purposes. All paper-based documentation is recorded by photograph or electronic conversion to .pdf.

8. Monitoring

8.1 Monitoring plan

Project monitoring complies with Section 6 of the methodology, with the following overview of the specifications. The cadence of the project monitoring will be annual since future projects will be registered every year at the same facility due to the recurring nature of the OWC projects.

The purpose of project monitoring is to quantify the GHG reductions from a composting project; the project must accurately measure the quantity of incoming waste delivered to the composting operation by waste stream.

The compost operation must keep a daily log showing:

- Date and time of all deliveries of material to the operation
- The weight of each delivered incoming waste stream
- The source of each delivered incoming waste stream

In addition, the project must retain all weigh scale receipts generated either on or offsite indicating the weight and source of all delivered material to the operation. This information is necessary to aggregate the weight of eligible food and soiled paper waste delivered to the site from each eligible waste stream according to the guidance provided in Section 5.1.1 and to verify eligibility of food waste from grocery store sources.

A QA/QC procedure for the inspection and calibration of weigh scales must be included in the Monitoring Plan. All weigh scales that are not used for commercial activities must be inspected

a) and calibrated in accordance with the manufacturer's specifications. The project may document incoming waste weight using commercial receipts from on or offsite scales.

8.2 Data and parameters remaining constant

Complete the table below for all data and parameters determined to remain fixed throughout the project crediting period (copy the table as necessary for each data/parameter).

Data / Parameter	Waste Received
Unit	Metric Tons
Description	Qualified food waste
Origin of data	Residential and small Commercial providers
Value applied	CO2
Justification of choice of data or description of measurement methods and procedures applied	Measurement requirement and means of measurement are in compliance with the methodology.
Purpose of Monitoring	☒ Calculation of baseline emissions ☒ Calculation of project emissions ☒ Calculation of leakage
Comments	All weights must assessed using a calibrated scale in compliance with Section 6.1 of the methodology.

8.3 Data and parameters monitored

Complete the table below for all data and parameters monitored during the project crediting period (copy the table as necessary for each data/parameter).

Table 4 Data and parameters to be monitored

Data / Parameter	Facility Electricity Usage

Unit	kwh
Description	Power usage for composting facility
Origin of data	Local electric utilities
Value applied	CO2
Justification of choice of data or description of measurement methods and procedures applied	Measurement requirement and means of measurement are in compliance with Section 6.5 of the methodology.
Monitoring frequency	Monthly
Purpose of data	☒ Calculation of baseline emissions ☒ Calculation of project emissions ☐ Calculation of leakage
Quality assurance and control	Verification of documents and power generation for the local electric utility.
Comments	Not Applicable

Data / Parameter	Material Handling Equipment
Unit	gallon
Description	Fossil fuel (diesel) used for composting operations
Origin of data	Fuel purchase receipts
Value applied	CO2
Justification of choice of data or description of	Measurement requirement and means of measurement are in compliance with Section 6.5 of the methodology.

measurement methods and procedures applied	
Monitoring frequency	Monthly
Purpose of data	☒ Calculation of baseline emissions ☒ Calculation of project emissions ☐ Calculation of leakage
Quality assurance and control	Verification of documents from local fuel purchases.
Comments	Not Applicable