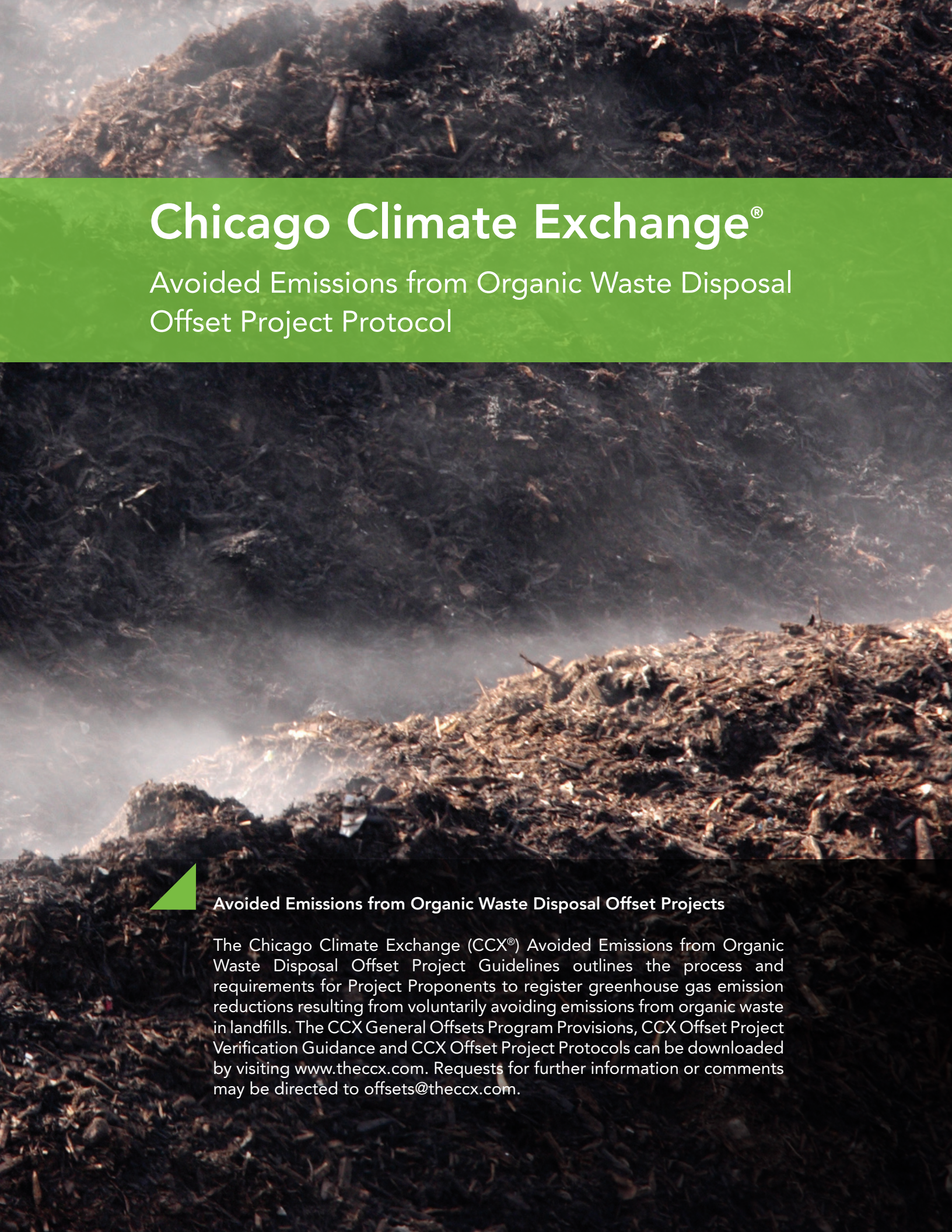

Chicago Climate Exchange®

Avoided Emissions from Organic Waste Disposal Offset Project Protocol

Avoided Emissions from Organic Waste Disposal Offset Projects

The Chicago Climate Exchange (CCX®) Avoided Emissions from Organic Waste Disposal Offset Project Guidelines outlines the process and requirements for Project Proponents to register greenhouse gas emission reductions resulting from voluntarily avoiding emissions from organic waste in landfills. The CCX General Offsets Program Provisions, CCX Offset Project Verification Guidance and CCX Offset Project Protocols can be downloaded by visiting www.theccx.com. Requests for further information or comments may be directed to offsets@theccx.com.

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CHICAGO CLIMATE EXCHANGE OFFSET PROJECT PROTOCOL

Avoided Emissions from Organic Waste Disposal Offset Projects

Updated as of 8/20/2009

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ACRONYMS, TERMS AND DEFINITIONS[1]

ANSI	American National Standards Institute
CCX	Chicago Climate Exchange
EPA	Environmental Protection Agency
GCCS	Gas Collection and Control System
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
NSPS	New Source Performance Standard
WBCSD	World Business Council on Sustainable Development
WRI	World Resources Institute

Emission Guidelines (EG) for Municipal Solid Waste (MSW) Landfills:	Guidelines developed by the EPA for state regulatory plans. Emission Guidelines for MSW Landfills, codified in 40 CFR 60 Subpart Cc., regulate emissions from existing landfills with a design capacity greater than 2.5 million megagrams (2.75 million tons) that began construction or made modifications before May 30,1991 and accepted waste at any time since November 8, 1987.
Landfill Gas (LFG):	Gas generated by biological decomposition of waste material in a landfill. The gas is typically comprised of methane, carbon dioxide, other trace gases and water vapor.
New Source Performance Standards (NSPS):	Federal rules for US landfills, codified in 40 CFR Subpart WWW, that govern emissions from existing landfills with a design capacity greater than 2.5 million megagrams (2.75 million tons) that began receiving waste or began construction or made modifications after May 30, 1991.

[1] Please refer to CCX General Offsets Program Provisions for additional "Acronyms, Terms and Definitions"

1. INTRODUCTION

Chicago Climate Exchange (CCX) is the world's first and North America's only active voluntary, legally binding integrated trading system to reduce emissions of all six major greenhouse gases (GHGs), with Offset Projects worldwide. CCX Members with significant GHG emissions voluntarily enter into a legally binding agreement to reach CCX GHG Emission Reduction Commitment[2]. Upon enrollment with CCX, Exchange Allowances are issued to Members in amounts equal to their emission reduction targets. CCX Offsets are issued to Owners or Aggregators of registered Projects on the basis of verified sequestration, destruction or reduction of GHG emissions not included under the CCX Emission Reduction Commitment. Members are required to turn in the amount of Exchange Allowances and/or Offsets equal their actual GHG emissions annually.

CCX strives to promote transparency and integrity in the carbon market. In accordance with this goal, in developing this document, CCX was guided by the fundamental principles of Project GHG accounting outlined in ISO 14064-2: *Specification with guidance at the Project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancemen*ts, Version 1. These principles include:

- Relevance
- Completeness
- Consistency
- Accuracy
- Transparency
- Conservativeness

The following sections of this Protocol discuss the Project criteria, boundaries, monitoring requirements, avoided emissions calculations and other guidelines that each Project Proponent must adhere to in order to generate Offsets from Avoided Emissions from Waste Disposal Offset Projects.

2. GENERAL PROVISIONS

Projects are subject to the conditions of this Protocol, the CCX General Offset Program Provisions and determinations of the CCX Committee on Offsets. All Project Proponents should review CCX General Offset Program Provisions and CCX Offset Project Protocol for Avoided Emissions from Organic Waste Disposal Offset Projects.

[2] http://theccx.com/content.jsf?id=72

3. ASSOCIATED DOCUMENTS

This Protocol references the use of several associated documents. These documents include:

- CCX General Offset Program Provisions
- CCX General Verification Guidance Document
- CCX Project Implementation Document (PID)
- CCX Project Specific Conflict of Interest Form
- CCX Greenhouse Gas Emission Factors Document
- CCX Project Owner Attestation

These documents are available on the Offsets section of the CCX website: www.theccx.com.

4. PROJECT DEFINITION

Projects are defined as new facilities or capacity and capacity utilization increases at existing facilities that compost organic waste that would have otherwise been landfilled. The facilities prevent methane release from anaerobic degradation of the waste through aerobic treatment by composting. This definition does not include projects which recover or combust methane, or undertake controlled combustion of the waste. Composting of organic waste streams that would otherwise be processed or disposed of in a manner other than landfilling (e.g., incineration) is not eligible for Offsets.

While the current Project definition includes only aerobic composting processes, other Projects using alternate process technologies such as the anaerobic digestion of organic wastes with methane capture would be eligible to earn Offsets based on the quantification and eligibility criteria herein after the review and approval of a Project specific monitoring and verification procedures by the CCX Offset Committee.

4.1 Eligible Waste Types

These guidelines are applicable to Projects that compost the following organic materials:

- Food waste, where this is domestic and industrial food scraps and organic residuals resulting from the processing, preparation and serving of food,
- Yard waste, where this is grass clippings and trimmings from bushes, trees, and other yard vegetation, and
- Wastewater biosolids nutrient-rich organic materials resulting from the treatment of sewage sludge (the name for the solid, semisolid or liquid untreated residue

generated during the treatment of domestic sewage in a treatment facility). This definition of wastewater biosolids, does not include grit, screenings or ash.[3]

Additional waste types and common disposal practices will be considered by CCX on a case-by-case basis.

5. ELIGIBILITY CRITERIA

Several factors determine a Project's eligibility for generating Offsets including the Proponent's membership status, ownership status, Project start date, location and whether the Project meets the CCX performance benchmark.

5.1 CCX Membership

The Project Proponent(s) must be a Member or Participant Member (Offset Provider or Aggregator) of CCX. For-profit entities, cooperatives, governmental bodies and non-profit organizations may act as CCX Offset Aggregators. An Aggregator serves as an administrative representative, on behalf of Project Owners, of one or more Projects. Project Proponents should contact CCX directly for membership rules and information.

5.2 Eligibility Governing Entities with Minor Emissions

Entities with an entity-wide emissions profile greater than 10,000 metric tons of carbon dioxide equivalent (Mt CO_2e) for the most recent calendar year may register and trade CCX Offsets only if the entity is a Member of CCX and undertakes the CCX Emission Reduction Commitment. For specific guidance on this provision, Project Proponents should review CCX General Offset Program Provisions.

Entities who are unsure of their emissions profile should estimate their direct CO_2 emission using well accepted methodologies such as those available at the World Resources Institute (WRI)/World Business Council on Sustainable Development (WBCSD). CCX requires that all entities that are not Members, including producers enrolled with Aggregators, provide an attestation relating to their direct emissions in a form provided by CCX.

5.3 Ownership Status

The Project Proponent must demonstrate clear ownership of the GHG mitigation rights associated with the Project in order to register ODS destruction offset Projects with CCX. Contract documentation may be provided by the Project Proponents to express ownership of

[3] When treated and processed, sewage sludge becomes biosolids that can be safely recycled and applied as fertilizer to improve and maintain productive soils and stimulate plant growth.

the GHG mitigation rights. Where appropriate, an attestation of Project Ownership shall satisfy this requirement

CCX Offset Aggregators must have acquired appropriate control of the GHG mitigation rights from the Project Owner in order to execute its responsibilities on CCX pursuant to CCX General Offset Program Provisions. Aggregators must demonstrate to the Project Verifier and CCX that they have acquired appropriate control.

5.4 Project Start Date

Projects must start on or after January 1, 2003, which corresponds with the beginning of the CCX cap and trade program.

5.5 Project Location

Methane avoidance Projects shall be located either in the United States (US) or in a country designated as a non-Annex I country under the Kyoto Protocol. Project Proponents with Projects in non-Annex I countries should submit the CCX Project Information Document to CCX for review and approval.

5.6 Performance Benchmark

Avoided Emissions from Organic Waste Disposal Projects are not eligible to generate offsets in instances where the practice can be considered a standard business practice or "business as usual", or is required by law or other legally binding framework. CCX has identified two performance criteria that Projects must meet to be eligible.

5.6.1 Regulatory Criteria

Waste streams subject to local, state, or federal laws that prohibit their disposal in landfills are not eligible for offsets. Organic waste streams covered by mandated and enforced partial waste diversion programs may be eligible for offsets based on the proportion of waste allowed to be landfilled. Local or state waste diversion 'goals' do not affect regulatory eligibility under this Protocol.

The regulatory criteria must be applied to both US and non-US Projects (approved Projects originating in non-Annex I Kyoto Protocol countries). For Projects in non-Annex 1 countries of the Kyoto Protocol, the Project Proponent must demonstrate that the Project is not required by law.

During the course of verification, the Project Proponent shall provide to the Verifier reasonable assurances necessary to prove that the Project is not required under any federal, state or local regulation or other legally binding framework and shall sign an attestation stating the same.

5.6.2 Common Practice Criteria

Nearly all of the food residuals generated in the US are landfilled, with only about 2.2% diverted from landfills in 2006.[4] Therefore, any new Project in the US that composts food residuals, therefore, meets or exceeds current common practice and future expectation for disposal under a "business-as-usual" scenario, with the following exception for industrial food waste. For industrial food wastes, it must be demonstrated (by commercial contracts, receipts, reports etc.) that the materials were from specific waste streams that were being landfilled immediately prior to the Project.

Although a much higher proportion (62%) of the yard waste generated in the US is currently being diverted from landfills[5] (due largely to local and state bans on landfilling of yard waste), recent trends in overall composting activity and diversion rates for yard waste composting suggest that additional diversion is not likely to occur without new regulations or other incentives for investment in collection and composting infrastructure.[6] Therefore, new Projects that compost yard waste, either from a new waste stream or from waste streams that were previously being landfilled, would meet or exceed current common practice and future expectation under a business-as-usual scenario, with exceptions as noted here. For yard wastes, it must be demonstrated (by commercial contracts, receipts, reports etc.) that the materials were from specific waste streams that were being landfilled immediately prior to the Project. Where a Project involves the additional collection of material in a region already subject to a landfill diversion mandate, a specific baseline and Project Boundary must be proposed to, and approved by, the CCX Committee on Offsets.

The most common disposal methods for biosolids are land application, incineration, and landfilling (including use as alternative daily cover). Currently 55% of biosolids are land applied for fertilizer value, with 15% incinerated and the remainder landfilled.[7] New Projects that compost biosolids that are diverted from existing (pre-Project) waste streams that were previously being landfilled would meet or exceed current common practice and future expectation under a business as usual scenario, with exceptions as noted below. It must be demonstrated (by commercial contracts, receipts, reports etc.) that the composted biosolids were from specific waste streams that were being landfilled immediately prior to the Project.

For Projects in non-Annex 1 countries of the Kyoto Protocol, the Project Proponent must demonstrate that the Project activity meets similar common practice criteria.

CCX will periodically review the common practice criteria data to assess whether the performance benchmark has changed and may implement modifications in the future based on the review.

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[4] EPA (2007) *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2006*. EPA-503-F-07-030

[5] Ibid

[6] Personal communication, Nora Goldstein, Editor, *BioCycle Magazine*

[7] North East Biosolids and Residuals Association (2007) *A national biosolids regulation, quality, end use & disposal survey, available* at http://www.nebiosolids.org/pdf/NtlBiosolidsReport-20July07.pdf

6. PROJECT BOUNDARY

A clearly defined boundary is vital to accurately assessing GHG mitigations from methane avoidance Projects. Although the destruction method may vary, the Project Boundary will include the facility where composting takes place and the itineraries between the collection and composting facility.

6.1 Identification of GHG Sources, Sinks and Reservoirs

The following list identifies the locations to be included within the Project Boundaries and the Relevant GHG Sources. These include:

a. Where the treatment of organic waste through composting takes place.

b. The itineraries between them (a and c), where transportation of waste or compost occurs.

The Project Boundary not included in this Protocol is:

c. The geographical site where the soil application of the compost takes place.

Composting may result in (i) methane and nitrous oxide emissions from biological activity; (ii) long-term carbon storage in the form of un-decomposed carbon compounds; and (iii) non-biogenic CO_2 emissions from collection and transportation of the organic materials to the central composting site, and from mechanical turning of the compost pile.[8] Recent reviews[9], however, suggest that composting, when managed properly, does not generate significant methane or nitrous oxide emissions, but does result in some carbon storage (associated with application of compost to soils), as well as only minimal CO_2 emissions from transportation and mechanical turning of the compost piles. Under this Protocol, methane and nitrous oxide emissions are not included in the GHG accounting boundary since only Projects that are properly managed, as demonstrated by compliance with applicable regulations and permit requirements, are eligible to earn offsets. Although carbon storage due to compost application to soil may result in additional emission reductions, this should be treated as a separate Project activity and is not included in the specific calculation of methane avoidance Offsets for composting Projects.

Composting also produces carbon dioxide from biological decomposition that is emitted during the composting process, as well as after compost is added to the soil. This is not included in the Project GHG accounting boundary because it is biogenic in origin and does not contribute to net increases in atmospheric concentrations of CO_2.

Direct and indirect emissions associated with the construction or expansion of composting facilities are likely to be minimal in most cases, are presumably comparable to emissions

[8] EPA (2005) *Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks*
[9] Brown, S., Kruger, C., & Subler, S. (2008). Greenhouse Gas Balance for Composting Operations. *Journal of Environmental Quality*, 37, 1396–1410. ; EPA (2005).

related to landfill construction, and therefore are not included in the Project GHG accounting boundary. The following table identifies the GHG Sources to be included in the Project.

Table 1 – Relevant GHG Sources to be Included within Project Boundary

GHG Source Category	GHG Source	GHG	Included in Project Boundary	Comment[10]
Project operations	Emissions resulting from fossil fuel derived energy used by, inter alia, compost handling equipment, monitoring system, etc.	CO_2	Yes	All CO_2 emissions (direct and indirect) due to fossil fuel combustion are required to be included.[11]
		CH_4	No	Excluded, as this emission source is assumed to be very small.
		N_2O	No	Excluded, as this emission source is assumed to be very small.
Composting process	Emissions resulting from composting	CO_2	No	Biogenic emissions are excluded.
		CH_4	No	Excluded, as this emission source is assumed to be very small.
		N_2O	No	Excluded, as this emission source is assumed to be very small.

The GHG sink(s) will be the composting and associated processes. No reservoirs are anticipated in Avoided Emissions from Organic Waste Disposal Projects and therefore are not discussed at greater length below.

ISO 14064-2 requires that the Project's GHG Sources and Sinks be categorized as controlled by the Project Proponent, related to the Project, or affected by the Project. These are discussed below.

6.1.1 Controlled GHG Sources and Sinks

Controlled GHG Sources and Sinks for Avoided Emissions from Organic Waste Disposal Projects are those that occur on-site and the various itineraries. Therefore, Controlled GHG Sources and Sinks for Avoided Emissions from Organic Waste Disposal Projects refer to those that are part of the composting systems and the transportation of compost to its end use.

[10] Based on emissions factors found in Volume 2, Table 2.2 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, all CH_4 and N_20 emissions are excluded (with the exception of CH_4 emissions from landfill gas destruction), as emissions will be small in comparison to CO_2 emissions.

[11] See Project emissions discussion in this section for exceptions to the inclusion of indirect emission sources.

6.1.2 Related GHG Sources and Sinks

Related GHG sources and sinks for Avoided Emissions from Organic Waste Disposal Projects refer to those that have material or energy flows into or out of the Project. Therefore, Related GHG Sources and Sinks are the energy grids that supply to the Project (if applicable) and transportation energy used in transportation of compost to its end use.

6.1.3 Affected GHG Sources and Sinks

Affected GHG sources and sinks are those that are influenced by the Avoided Emissions from Organic Waste Disposal Project and result in new or changed activities outside the boundary of the Project that actually increase GHG emissions. This concept is commonly referred to as leakage. Given that infrastructure and other requirements of the Project and baseline scenarios are similar, CCX does not expect Avoided Emissions from Organic Waste Disposal Projects to result in new or changed activities that increase GHG emissions outside of the Project Boundary and, therefore, no Project-specific leakage assessment is required.

6.2 Determining the Baseline Scenario

In accordance with the process outlined in ISO 14064-2, possible baseline scenarios were evaluated for Avoided Emissions from Organic Waste Disposal Projects. CCX identified three plausible baselines for new Avoided Emissions from Organic Waste Disposal Projects:

1. The unmitigated release of methane to the atmosphere.

2. Capture of landfill methane with a gas collection system installed pursuant to regulation.

3. The voluntary installation of a methane avoidance Project.

In the U.S., some landfills are required by state and federal regulations to collect and combust landfill gas, while others are not. The efficiency of landfill gas collection systems can vary widely among landfills and may also change over time at individual landfills.[12] Rather than requiring a Project specific determination of whether, in the absence of the composting Project, eligible organic waste streams would be disposed in landfills with or without gas collection systems and then applying either a site-specific or default factor for landfill gas collection efficiency (which would likely often be both complicated and highly uncertain), these guidelines take a standardized approach for all Projects by using a single activity baseline derived from estimates of landfill methane recovery averaged across all landfills in the U.S.

As discussed above, baseline emissions shall exclude methane emissions that would have to be captured and destroyed to comply with national, local or other legal requirements. The

[12] SCS Engineers, 2009, *Current MSW Industry Position and State-of-the-Practice on LFG Collection Efficiency, Methane Oxidation and Carbon Sequestration in Landfills* prepared for Solid Waste Industry for Climate Solutions (SWICS)

most commonly applicable regulation is within the federal New Source Performance Standards (NSPS), among other things defines how quickly a landfill gas collection and destruction system needs to be installed on regulated landfills to incorporate recently deposited waste. Under the NSPS rules gas collection wells must be installed in new waste cells to extract and control the non-methane organic compounds (NMOCs) present in the landfill gas within five years of the time waste is first placed in the cell if the cell is still active, or within two years of the time waste is first placed in the cell if the cell is closed or at final grade. Based on this schedule, it is assumed that, on average (and considering that some landfills operate for extended periods without landfill gas collection), methane generated from a batch of deposited waste is emitted unabated to the atmosphere (other than oxidation by the landfill cover) for up to five years from the time of deposition until captured by a gas collection system. Nonetheless, for the purpose of this Protocol, it is conservatively assumes that methane generated from a batch of deposited waste is emitted unabated to the atmosphere for only 3 years. Thus, the assumed baseline is a continuation of 1 and 3 above.

The EPA provides annual estimates of overall methane recovery (avoided emissions) from US landfills; in 2007, about 45% of the methane potentially emitted from all US landfills was recovered by landfill gas collection systems.[13] Assuming, as discussed above, that the amount of methane recovered by gas collections systems from recently placed waste (within three years) is insignificant, this would mean that the average recovery rate from waste in place longer than three years would be closer to 55%.[14] If energy prices, renewable energy incentives, and technology advances, or other factors, led to an increase in overall methane recovery rate from 45% to 50%, then the average recovery rate from waste in place greater than three years is estimated to be about 60%.[15] Nonetheless, for the purpose of this Protocol, it is conservatively assumes that the recovery rate of methane generated from a batch of deposited waste is 75% from years 4 through 10.

For clarity, the baseline for this Protocol is 100% release to the atmosphere of potential methane from deposited waste during the first 3 years and 25% release during years 4 through 10.

6.3 Project Emissions

In cases where Project emissions *are not* included in a legally binding emission reduction program (e.g. CCX), they shall be included as Project emissions and subtracted from Project emission reductions as provided in Section 8 below. Where Project emissions *are* included within a legally binding emissions reduction program, they may be omitted from the Project emissions calculation. Only those specific Project emission sources included under the capped portion of an emissions reduction program may be omitted. All other sources must be included.

[13] EPA (2008) Inventory of U.S. Greenhouse Gases and Sinks: 1990-2007. Annex 3, Table A-228.
[14] Using a first-order decay model that assumes a linear doubling in MSW input during a 40-year period (1966-2006); L_o = 100 and a regionally-weighted decay rate factor (k) of 0.04.
[15] Using FOD model as above.

Project emissions sources include, but are not limited to, the use of electricity from the grid, the consumption of purchased steam or heat, and the combustion of fossil fuel by the transportation equipment. Emissions associated with the transportation of waste material to the Project site are similar or less than those in the baseline and do no need to be separately assessed. Since carbon dioxide emissions from these sources are of much greater magnitude than emissions of other GHGs, only carbon dioxide emissions shall be included as Project emissions.

7. MONITORING REQUIREMENTS

The Project Proponent shall develop and maintain a monitoring plan with procedures for obtaining, recording, compiling and analyzing data and information required for quantifying and reporting GHG emission reductions. Specific Project monitoring must include all of the attributes identified in Appendix A of this Protocol.

The following parameters shall be monitored and recorded during the crediting period:

- Quantity of each eligible waste type composted (Qy, comp, j) from each specific source (waste stream). Material type will be determined by its origin and amounts determined based on weigh scale receipts and invoices.

- Scale calibration records. Frequency of calibration must be in accordance with manufacturer recommendation, state law or semi annually and have been conducted by a qualified 3rd party.

- Daily records and monthly tabulation of waste material time and temperature by distinct unit (batches, windrows, piles etc.) Only Projects that are conformant with the performance standard for pathogen reduction as outlined in the USEPA 503 standard are eligible to use this Protocol. These standards require that compost reach and maintain 55°C (131°F) or higher for pathogen destruction for prescribed periods. Specific guidance on the 503 regulation requirements are included in *Chapter 7 Processes to Further Reduce Pathogens* section *7.2 Composting* and *Appendix J The Biosolids Composting Process: Monitoring and Sampling of the Compost Pile*, of the (US EPA. Pathogen Equivalency Committee Principal Biosolids Guidance USEPA 625/R-92/013.[16]

- Pertinent composting facility permits and related annual reports (if required), along with an attestation of compliance with permit requirements during the crediting period.[17]

- Monthly tabulation of site electricity usage.

[16] available at http://www.epa.gov/nrmrl/pec/bsguidance.html

[17] Organic wastes composted during periods and in areas (batches, windrows, piles etc) that are not in compliance with permit requirements may not be included in emission reduction calculations.

- Monthly tabulation of site fuel usage (type and amounts).
- Monthly tabulation of transportation fuel usage (type and amounts), if applicable.
- Monthly tabulation of compost product weight sent for land application.

8. QUANTIFYING GHG EMISSION REDUCTIONS

Emission reductions are assumed to be the amount of methane that would be emitted during the crediting period in the absence of the Avoided Emissions from Organic Waste Disposal Project minus Project emissions.

8.1 Baseline Quantification

The baseline scenario is the situation where, in the absence of the Project activity, organic matter is left to decay anaerobically within the Project Boundary and methane is emitted to the atmosphere. The baseline emissions are the amount of methane emitted from the decay of the degradable organic carbon in the biomass solid waste composted in the Project activity.

Baseline emission reductions are calculated using a first order decay model (Equation 1)[18] for each eligible organic waste type and for each of ten years following disposal. The model differentiates between the different types of waste $\boldsymbol{j}$ with respectively different decay rates $\boldsymbol{k_j}$ and different fractions of both degradable organic carbon ($\boldsymbol{DOC_j}$) and the fraction of $\boldsymbol{DOC_j}$ that can decompose under landfill conditions ($\boldsymbol{DOC_f}$). Default values of $\boldsymbol{k_j}$, $\boldsymbol{DOC_j}$ and $\boldsymbol{DOC_f}$ for each eligible waste category are provided in Table 2. The model calculates methane generation based on actual waste streams $\boldsymbol{W_{j,x}}$ disposed in each year $\boldsymbol{x}$, starting with the first year after the start of the Project until the end of the year $\boldsymbol{y}$, for which baseline emissions are calculated (a maximum of ten years). Baseline emission reductions for years 1 to 10 following composting calculated using this model are provided in a lookup table for easy reference (Table 3). Projects may use the values in Table 3 matched to waste type and weight to calculate methane emissions avoided.

[18] From the CDM "*Tool to determine methane emissions avoided from dumping waste a solid waste disposal site*" (version 03) available at: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

Equation 1: Baseline GHG Emissions

$$BE_{CH4y} =$$

$$\varphi \cdot (1 - f) \cdot GWP_{CH4} \cdot (1\text{-}OX) \cdot (16/12) \cdot F \cdot DOC_f \cdot MCF \cdot \Sigma_{x=1}^{y} \Sigma_j W_{j,X} \cdot DOC_j \cdot e^{-kj.(y-x)} \cdot (1- e^{-kj})$$

Where:

BE_{CH4y}	Methane emissions avoided during the year y from the baseline during the period from the start of the Project activity to the end of the year y (tCO_2e)
φ	Model discount factor to account for model uncertainties (0.9)
f	Methane recovery rate; based on "better-than-average" national recovery rate for all US landfills (zero for the first three years; 0.75 thereafter)
GWP_{CH4}	Global Warming Potential (GWP) of methane, valid for the relevant commitment period (21)
OX	Oxidation factor (reflecting the assumed amount of methane that would be oxidized in the soil or other material covering the waste (0.10)
F	Fraction of methane in the landfill gas (volume fraction) (0.5)
DOC_f	Fraction of degradable organic carbon (DOC) that can decompose (from Table 2)
MCF	Methane correction factor (1)
$W_{j,X}$	Amount of organic waste type *j* composted year *x* (metric tons) (monitored)
DOC_j	Fraction of degradable organic carbon by weight in the waste type *j* (from Table 2)
k_j	Decay rate for the waste type *j* (from Table 2)
j	Waste type category (index)
X	Year during the crediting period: x runs from the first year of the first crediting period (x = 1) to the year y for which avoided emissions are calculated (x = y)
y	Year for which methane emissions are calculated

8.2 Calculation of Project Emissions

Project activity emissions consist of incremental fossil fuel use at the Project. Whereas literature reviews indicate that Project activity emissions are comparable to the baseline, the Project Proponent shall measure Project emissions.

CO_2 emissions due to transport distances from transporting compost from the site to its end use location must be measured (if not otherwise included in a GHG emission reduction program) based on transportation records.

CO_2 emissions from fossil fuel based energy used by the Project activity facilities (if not otherwise included in an GHG emission reduction program) shall include but not limited to energy used for aeration and/or turning of compost piles/heaps and chopping of biomass for size reduction, screening and where relevant drying of the final compost product. Default emission factors for grid electricity and fuel use are found at the CCX webpage http://www.theccx.com/docs/misc/GHG_Emission_Factors.pdf.

The Project Proponent shall estimate Project activity emissions with **Equation 3** below.

Equation 2a: CO_2 Emissions from Fossil Fuel Combustion

$$\mathbf{Dest_{CO2}} =$$

$$\mathbf{\sum_y (FF_y * EF_y) + Dest_{CO2y,transp}}$$

Where:

$\mathbf{Dest_{CO2}}$	CO_2 emissions from fossil fuel used in methane destruction process (tCO_2)
$\mathbf{FF_y}$	Total quantity of fossil fuel, y, consumed (as measured in volume of fuel)
$\mathbf{EF_y}$	Fuel specific emission factor for fuel, y (as measured in t_{CO2}/fuel quantity - values should be taken from the CCX GHG Emissions Factors online document[19])

Equation 2b: Fossil Fuel Use from Transportation in Year "y"

$$\mathbf{Dest_{CO2y,transp}} =$$

$$\mathbf{[(Q_y * Dist * VE_{CO2}] / 1000}$$

Where:

$\mathbf{Q_y}$	Quantity of final compost product produced in the year "y" (tons)
Dist	Distance from composting facility to end use (miles)
$\mathbf{VE_{CO2}}$	Vehicle transportation CO_2 emissions efficiency (0.299 kg CO_2/ton-mile)[20]

[19] Relevant GHG emission factors can be found here: http://theccx.com/docs/misc/GHG_Emission_Factors.pdf

[20] Project Proponents may use a factor of 0.297 kg CO_2/ton-mile transported as provided in EPA 2008. Climate Leaders GHG Inventory Protocol Core Module Guidance: Optional Emissions from Commuting, Business Travel and Product Transport, EPA430-R-08-006. (Equation 6).
[http://www.epa.gov/climateleaders/documents/resources/commute_travel_product.pdf]

Equation 2c: CO_2 Emissions from Project Specific Electricity Consumption

$$\mathbf{Elec_{CO2} =}$$

$$\mathbf{(EL_{total} * EF_{EL}) / 2204.62}$$

Where:

$\mathbf{Elec_{CO2}}$	Project specific electricity emissions (tCO_2)
$\mathbf{EL_{total}}$	Total grid connected electricity consumption (as measured in MWh)
$\mathbf{EF_{EL}}$	Carbon emission factor for grid electricity (taken from the most recent region specific eGrid values – measured in $lbCO_2/MWh$)
2204.62	$lbCO_2/tCO_2$

8.3 Calculation of Project Emission Reductions

Equation 3: Project Avoided GHG Emissions

$$\mathbf{AE_y =}$$
$$\mathbf{BE_{CH4}y - Dest_{CO2} - Elec_{CO2}}$$

Where:

AE	Avoided GHG emissions in year y.
$\mathbf{BE_{CH4y}}$	Methane emissions avoided during the year y from the baseline during the period from the start of the Project activity to the end of the year y (tCO_2e)
$\mathbf{DestCO_2}$	CO2 emissions from fossil fuel used in methane destruction process (tCO_2)
$\mathbf{Elec\ CO_2}$	Project specific electricity emissions (tCO_2)

9. Reporting and Record-Keeping Requirements

The Project Proponent must maintain all relevant data and documentation as required in Section 7 above. All relevant Project documentation shall be kept for a minimum of 2 years beyond each verification time-period.

10. VALIDATION AND VERIFICATION REQUIREMENTS

10.1 Validation

CCX Projects utilizing these guidelines are validated one of two ways. All projects must submit a PID to CCX Staff for review. Projects that adhere strictly to the requirements of this protocol are validated by CCX staff and do not require a separate Validation by CCX Offsets Committee. For all Projects seeking to deviate from specific components of this protocol, the Project Proponent is required to complete the deviation request section of the PID for review and approval by the CCX Offsets Committee. Upon receipt and review of the deviation request, the CCX Offsets Committee will review the feasibility and appropriateness of the requested deviation(s) and, as needed, seek guidance from appropriate technical experts. Under either approach, the Project Proponents will be notified of the Project or Deviation approval by notification letter.

10.2 Verification

Prior to undertaking verification, the prospective Verifier must conduct a Project specific conflict of interest process. The prospective Verifier must complete and submit the CCX Project Specific Conflict of Interest Form[21] to CCX for approval prior to the commencement of verification activities.

Projects seeking to register Offsets shall be verified by a CCX-Approved Verifier[22] in accordance with CCX General Offsets Program Provisions, CCX Verification Guidance Document and the Project Protocols. A checklist list of verification requirements is contained in Appendix A. Independent verification is critical to ensure that the requirements of this Protocol are correctly applied. Projects shall be verified on an annual basis at minimum.

To ensure impartiality, completeness and consistency in the verification report review process an additional independent review of the submitted verification reports is conducted by the CCX Provider of Regulatory Services. Further information about the roles and responsibilities of Verifiers and the roles and responsibility of Members during verification are discussed in detail in *Chicago Climate Offset Program Verification Guidance Document* available on the CCX webpage: www.theccx.com.

[21] CCX Project Specific Conflict of Interest Form can be found in the Associated Documents section of the CCX website: www.theccx.com.
[22] A list of CCX-Approved Verifiers is found on the CCX website: www.theccx.com

APPENDIX A - VERIFICATION CHECKLIST

CCX Requirement	Assessment Criteria	Verification Findings
Validation	CCX Project Approval Letter.	
Verification: Conflicts of Interest	Complete a conflicts of interest assessment.	
Contract Information	Verifier must obtain and review the contract to confirm inclusion of the information listed in the Protocol.	
Monitoring Plan	Confirmation that the Project developer has a Project data monitoring plan.	
Project Definition	Confirm the Project meets the definition and/or it has been specifically approved by the CCX Offsets Committee via a deviation request approval.	
CCX Membership	Confirm enrollment of the Project is by a CCX Member or Participant Member (Offset Aggregator or Provider).	
Eligibility Governing Entities with Minor Emissions	Confirm the Project Owner's attested emissions and the applicability the CCX rule on entities with minor emissions.	
Ownership Status	Confirm the Project owner has title to the CO_2 emission reductions and, if applicable, that the Offset Aggregator has the right to market them on CCX.	
Project Start Date	Confirm the Project began on or after January 1, 2003 or that it is a Project grandfathered by CCX.	

Project Location	Confirm Project is in the U.S. or in a non-Annex 1 country and the Project is specifically approved by CCX.	
Eligible Waste Type	Confirm waste material at Project matches eligible waste definitions.	
Regulatory Compliance	Confirm that Project owner has provided an attestation of regulatory compliance or other suitable evidence.	
Regulatory Criteria	Confirm the Project is not required by federal, state, local law or other legally binding framework (attestation or other suitable evidence).	
Common Practice Criteria	Confirm the Project as located in the US or that a similar analysis has been done for the host country and that it has been approved by CCX.	
	If applicable, confirm that the waste material was being landfilled immediately prior to the commencement of the Project.	
Identification of GHG Sources Sinks and Reservoirs	Confirmation of the identification of all sources, sinks and reservoirs.	
Project Emissions	Confirmation of whether the Project emission is included in the Project or if it is included in legally binding emission reduction commitment.	
Monitoring Requirements	Confirm existence of a Project data monitoring plan with procedures for obtaining, recording, compiling and analyzing data and required information.	
	Confirmation of records detailing the distinct waste types and specific waste streams.	
	Confirmation of weight scale records for waste streams.	

	Confirmation of scale calibration in accordance with manufacturer specifications and by a qualified 3rd party.	
	Confirmation of daily and monthly tabulation of waste material time and temperature by distinct unit.	
	Confirmation that each distinct unit achieved the required time and temperature threshold for the type of management unit.	
	Confirmation of valid permits.	
	Confirmation of monthly tabulation of site electricity usage.	
	Confirmation of transportation emissions.	
Baseline Quantification	Confirmation of proper calculation of equation 1	
Project Emissions	Confirmation of proper calculation of equation 2a-2c.	
Calculation of Project Emission Reductions	Confirmation of proper calculation of equation 3.	
	Confirm emission reductions by year.	
Reporting and Record Keeping Requirements	Confirmation of procedures to retain relevant Project records for, at least, 2 years beyond the verification date.	

APPENDIX B – AVOIDED EMISSIONS FROM ORGANIC WASTE DISPOSAL SUPPLEMENTAL INFORMATION

Table 2 – Default Values for Selected Parameters

Variable	Default Value	Reference
DOC_f	0.50	IPCC 2006 Guidelines for National GHG Inventories
DOC_j	0.26 = Food Waste	USEPA Inventory of U.S. GHG Emissions and Sinks: 1990 – 2007
	0.20 = Yard Waste	IPCC 2006 Guidelines for National GHG Inventories
	0.05 = Biosolids	IPCC 2006 Guidelines for National GHG Inventories
k_j	0.19 = Food Waste	USEPA Inventory of U.S. GHG Emissions and Sinks: 1990 – 2007
	0.100 = Yard Waste	IPCC 2006 Guidelines for National GHG Inventories
	0.19 = Biosolids	USEPA Inventory of U.S. GHG Emissions and Sinks: 1990 – 2007

Table 3 – Default Projected Yields of Waste Streams Diverted from Landfilling (CO_2e/wet ton waste diverted)

	$BE_{CH4SWDSy}$										
Waste Type	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Total**
Food Waste	0.255	0.211	0.174	0.036	0.030	0.025	0.020	0.017	0.014	0.012	0.794
Yard Waste	0.108	0.098	0.088	0.020	0.018	0.016	0.015	0.013	0.012	0.011	0.400
Biosolids	0.049	0.041	0.034	0.007	0.006	0.005	0.004	0.003	0.003	0.002	0.154