QUANTIFICATION PROTOCOL FOR AEROBIC COMPOSTING PROJECTS:

ABRIDGED

Submitted to:

Alberta Environment

and

Alberta Agriculture, Food and Rural Development

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Disclaimer

The following document presents an abridged version of the Aerobic Composting Project protocol prepared for Alberta Environment and Alberta Agriculture, Food and Rural Development which has completed an initial round of technical review. This document has been prepared as a means of supporting a broader stakeholder consultation process. As such, this document should not be used as a quantification protocol.

The full-length protocol was developed in consideration of the work done for the City of Edmonton for their compost facility, applicable Clean Development Mechanism protocols and components of the Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas Inventories.

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1.0 Project and Methodology Scope and Description

This quantification protocol is applicable to the quantification of direct and indirect reductions of greenhouse gas (GHG) emissions resulting from the implementation of aerobic composting projects. Specifically, this protocol covers the diversion of organic residues from landfill for biological decomposition to a condition sufficiently stable for nuisance-free storage and for safe use in land application. Given the potential range of materials, processes and technologies that may be applied, this protocol serves as a generic 'recipe' for project proponents to follow in order to meet the measurement, monitoring and GHG quantification requirements. **FIGURE 1.1** offers a project element life cycle chart for a typical project.

Composting of manure is specifically excluded from quantification under this protocol due to a lack of scientific understanding of the nitrous oxide emissions. Upon further research, these may be included such that the emissions of nitrous oxide during composting are better understood to prevent overestimation of the emission reductions for projects composting manure. Mixed streams, which include manures, may still be contemplated for this protocol, however, the manure portion of the stream must be excluded from the calculations.

In practice, there is considerable potential to divert streams of organic residues from landfill towards higher value and less greenhouse gas emission intensive end use. The baseline condition for projects applying this protocol is that the organic residues are being collected, handled and disposed of in a landfill (controlled or uncontrolled) such that anaerobic decomposition would typically occur. A broad variety of organic residues are considered, including agricultural and agri-food residues, the organic portion of municipal solid waste, food wastes, forestry and landscaping wastes, etc. These materials may be collected and handled as part of an on- or off-site waste management system. **FIGURE 1.2** offers an element life cycle chart for a typical baseline configuration.

The approach to quantifying the baseline will be projection-based as there are suitable models for the applicable baseline condition that can provide reasonable certainty. The projection-based baseline scenario for this protocol is dynamic as the emissions profile for the baseline activities would be expected to change materially relative to the mass of material composted.

It is not appropriate to apply this protocol to projects that involve any anaerobic processes within the composting operation, where treatment is not sufficient to generate a mature compost or where the organic residue was not diverted from landfill. While some procedures in this protocol may be transferable to such projects, there would be considerable differences which would lead to inaccuracy in the quantification of the GHG emission reductions.

To demonstrate that a project meets the requirements under this protocol, the project proponent must supply sufficient evidence to demonstrate that:

FIGURE 1.1: Project Element Life Cycle Chart

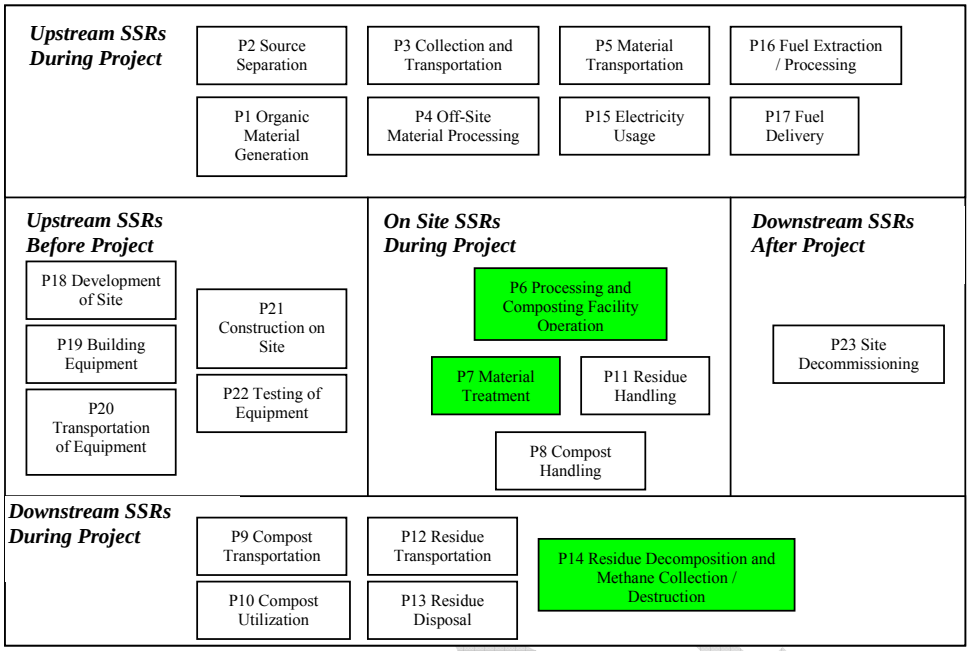
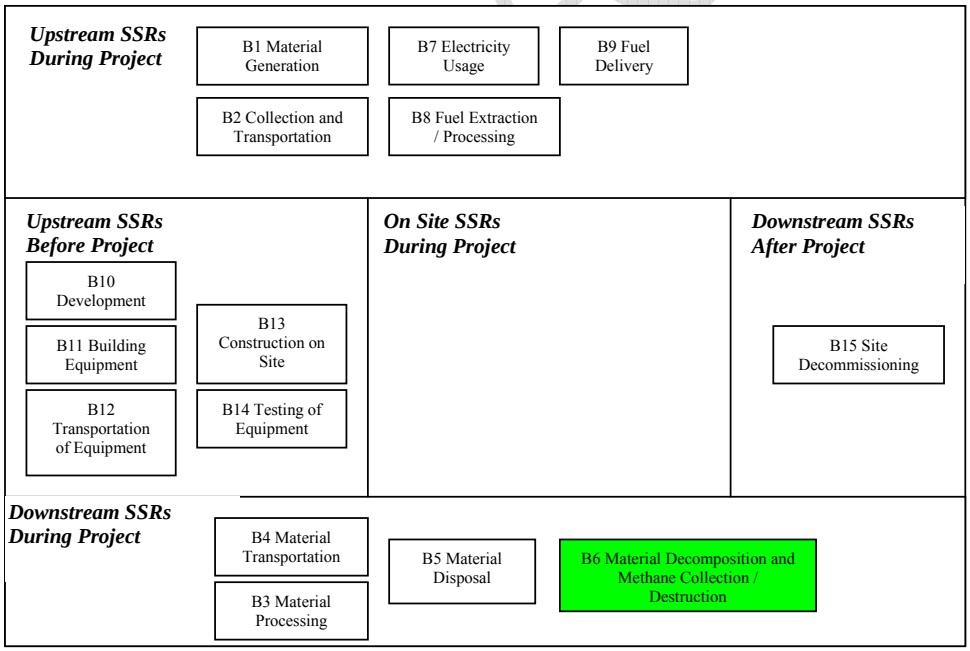


FIGURE 1.2: Baseline Element Life Cycle Chart



* Sources, sinks and reservoirs selected for measurement and monitoring under this protocol are highlighted.

1. The materials being diverted to the aerobic composting operation would otherwise be landfilled as confirmed by disposal records or other means;
2. The organic residue must be treated to the point of being mature as per the requirements of CCME for maturity and destruction of pathogenic organisms as per facility operating permits or other third party analysis; and
3. The quantification of reductions achieved by the project is based on actual measurement and monitoring (except where indicated in this protocol) as indicated by the proper application of this protocol.

Comment [MSOffice1]: Possible concern over achieving highest value for agricultural scenarios. Flexibility mechanism put forward, below, to address this concern.

Flexibility in applying the quantification protocol is provided to project developers in three ways.

1. There will be some sequestration of carbon within the compost. There may also be emissions of methane and nitrous oxide from its use. The net emissions of greenhouse gases are difficult to quantify and likely negligible for most end-uses of compost. However, the project proponent may wish to include these elements in the analysis. The analysis must include all elements and must trace the compost through to its end use;
2. Organic materials that are being land applied on agricultural lands may be excluded from the requirement to meet CCME guidelines for maturity. However, it must be demonstrated by the proponent that this material will not be stored in conditions that would allow for aenerobic conditions to develop;
3. Site specific emission factors and other project specific factors (i.e. relevant landfill characteristics) may be substituted for the generic emission factors indicated in this protocol document. The methodology for generation of these emission factors must be sufficiently robust as to ensure reasonable accuracy; and
4. The project proponent may provide other evidence to demonstrate that the compost is mature. Or, alternatively, they may demonstrate that the compost is of such a quality that the underlying principles of the protocol remain assured and that there is no risk of over-estimating the emission reductions.

Comment [MSOffice2]: Inserted to address concerns over practical composting end points to achieve highest value for agricultural scenarios.

If applicable, the proponent must indicate and justify why flexibility provisions have been used.

2.0 Quantification of Identified Sources, Sinks and Reservoirs

Quantification of the reductions, removals and reversals for the sources, sinks and reservoirs selected for measurement and monitoring under this protocol will be completed using the methodologies outlined in **TABLE 2.1**, below. These calculation methodologies serve to complete the following three equations for calculating the emission reductions from the comparison of the baseline and project conditions.

$$\text{Emission Reduction} = \text{Emissions}_{\text{Baseline}} - \text{Emissions}_{\text{Project}}$$

$$\text{Emissions}_{\text{Baseline}} = \text{Emissions}_{\text{Decomposition and Methane Collection / Destruction}}$$

$$\text{Emissions}_{\text{Project}} = \text{Emissions}_{\text{Facility Operation}} + \text{Emissions}_{\text{Material Treatment}} + \text{Emissions}_{\text{Decomposition and Methane Collection / Destruction}}$$

TABLE 2.1: Quantification Procedures

1. Project/Baseline SSR	2. Parameter / Variable	3. Unit
Project SSRs		
P6 Processing and Composting Facility Operation	$Emissions_{Collection\ of\ Biomass} = \sum (Vol.\ Fuel_i * EF\ Fuel_{i\ CO2}); \sum (Vol.\ Fuel_i * EF\ Fuel_{i\ CH4}) ; \sum (Vol.\ Fuel_i * EF\ Fuel_{i\ N20})$	
	$Emissions_{Collection\ of\ Biomass}$	kg of CO_2 ; CH_4 ; N_2O
	Volume of Each Type of Fuel / $Vol\ Fuel_i$	L, m^3 or other
	CO_2 Emissions Factor for Each Type of Fuel / $EF\ Fuel_{i\ CO2}$	kg CO_2 per L, m^3 or other
	CH_4 Emissions Factor for Each Type of Fuel / $EF\ Fuel_{i\ CH4}$	kg CH_4 per L, m^3 or other
	N_20 Emissions Factor for Each Type of Fuel / $EF\ Fuel_{i\ N2O}$	kg N_2O per L, m^3 or other
P7 Material Treatment	$Emissions_{Material\ Treatment} = Mass_{Material\ Composted} * EF_{CH4} - R; Mass_{Material\ Composted} * EF_{N2O}$	
	$Emissions_{Material\ Treatment}$	kg of CH_4 ; N_2O
	Mass of Material Composted (wet) / $Mass_{Material\ Composted}$	kg
	Recovered CH_4 from Compost / R	kg
	CH_4 Emissions Factor for Composting / EF_{CH4}	kg CH_4 per kg
	N_20 Emissions Factor for Composting / EF_{N2O}	kg N2O per kg
P14 Residue Decomposition and Methane Collection / Destruction	$Emissions_{Decomposition,\ Collection\ and\ Destruction} = (Mass_{Residue\ Disposed} * MCF * DOC * DOC_F * F * 16/12 - R) * (1 - OX)$	
	$Emissions_{Decomposition,\ Collection\ and\ Destruction}$	kg of CH_4
	Mass of Residue Material Sent for Disposal (wet) / $Mass_{Residue\ Disposed}$	kg
	Methane Correction Factor / MCF	-
	Degradable Organic Carbon / DOC	-
	Fraction of Degradable Organic Carbon Dissimilated / DOC_F	-
	Fraction of CH_4 in Landfill Gas / F	-
	Recovered CH_4 at Landfill / R	kg of CH4
	Oxidation Factor / OX	-
Baseline SSRs		
B6 Residue Decomposition and Methane Collection / Destruction	$Emissions_{Decomposition,\ Collection\ and\ Destruction} = (Mass_{Diverted} * MCF * DOC * DOC_F * F * 16/12 - R) * (1 - OX)$	
	$Emissions_{Decomposition,\ Collection\ and\ Destruction}$	kg of CH_4
	Mass of Material diverted from landfill / $Mass_{Diverted}$	kg

APPENDIX A: Glossary of New Terms

Compost	A solid mature product resulting from composting which is a managed process of bio-oxidation of a solid heterogeneous organic substrate including a thermophilic phase.
Composting	The biological decomposition of organic materials, substances or objects under controlled circumstances to a condition sufficiently stable for nuisance-free storage and for safe use in land application.
Mature Compost	To be considered as mature compost, the material must meet the requirements of CCME for maturity and destruction of pathogenic organisms.
Organic Residue	This includes vegetative matter, food processing waste, landscaping, garden and horticultural wastes, kitchen scraps, feed processing wastes, and other organic wastes which can be readily composted.
Landfill	A landfill is a site at which materials are stored where they can undergo anaerobic decomposition. This may include the materials being buried, piled, mixed with other waste materials, or otherwise. Landfills classified as either controlled or uncontrolled are included in this definition. The designation of controlled or uncontrolled refers to the level of permitting and technical controls in place at the disposal site. Uncontrolled landfills may exist where although there is no expressly stated goal to leave the materials in place, there is a track record of material residing in that place for extended periods (greater than 10 years) and there are no plans or regulatory requirements for the material to be transferred to another disposal site.