AIM ENVIRONMENTAL GROUP

Intelligent Strategies. One Source. Dependable Results.

GHG Emissions Reduction Report
Project:
Composting of Source Separated Organics from the Waterloo Region at Guelph facility

Period: from March 1st, 2012 to October 13th 2013

Project proponent: **AIM Environmental Group**

1100 South Service Rd., Suite 419
Stoney Creek (Ontario)
L8E 0C5

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ABBREVIATIONS

BS	Baseline Scnario (GHG Emission Source)
PS	Project Scenario (GHG Emission Source)
CAR	Climate Action Reserve
CDM	Clean Development Mechanism
CH_4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent (usually expressed in metric tons)
FS_6	Sulfur Hexafluoride
GHG	Greenhouse gases
HCF	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
LFG	Landfill gas
N_2O	Nitrous oxide
NIR	National Inventory Report
t	Ton
SWDS	Solid Waste Disposal Site
VCS	Verified Carbon Standard

1. INTRODUCTION

AIM Environmental Group (hereafter referred to as AIM) is a company that specializes in building demolition, soil decontamination, and compost processing. Since 2012, AIM has been sending waste from the Waterloo Region to the Organic Waste Processing Facility based in Guelph which processes the waste to produce an unrestricted use product in the form of compost.

In addition to the production of marketable compost, the project results in the avoidance of GHG emissions in the atmosphere by avoiding the disposal of organic material into solid waste disposal site (SWDS). Moreover, by reducing the waste stream sent to the landfill, the quantity of land required for this purpose is diminished. This, in turn, contributes to reducing the nuisance problems of odor, dust, vermin and noise pollution and hence public acceptance associated to SWDS and increases land use opportunities for other purposes such as residential or commercial developments or wildlife habitats.

The quantification is based on the *Quantification Protocol for Aerobic Composting Projects* [1] developed by Alberta Environment's Climate Change Policy Unit. Some changes were made to adapt the protocol to the Ontarian context including the use of parameters that better reflect the current state of affairs. These changes are presented in section 5. The selection of SSRs, the baseline scenario and the assessment of additionality were discussed following best practices and to the expert team's best knowledge. The selection of the most plausible baseline scenario is done considering alternatives that would have most likely taken place in the absence of the project. A barrier analysis is performed and used to confirm the most plausible scenario and to provide argumentation for the additionality assessment.

This GHG report is presented in a format that meets the requirements of CSA's GHG CleanProjects™ Registry and the ISO 14064-2 guidelines and principles:

- Relevance:

All relevant GHG sources are meticulously selected and presented in section 4. A precise methodology is used along with project specific parameters values.

- Completeness:

A complete assessment of GHG sources is made and all GHG types are considered in the applied quantification methodology. Complete information regarding project implementation, activities and GHG quantification is given through this GHG report.

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[1] *Quantification Protocol for Aerobic Composting Projects* (December 2008), Alberta Environment : Climate Change Policy Unit, Internet link: http://www.assembly.ab.ca/lao/library/egovdocs/2008/alen/171442.pdf

- Consistency:

Chosen quantification methodology is appropriate for AIM's specific project. Established baseline scenario, as explained in section 3, is consistent with the project level of activity related to the amount of waste to be collected and disposed of.

- Accuracy:

Calculation uncertainties are kept as small as possible.

- Transparency:

Project related information is transparently communicated through this document so that the intended user knows what the important data are, how they are collected and how the project actually leads to GHG emissions reduction. Data monitoring and GHG emission reductions calculation are clearly detailed in order to provide the reader sufficient information to allow the user to confidently make decisions.

- Conservativeness:

GHG emission reductions are not overestimated. When accuracy is jeopardized because of assumptions, conservative choices are made to make sure that GHG reductions are not overestimated.

This report will be made available for public consultation. It is intended to serve as a transparent reference document to support the prospection of potential verified emission reductions (VER) buyers.

2. PROJECT DESCRIPTION

2.1. Project Title

AIM composting activities performed at Guelph's Organic Waste Processing Facility for greenhouse gas emissions reduction.

2.2. Objectives

The objective of this project is to divert organic waste from the landfill waste stream via composting, thereby avoiding the methane emissions associated to the decomposition of the organic waste in a SWDS.

2.3. Project Lifetime

AIM's started sending Waterloo's waste to the Organic Waste Processing Facility in 2012 and stopped in October of 2013 when their agreement with the Waterloo Region concerning the ownership of the waste reached its end.

Considering that in-vessel or in-tunnel composting equipment has a useful life of up to 25 years[2], the project can potentially last as long as the equipment, if composting does not become obligatory (i.e. as long as the project respects the principle of additionality). However, because AIM has not secured the ownership of the waste after 2013, the project ends with the termination of the agreement between Waterloo Region and AIM.

2.4. Type of GHG project

The project is a waste diversion type of project.

2.5. Location

The organic waste was diverted from traditional landfills to the following location:

Organic Waste Processing Facility

110, Dunlop Drive

Guelph (Ontario)

Canada

Latitude: 43° 33' 11.8938" N

Longitude: 80° 12' 11.592" W

[2] SEPA, *IN-VESSEL COMPOSTING*, Available at: http://www.sepa.org.uk/waste/information__resources/resources.aspx

2.6. Conditions prior to project initiation

In the absence of AIM's collection project, the organic waste stream from the Waterloo Region would be disposed in a SWDS.

2.7. How the project achieves GHG emission reductions and/or removal enhancements

The project achieves GHG emissions reduction by avoiding methane (CH_4), a potent greenhouse gas, and emissions associated to the anaerobic degradation of organic waste in a SWDS. The organic waste is diverted from the landfill stream and aerobically degraded in a composting facility.

2.8. Project technologies, products, services and expected level of activity

Guelph's new state of the art Organic Waste Processing Facility (OWPF) is located at the Waste Resource Innovation Center. The OWPF is designed to handle 30,000 tons of organic material per year to ensure efficiencies of scale and to allow for future population growth[3]. The amount of organic waste that Guelph generates is expected to grow from approximately 10,000 tons to over 16,000 tons per year over a 25 year period.

Once the collection vehicles arrive at the facility, they are directed to the tip floor where the organic material is dumped. The organic waste is visually inspected to ensure that it is free of any large contaminants. The material is then loaded in a large shredder. The shredded material is transferred into a series of tunnels to begin the composting process.

The doors of the tunnels are closed and oxygen is pumped in through the floor to aid aerobic decomposition. The oxygen in the tunnel is passed through a biofilter before it is released into the environment. The temperatures are maintained above 55 degrees Celsius. After 14 days the material is halfway through the decomposition process and transferred into the next set of tunnels where the temperature, air flow, and moisture content are regulated.

The material remains in this second set of tunnels for 7 days. The material is then sent through a system where contaminants are removed, such as plastics. Next, the material is allowed to mature in the maturation hall for at least 21 days. During this time, the temperature and moisture level are monitored and the compost is turned at various stages. The material is sent through a fine screening process to remove any contaminants; samples are taken to test and ensure a quality finished product. The finish product can be used in various applications.

The chosen baseline scenario represents the same level of activity than the project scenario which is the treatment of the collected weight of organic waste.

[3] http://guelph.ca/living/garbage-and-recycling/owpf/

2.9. Aggregate GHG emission reductions and removal enhancements likely to occur from the GHG project

The present report covers the period of 2012-2013. The project is expected to produce about 10 000 t CO_2e in emission reductions during the 22 months it covers. It should be noted that for the year of 2013, the reductions were achieved from the composting of materials between January and October.

Table 2-1 Expected and Achieved Emission Reductions (t CO2e)

Year	Expected Emission Reductions (t CO_2e)	Achieved Emission Reductions (t CO_2e)
2012	5 000	4768
2013	5 000	5613
Total	10 000	10381

2.10. Identification of risks

This GHG emissions reductions report was written according to ISO 14064-2 Specifications Requirements for quantification, monitoring and reporting of greenhouse gas emissions reductions and removal enhancement assertions. In order to minimize risks, the methodology and GHG emission factors were selected based on their completeness and their international recognition.

Risks of not attaining the expected GHG reductions are mainly related with the evolution of the applicable laws and regulations which could alter the additionality of the project. Although, no changes are expected to occur within such a short time span, regulations on solid waste management will be monitored.

Emission reductions are permanent and may not result in any kind of reversal of reduction since once composted, organic carbon is emitted in the form of CO_2 and may not turn into CH_4. Avoidance of CH_4 is a permanent result of the composting process.

2.11. Roles and Responsibilities

2.11.1 Project proponent and representative

Theo Van Wely

AIM ENVIRONMENTAL GROUP
President
1100 South Service Rd., Suite 419
Stoney Creek ON L8E 0C5
Canada
Phone: (905) 560-0090
Email: theo@aimgroup.ca

2.11.2 Monitoring and data collection

Mark Jared
AIM ENVIRONNMENTAL GROUP
Central Composting Facility
Contract Manager/Administrator
Phone: (519) 822-3194
Email: mjared@aimgroup.ca

1.11.1. Quantification and reporting responsible entity

National Ecocredit is a firm specialized in non-traditional corporate financing. An expertise has been developed in the quantification of GHG emissions. Services are offered for GHG inventory, GHG emissions reduction project implementation, GHG markets advising, regulatory requirements and much more.

Camille Orthlieb works at National Ecocredit as a carbon credits advisor. She has an environmental engineering master degree from Ecole Polytechnique Fédérale de Lausanne, Switzerland. Before joining National Ecocredit, she worked with an engineering company, specialized on building energy efficiency.

Camille Orthlieb
Carbon credits advisor
National Ecocredit
corthlieb@nationalecocredit.com
514 871 5335 ext. 305

2.11.3 Authorized project contact

Theo Van Wely has the signing authority for AIM Environmental. He is authorized to perform requests and administrative tasks regarding the project registration.

Theo Van Wely

President
AIM Environmental Group
theo@aimgroup.ca
905-560-0090

2.12. Project eligibility under the GHG program

The only regulation that forces municipalities to take concrete action towards composting is the Ontario's regulation 101/94. This regulation stipulates that a municipality with a population of at least 50 000 has to establish, operate and maintain a leaf and yard waste system. During a conference with AIM, the later party confirmed that 100% of the organic waste stream from the Waterloo Region that was sent to the composting facility was food waste.

The project is eligible under the GHG CleanProject™ program. It is implemented following the ISO 14064 guidelines and principles, is not attempted to be registered under another GHG program and does not create any other environmental credit.

2.13. Environmental impact assessment

AIM makes all possible efforts to comply with all applicable laws and regulations. Environmental impacts generated by the plant activities are relatively low. The impacts are mainly GHG emissions from transportation and the composting process.

2.14. Stakeholder consultations and mechanisms for on-going communication

Mr. Mark Jared is responsible for any communications with the stakeholders which include the municipalities. All stakeholders gave their approval to the project.

2.15. Ownership

Two agreements have been defined for the carbon credit ownership.

The contract between AIM and the Waterloo Region for the period October 2009 to October 2013, stipulates that the product belongs to AIM.

Moreover, the contract between Wellington Organix and the City of Guelph stipulates that "All right, title and interest in and to and liability for the Waste Materials to be processed at the Facility, shall automatically pass from the City to the Operator once the Waste Materials have been deposited inside the Facility by the City or its contractors and the Operator has accepted the Waste materials for processing in accordance with the Contract".

Another section of the contract between Wellington Organix and Guelph stipulates that carbon credits belong to the city of Guelph. According to the same contract, Cédule E, Section4 stipulates that until the end of the agreement between AIM and Waterloo region (October 2013) carbon credits belong to the operator, Wellington Organix. The city of Guelph confirmed by a letter that they don't reclaim the carbon credits until October 2013.

Wellington Organix also emitted a letter in which they transfer their carbon credits to AIM Environmental Group for the period from March 2012 to October 2013.

However, AIM will no longer be able to claim the carbon credits from Waterloo's organic waste after October 2013 since it will no longer be their property.

2.16. Detailed chronological plan

AIM started sending Waterloo's waste to the Organic Waste Processing Facility in 2012 and stopped in October of 2013 when their agreement with the municipality ended. This first and last report includes the emissions reductions from year 2012 and 2013 which covers the duration of the whole project.

3. SELECTION OF THE BASELINE SCENARIO AND ASSESSMENT OF ADDITIONALITY

The baseline scenario is the scenario most likely to take place in the absence of the project. Three baseline scenarios were evaluated including the project scenario itself. According to Statistics Canada, the most common practice for handling municipal organic waste is disposal in SWDS[4]. This information was released in 2010 and remains to this date, the most recent source of information available. Even recent studies by Statistics Canada, such as the *Human Activity and the Environment – Waste management in Canada* released in 2012, use 2008 figures. In the table below, a barrier assessment is performed for each of the alternative baseline scenarios. A barrier assessment helps identify barriers to any of the identified plausible baseline scenarios; the most realistic scenario is the option facing the least barriers.

Table 3 - 1 : Barrier test- Identification of the baseline scenario

Obstacle	Project scenario (Composting)	Landfill with or without landfill gas capture	Incineration of waste material for energy generation
Law and regulation	Not a barrier	Not a barrier	Not a barrier
Financial	**Barrier** Significant investment for installations	Not a barrier	**Barrier** Significant investment for installations
Technology	**Barrier** Specific equipment and operations required	Not a barrier	**Barrier** Specific equipment and operations required
Common practice	**Barrier** Not the most common practice	Not a barrier	**Barrier** Still a marginal practice
Comments	Approximately 30% of organic waste is diverted from landfills in Canada[5]	As per Statistics Canada, the majority of the waste is sent to landfill[6]	Not suitable due to waste low calorific value and high moisture

The scenario of disposing the waste materials in SWDS is compliant with all legal and regulatory requirements and is the most common alternative in the country and around the project location. This scenario does not require any major infrastructural investment and is a viable alternative available to the project proponent.

[4] Statistics Canada(December 2010) *Waste Management Industry Survey: Business and Government Sectors2008,* Available at: http://www.statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=16F0023X&CHROPG=1&lang=eng

[5] Idem

[6] Idem

The baseline must be adjusted considering that some of the materials would be diverted regardless of the implementation of the project. The Quantification Protocol prescribes a subtraction of 24% of the total composted mass of material for the baseline emissions calculation to account for these diverted wastes[7].

Also, the baseline emissions must take into account landfill gas capture practices. According to a provincial landfills survey by Environment Canada, Ontario's landfills capture 31.7% of all gases for methane combustion[8] (data for 2012). This survey offers the most recent data available on methane capture in landfills in Ontario.

The project reduces GHG emissions in comparison to what would have occurred if the organic waste management and reclaiming activity described in this report had not been implemented. GHG emissions reductions are a direct output of voluntary and additional activities introduced in 2012.

The baseline scenario process and the project scenario process greatly differ; hence the SSRs are quite different but they process the same amount of material, therefore both scenarios represent the same level of activity.

[7] Ministry of the Environment of Ontario, Non-hazardous Waste Disposal and Diversion, Chapter 4, Section 4.09, page 383

[8] Craig Palmer from Environment Canada

4. IDENTIFICATION AND SELECTION OF GHG SOURCES, SINKS AND RESERVOIRS

The SSRs for the baseline and the project scenario are identified in the table below and it is stated whether they are included or excluded from the quantification and whether they are controlled, related, or affected SSR. The selection of each SSR is done to the best of the expert team's knowledge.

The SSRs included in the baseline scenario are the emissions from material decomposition and methane collection at the SWDS. The SSRs included in the project scenario are energy consumption (diesel and electricity) for operations at the composting facility. The selected protocol, *Quantification Protocol for Aerobic Composting Projects*[9], lists the same SSRs with the exception of electricity consumption.

As indicated in tables below, diesel production and extraction are excluded; the resulting emissions over the duration of the project are considered minimal compared to diesel combustion. What is more, this source of emissions will be functionally equivalent in the baseline and project scenario. Electricity usage is included because, depending on the source of electricity production, emissions can be significant. In the protocol, organic material decomposition and methane collection is considered in both the baseline and the project scenario. These SSRs are not included in the project scenario; these are neglected because the aerobic decomposition of organic waste results in much smaller amounts of GHG emissions compared to anaerobic degradation. What is more, as stated in the referred protocol, most end-uses of compost are likely negligible and the transportation is difficult to quantify, therefore the transportation of the compost was not included.

Organic residues emit biogas when landfilled. Biogas is composed of methane (CH_4); therefore this GHG is quantified for this source. Other GHG such as PFC, HFC and SF_6 are not accounted for because they are not specific to organic residue decomposing in a SWDS.

Diesel combustion emits a large quantity CO_2 and CH_4 and N2O in smaller proportions. Other GHG such as PFC, HFC and SF_6 are not accounted for because they are not specific to diesel combustion.

[9] *Quantification Protocol for Aerobic Composting Projects* (December 2008), Alberta Environment : Climate Change Policy Unit, Internet link: http://www.assembly.ab.ca/lao/library/egovdocs/2008/alen/171442.pdf

Table 4-1 SSRs Baseline scenario inventory

SSR - Baseline	Included / Excluded	Controlled / Related / Affected	GHG	Details
Diesel Production	Excluded	Related	-	It will be functionally equivalent in the baseline and project scenario.
Diesel Consumption for organic residues transportation	Excluded	Controlled	-	Similar to the project scenario and not monitored.
Organic residues in landfill: Biogas production	Included	Related	CH_4	Main baseline emissions

Table 4-2 SSRs Project scenario inventory

SSR - Project	Included / Excluded	Controlled / Related / Affected	GHG	Details
Diesel Production	Excluded	Related	-	It will be functionally equivalent in the baseline and project scenario.
Diesel Consumption (transportation of organic residues)	Excluded	Related	-	Similar to the baseline scenario and not monitored.
Transformation of organic residues (Electricity production)	Included	Related	CO_2, CH_4, N_2O	Transmission and distribution losses as well as SF_6 emissions are not included since they are not attributable to the electricity consumption by the project proponent.
Diesel Consumption for material handling (on-site)	Included	Controlled	CO_2, CH_4, N_2O	-
Material treatment	Excluded	Controlled	-	These emissions are negligible.
Diesel Consumption (transportation of finished products)	Excluded	Related	-	The emissions from transportation are likely functionally equivalent to the baseline scenario.
Manufacturing equipment	Excluded	Related	-	Minimal equipment is required.

5. QUANTIFICATION OF GHG EMISSIONS AND REMOVALS

A literature review of the methodologies was performed where the Clean Mechanism Development (CDM), the Verified Carbon Standard (VCS), the Climate Action Reserve (CAR) and the Alberta Offset System methodology repertories were consulted. Three methodologies are related to composting activities: *Avoidance of methane emissions through composting* from CDM, *Organic Waste Composting Project Protocol,* and *Quantification Protocol for Aerobic Composting Projects* from Alberta Offset System.

There are 2 ways to calculate emissions from landfill which is used to calculate emissions for the baseline scenario:

- Calculation can be done for the emissions from waste of the current year over a specific period of time (e.g. 10 years) and those are considered for the current year.
- Calculation can be done considering cumulative emissions of waste since the beginning of the project for the current year.

The methodology from CAR is currently under review. The approved version 1.0 is still valid but a new version 1.1 of *Organic Waste Composting Project Protocol* is now available for public review. The methodology for calculating is different from the two others and is not similar to what has been done in the past for AIM GHG reports (e.g. GHG Report covering the Hamilton's facility). This methodology is ruled out because there is a will to be consistent in the approach throughout the years. For consistency and because the applicability conditions for the protocol from Alberta Offset System match the project activities, the *Quantification Protocol for Aerobic Composting Projects* [10] methodology is selected. The protocol status is approved but a note states that it is currently being reviewed as many of the numbers used are dated. However, for this report, recent values have been selected to replace the ones originally used by the protocol. The guidelines and principles of the protocol have been followed and it was used as a reference for the quantification and for drafting this report.

[10] *Quantification Protocol for Aerobic Composting Projects* (December 2008), Alberta Environment : Climate Change Policy Unit, Internet link: http://www.assembly.ab.ca/lao/library/egovdocs/2008/alen/171442.pdf

The selected protocol is assumed to be suitable for this project because all the applicability conditions match the project:

- The materials would otherwise be landfilled
- The finished compost should be mature. AIM finished compost is certified as Ontario's highest "Grade A Unrestricted" composts, hence this condition is fulfilled.
- The quantification is based on actual measurement and monitoring as required by the methodology.

The non-applicable conditions refer to the specific GHG program from Alberta, the Alberta Offset System.

All emission factors in this report for electricity consumption and fuel combustion come from the Canadian National Inventory Report. The methodology used for this project takes into account the major gases (CO_2, CH_4 and N_2O) involved in all the emission sources identified.

For the baseline scenario, the equation proposed in the protocol was used with changes to the variables names to avoid confusion. The equation was also split in 3 different equations for simplicity (BSQo, EFO_{CO2eq} and the general equation BS1E).

Project scenario emissions are emissions from energy use on-site for the processing of the waste. Emissions from fossil fuel and electricity are calculated according to the protocol, whereby the quantity of fuel and electricity consumed are multiplied by the appropriate emission factors for each gas.

The project scenario emissions were computed using ratios due to the nature of the raw data. National Ecocredit only had access to the whole consumption of diesel and electricity of the facility which included the energy used to process the waste of Waterloo and Guelph. Therefore, in order to only consider the energy related to the waste stream, it was decided to use ratios between the total amounts of what the sought value over the total weight of the waste from both cities. The weight of the waste coming from Waterloo was multiplied by the ratio to obtain an approximation of the unknown value. Every ratio used for the quantification of the project scenario emissions are shown later in this section.

Emission factors for the province of Ontario for energy consumption are from most recent National Inventory Report (NIR) of Canada.

5.1. Baseline and project GHG emissions

BASELINE SCENARIO EMISSIONS

$BSTE_{,y} = BS1E_{,y}$

$BSTE_{,y}$ = Baseline scenario total emissions resulting from the baseline scenario of sending organic residues to landfill (metric tons CO_2e) for year "y";

$BS1E_{,y}$ = Baseline scenario emissions resulting from the anaerobic degradation of organic residues in landfill (metric tons CO_2e) for year "y";

ANAEROBIC DEGRADATION OF ORGANIC RESIDUES IN LANDFILL

$BS1E_{,y} = Qoy * (1\text{-}div) * EFO_{CH4} * (1 - EFF_{biogas}) * (1\text{-}OX) * GWP_{CH4}$

$Q_{o,y}$ = Quantity of organic waste sent for composting (metric tons) for year "y"

Div = Diversion rate of waste (% of waste that would be diverted anyway)[11]

EFO_{CH4}= CH_4 emission factor for anaerobic degradation of separated organic residues (t CO_2e / t waste)[12] [13];

EFF_{biogas} = Percentage of landfill gas capture (%)[14]

OX = Oxidation factor (reflecting the amount of CH_4 from SWDS that is oxidised in the soil or other material covering the waste)[15]

$Qo_{,y} = Q_{SSO,y} – WW_{,y} * R_{TORoTW,y}$

[11] Ministry of the Environment of Ontario, Non-hazardous Waste Disposal and Diversion, Chapter 4, Section 4.09, page 383

[12] National Inventory Report 1990-2010, Greenhouse Gas Source and Sinks in Canada

[13] 2006 IPCC Guidelines for National GHG Inventories, Volume 5 Waste, p.2.14 : Biological treatment of solid waste, Internet link : http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html

[14] Data sent by Mr. Palmer, Principal Engineer at Environment Canada in December 2011.

[15] "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" (Version 05) p.2
http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v5.pdf

$Q_{SSO,y}$ = Quantity of SSO (ton) for year "y"

$WW_{,y}$ = Waterloo's waste (ton) for year "y"

$R_{TORoTW,y}$ = Ratio of Output Residues over Total Waste of Guelph's facility (ton/ton) for year "y"

$$R_{TORoTW,y} = TOR_{,y}/TW_{,y}$$

$TOR_{,y}$ = Total Output Residues (ton) for year "y"

$TW_{,y}$ = Total Waste of Guelph's Facility (ton) for year "y"

$$EFO_{CH4} = MCF * DOC * DOC_f * F * 16/12$$

MCF = Methane correction factor (1)

DOC = Degradable organic carbon content ($DOC_{food\ waste}$ = 0.15)

DOC_f = Fraction of degradable organic carbon content dissimilated (DOC_f= 0.77)

F = Fraction of CH_4 in landfill gas (50%)

PROJECT SCENARIO EMISSIONS

$$PSTE_{,y} = PS1E_{,y} + PS2E_{,y}$$

$PSTE_{,y}$ = Project scenario total emissions resulting from the project scenario of recovery of organic residues to compost (metric tons CO_2e) for year "y"

$PS1E_{,y}$ = Project scenario emissions resulting from the electricity production for the project activities (metric tons CO_2e) for year "y"

$PS2E_{,y}$ = Project scenario emissions resulting from the diesel consumption in the project activities (metric tons CO_2e) for year "y"

$$PS1E_{,y} = [(EF_{E,CO2} + EF_{E,CH4} * GWP_{CH4} + EF_{E,N2O} * GWP_{N2O}) * PSQE_{,y}]$$

$PSQE_{,y}$ = Quantity of electricity consumed for the transformation of the organic residues (kWh) for year "y"

$EF_{E,CO2}$; $EF_{E,CH4}$; $EF_{E,N2O}$= GHG emission factor for electricity consumption (tCO_2/kWh; tCH_4/kWh; tN_2O/kWh)[16];

$GWPCH_4$= Global Warming Potential of methane

$GWPN_2O$= Global Warming Potential of nitrous oxide

$$PSQE_{,y} = WW_{,y} * R_{TEoTW,y}$$

$R_{TEoTW,y}$ = Ratio of Total Electricity consumed over Total Waste of Guelph's facility (kWh/ton) for year "y"

$$R_{TEoTW,y} = TE_{,y}/TW_{,y}$$

$TE_{,y}$ = Total Electricity consumption (kWh) for year "y"

$$PS2E = [(EF_{D,CO2} + EF_{D,CH4} * GWP_{CH4} + EF_{D,N2O} * GWP_{N2O}) * PSQD_{,y}]$$

PSQD = Quantity of diesel consumed in project activities (Liters);

$EF_{D,CO2}$; $EF_{D,CH4}$; $EF_{D,N2O}$ = GHG emission factor for diesel consumption ($t\ CO_2\ /L$; $t\ CH_4/L$; $t\ N_2O\ /L$)[17];

$$PSQD_{,y} = WW_{,y} * R_{TDoTW,y}$$

$R_{TDoTW,y}$ = Ratio of Total Diesel consumed over Total Waste of Guelph's facility (L/ton) for year "y"

$$R_{TDoTW,y} = TD_{,y}/TW_{,y}$$

$TD_{,y}$ = Total Diesel consumption (kWh) for year "y"

[16] National Inventory Report 1990-2010, Greenhouse Gas Source and Sinks in Canada, Part 3, Table A13-7

[17] National Inventory Report 1990-2010, Greenhouse Gas Source and Sinks in Canada, Part 2, Table A8-11

5.2. Emissions reductions

$$TPER_{,y} = BSTE_{,y} - PSTE_{,y}$$

$TPER_{,y}$ = Total Project Emission Reductions (metric tons CO_2e) for year "y"

5.3. Quantification limits and uncertainty

Uncertainty is associated with the project, in regards to data accuracy and variables used in the quantification of the GHG emissions. Production data are based on delivery and are closely monitored. Other activity data such as energy consumption and solid waste quantity are also closely monitored and controlled.

Efforts are made towards achieving as accurate results as possible. When accuracy is jeopardized because of assumptions, conservative choices are made in order not to overestimate the GHG emission reductions. By using factors from the Canadian National Inventory Report, the level of uncertainty is controlled as the report produced by Environment Canada is reliable.

5.4. Emissions factors and other parameters

Table 5-1 Emissions factors

Emission factors	Value	Units	Source
$EF_{E, CO2}$	97×10^{-6}	tCO_2 / kWh	National Inventory Report 1990-2011, Greenhouse Gas Source and Sinks in Canada, Part 3, Table A13-7
$EF_{E, CH4}$	0.02×10^{-6}	tCO_2 / kWh	
$EF_{E, N2O}$	0.002×10^{-6}	tCO_2 / kWh	
$EF_{D,CO2}$	2663×10^{-6}	tCO_2 / L	National Inventory Report 1990-2011, Greenhouse Gas Source and Sinks in Canada, Part 2, Table A8-11, value for heavy duty diesel trucks, moderate control
$EF_{D, CH4}$	$0.14x\ 10^{-6}$	tCO_2 / L	
$EF_{D, N2O}$	0.082×10^{-6}	tCO_2 / L	

Table 5-2 Global Warming Potential

GWP	Value 2012	Value 2013	Source
CH4	21	25	Environment Canada https://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=CAD07259-1#fnb2
N20	310	298	

Table 5-3 Other parameters

Parameter	EFF_{biogaz}
Data unit	%
Description	Percentage of landfill gas captured in Ontario
Value	31.7%
Source of data to be used	Mr. Craig Palmer, Principal Engineer at Environment Canada
Description of measurement methods and procedures applied	Most recent report by Environment Canada or consultation with Mr. Palmer.
Parameter	**OX**
Data unit	-
Description	Oxidation factor, reflecting the amount of CH_4 from SWDS that is oxidised in the soil or other material covering the waste
Value	10%
Source of data to be used	Methodological tool, "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" (Version 05) p.2; http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v5.pdf
Description of measurement methods and procedures applied	Default value for managed solid waste disposal site that are covered with oxidizing material such as soil or compost.

Parameter	Div
Data unit	%
Description	Diversion rate of waste (% of waste that would be diverted anyway)
Value	24
Source of data to be used	Ministry of the Environment of Ontario, Non-hazardous Waste Disposal and Diversion, Chapter 4, Section 4.09, page 383. Internet link: http://www.auditor.on.ca/en/reports_en/en12/409en12.pdf
Description of measurement methods and procedures applied	Most recent report.
Parameter	**EFO_{CO2e}**
Data unit	t CO_2e / t waste
Description	GHG emission factor for anaerobic degradation of organic residues
Value	1.617 Calculated from EFO_{CO2eq} = MCF * DOC* DOC_f * F * 16/12 *GWP_{CH4}
Source of data to be used	- National inventory report (NIR), Greenhouse Gas Source and Sinks in Canada, part2 -IPCC Guidelines for National GHG Inventories, Volume 5 Waste, p.2.14 : Biological treatment of solid waste
Description of measurement methods and procedures applied	Calculated from the most recent NIR and IPCC.
Further explanations	MCF: NIR is used for the methane correction factor DOC: IPCC is used for the degradable organic carbon content of solid waste. DOCf: Alberta Environment, Quantification Protocol for Aerobic Composting Projects is used. F: NIR is used.

6. DATA MONITORING AND CONTROL

All data are gathered by Mr. Mark Jared who prepares yearly energy consumption summaries and reports the annual quantity of collected organic waste. Data control system and procedures are very limited since they mostly come from the energy suppliers data acquisition and storage system. These external systems are deemed sufficiently safe and reliable and allow for transparent communication of the relevant data. These are easily verifiable. No limited access data storage system is implemented data for volume of waste collected is cross checked from two sources.

Data values are inputs in the quantification model and are therefore critical for accuracy of the GHG reductions estimation. Both calculations and data values are internally reviewed by the quantification team from National Ecocredit. Reported data are the responsibility of AIM management staff. Data from each year is compared with those of previous years in order to identify any possible mistakes in data communication: numbers should be relatively in the same order of magnitude for a comparable level of activity.

Table 6-1 Data monitoring

Data	Q_o
Data unit	Metric tons
Description	Quantity of organic waste that was collected at the facility during the year
Source of data to be used	Direct measurement
Description of measurement methods and procedures applied	City of Guelph: Data is primarily compiled by the City of Guelph. Weights of waste collected are recorded at the entrance and once again at the exit of the Waste Resource Innovation Centre (WRIC). Volume data is collected at weigh scales and stored in data management software called “GeoWare” where it becomes a line item. A corresponding paper ticket (per line item or full report) can be generated if necessary by the City. Data is electronically stored / archived in the City’s systems. The data stored in Geo Ware is manually manipulated to create spreadsheets to capture aggregate information. Project Proponent: Electronic copies of these spreadsheets are retained in AIM’s system. On a daily basis, Mr. Mark Jared compares the information in these spreadsheets with the AIM/WORX’s (Wellington Organix Inc.) truck sheet. Employees record all truck ID numbers coming into Organics Waste Production Facility (OWPF). This allows to check volume of waste collected from two sources. Monthly tonnage is also confirmed.

Data	PSQE
Data unit	kWh
Description	Quantity of electricity consumed at the facility to transform the organic residues
Source of data to be used	Energy monthly bills
Description of measurement methods and procedures applied	Project proponent: Measured by electricity meter and reported on invoice sent to the client. Electric consumption is derived from invoices generated by GHEC (Guelph Hydro Electrical Systems). The City retains paper and electronic copies. AIM/WORX retains electronic copies.

Data	PSQD
Data unit	L
Description	Quantity of diesel consumed at the facility to transform the organic residues
Source of data to be used	Energy monthly bills
Description of measurement methods and procedures applied	Project proponent: Diesel consumption is derived from fuel sheets generated by City software when the equipment is fueled at City of Guelph pumps. Electronic copies of fuel sheets are provided by the City and stored electronically. AIM/WORX also notes fueling quantities (when applicable) on their Loader Inspection Report (amongst other maintenance check items, date and equipment number is recorded). Paper copies of current sheets are filed in filing cabinet while older copies are archived in binders in OWPF Control Room. All equipment that requires fueling is (such as Skid Steer and Top Turner) are treated similarly.

7. REPORTING AND VERIFICATION DETAIL

The project plan and report is prepared in accordance with ISO 14064-2 standard and the GHG CleanProjects™ Registry requirements. The methodology that is used, the choice of region specific emission factors and a rigorous monitoring plan allow for a reasonably low level of uncertainty. National Ecocredit is confident that the emission reductions are not overestimated and that the numbers of emission reductions that are reported here are real and reflect the actual impacts of the project. Emission reductions are verified by an independent third party to a reasonable level of assurance.

Emission reductions are reported here for the years 2012 and 2013(until October 2013). This is the only GHG report for this project.

Table 7-1 Baseline Scenario GHG Emissions- Source of Total (t CO2e)

		BSTE		
Year	CO2	CH4	N2O	Total
2012	0	4890	0	4890
2013	0	5775	0	5775

Table 7-2 Project Scenario GHG Emissions- Sources (t CO2e)

		PS1E				PS2E		
Year	CO2	CH4	N2O	Sub-Total	CO2	CH4	N2O	Sub-total
2012	83	1	1	85	35	1	1	37
2013	108	1	1	110	50	1	1	52

Table 7-3 Project Scenario Total Emissions (t CO2e)

		PSTE		
Year	CO2	CH4	N2O	Total
2012	118	2	2	122
2013	158	2	2	162

Table 7-4 GHG Emission Reductions- Total (t CO2e)

		TPER		
Year	CO2	CH4	N2O	Total
2012	-118	4888	-2	4768
2013	-158	5773	-2	5613
Total				**10381**

APPENDIX I: Calculation example for 2012

EMISSIONS REDUCTIONS

$$\mathbf{TPER_{,y} = BSTE_{,y} - PSTE_{,y}}$$

$TPER_{,y}$ = 4890-122 = 4768 t CO2e

BASELINE EMISSIONS

$$BSTE_{,y} = BS1E_{,y}$$

$BSTE_{,y}$ =4890 t CO2e

ANAEROBIC DEGRADATION OF ORGANIC RESIDUES IN LANDFILL

$$BS1E_{,y} = Qoy * (1\text{-}div) * EFO_{CH4} * (1 - EFF_{biogas}) * (1\text{-}OX) * GWP_{CH4}$$

$BS1E_{,y}$ = 6471.7 * (1- 0.24) * 0.077 * (1-0.317) * (1-0.1) * 21 = 4890.24 tCO2e, rounded down = 4890 t CO2e

$$Qo_{,y} = Q_{SSO,y} - Q_{SSO,y} * R_{TORoTW,y}$$

$Qo_{,y}$ = 6573,8 – 6573,8*1,6% = 6471,7 tons

$$R_{TORoTW,y} = TOR_{,y}/TW_{,y}$$

$R_{TORoTW,y}$ = 249,34 / 6573,80 = 1,6%

$$EFO_{CH4} = MCF * DOC * DOC_f * F * 16/12$$

EFO_{CH4} = 0.077 tons CH4/tons of waste

PROJECT EMISSIONS

$$PSTE_{,y} = PS1E_{,y} + PS2E_{,y}$$

$PSTE_{,y}$ = 85+37 = **122 tCO2e**

$$PS1E_{,y} = [(EF_{E,CO2} + EF_{E,CH4} * GWP_{CH4} + EF_{E,N2O} * GWP_{N2O}) * PSQE_{,y}]$$

$PS1E_{,y}$ = [(97+0.02*21+0.002*310)/10^6*854063] = 85 tCO2e

$$PSQE_{,y} = WW_{,y} * R_{TEoTW,y}$$

$PSQE_{,y}$ = 2084931*41% = 854063 kWh

$$R_{TEoTW,y} = TE_{,y}/TW_{,y}$$

$R_{TEoTW,y}$ = = 6573,8/16048 = 41%

$$PS2E = [(EF_{D,CO2} + EF_{D,CH4} * GWP_{CH4} + EF_{D,N2O} * GWP_{N2O}) * PSQD_{,y}]$$

PS2E = [(2663+0.14*21+0.082*310)/10^6*854063] = 37 tCO2e

$$PSQD_{,y} = WW_{,y} * R_{TDoTW,y}$$

$PSQD_{,y}$ = 31687*41% = 12980 L

$R_{TDoTW,y} = TD_{,y}/TW_{,y}$

$R_{TDoTW,y}$ = 6573,8/16048 = 41%