CLEAN DEVELOPMENT MECHANISM
SIMPLIFIED PROJECT DESIGN DOCUMENT
FOR SMALL-SCALE PROJECT ACTIVITIES (SSC-CDM-PDD)
Version 02

CONTENTS

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.

SECTION A. General description of the small-scale project activity

A.1. Title of the small-scale project activity:

>>

Chile: Pullihue Composting Project
Version 1
Version Date: March 14, 2006

A.2. Description of the small-scale project activity:

>>

The objective of the Pullihue Composting Project (Project) is to avoid methane emissions from anaerobic decomposition of biomass – organic waste and biosolids (sludge) - through controlled aerobic decomposition. The aerated composting process will avoid methane emissions and will also result in compost as a product that can be utilized as a soil amendment in agriculture, horticulture, land rehabilitation, and landscaping.

The Project will treat organic waste and non-toxic wastewater biosolids from Santiago.. On average, it will divert approximately 266,000 tonnes of organic waste per year that otherwise would be disposed in sanitary landfills if the project was not constructed.

Although there are no official statistics on the composition of waste generated in Santiago, a study conducted by Agroindustrial Pullihue Ltda. in 2001 showed that total organic waste, including biosolids, generated in Santiago was about 83,320 tonnes per month (999,840 tonnes per year). Furthermore, Santiago's current waste production is expected to increase between 1.2 % and 5.0 % per year for the near future due to population and economic growth.

Currently, almost all of Santiago's Metropolitan Area waste material goes to 3 sanitary landfills. From a local environmental perspective, composting organic waste would reduce the pressure on sanitary landfills in Santiago, and therefore reduce future land requirements. In addition, the compost produced in the plant can be used as a soil conditioner for agricultural / horticultural purposes, to rehabilitate degraded lands, and/or to landscape gardens, parks and green spaces. Compost used in agricultural / horticultural applications will decrease the need for chemical fertilizer, which would reduce emissions from fertilizer manufacturing and nitrogen release from soil. No credit for these reductions were included in this assessment. Additionally, depending on the application, compost can be used as a substitute for the accumulated organic material of pre-mountainous forest environments (e.g. peat moss), which would aid in the conservation of this valuable ecosystem.

Currently there are no regulations in Chile requiring composting of organic waste or methane capture and flaring in landfills. Regulations only require that waste should be disposed at authorized sites and that landfill gas emissions should be controlled in order to avoid explosive hazards. To date, almost all waste generated in Santiago is disposed in sanitary landfills without any methane capture and flaring.

In contrast to the anaerobic decay of organic waste that occurs in the landfills, which results in methane generation among other gases, the composting project will contribute to mitigation of greenhouse gas emissions through aerobic decomposition of the organic waste, thus generating only non-fossil carbon dioxide (CO_2) emissions, which are neutral to the environment.

The Project will have two operational facilities, physically separated by about 27 kilometers (km) from each other. The first facility (Quilin Plant), that is expected to be fully operational in January 2007, will be located in the most eastern part of Santiago with capacity to process up to 50,000 tonnes of organic waste per year. The second facility (CEPROS Plant) will be located in the most western part of Santiago and with capacity to process up to 216,000 tonnes of organic waste per year. The CEPROS plant will be constructed in two phases, starting in 2007 with 108,000 tonnes per year capacity that will increase in January 2008 up to its full capacity (216,000 tonnes per year). Both plants represent a total capacity of 266,000 tonnes per year of organic waste, which is approximately 27% of the current total organic waste generated in Santiago. For the first 7 year crediting period (2007-2013), the project is expected to generate about 3.7 million tCO_2e.

The Project will also contribute towards achieving sustainable waste management in the city. The design and operation of the Project, in conjunction with the avoidance of methane emissions and production of compost as a soil amendment, will serve as an example to many other urban areas in the country that are facing similar waste management challenges. The Project will also demonstrate that the carbon credit finance mechanism can catalyze environmentally sustainable and profitable waste management practices. The Project will be the first aerated static pile composting facility, see Section A.4.2, to receive carbon finance credits in Latin America.

A.3. Project participants:

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Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Chile (host)	**-Agroindustrial Pullihue** project sponsor	No
Spain	**International Bank for Reconstruction and Development** as the Trustee of the Spanish Carbon Fund (SCF)	Yes

A.4. Technical description of the small-scale project activity:

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A.4.1. Location of the small-scale project activity:

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The locations of the two composting facilities are:

- CEPROS Plant: Camino Riconada de Maipú, within the Municipality of Maipú –Santiago.
- Quilin Plant: Av. Departamental 8250, within the Municipality of Peñalolén – Santiago.

Both sites are shown on the map provided below.

A.4.1.1. Host Party(ies):

>>

Chile.

A.4.1.2. Region/State/Province etc.:

>>
Metropolitan Region.

A.4.1.3. City/Town/Community etc:

>>
Santiago, Municipality of Maipú and Municipality of Peñalolén.

A.4.1.4. Detail of physical location, including information allowing the unique identification of this small-scale project activity(ies):

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The CEPROS Plant will be located on 50 ha of property owned by the Universidad de Chile "Riconada de Maipú" within the Municipality of Maipú.

The Quilin plant will be located on a 50 ha property of Agroindustrial Pullihue Ltda, within the municipality of Peñalolén.

Figure A.1. Road Map Location

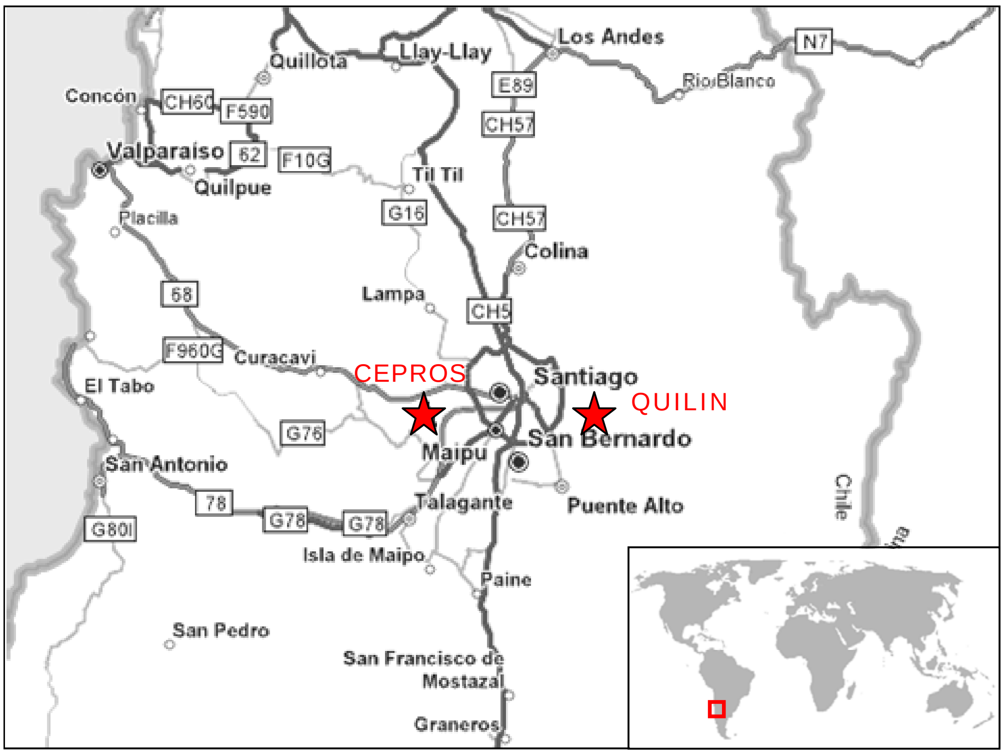
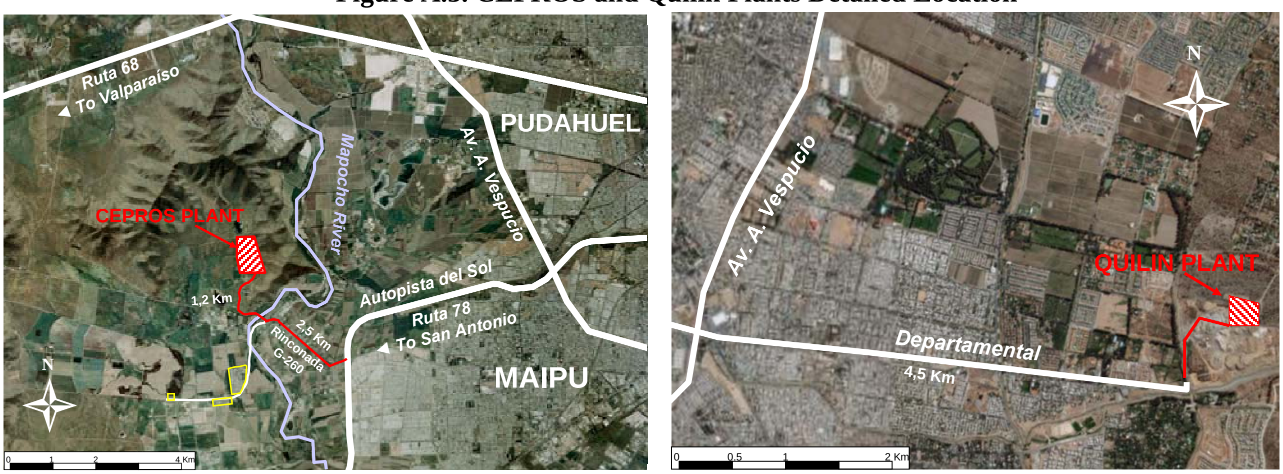


Figure A.2. Santiago General Satellite View

Figure A.3. CEPROS and Quilin Plants Detailed Location



A.4.2. Type and category(ies) and technology of the small-scale project activity:

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Type III. F: Avoidance of methane production from biomass decay through composting.

Composting is an aerobic process during which micro-organisms convert an organic substrate into stabilized organic matter with production of heat. Thus, avoiding anaerobic conversion in a landfill, where methane is produced. Through this composting project organic waste is aerobically degraded, producing heat and non-fossil fuel CO_2. The Project will not produce, recover, or combust methane. In order to fit this category, measures shall both reduce anthropogenic emissions by sources and directly emit less than of 15,000 (k) tonnes of carbon dioxide equivalent per year (tCO_2e/yr) over the entire crediting period.

The technology proposed for the composting project is “Aerated Static Pile”, and can be regarded as standard and proven technology, but new to Chile. This system consists of formation of static piles of organic waste mixed with a bulking agent. The piles are covered with screened compost to reduce odors and to maintain a high temperature inside the pile.

Waste enters the plant in a segregated manner, and is weighed and unloaded separately. Bulky waste such as branches or lumber will be shredded prior to processing. On the mixing ground, different types of waste are mixed to give the waste an optimum mixture and humidity.

Perforated tubes are inserted on the base of each pile. These are connected to ventilators in order to provide the amount of air required for the controlled aerobic biodegrading of the organic waste mass. Suctioned air is treated in biofilters, a proven odor control technology, that will minimize odors that may be generated in the composting process.

The product obtained from the forced aeration process is screened. Larger parts are recycled in the mixing zone and smaller parts, which are most of the processed material, are transferred to aging piles which are operated in a similar way as the first pile. Also, in the sifting process, some minor materials are rejected, corresponding to inert waste that is sent to landfills.

The final product is compost that will be adapted to the client’s needs and may be mixed with plant soil, inert substrata, soil conditioners, etc.

The use of compost may be associated with hazards to humans and the environment. Depending on the original raw material, compost products may contain various chemical and microbiological contaminants causing health and environmental risks. Humans and the environment may be exposed to contaminants during production and utilization of compost. In accordance with these risks, an unpublished Compost Quality Norm in Chile developed in 2000 by CONAMA, the environmental agency, states that hazardous and infectious organic waste cannot be composted. Following this directive, the Project will compost the following wastes:

- Municipal wastewater treatment plant sludge (biosolids);
- Animal manure (biosolids);
- Industrial organic (paper mill) sludge (biosolids);
- Fruit and vegetable waste;
- Paper fibre;
- Yard trimmings; and
- Wood waste and saw dust.

Regardless of the prohibition to receive hazardous and infectious organic waste, the Project will take further measures to eliminate and control pollution and health risks. Regarding production, all workers will be trained in security and health measures regarding the production of compost and they will wear all necessary clothing and safety equipment, including glasses, masks, shoes, gloves and helmets. Regarding compost use, the Project will follow the guidelines proposed in the Compost Quality Norm developed in 2000 on the control of the following pathogens: fecal coliforms, salmonella, enteric viruses and viable helminth ova. The Project will also follow the guidelines proposed in the same document regarding the control of heavy metals such as arsenic, cadmium, copper, mercury, molybdenum, nickel, lead and zinc.

Figure A.4 provides an outline of the different steps in the composting process

A.4.3. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed small-scale project activity, including why the emission reductions would not occur in the absence of the proposed small-scale project activity, taking into account national and/or sectoral policies and circumstances:

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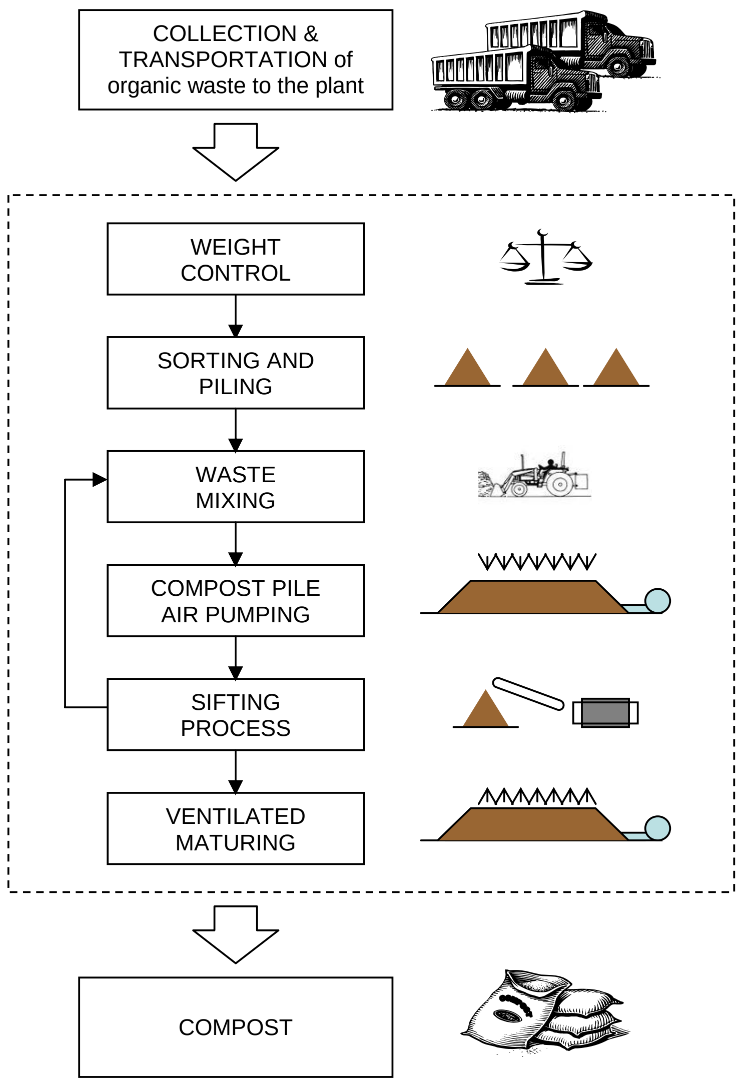
The Project will annually divert about 216,000 tonnes of waste to CEPROS Plant and another 50,000 tonnes of waste to Quilin Plant. In total, the two projects, will divert up to 266,000 tons/year of organic waste generated in Santiago, which otherwise would be disposed in sanitary landfills. As a result, instead of anaerobic decomposition of the waste in the landfill resulting in the generation of landfill gas (50% methane), the organic waste is degraded aerobically producing only non-fossil CO_2, which is neutral to the environment. The final output of the process will be converted into a reusable product (compost). By converting organic waste into compost, all methane emissions are prevented from anaerobic decomposition. The prevented emissions are the ERs claimed by the Project. Estimated total emission reductions are approximately 3.7 millions tCO_2e for the first crediting period of 2007-2013.

There are no regulations in Chile requiring composting of biodegradable urban waste or methane capture and flaring in landfills. Regulations only require that waste should be disposed at authorized sites and landfill gas emissions should be controlled in order to avoid explosive hazards. To date, almost all waste generated in Santiago is disposed in sanitary landfills without any methane capture and flaring.

The baseline scenario is defined as the most likely future scenario in the absence of the proposed CDM project activity. The baseline scenario for this project is continued disposal of the waste in the landfills and release of the majority of the landfill gas to the atmosphere, similar to the current situation of most landfills in Chile. The results of the financial analysis conducted for the Project demonstrate that composting of waste is not an economically attractive course of option and, therefore, is not a part of baseline scenario and proves to be additional (more details are provided in section B3).

The compost produced in the plant can be used for agricultural / horticultural purposes, rehabilitation of degraded lands, and/or to landscape gardens, parks and green spaces.

Figure A.4
AERATED COMPOST PROCESS


COLLECTION & TRANSPORTATION of organic waste to the plant
WEIGHT CONTROL
SORTING AND PILING
WASTE MIXING
COMPOST PILE AIR PUMPING
SIFTING PROCESS
VENTILATED MATURING
COMPOST

A.4.3.1 Estimated amount of emission reductions over the chosen crediting period:

The estimated emission reductions (baseline emission reduction less project emissions) for the Project are provided in Table A.1.

Table A.1
Estimated Emission Reductions (ER_y), Baseline Emission Reduction (BEy), and Project Emissions (PE_y)

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Number of years	Years	Baseline Emission Reductions, BE_y [1] (tCO_2e)	Project Emissions, PE_y [2] (tCO_2e)	Emission Reductions,ERy [3] (tCO_2e)
1	2007	158,408	6,063	152,345
2	2008	270,037	6,063	263,974
3	2009	456,979	6,063	450,916
4	2010	588,715	6,063	582,652
5	2011	681,548	6,063	675,485
6	2012	746,966	6,063	740903
7	2013	793,065	6,063	787,002
Total estimated reductions for the First Crediting Period (tCO_2e)		3,695,718	42,441	3,653,277
Total estimated reductions for all Crediting Period (tCO_2e)		15,950,831	127,323	15,950,831
Total number of crediting years		7 x 3 = 21	7 x 3 = 21	7 x 3 = 21
Annual average over the crediting period of estimated reductions (tCO_2e)		759,563	6,063	759,563

1. Source: Table E.4.
2. Source: Table E.5.
3. $ER_y = BE_y - PE_y$

A.4.4. Public funding of the small-scale project activity:

>>
There is no public funding involved in the Project.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a larger project activity:

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*Debundling i*s defined as the fragmentation of a large project activity into smaller parts. According to Appendix C (paragraph 2) of the Simplified M&P for Small-Scale CDM project activities. The Project cannot be deemed to be a debundled component of a larger project activity because, at the moment of registration of the Project proposal, there is no registered small-scale CDM project activity or an application to register another small-scale CDM project activity with the same project participants; in the same project category and technology/measure; registered within the previous 2 years; and whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

SECTION B. Application of a baseline methodology:

B.1. Title and reference of the approved baseline methodology applied to the small-scale project activity:

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AMS III. F: Avoidance of methane production from biomass decay through composting.

B.2 Project category applicable to the small-scale project activity:

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The project uses approved small-scale methodology AMS III. F: Avoidance of methane production from biomass decay through composting.

The Project comprises measures to avoid production of methane from solid waste and biosolids that would otherwise have been left to decay anaerobically in a landfill. Due to the project activity, anaerobic decay is prevented through aerobic composting, which avoids the generation of methane that would otherwise be produced and emitted to the atmosphere. Further, the Project is considered a small scale project, since direct emissions from project activity are below 15k tCO_2e per year.

In Santiago almost all of the waste is disposed at three main sanitary landfills: Santa Marta, Santiago Poniente and Los Colorados. All of these landfills receive organic and non organic materials from various municipalities. Landfills operated in Chile are not subject to definitive regulations regarding methane capture and flaring, rather that landfill gas be controlled to avoid explosive hazards, and moreover, regulations strictly prohibit flaring in the landfill due to safety reasons, unless permitted and enforced by CONAMA.

Although currently Chilean National Legislation does not require capture and flare of landfill gas, some landfills, such as Santa Marta, have been granted approval by CONAMA to flare about 5% to 8% of gas to prevent explosions. However, this landfill is being developed under the CDM and therefore does not constitute the baseline scenario.

The baseline scenario of the Pullihue Composting Project is the situation where, in the absence of the project activity, organic wastes and biosolids are sent to landfills and left to decay through anaerobic decomposition. Therefore, the baseline constitutes generation of methane, carbon dioxide and nitrous oxide emissions. The baseline emissions claimed by the project activities, as stated in the simplified methodology AMS III.F for small-scale CDM project activity, are the amount of methane produced from the decay of biomass from all of the organic waste treated in the project activity. The yearly methane generation potential is calculated using IPCC First Order Decay (FOD) Model. The formulae used to calculate the methane emission factor and the baseline emissions are presented in detail in Section E.1, but the key formula and information on used data is presented in the table below.

$$BE_y = MB_y * GWP\_CH_4 – MD_{y,reg} * GWP\_CH_4$$

where,

- BE_y: baseline methane emissions from waste decay per year, expressed as tonnes of carbon dioxide equivalent emissions per year (tCO_2e/year).
- MB_y: methane generation potential in the year “y” (tonnes of CH_4), estimated as in AMS III-G..
- $MD_{y, reg}$: methane that would be destroyed or removed in the year “y” for safety or to comply with regulation. In this situation, this factor was estimated to be ‘0’, as Chilean regulations strictly prohibit the flaring of landfill gas due to safety reasons, unless permitted and enforced by CONAMA.
- CH_4_GWP: value of 21 is used for the first commitment period (Source: UNFCC)...

The expected emission reductions for the composting project were estimated using the FOD Model, as specified in AMS III.F, see Section E.1.1.

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

>>

The baseline scenario of the Pullihue Composting Project is continued disposal of organic waste in landfills and release of the landfill gas to the atmosphere. The project uses approved methodology AMS III. F Avoidance of methane production from biomass decay through composting. The project emissions, which consist of emissions from diesel motors operation and electricity consumption, represent a maximum total of 6.1 ktCO_2e/year, which is less than the annual limit of 15 ktCO_2e/year.

The additionality of the Project is established through the barrier analysis as per Attachment A to Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities. As demonstrated below, it is concluded that the project is additional since it is not part of the business-as-usual scenario. The project would not be developed without carbon revenues.

(a) Technological barriers:

The project is first of its type in terms of size and waste to be processed in the country. Facilities using the aerated static pile compost process with the quantities and types of waste to be processed by the Project are being successfully operated in other countries. The Project’s management team are experienced, successful compost facility operators. Through financial aid provided by the State Technological Fund (FONDEF-www.fondef.cl), Agroindustrial Pullihue Ltda, the project sponsor, conducted a full research of the technology and contracted an international expert to build the pilot plant. This pilot project is Quilin Composting Plant which is a small plant with maximum capacity of approximately 20,000 tonnes of organic waste per year. .

There are two other small composting facilities in operation in Santiago (Armony, located in Pudahuel, and Idea Corp, located in San Bernardo), which in total have a processing capacity of about 18,000 tonnes per year of organic waste. However, these plants operate with a poorly aerated windrow turning technology (almost anaerobic), and have a very low investment cost, and operate with rudimentary procedures, minimum personnel and almost no environmental and quality controls.

The fact that no project with similar characteristics has been implemented in the past underpins that real and/or perceived risks exist for such project. Such considerations are likely to include the risks related to the ability to secure long term organic wastes with attractive tariffs taking into account technology/investment and generation costs.

(b) Barriers due to prevailing practice:

Currently all of waste that is generated in Santiago is disposed in the landfills. Most of the household waste that is generated in Santiago is organic and is an excellent source for composting. Nevertheless, composting of waste is not practiced due to high costs attached to separation of the organic waste. Currently there are no measures in place or subsidies provided to implement separate collection system for organic waste in the households or at the collection point. For municipalities this would imply additional costs and is not attractive without additional revenues like selling emission reductions. Some efforts have been made recently by Chilean authorities to promote recycling, namely separation of household waste, however due to lack of infrastructure, financial resources and incentives, this has not been successful. Additionally, municipalities are not familiar with composting technology and do not have sufficient knowledge and skills to implement new type of waste management. Therefore, current practice prevails in the country and is likely to continue unless these barriers are removed.

(c) Investment Barrier:

The likelihood of development of this project, as opposed to the continuation of the baseline, is determined by comparing its NPV and IRR with the benchmark of interest rates available to a local investor. As shown below, composting project without CER revenues is not profitable and therefore is not an attractive investment option.

Under the contractual agreements, the project sponsor had to run the Quilin composting facility in order to produce inert waste to remediate an excavation works. In 2005 the company has fulfilled its obligations and has no further incentives to run the facility. Without CER revenues, the revenues from sale of compost do not cover operational costs required by the plant nor its investment and therefore is not an attractive course of action.

(d) Impact of CDM registration and CER income:

The project is unlikely to move forward without the additional financial support of the CDM carbon credits. Assuming that the project gets registered and is able to sell CERs at a market price of US$6 /t$CO_2$e, the additional revenues derived from the sale of carbon credits will increase the Project's financial returns to a level sufficient to justify the inherent risks associated with long-term investment decisions and capital allocation for a compost facility with its associated equipment.

The following table shows the results of cash flow analysis prepared by the project sponsor, based on the experience of the pilot facility - Quilin composting plant. The table reflects the project's high sensitivity to carbon credits sales, making this additional income a key decision factor for project development.

Table B.2.
Cash Flow Sensitivity Analysis

	IRR
Without ER finance	4%
With ER finance (US$6 / t$CO_2$e)	38%

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the small-scale project activity:

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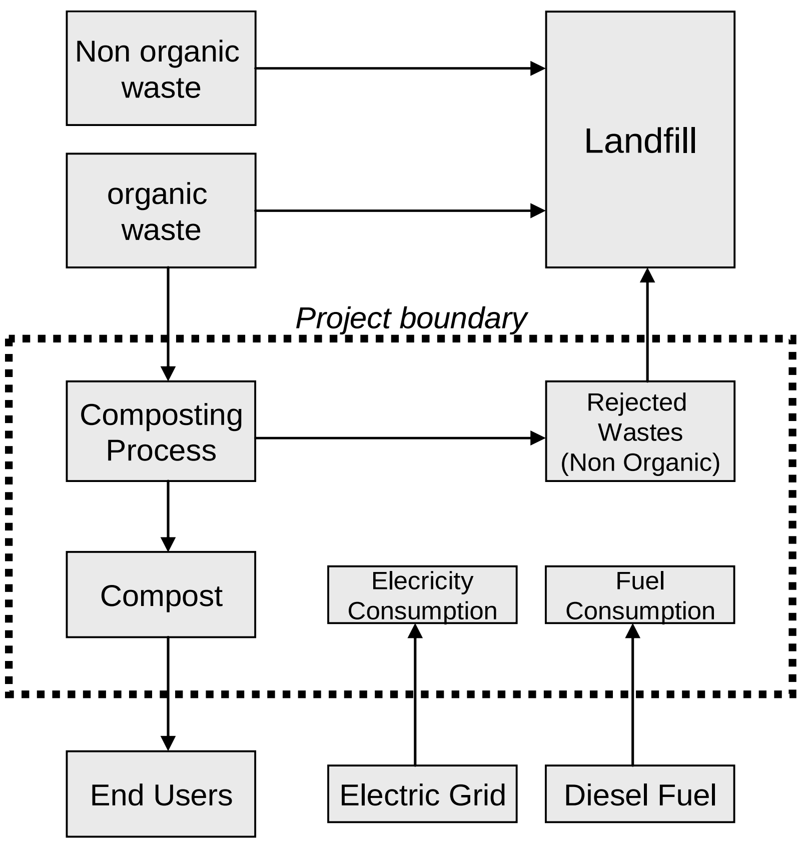
The project boundary is the physical, geographical site:

(a) where the solid waste would have been disposed and the methane emission occurs in absence of the proposed project activity,
(b) where the treatment of biomass through composting takes place,
(c) where the soil application of the produced compost takes place,

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

The project will account all emissions due to project activity in the project boundary.

Figure B.1
Project boundary



In the composting process some non-organic materials are rejected, however they represent a very small part of the process (near 0.6%). The rejected materials are sent to a landfill, but since it is inert material (mainly plastics), it does not contain any methane.

B.5. Details of the baseline and its development:

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The baseline for the project activity is calculated using IPCC First Order Decay Model as described in category AMS III.G.

The baseline was completed in January 2006.

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SECTION C. Duration of the project activity / Crediting period:

C.1. Duration of the small-scale project activity:
>>
21 years.

C.1.1. Starting date of the small-scale project activity:
>>
31.01.2007

C.1.2. Expected operational lifetime of the small-scale project activity:
>>
21 years.

C.2. Choice of crediting period and related information:
>>

C.2.1. Renewable crediting period:
>>
3 times 7 years (21 years).

C.2.1.1. Starting date of the first crediting period:
>>
31.01.2007

C.2.1.2. Length of the first crediting period:
>>
7 years: 31.01.2007 to 31.12.2013

C.2.2. Fixed crediting period:
>>
Not applicable.

C.2.2.1. Starting date:
>>
Not applicable.

C.2.2.2. Length:
>>

Not applicable.

SECTION D. Application of a monitoring methodology and plan:

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D.1. Name and reference of approved monitoring methodology applied to the small-scale project activity:

>>

Type III. F: Avoidance of methane production from biomass decay through composting.

D.2. Justification of the choice of the methodology and why it is applicable to the small-scale project activity:

>>

The project will use the approved SSC methodology AMS III. F: Avoidance of methane production from biomass decay through composting. Project emissions within the crediting period will not exceed the limit of 15ktCO_2e per year, therefore approved methodology type III. E is applied for this project.

D.3 Data to be monitored:

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To accurately estimate the ERs from avoided methane emissions during the operation of the Project, all relevant data must be recorded in order to properly estimate project emissions (PEy) and baseline emission (BEy). The following are the most relevant data to be registered:

- The actual volumes and sources of organic waste composted that enters to the project boundary will be monitored.
- Each source of wood waste will be treated separately and the methane emissions avoided is calculated using the AMS III.E, according to formula presented in Section E.1, at the end of each calendar year based on the characteristics of the waste treated in the composting process.
- On-site use of fuel will be monitored monthly through the survey of the amount of diesel oil purchased, including those for plant operation and trucks for incremental collection activities. Emissions of CO_2, CH_4, and N_2O will be determined using IPCC default values. These values will be added annually and fed into the monitoring spreadsheet.
- Electricity consumption will be monitored monthly based on the plant metering system or energy invoices. These values will be added annually and fed into the monitoring spreadsheet.
- Amount of rejected waste produced will be monitored using weight measurements equipment when leaving the project boundary.
- Supplementary information used to ensure effective monitoring of emissions is the annual amount of organic waste contracted from each supplier.

The monitoring spread sheet in Excel will automatically calculate the baseline emissions (BEy), emissions from the Project activity (PEy) and the total net emissions reduced by the Project (ERy).

These monitoring principles and provisions will be included in a separate Monitoring Plan that will be prepared for the Project.

All data to be monitored by the project activity are summarized in Table D.1:

Table D.1
Monitoring Plan - Data to be Measured

ID number	Source of data	Data variable	Data unit	Measured (M), calculated (C), estimated (E)	Recording frecuency	Proportion of data to be monitored	How will the data be archived? (electronic / paper)	For how long is archived data kept
1	Weighbridge	Waste entering composting plant (**Qbiomass**)	tonnes	M	Continuos / daily	100%	Paper & electronic	21 years can be just 2 years since it's how long it's required by CDM rules
2	KWh meter	Electricity consumption	kWh	M	Monthly	100%	Paper & electronic	21 years
3	Fuel invoices	Fuel consumption	Liters	M	Weekly	100%	Paper & electronic	21 years
4	Weighbridge	Rejected (Non-organic) residuals leaving the plant. (**Qwaste**)	tonnes	M	Continuos / daily	100%	Paper & electronic	21 years
5	Waste entrance records	Organic composition of waste entering the plant	Tonnes	C	Continuos / daily	100%	Paper & electronic	21 years
6	Lab. Analysis	Chemical composition of compost leaving the plant	%	M	Monthly	10% Sample	Paper & electronic	21 years
7	Odometer	Hours or km of motor and operation (trucks and petrol generators)	hr or km	M	Continuos / daily	100%	Paper & electronic	21 years
8	Truck Capacity	Capacity of each truck transporting waste inside the project site	tonnes	M	When necessary	100%	Paper & electronic	21 years
9	IPCC	IPCC default values for various formulae	-	M	When necessary	100%	Paper & electronic	21 years
10	GHG emission from baseline	MSW input to the plant	TPD	M	Daily	100%	Paper & electronic	21 year
11	GHG emissions	Organic Content of MSW (DOC)	%	C	Monthly or seasonal	100%	Paper & electronic	21 years

D.4. Qualitative explanation of how quality control (QC) and quality assurance (QA) procedures are undertaken:

>>

The Project will designate a competent manager who will be in charge of and accountable for the generation of ERs, including monitoring, record keeping, computation of ERs, audits and verification. The manager will officially sign off on all GHG emissions worksheets.

Well-defined protocols and routine procedures, with good, professional data entry, extraction and reporting procedures will reduce costs and time needed, while making it considerably easier for the auditor and verifier to do their work.

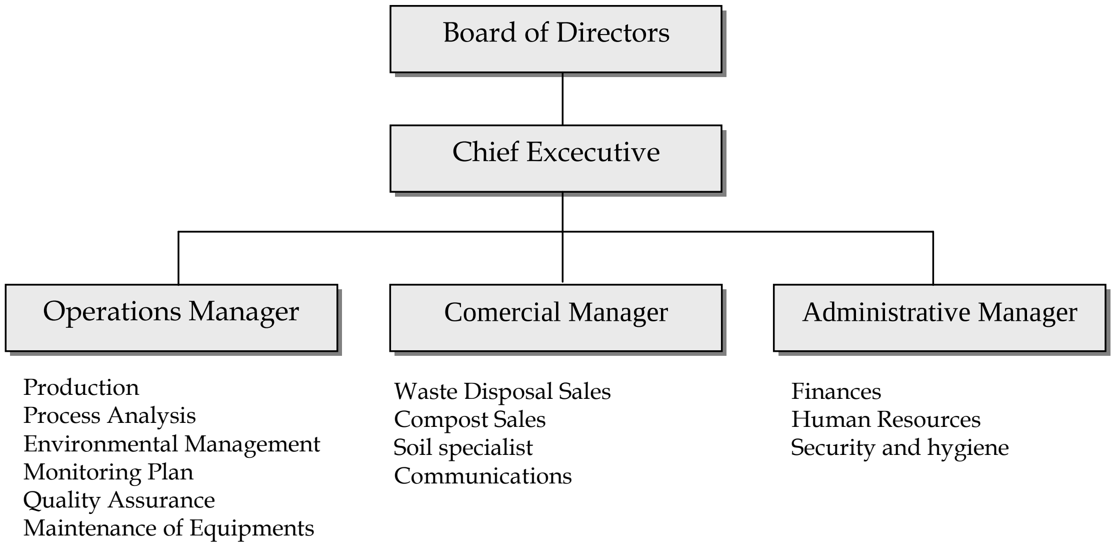
Proper management processes and systems records will be kept by the operator and made available to the auditors and designated operational entities. to check compliance with the required management system.

D.5. Please describe briefly the operational and management structure that the project participant(s) will implement in order to monitor emission reductions and any leakage effects generated by the project activity:

The project operator will have certain operational and data collection obligations to fulfill in order to maximize QA and QC measures in the process of CO_2 emission reductions estimation, and to ensure that sufficient information is available to calculate CO_2 in a transparent manner and to allow for a successful verification of these ERs.

In order to successfully ensure credibility and verifiability of the ERs achieved, the operator will have a well-defined management and operational system. It will include the operation and management of the monitoring and record keeping described in the Monitoring Plan. The proper functioning of the Project management and operational system will be monitored by the operator and will be subject to independent verification.

Figure D.1.
Management Organization



The Operational Manager is responsible for the activities related to the implementation of procedures, QA & QC, and internal audits. The Operations Manager will respond directly to the Chief Executive.

D.6. Name of person/entity determining the monitoring methodology:

Not listed as Annex one party.

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SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

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E.1.1 Selected formulae as provided in appendix B:

The project will use the approved SSC methodology AMS III. F: Avoidance of methane production from biomass decay through composting

The baseline scenario is the situation where organic waste and biosolids are landfilled and decay under anaerobic conditions thus producing methane that will be emitted to the atmosphere. The baseline emissions are the amount of methane produced from the anaerobic decay of organic waste and biosolids treated in the project activity.

Since the Pullihue Project will be an aerobic composting operation, factors that are appropriate to the project have been used in the FOD Model calculation of potential yearly methane generation reduction. These factors are based on a bioreactor landfill, rather than a passive landfill.

Bioreactor landfills seek to accelerate waste stabilization by re-circulating leachate and/or the addition of water into the landfill. (NOTE: The facility operator may add water to the composting material to maximize the efficiency of the operation, a process identical to a bioreactor landfill.) The higher moisture level maximizes waste decomposition, which results in a faster stabilization of the waste mass in the landfill, which reduces the period of potential environmental impacts (ground water contamination, methane gas emissions) associated with the landfilling of wastes. A side effect of accelerated stabilization is a compressed period during which landfill gas will be produced.

In a bioreactor landfill, the site could be mined after the waste has been decomposed. Decomposed waste and cover soil could be used as cover material at another disposal site or possibly as compost. A controlled composting project such as the one that will be operated by the Project is similar to a bioreactor landfill operated under aerobic conditions. Because the proposed composting project differs from a passive anaerobic landfill, alternate gas generation factors were used in the FOD model. The Yearly Methane Generation Potential was calculated using the FOD Model.

Yearly Methane Generation Potential

The method below is used to evaluate the yearly methane generation potential in the landfill. The quantity of methane projected to be formed during a given year is estimated using a FOD Model based on the discrete time estimate method proposed in the IPCC Guidelines.

$$\mathrm{MB_y} = \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j=A}^{D} A_{j,x} \cdot DOC_j \cdot \left(1 - e^{-k_j}\right) \cdot e^{-k_j \cdot (y-x)}$$

where:

- F is fraction of methane in the landfill gas (IPCC default 0.5).

- DOC_f is fraction of DOC converted to landfill gas (IPCC default 0.77). In a bioreactor landfill that would be mined to recover compost the fraction of DOC_f that would decompose and thus produce landfill gas would be 1.00. The same conditions apply in the proposed aerobic composting operation, as uncomposted organic material would be screened at the end of the processes and recycled through the composting process.

- DOCj is per cent of degradable organic carbon (by weight) in the waste type j, which was calculated to be 0.2371 based on the following formula:

$$\text{Percent } DOC_A*A + \text{Percent } DOC_B*B + \text{Percent } DOC_C*C + \text{Percent } DOC_D*D$$

where

Waste Stream	% Incoming Waste	% DOC_j (by weight)
A - Paper / Textile (paper mill sludge)s	21.0%	40%
B - Garden and park waste and other (non-food) putrescibles (wastewater treatment plant sludge)	50.0%	17%
C – Food Waste (fruits, vegetables, animal and fish waste)	9.0%	15%
D – Wood and straw waste (branches, sawdust, wood shavings, wood)	20.0%	30%

- MCF is Methane Correction Factor (fraction, IPCC default 1.0)

- Aj,x is amount of organic waste type j landfilled in the year x (tonnes/year).

- kj is decay rate for the average waste stream has been adjusted to 0.35, based on the following conditions. A higher moisture content in a landfill will accelerate waste decomposition. The high percentage of wastewater treatment plant sludge (moisture content, 85%, a standard rate for dewatered sludge – belt filter press - from a municipal wastewater treatment plant) combined with paper mill sludge in the composting facility relative to a landfill will raise the average moisture content of the incoming waste above that in a passive anaerobic landfill. When combined with the addition of water that may be added during the composting process (bioreactor type landfill), the adjusted k value provided above are justified. Additionally, larger waste such as wood or branches will be size reduced prior to composting, which will accelerate decomposition relative to landfill. Reported k values have been as high as 0.4. For the high moisture environment of the proposed composting system, a k value of 0.35 was used. (Source: 'Turning A Liability Into An Asset: A Landfill Gas-to-Energy Project Development Handbook' U.S. Environmental Protection Agency, Washington, D.C. September 1996).

- *j* is waste type distinguished into the waste categories (from A to D), as illustrated in the table above.

- x is year since the landfill started receiving wastes: x runs from the first year of landfill operation (x=1) to the year for which emissions are calculated (x=y). The composting project was estimated to begin operations in January 2007, which would be the start of emissions under the baseline scenario.

- y is year for which LFG emissions are calculated

Additionally it was estimated that the equivalent recovery efficiency of the aerobic composting operation would be more efficient than the standard for landfill gas recovery, which is 50% in landfills, except in the United States where landfills have synthetic bottom and top liners that restrict gas migration among other environmental management objectives. For the purpose of this analysis, the recovery efficiency was set at 95% to account for system leakage,

E.1.2 Description of formulae when not provided in appendix B:

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NA.

E.1.2.1 Describe the formulae used to estimate anthropogenic emissions by sources of GHGs due to the project activity within the project boundary:

Project Activity Direct Emissions as described in the AMS III. F are:

(a) Incremental CO2 emissions due to incremental distances between the collection points to the composting site and to the baseline disposal site as well as transportation of compost from composting site to soil application sites.

The incremental CO_2 emissions on this project are positive. The composting facility site is a comparable average distance from the waste generators (the city center was used as a proxy) as the existing landfills, see table below.

Waste Mgt Facility	Distance to City Center (km)	Annual Waste Quantity (tonnes)	Weighted Average Distance (km)
Landfill			56
Los Colorados	73	1,850,000	
Santa Marta	32	650,000	
Santiago Poniente	22	450,000	
Composting			\ 18
CEPROS	18	216,000	
Quilin	18	50,000	

(b) CO2 emissions related to the power used by the project activity facilities. Emission factors for grid electricity or diesel fuel use as the case may be shall be calculated as described in category I.D.

PEy = PEy,transp + PEy,power

where:

- PEy: project activity emissions in the year "y" (tonnes of CO2 equivalent).
- PEy,transp emissions through incremental transportation in the year "y".
- PEy,power emissions through electricity or diesel consumption in the year "y".

Data on the emission factors used is provided in Table E.1.

4. Project activity emissions from trucks for incremental waste collection and compost delivering activities will be estimated and considered as project activity emissions.

PEy,transp = (Qy/CTy) * DAFw * EFCO2 + (Qy,comp/CTy,comp) * DAFcomp * EFCO2

where:

- Qy quantity of waste composted in the year "y" (tonnes), incoming waste quantity will be 266,000 tonnes per year.

Table E.1
Emission Factors for Diesel Generator Systems (kg CO_2e/kWh[1])
for Three Different Levels of Load Factors [2]

Cases	Mini-Grid with 24 hour Service	i) Mini-Grid with Temporary Service (4-6 hr/day) ii) Productive Applications iii) Water Pumps	Mini-Grid with Storage
Load factors [%]	**25%**	**50%**	**100%**
<15 kW	2.4	1.4	1.2
>=15 <35 kW	1.9	1.3	1.1
>=35<135 kW	1.3	1.0	1.0
>=135<200 kW	0.9	0.8	0.8
>200 kW [3]	0.8	0.8	0.8

1. A conversion factor of 3.2 kg CO2 per kg of diesel has been used (following revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).
2. Figures are derived from fuel curves in the online manual of RETScreen lnternational's PV 2000 model, downloadable from http://retscreen.net/.
3. default values

- CT_y average truck capacity for waste transportation (tonnes/truck), five tones per truck.
- DAF average incremental distance for waste transportation (km/truck), the weighted average distance to landfill is greater (56 km) than the distance to the composting facilities (18 km), so the incremental distance is a negative (-38 km).
- EF_{CO2} CO_2 emission factor from fuel use due to transportation (kgCO_2/km, IPCC default values or local values can be used), based on World Bank data the emissions would be 1.65 kg of CO_2 per km for an articulated truck
- $Q_{y,comp}$ quantity of compost produced in the year "y" (tonnes), based on a standard weight reduction factor of 33%, the finished quantity of compost will be about 178,220 tonnes per year.
- $CT_{y,comp}$ average truck capacity for compost transportation (tonnes/truck), an articulated truck with a capacity of 17 tonnes.
- DAF_{comp} average distance for compost transportation (km/truck), compost facilities are located on either side of the city about 27 km apart, therefore the maximum distance a truck would travel was estimated to be 13.5 km (one way) or 27 km (round trip).

Based on the preceding factors, there would be no increase in emissions from transportation. In fact the composting project would result in a decrease in tCO_2e/yr, which was excluded from this assessment because the amount would be relatively small.

E.1.2.2 Describe the formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities

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No leakage is identified in this project. Nonetheless, an adjustment was made for leakage in assessing the BE_y. The estimated gas recovery efficiency for the baseline alternative (bioreactor landfill) was set at 95% rather than 100% to account for leakage.

E.1.2.3 The sum of E.1.2.1 and E.1.2.2 represents the small-scale project activity emissions:

>>

The total amount of Project Activity Emissions per year **(PEy)** is obtained through the sum of E.1.2.1 and E.1.2.2. But since E.1.2.2 is zero, PEy is equivalent to E.1.2.1

E.1.2.4 Describe the formulae used to estimate the anthropogenic emissions by sources of GHGs in the baseline using the baseline methodology for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities:

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The baseline emissions are the amount of methane from decay of the biomass content of the waste treated in the project activity. The Yearly Methane Generation Potential is calculated using the FOD Model based on the discrete time estimate method of the IPCC Guidelines as describe+ed in category AMS III.G, but adjusted to account for a bioreactor landfill, which is similar to a composting facility, than a passive landfill.

The baseline emission reduction (BE_y) for each year during the first crediting period are provided in Table E.2.

Table E.2
Baseline Emission Reductions, BE_y

Year	Emission Reductions in tCO_2e During First Crediting Period
2007	158,408
2008	270,037
2009	456,979
2010	588,715
2011	681,548
2012	746,966
2013	793,065
Total for 2007-2013	**3,695,718**

Formulae to estimate baseline emissions from biomass decay (BE_y) was provided in Section E.1.1

E.1.2.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:

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The emission reduction achieved by the project activity is 3,653,277 tCO_2e measured as the difference between the baseline emission and the sum of the project emissions and leakage.

$$ER_y = BE_y – (PE_y + Leakage_y)$$

where:

- ER_y Emission reduction in the year “y” (tCO_2e)

E.2 Table providing values obtained when applying formulae above:

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Table E.3
Project Emission due to Project Activity in CEPROS Plant

Project Equipment	Qty	Type	Power [KW]	Load factor	Average Energy per year [GWh]	Emission Factor [tCO2/GWh]	Project emissions per year [tCO2e]
Backhoe	1	diesel	89	53%	0,31	1.000	309
Electric Generator	1	diesel	56	5%	0,02	1.000	18
Electric Generator	1	diesel	224	5%	0,07	800	59
Mini Loader	1	diesel	60	53%	0,21	1.000	206
Trucks	4	diesel	686	53%	2,37	800	1.893
Chopper	1	diesel	127	53%	0,44	1.000	437
Trommel	2	electric	82	53%	0,28	1.000	283
Front Charger	4	diesel	298	53%	1,03	800	823
Primary Ventilators	60	electric	246	53%	0,85	800	679
Secondary Ventilators	6	electric	34	53%	0,12	1.300	150
Post production equipment	1	electric	60	53%	0,21	1.000	206
Feeding	1	electric	15	53%	0,05	1.400	72
Dosification	1	electric	11	53%	0,04	1.400	54
Sifting	1	electric	11	53%	0,04	1.400	54
Mixing	1	electric	11	53%	0,04	1.400	54
Packaging	1	electric	11	53%	0,04	1.400	54
TOTAL			**1.961**		**5,9**		**5.063**

Table E.4
Project Emission due to Project Activity in Quilin Plant

Project Equipment QUILIN	Qty	Type	Total Power [kW]	Load factor	Average Energy per year [GWh]	Emission Factor [tCO2/GWh]	Project emissions per year [tCO2e]
Backhoe	1	diesel	89	27%	0,08	1.300	109
Mini Loader	1	diesel	60	27%	0,06	1.300	73
Trucks	3	diesel	515	27%	0,48	800	387
Chopper	1	diesel	127	27%	0,12	1.300	155
Trommel	1	electric	41	27%	0,04	1.300	50
Front Charger	1	diesel	75	27%	0,07	1.300	91
Primary netilators	25	electric	103	27%	0,10	1.300	125
Secontadory Ventilators	2	electric	11	27%	0,01	2.400	25
TOTAL			**768**		**1,0**		**1.016**

Table E.5
Total Project Emissions, PE_y (power and transport) (tCO_2e/yr)

Years	Crediting period							
	2007	2008	2009	2010	2011	2012	2013	Total
$PE_{y, power}$	5,063	5,063	5,063	5,063	5,063	5,063	5,063	35,441
$PE_{y, power}$	1,000	1,000	1,000	1,000	1.000	1,000	1,000	7,000
$PE_{y,transp}$	0	0	0	0	0	0	0	0
Total, 2007-2013	6,063	6,063	6,063	6,063	6,063	6,063	6,063	4.520.118

SECTION F.: Environmental impacts:

F.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

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As required by legislation, an Environmental Impact Assessment (EIA) has been conducted for this project. The report has been presented to the “Comission Nacional del Medio Ambiente” (CONAMA), the authority in charge of analyzing the environmental impacts of the project. CONAMA has issued a positive resolution and granted the Agroindustrial Pullihue license for operation. All documentation can be obtained from the CONAMA website: www.seia.cl.

From a local environmental perspective, composting organic waste would reduce the pressure on sanitary landfills in Santiago, and, therefore, reduce future land requirements. In addition, the compost produced in the plant can be used in agriculture / horticulture, to rehabilitate degraded lands, and/or landscaping of gardens, parks and green spaces. Compost used in agricultural / horticultural applications will decrease the need for chemical fertilizer, which would reduce emissions from fertilizer manufacturing and nitrogen release from soil. No credit for these reductions was included in this assessment. Additionally, depending on the application, compost can be used as a substitute for the accumulated organic material of pre-mountainous forest environments (e.g. peat moss), which would aid in the conservation of this valuable ecosystem.

SECTION G. Stakeholders’ comments:

G.1. Brief description of how comments by local stakeholders have been invited and compiled:

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The environmental authority (CONAMA) oversaw a comprehensive consultation process. Public comments from a variety of stakeholders were sought over more than one. An extensive Environmental Assessment was undertaken (copy available). Endorsement from both CONAMA Regional and National CONAMA is being sought by the proponent. The proponent held several meetings with stakeholders including public workshops, meetings with local municipal council and university (the land owner) representatives, and neighbors. The World Bank reviewed the Environmental Assessment, met with affected stakeholders and requested an independent technical evaluation of the current site and proposed technology. The EA was listed on the proponent’s and CONAMA’s website fro over six months. The

World Bank also requested an Environmental management Plan as part of the EA – both documents were placed in the Bank's Infoshop and available for public review.

G.2. Summary of the comments received:

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The local community's main concerns about the new compost facility were increases in traffic and the possible odors from the composting process. Much of this resistance can be attributed to two near-by waste management facilities, a sanitary landfill and a waste water treatment plant (WWTP). The community feels that they are Santiago's 'dumping ground', so the process for the issuance of the environmental license was slower than usual. However the Mayor of the local community of Maipu is interested in exploring CF for the other two waste management facilities for improvement of their technologies and operations. There is a *credibility* issue with the community of Maipu for both the private and public sectors: the sanitary landfill operator never built the new access road that had been committed under the bidding documents, and the waste water treatment company never mitigated the odors problems. The community has been informed that in the ERPA a clause will be added to condition the annual disbursements to a third party's report, satisfactory to the Bank, to verify compliance with the environmental impacts mitigation plan as a means of social accountability and monitoring.

No public concerns were expressed on the increase of the volumes of composting at the existing site.

G.3. Report on how due account was taken of any comments received:

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Poorly operated compost sites can have local environmental impacts, mainly odor emissions. However odor reduction techniques are applied through biofilters in the aeration process, reducing significantly any odor emission.

Transportation and flow of vehicles: A traffic mitigation program, including *inter alia* enhancement of traffic signals, are part of the recommendations of the Traffic Impact Assessment carried out by certified expert as part of the preparation process

Operating Oversight: A community advisory group is being established as part of the project. They will prepare an annual public report that outlines any operating concerns with the new compost facility. The World Bank will review this report and request warranted remediation of any identified operational shortcomings. The proponent will also place on t heir website operating parameters and standard test results of odor and compost quality tests. CONAMA has required that the proponent carry out odor tests – both baseline and regular testing upon operation.

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding involved in this project.

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