**PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1**

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Methane Capture and Flaring from Addis Ababa Repi open dump fill
Version number of the PDD	04
Completion date of the PDD	06/05/2013
Project participant(s)	Addis Ababa City Administration
Host Party(ies)	Federal Democratic Republic of Ethiopia
Sectoral scope and selected methodology(ies)	Sectoral Scope: 13, Methodology: ACM0001, Version 13.0.0 - Flaring or use of landfill gas
Estimated amount of annual average GHG emission reductions	96,884 t CO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The Addis Ababa City Administration is responsible for the functioning of the currently active Repi Solid Waste Disposal Site (SWDS) located 13 km south-west of Addis Ababa City Center. Repi SWDS has been used as an unmanaged open dump since the year 1968. There is no further processing or treatment of the waste received at the site.

According to the SWRDPO[1], the amount of daily waste generation in 2010 from Addis Ababa was 1,125 tons, of which about 900 tons were collected and dumped at Repi SWDS. The largest contributor was households, accounting for about 76%, with the other 24% coming from institutions, hotels, industries, and street sweeping. According to the estimation based on data accessed from SWRDPO, the waste quantity at the site in 2010 was about 3.5 million tons with a daily addition of 900 tons.

Repi has high proportion of organic and biodegradable component in the waste. As a result, methane is uncontrollably released into the atmosphere leading to poor conditions in the local environment. There are no provisions at the landfill to either collect, treat, destruct or utilize methane.

AACA had received a soft loan from the French Development Agency to sanitarily close the landfill and implement gas ventilation systems (to vent the gas directly in the atmosphere). AACA awarded the Contract of Works for Reclamation, Gas and Leachate Collection of Koshe Repi Landfill to Ekokem Palvelu Oy on 03/05/2011. Later, AACA signed a supplementary contract agreement was signed with Ekokem on 13/03/2012 for construction of horizontal gas extraction line which was not included in the original agreement which was being funded through AFD (and hence had to be funded by AACA on its own). The contract for the flaring system (the proposed project activity) which will also be funded through AACA's internal sources (and not by AFD) is yet to be awarded.

The solid waste management project at the Repi landfill is proposed to be implemented in phases wherein Phase I involves sanitary closure of a major section of the landfill site (18 hectares) to capture and flare LFG. Under Phase II a small active portion of the site would continue to receive material until 2013 when a new landfill site 50 kilometres to the north of Addis Ababa becomes operational. The landfill site would subsequently be closed, not allowing any further dumping of material.

The project activity will encompass collection of LFG using vertical LFG collecting wells and/or horizontal LFG collection trenches, which will be interconnected through a LFG pipeline network (made of High Density Polyethylene (HDPE) pipes, manifolds and connecting parts). Through the LFG pipeline network, all collected LFG will be directed to a LFG destruction facility where all collected LFG will be combusted in enclosed high temperature flare.

In the absence of the proposed project activity (baseline scenario), the LFG would have been vented to the atmosphere without being collected or flared leading to emissions of greenhouse gases (primarily methane). The Project activity aims to reduce methane (CH_4) emissions by collection and flaring the LFG. Destruction of CH_4 in this manner is expected to result in a substantial net reduction of greenhouse gas (GHG) emissions, calculated ex-ante on a conservative basis at 968,845 tCO_2 over the fixed crediting period of ten years or an average of 96,884 tCO_2e annually during this period.

The baseline scenario and the existing scenario prior to the implementation of the proposed project activity are same since there is no collection or flaring of LFG.

[1] SWRDPO is the responsible department in the city administration for the collection and disposal of solid waste.

Contribution of the project activity to sustainable development:

In accordance with the criteria for sustainable development identified by the Ethiopian Designated National Authority (DNA), the project activity contributes to the sustainable development as follows:

1. The project activity will lead to improved air quality through capture of biogas leading to reduced odor. The flaring system will improve environmental health by destroying most of the non- CH_4 organic compounds, mainly volatile organic compounds (VOCs).

2. The project is expected to reduce the respiratory diseases as a result of which the productivity will be enhanced. The reclaimed land will also significantly contribute to the city's investment sector which will create job opportunities.

3. The project activity will use clean technology and environmental management for the first time for landfill sites in Ethiopia. This project will be the first in terms of post-closure management of landfill sites, capture and flaring of landfill gas. On successful implementation, the project will serve as an example for other landfills in the region to follow suit.

4. The project activity is in line with the efforts of the Environmental Protection Authority and the Ministry Health to catalyze carbon finance activity in Ethiopia. Further, the project activity contributes to the development of clean and healthy environment in the city.

5. The project activity will have no adverse impacts on community social structures, social heritage or social amenities. It will create short-term jobs during construction and long-term jobs during operation.

6. The project activity will reduce the risks of explosion in and around the landfill by actively capturing and destroying the LFG generated in the landfill and thus avoiding uncontrolled accumulation of LFG in the landfill.

7. The project activity will reduce emissions of greenhouse gases (methane) in the atmosphere leading to contribution in mitigation of climate change.

A.2. Location of project activity

A.2.1. Host Party(ies)

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Federal Democratic Republic of Ethiopia

A.2.2. Region/State/Province etc.

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Addis Ababa City (chartered city)

A.2.3. City/Town/Community etc.

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Addis Ababa City, Kolfe-Keranyo Sub-City, Wereda 16, Repi SWDS

A.2.4. Physical/Geographical location

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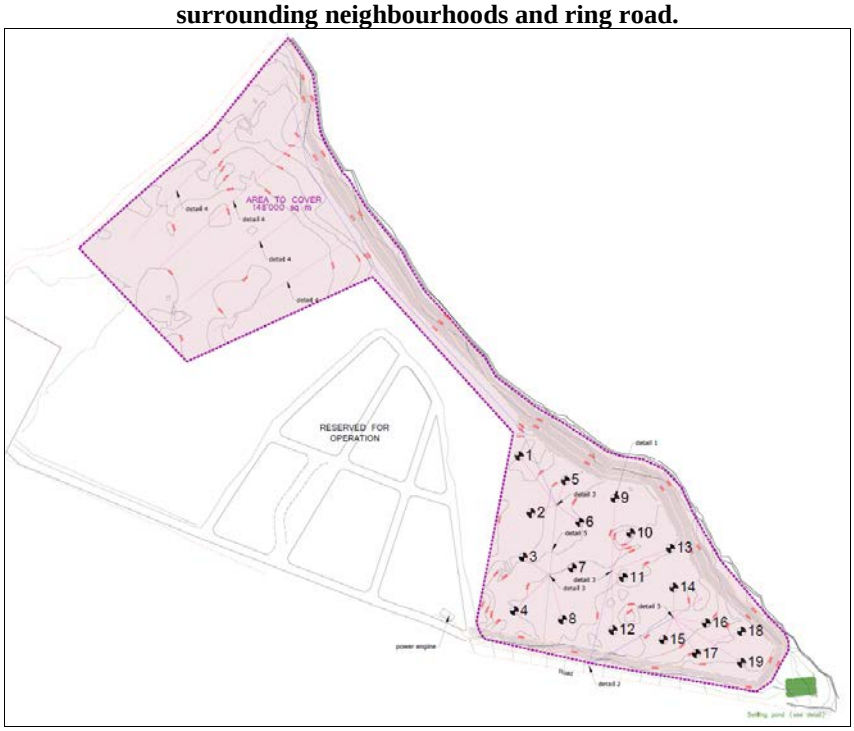
The Repi SWDS is located about 13 kms south-west of Addis Ababa City Center (De Gaulle Square, Municipality Building Complex of the City Administration of Addis Ababa), in the Kolfe-Keranyo Sub-City area. The Landfill's geographical coordinates are latitude 8° 58' 29.6754" N (or 8.9749° N) and longitude 38° 42' 43.6314" E (or 38.7121° E).

The solid waste is dumped on the fringe of Tinshu Akaki River and the dumping area covers 364,000 m^2 (or approximately 36.4 hectares). The site is on the north-eastern side of the new Addis Ababa Ring Road heading to the western parts of the City.

Map 1. (Left) Addis Ababa with Repi SWDS highlighted in orange; (right) Repi SWDS in context with surrounding neighbourhoods and ring road.



Map 2: Project site with construction plans

A.3. Technologies and/or measures

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As stated earlier, Repi SWDS has been used as an open dump receiving waste from the Addis Ababa City. In the absence of the proposed project activity (baseline scenario), the LFG would have been vented to the atmosphere without being collected or flared leading to emissions of greenhouse gases (primarily methane).

Since the existing and the baseline scenarios are same, the facilities, systems and equipment before the implementation of the project activity at the landfill site are as follows:

- 5 bulldozers, 1 new CAT, 4 old (Japan, CAT)

- 2 excavators
- 1 compactor (broken, out of use)
- 19 gas wells with safety valves (for venting)

There are no equipment to collect, treat, and utilize LFG in the landfill site prior to the proposed project. LFG would have been released into the atmosphere by several gas-guide pipelines (vertical wells) without flaring.

The proposed project activity envisages installation of a LFG collection system, a Gas pre-treatment system, a flaring system and associated monitoring equipments. The salient features and technical details of the equipment and systems are as follows:

1. LFG collection infrastructure specifications

a. Vertical Extraction Gas Wells

- Spacing: Spacing between gas wells will range from 60-120 m (200-400 ft) maximum and placed so as to capture gas from all areas to avoid leakage of LFG.
- Depth of extraction wells: The boring depth shall reach 75% of the waste thickness or to the water level. The depth of the well shall not extend to the bottom of the landfill or the liquid level.
- Boring: Long-arm excavator dug pits 1.5m in diameter.
- Extraction pipe diameter: The gas extraction HDP pipe will be 160 mm in diameter with perforations.
- Gravel pack: The back fill of the gravel shall be washed with 16-20 mm diameter or greater than the perforation of gas extraction wells.
- Size and spacing of perforation (screening): The perforation will have 13 mm diameter width.
- Cover material: The cover material will be clay soil of 50 cm thickness with porosity not less than 10-9m/sec or using acceptable level of clay soil porosity to prevent gas leakage.

b. Header pipe system

- Well heads will be built above ground level to provide simple access for adjustment and monitoring.
- Material used for well heads and pipes will be HDPE to resist corrosion.
- Well heads will be connected to collection pipe-work.

c. Collection pipe network

Connection pipes will link the gas collection wells with the treatment system station. Material for collection pipes will be HDPE. Connections will be made using flexible band seal couplings to allow for rearrangements of the collection layout. LFG collection design layout will consider:

- Gas monitoring
- Prevention of blockage and disruption by water, leachate or condensates and waste movement
- Condensate management
- Condensate collection and treatment system will be designed to accommodate the movement of seepage, runoff, and leachate and treated in a pond before the receiving river.

d. LFG treatment system

- Dewatering device will be installed upstream of the blower (before the gas reaches the flaring shaft) to reduce gas moisture content.
- Gas will be drawn through the collection pipe-work to the point of treatment. This will be achieved by incorporating a blower to generate a pressure differential.
- The blower will be composed of a single stage low pressure centrifugal blower providing at least 100 mbar of differential pressure.

e. Control systems

- The use of automated control reduces operational input and the proposed system will comprise of automated control of the flow rate of landfill gas through a butterfly valve and burner control.
- Emergency slam shut valve will be included along with flame arrester.
- All equipment will have an appropriate level of corrosion protection.

2. Technical specifications of enclosed flare for LFG

f. Enclosed combuster
-destruction efficiency: 99%
-operating temperature: 1000 - 1200 degrees C
-retention time: 0.3 sec at 1000 degrees C at 50% CH4

g. Flare combustion chamber and burners
-maximum gas flow LFG: 1500 m3/hr
-minimum gas flow LFG: 300 m3/hr
-maximum heat output: 7.5 Mkcal/hr
-minimum heat output: 1.5 Mkcal/hr
-methane content: 22 – 60%
-methane destruction efficiency: 99.9%
-resident time: 0.3 sec at 1000 degrees C at 50% CH4

h. LFG extraction blowers with variable frequency drive
-number of blowers at per set of flare system: 2 stainless steel gas boosters
-maximum capacity of each blower: 1500 m3/hr
-total differential pressure: 250 mbar at 1500 m3/hr
-inlet size: 250 mm
-outlet size: DN 250
-suction pressure at flare inlet: -80 mbar

i. Control panel
-Humane machine interface: Siemens S7 touch screen
-Siemens programmable-logic controller
-Siemens proportional, integral, derivative controller
-ABB variable frequency drivers
-data loggers
-Protego flame arrestor in main and pilot line
-Siemens motorized combustion air intake dampers
-Donkin moisture separator in gas line

j. Thermal mass flow meter
A 4-20mA output for remote flow monitoring on the control panel HMI display. The flow meter will display actual flow and total flow in m3/hr.

The operation of the project activity will consist on collecting LFG in a forced manner (with the use of blower(s)) and direct collected LFG to combustion (in high temperature flare). Such measures will enable methane contained in the LFG to be destroyed through combustion, thus promoting GHG emission reductions through abatement of methane.

The project system is expected to be equipped with all needed monitoring system which are required to measure all associated monitoring parameters (LFG mass flow, methane concentration in collected LFG,

LFG pressure, LFG temperature, etc.) in order to meet not only the requirements of the baseline and monitoring methodology ACM0001 (version 13.0.0) and applicable methodological tools (which the CDM baseline and monitoring methodology refers to), but also for meeting applicable safety and operational requirements.

The electricity demand will be met through the existing grid connection at the landfill site.

The project involves technology transfer since the equipment required for implementation of the proposed project activity will be purchased from a reputed international supplier. This will ensure that an environmentally safe and sound technology is implemented and local staff is sufficiently trained.

The expected operational lifetime for the LFG flaring system is 20 years. No technology substitution is expected to occur during the crediting period if adequate maintenance service is executed and if project's equipment operates under conditions in accordance with recommendations and technical requirements as established by the equipment manufacturers.

A.4. Parties and project participants

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Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Federal Democratic Republic of Ethiopia (Host country)	Addis Ababa City Administration (public entity)	No

A.5. Public funding of project activity

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The LFG collection and flaring system is not being funded by international public funding and only through AACA's internal accruals. The closure of Koshe Repi Landfill is however financed by a grant from Agence Française de Développement.

The City Government of Addis Ababa provided a letter of confirmation that the funding for methane capture and flaring installations for the Repi CDM project is not a diversion of Official Development Aid and is not a diversion of the "Solid Waste Management Project" grant from Agence Française de Développement for the "PHASE I – Closure of Koshe Repi Landfill".

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

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Title of approved consolidated baseline and monitoring methodology: "Flaring or use of landfill gas"

Reference: ACM0001, Version 13.0.0 (EB 67), Sectoral scope: 13

It has been referred from the list of approved methodologies for CDM project activities in the UNFCCC CDM website (http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html).

The approved methodology also draws upon:

- "Emissions from solid waste disposal sites" Version 06.0.1 (EB 66, Annex 46)[2]
- "Combined tool to identify the baseline scenario and demonstrate additionality" Version 05.0.0 (EB 70, Annex 9)[3]
- "Project emissions from flaring" Version 02.0.0 (EB 68, Annex 15)[4]
- "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" Version 01.0.0 (EB 39, Annex 7)[5]
- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" Version 02.0.0 (EB 41 Annex 11, 2nd August 2008)[6]
- "Tool to determine the remaining lifetime of equipment" Version 01.0.0 (EB 50, Annex 15)[7]
- "Tool to determine the baseline efficiency of thermal or electric energy generation systems" Version 01.0.0 (EB 48, Annex 12)[8]
- "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" Version 02.0.0 (EB 61, Annex 11)[9]

B.2. Applicability of methodology

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This methodology is applicable to project activities which:

(a) Install a new LFG capture system in a new or existing SWDS; or

✓ The project activity involves installation of a new LFG capture system in an existing SWDS. Hence, the applicability criterion is satisfied.

(b) Make an investment into an existing LFG capture system to increase the recovery rate or change the use of the captured LFG, provided that:

(i) The captured LFG was vented or flared and not used prior to the implementation of the project activity; and

[2] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v6.0.1.pdf
[3] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v5.0.0.pdf
[4] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v2.0.pdf
[5] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf
[6] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf
[7] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-10-v1.pdf
[8] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-09-v1.pdf
[9] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v2.0.0.pdf

(ii) In the case of an existing active LFG capture system for which the amount of LFG cannot be collected separately from the project system after the implementation of the project activity and its efficiency is not impacted on by the project system: historical data on the amount of LFG capture and flared is available.

✓ The project activity envisages implementation of a new LFG capture system at an existing landfill where there was no provision of LFG capture earlier. Hence, this applicability criterion is not applicable.

(c) Flare the LFG and/or use the captured LFG in any (combination) of the following ways:

(i) Generating electricity;

(ii) Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace; and/or

(iii) Supplying the LFG to consumers through a natural gas distribution network.

✓ The project activity envisages flaring of the captured LFG. Hence, the applicability criterion is satisfied.

(d) Do not reduce the amount of organic waste that would be recycled in the absence of the project activity.

✓ There was no provision of recycling of organic waste at the landfill. There are a few recycling units in Addis Ababa which continue to operate without being affected by the project activity since their source of organic waste is altogether different which was neither diverted earlier nor will be diverted to the landfill post implementation. Hence, the applicability criterion is satisfied.

The methodology is only applicable if the application of the procedure to identify the baseline scenario confirms that the most plausible baseline scenario is:

(a) Release of LFG from the SWDS; and

(b) In the case that the LFG is used in the project activity for generating electricity and/or generating heat in a boiler, air heater, glass melting furnace or kiln;

(i) For electricity generation: that electricity would be generated in the grid or in captive fossil fuel fired power plants; and/or

(ii) For heat generation: that heat would be generated using fossil fuels in equipment located within the project boundary.

✓ The "Combined tool to identify the baseline scenario and demonstrate additionality" Version 05.0.0 applied in section B.4 concludes that the most plausible baseline scenario for the project activity is the release of LFG from the SWDS. Hence, the applicability criterion is satisfied.

This methodology is not applicable:

(a) In combination with other approved methodologies. For instance, ACM0001 cannot be used to claim emission reductions for the displacement of fossil fuels in a kiln or glass melting furnace, where the purpose of the CDM project activity is to implement energy efficiency measures at a kiln or glass melting furnace;

✓ ACM0001 Version 13.0.0 is the only methodology that has been applied in the project activity. Hence, the applicability criterion is satisfied.

(b) If the management of the SWDS in the project activity is deliberately changed during the crediting in order to increase methane generation compared to the situation prior to the implementation of the project activity.

✓ Repi landfill has been operating as an open dump solid waste disposal site without any provision for capture of LFG. The project activity is being implemented in phases wherein Phase I involves sanitary closure of a major section of the landfill site to capture and flare LFG. Under Phase II a small active portion of the site would continue to receive material until 2013 when a new landfill site 50 kilometres to the north of Addis Ababa becomes operational. The landfill site would subsequently be closed, not allowing any further dumping of material. Hence, after Phase II there would be no possibility of increase in methane generation at the site compared to the situation prior to implementation of the project activity. Further, the project proponent confirms that there will be no change in management of SWDS as compared to the baseline situation in order to increase methane generation. Hence, the applicability criterion is satisfied.

B.3. Project boundary

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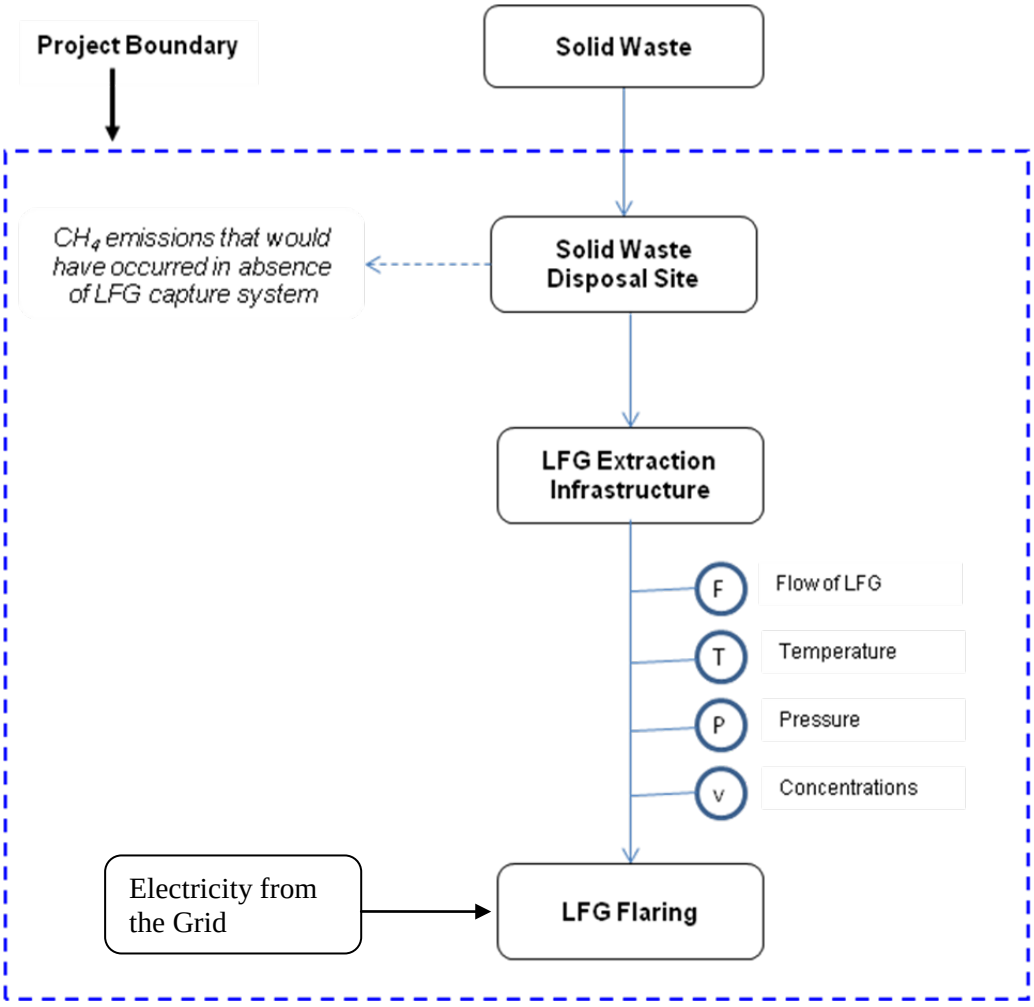
According to ACM0001 Version 13.0.0 the project boundary of the project activity includes the site where the LFG is captured and flared. The same has been shown below:



A summary of the greenhouse gases and sources included in and excluded from the project boundary is provided below:

Source		GHGs	Included?	Justification / Explanation
Baseline scenario	Emissions from decomposition of waste at the SWDS site	CO_2	No	CO_2 emissions from decomposition of organic waste are not accounted since the CO_2 is also released under the project activity.
		CH_4	Yes	This is a major source of emissions in the baseline scenario.
		N_2O	No	N_2O emissions are small compared to CH_4 emissions from SWDS.
	Emissions from electricity generation	CO_2	No	There is no power generation included in the project activity.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Emissions from heat generation	CO_2	No	There is no heat generation included in the project activity.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Emissions from the use of natural gas	CO_2	No	Excluded for simplification.
		CH_4	No	There is no involvement of supply of LFG through natural gas distribution network in the project activity.
		N_2O	No	Excluded for simplification.
Project scenario	Emissions from fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity	CO_2	No	There are no emissions from fossil fuel consumption in the project activity.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small
	Emissions from electricity consumption due to the project activity	CO_2	Yes	Certain equipments like the electric motors will consume electricity which will be supplied by the grid
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small

B.4. Establishment and description of baseline scenario

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There are currently no landfill gas collection systems installed anywhere in the country. Originally, the Addis Ababa landfill site was envisaged to be closed once it was filled to capacity, with the landfill gas vented out into the atmosphere through ventilation systems. Thus, the approved design of the landfill included only LFG ventilation system without any provision for collection. There are no approved plans for methane collection from existing landfill sites in other municipalities in the region either. However, the AACA has, taking CDM revenue into consideration, decided to install LFG collection and flaring system to avoid emissions of methane into the atmosphere.

In accordance with the approved consolidated baseline methodology ACM0001, Version 13 (EB 67), the "Combined tool to identify the baseline scenario and demonstrate additionality", Version 5.0 (EB 70) is being used to establish the baseline scenario as follows:

Step 0: Demonstration whether the proposed project activity is the First-of-its-kind

According to the "Guideline on additionality of first of its kind project activities", Version 02 (EB 69, Annex 7), a proposed project activity is the First-of-its-kind in the applicable geographical area if:

(a) The project is the first in the applicable geographical area that applies a technology that is different from technologies that are implemented by any other project, which are able to deliver the same output and have started commercial operation in the applicable geographical area before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of the proposed project activity, whichever is earlier;
(b) The project implements one or more of the measures;
(c) Project participants selected a crediting period for the project activity that is a maximum of 10 years with no option of renewal;

A step by step demonstration of the project activity being the First-of-its-kind using the guideline is presented below:

***1. Applicable geographical area** should be the entire host country. If the project participants opt to limit the applicable geographical area to a specific geographical area (such as province, region, etc.) within the host country, then they shall provide justification on the essential distinction between the identified specific geographical area and rest of the host country.*

As Ethiopia went through decentralization in the past twenty years, municipalities have increasingly been responsible for managing solid waste operation and landfills. Even though decentralization has given municipalities more autonomy, it has also created a constraint as many have to raise their budget internally from taxes or other means[10]. This presents a unique challenge for the municipalities in Ethiopia.

The economic development, in addition to high rate of urbanization and population growth, has put a constraint on municipalities in delivering essential services. Lack of manpower and technical skill remain to be the most important bottleneck in addressing solid waste collection and landfill management in the country. While the current decentralized system allows local administrations to be more accountable to citizens and be informed about the needs of the communities, local administrations are also poorly equipped to establish, manage and/or monitor solid waste collection and landfills[11].

Productivity levels in the Ethiopian economy remain very low when compared with almost all peer groups. Ethiopia has attracted relatively little FDI, and reform has stagnated. Ethiopian products remain uncompetitive in international markets[12]. The limited progress in raising productivity has contributed to Ethiopia's current macroeconomic challenges, in particular the

[10] Ethiopia Solid Waste & Landfill [Country Profile and Action Plan], Community Development Research through funding from the Global Methane Initiative
[11] Ethiopia Solid Waste & Landfill [Country Profile and Action Plan], Community Development Research through funding from the Global Methane Initiative
[12] Toward the Competitive Frontier: Strategies for Improving Ethiopia's Investment Climate June 2009, Finance and Private Sector Development Africa Region, World Bank

poor supply response to incentives and infrastructure spending, and the growing shortfall between imports and exports. Access to finance remains a significant constraint in the country.

Given the unique circumstances and distinct investment climate of Ethiopia, technology adoption capability of Ethiopia cannot be compared with other African countries. Thus, the applicable geographical area for this analysis has been kept as the default i.e. Ethiopia.

2. *Measure (for emission reduction activities) (for emission reduction activities) is a broad class of greenhouse gas emission reduction activities possessing common features. Four types of measures are currently covered in the framework:*

a. Fuel and feedstock switch (example: switch from naphtha to natural gas for energy generation, or switch from limestone to gypsum in cement clinker production);

b. Switch of technology with or without change of energy source including energy efficiency improvement as well as use of renewable energies (example: energy efficiency improvements, power generation based on renewable energy);

c. Methane destruction (example: landfill gas flaring);

d. *Methane formation avoidance (example: use of biomass that would have been left to decay in a solid waste disposal site resulting in the formation and emission of methane, for energy generation).*

The project entails reduction in GHG emissions by methane destruction through flaring. Thus, this criterion is satisfied.

3. *The project is the first in the applicable geographical area that applies a technology that is different from any other technologies able to deliver the same output and that have started commercial operation in the applicable geographical area before the start date of the project.*

Currently, there are no landfill gas collection and flaring systems installed anywhere in the geographical boundary of analysis i.e. Ethiopia[13]. Thus, this criterion is satisfied.

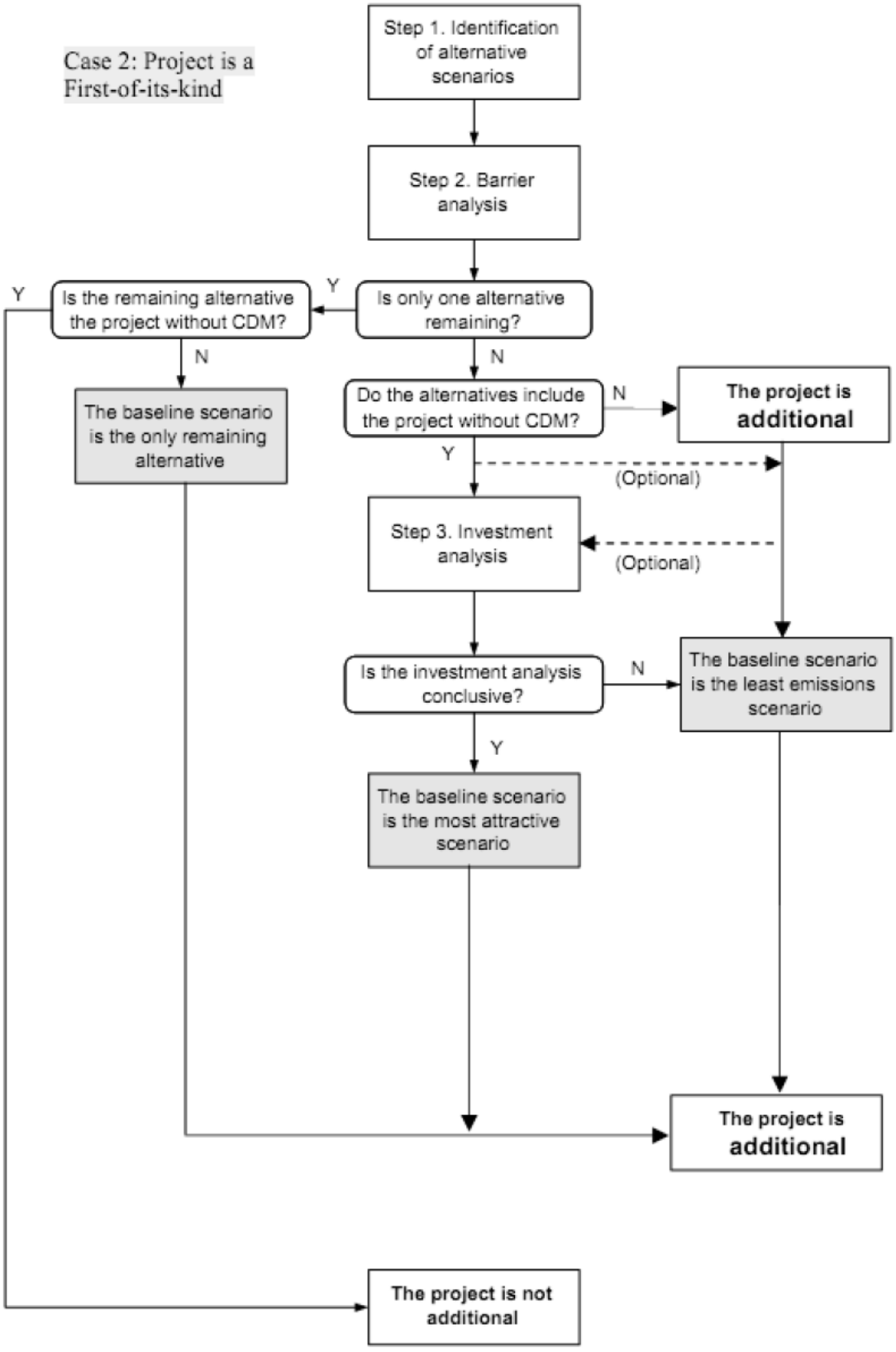
4. *Project participants selected a crediting period for the project activity that is a maximum of 10 years with no option of renewal"*

Fixed crediting period of 10 years has been chosen for the project activity. Hence, this criterion is satisfied.

The guidance further mentions that a proposed project activity that is identified as the First-of-its-kind project activity is additional. As demonstrated in this section, the project activity under consideration is the first-of-its kind, and hence is additional.

Outcome of step 0: The proposed project activity is the First-of-its-kind. Hence, case 2 of the "Combined tool to identify the baseline scenario and demonstrate additionality" (Version 05.0) is being referred.

13 http://www.globalmethane.org/activities/actActivityDetailsForLandfill.aspx?myObjId=a07G000000PMKkVIAX&mySiteObjId=a09A0000004vICIIA2



Step 1: Identification of alternative scenarios
Step 1a: Define alternative scenarios to the proposed CDM project activity

The methodology ACM0001, Version 13.0 specifies that in applying Step 1 of the combined tool, baseline alternatives for the destruction of LFG, shall take into consideration , inter alia, the following alternatives:

- *LFG1: The project activity implemented without being registered as a CDM project activity (i.e. capture and flaring or use of LFG);*
  This alternative faces prohibitive barriers, including investment barrier as highlighted in the next step. However, it has been retained as a plausible alternative for step 1.

- *LFG2: Atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, or to address safety and odour concerns;*
  The atmospheric release of LFG is a plausible baseline scenario. However, there are no regulations currently in the host country mandating the capture of LFG and its destruction through flaring. Further, there are no contractual requirements necessitating the same either. The project proponent is not implementing the project to address safety and odour concerns but to reduce GHG emissions (methane) into the atmosphere which contribute to climate change.

  This alternative also represents the existing situation in the landfill which is an open dump solid waste disposal site (SWDS) without collection, treatment, destruction or utilization of LFG with LFG from the site being directly discharged into the atmosphere.

- *LFG3: LFG is partially not generated because part of the organic fraction of the solid waste is recycled and not disposed in the SWDS;*
  No part of the organic fraction of the solid waste is being recycled at the Repi landfill; the entire quantum of waste that reached the landfill is being disposed. Hence, this is not a plausible baseline alternative.

- *LFG4: LFG is partially not generated because part of the organic fraction of the solid waste is treated aerobically and not disposed in the SWDS;*
  No part of the organic fraction of the solid waste is being treated aerobically, the entire quantum is being disposed in the landfill. Hence, this is not a plausible baseline alternative.

- *LFG5: LFG is partially not generated because part of the organic fraction of the solid waste is incinerated and not disposed in the SWDS.*
  No part of the organic fraction of the solid waste is being incinerated, the entire quantum is being disposed in the landfill. Hence, this is not a plausible baseline alternative.

The methodology states that in addition to the alternative baseline scenarios identified for the destruction of LFG, alternative scenarios for the use of LFG shall also be identified, however considering that LFG utilization is not an aspect of the project activity, the same is not being considered.

Outcome of Step 1a: As described above, plausible alternative scenarios for the Project are LFG1 and LFG2.

Step 1b: Consistency with mandatory applicable laws and regulations

Considering that there are no regulations governing flaring and/or combustion of landfill gas in Ethiopia, both the scenarios are not in conflict with any mandatory applicable legal and regulatory requirements. Moreover, there is no legal requirement in Ethiopia which compels to implement either of the two alternatives.

Outcome of Step 1b: Both plausible alternative scenarios i.e. LFG1 and LFG2 are in compliance with mandatory legislation and regulations.

Step 2: Barrier analysis

Step 2a: Identify barriers that would prevent the implementation of alternative scenarios

Guideline 7 of the "Guidelines for Objective Demonstration and Assessment of Barriers" (Version 01) states that *"for projects in Least Developed Countries it is sufficient to transparently describe the relevant barriers, as less stringency is needed with regards to data availability in the actual demonstration of barrier, as compared to the projects in other countries. Projects in Least Developed Countries are not bound by the provisions in this guideline and may use other approaches that are more adapted to the local circumstances".* The rationale provided for this guidance is that Projects in Least Developed Countries can be assumed in general to face significant barriers to their implementation. At the same time, data availability in these countries is considerably limited which complicates the demonstration of additionality.

The barriers identified for the proposed project activity are as follows:

a. Investment barriers

Capital for the implementation of this project activity is not adequately available due to a number of reasons:

- *No private capital is available from domestic or international capital markets due to real or perceived risks associated with investment in the country where the proposed CDM project activity is to be implemented, as demonstrated by the credit rating of the country or other country investments reports of reputed origin* – Euler Hermes Group, a leading global provider of trade related credit insurance solutions in its review of the country (Ethiopia) has given it a country risk grade "D" meaning highest risk[14]. The rating is based on an assessment of political stability, economic stability and structural business environment which are all at a high risk in the country. Many of the reputed credit risk rating agencies like Standard & Poor and Moody's etc. do not even provide a rating for Ethiopia in lieu of its dependence on foreign aid rather than foreign direct investment.

- Poor private sector involvement in the sector: Most of the waste in the country is administered by the government with no or little involvement of private sector[15]. Moreover, the development of the private sector in general is hampered by lack of skills and capital, weak investment climate and structural constrains such as market size and geography. Given this background, the proposed project, which does not provide financial incentive, would be impossible to fund through private sector capital.

- Poverty: In Ethiopia, where basic necessities are a struggle for a large part of the population, a project activity that generates no income and provides no additional benefit apart from GHG mitigation, cannot be considered feasible without additional funding. Ethiopia is one of the world's poorest countries (US 344.6 GDP in 2009)[16] per capita and classified as 'low income'.

[14] http://www.eulerhermes-aktuell.de/de/dokumente/country-review-ethiopia-20090821.pdf/country-review-ethiopia-20090821.pdf
[15] http://www.krepublishers.com/02-Journals/JHE/JHE-33-0-000-11-Web/JHE-33-3-000-11-Abst-PDF/JHE-33-3-179-11-2145-Regassa-N/JHE-33-3-179-11-2145-Regassa-N-Tt.pdf
[16] http://data.un.org/CountryProfile.aspx?crName=Ethiopia

Majority of the population lives in absolute poverty. The government has become increasingly dependent on aid in supporting its economic activities. Ethiopia remains a major recipient of foreign humanitarian aid in Africa[17] and majority of the Government's direct budget relies on it. A major portion of the population is engaged in subsistence farming and periodic famines remain a severe constraint on per capita GDP growth. Acute food shortages caused by drought is the most protracted economic problem and devastates a large portion of the Ethiopian population. Rural communities plagued with crop failures, pests, and extensive livestock losses and become dependent on international food assistance.

b. Technological barriers

Landfill gas capture technology is currently unavailable indigenously in the country, and will need to be imported. Given that the technology is to be implemented in the country for the first time, skilled and/or properly trained labour to operate and maintain the technology are not available. This will necessitate the investment of additional capital in training of manpower to construct and operate the facility.

The appropriate technology, although available in the other countries, will need to be localized and adapted to Ethiopia (with respect to local environment, variations in waste composition etc.). There is a need for demonstration of the technology to confirm its appropriateness and acceptability. Transfer of the technical knowhow including training of the manpower is a necessary element towards achieving this objective. Thus, the technology requires financial support for its demonstration and success and this project activity intends to achieve this objective with support from CDM.

Outcome of Step2: Given that the alternative scenario LFG1 is prevented by the identified barriers, it can be eliminated from further consideration. However, Step 3, investment analysis has also been demonstrated to strengthen the additionality argument.

Step 3: Investment analysis

Since the CDM project activity and the alternatives identified in Step1 generate no financial or economic benefits other than CDM related income, simple cost analysis can be applied for demonstrating financial additionality.

The purpose of this step is to demonstrate that there is at least one alternative which is less costly than the Project Activity. The cost of alternative LFG2 (atmospheric release of the LFG without capture and flaring) is null. The costs of alternative LFG1 (project activity undertaken without being registered as a CDM project) would incur a high front-end capital investment, future investments throughout the project's lifetime and annual operational costs. Further in the LFG1 scenario, no revenues are generated by the project. Therefore, it is not likely to be implemented.

The front-end capital investments required for the implementation of the project activity are broadly classified as follows:

Date	Expense	Source of funds	Amount (ETB)
13 March 2012	Supplementary works agreement for landfill gas capture, between EKOKEM and AACA	AACA self-finance to EKOKEM	6,804,421
(expected) September 2012	Purchase of flaring and monitoring equipment for CDM	AACA self-finance	3,181,856 (estimated)

[17] http://www.globalhumanitarianassistance.org/reports

		Total (ETB)	9,986,277

Outcome of Step 3: LFG2 is the only likely alternative and is thus identified as the baseline.

Step 4: Common practice analysis

If the proposed project activity is the First-of-its-kind then this step is not applicable. Hence, common practice analysis is not being undertaken.

Outcome of Step 4: Since the proposed project activity is first-of-its-kind and not regarded as common practice, hence the proposed project activity is additional.

B.5. Demonstration of additionality

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The project activity has already been demonstrated as being additional in step B.4. Hence in accordance with the "Guidelines for Completing the Project Design Document Form", Version 1.0, EB 66, the same information need not be replicated in both sections.

Since the start date of the proposed project activity is prior to the date of publication of the PDD for the global stakeholder consultation, the project participants had submitted the duly filled 'prior consideration of CDM form' dated 04/10/2010 to the UNFCCC secretariat as well as the host country DNA. A brief timeline of events demonstrating action towards securing CDM status vis a vis project implementation is provided below:

S. No.	Date	Event
1	25/01/2010	Preliminary Environmental and Social Impact Study submitted by Pyory to Addis Ababa City Administration for the closure of the landfill
2	04/10/2010	Prior consideration of CDM form filled and submitted to UNFCCC and Ethiopian DNA
3	27/10/2010	Date of receiving of the prior consideration of CDM at the UNFCCC (as mentioned on the website)
4	05/11/2010	No objection letter from the Federal Environmental Protection Agency (The DNA of Ethiopia)
5	03/05/2011	AACA and Ekokem sign Contract of Works for Reclamation, Gas venting and Leachate Collection of Koshe Repi Landfill
6	08/12/2011	Local Stakeholder Consultation public hearing held for Repi
7	13/03/2012	AACA signs supplementary contract with Ekokem for landfill gas collection
8	06/11/2012	Host country approval from the Environment Protection Authority

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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Baseline emissions

According to ACM0001 Version 13.0.0, the baseline emissions are determined according to equation 1 of the methodology which is as follows:

$$BE_y = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y}$$

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2e/yr)
$BE_{CH4,y}$	=	Baseline emissions of methane from the SWDS in year *y* (t CO_2e/yr)
$BE_{EC,y}$	=	Baseline emissions associated with electricity generation in year *y* (t CO_2/yr)
$BE_{HG,y}$	=	Baseline emissions associated with heat generation in year *y* (t CO_2/yr)
$BE_{NG,y}$	=	Baseline emissions associated with natural gas use in year *y* (t CO_2/yr)

The project activity does not involve electricity generation, heat generation or use of natural gas.

Therefore, $BE_{EC,y} = BE_{HG,y} = BE_{NG,y} = 0$.

The baseline emissions of methane from the SWDS are determined as per equation 2 of ACM0001 Version 13.0.0 which is as follows:

$$BE_{CH4,y} = (1 - OX_{top\_layer}) \times (F_{CH4,PJ,y} - F_{CH4,BL,y}) \times GWP_{CH4}$$

Where:

$BE_{CH4,y}$	=	Baseline emissions of LFG from the SWDS in year *y* (t CO_2e/yr)
OX_{top_layer}	=	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless)
$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$F_{CH4,BL,y}$	=	Amount of methane in the LFG that would be flared in the baseline in year *y* (t CH_4/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

Since there is no requirement to destroy methane in Ethiopia and there is no existing LFG capture system on site, according to Case 1, Table 2 of ACM 0001, Ver 13.0, $F_{CH4,BL,y} = 0$.

Ex-post determination of $F_{CH4,PJ,y}$

The amount of methane in the LFG which is flared and/or used in the project activity in year *y* ($F_{CH4,PJ,y}$) is determined as per equation 3 of ACM0001 Version 13.0.0 which is as follows:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} + F_{CH4,HG,y} + F_{CH4,NG,y}$$

Where:

$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year *y* (t CH_4/yr)
$F_{CH4,EL,y}$	=	Amount of methane in the LFG which is used for electricity generation in year *y* (t CH_4/yr)
$F_{CH4,HG,y}$	=	Amount of methane in the LFG which is used for heat generation in year *y* (t CH_4/yr)
$F_{CH4,NG,y}$	=	Amount of methane in the LFG which is sent to the natural gas distribution network in year *y* (t CH_4/yr)

Since the project activity does not involve electricity generation, heat generation or use of natural gas, $F_{CH4,EL,y} = F_{CH4,HG,y} = F_{CH4,NG,y} = 0$.

$F_{CH4,flared,y}$ is determined as per equation 4 of ACM0001 Version 13.0.0 which is as follows:

$$F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - \frac{PE_{flare,y}}{GWP_{CH4}}$$

Where:

$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year *y* (t CH_4/yr)
$F_{CH4,sent\ flare,y}$	=	Amount of methane in the LFG which is sent to the flare in year *y* (t CH_4/yr)
$PE_{flare,y}$	=	Project emissions from flaring of the residual gas stream in year *y* (t CO_2e/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

$F_{CH4,sent\_flare,y}$ is determined directly using option A (equation 5 and 6) of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" Version 2.0.0 as follows:

$$F_{CH4,m} = V_{m,db} * v_{CH4,m,db} * \rho_{CH4,m}$$

with

$$\rho_{CH4,m} = \frac{P_m * MM_{CH4}}{R_u * T_m}$$

Where:

$F_{CH4,m}$	=	Mass flow of methane in the residual gaseous stream in the minute *m* (kg CH_4/min)
$V_{m,db}$	=	Volumetric flow of the residual gaseous stream in the minute *m* on a dry basis (m^3 dry gas/min)
$v_{CH4,m,db}$	=	Volumetric fraction of methane in residual gaseous stream in the minute *m* on a dry basis (m^3 CH_4/m^3 dry gas)
$\rho_{CH4,m}$	=	Density of methane in the residual gaseous stream in minute *m* (kg gas *i*/m^3 gas *i*)
P_m	=	Absolute pressure of the residual gaseous stream in minute *m* (Pa)
MM_{CH4}	=	Molecular mass of CH_4 (kg/kmol)
R_u	=	Universal ideal gases constant (Pa.m^3/kmol.K)
T_m	=	Temperature of the gaseous stream in minute *m* (K)

The ex-post demonstration that the gaseous stream is dry would be done by measuring the temperature of the gaseous stream (T_t) and showing that it is less than 60°C (333.15 K) at the flow measurement point.

$PE_{flare,y}$ is determined using the methodological tool "Project emissions from flaring" Version 2.0.0 as follows:

Mass flow of methane in the residual gaseous stream in the minute *m* ($F_{CH4,m}$) is determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" Version 2.0.0 as explained above.

Since the project activity would involve enclosed flares, the flare efficiency for minute m ($\eta_{flare,m}$) shall be determined as per Option A - Default value for flare efficiency, under Step 2 of methodological tool "Project emissions from flaring".

The flare efficiency for the minute m ($\eta_{flare,m}$) would be 90% when the following two conditions are met to demonstrate that the flare is operating:

(1) The temperature of the flare ($T_{EG.m}$) and the flow rate of the residual gas to the flare ($F_{RG,m}$) is within the manufacturer's specification for the flare ($SPEC_{flare}$) in minute m; and
(2) The flame is detected in minute m ($Flame_m$).

Otherwise $\eta_{flare,m}$ is 0%.

Thus, project emissions from *i*th flare are calculated as:

$$PE_{flare,i,y} = GWP_{CH4} \times \sum_{m=1}^{525600} F_{CH4,i,RG,m} \times (1 - \eta_{flare,i,m}) \times 10^{-3}$$

Where:

$PE_{flare,i,y}$	=	Project emissions from flaring of the residual gas from *i*th flare in year *y* (tCO_2e)
GWP_{CH4}	=	Global warming potential of methane valid for the commitment period (tCO_2e/tCH_4)
$F_{CH4,i,RG,m}$	=	Mass flow of methane in the residual gas of *i*th flare in the minute *m* (kg)
$\eta_{flare,i,m}$	=	Flare efficiency of *i*th flare in minute m

$$PE_{flare,y} = \sum_{i=1}^{n} PE_{flare,i,y}$$

Where:

$PE_{flare,y}$	=	Project emissions from flaring of the residual gas from all flares in year *y* (tCO_2e)
$PE_{flare,i,y}$	=	Project emissions from flaring of the residual gas from *i*th flare in year *y* (tCO_2e)

Ex ante estimation of $F_{CH4,PJ,y}$

The *ex ante* estimate of $F_{CH4,PJ,y}$ is done using equation 5 of ACM0001 Version 13.0.0 which is as follows:

$$F_{CH4,PJ,y} = \eta_{PJ} \times BE_{CH4,SWDS,y} / GWP_{CH4}$$

Where:

$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$BE_{CH4,SWDS,y}$	=	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* (t CO_2e/yr)
η_{PJ}	=	Efficiency of the LFG capture system that will be installed in the project activity
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

$BE_{CH4,SWDS,y}$ is determined using the methodological tool "Emissions from solid waste disposal sites" Version 06.0.1 as follows:

Since, the amount of methane generated from disposal of waste at the SWDS is calculated for year *y*, equation 1 of the tool is used which is as follows:

$$BE_{CH4,y} = \varphi_y \cdot (1 - f_y) \cdot GWP_{CH4} \cdot (1 - OX) \cdot \frac{16}{12} \cdot F \cdot DOC_{f,y} \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot (1 - e^{-k_j})$$

Where:

$BE_{CH4,SWDS,y}$	=	Baseline, project or leakage methane emissions occurring in year *y* generated from waste disposal at a SWDS during a time period ending in year *y* (t CO_2e / yr)
X	=	Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period (*x* = 1) to year *y* (*x* = *y*).
Y	=	Year of the crediting period for which methane emissions are calculated (*y* is a consecutive period of 12 months)
$DOC_{f,y}$	=	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year *y* (weight fraction)
$W_{j,x}$	=	Amount of solid waste type *j* disposed or prevented from disposal in the SWDS in the year *x* (t)

φ_y	=	Model correction factor to account for model uncertainties for year *y*
f_y	=	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year *y*
GWP_{CH4}	=	Global Warming Potential of methane
OX	=	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
F	=	Fraction of methane in the SWDS gas (volume fraction)
MCF_y	=	Methane correction factor for year *y*
DOC_j	=	Fraction of degradable organic carbon in the waste type *j* (weight fraction)
k_j	=	Decay rate for the waste type *j* (1 / yr)
J	=	Type of residual waste or types of waste in the MSW

According to ACM0001 Version 13.0.0:

- f_y is assigned a value of 0 because the amount of LFG that would have been captured and destroyed is already accounted for in equation 2 of the methodology
- *x* begins with the year that the SWDS started receiving wastes (1968 in case of project activity)
- The oxidation effect (OX) has already been accounted for in equation 2 of the methodology
- kj is determined using table 5 of Methodological tool "Emissions from solid waste disposal sites" Version 06.0.1. Since the average temperature at the landfill site is 16.3°C (average of maximum and minimum temperature) and the ratio between mean annual precipitation and potential evapo-transpiration > 1 (referred from the Environment and Social Impact Study), the values are for Boreal and Temperate (mean annual temperature ≤ 20°C) and (ratio between the mean annual precipitation and the potential evapo-transpiration > 1) have been used.
- Sampling to determine the fractions of different waste types is not necessary because the waste composition can be obtained from previous studies.

The model correction factor (φ_y) is determined using the Option 1 i.e. use of the default value.

The amounts of waste types j disposed in the SWDS ($W_{j,x}$) have been determined using application A i.e. based on information from the SWDS owner and administration and from interviews with senior employees.

The fraction of DOC that decomposes in the SWDS ($DOC_{f,y}$) has been determined using Application A i.e. default value.

The methane correction factor (MCF_y) is determined using Application A i.e. default value.

Project emissions

According to ACM0001 Version 13.0.0, the project emissions are calculated using equation 22 of the methodology which is as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y}$$

Where:

PE_y	=	Project emissions in year *y* (t CO_2/yr)
$PE_{EC,y}$	=	Emissions from consumption of electricity due to the project activity in year *y* (t CO_2/yr)
$PE_{FC,y}$	=	Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year *y* (t CO_2/yr)

Some of the equipment implemented as a part of the project activity (such as motors) will require electricity for their operation. The project emissions due to consumption of electricity due to the project activity **($PE_{EC,y}$)** will be calculated using the "Tool to calculate baseline, project and/or leakage

emissions from electricity consumption" Version 1.0 (EB 39, Annex 7) and will be monitored ex-post as per the monitoring plan.

The project activity will meet its electricity requirements from the national electricity grid. There is an existing DG set on the landfill which caters to the electricity requirement of the transfer stations and is not proposed to supply electricity to the project activity owing to transmission constraints and higher cost of generation. Thus in accordance with the tool, **Scenario A** is applicable i.e."***Electricity consumption from the grid.*** *The electricity is purchased from the grid only. Either no captive power plant is installed at the site of electricity consumption or, if any on-site captive power plant exits, it is not operating or it can physically not provide electricity to the source of electricity consumption"*.

The tool specifies a generic approach to estimate project emissions from consumption of electricity which is calculated based on the quantity of electricity consumed, an emission factor for electricity generation and a factor to account for transmission losses, as follows (Equation 1) :

$$PE_{EC,y} = \sum_{j} EC_{PJ,y} \times EF_{EL,y} \times (1 + TDL_{y})$$

Where,

$PE_{EC,y}$	Project emissions from electricity consumption in year *y* (tCO_2/yr)
$EC_{PJ,y}$	Quantity of electricity consumed by the project from grid in year *y* (MWh/yr)
$EF_{EL,y}$	Emission factor for electricity generation from grid in year *y* (tCO_2/MWh)
TDL_y	Average technical transmission and distribution losses for providing electricity from grid in year *y*

The emission factor of electricity generation source ($EF_{EL,j,y}$) for 'Scenario A: Electricity consumption from the grid' can be estimated from one of the following two options prescribed by the tool:

Option A1: Calculate the combined margin emission factor of the applicable electricity system, using the procedures in the latest approved version of the "Tool to calculate the emission factor for an electricity system" ($EF_{EL,j/k/l,y} = EF_{grid,CM,y}$).

Being a Least Developing Country (LDC), recent reliable data for calculation of combined margin emission factor of the grid in accordance with the "Tool to calculate the emission factor for an electricity system" is not available. However, through the following sources, it can be observed that the grid emission factor for Ethiopia is significantly low:

- Calculation of the Combined margin emission factor of Ethiopia´s electric power system according the UNFCCC Methodological tool "Tool to calculate the emission factor for an electricity system" Version 1, Federal Ministry of Agriculture, Forestry, Environment and Water Management, Vienna[18] Page 34 states the grid emission factor for Ethiopia was 0.00591 tCO_2/MWh for 2007.
- CO_2 Emissions from fuel combustion - Highlights, 2012 Edition, International Energy Agency[19], Page 112 states the grid emission factor for Ethiopia was 0.007 tCO_2/MWh for 2010 and the average grid emission factor for 2008-10 was 0.082 tCO_2/MWh.

Option A2: Use the following conservative default values:

- A value of 1.3 tCO_2/MWh if:
  - (a) Scenario A applies only to project and/or leakage electricity consumption sources but not to baseline electricity consumption sources; or

[18] http://wenku.baidu.com/view/cf32a66427d3240c8447ef4c.html and http://www.ji-cdm-austria.at/blueline/upload/Ethiopia_EmissionFactor_FINALREPORT.pdf

[19] http://www.iea.org/publications/freepublications/publication/CO2emissionfromfuelcombustionHIGHLIGHTS.pdf

- (b) Scenario A applies to: both baseline and project (and/or leakage) electricity consumption sources; and the electricity consumption of the project and leakage sources is greater than the electricity consumption of the baseline sources.

- A value of 0.4 tCO_2/MWh for electricity grids where hydro power plants constitute less than 50% of total grid generation in 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production, and a value of 0.25 tCO2/MWh for other electricity grids. These values can be used if:
  - (a) Scenario A applies only to baseline electricity consumption sources but not to project or leakage electricity consumption sources ; or
  - (b) Scenario A applies to: both baseline and project (and/or leakage) electricity consumption sources; and the electricity consumption of the baseline sources is greater than the electricity consumption of the project and leakage sources.

Since this emission factor applies only to project electricity consumption sources and not baseline electricity consumption sources, therefore as per option A2, a value of 1.3 tCO_2/MWh can be used.Therefore, on a conservative basis, the emission factor for electricity consumption from the grid is being considered as 1.3 tCO_2/MWh in accordance with option A2.

Leakage

No leakage effects are accounted for under ACM0001 Version 13.0.0.

Emission reductions

According to ACM0001 Version 13.0.0, the emission reductions are calculated using equation 23 of the methodology which is as follows:

$$ER_y = BE_y - PE_y$$

Where:

ER_y = Emission reductions in year *y* (t CO_2e/yr)
BE_y = Baseline emissions in year *y* (t CO_2e/yr)
PE_y = Project emissions in year *y* (t CO_2/yr)

B.6.2. Data and parameters fixed ex ante

Data / Parameter	OX_{top_layer}
Unit	Dimensionless
Description	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data	Methodological tool “Emissions from solid waste disposal sites” Version 06.0.1
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	The value has been referenced from the methodological tool “Emissions from solid waste disposal sites” Version 06.0.1 that has determined it after an extensive review of published literature on this subject, including the IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Purpose of data	Calculation of baseline emissions
Additional comment	This value is fixed ex-ante for the entire crediting period.

Data / Parameter	GWP_{CH4}
Unit	t CO_2e/t CH_4
Description	Global warming potential of CH_4
Source of data	IPCC
Value(s) applied	25 for the second commitment period. Shall be updated according to any future COP/MOP decisions
Choice of data or Measurement methods and procedures	The value is based on IPCC reports and shall be updated according to any future COP/MOP decisions. The Decision 4/CMP.7[20] states that for the second commitment period of the Kyoto Protocol, the global warming potentials used by Parties to calculate the carbon dioxide equivalence of anthropogenic emissions by sources and removals by sinks of greenhouse gases listed in Annex A to the Kyoto Protocol shall be those listed in the column entitled "Global Warming Potential for Given Time Horizon" in table 2.14 of the Errata to the contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, based on the effects of greenhouse gases over a 100-year time horizon[21].
Purpose of data	Calculation of baseline emissions
Additional comment	This value is fixed ex-ante for the entire crediting period.

Data / Parameter	NCV_{CH4}
Unit	TJ/t CH_4
Description	Net calorific value of methane at reference conditions
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.0504
Choice of data or Measurement methods and procedures	The selected value is the upper limit specified for Natural Gas in Table 1.2 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2: Energy Chapter 1: Introduction
Purpose of data	Calculation of baseline emissions
Additional comment	This value is fixed ex-ante for the entire crediting period.

[20] http://unfccc.int/resource/docs/2011/cmp7/eng/10a01.pdf (Page 24 of pdf file)
[21] http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14

Data / Parameter	η_{PJ}
Unit	Dimensionless
Description	Efficiency of the LFG capture system that will be installed in the project activity
Source of data	Default value as per the methodology. Further, technical specifications of the LFG capture system will be referred.
Value(s) applied	50%
Choice of data or Measurement methods and procedures	Since the technical specifications of the LFG capture system to be installed are not available, a default value of 50% Has been assumed.
Purpose of data	Calculation of baseline emissions
Additional comment	This value is fixed ex-ante for the entire crediting period.

Data / Parameter	R_u
Unit	$Pa.m^3/kmol.K$
Description	Universal ideal gases constant
Source of data	Technical literature
Value(s) applied	8,314
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$SPEC_{flare}$
Unit	Flow rate or heat flux - kg/h or m^3/h Temperature - °C Maintenance schedule - number of days
Description	Manufacturer's flare specifications for temperature, flow rate and maintenance schedule
Source of data	Flare manufacturer
Value(s) applied	-
Choice of data or Measurement methods and procedures	The flare specifications set by the manufacturer for the correct operation of the flare are as follows: (a) LFG flow rate: a. maximum gas flow LFG: 1500 m3/hr b. minimum gas flow LFG: 300 m3/hr (b) Combustion temperature: –1000-1200°C (c) Maintenance schedule: in accordance with appropriate national / international standards/requirements and/or best practice.
Purpose of data	Calculation of baseline emissions
Additional comment	This value is fixed ex-ante for the entire crediting period.

Data / Parameter	MM_{CH4}
Unit	kg/kmol
Description	Molecular mass of methane
Source of data	Methodological tool "Project emissions from flaring" Version 02.0.0
Value(s) applied	16.04
Choice of data or Measurement methods and procedures	Referred from Table 1 of Methodological tool "Project emissions from flaring" Version 02.0.0
Purpose of data	Calculation of baseline emissions
Additional comment	This value is fixed ex-ante for the entire crediting period.

Data / Parameter	$\varphi_{default}$
Unit	-
Description	Default value for the model correction factor to account for model uncertainties
Source of data	Methodological tool "Emissions from solid waste disposal sites" Version 06.0.1
Value(s) applied	0.75
Choice of data or Measurement methods and procedures	Referred from Table 3 of Methodological tool "Emissions from solid waste disposal sites" Version 06.0.1
Purpose of data	Calculation of baseline emissions
Additional comment	This value is fixed ex-ante for the entire crediting period.

Data / Parameter	F
Unit	-
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	Referred from Methodological tool "Emissions from solid waste disposal sites" Version 06.0.1
Purpose of data	Calculation of baseline emissions
Additional comment	This value is fixed ex-ante for the entire crediting period.

Data / Parameter	DOC_f
Unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	Referred from Methodological tool "Emissions from solid waste disposal sites" Version 06.0.1
Purpose of data	Calculation of baseline emissions
Additional comment	This value is fixed ex-ante for the entire crediting period.

Data / Parameter	MCF
Unit	-
Description	Methane correction factor
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.8
Choice of data or Measurement methods and procedures	Referred from Methodological tool "Emissions from solid waste disposal sites" Version 06.0.1
Purpose of data	Calculation of baseline emissions
Additional comment	This value is fixed ex-ante for the entire crediting period.

Data / Parameter	DOC_j
Unit	-
Description	Fraction of degradable organic carbon in the waste type j (weight fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)
Value(s) applied	

Waste type j	**DOC_j (% wet waste)**
DOC_a: Wood and wood products	43%
DOC_b: Pulp, paper and cardboard (other than sludge)	40%
DOC_c: Food, food waste, beverages and tobacco	15%
DOC_d: Textiles	24%
DOC_e: Garden, yard and park waste	20%

Choice of data or Measurement methods and procedures	Referred from Table 4 of Methodological tool "Emissions from solid waste disposal sites" Version 06.0.1.
Purpose of data	Calculation of baseline emissions
Additional comment	This value is fixed ex-ante for the entire crediting period.

Data / Parameter	k_j
Unit	1/yr
Description	Decay rate for the waste type j
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
Value(s) applied	

Waste type j	**DOC_j (% wet waste)**
Wood and wood products	0.03
Pulp, paper and cardboard (other than sludge)	0.06
Food, food waste, beverages and tobacco	0.185
Textiles	0.06
Garden, yard and park waste	0.1

Choice of data or Measurement methods and procedures	Referred from Table 5 of Methodological tool "Emissions from solid waste disposal sites" Version 06.0.1. Since the average temperature at the landfill site is 16.3°C (average of maximum and minimum temperature) and the ratio between mean annual precipitation and potential evapo-transpiration > 1 (referred from the Environment and Social Impact Study), the values are for Boreal and Temperate (mean annual temperature ≤ 20°C) and (ratio between the mean annual precipitation and the potential evapo-transpiration > 1) have been used.
Purpose of data	Calculation of baseline emissions
Additional comment	This value is fixed ex-ante for the entire crediting period.

Data / Parameter	GWP_{CH4}
Unit	t CO_2e / t CH_4
Description	Global Warming Potential of methane
Source of data	IPCC
Value(s) applied	25
Choice of data or Measurement methods and procedures	Table 2.14 of the Errata to the contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, based on the effects of greenhouse gases over a 100-year time horizon
Purpose of data	Calculation of baseline emissions
Additional comment	This value is fixed ex-ante for the entire crediting period.

Data / Parameter	$EF_{EL,y}$
Unit	tCO_2/MWh
Description	Combined margin emission factor for the grid in year *y*
Source of data	Latest version of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" Option A2
Value(s) applied	1.3
Choice of data or Measurement methods and procedures	"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" Version 01
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	TDL_y
Unit	-
Description	Average technical transmission and distribution losses for providing electricity from the grid
Source of data	"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" Version 01
Value(s) applied	20% Default value for project electricity consumption sources
Choice of data or Measurement methods and procedures	As per the latest version of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
Purpose of data	Calculation of project emissions
Additional comment	-

B.6.3. Ex ante calculation of emission reductions

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Baseline emissions

According to ACM0001 Version 13.0.0, the baseline emissions are determined according to equation 1 of the methodology which is as follows:

$$BE_y = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y}$$

Where:

BE_y = Baseline emissions in year *y* (t CO_2e/yr)
$BE_{CH4,y}$ = Baseline emissions of methane from the SWDS in year *y* (t CO_2e/yr)
$BE_{EC,y}$ = Baseline emissions associated with electricity generation in year *y* (t CO_2/yr)
$BE_{HG,y}$ = Baseline emissions associated with heat generation in year *y* (t CO_2/yr)
$BE_{NG,y}$ = Baseline emissions associated with natural gas use in year *y* (t CO_2/yr)

The project activity does not involve electricity generation, heat generation or use of natural gas.

Therefore, $BE_{EC,y} = BE_{HG,y} = BE_{NG,y} = 0$.

The baseline emissions of methane from the SWDS are determined as per equation 2 of ACM0001 Version 13.0.0 which is as follows:

$$BE_{CH4,y} = (1 - OX_{top\_layer}) \times (F_{CH4,PJ,y} - F_{CH4,BL,y}) \times GWP_{CH4}$$

Where:

$BE_{CH4,y}$	=	Baseline emissions of LFG from the SWDS in year *y* (t CO_2e/yr)
OX_{top_layer}	=	Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless)
$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$F_{CH4,BL,y}$	=	Amount of methane in the LFG that would be flared in the baseline in year *y* (t CH_4/yr)
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

Since there was no flaring of methane in the baseline, $F_{CH4,BL,y} = 0$.

The *ex ante* estimate of $F_{CH4,PJ,y}$ in done using equation 5 of ACM0001 Version 13.0.0 which is as follows:

$$F_{CH4,PJ,y} = \eta_{PJ} \times BE_{CH4,SWDS,y}/GWP_{CH4}$$

Where:

$F_{CH4,PJ,y}$	=	Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (t CH_4/yr)
$BE_{CH4,SWDS,y}$	=	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* (t CO_2e/yr)
η_{PJ}	=	Efficiency of the LFG capture system that will be installed in the project activity
GWP_{CH4}	=	Global warming potential of CH_4 (t CO_2e/t CH_4)

$BE_{CH4,SWDS,y}$ is determined using the methodological tool "Emissions from solid waste disposal sites" Version 06.0.1 as follows:

Since, the amount of methane generated from disposal of waste at the SWDS is calculated for year *y*, equation 1 of the tool is used which is as follows:

$$BE_{CH4,y} = \varphi_y \cdot (1 - f_y) \cdot GWP_{CH4} \cdot (1 - OX) \cdot \frac{16}{12} \cdot F \cdot DOC_{f,y} \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot (1 - e^{-k_j})$$

Where:

$BE_{CH4,SWDS,y}$	=	Baseline, project or leakage methane emissions occurring in year *y* generated from waste disposal at a SWDS during a time period ending in year *y* (t CO_2e / yr)
x	=	Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period ($x = 1$) to year *y* ($x = y$).
y	=	Year of the crediting period for which methane emissions are calculated (*y* is a consecutive period of 12 months)
$DOC_{f,y}$	=	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year *y* (weight fraction)
$W_{j,x}$	=	Amount of solid waste type *j* disposed or prevented from disposal in the SWDS in the year *x* (t)
φ_y	=	Model correction factor to account for model uncertainties for year *y*
f_y	=	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year *y*
GWP_{CH4}	=	Global Warming Potential of methane
OX	=	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
F	=	Fraction of methane in the SWDS gas (volume fraction)

MCF_y = Methane correction factor for year *y*
DOC_j = Fraction of degradable organic carbon in the waste type *j* (weight fraction)
k_j = Decay rate for the waste type *j* (1 / yr)
J = Type of residual waste or types of waste in the MSW

The assumptions used to calculate the baseline emissions are as follows:

Parameter	Description	Value	Source
ϕ	Model correction factor to account for model uncertainties	0.75	Default value for site with humid/wet conditions has been used in accordance with Application A of table 1. Referred from: Methodology Tool - Emissions from Solid Waste Disposal Sites, Version 06.0.1.
GWP_{CH4}	Global Warming Potential (GWP) of methane, valid for the relevant commitment period(tCO_2e/tCH_4)	25	IPCC Fourth Assessment Report
DOC_f	Fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS	0.5	Methodology Tool - Emissions from Solid Waste Disposal Sites, Version 06.0.1. Default value has been used in accordance with Application A of table 1.
F	Fraction of methane in the SWDS gas (volume fraction)	0.5	Methodology Tool - Emissions from Solid Waste Disposal Sites, Version 06.0.1. Default value has been used in accordance with Application A of table 1.
f	Fraction of methane captured at the SWDS and flared, combusted or used in another manner	0	Landfill Administration
MCF	Methane correction factor for unmanaged solid waste disposal sites - deep	0.8	Since the landfill is unmanaged with an average depth of 9.4m which is more than 5m. The default value as specified by the "Methodology Tool - Emissions from Solid Waste Disposal Sites, Version 06.0.1" has been used (Application A).
OX	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)	0.1	Methodology Tool - Emissions from Solid Waste Disposal Sites, Version 06.0.1. Default value has been used in accordance with Application A of table 1.
Time	LFG annual generation hours (h)	8760	Landfill Administration
D_{CH4}	Density of Methane (tCH_4/m^3)	0.0007168	2006 IPCC Guidelines for National Greenhouse Gas Inventories
η_{PJ}	Efficiency of the LFG capture system	0.5	Default value as per the methodology

Waste type j	DOC_i: Fraction of degradable organic carbon (by weight) in the waste type j	Composition of Waste type at Landfill site	k_i: Decay rate for the waste type j	Source
DOC_a: Wood and wood products	43%	7%	0.03	Tool - Emissions from Solid Waste Disposal Sites, Version 06.0.1.
DOC_b: Pulp, paper and cardboard (other than sludge)	40%	8%	0.06	
DOC_c: Food, food waste, beverages and tobacco	15%	65%	0.185	
DOC_d: Textiles	24%	10%	0.06	
DOC_e: Garden, yard and park waste	20%	7%	0.1	

Year	Quantity of Waste disposed at the landfill (Metric Tonnes)	Year	Quantity of Waste disposed at the landfill (Metric Tonnes)
1968	13,977	1991	66,257
1969	14,955	1992	70,895
1970	16,002	1993	75,858
1971	17,122	1994	81,168
1972	18,321	1995	86,849
1973	19,603	1996	92,929
1974	20,975	1997	99,434
1975	22,444	1998	106,394
1976	24,015	1999	113,842
1977	25,696	2000	121,811
1978	27,494	2001	130,337
1979	29,419	2002	139,461
1980	31,478	2003	149,223
1981	33,682	2004	180,618
1982	36,039	2005	205,796
1983	38,562	2006	178,288
1984	41,262	2007	203,061
1985	44,150	2008	177,227
1986	47,240	2009	220,983
1987	50,547	2010	331,235
1988	54,085	2011	876,860
1989	57,871	2012	923,010
1990	61,922	2013	969,161

Using the above equation and assumptions, the ex-ante estimation of baseline emissions has been done in an excel sheet.

A sample of the calculation for estimation of baseline emissions for year 2014 is presented below:

$$BE_{CH4,y} = \varphi_y \cdot (1 - f_y) \cdot GWP_{CH4} \cdot (1 - OX) \cdot \frac{16}{12} \cdot F \cdot DOC_{f,y} \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot (1 - e^{-k_j})$$

Wood and wood products

Baseline emissions in 2014 due to waste deposited in 1968 = 0.75 * (1-0) * 25 * (1-0.1) * 16/12 * 0.5 * 0.5 * 0.8 * 13,977 * 7% * 43% * $e^{-0.03*(2014-1968)}$ * $(1-e^{-0.03})$ = 14.1 tCO_2e

Similarly, baseline emissions in 2014 are calculated due to waste deposited in years 1969 to 2013 and all values are added to obtain total emissions due to wood and wood products as 19,846.4 tCO_2e.

Pulp, paper and cardboard (other than sludge)

Baseline emissions in 2014 due to waste deposited in 1968 = 0.75 * (1-0) * 25 * (1-0.1) * 16/12 * 0.5 * 0.5 * 0.8 * 13,977 * 8% * 40% * $e^{-0.06*(2014-1968)}$ * $(1-e^{-0.06})$ = 7.4 tCO_2e

Similarly, baseline emissions in 2014 are calculated due to waste deposited in years 1969 to 2013 and all values are added to obtain total emissions due to pulp, paper and cardboard as 34,478.9 tCO_2e.

Food, food waste, beverages and tobacco

Baseline emissions in 2014 due to waste deposited in 1968 = 0.75 * (1-0) * 25 * (1-0.1) * 16/12 * 0.5 * 0.5 * 0.8 * 13,977 * 65% * 15% * $e^{-0.185*(2014-1968)}$ * $(1-e^{-0.185})$ = 0.2 tCO_2e

Similarly, baseline emissions in 2014 are calculated due to waste deposited in years 1969 to 2013 and all values are added to obtain total emissions due to food, food waste, beverages and tobacco as 185,357.5 tCO_2e.

Textiles

Baseline emissions in 2014 due to waste deposited in 1968 = 0.75 * (1-0) * 25 * (1-0.1) * 16/12 * 0.5 * 0.5 * 0.8 * 13,977 * 10% * 24% * $e^{-0.06*(2014-1968)}$ * $(1-e^{-0.06})$ = 5.6 tCO_2e

Similarly, baseline emissions in 2014 are calculated due to waste deposited in years 1969 to 2013 and all values are added to obtain total emissions due to textiles as 25,859.2 tCO_2e.

Garden, yard and park waste

Baseline emissions in 2014 due to waste deposited in 1968 = 0.75 * (1-0) * 25 * (1-0.1) * 16/12 * 0.5 * 0.5 * 0.8 * 13,977 * 7% * 20% * $e^{-0.1*(2014-1968)}$ * $(1-e^{-0.1})$ = 0.8 tCO_2e

Similarly, baseline emissions in 2014 are calculated due to waste deposited in years 1969 to 2013 and all values are added to obtain total emissions due to garden, yard and park waste as 20,309.8 tCO_2e.

Adding these baseline emissions for year 2014 we get,

$BE_{CH4,SWDS,2014}$ = 19,846.4 + 34,478.9 + 185,357.5 + 25,859.2 + 20,309.8 = 285,852 tCO_2e

$$F_{CH4,PJ,y} = \eta_{PJ} \times BE_{CH4,SWDS,y}/GWP_{CH4}$$

Therefore, $F_{CH4,PJ,2014}$ = 285,852 * 0.5 / 25 = 5,717 tCH_4

Further, $BE_{CH4,y} = F_{CH4,PJ,y} * GWP_{CH4}$

Therefore, $BE_{CH4,2014}$ = 5,717 * 25 = 142,926 tCO_2e

Project emissions

According to ACM0001 Version 13.0.0, the project emissions are calculated using equation 22 of the methodology which is as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y}$$

Where:

PE_y = Project emissions in year *y* (t CO_2/yr)
$PE_{EC,y}$ = Emissions from consumption of electricity due to the project activity in year *y* (t CO_2/yr)
$PE_{FC,y}$ = Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year *y* (t CO_2/yr)

The project activity does not involve consumption of fossil fuels.

Hence $PE_{FC,y} = 0$

$$PE_{EC,y} = \sum_j EC_{PJ,y} \times EF_{EL,y} \times (1 + TDL_y)$$

Where,

$PE_{EC,y}$ Project emissions from electricity consumption in year *y* (tCO_2/yr)
$EC_{PJ,y}$ Quantity of electricity consumed by the project from grid in year *y* (MWh/yr)
$EF_{EL,y}$ Emission factor for electricity generation from grid in year *y* (tCO_2/MWh)
TDL_y Average technical transmission and distribution losses for providing electricity from grid in year *y*

$EF_{EL,y}$ = 1.3 tCO_2/MWh in accordance with option A2 of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" Version 1.0 (EB 39, Annex 7).

TDL_y is also 20% as per the default value for project electricity consumption sources stated in "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" Version 1.0 (EB 39, Annex 7).

For the ex-ante estimation of project emissions, no electricity consumption from the grid has been assumed.

Therefore, $PE_{EC,y} = 0$ and $PE_y = PE_{EC,y} + PE_{FC,y} = 0$

Leakage

No leakage effects are accounted for under ACM0001 Version 13.0.0.

Emission reductions

According to ACM0001 Version 13.0.0, the emission reductions are calculated using equation 23 of the methodology which is as follows:

$$ER_y = BE_y - PE_y$$

Where:

ER_y = Emission reductions in year *y* (t CO_2e/yr)
BE_y = Baseline emissions in year *y* (t CO_2e/yr)
PE_y = Project emissions in year *y* (t CO_2/yr)

Therefore, using the above estimated value of baseline emissions, the ex-ante calculation of emission reductions has been done in the excel sheet.

B.6.4. Summary of ex ante estimates of emission reductions

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Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2013	164,996	0	0	164,996
2014	142,926	0	0	142,926
2015	124,256	0	0	124,256
2016	108,433	0	0	108,433
2017	94,996	0	0	94,996
2018	83,558	0	0	83,558
2019	73,800	0	0	73,800
2020	65,453	0	0	65,453
2021	58,293	0	0	58,293
2022	52,134	0	0	52,134
Total	**968,845**	**0**	**0**	**968,845**
Total number of crediting years	**10**			
Annual average over the crediting period	**96,884**	**0**	**0**	**96,884**

B.7. Monitoring plan
B.7.1. Data and parameters to be monitored

Data / Parameter	Management of SWDS
Unit	-
Description	Management of SWDS
Source of data	The following sources of data would be referred: • Original design of the landfill • Technical specifications for the management of the SWDS • Local or national regulations
Value(s) applied	Monitored ex-post
Measurement methods and procedures	Project participants would refer to the original design of the landfill to ensure that no practices are occurring that would increase methane generation at the site compared to the situation prior to implementation of the project activity. Any change in the management of the SWDS after completion of Phase II of implementation of the project activity would be justified by providing reference to technical or regulatory specifications.
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	-
Additional comment	The Repi landfill is currently an open dump solid waste disposal site without any capture of LFG. The solid waste management project at Repi is being implemented in phases wherein Phase I involves sanitary closure of a major section of the landfill site to capture and flare LFG. Under Phase II a small active portion of the site would continue to receive material until 2013 when a new landfill site 50 kilometres to the north of Addis Ababa becomes operational. This additional waste will also be connected to the landfill gas extraction infrastructure installed in the project activity. The landfill site would subsequently be closed, not allowing any further dumping of material. Hence, after completion of Phase II, the design of the landfill would remain unchanged allowing no possibility of increase in methane generation at the site compared to the situation prior to implementation of the project activity.

Data / Parameter	$V_{m,db}$
Unit	m^3 dry gas/h
Description	Volumetric flow of the residual gaseous stream in the minute *m* on a dry basis
Source of data	Plant records
Value(s) applied	Monitored ex-post
Measurement methods and procedures	The volumetric flow measurement would be at the actual pressure and temperature. Calculated based on the dry basis LFG flow measurement.
Monitoring frequency	Continuously
QA/QC procedures	Periodic calibration at least every 2 years would be carried out against a primary device provided by the independent accredited laboratory of the Federal EPA of Ethiopia. The calibration and frequency of calibration would be done according to manufacturer's specifications. The accuracy of the instruments will be within ±1%.
Purpose of data	Calculation of baseline emissions
Additional comment	In case the flow measurement is on wet basis, the same would be converted to dry basis using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" Version 02.0.0.

Data / Parameter	$v_{CH4,m,db}$
Unit	-
Description	Volumetric fraction of CH_4 in residual gaseous stream in the minute *m* on a dry basis
Source of data	Plant records
Value(s) applied	Monitored ex-post
Measurement methods and procedures	Continuous gas analyser would be used, operating on dry-basis. The volumetric flow measurement would always refer to the actual pressure and temperature.
Monitoring frequency	Continuously
QA/QC procedures	The calibration would include zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases would have a certificate provided by the manufacturer and would be under their validity period. The accuracy of the instruments will be within ±1%.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	T_m
Unit	K
Description	Temperature of the gaseous stream in minute *m*
Source of data	Plant records
Value(s) applied	Monitored ex-post
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) would be used.
Monitoring frequency	Continuously
QA/QC procedures	Periodic calibration at least every 2 years against a primary device would be conducted by an independent accredited laboratory. The calibration and frequency of calibration would be as per the manufacturer's specifications. The accuracy of the instruments will be within ±1%.
Purpose of data	Calculation of baseline emissions
Additional comment	It would be ensured that the gaseous stream flow temperature remains below 60ºC, else, volumetric flow of the residual gaseous stream would be changed to dry basis.

Data / Parameter	P_m
Unit	Pa
Description	Absolute pressure of the residual gaseous stream in minute *m*
Source of data	Plant records
Value(s) applied	Monitored ex-post
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) would be used. The accuracy of the instruments will be within ±1%.
Monitoring frequency	Continuously
QA/QC procedures	Periodic calibration at least every 2 years against a primary device would be performed and records of calibration procedures would be kept available along with the primary device and its calibration certificate.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$T_{EG,m}$
Unit	°C
Description	Temperature in the exhaust gas of the enclosed flare in minute *m*
Source of data	Plant records
Value(s) applied	Would be measured ex-post
Measurement methods and procedures	The temperature of the exhaust gas in the flare would be measured using temperature gauges. Suitable monitoring ports would be provided by flare manufactures for the monitoring of the temperature of the flare. In case more than one temperature port is fitted to the flare, the flare manufacturer would provide instructions detailing the conditions under which each location shall be used and the port most suitable for monitoring the operation of the flare according to manufacturers specifications for temperature.
Monitoring frequency	Once per minute
QA/QC procedures	Temperature gauges would be replaced or calibrated in accordance with the maintenance schedule. The accuracy of the instruments will be within ±1%.
Purpose of data	Calculation of baseline emissions
Additional comment	Unexpected changes such as a sudden increase/drop in temperature can occur for different reasons. These events would be noted in the site records along with any corrective action that was implemented to correct the issue. These measurements would be done to determine if manufacturer's flare specifications for operating temperature are met.

Data / Parameter	$Flame_m$
Unit	Flame on or off
Description	Flame detection in the minute *m*
Source of data	Plant records
Value(s) applied	Monitored ex-post
Measurement methods and procedures	It would be measured using a fixed installation optical flame detector: Ultra Violet detector or Infra Red or both
Monitoring frequency	Once per minute - Detection of flame recorded as a minute that the flame was on, otherwise recorded as a minute that the flame was off.
QA/QC procedures	The equipment would be maintained and calibrated in accordance with manufacturer's recommendations.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$Maintenance_y$
Unit	Calendar dates
Description	Maintenance events completed in year *y*
Source of data	Plant records
Value(s) applied	Monitored ex-post
Measurement methods and procedures	Records of the date when maintenance events were completed in year *y* would be maintained electronically. These maintenance logs would include all aspects of the maintenance including the details of the person(s) undertaking the work, parts replaced, or needing to be replaced, source of replacement parts, serial numbers and calibration certificates.
Monitoring frequency	Annually
QA/QC procedures	Records would be kept in a maintenance log for two years beyond the life of the flare
Purpose of data	Calculation of baseline emissions
Additional comment	These dates are required so that they can be compared to the maintenance schedule to check that maintenance events were completed within the minimum time between maintenance events specified by the manufacturer ($SPEC_{,flare}$)

Data / Parameter	$EC_{PJ,y}$
Unit	MWh/yr
Description	Quantity of electricity consumed by the project from grid in year *y*
Source of data	Plant records
Value(s) applied	Monitored ex-post
Measurement methods and procedures	The quantity of electricity imported by the project activity in year *y* will be recorded using electronic main and check meters. Meter reading will be taken by grid utility on a monthly basis.
Monitoring frequency	Measured continuously and recorded monthly
QA/QC procedures	Calibration of the meters shall be done at least once in three years. Electronic energy meters will be installed with an accuracy class of 0.5s or better. In case the main meter is not in service, the check meters shall be used.
Purpose of data	Calculation of project emissions
Additional comment	For ex-ante calculation of emissions, no electricity consumption by the project from the grid has been considered.

B.7.2. Sampling plan

>>

There is no sampling required for this project activity.

B.7.3. Other elements of monitoring plan

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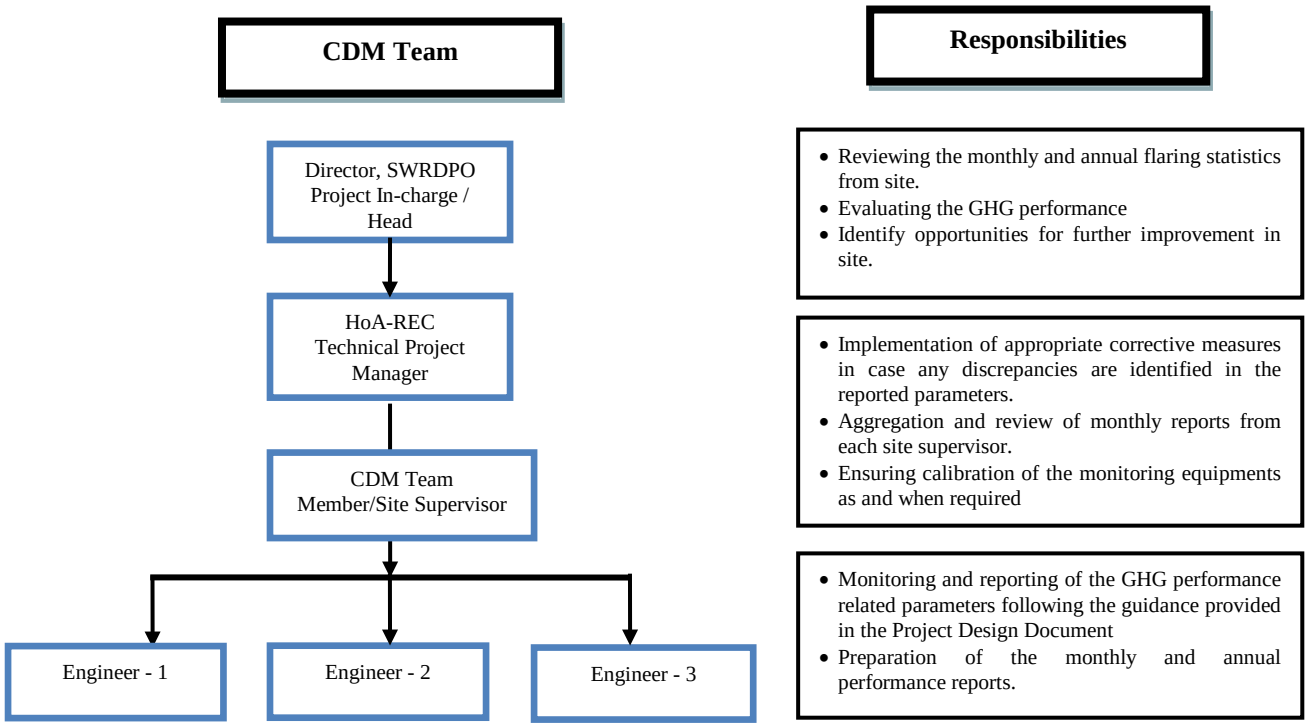
The authority and responsibility of project management as well as registration, monitoring, measurement and reporting will rest collectively with AACA. The responsibility for ensuring proper and continuous monitoring of the flaring operations is to be fulfilled by a project team established by HoA-REC, as stipulated in Addendum to Contract for the Supervision of Integrated Solid Waste Management between Addis Ababa City Administration and HoA-REC as signed in 2010.

The operation and management structure that will be implemented for the purpose of monitoring is illustrated below:



Monitoring Plan Objective and Organisation

The purpose of the monitoring plan is to measure the quantity of methane that is captured and destroyed by flaring. Within the CDM team, a supervisor will be designated for the site and will be responsible for compiling, monitoring and reporting of GHG performance related parameters (Process Parameters, Procedures, Calibration).

This data collated from the site will be aggregated by the senior CDM team member. The data and documents received from the site supervisor will be compiled in a format called the CDM format / report. Quality checks will also be undertaken at this level to ensure all discrepancies are addressed. The onus of reviewing, storing and archiving of all CDM related information relevant to the project in a suitable manner would rest with this team member.

The Technical Project Manager will aggregate and review all the data received from site supervisor. The review will be conducted to ensure compliance to the requirements of the monitoring plan and other

CDM modalities and procedures including calibration frequency. Corrective measures will be applied in case any discrepancy is observed. The Project Manager will further submit a consolidated report to the Project In-charge who will finally review and sign the monthly performance from the project activity.

To ensure that the data is reliable and transparent, the project entity will establish Quality Assurance and Quality Control (QA&QC) measures to effectively control and manage data reading, recording, auditing as well as archiving data and all relevant documents.

Monitoring and Archiving of Data

The monitoring data will be recorded electronically, plotted and archived from input signals from a data logger. Data will be stored by an internal memory and kept by the owners at SWRDPO. Copy will be maintained by the CDM technical team at HoA-REC. The CDM team within the plant will be responsible for collecting the monitoring data and will provide the metered results along with calibration certificates (if available) in the CDM format / report.

The data will be archived electronically and be stored for 2 years after the end of the crediting period of the project activity.

Procedure for Need Based Training of Employees Associated with Project Activity

The aim of the procedure is to ensure training of SWRDPO and HoA-REC staff members associated with project activity. The training will be on the following aspects of equipments involved in the project activity – start up techniques, operation, maintenance, monitoring of parameters, precautions, safety instructions and emergency preparedness etc. The following procedure will be followed for training:

- A copy of Operation and Maintenance manual, safety instructions related to the equipment involved in the project activity will be made available to the project staff members involved in the project.
- During commissioning of the new equipments (of the project activity), training on all above aspects to all employees involved in the project activity will be provided.
- Whenever an employee handles the equipments involved in the project activity for the first time, training will be provided to him/her on start up techniques, operation, maintenance, monitoring of parameters, precautions, safety instructions and emergency preparedness etc.
- The training will be provided by the equipment supplier and HoA-REC.

The equipment supplier will provide on-site trainings for staff assigned to work on the landfill gas flaring station.

Quality Assurance and Quality Control

AACA will implement QA&QC measures to calibrate and guarantee the accuracy of metering and safety of the project operation. The metering devices will be calibrated and inspected properly and periodically as per manufacturer specifications but at least every 2 years.

The CDM team will meet at least every three months to review project parameters, check data collected, emissions reduced etc. The following will be the procedure for taking corrective action and addressing any non-conformances discovered:

- All the mismatching data along with the name of the in-charge of logbooks name will be recorded in a Note Book.
- The site supervisor in the CDM team will send FAR (Forward Action Request) or CAR (Corrective Action Request) to the concerned CDM Member.
- After receipt of the communication, within one week, the concerned site in-charge will correct the data and will reply to the site supervisor in the CDM team.

The corrected data will then be compiled by the site supervisor and archived electronically for at least 2 years beyond the crediting period.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>

13/03/2012

In accordance with the CDM Glossary of terms[22], "*the earliest date at which either the implementation or construction or real action of a CDM project activity begins*" has to be considered as the start date. Further, Paragraph 67 of the EB 41 meeting report clarifies that "*the start date shall be considered to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the project activity. This, for example, can be the date on which contracts have been signed for equipment or construction/operation services required for the project activity*".

Accordingly, in the context of the proposed project activity, the signing of the supplementary contract agreement between Addis Ababa City Government and Ekolem-Palvelu Oy for reclamation, gas and leachate collection of Repi Landfill has been considered as the start date.

C.1.2. Expected operational lifetime of project activity

>>

20 Years, 0 Months

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>

Fixed Crediting period

C.2.2. Start date of crediting period

>>

01/06/2013 or date of registration, whichever is later.

C.2.3. Length of crediting period

>>

10 Years, 0 Months

[22] http://cdm.unfccc.int/Reference/Guidclarif/glos_CDM.pdf

SECTION D. Environmental impacts
D.1. Analysis of environmental impacts
>>
The Ethiopian Environmental Protection Authority (EEPA) is responsible for framing and implementation of laws related to environment in the Federal Republic of Ethiopia. Although there are existing regulations related to management of solid waste in the country, there are no provisions for mandating closure of the landfills and flaring/utilisation of landfill gas. Further, the Environment Impact Assessment (EIA) proclamation (http://www.epa.gov.et/Download/Proclamations/Proc%20No.%20299-2002%20Environmental%20Impact%20Assessment.pdf) does not categorically mentions whether the proposed project activity requires conducting a mandatory EIA.

Inspite of no regulatory obligation, the project proponent appointed Poyry SAS to conduct an Environment and Social Impact assessment of the project including for the development of a new landfill post closure of the Repi and transfer stations. A detailed social assessment for closure and reclamation of the landfill has also been conducted.

As mentioned earlier, the solid waste management project at Repi is proposed to be implemented in two consecutive phases, which will be completed within two years after its commencement. The first phase will involve the reclamation of 18 ha of land of the site and it will involve the following steps:

- Reduce negative impact on Abuna Basslios secondary school by clearing the waste over 4 ha of area neighbouring the school;
- Stabilize side banks in order to limit the risks of erosion from the creek and ensure long term stability of banks and cover layer; and restore road on top of cover layer
- Limit rain water infiltration and leachate generation by final grading of waste deposit maximizing runoff and by covering 18 ha of the landfill with a 0.7 m thick cover layer; and collect leachate and runoff water in a trench drain surrounding the deposit; and
- Planting low vegetation over the surface of the reclaimed area.

The second phase focuses on the final closure of the site, which includes complete cover of the remaining area, landscaping of the area in operation, plant vegetation, construction of the transfer station on the site, and implementation of the environmental management plan.

The environmental impacts of the project activity are mostly positive and can be summarised as follows:

- *Impact on air and climate*

The flaring and destruction of the methane contained in landfill gas will contribute to the reduction of greenhouse gas emissions which cause global warming. The project activity will prevent all nuisance created by the total release of the landfill gas to the atmosphere, such as the release of H2S, mercaptenes and other chemical compounds that result in bad odours and sanitary risks in the neighbouring populations, such as diseases and asthma due to the air pollution.

There are public institutions like school and residences in the neighbourhood of the dumping site which are vulnerable to health and environmental impacts caused by the dumping site. The most harmful impacts from the Repi dumping site are associated with air pollution of the surrounding triggered by windblown suspended particles originating from the dumpsite, uncontrolled release of gas and smoke from the burning wastes of the site. Other harmful effects of the air pollution are the possibilities of inhaling the floating particles which could be contaminated with toxic heavy metals, microbiological pollution and unpleasant smell. There could also appear spreading of fire around the dump site which

exacerbates the ambient air pollution. Therefore, the flaring of gas will bring significant positive environmental and health impacts to the neighbourhood communities.

D.2. Environmental impact assessment

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As stated above, EIA is not mandatory for the proposed project activity according to existing guidelines promulgated by the Ethiopian Environmental Protection Agency (EPA) and no environmental clearances are required for the project activity. However, the closure of the landfill requires an environmental clearance. The EPA of Ethiopia has provided clearance for the closure of the landfill on 5 November 2010. Evidence has been provided to the DOE.

The city administration has conducted an environment and social impact assessment of the project, the results of which clearly demonstrate that the project activity will bring about positive changes.

Despite the many positive environmental impacts that the project is expected to bring, the assessment carried out concluded that the planned project activities will trigger loss of income or disrupt the basis of the livelihood of the waste-pickers (i.e. project affected people) community in Koshe. Therefore, to restore their livelihood or to enable them to get sustainable income (that is at least the same as to what the waste picker used to earn), the following mitigation measures are proposed:

1. Restoring the livelihood of the waste pickers through creating new income generation opportunities

Organizing the waste pickers in SMEs

One of the proposed mechanisms to restore the livelihood of the project affected parties is to engage them in new income generating activities by organizing them in small and micro enterprises (SMEs) and providing them access to credit. In the discussion held with the project affected parties, some of the waste pickers have a desire to be organized in cooperatives of small and medium enterprises and to get the necessary skill trainings as well as provision of credit necessary to run their own business. On the other side a consultation meeting was held with the Small and Micro Enterprise Development Bureau. The Bureau asserted that there is strong government commitment to organize the waste pickers in SMEs. The business sectors for which Small and Micro Enterprise Development Bureau give due attentions (priorities) are:

1. Textile and Garments small (sub) sector
2. Preparation of dry foods small sector
3. Metal and wood works small sector
4. Construction small sector
5. Municipality service small sector
6. Urban Agriculture small sector
7. Cobble stone small sector
8. Hair dressing small sector
9. Commission agent for product sales small sector
10. Computer maintenance and ICT small sector
11. Broidery products small sector

The business areas where the project affected women want to be engaged as a way of restoring their income are, Baltna works (traditional food preparation), Gulit works (open market stalls), hair dressing, opening small shops, and trading of cloth. The areas of business activity the men waste pickers want to engage in, among others are: metal works, mechanics, poultry, opening shop, and getting training on driving license. The areas of interest raised by both women and men waste picker groups are compatible with the SME sectors listed above. Therefore, there is a huge opportunity to organize them in SMEs

under the various sectors based on their choices and to help them come up with new income generating activities that will restore their livelihood.

However, one of the requirements to get credit from the Micro Finance as a Small and Micro Enterprise is to deposit 20% of the total investment cost the business needs. As it is pointed out in the survey result, waste-pickers income is subsistence and thus they may not have sufficient capital to deposit the required amount in a bank. Given the different socio–economic nature of the waste pickers, and the primary responsibility of restoring their livelihood, the project office will have to support them by availing a credit necessary to deposit the 20% of the total investment.

The current practice of SME organizers show that credit is given to groups and not to individuals. However this can have drawbacks in the waste-pickers case unless some extra efforts are taken. As it is indicated in the survey result, the cooperative culture and practice of saving in a group is none-existent in the waste pickers. To this effect the credit scheme should take this in to account and needs to be given intensive training on cooperative work culture and saving habits.

Enabling waste pickers to restore livelihood individually
Although a number of the waste pickers want to work in cooperatives, there are few individual waste pickers who do not want to work there. Rather, they want to get the necessary support and work individually. Such individual waste pickers, however, do not seem that they want to avoid the group collateral scheme in getting credits. There will be two options to accommodate the interest of these waste pickers. The first is to provide them with some coaching or indoctrination to make them understand the benefits of working in cooperatives organised as SMEs. If that fails, credit has to be given to individual waste pickers by group collateral to work on some of the business areas identified under the SME sectors.

To implement the above mitigation measures, the project office will have to formulate and develop an action plan so that it can initiate, organize and facilitate the necessary support from the relevant stakeholders as well as to monitor and evaluate the implementation of the mitigation measures. The action plan will set the road map to organize interested waste pickers into SMEs and help them through to get the trainings and credit provisions. The project office will also have to include in its plan important stakeholders such as Woreda one in Kolfe-Keranyo and Wereda two in Nifas -Silk Lafto sub cities, and seek their assistance to organize the waste pickers and to give them the necessary support to that end. The basic work of organizing such groups into SMEs is done by the woreda level branches of the Bureau and thus the project office will need to establish close working relationship with them at woreda level.

Care should be taken in the sequencing of the commencement of new income generating activities and the closure of the dumping site. The commencement of the new income generating activity should be done concomitantly with the closure of the dumping site. Otherwise if the new income generating activity lags behind the closure, the waste pickers' income could be affected in the mean time. Thus there should be a mechanism to give some sort of subsidy for the possible transition time.

2. Professionalizing waste pickers in waste segregation and recovery system
The waste pickers have been doing this job for quite a long time, majority of them have been in this job for more than ten years. Thus, they have already developed many years of experience in waste segregation and recovery systems and they are valuable labour resource for waste management related work. To reap this advantage and benefit the waste picker themselves, they have to be integrated with the new formal solid waste management system of the city in a professional manner. Such practice will create a win –win situation for both the government and the waste pickers.

According to the information obtained from the Recycling and Disposal Project Office, the new sanitary landfill and transfer station has quite a large number of vacancies to be filled. One transfer station alone

will have about 246 vacancies and the four transfer stations will accommodate a total of 984 employees. Therefore, the new sanitary landfill and transfer station will take in a large number of workers. This provides huge potential opportunity to absorb the waste pickers who have interest to work in waste segregation and recovery scheme at the new transfer stations.

This being the case, past experience of recruiting the waste pickers on formal employment basis has shown failure. In the recent past, some waste pickers were employed as permanent workers for preparation of compost in the Koshe dumping site. However the work failed to achieve its purpose mainly because the employed waste pickers were reluctant to do the job on monthly salary payments. As a consequence both the project office and the waste pickers do not appear to have any interest to work on formal employment modalities. Therefore not to repeat the previous mistake, the integration of the waste pickers should not be on permanent employment basis. Instead it would be more convenient to provide them some concession and contract to operate the waste segregation and recovery scheme in the transfer stations. In doing so, the waste pickers will be organized to form cooperatives of waste segregation and recovery enterprises and enter into contracts. Moreover they have to get the necessary credit facilities and support from the Small and Micro Enterprise Development Bureau. To conclude, the waste segregation and recovery workers drawn from the project affected parties should work in a very formal and on private business modality (entity).

In order to make the system more productive and efficient, the waste pickers will be required to be trained regarding the new sanitary landfill, the transfer stations and the associated waste segregation and recovery schemes as well as health and safety issues. In other words, they have to be professional waste pickers that fulfil the necessary safety and health requirements.

Those waste pickers who happen to work on the new transfer stations will obviously move out to near places of the Akaki and Filidoro transfer stations. Clearly, this would trigger relocation from their present home. To this effect, those people should be provided with some relocation compensation schemes and support. The project affected people should get preferential treatment to work on the Koshe transfer station, which is one of the transfer stations to be built by the project office. The Filidoro and Akaki transfer stations should be used as the next and last option to absorb interested waste pickers who desire to become professional waste pickers.

3. Providing Alternative Employment

Although some segment of the waste pickers are reluctant to work on formal employment basis, others especially those who are in the old age and have low level of education are keen to be employed. During the focus group discussion some participants have expressed their preference to work in the reclamation process such as in the biogas generation, greening and landscaping activities and as guards. Some others have the desire to work as skip truck driver and driver assistant. The latter group feels that they have the competence more than any other to work as driver assistance in the solid waste collection skip trucks. This is because they are already strongly attached with the solid waste collection, disposal and recovery works and hence they have special affinity to do it without any reservation.

Therefore, the project office in collaboration with the Addis Ababa Beautification and Solid Waste Management Office will have to facilitate to give preferential employment opportunity for those waste pickers who want to work as skip truck driver assistants when recruiting new staff for the job, and on reclamation of the Koshe dumping site as well as on other related jobs in the new sanitary landfill.

4. Providing formal and non-formal training

Large numbers of the waste pickers have never attended school. Moreover, there are children who are involved in waste picking activities that never attended school or are drop outs from school. This will be the stumbling block for the waste pickers to get job opportunities in other areas of activities. Therefore, there is a need to give support to pursue their formal education. This appears to be a long term

intervention, but can be handled by working together with interested NGOs. True Concern for Community Development is one of the NGOs, who run their own development programme to assist the waste picker's community. Thus NGOs like these can play an important role in providing a helping hand to enable the children to continue their education.

The older group (13 years and above) has been out of school for too long and they are more attached to the waste picking way of life. For this reason, most of them have no other skills (or at least in the short run they will have difficulties) to engage in other line of economic activities. They need to be trained based on their respective capacities and capabilities. Considering the socio-economic condition of the waste pickers, the training should be combined with vocational training, income generation activities ('learn and earn projects') and entrepreneurship. This seems to be a good approach for the young and old waste pickers (13 and above years old).

Once again the role of NGOs in conducting such trainings for the waste pickers is significant. True Concern for Community Development is already running a vocational training programme that is offered to the waste pickers. Working with them and others such as ENDA-Ethiopia will have a beneficial outcome both for the waste pickers and the project office.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

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The city administration of Addis Ababa gives prime importance to public acceptance and awareness in development projects. In recognition with the objective of informing and soliciting comments, the project proponent identified all the stakeholders directly or indirectly affected by the implementation of the project activity. These included local residents and communities surrounding the landfill, government agencies, non-government/development organisations, representatives of schools etc.

In order to ensure maximum participation, the project proponent sent personal invitation letters alongside putting up public notices in local language at relevant locations on 24/11/2011, well in advance of the meeting date.

The stakeholder consultation meeting took place on 08/12/2011 at Hager Fikir Theatre Hall, Addis Ababa. The meeting was attended by more than 70 stakeholders representing various sections of the society such as scavengers (who work at the Repi landfill), artists, foresters, engineers, businessmen, solid waste management experts, policemen, environmentalists, workers, local residents, government officials etc. The meeting proceeded with the following agenda:

Time	**Program**
9:00	OPENING Ato Haile (Addis Ababa City Administration)
9:20	DESCRIPTION OF PROJECT ACTIVITY Dr. Araya (HoA-REC)
9:40	QUESTIONS AND ANSWERS Panel of experts – Moderated by Dr. Araya (HoA-REC)
10:00	EVALUATION FORM FOR PARTICIPANTS Aysheshum (HoA-REC)
10:15	COFFE AND TEA BREAK
10:30	PANEL DISCUSSION ON PROJECT PERIOD Panel of experts – Facilitated by Abiy (HoA-REC)
12:00	CLOSURE Addis Ababa City Administration

E.2. Summary of comments received

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Ato Haile Fisseha, General Manager of the Addis Ababa City Administration, opened the meeting with a briefing on how the 43-year-old landfill was already in the process of being closed and will serve as a model for Ethiopia in terms of future landfill closures throughout the country. Dr. Araya of HoA-REC then described the project activity in details including provision of information on impacts of the project

on environment and the communities. He further explained that the closure of the Repi landfill will reduce carbon emissions. The methane capturing system will be a part of the planned CDM project that will generate income for trash collection and the maintenance of a future landfill in and around Addis Ababa.

The participants of the meeting were asked to fill evaluation forms of current conditions related to the landfill. They engaged the panel of experts (representing the Addis Ababa City Administration, HoA-REC, ENDA-Ethiopia and AfD) with first-hand accounts of life in the neighbouring community of Koshe and their desire to fully participate in the facilitation of the Repi landfill closure.

An account of the questions asked by the participants and the clarifications provided thereof is provided below:

Questions and answers on the project activity

1. **Stakeholder Name: Addis Mekuria** - Q: A resident expressed his thanks for the development of the project. He noted that previously, it had been difficult trying to rent out homes and though the closure had been promised in the past, it never happened. The question: When will the facility actually be closed?

   A: Dr. Araya stated that the initial closure of Repi has already begun, and the first phase (closure of the two inactive areas within the landfill) will result in 70% of Repi being closed by May 2012. The entire closure process will take 2 years in total. The French Development Agency, AfD, has already contracted a Finnish company to oversee the closure at a cost of 30,000,000 ET (approximately $1.7 million USD)

2. **Stakeholder Name: Desalegn Busta -** Q: A resident who has lived and worked in Repi for the past 24 years expressed that she is happy with the project development. The questions: i) What will happen to the residents – and how will they benefit from the closure; and ii) What will happen with the pungent smell of the dump, usually worst in the months of September and October?

   A.i) Ato Nega of the AACA stated that the organization ENDA-Ethiopia has received a 1 million ETB (approximately $58,000 USD) to conduct an assessment of the existing Repi community, including those living on the landfill, to determine their future needs.

   A.ii) Dr. Araya of HoA-REC stated that the smell coming from the dump tends to be worse in the rain and during the rainy season due to a higher release of methane gas. But by May 2012, there is expected to be a great reduction in the release of methane and, subsequently, the smell.

3. **Stakeholder Name: Mulgeta Abrhaim** - Q: An official from the Energy Ministry asked, for how long can the methane be captured?

   A: Dr. Araya stated that this is a 10-year CDM project and that the release of methane gas should be reduced by ½ during that period. The methane will however be captured for a period of 20 years which is the operational lifetime of the project.

4. **Stakeholder Name: Dereje Gudeteria -** Q: From the organization True Concern, this man stated that they have provided health benefits to over 1,000 members of the neighboring community. The question: how many residents live on the landfill?

   A: Ato Nega of responded that Azeb will elaborate on community issues during the afternoon session, but that approximately 500-600 residents are affected.

Discussion on the project period

1. **Stakeholder Name: Feye Bedane** - Q: A resident expressed that he is very happy about the project and said that during the Derg Regime, an official told them (in response to questions about the closure of Repi) that they came to the trash; the trash did not come to them. Also, the smoke is not coming from leaves or wood- it's plastic. It is especially strong in the morning. The question: when will this smell subside?

   A: Dr. Araya responded that beginning in May 2012, the smell should subside considerably.

2. **Stakeholder Name: Demelash Mekele -** Comment only: A resident expressed his thanks for the gathering, and the opportunity to share his thoughts. He said the closure of Repi is a bit late, but that it's never really too late. He also stated that he takes medication every 6 hours because of the effects of the odor coming from Repi.

3. **Stakeholder Name: Mesam Chere -** Comment only: An inspector from the local police station stated that someone should go to Repi for a community briefing on this matter.

4. **Stakeholder Name: Abebe Mokyarew -** Q: A kebele (local sub-discrict) official comment that this community has been given hope for some time on the closure of Repi and that he estimates that over 300 people scavenge at the dumpsite and consider this a wealth-maker. The question: What are the plans for these scavengers?

   A: Azeb of ENDA replied that the community knows better than anyone what their best options are which direction we should be going in, in terms of future planning. Her organization will solicit suggestions from these community members at future community meetings. Also, she said that she is open to suggestions from participants of today's meeting for suggestions on how to assist community members.

5. **Stakeholder Name: Dawit Mitiku -** Comment only: What appeared to be a resident of the actual landfill asked, are we giving priority to the trash or the community members? We need to clean up both the landfill and the community members.

6. **Stakeholder Name: Bergisa Bekele -** Q: A resident who lives and works in Repi stated that the direction of the river should matter in the plan. The question: he had not heard of health services being offered to the community and when will organizers register members of the community to ensure that they all receive necessary benefits?

   A: Azeb of ENDA replied that registration of community members has not begun yet.

7. **Stakeholder Name: Ajema Degi -** Q: A police officer asked who is managing incoming vehicles, trucks especially, which sometimes dump the trash, then travel in the opposite direction of oncoming traffic during their return to Addis Ababa?

   A: Dr. Araya oh HoA-REC replied that this will no longer be an issue once Repi is completely closed.

8. **Stakeholder Name : Mekonnen Maschal -** Comment only: A participant emphasized the importance of keeping the residents in mind when developing the business plan for the planned recreational park at Repi. He suggested that the current residents living on the landfill could take on jobs such as tree planting.

E.3. Report on consideration of comments received

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The project proponents took note of all the comments and provided appropriate clarifications (as stated above) to the queries/concerns of the local stakeholders. The following table provides a brief assessment of the comments received:

Stakeholder comment	Was comment taken into account (Yes/ No)?	Explanation (Why? How?)
Resident thankful for the gathering, and that he had been getting sick from the landfill before the project activity.	Yes	Reaffirmation of the benefits of the project activity
Local police stated that the presentation should also be given in the locality in addition to in the City Hall.	Yes	Another presentation of the project activity is planned for in the locality, facilitated by ENDA.
Resident of the project site said that both the waste and the people should be cleaned.	Yes	The City Administration has put 1million ETB (US$58,000) into a project for the reintegration of those affected by their loss of incomes by the project activity.
Resident of the local area said that the City Administration should hire local people for labour of the landfill closure, for example tree planting.	Yes	The final closure the landfill site will not eventuate until the end of 2013. However, interim works such as assistance during the landfill gas pump tests have used local labourers.

Table: Assessment of Comments

A detailed stakeholder consultation report has been prepared which provides all the details on the invitation process, meeting attendees, presentation content, queries and their responses, evaluation forms etc.

SECTION F. Approval and authorization

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The Letter of Approval from the Environmental Protection Authority, the DNA of Ethiopia was obtained on 06/11/2012.

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Appendix 1: Contact information of project participants

Organization name	Addis Ababa City Administration
Street/P.O. Box	N/A
Building	Woreda 16
City	Kolfe-Keranyo Sub-City, Addis Ababa
State/Region	Addis Ababa
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Mobile	+251911334044
Direct fax	+251111568736
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Personal e-mail	hailefes@yahoo.com

Appendix 2: Affirmation regarding public funding

There is no recourse to any public funding for the proposed project activity.

Appendix 3: Applicability of selected methodology

An account of the applicability of the selected methodology has already been stated under section B.2.

Appendix 4: Further background information on ex ante calculation of emission reductions

The information on ex ante calculations is already provided under section B.6.3.

Appendix 5: Further background information on monitoring plan

All information related to the monitoring plan has already been provided under section B.7.

Appendix 6: Summary of post registration changes

Not applicable.

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for CDM project activities" (EB 66, Annex 8).
03	EB 25, Annex 15 26 July 2006	
02	EB 14, Annex 06b 14 June 2004	
01	EB 05, Paragraph 12 03 August 2002	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		