JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
Version 01 - in effect as of: 15 June 2006

CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

"Landfill methane capture and flaring at Yalta and Alushta landfills, Ukraine"
Document version number: 08
17 February 2009

A.2. Description of the project:

The project "Landfill methane capture and flaring at Yalta and Alushta landfills {hereinafter referred to as Sites}, Ukraine" {hereinafter referred to as Project} has been developed by Scientific-Engineering Centre Biomass, Ukraine and Carbon Capital Markets Ltd., UK.

The Project consists of developing a Landfill Gas ("LFG") collection and flaring system in order to avoid emissions of methane being released into the atmosphere. LFG production results from waste decay in the anaerobic conditions created in the landfill body and contains approximately 50% methane ("CH_4"), which is a powerful greenhouse gas ("GhG") contributing to global warming. Additionally, LFG is a fire hazard and causes bad odours in the vicinity of the site. By capturing the LFG, GhG emissions are reduced, local environmental impacts are mitigated and the operational safety of the site is increased.

The Ukrainian towns of Yalta and Alushta have a population of 150,000 and 60,000 inhabitants, respectively, and are located 30 km apart. They are served by two separate landfills located at a distances of up to 10 km from the towns.

The **Yalta landfill** has a total extension of 5.7 hectares and commenced operation in 1973. It is located at the distance of 1 km from the Gaspra village at the territory of a nature reserve. Initially, the landfill was opened as a waste dump without any environmental protection measures: there is no lining system at the landfill bottom and a leachate drainage system was constructed, however it is not in operation. The waste is placed in an area of 4.15 hectares. Approximately 110,000 tonnes of waste per year enters the landfill and the total amount of waste in the landfill is approximately 1.2 million tonnes. The waste type is mainly the municipal solid waste, but also a portion of construction debris is reported to make about 10-20% of waste amount in the non-summer period when the construction and rehabilitation of resort places is very active. Yalta landfill consists of two sections one of which with a total area of 3.4 hectare has already reached its capacity and is closed. The other adjacent part that is currently receiving waste has an area of 0.75 hectare and is about to be closed in the coming months. The LFG collection system will be installed both at the old part of the landfill and currently filled new part after its closure.

The landfill owner is Yalta community (in person of Yalta City State Administration). A company, Altvater-Krim, leased the landfill from municipality in 1997 and is currently the only waste transportation and landfill operation company in "Big Yalta". Big Yalta consists of the city of Yalta and 8 adjacent town-type villages with total population of 150,000 inhabitants. However, in the summer period the population of the region is approximately doubled due as a result of tourism. Altvater-Krim has 61 working staff and 17 waste delivery trucks of 12, 15, 16 m^3 capacity that are collecting waste from the households, offices, private and communal organizations on a daily basis. The waste coming to the landfill is registered by number and capacity of incoming trucks considering the compacting factor of 3.5. The levelling of waste is carried out by bulldozers on a regular basis (each 2 meters of waste layer height).

Operation of the **Alushta landfill** commenced in 1960 as a waste dump. It is placed at the distance of 4 km from closest Luchistoe village. The landfill total area is 6.9 hectares with approximately 830,000 tonnes of waste in place dumped on the area of 3.2 hectare. The landfill owner is Alushta community (in person of Alushta City State Administration) and the landfill operator is the municipal waste transportation company with 100% communal ownership. The yearly amount of waste delivered to the landfill is about 40 thousand tonnes. Today, the landfill has not reached capacity and, therefore, has no plans to close during the next 10 to 15 years. The waste type is mainly the municipal solid waste, but a portion of construction debris is reported to make about 10 to 20% of the waste in the non-summer period when the construction and rehabilitation of resort places is very active. The landfill bottom is a ravine with declining elevation level. Currently the landfill depth varies from between 5 to 10 metres to about 40 metres. The area where a LFG collection system will be installed is about 2.8 hectare with depth of 10-40 metres.

Municipal transportation company serves “Big Alushta” district consisting of Alushta town and 27 adjacent villages with total number of inhabitants of about 60,000. However, in the summer period, the population of the region is approximately doubled due to tourists. The company has 57 employees and 11 waste collection vehicles. Waste collection is being carried out on a daily basis and up to 3 times a day in summer period. The waste coming to the landfill is registered by number and capacity of incoming trucks. The levelling of waste is carried out by bulldozers on a regular basis (each 2 meters of waste layer height).

On both Sites, connection to the power grid is unavailable and there are no plans for it to be connected in the next 10 years. Consequently power generation will not be realized as part of the project activity.

Municipalities of both towns have signed the concession agreement granting the rights for degasification of landfills and utilization of LFG to the Ukrainian private company Gafsa-Skhid for a 10-year period. Gafsa-Skhid (solely as a part of special-purpose investment and operation vehicle) will be the owner and operator of the described projects at both sites.

The Project will contain the main activities at the Sites including:

- installation of wells and a piping network for LFG collection,
- installation of a flaring system including gas booster, flare and monitoring system, and
- a gas engine generator for onsite power requirements

Additional remediation activities at the landfill will address its environmental liabilities. These include:

- reshaping the land and accumulated residues; and
- sealing the site with an industrial liner to facilitate the correct drainage of the biogas and contribute to the stability of the landfill as well as prevent methane from leaking into the atmosphere.

Planned Project Implementation is presented below.

1. **June 2007 –** Project Design Document (PDD) prepared and project business plan finalized.
2. **July 2007** – Investment agreement completed and signed.
3. **August 2007** – Obtaining Letter of Approval from Ukrainian Government
4. **September 2007**- Drilling of wells started. Installation of pipes. Purchase of flaring plant and monitoring equipment.
5. **February 2008** – Drilling of wells completed.
6. **March** to April 2008 – The project management company, Carbon Assets Fund Ukraine LLC, was incorporated under the Ukrainian law.

7. **May to June 2008** – Importing of flaring equipment to Ukraine and delivery to the site[1].
8. **June to August 2008 –** Project testing and project trials
9. **September 2008 –** Project fully operational.

The ex-ante analysis shows that the average amount of methane collected annually during the period of 2008-2012 will be 1.4-1.8 thousand tonnes of methane tonnes per year at the Yalta landfill and 0.6-0.7 thousand tonnes of methane per year at the Alushta landfill. Flaring of the LFG is expected to achieve an estimate of **217,182 tonnes** of CO_2e reductions over the 5-year commitment period.

Besides GHG emission reductions, degasification of the landfill will contribute to the improvement of local environmental, economic and social situations; providing benefits; the most important of which are listed below:

- increasing safety of landfill operational procedures;
- demonstrating the state-of-the-art technology of LFG recovery in Ukraine and knowledge of the best landfill site management after the closing time, thus creating a better environment for replicating of similar investments projects; and
- increasing clean technology investments and promoting of renewable energy sources.

A.3. Project participants:

Party Involved	Legal entity project participant	Does the Party involved wish to be considered as project participant
Ukraine (Host Country)	• Gafsa-Skhid	No
UK	• Carbon Capital Markets Ltd	No

A.4. Technical description of the project:

A.4.1. Location of the project:

The project location is shown on the maps below.

A.4.1.1. Host Party(ies):

Ukraine

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

Autonomous Republic of Crimea.

A.4.1.3. City/Town/Community etc.:

Yalta and Alushta towns.

[1] Invoices confirming the ownership transfer of the flaring equipment from Carbon Assets Fund to Carbon Assets Fund Ukraine LLC have been provided to the DOE. They were dated on 2008-05-15 and they contain custom seals with dates (2008-05-29 for Yalta and 2008-05-28 for Alushta) corresponding to the dates when the equipment cleared the custom in Ukraine. They are the evidence of the date when the equipment was physically imported to Ukraine for the project.

A.4.1.4. Detail of physical location, including information allowing the unique identification of the project (maximum one page):

The Project is located in the Autonomous Republic of Crimea in the Ukraine on the Black Sea at the municipal landfills of Yalta and Alushta. The two towns are located approximately 30 km apart. Yalta has a population of 150,000 inhabitants and Alushta has 60,000 inhabitants. Yalta and Alushta towns are marked with red dots on the map below (*Figure 1*).

Figure 1: Towns of Yalta and Alushta (Autonomous Republic of Crimea, the Ukraine)

The Yalta landfill is located next to the village of Gaspra at a distance of 8-10 kilometres from Yalta and 40 kilometres from Alushta. The Alushta landfill is located next to Alushta at a distance of 6 kilometres from Alushta and 35 kilometres from Yalta. The Sites are highlighted below (*Figure 2*).

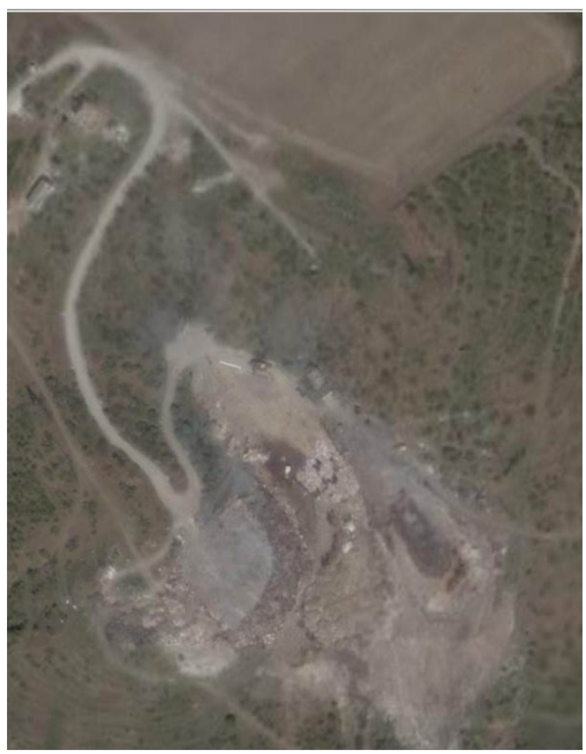

Figure 2:Yalta and Alushta landfills (left to right)

The Yalta landfill site is located at the following coordinates: 44º27’01’’N and 34º06’323’’E. The Alushta landfill site is located at the following coordinates: 44º43’18’’N and 34º26’06’’E.

A.4.2. Technology(ies) to be employed, or measures, operations or actions to be implemented by the project:

The Project activity involves installation of active LFG collection systems and efficient gas flaring plants on the Sites.

Additional future remediation activities could include reshaping of the landfill body in order to prepare it for LFG collection system installation and landfill capping.

The Project activities are summarized below:

(a) Remediation (landfill covering system)
(b) Landfill gas collection system
(c) Gas flaring
(d) Gas engine generator (for onsite use only)

(a) Remediation

The landfill will be prepared to support the collection and flaring of the landfill gas, as well as to mitigate current, adverse environmental impacts. This could include capping the landfill surface and slopes to prevent ingress of water and natural ventilation of the landfill gas. Capping will either be a layer of compacted clay or a low permeability geomembrane.

(b) Landfill gas collection system

Technology description. The main elements of LFG collection system are listed below:

- vertical gas extraction wells with regulation valves and connection units for monitoring of gas composition;
- gas transport pipes, transporting gas from the wells to the integrated gas boosting and flaring plant; and
- condensate shafts.

At each landfill, perforated plastic vertical gas extraction wells will be established in the waste material and will be connected to the blower system through a network of horizontal underground piping installed on/around the perimeter of the landfill. The LFG collection piping consists of a header, sub-headers, and laterals. LFG flows from the wells through the lateral and sub-header piping to the header piping to the gas control plant. The flow of gas can be controlled at each of the individual vertical extraction wells through the use of a valve located at the top of the well piping. Each well will be individually controlled to ensure that the collection systems can be effectively set up and balanced. The systems will be manually monitored and controlled and each wellhead will be equipped with a secure monitoring chamber and monitoring ports for gas composition, pressure, and temperature readings. Non-perforated LFG collection piping will be utilized to convey the LFG from the extraction wells to the gas control plant at the landfills. The gas collection pipe work allows for effective condensate management by employing dewatering points at strategic low points and returning the condensate back to landfill. It should be noted that the project will not affect the wastewater treatment of the landfill.

Projection for LFG collection at the Sites. Tentative analysis shows that approximately 8-10 million m^3 of LFG with 50% methane content is likely to be generated annually during the period of 2008-2012 at the **Yalta** landfill. It is assumed that about 35 LFG extraction wells will be installed at

Yalta landfill providing coverage of 70% of waste accumulated. The system of pipes is radial with the flaring plant placed in the centre of landfill. Each set of 5 to 7 wells will be radially combined through laterals in the 1st stage collector. After which, the gas will pass to subheaders and headers and finally proceed to the flaring plant.

The overall LFG collection efficiency is a function of percentage of the area covered by extraction wells (70%), well efficiency (80%) and well availability (90%). Considering the overall recovery rate of 50% approximately 3.9-5.1 million m^3 of LFG (**1.4-1.8 thousand tonnes of methane**) will be annually collected.

A similar design of the methane collection system will be applied at Alushta landfill. Tentative analysis for **Alushta** landfill shows that approximately 3.4-.4.0 million m^3 of LFG with 50% methane content can be generated annually during the period of 2008-2012. It is assumed that about 36 LFG extraction wells will be installed at Alushta landfill providing coverage of 70% of waste accumulated. Considering the overall recovery rate of 50% approximately 1.7-2.0 million m^3 of LFG **(0.6-0.7 thousand tonnes of methane)** will be annually collected.

The configuration of the gas collection wells will be sensitive to landfill characteristics, such as varying depths and slopes, determined in the design phase.

(c) Gas flaring integrated booster and flare station

The majority of the collected LFG will be flared with a small proportion being utilised by the gas engine generator to provide electricity to the project activity.

Flaring will use a high-temperature flare in an integrated booster and flare station. The system operates at slightly lower than atmospheric pressure. The blower system will exert vacuum through the piping system to the system of vertical wells. Extracted LFG will be delivered to high-efficiency, state-of-the-art, enclosed flares for destruction of the methane component of the extracted landfill gas.

The flaring plant consists mainly of the following components: manifold for the incoming pipes, flow control valves, gas pressure boosting pumps, enclosed high-temperature flare stack, gas monitoring and analysis system.

The main components of the gas flare system are presented below:

- Pipe work: connects all the elements of the flare from the mains header pipe to the burners via a demister with filter element, isolation and control valves, blower and instrumentation. The demister element protects the fan from moisture and particulates that flow with the gas from the waste deposit.
- Flame arrestor device: to avoid flashback of a flame to the fuel feed pipe.
- Burner(s): to provide controlled mixing of the fuel and air and ensure controlled combustion over a range of landfill gas flow rates.
- Ignition system: to provide safe, controlled ignition of the landfill gas.
- Air inlet dampers and thermocouples in the stack: control flame temperature.
- Combustion air system: to provide air for combustion support, depending on burner load. The additional air is drawn into the chamber by natural draught via control louvres or open vents.
- Stack: the stack height of the flares will be specified to provide sufficient residence time for destruction of compounds in the gas at high temperature and in a controlled environment to destroy extracted methane.
- Control panel: houses all of the flare controls, motor starters, alarms and interlocks that ensure safe operation of the flare.
- Gas engine generator: used to supply the project activity with power
- Start-up diesel generator: used to start up the whole project system

The unit includes sophisticated monitoring equipment that will be comprehensively described in the following sections (please refer to the section D) and is briefly listed below:

- flow meter to measure the volumetric flow of the gas through the system;
- LFG pressure and temperature transducers for calculation of the gas mass flow rate;
- gas analyser (methane, carbon dioxide, oxygen, nitrogen) that measures the quality of the gas delivered to the flare;
- sampling points for taking gas samples with portable instrumentation and for laboratory analysis;
- thermocouple that monitors the temperature of the flame in the stack and feeds back the signal to the automated air louver in order to maintain the temperature within the stack at the desired level; and
- data logging system.

(d) Electricity Generation

The LFG utilisation system requires a certain quantity of electricity to operate. A small gas engine generator is used to provide electricity for on-site system power requirements including blowers, computers, lighting, etc. Uniquely, the gas engine generator utilises LFG derived from the landfill site as fuel. Additionally, to start up the entire system requires a small diesel generator is used. Once the gas engine generator has commenced full operation and is delivering power to the system the start-up diesel generator turns off. Consequently, the start-up diesel generator is only in operation for approximately 5 minutes during the system start-up period.

The start-up diesel generator unit is a fully containerised external unit. Whilst the gas engine generator consists of an indoor , acoustic, containerized generating set with an engine/alternator set.

Origin of technology. There are no landfills applying active LFG collecting and flaring. Much of the flaring system and controls, therefore, will come from abroad. Training to properly maintain and operate the equipment will be arranged for local operators and engineers.

In the table below, the expected origin of the LFG collection and flaring/LFGTE system components is given.

Component	Imported or locally manufactured	Standard
Wells	Locally manufactured	According to Ukraine standards
Gas collection system	Locally manufactured	According to Ukraine standards
Flaring system	Imported from EU	According to EU Standards
Diesel power plant	Locally manufactured	According to Ukraine standards
Gas engine generator	Locally manufactured	According to Ukraine and EU standards
Monitoring and control systems	Imported from EU	According to EU Standards

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

Most Ukrainian landfills were started as unauthorized dumps and are not in compliance with any environmental protection measures as regards LFG control. Before 2005, national standards on landfills operation did not envisage mandatory LFG control. In 2005, National Construction Standard DBN V.2.4-2-2005 Basics of Sites Design was introduced containing requirements on LFG collection and flaring/utilisation after the landfill closure. However, municipalities and municipal companies operating landfills are in a poor financial state and cannot invest in such projects. Moreover, implementation of LFGTE technologies in Ukraine as commercial projects is not possible due to low electricity tariffs. Other hurdles for introduction of LFG collection technologies are presented by a number of investment and technological barriers. LFG recovery projects have yet to be implemented in Ukraine and are unlikely to be implemented on a wider scale for the coming decade.

At present, LFG at the Project Sites is vented into the atmosphere. Application of LFG capture and flaring technology will allow abatement of methane release into the atmosphere that would otherwise occur under the continuation of the current landfill operation practice.

In the baseline scenario-without-project the GhG emissions will be as follows:

1. full release of landfill methane into the atmosphere;

The emission reduction from the Project implementation will be as follows:

1. **Abatement of methane release into the atmosphere.** Methane in the form of landfill gas will be captured and destroyed through flaring and utilisation from the onsite gas engine generator.

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

The emission reduction estimates for Yalta and Alushta landfills are given in the table below.

Length of the crediting period	Estimate of annual emission reductions in tonnes of CO2equivalent		
Year	**Yalta**	**Alushta**	**TOTAL**
2008*	15,507	6,925	22,432
2009	28,705	12,368	41,074
2010	30,706	12,848	43,553
2011	32,603	13,313	45,917
2012	34,415	13,768	48,183
Total estimated emission reductions over the crediting period **2008-2012** (tonnes of CO_2equivalent) reflects only operating months in 2008.	**141,937**	**59,222**	**201,159**
Average emissions reductions over the crediting period **2008-2012** (tonnes of CO_2equivalent)	**30,968**	**12,921**	**43,889**

*Reflects only the expected operating months in 2008 (full 5 years would be 217,182 tonnes)
Note numbers may not add exactly due to rounding.

A.5. Project approval by the Parties involved:

Letter of Endorsement for Yalta and Alushta LFG project from the Ministry of Environmental Protection of Ukraine is available on request.

SECTION B. Baseline

B.1. Description and justification of the baseline chosen:

The baseline and monitoring methodology to be applied for the proposed project activity is the approved consolidated baseline methodology ACM0001, version 5, December 2006: ***"Consolidated baseline methodology for landfill gas project activities"*** and ***"Consolidated monitoring methodology for landfill gas project activities"***.

B.2. Description of how the anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the JI project:

The baseline is the atmospheric release of the gas with no capture and destruction. Landfills in Ukraine operate in a state of non-compliance with existing environmental legislation due to poor finances of landfill owners and operators as well as lack of technical knowledge.

The determination of project scenario additionality is made using the *"**Tool for the demonstration and assessment of additionality, version 5, Annex 10, EB 39**"* agreed by the CDM Executive Board:

Step 0: Preliminary screening based on the starting date of the project activity

This step is not applicable to the Project Activity.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define alternatives to the project activity:

	Alternatives to Project Activity	Probability of Scenario
1	The continuation of the current situation: no landfill gas extraction	*Most probable*: Current practice shows that the regulations on landfills across the Ukraine are not enforced. In addition, the technical expertise and financial investment to engage in the LFG collection project is not available in Ukraine. Therefore, it is not expected that the regulation requiring the capture and destruction of landfill gas at the Sites will be followed.
2	Extraction of landfill gas and combustion of the gas in a flaring stack for methane emission reduction only (as non-JI project);	*Not probable*: The project activity requires funds for both construction of the required facilities and to maintain operations. There are no known or funding sources available to support this project and the existing regulatory requirements regarding emissions control is not expected

	Alternatives to Project Activity	Probability of Scenario
		to be followed. Furthermore, this alternative does not itself provide any potential revenue to the landfills, it is therefore not considered a plausible alternative.
3	Landfill owner invests in the landfill gas extraction system and LFG power generation equipment for electricity production and supply to the public network (as non-JI project);	*Not probable*: On both Sites, connection to the power grid is unavailable and there are no current plans for it to be connected. Thus provision of electricity to potential consumers would require additional spending on electricity generation units, transformer, and construction of transmission lines. As well, power generation is not a business area of the project developer's. Consequently power generation is not an attractive option and, therefore, not probable.
4	A different use of biogas offsite is proposed	*Not probable:* *Heat off-take:* No significant off-takers for heat energy are within reasonable distance. Delivery of heat energy to a long-distance off-takers will require installation of additional equipment and significant heat transportation pipelines. Thus energy deliveries are economically unattractive. *Fuel production:* The fuel production and transportation would add high cost, risks and complication to the project that are out of the main business area for the project developer. The fuel production would require installation of additional equipment, gas condensation station and execution of additional agreements with a fuel retail network. Due to location of the landfill sites – high latitudes – the logistics of the fuel product distribution is not viable. Consequently fuel production is not probable.

The above analysis shows that alternative 4 is not plausible. Alternatives 2 and 3 are plausible, but not probable. The only reasonable alternative to the project activity is the continued uncontrolled release of landfill gas to the atmosphere as part of the "business-as-usual" scenario at the site.

Sub-step 1b. Enforcement of applicable laws and regulations:

Before 2005, national standards on the operation of landfills did not envisage mandatory LFG control. In 2005, National Construction Standard DBN V.2.4-2-2005 Basics of Sites Design was introduced containing requirements on LFG collection and venting after the landfill closure. However, historically, the legal requirements on proper operation of landfills have not been enforced mainly due to financial barriers. Hence non-compliance with those requirements is widespread in the Host country. Due to financial state and lack of technical knowledge, this is expected to continue. Presently, common practice shows that existing landfills in Ukraine do not capture and flare or utilise their landfill gas (please refer also to *Step 4. Common Practice Analysis* below).

Thus, even if Alternative 1 does not comply with the existing regulation it is considered a plausible baseline scenario. All other alternatives are consistent with aforementioned legislation.

Step 2. Investment Analysis

Sub-step 2a: Determine appropriate analysis method
According to the "Tool for the demonstration and assessment of additionality", one of three options must be applied for this step: (1) simple cost analysis (where no benefits other than JI income exist for the project), (2) investment comparison analysis (where comparable alternatives to the project exist), or (3) benchmark analysis.

As no benefits other than JI income exist for the project, the simple cost analysis will be applied.

Sub-step 2b: Apply simple cost analysis
In order to implement and register the project under the Joint Implementation, investment needed to be made to the purchase of project equipments, and the inclusion of the feasibility study and pumping tests, which is estimated to be about 850,501 Euro. The LFG system will also incur additional expenses once it becomes operational (e.g., maintenance, management, administrative) of approximately 6% of the total capital cost.

The Table below summarizes approximate values regarding the project:

Investment	
Project equipments, feasibility study and pumping test	€850,501
Operational Expense (maintenance, management, administrative)	
6% of the total capital cost	€51,030

The project is set-up to destroy the methane contained in the LFG for environmental purpose. The result of the above analysis shows that the project is not the most financially attractive option, and that it can only be implemented with the income associated with the JI registration.

Sub-step 2c: Calculation and comparison of financial indicators.

Not applicable due to the selection of the simple cost analysis method.

Sub-step 2d: Sensitivity analysis

Not applicable due to the selection of the simple cost analysis method.

Step 3. Barrier analysis

Step 2 of the *'Tool for the demonstration and assessment of additionality'* has been used, thus this step is no longer necessary.

Step 4. Common Practice Analysis

Sub-step 4a: Analyse other activities similar to the proposed project activity
In spite of the 2005 regulation, waste disposal in Ukraine is, in many cases, carried out at landfills and dumpsites that are improperly located, mainly in terms of hydro geological conditions and distance to water bodies, wells and aquifers.

Furthermore, the vast majority of the landfills and dumpsites, of a similar age to the Project Sites (20 – 40 years old), are not properly designed with regard to surface water diversion, leachate collection and treatment and also landfill gas management. The operation of many landfills and dumpsites is not carried out with a view to minimise the adverse impacts on environment and human health.

Waste is often disposed over large areas rather than in small well-defined cells and without proper soil cover, resulting in wind dispersal of waste and odour nuisances and enhanced leachate generation. Proper operation of leachate collection and treatment systems as well as gas management systems is uncommon.

The table below presents information regarding a representative sample of landfills throughout the Host Country.[2] The sample represents 40% of the major landfills servicing large cities with number of inhabitants of more than 200 thousand persons.

Landfill site / Aspects investigated	Number of inhabitants serviced by landfill, in thousand	Annual waste amount (uncompacted) 1000 m^3 in 2004	Total amount of waste collected to 2007 (uncompacted), million. m3	Starting year of landfill site operation	Total landfill area, ha	LFG control
Yalta	150	379	3.8	1973	5.7	None
Alushta	60	142	3.5	1960	6.9	None
Zhytomir	300	300	8.0	1957	18.7	None
Vinnitsa	385	340	5.1	1985	5	None
Khmelnitsky	250	490	14.8	1956	8.8	None
Chernivtsi	260	340	2.7	1995	25	Passive venting
Ivano-Frankivsk	230	260	3.0	1992	22.4	None
Lutsk	215	340	3.6	1991	9.9	None
Rivne	245	400	12.2	1959	24.5	None
Kirovohrad	280	260	10.9	1949	23	None
Cherkassy	310	360	4.8	1992	9	Passive venting
Kremenchuk	245	290	12.3	1965	28	None

As the table indicates, landfills in Host Country either have: a) no system for collecting, venting or flaring LFG, or b) passive system for venting LFG only.

One demonstration project on LFG collection and flaring was implemented at the Lugansk landfill in 2002 supported by EcoLinks grant and USAID. The project was aimed at demonstration of LFG control practice, thus promoting development of clean technologies and renewable energy sources. Three LFG extraction wells, collecting pipe and a flare were installed at the landfill and monitored for a year, however this work has not had any follow-up activities upon project completion.

Other than this demonstration project, LFG collection and flaring or utilisation systems have not been implemented in Ukraine, and the vast majority of landfills do not have a LFG control system at all. Development of LFG projects was started in the JI framework only, specifically: project design

[2] Identification and preparation of ProjectPreCheck (PPC) documents for LFG collection and utilization projects in Ukraine. Final report. For KfW Entwicklungsbank; by DECON Gmbh, SEC “Biomass”, June 2005.

documents for Kyiv, Donetsk and Kharkiv landfills were developed by Danish Environment Protection Agency (DEPA, Copenhagen, Denmark) in the beginning of 2004 and letter of approval was obtained for Kharkiv landfill. However, implementation of the above projects has not been started due to reduction of the project activities of DEPA in Ukraine and absence of a potential project investment company.

There are also LFG capture projects currently being developed as JI projects at several other landfills (e.g. Poltava, Belaya Tserkov, Kremenchuk, Dnipropetrovsk), that are at different stages of development.

Sub-step 4b: Discuss any similar options that are occurring
Discussions on installation of gas collection and flaring systems in Ukraine have only started in the context of the JI scheme application. Several projects are being prepared as JI projects and are at the different stages of development from Project Idea Note to development of PDD.

B.3. Description of how the definition of the project boundary is applied to the project:

The flow diagrams of the Project activity and system boundaries are presented on the figures below.

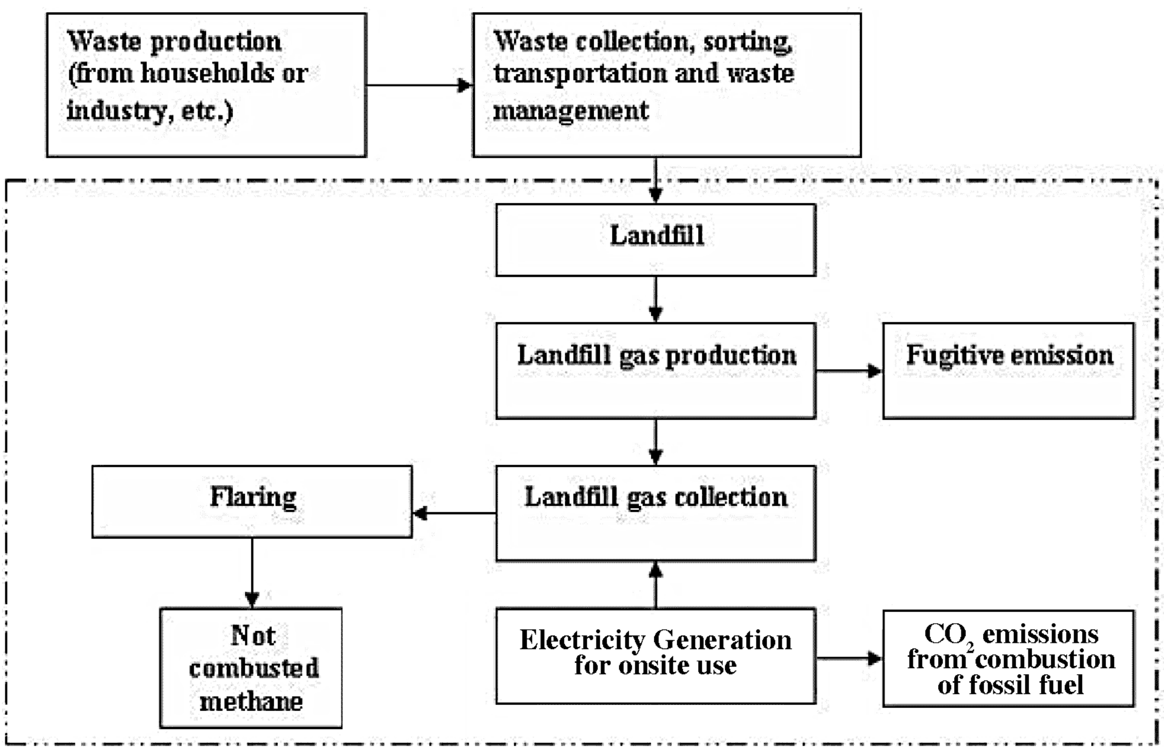

Figure 3: Project boundary for the LFG flaring option

Summary of system and project boundaries

Emissions	Project scenario	Baseline scenario
Direct on-site	**CH_4:** Emissions associated with fugitive LFG emissions. **CH_4:** Emissions from methane not combusted in the flare (default value of 10%) **CO_2:** Emissions from LFG combustion either in flare or in power engine – not applicable. When combusted, methane is converted into CO_2. As the methane is organic in nature these emissions are not counted as project emissions. The CO_2 released during the combustion process was originally fixed via biomass so that the life cycle CO_2 emissions of LFG are zero. The CO_2 released is carbon neutral in the carbon cycle.	**CH_4:** Uncontrolled release of LFG generated.
Direct off-site	Transportation of equipment to project site – non-significant Emissions from diesel generator used for production of electricity for the needs of the plant.	None
Indirect on-site	None	None
Indirect off-site	None	None

B.4. Further baseline information, including the date of baseline setting and the name(s) of the person(s)/entity(ies) setting the baseline:

Date of baseline setting: 31 March 2007
Person/entity determining the monitoring methodology:

Scientific Engineering Centre "Biomass"
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SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

01/06/2008

The starting date was determined according to its definition in the JI glossary. As described in Section A.2, the flaring equipment was imported at the end of May[3]. The equipment arrived at the beginning of June and the installation commenced at that time.

C.2. Expected operational lifetime of the project:

15 years

C.3. Length of the crediting period:

During the first commitment period:
01/06/2008 – 31/12/2012

Beyond the first commitment period:
In consideration of recent Ukrainian government recognition, the project will request ERUs for the duration of, but not exceeding, the project operational lifetime.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

The approved monitoring methodology applied to this project activity is the **ACM0001 "Consolidated monitoring methodology for landfill gas project activities"** (Ver 05)**.** The methodology also refers to **"Tool to determine project emissions from flaring gases containing methane"** (Ver 01).

The monitoring methodology is based on direct measurement of the amount of methane captured and destroyed in the flare. The main variables that need to be determined are the quantity of methane actually captured, quantity of methane flared, and the fuel consumed by the start-up diesel power generator.

The actual tonnage of methane emissions reduced by the project is calculated based on flow rate of the landfill gas, methane concentration, and destruction/conversion efficiency of the combustion equipment. The monitoring plan provides for the continuous measurement of both quantity and quality of LFG captured and fed to the combustion equipment using a continuous flow meter and on-line LFG analyzer. Temperature and pressure of the landfill gas will also be measured.

The enclosed flare will be used for the LFG combustion and its efficiency is determined according to the ***"Tool to determine project emissions from flaring gases containing methane"*** (Version 01). This tool provides for a continuous monitoring of the residual and exhaust gas to determine flare efficiency. Should this not be possible, the tool's 90% default value will be used provided that compliance with manufacturer's specification of flare (temperature of the flare exhaust gas and others if applicable) proven through continuous monitoring of the specifications.

[3] Pro-forma Invoices stamped by the Ukrainian Custom House indicate that the equipment passed the custom clearance (28/05/08 for Alushta and 29/05/08 for Yalta). Shipping from Kyiv to Yalta/Alushta sites takes less than 48hr.

Calibration of the equipment and training of personnel will be conducted according to manufacturer's requirements. Detailed information will be provided in the final monitoring plan.

D.1.1. Option 1 – Monitoring of the emissions in the project scenario and the baseline scenario:

The section was left blank on purpose. Option 2 was selected.

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

The section was left blank on purpose. Option 2 was selected.

D.1.1.2. Description of formulae used to estimate project emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

The section was left blank on purpose. Option 2 was selected.

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

The section was left blank on purpose. Option 2 was selected.

D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

The section was left blank on purpose. Option 2 was selected.

D. 1.2. Option 2 – Direct monitoring of emission reductions from the project (values should be consistent with those in section E.):

D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	**Data variable**	**Data variable**	**Source of data**	**Data unit**	**Measured (m), calculated (c), estimated (e)**	**Recording frequency**	**Proportion of data to be monitored**	**How will the data be archived? (electronic/ paper)**	**Comment**
1.	$LFG_{total,y}$	Total amount of landfill gas captured	On-line LFG flow meter	m^3	m	Continuously	100%	electronic	Measured by a flow meter. Values to be averaged hourly or more frequently[4]. Data to be aggregated monthly and yearly. The methane fraction of LFG will be measured in ID 6.
2.	$LFG_{flared,y}$	Amount of landfill gas flared	On-line LFG flow meter	m^3	m	Continuously	100%	electronic	Measured by a flow meter. Values to be averaged hourly or more frequently[5]. Data to be aggregated monthly and yearly. The flow meter will collectively measure total LFG going both to the flare and gas engine generator.

[4] If values are averaged or measured more frequently than hourly, the monitored data would be at the same or higher level of rigour.

[5] Ibid

D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
3.	$LFG_{electricity,y}$	Amount of landfill gas combusted in power plant	On-line LFG flow meter (shared with 'LFG_{flared}')	m^3	m	Continuously	100%	electronic	Measured by the one LFG flow meter. Consequently, the gas engine generator will be treated like a flare, with the same combustion efficiency being applied. This approach is deemed conservative since the destruction efficiency of the flare is 'actual', and thus less than that of the destruction efficiency of a power generation unit (100%)
4.	$LFG_{thermal,y}$	Amount of methane combusted in boiler	N/A	N/A	N/A	N/A	N/A	N/A	No thermal boiler in this project

D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:									
ID number ***(Please use numbers to ease cross-referencing to D.2.)***	**Data variable**	**Data variable**	**Source of data**	**Data unit**	**Measured (m), calculated (c), estimated (e)**	**Recording frequency**	**Proportion of data to be monitored**	**How will the data be archived? (electronic/ paper)**	**Comment**
5.	$PE_{flare,y}$	Project emissions from flaring of the residual gas stream in year y	Various	tCO_2e	m/c	see comments	n/a	electronic	The parameters to determine project emissions from flaring will be monitored as per "Tool to determine project emissions from flaring gases containing Methane". These are: $fv_{i,h}$, $fv_{CH4,FG,h}$, $t_{O2,h}$ using a continuous gas analyser; $FV_{RG,h}$ using a flow meter; T_{flare} using a temperature sensor. Alternatively, a default of 90% will be used and the manufacturer's flare specifications (specific to the final flare design) will be continuously monitored.
5. (a)	T_{ex}	Thermocouple	Measure the temperature of flame in the flare	K	m	Continuously	100%	electronic	

D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:									
ID number *(Please use numbers to ease cross-referencing to D.2.)*	**Data variable**	**Data variable**	**Source of data**	**Data unit**	**Measured (m), calculated (c), estimated (e)**	**Recording frequency**	**Proportion of data to be monitored**	**How will the data be archived? (electronic/ paper)**	**Comment**
5. (b)	W_{O2ex} W_{CH4ex}	Measure volumetric fraction of O_2 and CH_4 in the exhaust gas	Gas analyser(s)	%	m	Continuously	100%	electronic	Measured continuously by Fluegas Analyser.
5. (c)	W_{CO2r} W_{O2r}	Measure volumetric fraction of components CO_2, O_2 in the residual gas	Gas analyser(s)	%	m	Continuously	100%	electronic	Monitored in accordance with Annex 13 Methodological “Tool to determine project emissions from flaring gases containing methane”. Measured by continuous gas quality analyser.
6.	$W_{CH4,y}$	Methane fraction in LFG	On-line gas analyser	m^3 CH_4 /m^3 LFG	m	Continuously	100%	electronic	Measured by continuous gas quality analyser, on dry basis. Values to be averaged hourly or more frequently[6]. Data to be aggregated monthly and yearly.
7.	T	Temperature of the landfill gas	Temperature probe	^oC	m	Continuously	100%	electronic	Temperature of the landfill gas will be measured to determine the density of methane in the landfill gas

[6] If values averaged or measured more frequently than hourly, the monitored data would be at the same or higher level of rigour.

D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
8.	P	Pressure of the landfill gas	Pressure gauge	Pa	m	Continuously	100%	electronic	Pressure of the landfill gas will be measured to determine the density of methane in the landfill gas
9.	ET_y	Thermal energy used in landfill during project	N/A	TJ	m	Annually	100%	electronic	Based on the operating hours of the diesel generator to draw a conservative estimate of fuel used.
9b.	$CEF_{thermal}$	CO_2 emission intensity of the thermal energy	UNFCCC Guidelines	t_{CO2}/ TJ	c	Annually	100%	electronic	Will be specific to the fossil fuel used on-site (diesel)
10.		Regulatory requirements relating to landfill gas projects	National regulations	Text	n/a	At the renewal of crediting period	100%	electronic	Required for any changes to the adjustment factor (AF) or directly MDreg,y.
11.	h	Operation of the energy plant	meter	Hours	m	Annually	100%	electronic	
12.		Operation of the boiler	N/A	Hours	N/A	N/A	N/A	N/A	N/A

D.1.2.2. Description of formulae used to calculate emission reductions from the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

The methodology ACM0001 "Consolidated monitoring methodology for landfill gas project activities" uses following formula for estimation of the GhG emissions reduction from the Project activity:

$$ER_y = (MD_{project,\ y} - MD_{reg})*GWP_{CH4} + EL_y*CEF_{electricity,\ y} - ET_y * CEF_{thermal,\ y} \quad (1)$$

Since electricity will not be generated nor exported to the grid the formula is amended to be:

$$ER_y = (MD_{project,\ y} - MD_{reg})*GWP_{CH4} - ET_y * CEF_{thermal,\ y} \quad (1)$$

Step 1

ER_y	GHG emissions reduction (in year y), in tonnes of CO_2 equivalents (tCO_2) as a result of project implementation
$MD_{project,\ y}$	The amount of methane that will be destroyed/combusted during the year, in, tonnes of methane (tCH_4)
$MD_{reg,\ y}$	The amount of methane that would have been destroyed/combusted during the year in absence of the project, in, tonnes of methane (tCH_4)
GWP_{CH4}	Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/CH_4
ET_y	Incremental quantity of fossil fuel, defined as difference of fossil fuel used in the baseline and fossil use during project, for energy requirement on site under project activity during the year y, in TJ
$CEF_{thermal,\ y}$	CO_2 emissions intensity of the fuel used to generate thermal / mechanical energy, in tCO_{2e}/TJ

Step 2

The amount of methane that would have been destroyed/consumed in the absence of the Project Activity is as:

$$MD_{reg} = MD_{project,y} * AF \quad (2)$$

The Adjustment factor ("AF") is defined as the ratio of the destruction efficiency of the collection and destruction system mandated by regulatory or contractual requirements to that of the collection and destruction system in the Project Activity. For this project, regulatory and contractual requirements are not considered and the baseline scenario chosen above is that all landfill gas would be released into the atmosphere. Therefore, the AF applied to the Project Activity is 0% and MD_{reg} is = 0.

Step 3

In the general case the formula used to determine $MD_{project,\ y}$ is as follows:

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y}$$

In Project activity following formulas can be applied:

$$MD_{project,y} = MD_{flared,y} \quad (3a)$$

Both components of the equations above are expressed separately in Step 4 and Step 7

Step 4

$MD_{flared,y}$ is the quantity of methane destroyed by flaring by the Project Activity. It is calculated as follows:

$$MD_{flared,y} = (LFG_{flared,y} * W_{CH4y} * D_{CH4}) - (PE_{flare,y} / GWP_{CH4}) \quad (4)$$

$LFG_{flare,y}$	The quantity of landfill gas fed to the flare during the year measured in cubic meters (m^3)
W_{CH4}	The average methane fraction of the landfill gas as measured* during the year and expressed as a fraction (in m^3 CH_4 / m^3 LFG)
D_{CH4}	The methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4)**
$PE_{flare,y}$	The project emissions from flaring of the residual gas stream in the year y (tCO_2)

(*) Methane fraction of the landfill gas to be measured on wet basis
(**) At standard temperature and pressure (101.325 kPa and 273.15 K) the density of methane is 0.0007168 tCH_4/m^3CH_4)

Formula for calculation of methane density D_{CH4} in every specific hour is:

$$D_{CH4} = \frac{P_{CH4}}{\frac{R_U}{MM_{CH4}} \times T_{CH4}}$$, where

D_{CH4}	The methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4)
P_{CH4}	Measured pressure of methane in the hour *h* (Pa)
R_U	Universal ideal gas constant (8 314 Pa.m3/kmol.K)
MM_{CH4}	Molecular mass of methane (kg/kmol)
T_{CH4}	Measured temperature of methane in the hour *h* (K)

Step 5

The Project Emissions (PE) will be determined following the procedure described in the "*Tool to determine project emissions from flaring gases containing Methane*". The tool offers two options for enclosed flares. Where possible, option 2 will be used: continuous monitoring of the methane destruction efficiency of the flare as per the tool methodology. According to the methodology, when the recorded temperature of the exhaust gas of the flare is lower than 500 °C for more than 20 minutes in an hour, the flare efficiency of the hour will be considered 0%. When option 2 is not possible, option 1 will be used: 90% default efficiency factor with continuous monitoring of manufacturer's specifications (temperature and flow rate of residual gas at the inlet of the flare). If in any specific hour, any parameter is out of the limit of manufacturer's specifications, an efficiency of 50% will be used.

This tool involves the following seven steps:
STEP 1: Determination of the mass flow rate of the residual gas that is flared
STEP 2: Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas
STEP 3: Determination of the volumetric flow rate of the exhaust gas on a dry basis
STEP 4: Determination of methane mass flow rate of the exhaust gas on a dry basis
STEP 5: Determination of methane mass flow rate of the residual gas on a dry basis
STEP 6: Determination of the hourly flare efficiency
STEP 7: Calculation of annual project emissions from flaring based on measured hourly values or based on default flare efficiencies.

These steps will be applied to calculate project emissions from flaring ($PE_{flare,y}$) based on the measured hourly flare efficiency or based on the default values for the flare efficiency ($PE_{flare,h}$). Steps 3 and 4 will be applied only in case of enclosed flares and continuous monitoring of the flare efficiency.

The calculation procedure in this tool determines the flow rate of methane before and after the destruction in the flare, taking into account the amount of air supplied to the combustion reaction and the exhaust gas composition (oxygen and methane). The flare efficiency is calculated for each hour of a year based either on measurements or default values plus operational parameters. Project emissions are determined by multiplying the methane flow rate in the residual gas with the flare efficiency for each hour of the year.

Step 6

For calculation of the amount of fossil fuel (diesel) used to generate electricity for the start-up of the LFG plant (ET_y, TJ) the quantity of diesel flow will be calculated based on the time the generator is in operation.

D.1.3. Treatment of leakage in the monitoring plan:

No leakage effects have to be accounted for under this methodology.

D.1.3. Treatment of leakage in the monitoring plan:

D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project:								
ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

No leakage effects have to be accounted for under the applied methodology.

D.1.3.2. Description of formulae used to estimate leakage (for each gas, source etc.; emissions in units of CO_2 equivalent):

No leakage effects have to be accounted for under this methodology.

D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

Please see Section D 1.2.2 for details.

D.1.5. Where applicable, in accordance with procedures as required by the host Party, information on the collection and archiving of information on the environmental impacts of the project:

Not applicable.

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:		
Data *(Indicate table and ID number)*	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
Table D.1.2.1 #1. $LFG_{total,y}$	Low	Flow meters will be subject to a regular maintenance and periodical calibration according to the manufacturer's recommendation to ensure accuracy.
Table D.1.2.1 #2. $LFG_{flared,y}$	Low	Flow meters will be subject to a regular maintenance and periodical calibration according to the manufacturer's recommendation to ensure accuracy.
Table D.1.2.1 #3. $LFG_{electricity,y}$	Low	Flow meters will be subject to a regular maintenance and periodical calibration according to the manufacturer's recommendation to ensure accuracy.
Table D.1.2.1 #5. $PE_{flare,y}$	Low	All equipment used to collect data will be subject to regular maintenance and calibration according to the manufacturer's recommendation to ensure accuracy.
Table D.1.2.1 #5(a) T_{flare}	Low	Thermocouples should be replaced or calibrated every year.
Table D.1.2.1 #5b,#5c W_{CH4ex}., W_{O2ex}, W_{CO2r}, W_{O2r}	Low	The gas analysers will be subject to a regular maintenance and testing regime to ensure accuracy.
Table D.1.2.1 #6. $W_{CH4,y}$	Low	The gas analyser will be subject to a regular maintenance and testing regime to ensure accuracy.
Table D.1.2.1 #7. T	Low	The temperature probe should be subject to a regular maintenance and testing regime to ensure accuracy.
Table D.1.2.1 #8. P	Low	The pressure gauge should be subject to a regular maintenance and testing regime to ensure accuracy.
Table D.1.2.1 #9, 10 $EL_{ex,lfg}$, EL_{imp}	Low	Electricity meters will be periodically calibrated according to the manufacturer's recommendation.
Table D.1.2.1 #11, 12b CEF	Low	Default data for emission factors will be used from UNFCCC Guidelines.

D.3. Please describe the operational and management structure that the project operator will apply in implementing the monitoring plan:

All continuously measured parameters (LFG flow, CH_4, CO_2, N_2, O_2 concentrations, flare temperature, and flare operating hours), will be recorded electronically via a data logger, which will have the capability to aggregate and print the collected data at the frequencies as specified above.

Before commencement of the O&M phase, a training and quality control program will be enacted to ensure that good management practices are ensured and implemented by all personnel operating the project. A minimum 3 people (1 site engineer, 1 from project developer staff and 1 from project owner staff) will be trained: in terms of general knowledge about the equipment used in the landfill, record-keeping, equipment calibration, overall maintenance, procedures for corrective action, emergency situation (for instance too high oxygen level or electricity breakdown). An operations manual will be developed for the operating personnel.

Operational procedures and responsibilities for monitoring and quality assurance of emission reductions from the Project activity are presented in the table below (E –executing data collection, R – responsible for overseeing and assuring quality, I- to be informed).

Task	Site Engineer	Equipment Supplier	Project Developer	Manager from ERUs purchaser side
Collect Data	E			
Enter data into Spreadsheet	E		R	
Make monthly and annual reports	E		R	I
Archive data & reports	E		R	I
Calibration/Maintenance, rectify faults	R	E	I	I

For details please also refer to the Annex 3.

D.4. Name of person(s)/entity(ies) establishing the monitoring plan:

Date of conclusion: 31 March 2007

Person/entity determining the monitoring methodology:

Scientific Engineering Centre "Biomass"
Contact person: Alexandra Pukhnyuk
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SECTION E. Estimation of greenhouse gas emission reductions

The estimate of ex-ante emissions reduction is given in this section for reference purpose only, since direct monitoring of methane destroyed in the Project scenario will be applied according to the ACM0001 methodology version 5.

E.1. Estimated project emissions:

The Project emissions are potentially represented by three sources:

1. Fugitive methane emissions due to not captured LFG.*

One source of project emissions identified within the system boundary is fugitive methane emissions from the landfill, i.e. methane not captured by the collection system. It is assumed that the gas collection system installed will capture approximately 50% of the total amount of gas released by the landfill in the baseline scenario. This figure is obtained from considering the percentage of the landfill covered by LFG extraction wells (in average 70% for both landfills), well efficiency (80%) and well availability (90%). Therefore the remaining 50% of fugitive emissions will be considered as Project emissions.

***Note:** these emissions are not caused by the Project, but would take place also in the baseline scenario.

The fugitive methane emissions from not captured LFG can be estimated from the following equation:

$$PEy_1 = CH_{4,y} * D_{CH4} * (1\text{-}CE) * GWP_{CH4} \quad (\text{tonne } CO_{2\text{-eq}}/\text{year})$$

2. Fugitive methane emissions in the flare due to the flare efficiency *(applicable for LFG flaring option only)***.***

Another relevant source of project emissions is methane not combusted in the flare. This source is covered through the parameter "flare efficiency" ($\eta_{flare,h}$ [%]), which enters the calculation of the emission reductions. Depending on availability of the monitoring equipment, either a default value of flare efficiency of 90% will be used or continuous monitoring of flare efficiency will be used to claim more than 90% efficiency methane destruction. In further calculations, the more conservative option of default value of 90% flare efficiency is applied.

The methane emissions in the flare due to the flare efficiency can be estimated from the following equation:

$$PE_{y2} = W_{CH_{4,y}} * D_{CH4} * (1\text{-}CE) * (1\text{-}FE) * GWP_{CH4} \quad (\text{tonne } CO_{2\text{-eq}}/\text{year})$$

where:

PE_{y1} estimated project emissions from non captured methane [tonnes CO_{2eq}]

PE_{y2} estimated project emissions from non combusted methane in [tonnes CO_{2eq}]

$W_{CH_{4,y}}$ is the methane generated at the landfill in [m^3 of CH_4]

D_{CH4} is the methane density in [kg/m³ of CH_4][7]

CE is the LFG collection efficiency

FE is the flare efficiency

GWP_{CH4} is the global warming factor of methane (GWP = 21).

Landfill gas collection efficiency is estimated at the level of ***CE= 50%*** for both landfills.

Default value for flare efficiency is fixed at the level of ***FE=90%***.

[7] At standard temperature and pressure (0 degree Celsius and 1,013 bar) the density of methane is 0.0007168 tCH_4/m^3CH_4.

3. CO_2 emissions resulting from electricity used by LFG pumping equipment *(applicable for LFG flaring option only)*

Emissions from fossil fuel (diesel) used during the Project for energy requirement on site under project activity during the year y, in TJ are determined according to the following equation:

$$PEy_3 = ET_y * CEF_{thermal, y}$$

where:

ETy quantity of diesel used for own needs of the LFG flaring plant during the year y, in TJ (please refer to the Annex 2 for details)

$CEF_{thermal, y}$ CO2 emissions intensity of the diesel ($CEF_{thermal, y}$=0.0741 ktonne CO2/TJ[8])

a) LFG flaring option: If only LFG flaring is applied, emissions from diesel power station represent Project emissions.

The sum of the Project emission is equal to:

$$PE_y = PE_{y1} + PE_{y2} + PE_{y3}$$

4. Emissions from construction works on installation of LFG collection system.

These emissions are determined as sum of the emission from transportation of drilling equipment to the site and emissions during drilling works at the Sites.

Drilling of LFG collection wells will be executed by auger drilling machine with drilling diameter of 300 mm placed at the platform of ZIL- 157 automobile. The machine will be transported to the site from Poltava city, Ukraine.

For calculation of the above emissions following parameters were used:

Parameter	Value
Type of fossil fuel used by the drilling machine	Gasoline, A 76/A 80
Emission factor for fossil fuel	EFg= 69.3 tonneCO_2/TJ
Heating value of fossil fuel (gasoline)	HVg = 30.5 MJ/l = $30.5*10^{-6}$ TJ/l
Emissions at drilling machine transportation to the Sites	
Specific fossil fuel consumption at drilling machine transportation to the sites	FC=32 l/100 km
Transportation distance (Poltava-Yalta-Alushta-Poltava) Moving distance at the Sites Total distance:	TD_1=1380 km TD_2 = 2*10 = 20 km TD = 1400 km

[8] IPCC Inventory Guidelines, Chapter 2 Stationary Combustion, pg 2.16, Table 2.2

Emissions at drilling at the Sites	
Drilling depth	25 m
Number of wells	N_w= 35*2 = 70
Total length of wells drilled	Lw = 25*70 = 1750 m
Specific fossil fuel consumption at drilling	$FC_{d,h}$ = 8 l/h
Time of drilling for 1 well meter	$T_{d,1m}$ = 0.5 hours/m
Total time for drilling of N_w wells	Td = $T_{d,1m}$*L_w= 0.5*1750 = 875 h

Emissions will be calculated using the following formula:

1. Emissions from transportation of drilling machine to the Sites:

Fuel consumption for equipment transportation **FC_t = FC*TD/100**= 32*1400/100= 448 [l]

Emissions from transportation:

$$\mathbf{PE_{y4,t} = EFg*HVg*FC_t} = 69.3*30.5*10^{-6}*448 = \mathbf{0.95\ [\ t\ CO2\text{-}eq.]}$$

2. Emissions during drilling works at the Sites:

Fuel consumption for drilling works: **FC_d = $FC_{d,h}$*Td** = 8*875 = 7000 [l]

Emissions from drilling works:

$$\mathbf{PE_{y4,d} = EFg*HVg*FC_d} = 69.3*30.5*10^{-6}*7000 = \mathbf{14.8\ [\ t\ CO2\text{-}eq.]}$$

3. Total emissions from construction works:

$$\mathbf{PE_{y4} = PE_{y4,t} + PE_{y4,d} = 0.95+14.8 = 15.75\ [\ t\ CO2\text{-}eq.]}$$

Since share of the construction emissions is less than 1% of the total baseline emissions of 481,373 t CO2-eq. (see E.4), it can be neglected.

Results of calculation of the Project emission are given below.

	Project emission (flaring) Yalta landfill				Project emission (flaring) Alushta landfill				Total Project emission (flaring) Yalta and Alushta landfills
Years	***PE_{y1}***	***PE_{y2}***	***PE_{y3}***	***Total $PE_{y, Yalta}$***	***PE_{y1}***	***PE_{y2}***	***PE_{y3}***	***Total $PE_{y,Alushta}$***	***$PE_{y, Yal+Al}$***
	t CO2/yr	t CO2/yr	t CO2/yr	t CO2/yr	t CO2/yr	t CO2/yr	t CO2/yr	t CO2/yr	t CO2/yr
2008*	17,046	1,732	82	18,860	7,632	776	55	8,462	27,322
2009	31,542	3,205	140	34,887	13,626	1,385	94	15,105	49,992
2010	33,729	3,427	140	37,297	14,151	1,438	94	15,682	52,979
2011	35,804	3,638	140	39,583	14,660	1,490	94	16,243	55,826
2012	37,785	3,839	140	41,765	15,157	1,540	94	16,791	58,556
2008-12	**155,907**	**15,842**	**643**	**172,392**	**65,227**	**6,628**	**429**	**72,283**	**244,675**

*Reflects only the expected operating months in 2008

E.2. Estimated leakage:

No leakage needs to be accounted for by this methodology.

E.3. The sum of E.1. and E.2.:

The sum of E.1 and E.2 is equal to:

$$PE_y = PE_{y1} + PE_{y2} + PE_{y3}$$

For the results of the calculation of the project emission please refer to the Section E6.

E.4. Estimated baseline emissions:

For calculation of baseline emissions:

If the LFG is flared in the project scenario, then the GHG emissions in the scenario-without-project will come from open-air decay of the whole amount of waste at Yalta and Alushta landfills.

1. Estimation of baseline methane emissions into the atmosphere

The amount of methane release in the baseline scenario is estimated using **Methodological tool "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site (Version 04), Annex 10, EB 41".**

Under this methodology the amount of methane that would in the absence of the project activity be generated from disposal of waste at the solid waste disposal site ($BE_{CH4,SWDS,y}$) is calculated with a multi-phase model. The calculation is based on a first order decay (FOD) model. The model differentiates between the different types of waste *j* with respectively different decay rates k_j and different fractions of degradable organic carbon (DOC_j).

The model calculates the methane generation based on the actual (or estimated) waste streams $W_{j,x}$ disposed in each year *x*, starting with the first year after the start of the project activity (the year 2008) until the end of the year *y* (the year 2012), for which baseline emissions are calculated years *x* with x = 1 to x = y).

Since in our case, no SWDS methane is captured and flared, combusted or used in another manner in the baseline scenario, the baseline emissions are not adjusted for the fraction of methane captured at the SWDS.

The amount of methane produced in the year *y* ($BE_{CH4,SWDS,y}$) is calculated as follows:

(*)

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot 16/12 \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot (e^{-k(y-x)} \cdot (1-e^{-k_j})$$

Where:

$BE_{CH4,SWDS,y}$ = Methane emissions avoided during the year *y* from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year (tCO_2e)
φ = Model correction factor to account for model uncertainties (0.9)
f = Fraction of methane captured at the SWDS and flared, combusted or used in another manner (0 in our case)
GWP_{CH4} = Global Warming Potential (GWP) of methane, valid for the relevant commitment Period (21)
OX = Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste) (0 in our case)
F = Fraction of methane in the SWDS gas (volume fraction) (0.5)
DOCf = Fraction of degradable organic carbon (DOC) that can decompose (0.5)
MCF = Methane correction factor (0.8 in our case)
$W_{j,x}$ = Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tonnes)
DOC_j = Fraction of degradable organic carbon (by weight) in the waste type *j*
k_j = Decay rate for the waste type *j*
j = Waste type category (index)
x = Year during the period: x runs from the first year of the period (x = 1) to the year y for which avoided emissions are calculated (x = y)
y = Year for which methane emissions are calculated

Model correction factor to account for model uncertainties *(φ)*
Given the uncertainties associated with the model and in order to estimate emission reductions in a conservative manner, a discount of 10% is applied to the model results, therefore φ=0.9.

Fraction of methane captured at the SWDS and flared, combusted or used in another manner *(f)*
No methane capture is currently applied at the site, therefore f=0.

Oxidation factor *(OX)*
Oxidation factor reflects the amount of methane from SWDS that is oxidized in the soil or other material covering the waste. IPCC [2006 Guidelines for National Greenhouse Gas Inventories] recommends the following values MCF(x) for the different types of dumps:

Data / parameter:	**OX**
Data unit:	-
Source of data:	Conduct a site visit at the solid waste disposal site in order to assess the type of cover of the solid waste disposal site. Use the IPCC 2006 Guidelines for National Greenhouse Gas Inventories for the choice of the value to be applied.
Value to be applied:	Use 0.1 for managed solid waste disposal sites that are covered with oxidizing material such as soil or compost. Use 0 for other types of solid waste disposal sites.

Since no oxidizing material is applied at Yalta and Alushta landfills, value 0 was used in our case.

Fraction of methane in the SWDS gas *(F)*

This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0.5 is recommended by IPCC.

Fraction of degradable organic carbon (DOC) that can decompose *(DOCf)*

IPCC 2006 Guidelines for National Greenhouse Gas Inventories recommends 0.5 value to be applied.

Methane correction factor *(MCF)*

The methane correction factor (MCF) accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS.

Data / parameter:	**MCF**
Data unit:	-
Description:	Methane correction factor
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value to be applied:	Use the following values for MCF: • 1.0 for **anaerobic managed solid waste disposal sites**. These must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste. • 0.5 for **semi-aerobic managed solid waste disposal sites**. These must have controlled placement of waste and will include all of the following structures for introducing air to waste layer: (i) permeable cover material; (ii) leachate drainage system; (iii) regulating pondage; and (iv) gas ventilation system. • 0.8 for **unmanaged solid waste disposal sites – deep and/or with high water table**. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 meters and/or high water table at near ground level. Latter situation corresponds to filling inland water, such as pond, river or wetland, by waste. • 0.4 for **unmanaged-shallow solid waste disposal sites.** This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of less than 5 metres.

For Yalta and Alushta landfills the MCF value of 0.8 was used.

Fraction of degradable organic carbon (by weight) in the waste type *j* *(DOC_j)*

The values for fraction of degradable organic carbon (by weight) for different types of waste *j* recommended by IPCC are given in the table below.

Data / parameter:	**DOC_j**
Data unit:	-
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)
Value to be applied	Apply the following values for the different waste types *j*:

Waste type *J*	DOC_j (% wet waste)	DOC_j (% dry waste)
Wood and wood products	43	50
Pulp, paper and cardboard (other than sludge)	40	44
Food, food waste, beverages and tobacco (other than sludge)	15	38
Textiles	24	30
Garden, yard and park waste	20	49
Glass, plastic, metal, other inert waste	0	0

If a waste type, prevented from disposal by the proposed CDM project activity, can not clearly be attributed to one of the waste types in the table above, project participants should choose among the waste types that have similar characteristics that waste type where the values of DOC_j and k_j result in a conservative estimate (lowest emissions), or request a revision of / deviation from this methodology.

Data used for the calculations are based on the recommended data on waste content for Ukraine and Russia[9].

Recommended date on waste composition for Ukraine and Russia

Waste category	Weight portion %	Waste type (j)	DOCj (portion of wet waste)
Food waste	41.4	I	0.15
Paper, cardboard	22.1	II	0.40
Wood	4.2	III	0.43
Ferrous and non-ferrous metal	4.1	VI	0.00
Textiles	5.1	IV	0.24
Bones	1.0	V	0.17
Glass	4.0	VI	0.00
Leather, rubber	3.3	V	0.17
Stones	3.2	VI	0.00
Plastic	5.2	VI	0.00
Other	0.4	V	0.17
Screening (less than 15 mm)	6.0	V	0.17
Total	100.0		

Decay rate for the waste type j *(k_j)*
The values for decay rate for different types of waste *j* recommended by IPCC are given in the table below.

[9] Sister V.G., Mirniy A.N., Skvortsov L.S. etc. (2001). Solid Municipal Waste Hand-book. Academy of municipal service named after K.D. Panfilov, Moscow (in Russian).

Data / parameter:	**K_j**
Data unit:	-
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 to be applied	Apply the following default values for the different waste types *j:*

Waste type *j*		**Boreal and Temperate (MAT≤20°C)**		**Tropical (MAT>20°C)**	
		Dry (MAP/PET <1)	Wet (MAP/PET >1)	Dry (MAP< 1000mm)	Wet (MAP> 1000mm)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0.06	0.045	0.07
	Wood, wood products and straw	0.02	0.03	0.025	0.035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.10	0.065	0.17
Rapidly degrading	Food, food waste, beverages and tobacco (other than sludge)	0.06	0.185	0.085	0.40

NB: MAT – mean annual temperature, MAP – Mean annual precipitation, PET – potential evapotranspiration. MAP/PET is the ratio between the mean annual precipitation and the potential evapotranspiration.

If a waste type, prevented from disposal by the proposed CDM project activity, cannot clearly be attributed to one of the waste types in the table above, project participants should choose among the waste types that have similar characteristics that waste type where the values of *DOCj* and *kj* result in a conservative estimate (lowest emissions), or request a revision of / deviation from this methodology.

For the calculations for Yalta and Alushta landfills following values for $\mathbf{k_j}$ were used:

Waste type *j*			**Temperate (MAT≤20°C)** Wet (MAP/PET >1)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	II, IV	0.06
	Wood, wood products and straw	III	0.03
Moderately degrading	Other (non-food) organic putrescible garden and park waste	V	0.10
Rapidly degrading	Food, food waste, beverages and tobacco (other than sludge)	I	0.185

Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tonnes) (*Wj,x*)
The annual amount of waste disposed at the landfills during the recent years is close to 40 thousand tonnes for Alushta landfill and 110 thousand tonnes for Yalta landfill. Waste amounts are measured based on capacity and number of incoming trucks. The total amount of waste collected at the landfills as reported by the landfill operator is approximately 1.2 million tonnes for Yalta landfill and 0.91 million tonnes for Alushta landfill.

The statistical data on the waste delivery to Yalta and Alushta landfills through the whole period of landfills operation (back to 1973 and 1960 respectively) is not available at municipalities. Therefore the linear approximation approach based on the recent data on waste delivery and the reported value for total waste accumulated at the sites was applied. These data obtained from the landfill operators on amounts of waste delivered to the landfill in the last 5 -10 years period and are shown in the table below:

Year/	Amount of waste delivered to the landfill, thousand tonnes (estimated)	
	Yalta landfill	Alushta landfill
1997	23.02	(22.91)
1998	35.81	(23.37)
1999	49.31	(23.84)
2000	50.74	(24.32)
2001	55.68	(24.80)
2002	67.80	25.30
2003	75.90	26.45
2004	87.17	32.66
2005	92.25	38.18
2006	111.80	38.18
2007	(114.04)	(38.94)
Total from landfill commissioning	(1973-2007) 1,2 million tonnes	(1960-2007) 0.91 million tonnes

The calculation of the annual amount of waste delivered to landfill throughout the period of landfill operation is based on several assumptions:

- The total amount of waste is 1.2 million tonnes for Yalta landfill and 0.91 million tonnes for Alushta landfill;
- The annual amount of waste delivered to the landfills in the recent years equals values in the table above;
- Amount of waste grows linearly during all landfill life period (the calculated yearly growth factor is 2%).

The tables providing the calculated values of yearly waste delivery to the landfills are given in Annex 2.

Summary of correction factors applied
Values of correction factors and other parameters used for calculation are summarized in the table below:

Factor	Value	Source of data
φ	0.9	"Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site"
f	0	Site situation
$GWPCH_4$	21	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
OX	0	IPCC 2006 Guidelines for National Greenhouse Gas Inventories, Site situation
F	0.5	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
DOCf	0.5	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
MCF(x)	0.8	IPCC 2006 Guidelines for National Greenhouse Gas Inventories, Site situation

Total baseline emissions

	Baseline emission Yalta landfill		**Baseline emission Alushta landfill**		**Total baseline emission Yalta and Alushta landfills**
	Methane release, tonnes	Emission from CH4 release, t CO2/yr	Methane release, tonnes	Emission from CH4 release, t CO2/yr	t CO2/yr
2008*	1,637	34,368	733	15,387	49,755
2009	3,028	63,593	1,308	27,473	91,065
2010	3,238	68,002	1,359	28,530	96,532
2011	3,437	72,186	1,407	29,557	101,743
2012	3,628	76,180	1,455	30,559	106,739
2008-12	**14,968**	**314,329**	**6,262**	**131,505**	**445,834**

*Reflects only the expected operating months in 2008

E.5. Difference between E.4. and E.3. representing the emission reductions of the project:

The baseline emissions, project emissions and emission reductions are summarized in the section E.6.

E.6. Table providing values obtained when applying formulae above:

The estimated results are expressed in the following table. The actual emission reductions generated by this project will be measured directly after the project is operational. The calculations are bundled for Yalta and Alushta landfills.

Years	**Total baseline emission**	**Total project emission**	**Emission reduction**
	t CO2/yr	t CO2/yr	t CO2/yr
2008*	49,755	27,322	22,432
2009	91,065	49,992	41,074
2010	96,532	52,979	43,553
2011	101,743	55,826	45,917
2012	106,739	58,556	48,183
2008-12	**445,834**	**244,675**	**201,159**
Average emission reductions			**43,889**

*Reflects only the expected operating months in 2008
Note numbers may not add exactly due to rounding

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts of the project, including transboundary impacts, in accordance with procedures as determined by the host Party:

In the baseline situation, landfill gas is generated as a result of decomposition of municipal waste under anaerobic conditions. Landfill gas is mainly composed of carbon dioxide and methane. Carbon dioxide and methane are greenhouse gases, which contribute to global warming. LFG in general causes harmful effects to the local environment and effect the economic value of the area where the landfill is implemented. In the baseline situation, landfill gas is associated with the following negative impacts:

- Undesirable odour, nuisance especially for human settlements surrounding the landfill area;
- Methane migration destroying vegetation next to the landfill or on the rehabilitated landfill compartments;
- Safety and health risks to landfills staff due to generation of methane concentration above safe limits as well as explosions and fires at the landfill site;
- Potential for landfill fires and the associated release of incomplete combustion products; and
- Slowing down of the mineralisation process of the waste body leading to more leachate generation and leachate seeping.

A very small percentage of volatile organic compounds (VOCs) are also found in the landfill gas, contributing to the undesirable odour. VOCs emissions are photochemically reactive, and result in the formation of tropospheric ozone. The latter might cause adverse effects to the respiratory system such as breathing difficulties and aggravated asthma, and damages to crops and plants. VOCs are also known for their toxicity and carcinogenic effect from chronic exposure.

In the project activity, the main activity is combusting the landfill gas to convert methane to carbon dioxide. Flaring of the collected biogas will destroy methane and thus lead to a decrease in the amount of greenhouse gases released to the atmosphere. By capture and combustion of LFG, release of VOCs into the atmosphere is significantly reduced. Overall, the project activity leads to positive environmental impacts which contribute to the sustainable development of the area with no significant negative impacts expected.

The potential environmental effects from implementation of the Project according to the EIA requirements are presented herein:

Human

High concentration of gases in the landfills brings about a risk of explosion. Controlled capture and combustion of LFG will reduce the risks of explosions or poisoning with high-toxic combustion products of inhabitants of surroundings and on site workers.

While the LFG collection and utilization system will minimize explosion risks from methane emissions on the whole landfill site, there are obviously some risks associated with the operation of the flare, similar to any other industrial risks involving a source of fire. Safety devices on the flaring unit will mitigate this risk.

Flora and fauna

Remediation of the landfill site (reshaping and capping) will reduce presence of birds searching for prey and food, abating the pests and disease vectors. The Project will also abate methane migration destroying vegetation next to the landfill.

Air

The LFG collection and flaring system might lead to some minor CO, NOx and VOCs emissions. However, due to the high-efficiency combustion and high-temperature an almost total destruction of the gases is ensured. In that way, emissions of CO, NOx and VOCs and other compounds present in the biogas such as ammonia will be minimal, and much lower to that which would have occurred in the absence of the project activity.

The installed equipment does not produce any significant noise, since it will be placed in noise insulated container or small buildings that will form a sound-absorbing casing.

The landscape

The reshaped body and capped top of the landfill will contribute to better fitting of the landfill into the surrounding landscape. Visual impact from the flare, and noise and vibration will be limited to the localized site.

Conclusions

The landfill collection and flaring system has a significant positive impact on the environment. The system reduces emissions of greenhouse gases, odours and gases causing explosions as well as open fires and damage to wildlife. Additionally, the project will produce the following:

- positive effects on climate and local air quality;
- positive effects on flora and fauna in the surroundings; and
- improved conditions for local inhabitants and site workers.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to supporting documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

Local EIA procedure

In the Ukraine, both an Environmental Impact Assessment (EIA) and a State Environmental Expertise (EE) are used for estimation of environmental impact of the project activity.

An EIA estimates impact the levels a project may have on the environment, development of actions on prevention or reduction of these influences, and acceptability of design decisions from the environmental point of view. An EIA is a compulsory part of the design documentation of any economic activity and is carried out under strictly established requirements.

An EE is determined based on the analysis and estimation of pre-design, design documentation and other documents concerning the Project which have potential impacts on the state of the environment. Also, an EE is used to determine conformity of the planned project activity with norms and requirements of the legislation on environmental protection and for maintenance of ecological safety.

EIA legislative requirements are defined by Clause 36 of the Law of Ukraine "On Environmental Expertise". Requirements for the EIA structure is contained in the state construction norms of Ukraine DBN A.2.2-1-2003. Requirements for the documentation of the state EE are set in the “Instruction on realization of the state environmental expertise”. Requirements for the conclusions of the EE are defined by the Clause 43 of the Law of Ukraine "On Environmental Expertise ".

Design documentation including the EIA is submitted for execution of environmental expertise to the Ministry of Environment and Natural Resources Protection of Ukraine (MENRPU) or its regional bodies. The State EE is undertaken by the MENRPU who then issues an official response.

According to the aforementioned documents, the EIA must contain data about local public opinion on the project activity and problems that should be solved. However, methods and procedures for collection and consideration of public opinions are not specified.

For the proposed Project, the project design documentation (including an EIA) was submitted to the Republic Committee of the Environmental Protection of the Autonomous Republic of Crimea for environmental expertise. In the EIA section of the design documentation the conclusion was made by the project developer that no significant negative environmental impacts are related to the project activity.

SECTION G. Stakeholders' comments

G.1. Information on stakeholders' comments on the project, as appropriate:

Ukrainian EIA legislation stipulates that for every EIA, a public stakeholder consultation process, during which the affected public is informed and invited for commenting must be carried out. This can either be done by publication of the project activity in a local newspaper or by holding an information session to which representatives of the public affected by the project activity are invited to comment on the Project activities.

Stakeholders were invited by local, on the ground consultants. Personal invitations were made to a range of stakeholders in their local language to ensure the purpose of the meeting and its context was clearly communicated. The stakeholders present have been listed below.

Two consultations were separately held for participants in Yalta and Alushta on the 21st and 22nd of March 2007. Each consultation was given using the Power Point presentation format and technical translators to ensure that its content was suitably communicated. An open discussion was then held enabling questions to be raised and answers to be discussed about the Project Activity.

A summary of both stakeholder consultations is described below:

The following activities were conducted by the Project Participants in the framework of a stakeholder consultation for the Yalta and Alushta Projects:

1. Stakeholders meeting in Republic Committee of The Environment and Natural Resources of the Autonomous Republic of Crimea (RCENR), March, 21st, 2007. The participants of the meeting included:

- Head and deputy head of RCENR;
- Head of department of the RCENR for waste management,
- Head of department of the RCENR atmospheric air protection
- Heads of other relevant departments of RCENR;
- Deputy head of Crimean Regional subdivision of the Green Party of Ukraine;

- Head of NGO “Environment and the World”, head of the Crimean subdivision of National Academy of Sciences of Ukraine.

2. Stakeholders meeting in municipality of Alushta City, March, 22, 2007. Meeting participants included:

- Deputy Mayor of The Alushta Municipality;
- Director of Municipal Transportation Company (Landfill Operator)

3. Stakeholders meeting in municipality of Yalta City, March, 22, 2007. The participants of the meeting were:

- Deputy Head of Municipal Services Department of Yalta Municipality
- Head of Environmental Protection Department of Yalta Municipality

4. Publication of the information article on the Project activities in the web mass media.

Yalta and Alushta landfills were visited and opinions of waste pickers were collected. Stakeholders were informed, according to their group, about:

- Problems caused by solid wastes;
- Joint Implementation Mechanisms, GHG and Kyoto protocol;
- Reason to capture the biogas;
- Detailed descriptions about the landfill site;
- Benefits generated by a degassing plant;
- Adopted hypothesis and biogas production model; and
- Information about Project Participants.

During the period for public commenting no negative questions were raised.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

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Annex 2

BASELINE INFORMATION

LANDFILL CALCULATION PARAMETERS			
Parameter	Units	**Data**	
Landfill data			
		Yalta landfill	**Alushta landfill**
Year landfill started operation		1973	1960
Waste in place at the beginning of project	Tonnes	1.2 million	0.91 million
Density of waste (non-compacted)	tonne/m3	0.23	0.23
Area of site	Hectare	5.7	6.9
Average yearly waste rate	thousand tonnes/year	110	40
Date gas collection project starts		2008	2008
Project operational data			
Gas collection efficiency	%	50%	50%
Flare efficiency	%	90%	90%
Flare capacity (estimated)	m3/h	800	500
LFG pump & flaring station capacity	kW	15	11
Diesel CO2 emission factor	ktonne CO2/TJ	0.0741	
Diesel calorific value	MJ/L	36	
Diesel consumption by pumping & flaring system[10]	L/h	6	4
General data			
Methane content of landfill gas	%	50%	
CH4 GWP	T CO2/T CH4	21	
Density of Methane	Tonne CH4/m3	0.0007168	
Baseline data			
Proportion of methane flared in Baseline (AF)		0%	

[10] For purposes of ex-ante project emissions, we conservatively assumed that the diesel engine would be using fuel for 8760 hours of the year. Actual fuel use will be measured and only incurred on start-up. The consumption rate is

INPUT DATA FOR THE ELECTRICITY GENERATION COMPONENT OF THE PROJECT ACTIVITY	
PROJECT DATA	
Date project starts operating (year)	2008
Installed capacity (MW)	Yalta landfill: 1.0 Alushta landfill: 0.5
Estimated on-line availability of equipment (%)	0.9
Operating period (h/yr)	7884 (flare expected to run 90% of the time in a year with 10% as maintenance/downtime). Actual flare operation will be determined once the Project is operational

DATA ON WASTE DELIVERY FOR YALTA AND ALUSHTA LANDFILLS

Simulated waste delivery schedule for Yalta landfill	
Year	Waste, thousand tonnes
1973	14.31
1974	14.60
1975	14.89
1976	15.19
1977	15.49
1978	15.80
1979	16.12
1980	16.44
1981	16.77
1982	17.11
1983	17.45
1984	17.80
1985	18.15
1986	18.52

Simulated waste delivery schedule for Alushta landfill	
Year	Waste, thousand tonnes
1960	11.01
1961	11.23
1962	11.46
1963	11.69
1964	11.92
1965	12.16
1966	12.40
1967	12.65
1968	12.90
1969	13.16
1970	13.43
1971	13.69
1972	13.97
1973	14.25

conservative compared to the operating data collected between 2009-02-08 and 2009-02-15 at Yalta. During the week, the diesel engine was used for 15 minutes for start-up and 0.8 litres was consumed.

1987	18.89
1988	19.26
1989	19.65
1990	20.04
1991	20.44
1992	20.85
1993	21.27
1994	21.70
1995	22.13
1996	22.57
1997	23.02
1998	35.81
1999	49.31
2000	50.74
2001	55.68
2002	67.80
2003	75.90
2004	87.17
2005	92.25
2006	111.80
2007	114.04
2008	116.32
2009	118.65
2010	121.02
2011	123.44
2012	125.91

1974	14.53
1975	14.82
1976	15.12
1977	15.42
1978	15.73
1979	16.04
1980	16.37
1981	16.69
1982	17.03
1983	17.37
1984	17.71
1985	18.07
1986	18.43
1987	18.80
1988	19.17
1989	19.56
1990	19.95
1991	20.35
1992	20.75
1993	21.17
1994	21.59
1995	22.03
1996	22.47
1997	22.91
1998	23.37
1999	23.84
2000	24.32
2001	24.80
2002	25.30
2003	26.45
2004	32.66
2005	38.18
2006	38.18
2007	38.94
2008	39.72
2009	40.52
2010	41.33
2011	42.15
2012	43.00

Annex 3

MONITORING PLAN

Summary of Monitoring Approach The monitoring will be carried out as described in Section D of this PDD, and in line with ACM0001. The basic approach is to monitor on a continuous basis the amount of methane destroyed through flaring and combustion. The main parameters to be monitored include:

- Total flow of captured landfill gas [Nm3]
- Landfill gas flow to flare and captive biogas generator [Nm3]
- LFG temperature [°C] and pressure [Pa]
- Methane content in the landfill gas [%]
- Flare operation time [h]
- Temperature of the flare exhaust gases [°C]
- O_2, CH_4 in the flare exhaust gas (for determining flare efficiency) [%]

Landfill gas flows and methane content will be determined on a continuous basis. The same applies for the flare operation time and the gross electricity production. The amount of flared methane will be calculated from the flow of landfill gas to the flare, the methane content of the gas, and the flare efficiency.

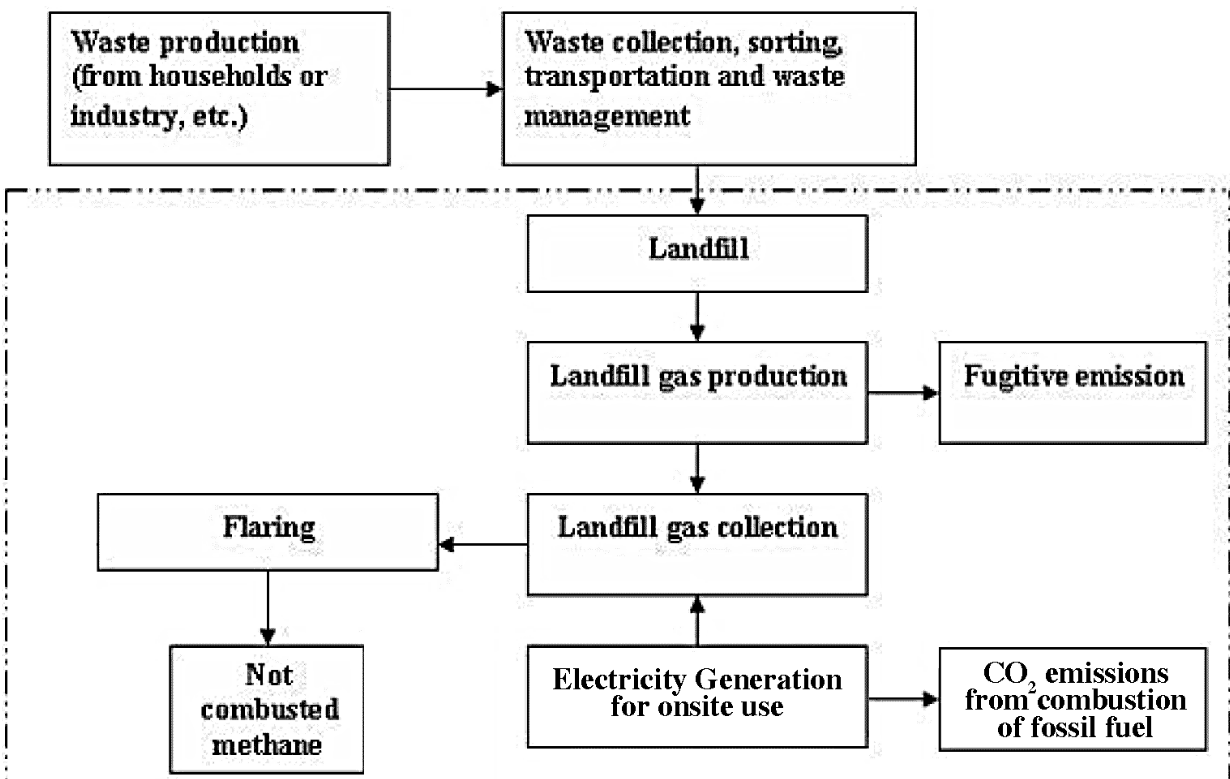

Table. Equipment used to monitor emissions reductions from the project activity

Equipment	Variables Monitored	Operational range	Calibration procedures	Parties responsible for operating equipment	Procedure in case of failure	Default value to use in case of failure	Comments
LFG flow meter	1. $LFG_{total,y}$ 2. $LFG_{flare,y}$ 3.$LFG_{electricity,y}$	+/- 1-2 %	Equipment will be calibrated annually after initial installation by the local accredited standardization and certification entity on site	Project Developer	Failure reported to equipment supplier and repairs carried out. If repair is not possible, equipment will be replaced by equivalent item within one month. Failure events will be recorded in the site events log book.	The minimum amount required by the flare will be used in case of failure.	
Portable gas analyser	2. $PE_{flare,y}$ (O2, CH4 in the flare exhaust gas)	< 1%	Calibration of gas analysers should be carried out weekly	Project Developer	Failure reported to equipment supplier and repairs carried out. If repair is not possible, equipment will be replaced by equivalent item within one month. Failure events will be recorded in the site events log book. Repeat procedure within one month and if not possible contact other external company.	90% based on manufacturer's specifications	

Fixed Gas Analyser	4. $W_{CH4,\ y}$	+/- 2%	Calibration of gas analysers should be carried out weekly	Project Developer	Failure reported to equipment supplier and repairs carried out. If repair is not possible, equipment will be replaced by equivalent item within one month. Failure events will be recorded in the site events log book.	The minimum concentration value required by the flare will be used in case of failure.	

The monitoring plan will be described in detail in an Operational Manual. It will be the responsibility of the site manager and undertaken by site staff responsible for the maintenance and care of the landfill gas collection system and flaring unit. The monitoring plan covers:

- responsibility of members of the monitoring team;
- QA/QC procedures;
- corrective action plans;
- maintenance plans; and
- monitoring schedules.

The site manager will ensure the measurements are recorded and calibration/maintenance actions are performed per schedule, review the results of the measurements, ensure proper records are kept and transmit data for archiving.

Project developer and project investor will perform quality assurance on the data and ensure archiving of the data for the specified period (crediting period plus two years). At the time of verification, training materials and information about the timing of completed trainings would be provided to the DOE.

The monitoring plan covers procedures for the systematic surveillance of the CDM Project Activity's performance by measuring and recording performance-related indicators relevant to the project or activity. The Plan includes:

- **Corrective Actions:** There will be quality assurance measures to handle and correct nonconformities in the implementation of the Project or this Monitoring Plan. In case such nonconformities are observed:
    - An analysis of the nonconformity and its causes will be carried out,
    - Appropriate corrective actions to eliminate the non-conformity and its causes will be identified, and
    - The implementation of corrective actions will be reported.
    - In the case that the gas engine generator fails to work for any reason, the blowers and flare will be shut down, that is, not run off the diesel engine. Therefore, in these cases, no ERUs will be claimed and no LFG will be vented.

- **Calibration of measurement equipment:** Calibration of measurement equipment will be defined and scheduled by the technology provider.

- **Operational Manual**: All the information about monitoring procedures and quality assurance measures will be included in an Operational Manual.

There will be a team that will cover all aspects of the monitoring. The team members will be responsible for collecting, reviewing, recording and archiving the data. There will be a JI Monitoring Manager who will quality check the team's work ensuring that the monitoring is performed correctly and on time. The manager will report monthly to project investor and developer about project performance and data. He/She will inform investor and project developer immediately in the event of non-conformance and technical problems. The manager will be the one of the main contacts for the verifier, DNA of Ukraine, and local authorities, during the crediting period.

A JI Project Team will be formed for monitoring purposes for the project activity. The project team comprises at least one representative of project investor, project developer, the chief engineer of the landfill, and the Carbon Monitoring Manager.

The monitoring tools that will be available to the team and the manager include:

- Operational Manual (see above) including procedures on what is to be monitored, frequency of the monitoring, equipment to be used, maintenance required on instrumentation, corrective actions, etc.
- This Project Design Document UNFCCC baseline and monitoring methodology
- Spreadsheets

The spreadsheets will serve as a registry of the all data collected by the different measuring equipments distributed all over the facilities. They will also be used to quantify ERs achieved by the projects activity during specific time periods through the use of auxiliary equations.

For the purposes of QA/QC and archiving data will be transmitted electronically to project investor and developer on a weekly basis as well as a reporting of any anomalies, equipment failures or any other causes of data loss. A final data quality check of the information will be made before an archived copy is created.