



Monitoring report form
(Version 05.1)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.

MONITORING REPORT

Title of the project activity	Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040	
UNFCCC reference number of the project activity	3464	
Version number of the monitoring report	Version 1	
Completion date of the monitoring report	05/05/2016	
Monitoring period number and duration of this monitoring period	Monitoring period #2 (01/10/2011 – 31/12/2015)	
Project participant(s)	Consórcio Horizonte Asja Asja Brasil Serviços para o Meio Ambiente Ltda.	
Host Party	Brazil	
Sectoral scope(s)	Sectoral scope 13 – Waste handling and disposal	
Selected methodology(ies)	ACM0001 "Consolidated baseline and monitoring methodology for landfill gas project activities" (Version 11)	
Selected standardized baseline(s)	NA	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	618,892 tCO ₂ e	
Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	281,437 tCO ₂ e	319,386 tCO ₂ e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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Purpose of the project activity and the measures taken to reduce greenhouse gas emissions

The Project consists of a collection, transport and treatment system for landfill gas with production of electricity for self-consumption and incorporation to the national grid. Since the landfill gas major constituent is methane, whose GHG potential is 21 to 25 times the CO₂, the Project reduces the emission of GHG into the atmosphere by means of methane destruction in high temperature flares and of displacement of electricity generated from fossil fuel sources.

Brief description of the installed technology and equipments

The LFG is collected through vertical wells drilled in the waste mass and is transported through a pipeline system connected to blowers towards the gas use section, where energy production and flare combustion sections are located.

Entering the gas use section, the LFG collected is treated from humidity and other impurities to be then sent to the electricity generation sets and/or to the enclosed flares. The LFG preferably flows to the power house; therefore, the major part of the LFG collected is turned into electric energy. The enclosed flare section aims to safely combust the surplus of gas in case the LFG flow exceeds the maximum utilization capacity of the power house or it is in maintenance. Both uses lead to a complete destruction of the methane present in the LFG.

The electric energy produced from LFG is set both for the self consumption of the plant and the supply to the grid. The Project total installed capacity of project activity was 5.704 MW composed by four engines of 1.426 MW individual capacities until 21/09/2012, when one engine was definitively uninstalled. From that day on the project remained with 4.278 MW of installed capacity.

Relevant dates for the project activity

The landfill began accepting waste in 1975. By the end 2006, more than 17,400,000 m³ of solid urban waste have been filled over the landfill. The maximum landfill height is about 64 meters. The lifetime of the landfill was 32 years, ending on December 2007.

The Project's infrastructure construction started in December 2008 and the first landfill gas collection wells were drilled by the beginning of 2009.

The landfill gas aspiration and flare combustion plant was installed in 12/09/2009 and it is operational since 29/10/2009. Combustion plant was initially composed by 2 enclosed flares of 2,500 Nm³/h of capacity each one.

The electricity generation plant was commissioned in the second fortnight of November and started operating in 29/11/2010, with 4.278 MW of installed capacity.

In 04/06/2011 one of the enclosed flares installed in the combustion plant was definitively turned off, because it had been idle since the generation plant started operating.

In 21/09/2011 an additional engine of 1.426 MW was installed, so the energy plant operated with 5.704 MW of capacity onwards. Later, in 21/09/2012, one engine was definitively uninstalled and the energy plant remained with 4.278 MW of installed capacity.

In 15/05/2013 the remaining enclosed flare was temporarily turned off due to lack of landfill gas. It is still installed and operational, so it can be promptly restarted in case the landfill gas flow surpasses the capacity of the engines. No emission reductions will be claimed for flaring landfill gas from that date on.

In January 2014 and from October 2014 on, the supervisory software suffered an outage causing the lack of registration of the main data for those periods. Nevertheless, it caused no constraint to the operation, so the landfill gas suction and electricity generation systems operated normally, what can be clearly demonstrated by the electricity meter data, which has registered all the electricity exported and consumed from the grid. A temporary deviation from the monitoring plan as described in the registered PDD will be requested for such period and emission reductions will be claimed according to a conservative estimation.

CDM validation was contracted in 19/10/2008 and completed in 24/02/2010. The project activity accomplished its CDM registration in 04/06/2011 with the reference number 3464. The first CDM verification was successfully conducted over the monitoring period of 04/06/2011 to 30/09/2011.

Total emission reductions achieved in this monitoring period

In the monitoring period, from 01/10/2011 to 31/12/2015 (both dates included), the Project achieved 600,823 tCO₂e.

A.2. Location of project activity

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Host Party (ies)

Brazil

Region/ State/ Province, etc.

Minas Gerais

City/ Town/ Community, etc.

Belo Horizonte

Physical/ Geographical location

The Project is located in CTRS/BR.040 Landfill, to be found on highway BR.040, section Belo Horizonte – Sete Lagoas, near km 531, Jardim Filadélfia neighbourhood in Belo Horizonte city, Minas Gerais state, Brazil.

CTRS / BR.040 landfill is located, according to Google Earth, at the following coordinates:

- Latitude S: 19.9159°
- Longitude W: 44.0181°

The figures below present the detailed location of the landfill:

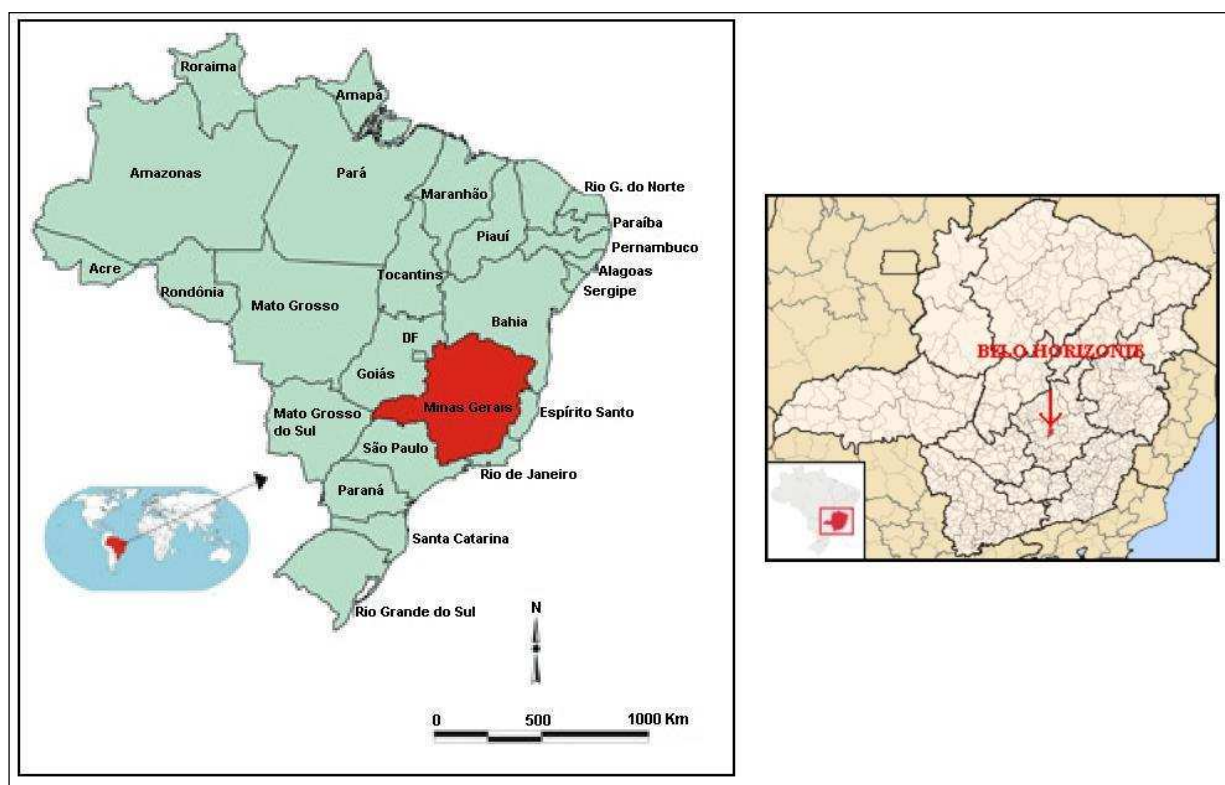


Figure 1: Project location.

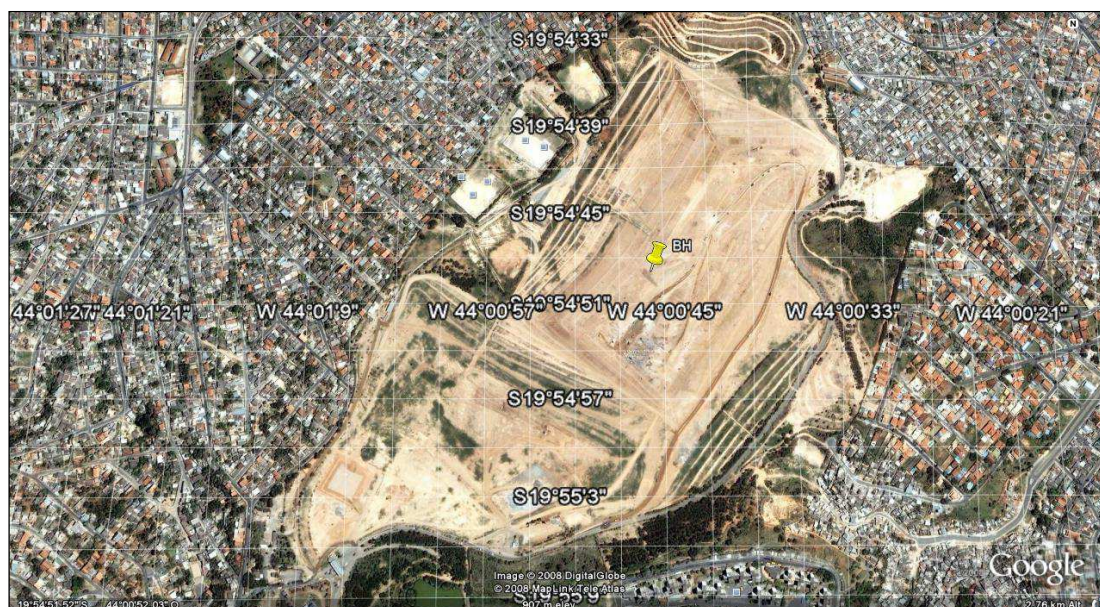


Figure 2: CTRS / BR.040 landfill location. (Source: Google Earth)

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate whether the Party involved wishes to be considered as project participant (yes/no)
Brazil (host)	Consórcio Horizonte Asja (Private entity) Asja Brasil Serviços para o Meio Ambiente Ltda. (Private entity)	No.
Switzerland	Consórcio Horizonte Asja (Private entity)	No.

A.4. Reference of applied methodology and standardized baseline

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The Project applies the following methodology and related tools:

- ACM0001 "Consolidated baseline and monitoring methodology for landfill gas project activities" (Version 11);
- "Tool for the demonstration and assessment of additionality" (Version 05.2);
- "Tool to determine project emissions from flaring gases containing methane" (Version 01);
- "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (Version 01);
- "Tool to calculate the emission factor for an electricity system" (Version 02);
- "Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion" (Version 02);
- "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" (Version 04).

A.5. Crediting period of project activity

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Choice of crediting period: fixed for 10 years (120 months).

Crediting period from 04/06/2011 to 03/06/2021.

A.6. Contact information of responsible persons/entities

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The monitoring report was completed by Asja Brasil Serviços para o Meio Ambiente Ltda. (Project Participant). The contact information is the following:

Asja Brasil Serviços para o Meio Ambiente Ltda.

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SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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The Project's infrastructure construction started in December 2008 and the first landfill gas collection wells were drilled by the beginning of 2009. The landfill gas aspiration and flare combustion plant, composed by 2 enclosed flares of capacity of 2,500 Nm³/h each one, was installed in 12/09/2009 and it is operational since 29/10/2009. The electricity generation plant started operating with 4.278 MW of installed capacity in 29/11/2010. From this day on the major part of LFG is converted into energy and so the flare combustion section became super estimated; for this reason one of the enclosed flares (Flare 2) was turned off in 04/06/2011. In 21/09/2011 an additional engine of 1.426 MW was installed which operated for one year, i.e. it was uninstalled in 21/09/2012, and the energy plant remained with the initial 4.278 MW of capacity. In 15/05/2013 the enclosed flare still left was temporarily turned off due to lack of landfill gas; no emission reductions from flaring landfill gas will be claimed from that date on. In January 2014 and from October 2014 on, an outage in the supervisory software occurred causing the lack of registration of the main data for those periods. Nevertheless, it caused no constraint to the operation, so the landfill gas suction and electricity generation systems operated normally, what can be clearly demonstrated by the electricity meter data, which has registered all the electricity exported and consumed from the grid. A temporary deviation from the monitoring plan as described in the registered PDD will be requested for such period and emission reductions will be claimed according to a conservative estimation.

The project activity accomplished its CDM registration in 04/06/2011 with the reference number 3464.

The first CDM/CER period for verification is from 04/06/2011 to 30/09/2011, both dates included. The second CDM/CER period for verification is from 01/10/2011 to 31/12/2015, both dates included.

Events such planned and forced outages for change of equipments did not require corrective actions, since no emission reduction was claimed for the moments on which the plant was out of service. Normally, the changes of equipments are done using calibrated and certified devices and do not have impacts on the GHG emission reductions calculation. No emission reduction will be claimed for periods in which a failure in the equipment calibration program occurs.

All equipment exchanges during the present monitoring report are resumed on the table below; anyway, more detailed information was presented for each specific on the Section D.2.

None of mentioned events impacts any applicability conditions stated in the Version 11 of ACM0001 – "Consolidated baseline and monitoring methodology for landfill gas project activities".

Table 1: Exchange of equipments during the monitoring period.

Change date (dd/mm/yyyy)	Position at the plant	Old equipment serial number	New equipment serial number
01/12/2011	Temperature probe – Energy line	Ecil 1037.157655	Ecil 1119.509260
01/12/2011	Temperature probe – Flare 1 line	Ecil 1037.157644	Ecil 1119.509238

19/03/2012	Relative pressure probe – Main line	ABB 6409016561	Smar U305351
19/03/2012	Temperature probe – Main line	Ecil 1028.138141	Ecil 1003.073042
19/03/2012	Relative pressure probe – Flare 1 line	ABB 6409016558	Smar U305353
05/05/2012	Differential pressure probe – Flare 1 line	ABB 6409016458	ABB 6409016455
05/05/2012	Relative pressure probe – Flare 1 line	Smar U305353	ABB 6410003214
05/05/2012	Relative pressure probe – Energy line	Smar U305352	ABB 6409016558
12/05/2012	Thermocouple – Flare 1	Ecil 0950.064353	Ecil 0950.064307
15/05/2012	Relative pressure probe – Main line	Smar U305351	ABB 6409016561
26/06/2012	Temperature probe – Flare 1 line	Ecil 1119.509238	Ecil 1037.157644
26/06/2012	Temperature probe – Energy line	Ecil 1119.509260	Ecil 1037.157655
12/07/2012	Differential pressure probe – Main line	ABB 6409016459	Smar U319327
12/07/2012	Differential pressure probe – Energy line	ABB 6409016454	Smar U319329
12/07/2012	Differential pressure probe – Flare 1 line	ABB 6409016455	Smar U319328
12/07/2012	Relative pressure probe – Flare 1 line	ABB 6410003214	Smar U318006
14/01/2013	Temperature probe – Main line	Ecil 1003.073042	Ecil 1119.509260
14/01/2013	Temperature probe – Energy line	Ecil 1037.157655	Ecil 1028.137493
14/01/2013	Temperature probe – Flare 1 line	Ecil 1037.157644	Ecil 1025.128029
12/03/2013	Relative pressure probe – Main line	ABB 6409016561	Smar U305351
12/03/2013	Relative pressure probe – Energy line	ABB 6409016558	Smar U305352
12/03/2013	Relative pressure probe – Flare 1 line	Smar U318006	Smar U305353
12/03/2013	Thermocouple – Flare 1	Ecil 0950.064307	Ecil 1121.513793
31/05/2013	Relative pressure probe – Main line	Smar U305351	ABB 6409016561
31/05/2013	Relative pressure probe – Energy line	Smar U305352	ABB 6409016558
31/05/2013	Differential pressure probe – Main line	Smar U319327	ABB 6409016459
31/05/2013	Differential pressure probe – Energy line	Smar U319329	ABB 6409016454
28/06/2013	Temperature probe – Main line	Ecil 1119.509260	Ecil 1003.073042
28/06/2013	Temperature probe – Energy line	Ecil 1028.137493	Ecil 1028.138141
11/02/2014	Temperature probe – Main line	Ecil 1003.073042	Ecil 1037.157655
11/02/2014	Temperature probe – Energy line	Ecil 1028.138141	Ecil 1037.157644
25/03/2014	Differential pressure probe – Energy line	ABB 6409016454	Smar U319329
25/03/2014	Relative pressure probe – Energy line	ABB 6409016558	Smar U305352
22/04/2014	Differential pressure probe – Main line	ABB 6409016459	ABB 6409016455
22/04/2014	Differential pressure probe – Energy line	Smar U319329	ABB 6409016454
22/04/2014	Relative pressure probe – Main line	ABB 6409016561	ABB 6409016558

22/04/2014	Relative pressure probe – Energy line	Smar U305352	ABB 6410003214
11/03/2015	Differential pressure probe – Main line	ABB 6409016455	ABB 6409016459
11/03/2015	Differential pressure probe – Energy line	ABB 6409016454	ABB 6409016458
11/03/2015	Relative pressure probe – Main line	ABB 6409016558	ABB 6409016561
11/03/2015	Relative pressure probe – Energy line	ABB 6410003214	Smar U318006
11/03/2015	Temperature probe – Main line	Ecil 1037.157655	Ecil 1003.073042
11/03/2015	Temperature probe – Energy line	Ecil 1037.157644	Ecil 1028.138141
17/12/2015	Relative pressure probe – Main line	ABB 6409016561	Smar U305351
17/12/2015	Relative pressure probe – Energy line	Smar U318006	Smar U305352
17/12/2015	Temperature probe – Main line	Ecil 1003.073042	Ecil 1119.509238
17/12/2015	Temperature probe – Energy line	Ecil 1028.138141	Ecil 1028.137493

Important clarifications:

- Calibrations are performed by an external certified company.

B.2. Post-registration changes**B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline**

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In the registered monitoring plan described in the PDD, direct monitoring is conducted on the LFG captured, destroyed by flare and used for power generation. The equipments in the plant are connected through a Programmable Logic Control (PLC) that permits the operator to quickly check the main working parameters through a user-friendly interface of the supervisory system. The process parameters are continuously sampled and stored in the data logger of the plant. Then information registered is automatically aggregated per hour in a standard form used for reporting purposes.

In January 2014 and from October 2014 on, the supervisory software suffered an outage causing the lack of registration of the main data for those periods. Nevertheless, it caused no constraint to the operation, so the landfill gas suction and electricity generation systems operated normally, what can be clearly demonstrated by the electricity meter data, which has registered all the electricity exported and consumed from the grid. Moreover, the QA/QC procedures (regular checks and calibrations of the measurement instruments) continued to be implemented even if measured data could not be registered by the supervisory software.

For this reason, a temporary deviation from the monitoring plan described in the registered PDD will be requested for the period while the plant operated normally but no data was registered by the supervisory system, and emission reductions will be claimed according to a conservative estimative based on the electricity generated using landfill gas.

Estimative of landfill gas flow into power plant

In the registered PDD, ex-ante estimative of electricity generation was calculated based on the estimated amount of LFG flowed into the power plant, methane fraction in the LFG and engine's efficiency. Similarly, the LFG amount flowed into the power plant can be estimated based on the electricity generated, methane fraction in the LFG and engine's efficiency.

To be conservative, the estimative will consider the same constants applied in the ex-ante estimation of the registered PDD. Besides that, the estimative will be based on the electricity exported to the grid instead of electricity generated by the power plant, which is greater as it includes the electricity self-consumed by the plant' equipments. The LFG feed to the engines will be calculated as per:

$$LFG_{electricity,y} = \frac{EL_{LFG} \times \text{Energy conversion rate}}{Eff. engine \times \text{Methane calorific value} \times w_{CH_4}}$$

Where:

$LFG_{electricity,y}$	=	Quantity of landfill gas fed into electricity generator during the monitoring period measured in cubic meters (m^3)
EL_{LFG}	=	Net quantity of electricity produced using LFG, which in the absence of the project activity would have been produced by power plants connected to the grid or by an onsite/off-site fossil fuel based captive power generation, during the monitoring period, in megawatt hours (MWh)
<i>Energy conversion rate</i>	=	Energy conversion rate (kcal / kWh thermal). Value is 860 kcal/kWh thermal as applied in the ex-ante estimation of PDD
<i>Eff. engine</i>	=	Efficiency of engine (%). Value is 38.9% as applied in the ex-ante estimation of PDD
<i>Methane calorific value</i>	=	Methane calorific value (kcal / m^3 CH ₄). Value is 8250 kcal/ m^3 CH ₄ as applied in the ex-ante estimation of PDD
$w_{CH_4,y}$	=	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). Value is 50% as applied in the ex-ante estimation of PDD

Then, the emission reductions will be normally calculated according to the methodologies and tools defined in the registered PDD and in the Section E of this monitoring report.

B.2.2. Corrections

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Not applicable.

B.2.3. Changes to start date of crediting period

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Not applicable.

B.2.4. Inclusion of a monitoring plan to the registered PDD that was not included at registration

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Not applicable.

B.2.5. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

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Not applicable.

B.2.6. Changes to project design of registered project activity

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The project design was changed from Version 2a of 25/11/2009 (registered PDD) to Version 3 of 03/10/2012 (revised PDD), after the project activity registration. The changes were approved in 13/03/2013.

In the registered PDD, the indicative output power of the project activity is stated to be 4.5 MW, planned to be implemented in two phases; the first phase of 0.5 MW to occur in 2009 and the second phase of 4.0 MW, in 2010. However the project has been implemented in three phases as follows:

1. On November 2010, three engines of 1.426 MW each were installed, totalizing 4.278 MW of capacity;
2. On September 2011, an additional engine of 1.426 MW was installed, totalizing 5.704 MW of capacity; and
3. In January 2013, the forth engine will be removed and sold. Therefore the energy plant will have a installed capacity of 4.278 MW.

Other minor changes in the registered PDD were:

- The equipment indicated in the general layout of biogas plant was reorganized and includes two additional boosters as per the implemented project (Picture A.4.3-1 of registered PDD);
- The total number of drilled vertical wells was increased from 165 to 195, as per the implemented project;
- The collection efficiency of the degassing system was changed from 80% to 85% as the number of wells increased and the closed landfill permitted a more efficient suction of the landfill gas; and
- The operational lifetime of the project activity was changed from 10 years to 12 years, since it is linked to the production of CERs and since registration date has delayed two years from the first estimative in the validation.

The changes did not adversely affect the additionality, the scale of CDM project activity and/or the applicability and application of the baseline methodology.

B.2.7. Types of changes specific to afforestation or reforestation project activity

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Not applicable.

SECTION C. Description of monitoring system

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According to version 11 of ACM0001 – “*Consolidated baseline and monitoring methodology for landfill gas project activities*”, direct monitoring is conducted on the LFG captured, destroyed by flare and used for power generation.

An operative manual of the project is available. This Management Manual is the applicative document of the monitoring plan (description of the project and responsibilities, operative procedures for measurements and handlings of data and details about internal audits, etc.).

1. Parameters monitored

The following parameters are monitored and logged in accordance to the Monitoring Plan:

- Landfill gas collected from project wells;
- Landfill gas flow into flares;
- Landfill gas flow into power plant;
- Methane content in the landfill gas;
- Temperature of exhaust gas from flaring;
- Methane and oxygen content in the exhaust gas from flaring;
- Electricity imported from the power grid;
- Electricity exported to the power grid;
- Power plant working hours;
- Emissions from flaring;
- Local and national regulatory framework;

- Carbon emission factor from the grid;
- TDL_y = average technical transmission and distribution losses for providing electricity to the Project in the year y ; and
- $MD_{project,y}$ = amount of methane destroyed by the project activity during the year y of the project activity (tCH_4).

The equipments in the plant are connected through a Programmable Logic Control (PLC) that permits the operator to quickly check the main working parameters through a user-friendly interface. The process parameters are continuously sampled and stored in the data logger of the plant. Then information registered is automatically aggregated per hour in a standard form used for reporting purposes.

All measurements instruments are subject to regular checks and calibrations whose procedures are described in detail in the Managing Manual of the plant. All procedures comply with manufacturer's instructions or specifications of methodology applied.

The PM (Project Manager) is responsible for the general management of the plant, including controlling equipments subjected to regular checks and calibration, in order not to surpass the frequencies established for each QA/QC procedure, and for checking the equipment's proper working order, as well as checking and storing up the calibration certificates and records.

Calibrations performed internally, by the plant's operators themselves, are registered in specific forms for each activity and calibrations performed by external companies receive calibration certificates. Both forms and certificates are stored in the plant.

Description of how parameters are properly monitored is found below.

1.1. Landfill gas collected from project wells, flowed into flares and into power plant

Instant flows collected from the project wells, sent to the flares and to the power plant are measured by flow meters installed in each line, as represented in the Figure 3 below. Flows are normalized according to landfill gas temperature and pressure automatically measured by probes connected to each flow meter, so PLC continuously monitors the Nm^3/h flowing into the plant.

These data is hourly aggregated to summarize the Nm^3 of LFG being collected from the wells, being delivered to each flare and being sent to the power plant. Emission reduction generated by the Project is calculated based on hourly aggregated data.

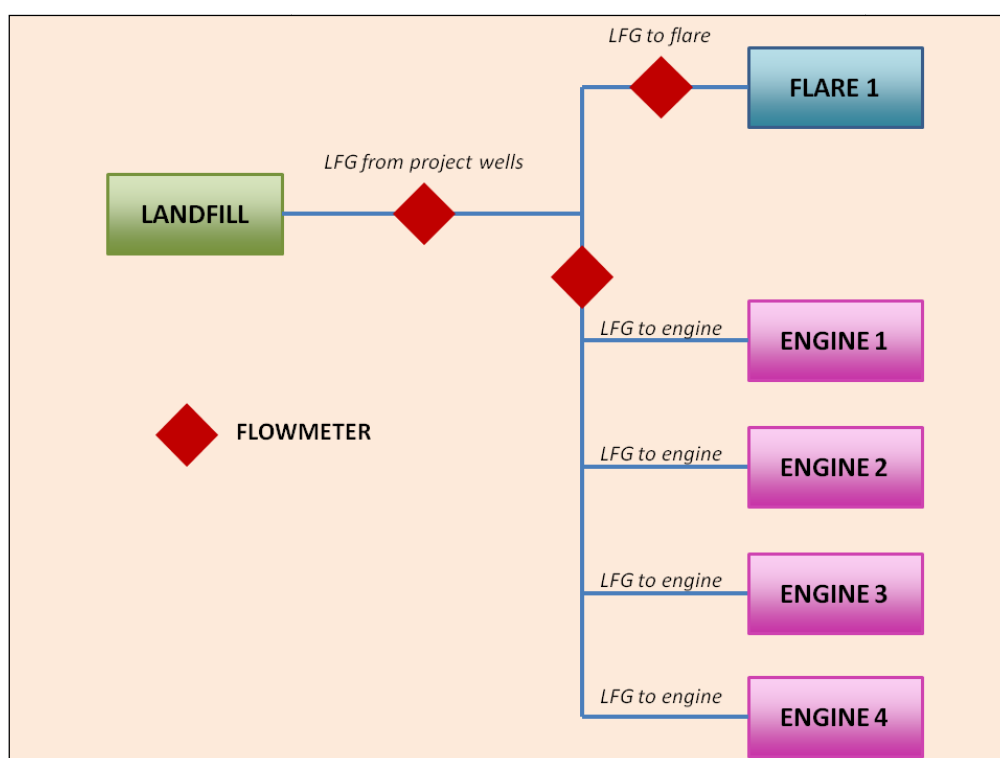


Figure 3: Flow meters' position in the landfill gas plant.

1.2. Methane content in the landfill gas

Methane content of the landfill gas is continuously measured with an infrared ray system analyzer (Siemens – Ultramat 23) and data sampled is stored in the data logger of the plant and aggregated per hour.

The gas analyzer is subject to regular maintenance according to manufacturer's instructions, and calibration records are kept available in the plant.

1.3. Temperature of exhaust gas from flaring

The temperature of the exhaust gas is continuously measured with a thermocouple installed in upper section of each flare, at 80% of flare's height. Data is registered in continuous base by the PLC and aggregated per hour.

As required by methodology, the flare efficiency is correlated with the temperature of the exhaust gas, and is only calculated if temperature of exhaust gas is higher than 500°C for more than 40 minutes during the hour considered. All calculations are made by the software (PLC) that in a conservative approach imposes a maximum flare efficiency of 99.999%, i.e. flare efficiency range is 0 to 0.99999.

1.4. Methane and oxygen content in the exhaust gas from flaring

The quantity of methane and oxygen emitted by the flares is measured by continuous analyzer (Siemens – Ultramat 23) equipped with a sampling probe for collection of exhaust gas samples installed in the upper section of each flare, at 80% of flare's height. Data is registered in continuous base by the PLC and aggregated per hour.

The gas analyzer is subject to regular maintenance according to manufacturer's instructions, and calibration records are kept available in the plant.

1.5. Electricity imported from the power grid

Electricity imported from the national grid during the monitoring period was measured by an electricity meter owned by the local electricity supplier – CEMIG (Companhia Energética de Minas Gerais). The quantity of electricity imported is determined monthly through the bills issued by the supplier company (every month) and values are recorded in a specific controlling form.

Electricity meter's management and maintenance are made by CEMIG. Project Proponents are not allowed to work on it.

When there is no electrical power the blower of the biogas plant cannot operate, therefore no landfill gas stream is available. The flow meter detects no landfill gas stream and does not count any CO₂e emission reduction. No special actions are possible to avoid this.

1.6. Electricity exported to the power grid

Electricity produced from landfill gas and exported to the national grid is continuously measured by an electricity meter whose management and maintenance are made by the buyer company – CEMIG (Companhia Energética de Minas Gerais). Project Proponents are not allowed to work on it. Amounts of electricity sold to the grid can be attested thanks to official electricity bills.

The power plant is able to supply the energy needed for the entire Project. However the power plant is dependent of availability of power grid, i.e. generating engines cannot work if no electricity is available in national grid and no emission reduction is produced in this case.

1.7. Power Plant Working Hours

Engines' working hour meters are connected to the PLC and so this parameter is continuously monitored and hourly reported.

1.8. Emissions from flaring

Project emissions from flaring of the residual gas stream in year y (tCO₂e) are determined by the procedure described in the “*Tool to determine project emissions from flaring gases containing Methane*” for each flare. Please refer to the Section E.1 of this document.

1.9. Local and National Regulatory Framework

Local and national regulatory framework (related to the project) is monitored on an annual basis in order to verify that the project complies with it.

1.10. Carbon emission factor from the grid

Since “*ex post*” option has been chosen in the Operating Margin calculations applying the “*Tool to calculate the emission factor for an electricity system*”, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required calculating the emission factor for year y is usually only available later than six months after the end of year y , alternatively the emission factor of the previous year ($y-1$) may be used. If the data is usually only available 18 months after the end of year y , the emission factor of the year proceeding the previous year ($y-2$) may be used. The same data vintage (y , $y-1$ or $y-2$) will be used throughout all crediting periods.

For more information, please refer to Section E.1 of this document

1.11. TDL_y

Project emissions from consumption of electricity are calculated based on the quantity of electricity consumed, an emission factor for electricity generation and TDL – a factor to account for transmission losses.

The Average technical transmission and distribution losses for providing electricity to the Project in year y is monitored annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.

TDL_y should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed CDM project activity is connected to. The technical distribution losses should not contain other types of grid losses (e.g. commercial losses/theft). The distribution losses can either be calculated by the project participants or be based on references from utilities, network operators or other official documentation.

Internal Audits are going to be performed in order to ensure correct monitoring of this parameter.

1.12. $MD_{project y}$

Amount of methane destroyed by the Project during the year y (tCH₄).

The methane destroyed by the project activity is determined by monitoring the quantity of methane actually flared and used to generate electricity and the total quantity of methane captured and calculated, as described in Section E.1 of this document

2. Monitoring equipments and installation

All measuring equipments are maintained and managed on general technical standards. The Management Manual determines the quality control regime for each equipment that includes regular maintenance and calibration. In order to determine the quantity of ERs generated during the project operation the following equipments, represented in the Figure 4 below, are installed.

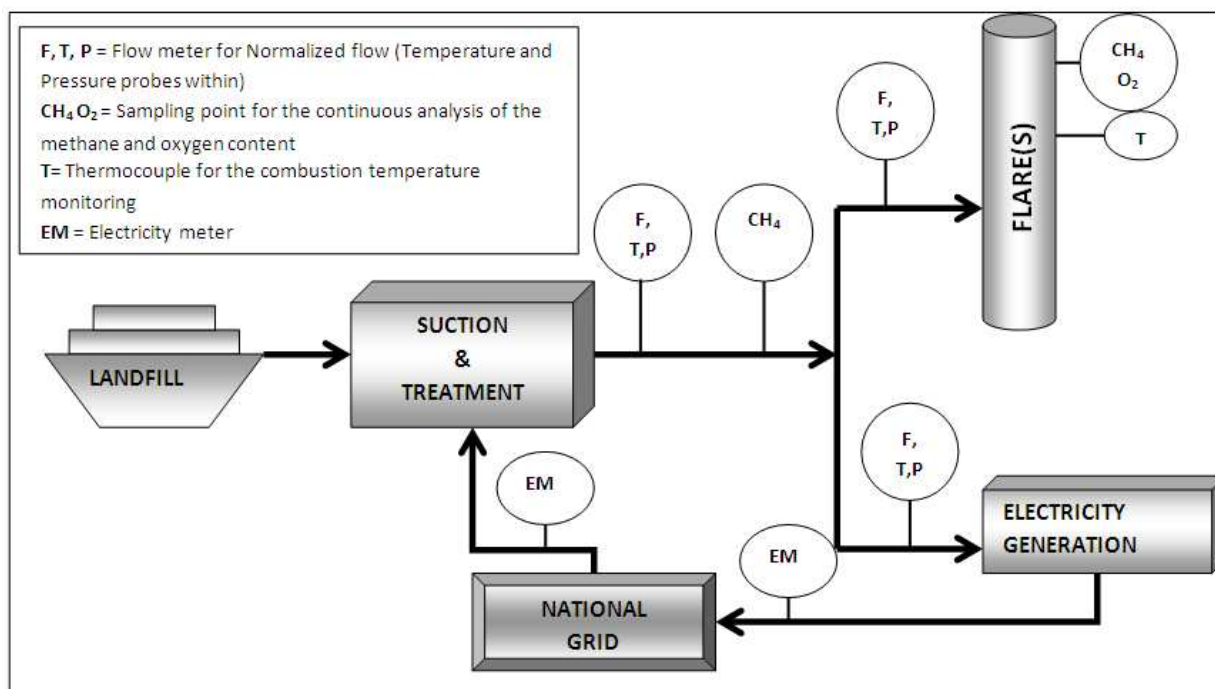


Figure 4: Monitoring points

To assure a correct monitoring, the personnel are trained on the following subjects:

- General knowledge about the equipment used in the landfill;
- Reading and recording data;
- Calibration methodology; and
- Emergency situation.

The personnel had been trained before the plant entered in operation. Chosen trainees have a good understanding of the processes and installation of the technology for the landfill gas extraction. See Organization Figure 5 below.

A Management Manual describing all operation and calibration procedures in details is also available.

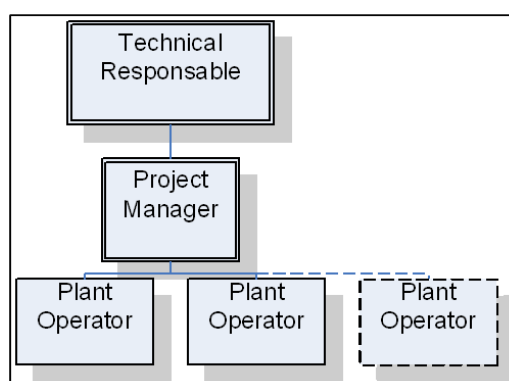


Figure 5: Organization chart

The PLC continuously receives the value of the parameters monitored on-site and automatically generates spreadsheets that are archived. The information archived is hourly aggregated in a standard format for reporting purposes.

The quality control system ensures that all the necessary documents (such as operational manual, drawings, maintenance and calibration instructions, etc.) are available and stored in a proper manner. Monitored data

and Monitoring Sheets are daily copied to local extra HD and to Project Proponent's digital server every 6 months.

All data, including calibration records and Monitoring Reports, will be kept until 2 years after the end of the crediting period.

3. Audit review

Internal audits are performed by an auditor not involved in the daily operation of the biogas plant, in order to assess the implementation of the Monitoring Plan and to prepare the Monitoring Report.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

(Copy this table for each piece of data and parameter)

Data/parameter:	Regulatory requirements relating to landfill gas
Unit	-
Description	Regulatory requirements relating to landfill gas
Source of data	Publicly available information of the Brazilian's regulatory requirements relating to landfill gas. The Designated National Authority (DNA) has been contacted to provide information.
Value(s) applied	Brazilian government does not mandate to flare or collect the Landfill Gas (LFG) emitted from landfills (communication <i>Ofício nº058/2008/CIMGC</i>).
Choice of data or measurement methods and procedures	The information though recorded annually is not used to change the adjustment factor (AF) or directly the amount of methane that would have been destroyed/combusted during the year y in the absence of the project ($MD_{BL,y}$) at renewal of the credit period because for this Project it has been chosen a fixed Crediting Period.
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks.
Additional comments	-

Data/parameter:	η_{PV}
Unit	%
Description	Capture efficiency of the baseline passive venting system
Source of data	<i>2006 IPCC Guidelines for National Greenhouse Gas Inventories</i>
Value(s) applied)	37%
Choice of data or measurement methods and procedures	As per measurements made in 11 Dutch landfills, in the closed unlined period, Oonk and Boom (1995) measures efficiencies in between 10 and 80%, the average being 37%.
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks.
Additional comments	Used to calculate Adjustment Factor.

Data/parameter:	η_{LFGF}
Unit	%
Description	Landfill Gas (LFG) Flaring efficiency of the passive venting system's connected wells
Source of data	<i>Version 01 of the "Tool to determine project emissions from flaring gases containing methane"</i>
Value(s) applied)	50%

Choice of data or measurement methods and procedures	It can be considered that lighted wells can burn methane less efficiently than an open flare. In the <i>"Tool to determine project emissions from flaring gases containing methane"</i> open flares are defined as devices where the residual gas is burned in an open air tip with or without any auxiliary fluid assistance, therefore it is conservative to adopt for these wells the open flare efficiency value which is equal to 50%.
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks.
Additional comments	Used to calculate Adjustment Factor.

Data/parameter:	GWP_{CH4}
Unit	t CO _{2e} / t CH ₄
Description	Global Warming Potential (GWP) of methane
Source of data	ACM0001 version 11 <i>"Consolidated baseline and monitoring methodology for landfill gas project activities"</i>
Value(s) applied)	<ul style="list-style-type: none"> Up to the year 2012: 21 From the year 2013: 25
Choice of data or measurement methods and procedures	Decisions under UNFCCC and the Kyoto Protocol (a value of 21 is to be applied for the first commitment period of the Kyoto Protocol, and a value of 25 is to be applied for the second commitment period of the Kyoto Protocol).
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks.
Additional comments	Parameter is fixed since for this Project Activity crediting period is fixed and the landfill is already closed.

Data/parameter:	N_{fw}
Unit	-
Description	Number of wells lighted on in the baseline
Source of data	Survey data, see Annex 3 of <i>CDM Project Design Document</i> (CDM PDD) <i>"Baseline information"</i> for the Survey Report
Value(s) applied)	25
Choice of data or measurement methods and procedures	It has been measured that the average number of wells lighted on in the CTRS / BR.040 landfill in the survey period was 23; in the calculation it has been assumed a value of 25 to be more conservative. Moreover the ignited wells were conservatively considered to remain lighted all day long, for the whole year, not taking into account seasonal rains, windy days and the frequent quenching attested from the survey in order to act in the most conservative way. No other data source was available.
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks.
Additional comments	Used to calculate Adjustment Factor.

Data/parameter:	N_{vw}
Unit	-
Description	Total number of wells present on site that can be ignited
Source of data	Survey data, see Annex 3 of <i>CDM Project Design Document</i> (CDM PDD) <i>"Baseline information"</i> for the Survey Report
Value(s) applied)	123
Choice of data or measurement methods and procedures	Attested from the Survey, see Report attached to CDM PDD with picture and drawings, no other data source were available.
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks.

Additional comments	Used to calculate Adjustment Factor.
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Data/parameter:	D_{CH₄}
Unit	tCH ₄ /m ³ CH ₄
Description	Methane Density
Source of data	-
Value(s) applied)	0.0007168
Choice of data or measurement methods and procedures	At standard temperature and pressure (0 degree Celsius and 1.013 bar) the density of methane is 0.0007168 tCH ₄ /m ³ CH ₄ .
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks.
Additional comments	-

D.2. Data and parameters monitored

(Copy this table for each piece of data and parameter)

Data/parameter:	LFG_{total,y}
Unit	Nm ³
Description	Total amount of landfill gas captured at normal Temperature and Pressure
Measured/calculated/default	Measured
Source of data	Flow meter

Value(s) of monitored parameter	Instant flow is measured by a flow meter, normalized according to landfill gas temperature and pressure. Automatic measurement of temperature and pressure are made by probes connected to the flow meter. The flow is measured continuously in Nm ³ /h and data is aggregated hourly to summarize Nm ³ of LFG being delivered to the plant. Calculation of emission reductions is made based on data aggregated every one hour.			
	Due to an outage in the supervisory software responsible for registering the data measured by the flow meter, in January 2014 and from October 2014 onwards the total amount of landfill gas captured could not be registered. As an illustrative representation of the values of this parameter, in the monitoring period, data were aggregated monthly as shown in the table below:			
	Month	LFG _{total,y} (Nm ³)	Month	LFG _{total,y} (Nm ³)
	2011 Oct	3,016,734	2013 Dec	742,975
	2011 Nov	2,817,522	2014 Jan	-
	2011 Dec	2,906,557	2014 Feb	600,022
	2012 Jan	2,879,649	2014 Mar	1,277,556
	2012 Feb	2,677,779	2014 Apr	443,952.53
	2012 Mar	3,036,906	2014 May	1,287,499.17
	2012 Apr	2,888,486	2014 Jun	1,498,793.47
	2012 May	3,006,536	2014 Jul	1,386,701.97
	2012 Jun	2,881,555	2014 Aug	1,424,243.03
	2012 Jul	2,899,609	2014 Sep	1,438,668.17
	2012 Aug	2,702,801	2014 Oct	-
	2012 Sep	2,804,964	2014 Nov	-
	2012 Oct	2,739,702	2014 Dec	-
	2012 Nov	2,663,157	2015 Jan	-
	2012 Dec	2,448,280	2015 Feb	-
	2013 Jan	1,541,854	2015 Mar	-
	2013 Feb	2,240,644	2015 Apr	-
	2013 Mar	2,689,946	2015 May	-
	2013 Apr	2,574,667	2015 Jun	-
	2013 May	2,565,444	2015 Jul	-
	2013 Jun	2,144,888	2015 Aug	-
	2013 Jul	1,861,739	2015 Sep	-
	2013 Aug	817,256	2015 Oct	-
	2013 Sep	119,695	2015 Nov	-
2013 Oct	170,671	2015 Dec	-	
2013 Nov	2,106,022			
Please refer to the Hourly Report data sheet, attached as a document, to see the values aggregated every one hour, which are used to calculate the emission reductions of project.				

Monitoring equipment	<p>The monitoring equipments are listed in the sheet below. For the calibration frequency, date of last calibration and validity please refer to "QA/QC procedures applied".</p> <table border="1"> <tr> <td data-bbox="544 248 986 936"> <u>Flow meter</u> Brand & Type: Rosemount Annubar 285 Accuracy: +/- 0.25% Serial number: 78147 </td><td data-bbox="986 248 1428 936"> <u>Differential pressure sensor</u> (~ 12/07/2012) Brand & Type : ABB 264 DS Accuracy: +/- 0.075% Serial number: 6409016459 (12/07/2012 ~ 31/05/2013) Brand & Type: Smar LD301D Accuracy: +/- 0.05% Serial number: U319327 (31/05/2013 ~ 22/04/2014) Brand & Type: ABB 264 DS Accuracy: +/- 0.075% Serial number: 6409016459 (22/04/2014 ~ 11/03/2015) Brand & Type: ABB 264 DS Accuracy: +/- 0.075% Serial number: 6409016455 (11/03/2015 ~) Brand & Type: ABB 264 DS Accuracy: +/- 0.075% Serial number: 6406016459 </td></tr> <tr> <td data-bbox="544 936 986 2033"> <u>Relative pressure probe</u> (~ 19/03/2012) Brand & Type: ABB 264 HS Accuracy: +/- 0.075% Serial number: 6409016561 (19/03/2012 ~ 15/05/2012) Brand & Type: Smar LD301M Accuracy: +/- 0.075% Serial number: U305351 (15/05/2012 ~ 12/03/2013) Brand & Type: ABB 264 HS Accuracy: +/- 0.075% Serial number: 6409016561 (12/03/2013 ~ 31/05/2013) Brand & Type: Smar LD301M Accuracy: +/- 0.075% Serial number: U305351 (31/05/2013 ~ 22/04/2014) Brand & Type: ABB 264 HS Accuracy: +/- 0.075% Serial number: 6409016561 (22/04/2014 ~ 11/03/2015) Brand & type: ABB 264 HS Accuracy: +/- 0.075% Serial number: 6409016558 (11/03/2015 ~ 17/12/2015) Brand & Type: ABB 264 HS Accuracy: +/- 0.075% Serial number: 6409016561 (17/12/2015 ~) Brand & Type: Smar LD301M Accuracy: +/- 0.075% Serial number: U305351 </td><td data-bbox="986 936 1428 2033"> <u>Temperature probe</u> (~ 19/03/2012) Brand & Type: Ecil Pt-100 Accuracy: 0.15 °C + 0.002*T Serial number: 1028.138141 (19/03/2012 ~ 14/01/2013) Brand & Type: Ecil Pt-100 Accuracy: 0.15 °C + 0.002*T Serial number: 1003.073042 (14/01/2013 ~ 28/06/2013) Brand & Type: Ecil Pt-100 Accuracy: 0.15°C + 0.002*T Serial number: 1119.509260 (28/06/2013 ~ 11/02/2014) Brand & Type: Ecil Pt-100 Accuracy: 0.15°C + 0.002*T Serial number: 1003.073042 (11/02/2014 ~ 11/03/2015) Brand & Type: Ecil Pt-100 Accuracy: 0.15°C + 0.002*T Serial number: 1037.157655 (11/03/2015 ~ 17/12/2015) Brand & Type: Ecil Pt-100 Accuracy: 0.15°C + 0.002*T Serial number: 1003.073042 (17/12/2015 ~) Brand & Type: Ecil Pt-100 Accuracy: 0.15°C + 0.002*T Serial number: 1119.509238 </td></tr> </table>	<u>Flow meter</u> Brand & Type: Rosemount Annubar 285 Accuracy: +/- 0.25% Serial number: 78147	<u>Differential pressure sensor</u> (~ 12/07/2012) Brand & Type : ABB 264 DS Accuracy: +/- 0.075% Serial number: 6409016459 (12/07/2012 ~ 31/05/2013) Brand & Type: Smar LD301D Accuracy: +/- 0.05% Serial number: U319327 (31/05/2013 ~ 22/04/2014) Brand & Type: ABB 264 DS Accuracy: +/- 0.075% Serial number: 6409016459 (22/04/2014 ~ 11/03/2015) Brand & Type: ABB 264 DS Accuracy: +/- 0.075% Serial number: 6409016455 (11/03/2015 ~) Brand & Type: ABB 264 DS Accuracy: +/- 0.075% Serial number: 6406016459	<u>Relative pressure probe</u> (~ 19/03/2012) Brand & Type: ABB 264 HS Accuracy: +/- 0.075% Serial number: 6409016561 (19/03/2012 ~ 15/05/2012) Brand & Type: Smar LD301M Accuracy: +/- 0.075% Serial number: U305351 (15/05/2012 ~ 12/03/2013) Brand & Type: ABB 264 HS Accuracy: +/- 0.075% Serial number: 6409016561 (12/03/2013 ~ 31/05/2013) Brand & Type: Smar LD301M Accuracy: +/- 0.075% Serial number: U305351 (31/05/2013 ~ 22/04/2014) Brand & Type: ABB 264 HS Accuracy: +/- 0.075% Serial number: 6409016561 (22/04/2014 ~ 11/03/2015) Brand & type: ABB 264 HS Accuracy: +/- 0.075% Serial number: 6409016558 (11/03/2015 ~ 17/12/2015) Brand & Type: ABB 264 HS Accuracy: +/- 0.075% Serial number: 6409016561 (17/12/2015 ~) Brand & Type: Smar LD301M Accuracy: +/- 0.075% Serial number: U305351	<u>Temperature probe</u> (~ 19/03/2012) Brand & Type: Ecil Pt-100 Accuracy: 0.15 °C + 0.002*T Serial number: 1028.138141 (19/03/2012 ~ 14/01/2013) Brand & Type: Ecil Pt-100 Accuracy: 0.15 °C + 0.002*T Serial number: 1003.073042 (14/01/2013 ~ 28/06/2013) Brand & Type: Ecil Pt-100 Accuracy: 0.15°C + 0.002*T Serial number: 1119.509260 (28/06/2013 ~ 11/02/2014) Brand & Type: Ecil Pt-100 Accuracy: 0.15°C + 0.002*T Serial number: 1003.073042 (11/02/2014 ~ 11/03/2015) Brand & Type: Ecil Pt-100 Accuracy: 0.15°C + 0.002*T Serial number: 1037.157655 (11/03/2015 ~ 17/12/2015) Brand & Type: Ecil Pt-100 Accuracy: 0.15°C + 0.002*T Serial number: 1003.073042 (17/12/2015 ~) Brand & Type: Ecil Pt-100 Accuracy: 0.15°C + 0.002*T Serial number: 1119.509238
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Measuring/reading/recording frequency:	Monitoring frequency: continuous Recording frequency: every two minutes Aggregation frequency: hourly, daily, monthly																																																																					
Calculation method (if applicable):	Not applicable.																																																																					
QA/QC procedures:	<p>Flow meter A calibration is required each 10 years, for this equipment, according to manufacturer specifications. In this monitoring period, no calibration was necessary, since the last one (12/09/2009) is still valid.</p> <p>Differential pressure sensor External calibration is applied to this equipment annually.</p> <table border="1"> <thead> <tr> <th>Brand and Serial nº of equipment</th> <th>Calibration date</th> <th>Calibration certificate nº (name of company)</th> </tr> </thead> <tbody> <tr> <td>ABB 6409016459</td> <td>13/07/2011</td> <td>P00266 (Lamon)</td> </tr> <tr> <td>Smar U319327</td> <td>20/06/2012</td> <td>U319327⁽¹⁾ (Smar)</td> </tr> <tr> <td>ABB 6409016459</td> <td>24/04/2013</td> <td>LMP118830/13 (Wika)</td> </tr> <tr> <td>ABB 6409016455</td> <td>14/04/2014</td> <td>LMP143194/14 (Wika)</td> </tr> <tr> <td>ABB 6409016459</td> <td>22/02/2015</td> <td>LMP172651/15 (Wika)</td> </tr> </tbody> </table> <p>⁽¹⁾ The calibration certificate does not have a specific number.</p> <p>Relative pressure probe External calibration is applied to this equipment annually.</p> <table border="1"> <thead> <tr> <th>Brand and Serial nº of equipment</th> <th>Calibration date</th> <th>Calibration certificate nº (name of company)</th> </tr> </thead> <tbody> <tr> <td>ABB 6409016561</td> <td>23/03/2011</td> <td>CAL00141 (Lamon)</td> </tr> <tr> <td>Smar U305351</td> <td>16/05/2011</td> <td>U305351⁽¹⁾ (Smar)</td> </tr> <tr> <td>ABB 6409016561</td> <td>18/04/2012</td> <td>1352 001 (Atma)</td> </tr> <tr> <td>Smar U305351</td> <td>07/08/2012</td> <td>1121 (Smar)</td> </tr> <tr> <td>ABB 6409016561</td> <td>24/03/2013</td> <td>LMP118831/13 (Wika)</td> </tr> <tr> <td>ABB 6409016558</td> <td>14/04/2014</td> <td>LMP143192/14 (Wika)</td> </tr> <tr> <td>ABB 6409016561</td> <td>22/02/2015</td> <td>LMP169072/15 (Wika)</td> </tr> <tr> <td>Smar U305351</td> <td>10/12/2015</td> <td>182263/15 (Medição)</td> </tr> </tbody> </table> <p>⁽¹⁾ The calibration certificate does not have a specific number.</p> <p>Temperature probe External calibration is applied to this equipment annually.</p> <table border="1"> <thead> <tr> <th>Brand and Serial nº of equipment</th> <th>Calibration date</th> <th>Calibration certificate nº (name of company)</th> </tr> </thead> <tbody> <tr> <td>Ecil 1028.138141</td> <td>31/03/2011</td> <td>2212/11 (Ecil)</td> </tr> <tr> <td>Ecil 1003.073042</td> <td>24/02/2012</td> <td>06407/12 (Calibratec)</td> </tr> <tr> <td>Ecil 119.509260</td> <td>24/08/2012</td> <td>6642/12 (Ecil)</td> </tr> <tr> <td>Ecil 1003.073042</td> <td>05/02/2013</td> <td>0408/13 (Ecil)</td> </tr> <tr> <td>Ecil 1037.157655</td> <td>06/02/2014</td> <td>0651/14 (Ecil)</td> </tr> <tr> <td>Ecil 1003.073042</td> <td>15/01/2015</td> <td>LMT166783/15 (Wika)</td> </tr> <tr> <td>Ecil 1119.509238</td> <td>11/12/2015</td> <td>182683/15 (Medição)</td> </tr> </tbody> </table>	Brand and Serial nº of equipment	Calibration date	Calibration certificate nº (name of company)	ABB 6409016459	13/07/2011	P00266 (Lamon)	Smar U319327	20/06/2012	U319327 ⁽¹⁾ (Smar)	ABB 6409016459	24/04/2013	LMP118830/13 (Wika)	ABB 6409016455	14/04/2014	LMP143194/14 (Wika)	ABB 6409016459	22/02/2015	LMP172651/15 (Wika)	Brand and Serial nº of equipment	Calibration date	Calibration certificate nº (name of company)	ABB 6409016561	23/03/2011	CAL00141 (Lamon)	Smar U305351	16/05/2011	U305351 ⁽¹⁾ (Smar)	ABB 6409016561	18/04/2012	1352 001 (Atma)	Smar U305351	07/08/2012	1121 (Smar)	ABB 6409016561	24/03/2013	LMP118831/13 (Wika)	ABB 6409016558	14/04/2014	LMP143192/14 (Wika)	ABB 6409016561	22/02/2015	LMP169072/15 (Wika)	Smar U305351	10/12/2015	182263/15 (Medição)	Brand and Serial nº of equipment	Calibration date	Calibration certificate nº (name of company)	Ecil 1028.138141	31/03/2011	2212/11 (Ecil)	Ecil 1003.073042	24/02/2012	06407/12 (Calibratec)	Ecil 119.509260	24/08/2012	6642/12 (Ecil)	Ecil 1003.073042	05/02/2013	0408/13 (Ecil)	Ecil 1037.157655	06/02/2014	0651/14 (Ecil)	Ecil 1003.073042	15/01/2015	LMT166783/15 (Wika)	Ecil 1119.509238	11/12/2015	182683/15 (Medição)
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Purpose of data:	Calculation of baseline emissions and baseline net GHG removals by sinks.																																																																					
Additional comments:	-																																																																					

Data/parameter:	LFG _{flare,y}
Unit	Nm ³
Description	Amount of landfill gas flared
Measured/calculated/default	Measured
Source of data	Flow meter

Value(s) of monitored parameter	<p>Instant flow is measured by a flow meter normalized according to landfill gas temperature and pressure. Automatic measurement of temperature and pressure was made by probes connected to the flow meter.</p> <p>The flow is measured continuously in Nm³/h and data is aggregated hourly to summarize Nm³ of LFG being delivered to the plant. Calculation of emission reductions is made based on data aggregated every one hour.</p> <p>In 15/05/2013 the remaining enclosed flare was temporarily turned off due to lack of landfill gas. No emission reductions will be claimed for flaring landfill gas from that date on.</p> <p>As an illustrative representation of the values of this parameter, in the monitoring period, data were aggregated monthly as shown in the table below:</p>			
	Month	LFG _{flare,y} (Nm ³)	Month	LFG _{flare,y} (Nm ³)
	2011 Oct	466	2012 Ago	-
	2011 Nov	-	2012 Sep	-
	2011 Dec	7,531	2012 Oct	-
	2012 Jan	-	2012 Nov	-
	2012 Feb	-	2012 Dec	-
	2012 Mar	-	2013 Jan	-
	2012 Apr	-	2013 Feb	-
	2012 May	-	2013 Mar	-
	2012 Jun	6,377	2013 Apr	-
	2012 Jul	920	2013 May	-
<p>Please refer to the Hourly Report data sheet, attached as a document, to see the values aggregated every one hour, which are used to calculate the emission reductions of project.</p>				

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Measuring/reading/recording frequency:	Monitoring frequency: continuous Recording frequency: every two minutes Aggregation frequency: hourly, daily, monthly				
Calculation method (if applicable):	Not applicable.				

QA/QC procedures:	Flow meter A calibration is required each 10 years, for this equipment, according to manufacturer specifications. In this monitoring period, no calibration was necessary, since the last one (12/09/2009) is still valid.																	
	Differential pressure sensor External calibration is applied to this equipment annually.																	
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Purpose of data: Calculation of baseline emissions or baseline net GHG removals by sinks.																		
Additional comments: -																		

Data/parameter:	LFG_{electricity,y}
Unit	Nm ³
Description	Amount of landfill gas combusted in power plant
Measured/calculated/default	Measured
Source of data	Flow meter

Value(s) of monitored parameter	<p>Instant flow was measured by a flow meter, normalized according to landfill gas temperature and pressure. Automatic measurement of temperature and pressure was made by probes connected to the flow meter. The flow is measured continuously in Nm³/h and data is aggregated hourly to summarize Nm³ of LFG being delivered to the plant. Calculation of emission reductions is made based on data aggregated every one hour.</p> <p>Due to an outage in the supervisory software responsible for registering the data measured by the flow meter, in January 2014 and from October 2014 onwards, the total amount of landfill gas combusted in the power plant could not be registered. Nevertheless, the amounts were conservatively estimated based on the electricity exported to the grid.</p> <p>As an illustrative representation of the values of this parameter, in the monitoring period, data were aggregated monthly as shown in the table below:</p>			
	Month	LFG_{electricity,y} (Nm³)	Month	LFG_{electricity,y} (Nm³)
	2011 Oct	2,890,868.90	2013 Dec	722,554.27
	2011 Nov	2,655,039.90	2014 Jan	1,020,225.70
	2011 Dec	2,769,774.73	2014 Feb	585,051.87
	2012 Jan	2,740,715.20	2014 Mar	793,419.33
	2012 Feb	2,565,297.73	2014 Apr	130,474.90
	2012 Mar	2,970,367.47	2014 May	1,244,968.90
	2012 Apr	2,816,647.93	2014 Jun	1,445,386.67
	2012 May	2,929,684.60	2014 Jul	1,327,392.90
	2012 Jun	2,806,412.30	2014 Aug	1,372,259.40
	2012 Jul	2,832,231.83	2014 Sep	1,389,608.57
	2012 Ago	2,645,678.90	2014 Oct	858,689.06
	2012 Sep	2,741,468.97	2014 Nov	844,417.23
	2012 Oct	2,662,141.73	2014 Dec	873,560.63
	2012 Nov	2,601,770.43	2015 Jan	821,059.96
	2012 Dec	2,383,359.57	2015 Feb	131,825.99
	2013 Jan	1,466,306.37	2015 Mar	520,452.80
	2013 Feb	2,174,852.83	2015 Apr	762,243.12
	2013 Mar	2,622,930.80	2015 May	779,607.92
	2013 Apr	2,518,355.87	2015 Jun	733,363.94
	2013 May	2,507,193.13	2015 Jul	756,190.62
	2013 Jun	2,081,186.23	2015 Aug	726,334.41
	2013 Jul	1,794,502.57	2015 Sep	-
	2013 Ago	769,305.00	2015 Oct	598,897.65
	2013 Sep	112,273.33	2015 Nov	651,191.44
	2013 Oct	165,995.23	2015 Dec	712,719.12
	2013 Nov	2,051,553.40		
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QA/QC procedures:	<p>Flow meter A calibration is required each 10 years, for this equipment, according to manufacturer specifications. In this monitoring period, no calibration was necessary, since the last one (12/09/2009) is still valid.</p> <p>Differential pressure sensor External calibration is applied to this equipment annually.</p> <table border="1"> <thead> <tr> <th>Brand and Serial nº of equipment</th><th>Calibration date</th><th>Calibration certificate nº (name of company)</th></tr> </thead> <tbody> <tr> <td>ABB 6409016454</td><td>13/07/2011</td><td>CAL00265 (Lamon)</td></tr> <tr> <td>Smar U319329</td><td>20/06/2012</td><td>U319329⁽¹⁾ (Smar)</td></tr> <tr> <td>ABB 6409016454</td><td>24/04/2013</td><td>LMP118828/13 (Wika)</td></tr> <tr> <td>Smar U319329</td><td>20/06/2012</td><td>U319329⁽¹⁾ (Smar)</td></tr> <tr> <td>ABB 6409016454</td><td>14/04/2014</td><td>LMP143193/14 (Wika)</td></tr> <tr> <td>ABB 6409016458</td><td>22/02/2015</td><td>LMP172650/15 (Wika)</td></tr> </tbody> </table> <p>⁽¹⁾ The calibration certificate does not have a specific number.</p> <p>Relative pressure probe External calibration is applied to this equipment annually.</p> <table border="1"> <thead> <tr> <th>Brand and Serial nº of equipment</th><th>Calibration date</th><th>Calibration certificate nº (name of company)</th></tr> </thead> <tbody> <tr> <td>Smar U305352</td><td>12/05/2011</td><td>U305352⁽¹⁾ (Smar)</td></tr> <tr> <td>ABB 6409016558</td><td>18/04/2012</td><td>1352 002 (Atma)</td></tr> <tr> <td>Smar U305352</td><td>07/08/2012</td><td>1120 (Smar)</td></tr> <tr> <td>ABB 6409016558</td><td>24/04/2013</td><td>LMP18833/13 (Wika)</td></tr> <tr> <td>Smar U305352</td><td>07/08/2012</td><td>1120 (Smar)</td></tr> <tr> <td>ABB 6410003214</td><td>14/04/2014</td><td>LMP143191/14 (Wika)</td></tr> <tr> <td>Smar U318006</td><td>22/02/2015</td><td>LMP169070/15 (Wika)</td></tr> <tr> <td>Smar U305352</td><td>10/12/2015</td><td>182265/15 (Medição)</td></tr> </tbody> </table> <p>⁽¹⁾ The calibration certificate does not have a specific number.</p> <p>Temperature probe External calibration is applied to this equipment annually.</p> <table border="1"> <thead> <tr> <th>Brand and Serial nº of equipment</th><th>Calibration date</th><th>Calibration certificate nº (name of company)</th></tr> </thead> <tbody> <tr> <td>Ecil 1037.157655</td><td>14/12/2010</td><td>8616/10 (Ecil)</td></tr> <tr> <td>Ecil 1119.509260</td><td>27/06/2011</td><td>4478/11 (Ecil)</td></tr> <tr> <td>Ecil 1037.157655</td><td>24/02/2012</td><td>06411/12 (Calibratec)</td></tr> <tr> <td>Ecil 1028.137493</td><td>24/08/2012</td><td>6641/12 (Ecil)</td></tr> <tr> <td>Ecil 1028.138141</td><td>05/02/2013</td><td>0410/13 (Ecil)</td></tr> <tr> <td>Ecil 1037.157644</td><td>06/02/2014</td><td>0650/14 (Ecil)</td></tr> <tr> <td>Ecil 1028.138141</td><td>15/01/2015</td><td>LMT166784/15 (Wika)</td></tr> <tr> <td>Ecil 1028.137493</td><td>11/12/2015</td><td>182730/15 (Medição)</td></tr> </tbody> </table>	Brand and Serial nº of equipment	Calibration date	Calibration certificate nº (name of company)	ABB 6409016454	13/07/2011	CAL00265 (Lamon)	Smar U319329	20/06/2012	U319329 ⁽¹⁾ (Smar)	ABB 6409016454	24/04/2013	LMP118828/13 (Wika)	Smar U319329	20/06/2012	U319329 ⁽¹⁾ (Smar)	ABB 6409016454	14/04/2014	LMP143193/14 (Wika)	ABB 6409016458	22/02/2015	LMP172650/15 (Wika)	Brand and Serial nº of equipment	Calibration date	Calibration certificate nº (name of company)	Smar U305352	12/05/2011	U305352 ⁽¹⁾ (Smar)	ABB 6409016558	18/04/2012	1352 002 (Atma)	Smar U305352	07/08/2012	1120 (Smar)	ABB 6409016558	24/04/2013	LMP18833/13 (Wika)	Smar U305352	07/08/2012	1120 (Smar)	ABB 6410003214	14/04/2014	LMP143191/14 (Wika)	Smar U318006	22/02/2015	LMP169070/15 (Wika)	Smar U305352	10/12/2015	182265/15 (Medição)	Brand and Serial nº of equipment	Calibration date	Calibration certificate nº (name of company)	Ecil 1037.157655	14/12/2010	8616/10 (Ecil)	Ecil 1119.509260	27/06/2011	4478/11 (Ecil)	Ecil 1037.157655	24/02/2012	06411/12 (Calibratec)	Ecil 1028.137493	24/08/2012	6641/12 (Ecil)	Ecil 1028.138141	05/02/2013	0410/13 (Ecil)	Ecil 1037.157644	06/02/2014	0650/14 (Ecil)	Ecil 1028.138141	15/01/2015	LMT166784/15 (Wika)	Ecil 1028.137493	11/12/2015	182730/15 (Medição)
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Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks.																																																																											
Additional comments:	-																																																																											

Data/parameter:	W _{CH₄,y}
Unit	m ³ CH ₄ / m ³ LFG
Description	Methane fraction in the landfill gas
Measured/calculated/default	Measured
Source of data	Continuous methane analyzer

Value(s) of monitored parameter	<p>Due to an outage in the supervisory software responsible for registering the data measured by the gas analyzer, in January 2014 and from October 2014 onwards, a default value for the fraction of methane was considered.</p> <p>As an illustrative representation of the values of this parameter in the monitoring report period data were aggregated monthly, as shown in the table below:</p> <table border="1" data-bbox="520 338 1439 1323"> <thead> <tr> <th>Month</th><th>w_{CH₄,y} (%)</th><th>Month</th><th>w_{CH₄,y} (%)</th></tr> </thead> <tbody> <tr><td>2011 Oct</td><td>49.30</td><td>2013 Dec</td><td>14.41</td></tr> <tr><td>2011 Nov</td><td>49.52</td><td>2014 Jan</td><td>50.00</td></tr> <tr><td>2011 Dec</td><td>49.69</td><td>2014 Feb</td><td>12.04</td></tr> <tr><td>2012 Jan</td><td>49.54</td><td>2014 Mar</td><td>26.25</td></tr> <tr><td>2012 Feb</td><td>49.70</td><td>2014 May</td><td>13.43</td></tr> <tr><td>2012 Mar</td><td>46.09</td><td>2014 Jun</td><td>28.78</td></tr> <tr><td>2012 Apr</td><td>45.12</td><td>2014 Jun</td><td>35.61</td></tr> <tr><td>2012 May</td><td>44.14</td><td>2014 Jul</td><td>35.66</td></tr> <tr><td>2012 Jun</td><td>42.36</td><td>2014 Aug</td><td>32.11</td></tr> <tr><td>2012 Jul</td><td>40.70</td><td>2014 Sep</td><td>32.21</td></tr> <tr><td>2012 Ago</td><td>43.79</td><td>2014 Oct</td><td>50.00</td></tr> <tr><td>2012 Sep</td><td>40.69</td><td>2014 Nov</td><td>50.00</td></tr> <tr><td>2012 Oct</td><td>42.00</td><td>2014 Dec</td><td>50.00</td></tr> <tr><td>2012 Nov</td><td>42.96</td><td>2015 Jan</td><td>50.00</td></tr> <tr><td>2012 Dec</td><td>46.42</td><td>2015 Feb</td><td>50.00</td></tr> <tr><td>2013 Jan</td><td>57.64</td><td>2015 Mar</td><td>50.00</td></tr> <tr><td>2013 Feb</td><td>47.53</td><td>2015 Apr</td><td>50.00</td></tr> <tr><td>2013 Mar</td><td>41.32</td><td>2015 May</td><td>50.00</td></tr> <tr><td>2013 Apr</td><td>40.70</td><td>2015 Jun</td><td>50.00</td></tr> <tr><td>2013 May</td><td>39.47</td><td>2015 Jul</td><td>50.00</td></tr> <tr><td>2013 Jun</td><td>45.31</td><td>2015 Aug</td><td>50.00</td></tr> <tr><td>2013 Jul</td><td>51.77</td><td>2015 Sep</td><td>50.00</td></tr> <tr><td>2013 Ago</td><td>55.65</td><td>2015 Oct</td><td>50.00</td></tr> <tr><td>2013 Sep</td><td>8.07</td><td>2015 Nov</td><td>50.00</td></tr> <tr><td>2013 Oct</td><td>2.95</td><td>2015 Dec</td><td>50.00</td></tr> <tr><td>2013 Nov</td><td>38.68</td><td></td><td></td></tr> </tbody> </table> <p>Please refer to the Hourly Report data sheet, attached as a document, to see the values aggregated every one hour, which are used to calculate the emission reductions of project.</p>	Month	w _{CH₄,y} (%)	Month	w _{CH₄,y} (%)	2011 Oct	49.30	2013 Dec	14.41	2011 Nov	49.52	2014 Jan	50.00	2011 Dec	49.69	2014 Feb	12.04	2012 Jan	49.54	2014 Mar	26.25	2012 Feb	49.70	2014 May	13.43	2012 Mar	46.09	2014 Jun	28.78	2012 Apr	45.12	2014 Jun	35.61	2012 May	44.14	2014 Jul	35.66	2012 Jun	42.36	2014 Aug	32.11	2012 Jul	40.70	2014 Sep	32.21	2012 Ago	43.79	2014 Oct	50.00	2012 Sep	40.69	2014 Nov	50.00	2012 Oct	42.00	2014 Dec	50.00	2012 Nov	42.96	2015 Jan	50.00	2012 Dec	46.42	2015 Feb	50.00	2013 Jan	57.64	2015 Mar	50.00	2013 Feb	47.53	2015 Apr	50.00	2013 Mar	41.32	2015 May	50.00	2013 Apr	40.70	2015 Jun	50.00	2013 May	39.47	2015 Jul	50.00	2013 Jun	45.31	2015 Aug	50.00	2013 Jul	51.77	2015 Sep	50.00	2013 Ago	55.65	2015 Oct	50.00	2013 Sep	8.07	2015 Nov	50.00	2013 Oct	2.95	2015 Dec	50.00	2013 Nov	38.68		
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Monitoring equipment	Brand: Siemens Type: Ultramat 23 Accuracy: +/-1% for the CH ₄ and 0.5% for the O ₂ Serial Number: ULT 01 - N1 X 6-991 For the calibration frequency, date of last calibration and validity please refer to "QA/QC procedures applied".																																																																																																												
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QA/QC procedures:	<p>The supplier of the methane analyzer recommends calibrating the instrument every six or twelve months depending on the application. However, it has been decided to perform the calibration on a monthly basis in order to get a more conservative measure.</p> <p>The methane analyzer is calibrated every month by a trained plant operator and supervised by the Project Manager (PM). The plant operator applies the calibration procedure suggested by the manufacturer which is documented within the Plant Maintenance Manual. The internal calibration is registered on the respective form: "Formulario de calibração analisador fixo de biogás" – FO CAL/002.</p> <p>The plant operator and the PM have been trained in order to be qualified to carry out the calibration procedure correctly. All the training certificates are available at the plant. The process for calibration is performed by use of gas cylinders which are purchased from a certified gas supplier. The cylinders have a quality certificate that assures the quality of the calibration gases. Calibrated gases cylinders' certificate numbers are listed below:</p> <table border="1" data-bbox="520 645 1439 1115"> <thead> <tr> <th>Period of use</th><th>Type of gas mixture</th><th>Cylinder nº</th><th>Calibration date (validity)</th><th>Certificate nº (name of company)</th></tr> </thead> <tbody> <tr> <td>~ 09/03/2012</td><td rowspan="3">60% CH₄ and 40% CO₂</td><td>EGE 8142</td><td>06/09/2010 (36 months)</td><td>2318/10 (Linde)</td></tr> <tr> <td>06/04/2012 ~ 23/08/2013</td><td>EDE 4058</td><td>17/05/2011 (36 months)</td><td>1191/11 (Linde)</td></tr> <tr> <td>20/09/2013 ~</td><td>EGE 8142</td><td>07/08/2013 (36 months)</td><td>2553/13 (Linde)</td></tr> <tr> <td>~ 10/02/2012</td><td rowspan="3">100% N₂</td><td>EGE 8143</td><td>09/2010 (36 months)</td><td>1125/11 (Linde)</td></tr> <tr> <td>09/03/2012 ~ 06/03/2014</td><td>EDI 8188</td><td>13/04/2011 (36 months)</td><td>641/12 (Linde)</td></tr> <tr> <td>04/04/2014 ~</td><td>EGE 8143</td><td>11/04/2013 (36 months)</td><td>3214/2014 (Linde)</td></tr> </tbody> </table> <p>During the monitoring period Ultramat 23 was calibrated in the following dates:</p> <table border="1" data-bbox="520 1205 1439 1821"> <tbody> <tr> <td>• 19/09/2011</td><td>• 04/03/2013</td><td>• 22/08/2014</td></tr> <tr> <td>• 17/10/2011</td><td>• 03/04/2013</td><td>• 19/09/2014</td></tr> <tr> <td>• 16/11/2011</td><td>• 02/05/2013</td><td>• 17/10/2014</td></tr> <tr> <td>• 13/12/2011</td><td>• 28/05/2013</td><td>• 14/11/2014</td></tr> <tr> <td>• 12/01/2012</td><td>• 26/06/2013</td><td>• 12/12/2014</td></tr> <tr> <td>• 10/02/2012</td><td>• 25/07/2013</td><td>• 08/01/2015</td></tr> <tr> <td>• 09/03/2012</td><td>• 23/08/2013</td><td>• 05/02/2015</td></tr> <tr> <td>• 06/04/2012</td><td>• 20/09/2013</td><td>• 03/03/2015</td></tr> <tr> <td>• 04/05/2012</td><td>• 15/10/2013</td><td>• 01/04/2015</td></tr> <tr> <td>• 01/06/2012</td><td>• 14/11/2013</td><td>• 28/04/2015</td></tr> <tr> <td>• 29/06/2012</td><td>• 12/12/2013</td><td>• 27/05/2015</td></tr> <tr> <td>• 27/07/2012</td><td>• 10/01/2014</td><td>• 25/06/2015</td></tr> <tr> <td>• 24/08/2012</td><td>• 07/02/2014</td><td>• 23/07/2015</td></tr> <tr> <td>• 21/09/2012</td><td>• 06/03/2014</td><td>• 03/08/2015</td></tr> <tr> <td>• 19/10/2012</td><td>• 04/04/2014</td><td>• 05/10/2015</td></tr> <tr> <td>• 13/11/2012</td><td>• 01/05/2014</td><td>• 30/10/2015</td></tr> <tr> <td>• 12/12/2012</td><td>• 30/05/2014</td><td>• 25/11/2015</td></tr> <tr> <td>• 11/01/2013</td><td>• 27/06/2014</td><td>• 18/12/2015</td></tr> <tr> <td>• 05/02/2013</td><td>• 25/07/2014</td><td></td></tr> </tbody> </table> <p>Notice that the Ultramat 23 was out of service from 01/09/2015 to 05/10/2015 as it passed through external maintenance. No emission reductions will be claimed for methane destruction during this period.</p>	Period of use	Type of gas mixture	Cylinder nº	Calibration date (validity)	Certificate nº (name of company)	~ 09/03/2012	60% CH ₄ and 40% CO ₂	EGE 8142	06/09/2010 (36 months)	2318/10 (Linde)	06/04/2012 ~ 23/08/2013	EDE 4058	17/05/2011 (36 months)	1191/11 (Linde)	20/09/2013 ~	EGE 8142	07/08/2013 (36 months)	2553/13 (Linde)	~ 10/02/2012	100% N ₂	EGE 8143	09/2010 (36 months)	1125/11 (Linde)	09/03/2012 ~ 06/03/2014	EDI 8188	13/04/2011 (36 months)	641/12 (Linde)	04/04/2014 ~	EGE 8143	11/04/2013 (36 months)	3214/2014 (Linde)	• 19/09/2011	• 04/03/2013	• 22/08/2014	• 17/10/2011	• 03/04/2013	• 19/09/2014	• 16/11/2011	• 02/05/2013	• 17/10/2014	• 13/12/2011	• 28/05/2013	• 14/11/2014	• 12/01/2012	• 26/06/2013	• 12/12/2014	• 10/02/2012	• 25/07/2013	• 08/01/2015	• 09/03/2012	• 23/08/2013	• 05/02/2015	• 06/04/2012	• 20/09/2013	• 03/03/2015	• 04/05/2012	• 15/10/2013	• 01/04/2015	• 01/06/2012	• 14/11/2013	• 28/04/2015	• 29/06/2012	• 12/12/2013	• 27/05/2015	• 27/07/2012	• 10/01/2014	• 25/06/2015	• 24/08/2012	• 07/02/2014	• 23/07/2015	• 21/09/2012	• 06/03/2014	• 03/08/2015	• 19/10/2012	• 04/04/2014	• 05/10/2015	• 13/11/2012	• 01/05/2014	• 30/10/2015	• 12/12/2012	• 30/05/2014	• 25/11/2015	• 11/01/2013	• 27/06/2014	• 18/12/2015	• 05/02/2013	• 25/07/2014	
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• 27/07/2012	• 10/01/2014	• 25/06/2015																																																																																							
• 24/08/2012	• 07/02/2014	• 23/07/2015																																																																																							
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Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks.																																																																																								
Additional comments:	-																																																																																								

Data/parameter:	Operation of the energy plant				
Unit	Hours				
Description	Operation of the energy plant				
Measured/calculated/default	Measured				
Source of data	Engine's working hour counter meters				
Value(s) of monitored parameter	Due to an outage in the supervisory software responsible for registering the data measured by the counter meter, from 01/10/2014 onwards the engine's working hours could not be registered. As an illustrative representation of the values of this parameter, in the monitoring period, data were aggregated monthly as shown in the table below:				
	Month	Working hours of engines [h]			
		Engine 1	Engine 2	Engine 3	Engine 4
	2011 Oct	713	546	628	605
	2011 Nov	694	256	707	633
	2011 Dec	676	652	693	503
	2012 Jan	588	536	622	532
	2012 Feb	529	499	529	585
	2012 Mar	649	184	635	706
	2012 Apr	658	421	301	683
	2012 May	699	168	589	654
	2012 Jun	692	689	5	710
	2012 Jul	239	703	551	616
	2012 Ago	662	555	148	705
	2012 Sep	691	713	713	0
	2012 Oct	732	732	679	0
	2012 Nov	700	704	703	0
	2012 Dec	725	723	519	0
	2013 Jan	730	679	0	0
	2013 Feb	659	656	534	0
	2013 Mar	733	709	735	0
	2013 Apr	703	690	698	0
	2013 May	725	701	691	0
	2013 Jun	266	705	713	0
	2013 Jul	7	701	724	0
	2013 Ago	18	662	27	0
	2013 Sep	0	96	0	0
	2013 Oct	50	51	51	0
	2013 Nov	84	711	685	0
	2013 Dec	236	241	233	0
	2014 Jan	0	0	0	0
	2014 Feb	183	211	32	0
	2014 Mar	0	599	599	0
	2014 May	0	0	0	0
	2014 Jun	0	0	0	0
	2014 Jun	0	0	0	0
	2014 Jul	0	0	0	0
	2014 Aug	0	0	0	0
	2014 Sep	0	0	0	0
	2014 Oct	0	0	0	0
2014 Nov	0	0	0	0	
2014 Dec	0	0	0	0	
2015 Jan	0	0	0	0	
2015 Feb	0	0	0	0	
2015 Mar	0	0	0	0	
2015 Apr	0	0	0	0	
2015 May	0	0	0	0	
2015 Jun	0	0	0	0	
2015 Jul	0	0	0	0	
2015 Aug	0	0	0	0	
2015 Sep	0	0	0	0	
2015 Oct	0	0	0	0	
2015 Nov	0	0	0	0	
2015 Dec	0	0	0	0	

Monitoring equipment	Engine's working hour counter meters.
Measuring/reading/recording frequency:	Monitoring frequency: continuous Recording frequency: every two minutes Aggregation frequency: hourly, daily, monthly
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Not applicable.
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks.
Additional comments:	-

Data/parameter:	EL _{LFG}			
Unit	MWh			
Description	Net amount of electricity generated using landfill gas			
Measured/calculated/default	Measured			
Source of data	Electricity meter			
Value(s) of monitored parameter	Values measured by the electricity meter.			
	Month	EL _{LFG} (MWh)	Month	EL _{LFG} (MWh)
	2011 Oct	2,939	2013 Dec	1,893
	2011 Nov	2,908	2014 Jan	1,904
	2011 Dec	2,996	2014 Feb	1,664
	2012 Jan	2,976	2014 Mar	1,782
	2012 Feb	2,771	2014 May	1,665
	2012 Mar	2,918	2014 Jun	1,774
	2012 Apr	2,775	2014 Jun	1,652
	2012 May	2,698	2014 Jul	1,561
	2012 Jun	2,564	2014 Aug	1,606
	2012 Jul	2,486	2014 Sep	1,547
	2012 Ago	2,429	2014 Oct	1,602
	2012 Sep	2,356	2014 Nov	1,576
	2012 Oct	2,336	2014 Dec	1,630
	2012 Nov	2,326	2015 Jan	1,532
	2012 Dec	2,278	2015 Feb	1,377
	2013 Jan	1,844	2015 Mar	1,505
	2013 Feb	2,140	2015 Apr	1,422
	2013 Mar	2,258	2015 May	1,455
	2013 Apr	2,141	2015 Jun	1,368
	2013 May	2,072	2015 Jul	1,411
	2013 Jun	1,953	2015 Aug	1,355
	2013 Jul	1,914	2015 Sep	1,292
	2013 Ago	923	2015 Oct	1,283
	2013 Sep	865	2015 Nov	1,215
	2013 Oct	1,826	2015 Dec	1,330
2013 Nov	1,801			

Monitoring equipment	<p>Data measured continuously with an electricity meter specifying the total amount of electricity exported in the time interval.</p> <p>In accordance with the local energy concessionaire CEMIG specifications, the electricity meter do not need regular maintenance to ensure its accuracy. The equipment has an accuracy of +/- 0.2%.</p> <p>The initial calibration done by CAM Endesa are the following:</p> <p>Main Electricity Meter Brand and type: Schneider ION 8600C Serial n° of equipment: PT-0912A354-01 Calibration frequency: none Calibration date [dd/mm/yyyy]: 27/01/2010 Calibration certificate n°: 852/2010</p> <p>Standby Electricity Meter Brand and type: Schneider ION 8600C Serial n° of equipment: PT-0912A361-01 Calibration frequency: none Calibration date [dd/mm/yyyy]: 26/01/2010 Calibration certificate n°: 734/2010</p>
Measuring/reading/recording frequency:	<p>Monitoring frequency: continuous</p> <p>Recording and aggregation frequency: monthly (CEMIG's invoices emission frequency)</p>
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Electricity meter belongs to CEMIG, which is responsible for its maintenance.
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks.
Additional comments:	-

Data/parameter:	EL_{PR}
Unit	MWh
Description	Total amount of electricity imported to meet the requirements of the Project
Measured/calculated/default	Measured
Source of data	Electricity meter

Value(s) of monitored parameter	<p>In accordance with the local energy concessionaire – CEMIG specifications, the electricity meter do not need regular maintenance to ensure its accuracy.</p> <table border="1"> <thead> <tr> <th>Month</th><th>EL_{PR} (kWh)</th><th>Month</th><th>EL_{PR} (kWh)</th></tr> </thead> <tbody> <tr><td>2011 Oct</td><td>1,119</td><td>2013 Dec</td><td>180</td></tr> <tr><td>2011 Nov</td><td>375</td><td>2014 Jan</td><td>56</td></tr> <tr><td>2011 Dec</td><td>709</td><td>2014 Feb</td><td>85</td></tr> <tr><td>2012 Jan</td><td>436</td><td>2014 Mar</td><td>89</td></tr> <tr><td>2012 Feb</td><td>213</td><td>2014 May</td><td>176</td></tr> <tr><td>2012 Mar</td><td>314</td><td>2014 Jun</td><td>89</td></tr> <tr><td>2012 Apr</td><td>281</td><td>2014 Jun</td><td>171</td></tr> <tr><td>2012 May</td><td>193</td><td>2014 Jul</td><td>630</td></tr> <tr><td>2012 Jun</td><td>168</td><td>2014 Aug</td><td>46</td></tr> <tr><td>2012 Jul</td><td>962</td><td>2014 Sep</td><td>117</td></tr> <tr><td>2012 Ago</td><td>947</td><td>2014 Oct</td><td>133</td></tr> <tr><td>2012 Sep</td><td>82</td><td>2014 Nov</td><td>82</td></tr> <tr><td>2012 Oct</td><td>72</td><td>2014 Dec</td><td>114</td></tr> <tr><td>2012 Nov</td><td>388</td><td>2015 Jan</td><td>208</td></tr> <tr><td>2012 Dec</td><td>496</td><td>2015 Feb</td><td>387</td></tr> <tr><td>2013 Jan</td><td>428</td><td>2015 Mar</td><td>376</td></tr> <tr><td>2013 Feb</td><td>386</td><td>2015 Apr</td><td>315</td></tr> <tr><td>2013 Mar</td><td>216</td><td>2015 May</td><td>235</td></tr> <tr><td>2013 Apr</td><td>435</td><td>2015 Jun</td><td>396</td></tr> <tr><td>2013 May</td><td>241</td><td>2015 Jul</td><td>542</td></tr> <tr><td>2013 Jun</td><td>34</td><td>2015 Aug</td><td>142</td></tr> <tr><td>2013 Jul</td><td>73</td><td>2015 Sep</td><td>509</td></tr> <tr><td>2013 Ago</td><td>1,969</td><td>2015 Oct</td><td>1,519</td></tr> <tr><td>2013 Sep</td><td>1,175</td><td>2015 Nov</td><td>2,201</td></tr> <tr><td>2013 Oct</td><td>277</td><td>2015 Dec</td><td>542</td></tr> <tr><td>2013 Nov</td><td>177</td><td></td><td></td></tr> </tbody> </table>	Month	EL _{PR} (kWh)	Month	EL _{PR} (kWh)	2011 Oct	1,119	2013 Dec	180	2011 Nov	375	2014 Jan	56	2011 Dec	709	2014 Feb	85	2012 Jan	436	2014 Mar	89	2012 Feb	213	2014 May	176	2012 Mar	314	2014 Jun	89	2012 Apr	281	2014 Jun	171	2012 May	193	2014 Jul	630	2012 Jun	168	2014 Aug	46	2012 Jul	962	2014 Sep	117	2012 Ago	947	2014 Oct	133	2012 Sep	82	2014 Nov	82	2012 Oct	72	2014 Dec	114	2012 Nov	388	2015 Jan	208	2012 Dec	496	2015 Feb	387	2013 Jan	428	2015 Mar	376	2013 Feb	386	2015 Apr	315	2013 Mar	216	2015 May	235	2013 Apr	435	2015 Jun	396	2013 May	241	2015 Jul	542	2013 Jun	34	2015 Aug	142	2013 Jul	73	2015 Sep	509	2013 Ago	1,969	2015 Oct	1,519	2013 Sep	1,175	2015 Nov	2,201	2013 Oct	277	2015 Dec	542	2013 Nov	177		
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QA/QC procedures:	Electricity meter belongs to CEMIG, which is responsible for its maintenance.																																																																																																												

Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks.
Additional comments:	-

Data/parameter:	CEF_{elec,y,BL,y}
Unit	tCO ₂ /MWh
Description	Carbon Emission Factor for electricity
Measured/calculated/default	Calculated
Source of data	Official data from DNA
Value(s) of monitored parameter	2011: 0.1988 tCO ₂ /MWh 2012: 0.3593 tCO ₂ /MWh 3013: 0.4322 tCO ₂ /MWh 2014: 0.4400 tCO ₂ /MWh
Monitoring equipment	Not applicable.
Measuring/reading/recording frequency:	Annual.
Calculation method (if applicable):	Please refer to the Section E.1.
QA/QC procedures:	Internal audits are performed in order to ensure correct monitoring of this parameter. The audits will be performed each year through the verification of the parameters in the site of the government of Brazil. http://www.mct.gov.br/index.php/content/view/74689.html (Web site checked in 01/04/2016).
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks.
Additional comments:	-

Data/parameter:	PE_{EC,y}
Unit	tCO ₂
Description	Project emissions from electricity consumption by the project activity during the year y.
Measured/calculated/default	Calculated
Source of data	Calculated as per the <i>"Tool to calculate baseline, project and/or leakage emissions from electricity consumption"</i> .
Value(s) of monitored parameter	Total PE _{EC,y} in the monitoring period is 10.144 tCO ₂ e.
Monitoring equipment	Not applicable.
Measuring/reading/recording frequency:	Calculated for monitoring period as it depends on the CEF _{elec,y,BL,y} to be applied (the most recent available).
Calculation method (if applicable):	Please refer to the Section E.2 of this document.
QA/QC procedures:	Internal Audits are going to be performed in order to ensure correct monitoring of this parameter
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks.
Additional comments:	-

Data/parameter:	TDL_{j,y}
Unit	%
Description	Average technical transmission and distribution losses for providing electricity to source j in year y

Measured/calculated/default	Default
Source of data	According to the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”, scenario A applies to the project as the source of electricity consumption and, since no recent, accurate and reliable data were available, the option to choose a default value of 20% was chosen.
Value(s) of monitored parameter	20%
Monitoring equipment	Not applicable.
Measuring/reading/recording frequency:	Monitored annually. Data will be archived electronically during the crediting period and two years after.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Internal audits are performed in order to ensure correct monitoring of this parameter.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks.
Additional comments:	-

Data/parameter:	EF_{CM,y}
Unit	tCO ₂ /MWh
Description	Combined margin emissions factor required to evaluate CO ₂ emissions due to the power consumption of the project activity imported from the National Grid.
Measured/calculated/default	Calculated
Source of data	Official data from DNA
Value(s) of monitored parameter	2011: 0.1988 tCO ₂ /MWh 2012: 0.3593 tCO ₂ /MWh 3013: 0.4322 tCO ₂ /MWh 2014: 0.4400 tCO ₂ /MWh
Monitoring equipment	Not applicable.
Measuring/reading/recording frequency:	Annually.
Calculation method (if applicable):	Please refer to Section E.1 of this document.
QA/QC procedures:	Internal audits are performed in order to ensure correct monitoring of this parameter. The audits will be performed each year through the verification of the parameters in the site of the government of Brazil. http://www.mct.gov.br/index.php/content/view/74689.html (Web site checked in 01/04/2016)
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks.
Additional comments:	-

Data/parameter:	fv_{i,h}
Unit	-
Description	Volumetric fraction of component i in the residual gas in the hour h where i = CH ₄ , CO, CO ₂ , O ₂ , H ₂ , N ₂
Measured/calculated/default	Measured
Source of data	Continuous gas analyzer
Value(s) of monitored parameter	As a simplified approach, in this Project it is only measured the methane content of the residual gas and considered the remaining part as N ₂ . See parameter w _{CH₄,y} .

Monitoring equipment	See parameter $w_{CH_4,y}$.
Measuring/reading/recording frequency:	See parameter $w_{CH_4,y}$.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	See parameter $w_{CH_4,y}$.
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks.
Additional comments:	-

Data/parameter:	t _{O₂,h}																																														
Unit	-																																														
Description	Volumetric fraction of O ₂ in the exhaust gas of the flare in the hour h (only in case the flare efficiency is continuously monitored)																																														
Measured/calculated/default	Measured																																														
Source of data	Continuous gas extractive sampling analyzer with water and particulates removal devices.																																														
Value(s) of monitored parameter	<p>In 15/05/2013 the remaining enclosed flare was temporarily turned off due to lack of landfill gas. No emission reductions will be claimed for flaring landfill gas from that date on.</p> <p>As an illustrative representation of the values of this parameter, in the monitoring period data were aggregated monthly as shown in the table below:</p> <table><tr><th>Month</th><th>t_{O₂} (%)</th><th>Month</th><th>t_{O₂} (%)</th></tr><tr><td>2011 Oct</td><td>0.0</td><td>2012 Ago</td><td>0.0</td></tr><tr><td>2011 Nov</td><td>0.0</td><td>2012 Sep</td><td>0.0</td></tr><tr><td>2011 Dec</td><td>0.2</td><td>2012 Oct</td><td>0.0</td></tr><tr><td>2012 Jan</td><td>0.0</td><td>2012 Nov</td><td>0.0</td></tr><tr><td>2012 Feb</td><td>0.0</td><td>2012 Dec</td><td>0.0</td></tr><tr><td>2012 Mar</td><td>0.0</td><td>2013 Jan</td><td>0.0</td></tr><tr><td>2012 Apr</td><td>0.0</td><td>2013 Feb</td><td>0.0</td></tr><tr><td>2012 May</td><td>0.0</td><td>2013 Mar</td><td>0.0</td></tr><tr><td>2012 Jun</td><td>0.1</td><td>2013 Apr</td><td>0.0</td></tr><tr><td>2012 Jul</td><td>0.0</td><td>2013 May</td><td>0.0</td></tr></table> <p>Please refer to the Hourly Report data sheet, attached as a document, to see the values aggregated every one hour, which are used to calculate the emission reductions of project.</p>			Month	t _{O₂} (%)	Month	t _{O₂} (%)	2011 Oct	0.0	2012 Ago	0.0	2011 Nov	0.0	2012 Sep	0.0	2011 Dec	0.2	2012 Oct	0.0	2012 Jan	0.0	2012 Nov	0.0	2012 Feb	0.0	2012 Dec	0.0	2012 Mar	0.0	2013 Jan	0.0	2012 Apr	0.0	2013 Feb	0.0	2012 May	0.0	2013 Mar	0.0	2012 Jun	0.1	2013 Apr	0.0	2012 Jul	0.0	2013 May	0.0
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2012 Jun	0.1	2013 Apr	0.0																																												
2012 Jul	0.0	2013 May	0.0																																												
Monitoring equipment	Brand: Siemens Type: Ultramat 23 Accuracy: +/-1% for the CH ₄ and 0.5% for the O ₂ Serial Number: ULT 02 - N1X6-992 For the calibration frequency, date of last calibration and validity please refer to “QA/QC procedures applied”.																																														
Measuring/reading/recording frequency:	Monitoring frequency: continuous Recording frequency: every two minutes Aggregation frequency: hourly, daily, monthly																																														
Calculation method (if applicable):	Not applicable.																																														

QA/QC procedures:	<p>The supplier of the gas analyzer recommends calibrating the instrument every six or twelve months depending on the application. However, it has been decided to perform the calibration on a monthly basis in order to get a more conservative measure.</p> <p>The gas analyzer is every month calibrated by a trained operator and the PM. The PM applies the calibration procedure suggested by the manufacturer which is documented within the Plant Maintenance Manual. The internal calibration is registered on the respective form: "Formulario de calibração analisador fixo de fumos" – FO CAL/003.</p> <p>The plant operator and the PM have been trained in order to be qualified to carry out the calibration procedure correctly. All the training certificates are available at the plant. The process for calibration is performed by use of gas cylinders which are purchased from a certified gas supplier. The cylinders have a quality certificate that makes assures the quality of the calibration gases.</p> <p>Calibrated gases cylinders' certificate numbers are listed below:</p> <table border="1"> <thead> <tr> <th>Period of use</th><th>Type of gas mixture</th><th>Cylinder nº</th><th>Calibration date (validity)</th><th>Certificate nº (name of company)</th></tr> </thead> <tbody> <tr> <td>~ 13/12/2011</td><td rowspan="2">2587 vpm CH₄</td><td>EGE 8114</td><td>09/09/2010 (24 months)</td><td>2391/10 (Linde)</td></tr> <tr> <td>12/01/2012 ~ 02/05/2013</td><td>EDE 4048</td><td>17/05/2011 (36 months)</td><td>1193/11 (Linde)</td></tr> <tr> <td>~ 10/02/2012</td><td rowspan="2">100% N₂</td><td>EGE 8143</td><td>09/2010 (36 months)</td><td>1125/11 (Linde)</td></tr> <tr> <td>09/03/2012 ~ 02/05/2013</td><td>EDI 8188</td><td>13/04/2011 (36 months)</td><td>641/12 (Linde)</td></tr> </tbody> </table> <p>During the monitoring period the Ultramat 23 was calibrated in the following dates:</p> <table border="1"> <tbody> <tr> <td>• 19/09/2011</td><td>• 04/05/2012</td><td>• 12/12/2012</td></tr> <tr> <td>• 17/10/2011</td><td>• 01/06/2012</td><td>• 11/01/2013</td></tr> <tr> <td>• 16/11/2011</td><td>• 29/06/2012</td><td>• 05/02/2013</td></tr> <tr> <td>• 13/12/2011</td><td>• 27/07/2012</td><td>• 04/03/2013</td></tr> <tr> <td>• 12/01/2012</td><td>• 24/08/2012</td><td>• 03/04/2013</td></tr> <tr> <td>• 10/02/2012</td><td>• 21/09/2012</td><td>• 02/05/2013</td></tr> <tr> <td>• 09/03/2012</td><td>• 19/10/2012</td><td></td></tr> <tr> <td>• 06/04/2012</td><td>• 13/11/2012</td><td></td></tr> </tbody> </table>	Period of use	Type of gas mixture	Cylinder nº	Calibration date (validity)	Certificate nº (name of company)	~ 13/12/2011	2587 vpm CH ₄	EGE 8114	09/09/2010 (24 months)	2391/10 (Linde)	12/01/2012 ~ 02/05/2013	EDE 4048	17/05/2011 (36 months)	1193/11 (Linde)	~ 10/02/2012	100% N ₂	EGE 8143	09/2010 (36 months)	1125/11 (Linde)	09/03/2012 ~ 02/05/2013	EDI 8188	13/04/2011 (36 months)	641/12 (Linde)	• 19/09/2011	• 04/05/2012	• 12/12/2012	• 17/10/2011	• 01/06/2012	• 11/01/2013	• 16/11/2011	• 29/06/2012	• 05/02/2013	• 13/12/2011	• 27/07/2012	• 04/03/2013	• 12/01/2012	• 24/08/2012	• 03/04/2013	• 10/02/2012	• 21/09/2012	• 02/05/2013	• 09/03/2012	• 19/10/2012		• 06/04/2012	• 13/11/2012	
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Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks.																																															
Additional comments:	-																																															

Data/parameter:	f_{vCH₄,FG,h}
Unit	mg/m ³
Description	Concentration of methane in the exhaust gas of the flares in dry basis at normal conditions in the hour <i>h</i>
Measured/calculated/default	Measured
Source of data	Continuous gas extractive sampling analyzer with water and particulates removal devices.

Value(s) of monitored parameter	<p>In 15/05/2013 the remaining enclosed flare was temporarily turned off due to lack of landfill gas. No emission reductions will be claimed for flaring landfill gas from that date on.</p> <p>As an illustrative representation of the values of this parameter, in the monitoring period, data were aggregated monthly as shown in the table below:</p> <table border="1"> <thead> <tr> <th>Month</th><th>fv_{CH₄,FG,h} (mg/m³)</th><th>Month</th><th>fv_{CH₄,FG,h} (mg/m³)</th></tr> </thead> <tbody> <tr><td>2011 Oct</td><td>0.0</td><td>2012 Ago</td><td>0.0</td></tr> <tr><td>2011 Nov</td><td>0.0</td><td>2012 Sep</td><td>0.0</td></tr> <tr><td>2011 Dec</td><td>0.0</td><td>2012 Oct</td><td>0.0</td></tr> <tr><td>2012 Jan</td><td>0.0</td><td>2012 Nov</td><td>0.0</td></tr> <tr><td>2012 Feb</td><td>0.0</td><td>2012 Dec</td><td>0.0</td></tr> <tr><td>2012 Mar</td><td>0.0</td><td>2013 Jan</td><td>0.0</td></tr> <tr><td>2012 Apr</td><td>0.0</td><td>2013 Feb</td><td>0.0</td></tr> <tr><td>2012 May</td><td>0.0</td><td>2013 Mar</td><td>0.0</td></tr> <tr><td>2012 Jun</td><td>0.0</td><td>2013 Apr</td><td>0.0</td></tr> <tr><td>2012 Jul</td><td>0.0</td><td>2013 May</td><td>0.0</td></tr> </tbody> </table> <p>Please refer to the Hourly Report data sheet, attached as a document, to see the values aggregated every one hour, which are used to calculate the emission reductions of project.</p>	Month	fv _{CH₄,FG,h} (mg/m ³)	Month	fv _{CH₄,FG,h} (mg/m ³)	2011 Oct	0.0	2012 Ago	0.0	2011 Nov	0.0	2012 Sep	0.0	2011 Dec	0.0	2012 Oct	0.0	2012 Jan	0.0	2012 Nov	0.0	2012 Feb	0.0	2012 Dec	0.0	2012 Mar	0.0	2013 Jan	0.0	2012 Apr	0.0	2013 Feb	0.0	2012 May	0.0	2013 Mar	0.0	2012 Jun	0.0	2013 Apr	0.0	2012 Jul	0.0	2013 May	0.0
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Monitoring equipment	<p>Brand: Siemens</p> <p>Type: Ultramat 23</p> <p>Accuracy: ± 1% CH₄ and 0.5% O₂</p> <p>Serial Number: ULT 02 - N1X6-992</p> <p>For the calibration frequency, date of last calibration and validity please refer to "QA/QC procedures applied".</p>																																												
Measuring/reading/recording frequency:	<p>Monitoring frequency: continuous</p> <p>Recording frequency: every two minutes</p> <p>Aggregation frequency: hourly</p>																																												
Calculation method (if applicable):	<p>Ultramat 23 reads ppm values. To convert from ppmv to mg/m³ value is multiplied by 0.716.</p>																																												

QA/QC procedures:	<p>The supplier of the gas analyzer recommends calibrating the instrument every six or twelve months depending on the application. However, it has been decided to perform the calibration on a monthly basis in order to get a more conservative measure.</p> <p>The gas analyzer is every month calibrated by a trained operator and the PM. The PM applies the calibration procedure suggested by the manufacturer which is documented within the Plant Maintenance Manual. The internal calibration is registered on the respective form: “Formulario de calibração analisador fixo de fumos” – FO CAL/003.</p> <p>The plant operator and the PM have been trained in order to be qualified to carry out the calibration procedure correctly. All the training certificates are available at the plant. The process for calibration is performed by use of gas cylinders which are purchased from a certified gas supplier. The cylinders have a quality certificate that makes assures the quality of the calibration gases.</p> <p>Calibrated gases cylinders’ certificate numbers are listed below:</p> <table border="1"> <thead> <tr> <th>Period of use</th><th>Type of gas mixture</th><th>Cylinder nº</th><th>Calibration date (validity)</th><th>Certificate nº (name of company)</th></tr> </thead> <tbody> <tr> <td>~ 13/12/2011</td><td rowspan="2">2587 vpm CH₄</td><td>EGE 8114</td><td>09/09/2010 (24 months)</td><td>2391/10 (Linde)</td></tr> <tr> <td>12/01/2012 ~ 02/05/2013</td><td>EDE 4048</td><td>17/05/2011 (36 months)</td><td>1193/11 (Linde)</td></tr> <tr> <td>~ 10/02/2012</td><td rowspan="2">100% N₂</td><td>EGE 8143</td><td>09/2010 (36 months)</td><td>1125/11 (Linde)</td></tr> <tr> <td>09/03/2012 ~ 02/05/2013</td><td>EDI 8188</td><td>13/04/2011 (36 months)</td><td>641/12 (Linde)</td></tr> </tbody> </table> <p>During the monitoring period the Ultramat 23 was calibrated in the following dates:</p> <table border="1"> <tbody> <tr> <td>• 19/09/2011</td><td>• 04/05/2012</td><td>• 12/12/2012</td></tr> <tr> <td>• 17/10/2011</td><td>• 01/06/2012</td><td>• 11/01/2013</td></tr> <tr> <td>• 16/11/2011</td><td>• 29/06/2012</td><td>• 05/02/2013</td></tr> <tr> <td>• 13/12/2011</td><td>• 27/07/2012</td><td>• 04/03/2013</td></tr> <tr> <td>• 12/01/2012</td><td>• 24/08/2012</td><td>• 03/04/2013</td></tr> <tr> <td>• 10/02/2012</td><td>• 21/09/2012</td><td>• 02/05/2013</td></tr> <tr> <td>• 09/03/2012</td><td>• 19/10/2012</td><td></td></tr> <tr> <td>• 06/04/2012</td><td>• 13/11/2012</td><td></td></tr> </tbody> </table>	Period of use	Type of gas mixture	Cylinder nº	Calibration date (validity)	Certificate nº (name of company)	~ 13/12/2011	2587 vpm CH ₄	EGE 8114	09/09/2010 (24 months)	2391/10 (Linde)	12/01/2012 ~ 02/05/2013	EDE 4048	17/05/2011 (36 months)	1193/11 (Linde)	~ 10/02/2012	100% N ₂	EGE 8143	09/2010 (36 months)	1125/11 (Linde)	09/03/2012 ~ 02/05/2013	EDI 8188	13/04/2011 (36 months)	641/12 (Linde)	• 19/09/2011	• 04/05/2012	• 12/12/2012	• 17/10/2011	• 01/06/2012	• 11/01/2013	• 16/11/2011	• 29/06/2012	• 05/02/2013	• 13/12/2011	• 27/07/2012	• 04/03/2013	• 12/01/2012	• 24/08/2012	• 03/04/2013	• 10/02/2012	• 21/09/2012	• 02/05/2013	• 09/03/2012	• 19/10/2012		• 06/04/2012	• 13/11/2012	
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Purpose of data:	Calculation of baseline emissions of baseline net GHG removals by sinks.																																															
Additional comments:	-																																															

Data/parameter:	T_{flare}
Unit	°C
Description	Temperature in the exhaust gas of the enclosed flares
Measured/calculated/default	Measured
Source of data	Thermocouple type S

Value(s) of monitored parameter	<p>In 15/05/2013 the remaining enclosed flare was temporarily turned off due to lack of landfill gas. No emission reductions will be claimed for flaring landfill gas from that date on.</p> <p>As an illustrative representation of the values of this parameter, in the monitoring period, data were aggregated monthly as shown in the table below:</p> <table border="1"> <thead> <tr> <th>Month</th><th>T_{flare} (°C)</th><th>Month</th><th>T_{flare} (°C)</th></tr> </thead> <tbody> <tr><td>2011 Oct</td><td>17.5</td><td>2012 Ago</td><td>14.5</td></tr> <tr><td>2011 Nov</td><td>15.9</td><td>2012 Sep</td><td>16.7</td></tr> <tr><td>2011 Dec</td><td>26.3</td><td>2012 Oct</td><td>18.1</td></tr> <tr><td>2012 Jan</td><td>16.4</td><td>2012 Nov</td><td>15.8</td></tr> <tr><td>2012 Feb</td><td>18.2</td><td>2012 Dec</td><td>18.1</td></tr> <tr><td>2012 Mar</td><td>17.9</td><td>2013 Jan</td><td>16.3</td></tr> <tr><td>2012 Apr</td><td>17.2</td><td>2013 Feb</td><td>17.9</td></tr> <tr><td>2012 May</td><td>14.4</td><td>2013 Mar</td><td>17.1</td></tr> <tr><td>2012 Jun</td><td>24.4</td><td>2013 Apr</td><td>15.1</td></tr> <tr><td>2012 Jul</td><td>16.6</td><td>2013 May</td><td>14.9</td></tr> </tbody> </table> <p>Please refer to the Hourly Report data sheet, attached as a document, to see the values aggregated every one hour, which are used to calculate the emission reductions of project.</p>	Month	T _{flare} (°C)	Month	T _{flare} (°C)	2011 Oct	17.5	2012 Ago	14.5	2011 Nov	15.9	2012 Sep	16.7	2011 Dec	26.3	2012 Oct	18.1	2012 Jan	16.4	2012 Nov	15.8	2012 Feb	18.2	2012 Dec	18.1	2012 Mar	17.9	2013 Jan	16.3	2012 Apr	17.2	2013 Feb	17.9	2012 May	14.4	2013 Mar	17.1	2012 Jun	24.4	2013 Apr	15.1	2012 Jul	16.6	2013 May	14.9
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Monitoring equipment	<p>For the calibration frequency, date of last calibration and validity please refer to "QA/QC procedures applied".</p> <p>(~ 12/05/2012) Brand: Ecil Type: Thermocouple that withstands temperatures up to 1,600°C Accuracy: +/-1.5°C or 0.25% of the temperature (the one which is greater) Serial number: 0950.064353</p> <p>(12/05/2012 ~12/03/2013) Brand: Ecil Type: Thermocouple that withstands temperatures up to 1,600°C Accuracy: +/-1.5°C or 0.25% of the temperature (the one which is greater) Serial number: 0950.064307</p> <p>(12/03/2013 ~) Brand: Ecil Type: Thermocouple that withstands temperatures up to 1,600°C Accuracy: +/-1.5°C or 0.25% of the temperature (the one which is greater) Serial number: 1121.513793</p>																																												
Measuring/reading/recording frequency:	<p>Monitoring frequency: continuous Recording frequency: every two minutes Aggregation frequency: hourly, daily, monthly</p>																																												
Calculation method (if applicable):	Not applicable.																																												
QA/QC procedures:	<p>External calibration is applied to this equipment annually.</p> <table border="1"> <thead> <tr> <th>Brand and serial n° of equipment</th><th>Calibration date</th><th>Calibration certificate n° (name of company)</th></tr> </thead> <tbody> <tr> <td>Ecil 0950.064353</td><td>24/05/2011</td><td>3504/11 (Ecil)</td></tr> <tr> <td>Ecil 0950.064307</td><td>03/04/2012</td><td>2096/12 (Ecil)</td></tr> <tr> <td>Ecil 1121.513793</td><td>06/02/2013</td><td>0403/13 (Ecil)</td></tr> </tbody> </table>	Brand and serial n° of equipment	Calibration date	Calibration certificate n° (name of company)	Ecil 0950.064353	24/05/2011	3504/11 (Ecil)	Ecil 0950.064307	03/04/2012	2096/12 (Ecil)	Ecil 1121.513793	06/02/2013	0403/13 (Ecil)																																
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Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks.																																												
Additional comments:	-																																												

Data/parameter:	PE _{flare,y}
Unit	tCO _{2e}

Description	Project emissions from flaring of the residual gas stream in year y			
Measured/calculated/default	Calculated			
Source of data	Calculated as per the “Tool to determine project emissions from flaring gases containing methane”.			
Value(s) of monitored parameter	In 15/05/2013 the remaining enclosed flare was temporarily turned off due to lack of landfill gas. No emission reductions will be claimed for flaring landfill gas from that date on.			
	As an illustrative representation of the values of this parameter, in the monitoring period, data were aggregated monthly as shown in the table below:			
	Month	PE _{flare,y} (tCO ₂ e)	Month	PE _{flare,y} (tCO ₂ e)
	2011 Oct	3.4041	2012 Ago	0.0000
	2011 Nov	0.0000	2012 Sep	0.0000
	2011 Dec	0.0007	2012 Oct	0.0000
	2012 Jan	0.0000	2012 Nov	0.0000
	2012 Feb	0.0000	2012 Dec	0.0000
	2012 Mar	0.0000	2013 Jan	0.0000
	2012 Apr	0.0000	2013 Feb	0.0000
	2012 May	0.0000	2013 Mar	0.0000
	2012 Jun	1.3536	2013 Apr	0.0000
	2012 Jul	0.0001	2013 May	0.0000
	Please refer to the Hourly Report data sheet, attached as a document, to see the values aggregated every one hour, which is used to calculate the emission reductions of project.			
Monitoring equipment	Not applicable.			
Measuring/reading/recording frequency:	Calculated for each hour using hourly aggregated data. Aggregated also daily and monthly for reporting purposes.			
Calculation method (if applicable):	Please refer to the Section E.1 of this document.			
QA/QC procedures:	Internal audits are going to be performed in order to ensure correct monitoring of this parameter.			
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks.			
Additional comments:	-			

Data/parameter:	f_{vCH4,RG,h}
Unit	m ³ CH ₄ / m ³ LFG
Description	Methane fraction in the landfill gas
Measured/calculated/default	Measured
Source of data	Gas analyzer
Value(s) of monitored parameter	See parameter w _{CH4,y} .
Monitoring equipment	See parameter w _{CH4,y} .
Measuring/reading/recording frequency:	See parameter w _{CH4,y} .
Calculation method (if applicable):	See parameter w _{CH4,y} .
QA/QC procedures:	See parameter w _{CH4,y} .
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks.
Additional comments:	-

Data/parameter:	$FV_{RG,h}$
Unit	m ³ /h
Description	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h
Measured/calculated/default	See parameter LFG_{Flare} .
Source of data	See parameter LFG_{Flare} .
Value(s) of monitored parameter	See parameter LFG_{Flare} .
Monitoring equipment	See parameter LFG_{Flare} .
Measuring/reading/recording frequency:	See parameter LFG_{Flare} .
Calculation method (if applicable):	See parameter LFG_{Flare} .
QA/QC procedures:	See parameter LFG_{Flare} .
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks.
Additional comments:	-

D.3. Implementation of sampling plan

>>

Not applicable

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

>>

According to ACM0001 version 11 baseline emissions were calculated with the following formula:

$$BE_y = (MD_{project,y} - MD_{BL,y}) \times GWP_{CH_4} + EL_{LFG,y} \times CEF_{elec,BL,y} + ET_{LFG,y} \times CEF_{ther,BL,y} \quad (1)$$

Where:

BE_y	=	Baseline emissions in year y (tCO ₂ e)
$MD_{project,y}$	=	The amount of methane that would have been destroyed/combusted during the year, in tones of methane (tCH ₄) in project scenario
$MD_{BL,y}$	=	The amount of methane that would have been destroyed/combusted during the year in the absence of the project due to regulatory and/or contractual requirement, in tones of methane (tCH ₄)
GWP_{CH_4}	=	Global Warming Potential value for methane for the first commitment period is 21 tCO ₂ e/tCH ₄ and for the second commitment period is 25 tCO ₂ e/tCH ₄
$EL_{LFG,y}$	=	Net quantity of electricity produced using LFG, which in the absence of the project activity would have been produced by power plants connected to the grid or by an onsite/off-site fossil fuel based captive power generation, during year y, in megawatt hours (MWh)
$CEF_{elec,BL,y}$	=	CO ₂ emissions intensity of the baseline source of electricity displaced, in tCO ₂ e/MWh

$ET_{LFG,y}$	=	The quantity of thermal energy produced utilizing the landfill gas, which in the absence of the project activity would have been produced from onsite/offsite fossil fuel fired boiler, during the year y in TJ, for this Project is equal to 0 since no thermal energy will be produced
$CEF_{ther,BL,y}$	=	CO ₂ emissions intensity of the fuel used by boiler to generate thermal energy which is displaced by LFG based thermal energy generation, in tCO ₂ e/TJ; for this Project is equal to 0 since no thermal energy will be produced

For this Project, since regulatory or contractual requirements do not specify $MD_{BL,y}$ and no historic data exists for LFG captured and destroyed, an “Adjustment Factor” (AF) was used and justified, taking into account the project context

(2)

$$MD_{BL,y} = MD_{project,y} \times AF$$

Calculation of AF

Baseline scenario consisted in a passive LFG venting system with partial LFG destruction by flaring since some of the wells were on occasion manually lighted on.

Therefore a specific system for collection and destruction of methane existed and according to ACM0001 requirements, the ratio of the destruction efficiency of the baseline system to the destruction efficiency of the system used in the project has been used and the following procedure followed.

The procedure to calculate the “Adjustment Factor” AF involves the following three steps:

Step 1: The calculation of the destruction efficiency of the system (ε_{BL});

Step 2: The calculation of the destruction efficiency of the system used in the project activity (ε_{PR});

Step 3: The calculation of the adjustment factor ($AF = \varepsilon_{BL} / \varepsilon_{PR}$).

Step 1: Calculating the destruction efficiency of the system (ε_{BL})

$$\varepsilon_{BL} = \frac{MD_{Hist}}{MG_{Hist}}; \quad (3)$$

Where:

ε_{BL}	=	Destruction efficiency of the baseline system (fraction)
MD_{Hist}	=	Amount of methane destroyed historically measured for the previous year before the start of project activity (tCH ₄)
MG_{Hist}	=	Amount of methane generated historically for the previous year before the start of project activity, estimated using the actual amount of waste disposed in the landfill as per Version 05 of the <i>Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site</i> (tCH ₄)

Since no measured data are available for the estimation of MD_{Hist} , the following approach was applied to determine this parameter as, per option b) of the cited methodology.

As there were no historical records of the amount of LFG collected and destroyed in the landfill's wells, a procedure for estimating the amount of landfill gas that would be captured in absence of the project activity was provided:

1. MD_{Hist} was a fraction of MG_{Hist} by the formula:

$$MD_{Hist} = \eta_{BL} \times MG_{Hist} \quad (3.1)$$

Where MG_{Hist} is the amount of methane generated historically for the previous year before the start of project activity; and:

2. The abovementioned η_{BL} is the overall destruction efficiency in the baseline and has been calculated with the following formula:

$$\eta_{BL} = \eta_{PV} \times \eta_{LFGF} \times \frac{N_{fw}}{N_{vw}} \quad (3.2)$$

Where:

- η_{PV} = Collection efficiency of passive venting systems in closed landfills. CTRS / BR.040 landfill has a passive venting system, which was way less efficient than the active systems because of the pressure: in the passive system landfill gas is emitted to the atmosphere due to variation of the barometric pressure. As per measurements made in 11 Dutch landfills, an average collection efficiency value of passive system is equal to 37%¹
- η_{LFGF} = Efficiency of methane destruction in open flares. It can be considered that lighted wells can burn methane less efficiently than an open flare, in the *"Tool to determine project emissions from flaring gases containing methane"* open flares are defined as devices where the residual gas is burned in an open air tip with or without any auxiliary fluid assistance, therefore it is conservative to adopt for these wells the open flare efficiency value which is equal to 50%
- N_{fw} = Number of vertical wells actually burning the landfill gas collected in the passive system as from survey *"Baseline information"*, the average was 23, in this calculation we considered 25 wells lighted to be conservative. Moreover the ignited wells were conservatively considered to remain lighted all day long, for the whole year, not taking into account seasonal rains, windy days and the frequent quenching attested from the survey
- N_{vw} = Number of wells that could be ignited. As shown in *"Baseline information"* survey the total number of wells that could be lighted on was 123

The calculation is therefore as follows:

$$\eta_{BL} = 37\% \times 50\% \times \frac{25}{123} = 3.8\%$$

As per formula (3.1)

$$MD_{Hist} = 3.8\% \times MG_{Hist}$$

Therefore, according to the formula (3) the final baseline efficiency (ε_{BL}) value is:

$$\varepsilon_{BL} = \frac{MD_{Hist}}{MG_{Hist}} = 3.8\% \times \frac{MG_{Hist}}{MG_{Hist}} = 3.8\%$$

¹ 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Step 2: Calculation of the destruction efficiency of the system used in the project activity (ϵ_{PR})

According to the ACM0001, it has been selected the following:

Option-2:

The destruction efficiency of the system used in the project activity was estimated every year as follows:

$$\epsilon_{PR,y} = \frac{MD_{project,y}}{MG_{PR,y}} \quad (4)$$

Where:

$\epsilon_{PR,y}$	=	Destruction efficiency of the system used in the project activity for year y (fraction)
$MD_{project,y}$	=	Amount of methane destroyed by the project activity during the year y of the project activity (tCH ₄)
$MG_{PR,y}$	=	Amount of methane generated during year y of the project activity

$MD_{project,y}$ was determined *ex post* by metering the actual quantity of methane captured and destroyed once the project activity was operational. The methane destroyed by the project activity ($MD_{project,y}$) during a year was determined by monitoring the quantity of methane actually flared/ destroyed on the energy generation sets and the total quantity of methane captured.

The measured quantities fed to the flare and/or to the generation set were compared annually with the total quantity of methane collected from the Project wells. The lowest value of the two was adopted as $MD_{project,y}$.

$MG_{PR,y}$ was considered as the highest value, comparing measured quantities of methane going to the flares and/or to the generation sets with the total quantity of methane collected from the Project wells. Thus, the calculation of the destruction efficiency was more conservative.

Based on the information of MG_{PR} and $MD_{project,y}$ described above, the destruction efficiency of the system was calculated in the Hourly Report data sheets, attached as a document, into the formula of calculation of the adjustment factor.

Step 3: Calculation of the adjustment factor (AF)

Since Option 2 has been used in Step 2 and the destruction efficiency of the system used in the Project (ϵ_{PR}) was estimated every year, then the 'Adjustment Factor' (AF) also was calculated every year with the following formula:

$$AF_y = \frac{\epsilon_{BL}}{\epsilon_{PRy}} \quad (5)$$

Where:

AF_y	=	Adjustment factor for year y , this factor was then used in equation (2) in place of AF
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No emissions reductions were claimed for methane destruction during non operational hours and $MD_{project}$ was calculated as:

- In case the measured quantities of methane fed to the flare and/or to the generation set is higher than the total quantity of methane captured from the project wells

(6.1)

$$MD_{\text{project},y} = LFG_{\text{total},y} \times W_{\text{CH}_4,y} \times D_{\text{CH}_4}$$

$LFG_{\text{total},y}$	=	Total quantity of landfill gas captured from the Project wells during the year measured in cubic meters (m^3)
$W_{\text{CH}_4,y}$	=	Average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in $\text{m}^3 \text{CH}_4 / \text{m}^3 \text{LFG}$)
D_{CH_4}	=	Methane density expressed in tonnes of methane per cubic meter of methane ($\text{tCH}_4/\text{m}^3\text{CH}_4$)

- In case the measured quantities of methane fed to the flares and/or to the generation set is lower than the total quantity of methane captured from the project wells.

$$MD_{\text{project},y} = MD_{\text{flare},y} + MD_{\text{electricity},y} + MD_{\text{thermal},y} + MD_{\text{PL},y} \quad (6.2)$$

Where:

$MD_{\text{flared},y}$	=	Quantity of methane destroyed by flaring (tCH_4)
$MD_{\text{electricity},y}$	=	Quantity of methane destroyed by generation of electricity (tCH_4).
$MD_{\text{thermal},y}$	=	Quantity of methane destroyed for the generation of thermal energy (tCH_4), for the proposed Project this is equal to 0
$MD_{\text{PL},y}$	=	Quantity of methane sent to the pipeline for feeding to the natural gas distribution network (tCH_4), for the proposed Project this is equal to 0

And

$$MD_{\text{flared},y} = LFG_{\text{flared},y} \times W_{\text{CH}_4,y} \times D_{\text{CH}_4} - \left(\frac{PE_{\text{flare},y}}{GWP_{\text{CH}_4}} \right) \quad (7)$$

Where:

$LFG_{\text{flare},y}$	=	Quantity of landfill gas fed to the flare(s) during the year measured in cubic meters (m^3)
$W_{\text{CH}_4,y}$	=	Average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in $\text{m}^3 \text{CH}_4 / \text{m}^3 \text{LFG}$)
D_{CH_4}	=	Methane density expressed in tonnes of methane per cubic meter of methane ($\text{tCH}_4/\text{m}^3\text{CH}_4$)
$PE_{\text{flare},y}$	=	Project emissions from flaring of the residual gas stream in year y (tCO_2e)

Application of "Tool to determine project emissions from flaring gases containing methane"

For the Project enclosed flares are installed and continuous monitoring of the flare efficiency is made.

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

STEP 1

This step calculates the residual gas mass flow rate in each hour h , based on the volumetric flow rate and the density of the residual gas. The density of the residual gas is determined based on the volumetric fraction of all components in the gas.

$$FM_{RG,h} = \rho_{RG,n,h} \cdot FV_{RD,h} \quad (7.1)$$

Where:

Variable	SI Unit	Description
$FM_{RG,h}$	kg/h	Mass flow rate of the residual gas in hour h
$\rho_{RG,n,h}$	kg/m ³	Density of the residual gas at normal conditions in hour h
$FV_{RG,h}$	m ³ /h	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h

Where:

$$\rho_{RG,n,h} = \frac{P_n}{\frac{R_u}{MM_{RG,h}} \cdot T_n} \quad (7.2)$$

Where:

Variable	SI Unit	Description
$\rho_{RG,n,h}$	kg/m ³	Density of the residual gas at normal conditions in hour h
P_n	Pa	Atmospheric pressure at normal conditions (101,325)
R_u	Pa.m ³ /kmol.K	Universal ideal gas constant (8,314)
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour h
T_n	K	Temperature at normal conditions (273.15)

and:

$$MM_{RG,h} = \sum_i (f_{vi,h} \cdot MM_i) \quad (7.3)$$

Where:

Variable	SI Unit	Description
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour h
$f_{vi,h}$	-	Volumetric fraction of component i in the residual gas in the hour h
MM_i	kg/kmol	Molecular mass of residual gas component i
i		The components CH ₄ , CO, CO ₂ , O ₂ , H ₂ , N ₂

For this Project it has been chosen, as a simplified approach, to measure only the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N₂).

STEP 2

Determine the mass fractions of carbon, hydrogen, oxygen and nitrogen in the residual gas, calculated from the volumetric fraction of each component i in the residual gas, as follows:

$$fm_{j,h} = \frac{\sum_i fv_{i,h} \cdot AM_j \cdot NA_{j,i}}{MM_{RG,h}} \quad (7.4)$$

Where:

Variable	SI Unit	Description
$fm_{j,h}$	-	Mass fraction of element j in the residual gas in hour h
$fv_{i,h}$	-	Volumetric fraction of component i in the residual gas in the hour h
AM_j	kg/kmol	Atomic mass of element j
$NA_{j,i}$	-	Number of atoms of element j in component i
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour h
j		The elements carbon, hydrogen, oxygen and nitrogen
i		The components CH ₄ , CO, CO ₂ , O ₂ , H ₂ , N ₂

STEP 3

This step was applied in the Project since the methane combustion efficiency of the flare(s) has been continuously monitored.

Determine the average volumetric flow rate of the exhaust gas in each hour h based on a stoichiometric calculation of the combustion process, which depends on the chemical composition of the residual gas, the amount of air supplied to combust it and the composition of the exhaust gas, as follows:

$$TV_{n,FG,h} = V_{n,FG,h} \cdot FM_{RG,h} \quad (7.5)$$

Where:

Variable	SI Unit	Description
$TV_{n,FG,h}$	m ³ /h	Volumetric flow rate of the exhaust gas in dry basis at normal conditions in hour h
$V_{n,FG,h}$	m ³ /kg residual gas	Volume of the exhaust gas of the flare in dry basis at normal conditions per kg of residual gas in hour h
$FM_{RG,h}$	kg residual gas/h	Mass flow rate of the residual gas in the hour h

$$V_{n,FG,h} = V_{n,CO_2,h} + V_{n,O_2,h} + V_{n,N_2,h} \quad (7.6)$$

Where:

Variable	SI Unit	Description
$V_{n,FG,h}$	m ³ /kg residual gas	Volume of the exhaust gas of the flare in dry basis at normal conditions per kg of residual gas in the hour h
$V_{n,CO_2,h}$	m ³ /kg residual gas	Quantity of CO ₂ volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour h
$V_{n,N_2,h}$	m ³ /kg residual gas	Quantity of N ₂ volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour h
$V_{n,O_2,h}$	m ³ /kg residual gas	Quantity of O ₂ volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour h

$$V_{n,O_2,h} = n_{O_2,h} \cdot MV_n \quad (7.7)$$

Where:

Variable	SI Unit	Description
$V_{n,O_2,h}$	m ³ /kg residual gas	Quantity of O ₂ volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour h
$n_{O_2,h}$	kmol/kg residual gas	Quantity of moles O ₂ in the exhaust gas of the flare per kg residual gas flared in hour h
MV_n	m ³ /kmol	Volume of one mole of any ideal gas at normal temperature and pressure (22.4 L/mol)

$$V_{n,N_2,h} = MV_n \cdot \left\{ \frac{fm_{N,h}}{200AM_N} + \left(\frac{1 - MF_{O_2}}{MF_{O_2}} \right) \cdot [F_h + n_{O_2,h}] \right\} \quad (7.8)$$

Where:

Variable	SI Unit	Description
$V_{n,N_2,h}$	m ³ /kg residual gas	Quantity of N ₂ volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour h
MV_n	m ³ /kmol	Volume of one mole of any ideal gas at normal temperature and pressure (22.4 m ³ /Kmol)
$fm_{N,h}$	-	Mass fraction of nitrogen in the residual gas in the hour h
AM_n	kg/kmol	Atomic mass of nitrogen
MF_{O_2}	-	O ₂ volumetric fraction of air
F_h	kmol/kg residual gas	Stoichiometric quantity of moles of O ₂ required for a complete oxidation of one kg residual gas in hour h
$n_{O_2,h}$	kmol/kg residual gas	Quantity of moles O ₂ in the exhaust gas of the flare per kg residual gas flared in hour h

$$V_{n,CO_2,h} = \frac{fm_{C,h}}{AM_C} \cdot MV_n \quad (7.9)$$

Where:

Variable	SI Unit	Description
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$V_{n,CO_2,h}$	m ³ /kg residual gas	Quantity of CO ₂ volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour h
$fm_{C,h}$	-	Mass fraction of carbon in the residual gas in the hour h
AM_C	kg/kmol	Atomic mass of carbon
MV_n	m ³ /kmol	Volume of one mole of any ideal gas at normal temperature and pressure (22.4 m ³ /Kmol)

$$n_{O_2,h} = \frac{t_{O_2,h}}{[1 - (t_{O_2,h} / MF_{O_2})]} \cdot \left[\frac{fm_{C,h}}{AM_C} + \frac{fm_{N,h}}{2AM_N} + \left(\frac{1 - MF_{O_2}}{MF_{O_2}} \right) \cdot F_h \right] \quad (7.10)$$

Where:

Variable	SI Unit	Description
$n_{O_2,h}$	kmol/kg residual gas	Quantity of moles O ₂ in the exhaust gas of the flare per kg residual gas flared in hour h
$t_{O_2,h}$	-	Volumetric fraction of O ₂ in the exhaust gas in the hour h
MF_{O_2}	-	Volumetric fraction of O ₂ in the air (0.21)
F_h	kmol/kg residual gas	Stoichiometric quantity of moles of O ₂ required for a complete oxidation of one kg residual gas in hour h
$fm_{j,h}$	-	Mass fraction of element j in the residual gas in hour h (from equation 7.4)
AM_j	kg/kmol	Atomic mass of element j
j		The elements carbon (index C) and nitrogen (index N)

$$F_h = \frac{fm_{C,h}}{AM_C} + \frac{fm_{H,h}}{4AM_H} - \frac{fm_{O,h}}{2AM_O} \quad (7.11)$$

Where:

Variable	SI Unit	Description
F_h	kmol O ₂ /kg residual gas	Stoichiometric quantity of moles of O ₂ required for a complete oxidation of one kg residual gas in hour h
$fm_{j,h}$	-	Mass fraction of element j in the residual gas in hour h (from equation 7.4)
AM_j	kg/kmol	Atomic mass of element j
j		The elements carbon (index C), hydrogen (index H) and oxygen (index O)

STEP 4

This step was applied in the Project since the methane combustion efficiency of the flare(s) has been continuously monitored.

The mass flow of methane in the exhaust gas is based on the volumetric flow of the exhaust gas and the measured concentration of methane in the exhaust gas, as follows:

$$TM_{FG,h} = \frac{TV_{n,FG,h} \bullet f_{VCH_4,FG,h}}{1000000} \quad (7.12)$$

Where:

Variable	SI Unit	Description
$TM_{FG,h}$	kg/h	Mass flow rate of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour h
$TV_{n,FG,h}$	m ³ /h exhaust gas	Volumetric flow rate of the exhaust gas in dry basis at normal conditions in hour h
$f_{VCH_4,FG,h}$	mg/m ³	Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in hour h

STEP 5

The quantity of methane in the residual gas flowing into the flare is the product of the volumetric flow rate of the residual gas ($FV_{RG,h}$), the volumetric fraction of methane in the residual gas ($f_{VCH_4,RG,h}$) and the density of methane ($\rho_{CH_4,n,h}$) in the same reference conditions (normal conditions and dry or wet basis).

The residual gas moisture is not significant in the Project because several treatment units were foreseen in order to reduce significantly the landfill gas moisture content; therefore the measured flow rate of the residual gas do not need to be corrected to dry basis to be comparable with the measurement of methane that is undertaken on a dry basis.

$$TM_{RG,h} = FV_{RG,h} \bullet f_{VCH_4,RG,h} \bullet \rho_{CH_4,n} \quad (7.13)$$

Where:

Variable	SI Unit	Description
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour h
$FV_{RG,h}$	m ³ /h	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour h
$f_{VCH_4,RG,h}$	-	Volumetric fraction of methane in the residual gas on dry basis in hour h (NB: this corresponds to $f_{V_i,RG,h}$ where i refers to methane).
$\rho_{CH_4,n}$	kg/m ³	Density of methane at normal conditions (0.716)

STEP 6

Since this Project installed enclosed flares and does a continuous monitoring, the flare efficiency in the hour h ($\eta_{flare,h}$) is:

- 0% if the temperature of the exhaust gas of the flare (T_{flare}) is below 500°C during more than 20 minutes during the hour h .
- determined as follows in cases where the temperature of the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour h :
-

$$\eta_{flare,h} = 1 - \frac{TM_{FG,h}}{TM_{RG,h}} \quad (7.14)$$

Where:

Variable	SI Unit	Description
$\eta_{\text{flare},h}$	-	Flare efficiency in the hour h
$TM_{\text{FG},h}$	kg/h	Methane mass flow rate in exhaust gas averaged in a period of time t (hour, two months or year)
$TM_{\text{RG},h}$	kg/h	Mass flow rate of methane in the residual gas in the hour h

STEP 7

Project emissions from flaring are calculated as the sum of emissions from each hour h , based on the methane flow rate in the residual gas ($TM_{\text{RG},h}$) and the flare efficiency during each hour h ($\eta_{\text{flare},h}$), as follows:

$$PE_{\text{flare},y} = \sum_{h=1}^{8760} TM_{\text{RG},h} \cdot (1 - \eta_{\text{flare},h}) \cdot \frac{GWP_{\text{CH}_4}}{1000} \quad (7.15)$$

Where:

$PE_{\text{flare},y}$	=	Project emissions from flaring of the residual gas stream (tCO ₂ e/y)
$TM_{\text{RG},h}$	=	Mass flow rate of methane in the residual gas in the hour h (kg/h)
$\eta_{\text{flare},h}$	=	Flare efficiency in hour h
GWP_{CH_4}	=	Global Warming Potential of methane valid for the commitment period (tCO ₂ e/tCH ₄)

$$MD_{\text{electricity},y} = LFG_{\text{electricity}} \cdot W_{\text{CH}_4,y} \cdot D_{\text{CH}_4} \quad (8)$$

Where:

$MD_{\text{electricity},y}$	=	Quantity of methane destroyed by generation of electricity
$LFG_{\text{electricity},y}$	=	Quantity of methane destroyed by generation of electricity

Determination of CEF_{elec,BL,y} in equation (1) and (13) - Application of "Tool to calculate the emission factor for an electricity system"

Since the baseline was electricity generated by plants connected to the grid the emission factor have been calculated according to "Tool to calculate the emission factor for an electricity system" version 2.

The emission factor is calculated as the *Combined Margin (CM)*, comprised by two components: the *Built Margin (BM)* and the *Operation Margin (OM)*. The OM is the emission factor that refers to the group of existing power plants whose current electricity generation would be affected by the proposed CDM project activity. The BM is the emission factor that refers to the group of prospective power plants whose construction and future operation would be affected by the CDM project activity.

The CM calculation must be based in data from an official source, preferable the dispatch authority. The capacity additions and the values generated from the power plants registered as CDM project activities must be excluded from the calculation.

This tool involves the following six steps:

STEP 1. Identify the relevant electricity systems;

STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional);

STEP 3. Select a method to determine the operating margin (OM);

STEP 4. Calculate the operating margin emission factor according to the selected method;

STEP 5. Calculate the build margin (BM) emission factor;

STEP 6. Calculate the combined margin (CM) emissions factor.

STEP 1. Identify the relevant electricity systems

For determining the electricity emission factors, a project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints.

According to the tool, if the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used. The Brazilian DNA, Comissão Interministerial de Mudança Global do Clima – CIMGC, defined through its Resolução nº 8² the use a single interconnected electric system for CDM project activities applying the tool.

STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional)

This step is applied by the Brazilian DNA, CIMGC. As Option I is chosen, the CIMGC includes only the grid power plants in the calculation.

STEP 3. Select a method to determine the operating margin (OM)

This step is applied by the Brazilian DNA, CIMGC. The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

- (a) Simple OM; or
- (b) Simple adjusted OM; or
- (c) Dispatch data analysis OM; or
- (d) Average OM.

The CIMGC calculates the OM based on method c) Dispatched data analysis OM.

For the dispatch data analysis OM, it is necessary to use the year in which the project activity displaces grid electricity and update the emission factor annually during monitoring.

STEP 4. Calculate the operating margin emission factor according to the selected method

This step is applied by the Brazilian DNA, CIMGC.

The dispatch data analysis OM emission factor ($EF_{grid,OM-DD,y}$) is determined based on the grid power units that are actually dispatched at the margin during each hour h where the project is displacing grid electricity. This approach is not applicable to historical data and, thus, requires annual monitoring of $EF_{grid,OM-DD,y}$.

The emission factor is calculated as follows:

$$EF_{grid, OM - DD, h} = \frac{\sum_h EG_{PJ,h} \times EF_{EL,DD,h}}{EG_{PJ,y}} \quad (9)$$

Where:

- $EF_{grid,OM-DD,h}$ = Dispatch data analysis operating margin CO₂ emission factor in year y (tCO₂/MWh)
- $EG_{PJ,h}$ = Electricity displaced by the project activity in hour h of year y (MWh)
- $EF_{EL,DD,h}$ = CO₂ emission factor for grid power units in the top of the dispatch order in hour h in

² CIMGC – Comissão Interministerial de Mudança Global do Clima; “Resolução nº 8, de 26 de maio de 2009, que adota, para fins de atividade de projeto de MDL, um único sistema como definição de sistema elétrico do projeto no Sistema Interligado Nacional”, available at <<http://www.mct.gov.br/>> , accessed on 01/04/2016.

year y (tCO₂/MWh)

$EG_{PJ,y}$	=	Total electricity displaced by the project activity in year y (MWh)
h	=	Hours in year y in which the project activity is displacing grid electricity
y	=	Year in which the project activity is displacing grid electricity

STEP 5. Calculate the build margin (BM) emission factor

The BM emission factor is calculated by the Brazilian DNA, CIMGC.

In terms of vintage of data, project participants can choose between one of the following two options:

Option 1: For the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated *ex ante*, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

The **Option 2** has been chosen for this Project.

STEP 6. Calculate the combined margin (CM) emissions factor

The calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is based on one of the following methods:

- (a) Weighted average CM; or
- (b) Simplified CM.

The weighted average CM method (option A) should be used as the preferred option and has been chosen for this Project.

The combined margin emissions factor will be calculated as follows:

$$EF_{grid, CM, y} = (EF_{grid, OM, y} \times w_{OM}) + (EF_{grid, BM, y} \times w_{BM}) \quad (10)$$

Where:

$EF_{grid, CM, y}$	=	Emission factor for the Brazilian electric grid in year y (tCO ₂ /MWh)
$EF_{grid, OM, y}$	=	Operating margin CO ₂ emission factor in year y (tCO ₂ /MWh)
$EF_{grid, BM, y}$	=	Build margin CO ₂ emission factor in year y (tCO ₂ /MWh)
w_{OM}	=	Weighting of operating margin emissions factor (%)
w_{BM}	=	Weighting of build margin emissions factor (%)

According with the tool, values adopted for w_{OM} and w_{BM} were equal to 0.5 for each one.

The data used to calculate the grid emission factor was taken from publicly available information available in the Brazilian DNA's website³ for the years 2011, 2012, 2013 and 2014, as demonstrated in the Tables 2 and 3 below. The most recent complete data refers to 2014, which was applied also for 2015.

Table 2: Combined emission factor calculation for 2011

$EF_{CM} = (EF_{OM} \times W_{OM}) + (EF_{BM} \times W_{BM})$					
EMISSION FACTOR (tCO ₂ /MWh)					
MONTH	EF _{OM}	EF _{BM}	W _{OM}	W _{BM}	EF _{CM}
Jan	0.2621	0.1056	0.50	0.50	0.1839
Feb	0.2876	0.1056	0.50	0.50	0.1966
Mar	0.2076	0.1056	0.50	0.50	0.1566
Apr	0.1977	0.1056	0.50	0.50	0.1517
May	0.2698	0.1056	0.50	0.50	0.1877
Jun	0.3410	0.1056	0.50	0.50	0.2233
Jul	0.3076	0.1056	0.50	0.50	0.2066
Aug	0.3009	0.1056	0.50	0.50	0.2033
Sep	0.2734	0.1056	0.50	0.50	0.1895
Oct	0.3498	0.1056	0.50	0.50	0.2277
Nov	0.3565	0.1056	0.50	0.50	0.2311
Dec	0.3495	0.1056	0.50	0.50	0.2276
FINAL	0.2920	0.1056	0.50	0.50	0.1988

Table 3: Combined emission factor calculation for 2012

$EF_{CM} = (EF_{OM} \times W_{OM}) + (EF_{BM} \times W_{BM})$					
EMISSION FACTOR (tCO ₂ /MWh)					
MONTH	EF _{OM}	EF _{BM}	W _{OM}	W _{BM}	EF _{CM}
Jan	0.2935	0.2010	0.50	0.50	0.2473
Feb	0.3218	0.2010	0.50	0.50	0.2614
Mar	0.4050	0.2010	0.50	0.50	0.3030
Apr	0.6236	0.2010	0.50	0.50	0.4123
May	0.5943	0.2010	0.50	0.50	0.3977
Jun	0.5056	0.2010	0.50	0.50	0.3533
Jul	0.3942	0.2010	0.50	0.50	0.2976
Aug	0.4490	0.2010	0.50	0.50	0.3250
Sep	0.6433	0.2010	0.50	0.50	0.4222
Oct	0.6573	0.2010	0.50	0.50	0.4292
Nov	0.6641	0.2010	0.50	0.50	0.4326
Dec	0.6597	0.2010	0.50	0.50	0.4304
FINAL	0.5176	0.2010	0.50	0.50	0.3593

Table 4: Combined emission factor calculation for 2013

$EF_{CM} = (EF_{OM} \times W_{OM}) + (EF_{BM} \times W_{BM})$					
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³ <http://www.mct.gov.br/index.php/content/view/74689.html> (accessed in 01/04/2016).

EMISSION FACTOR (tCO ₂ /MWh)					
MONTH	EF _{OM}	EF _{BM}	W _{OM}	W _{BM}	EF _{CM}
Jan	0.6079	0.2713	0.50	0.50	0.4396
Feb	0.5958	0.2713	0.50	0.50	0.4336
Mar	0.5896	0.2713	0.50	0.50	0.4305
Apr	0.6010	0.2713	0.50	0.50	0.4362
May	0.5830	0.2713	0.50	0.50	0.4272
Jun	0.6080	0.2713	0.50	0.50	0.4397
Jul	0.5777	0.2713	0.50	0.50	0.4245
Aug	0.5568	0.2713	0.50	0.50	0.4141
Sep	0.5910	0.2713	0.50	0.50	0.4312
Oct	0.5891	0.2713	0.50	0.50	0.4302
Nov	0.6082	0.2713	0.50	0.50	0.4398
Dec	0.6102	0.2713	0.50	0.50	0.4408
FINAL	0.5932	0.2713	0.50	0.50	0.4322

Table 5: Combined emission factor calculation for 2014

EF _{CM} = (EF _{OM} X W _{OM}) + (EF _{BM} X W _{BM})					
EMISSION FACTOR (tCO ₂ /MWh)					
MONTH	EF _{OM}	EF _{BM}	W _{OM}	W _{BM}	EF _{CM}
Jan	0.6155	0.2963	0.50	0.50	0.4559
Feb	0.5989	0.2963	0.50	0.50	0.4476
Mar	0.5699	0.2963	0.50	0.50	0.4331
Apr	0.5772	0.2963	0.50	0.50	0.4368
May	0.5605	0.2963	0.50	0.50	0.4284
Jun	0.5678	0.2963	0.50	0.50	0.4321
Jul	0.5674	0.2963	0.50	0.50	0.4319
Aug	0.5862	0.2963	0.50	0.50	0.4413
Sep	0.5994	0.2963	0.50	0.50	0.4479
Oct	0.5901	0.2963	0.50	0.50	0.4432
Nov	0.5885	0.2963	0.50	0.50	0.4424
Dec	0.5825	0.2963	0.50	0.50	0.4394
FINAL	0.5837	0.2963	0.50	0.50	0.4400

For other calculations applying actual values, please refer to the Hourly Report data sheet, attached as a document, to see the values aggregated every one hour.

The values for the monitoring period, as an illustrative representation, are presented in the tables below, aggregated monthly.

Table 6: Adjustment Factor.

Month	AF (%)	Month	AF (%)	Month	AF (%)
2011 Oct	0.056	2013 Mar	0.039	2014 Ago	0.140
2011 Nov	0.042	2013 Apr	0.046	2014 Sep	0.150

2011 Dec	0.060	2013 May	0.045	2014 Oct	0.038
2012 Jan	0.048	2013 Jun	0.041	2014 Nov	0.038
2012 Feb	0.045	2013 Jul	0.042	2014 Dec	0.038
2012 Mar	0.045	2013 Ago	0.142	2015 Jan	0.038
2012 Apr	0.040	2013 Sep	0.865	2015 Feb	0.038
2012 May	0.048	2013 Oct	0.933	2015 Mar	0.038
2012 Jun	0.040	2013 Nov	0.086	2015 Apr	0.038
2012 Jul	0.045	2013 Dec	0.667	2015 May	0.038
2012 Ago	0.049	2014 Jan	0.038	2015 Jun	0.038
2012 Sep	0.039	2014 Feb	0.703	2015 Jul	0.038
2012 Oct	0.040	2014 Mar	0.613	2015 Ago	0.038
2012 Nov	0.044	2014 Apr	0.916	2015 Sep	1.000
2012 Dec	0.043	2014 May	0.313	2015 Oct	0.038
2013 Jan	0.045	2014 Jun	0.150	2015 Nov	0.038
2013 Feb	0.041	2014 Jul	0.138	2015 Dec	0.038

Since,

$$CEF_{elec,BL,y} = EF_{EL,j,y} = CM_y = (OM_y \times 0.5) + (BM_y \times 0.5) \quad (11)$$

Table 7: Methane destroyed by the project, Methane that would have been destroyed in the absence of the project due to regulatory and/or contractual requirement and Baseline emissions.

Month	MD _{project,y}	MD _{BL,y}	GWP _{CH4}	EL _{LFG,y}	CEF _{elec,BL,y}	BE _y
	(tCH ₄)	(tCH ₄)	-	MWh	(tCO ₂ /MWh)	(tCO ₂ e)
2011 Oct	1,024.451	40.599	21	2,939	0.1988	21,245.086
2011 Nov	939.979	37.910	21	2,908	0.1988	19,521.535
2011 Dec	995.376	39.590	21	2,996	0.1988	20,667.065
2012 Jan	971.032	38.787	21	2,976	0.3593	20,646.542
2012 Feb	911.542	36.172	21	2,771	0.3593	19,378.510
2012 Mar	982.738	38.196	21	2,918	0.3593	20,883.922
2012 Apr	903.428	35.223	21	2,775	0.3593	19,229.480
2012 May	932.378	36.360	21	2,698	0.3593	19,785.700
2012 Jun	852.598	33.193	21	2,564	0.3593	18,128.738
2012 Jul	822.765	32.003	21	2,486	0.3593	17,499.173
2012 Ago	819.268	31.811	21	2,429	0.3593	17,409.256
2012 Sep	796.417	30.966	21	2,356	0.3593	16,921.057
2012 Oct	793.938	31.057	21	2,336	0.3593	16,859.692
2012 Nov	797.243	31.011	21	2,326	0.3593	16,926.642
2012 Dec	769.020	30.047	21	2,278	0.3593	16,336.782
2013 Jan	602.209	24.071	25	1,844	0.4322	15,250.493
2013 Feb	717.687	28.125	25	2,140	0.4322	18,163.853
2013 Mar	772.692	30.115	25	2,258	0.4322	19,540.587
2013 Apr	732.697	28.468	25	2,141	0.4322	18,531.036
2013 May	706.035	27.458	25	2,072	0.4322	17,859.837

2013 Jun	666.289	26.106	25	1,953	0.4322	16,848.833
2013 Jul	661.738	26.092	25	1,914	0.4322	16,718.382
2013 Ago	320.035	12.924	25	923	0.4322	8,076.737
2013 Sep	46.216	1.872	25	865	0.4322	1,482.660
2013 Oct	48.132	1.881	25	1,826	0.4322	1,945.616
2013 Nov	593.664	23.161	25	1,801	0.4322	15,041.112
2013 Dec	213.459	8.342	25	1,893	0.4322	5,946.129
2014 Jan	365.649	13.895	25	1,904	0.4400	9,631.392
2014 Feb	162.396	6.329	25	1,664	0.4400	4,633.770
2014 Mar	224.129	8.774	25	1,782	0.4400	6,168.124
2014 Apr	40.435	1.585	25	1,665	0.4400	1,703.996
2014 May	356.335	14.008	25	1,774	0.4400	9,338.620
2014 Jun	415.801	16.385	25	1,652	0.4400	10,712.386
2014 Jul	376.075	14.932	25	1,561	0.4400	9,715.561
2014 Ago	352.397	13.899	25	1,606	0.4400	9,169.067
2014 Sep	359.026	14.127	25	1,547	0.4400	9,302.943
2014 Oct	307.754	11.695	25	1,602	0.4400	8,106.413
2014 Nov	302.639	11.500	25	1,576	0.4400	7,971.680
2014 Dec	313.084	11.897	25	1,630	0.4400	8,246.807
2015 Jan	294.268	11.182	25	1,532	0.4400	7,751.177
2015 Feb	47.246	1.795	25	1,377	0.4400	1,742.310
2015 Mar	186.530	7.088	25	1,505	0.4400	5,148.301
2015 Apr	273.188	10.381	25	1,422	0.4400	7,195.920
2015 May	279.411	10.618	25	1,455	0.4400	7,359.851
2015 Jun	262.838	9.988	25	1,368	0.4400	6,923.287
2015 Jul	271.019	10.299	25	1,411	0.4400	7,138.781
2015 Ago	260.318	9.892	25	1,355	0.4400	6,856.925
2015 Sep	-	0.000	25	1,292	0.4400	568.292
2015 Oct	214.645	8.157	25	1,283	0.4400	5,726.702
2015 Nov	233.387	8.869	25	1,215	0.4400	6,147.542
2015 Dec	255.439	9.707	25	1,330	0.4400	6,728.391
Total						600,832.692

E.2. Calculation of project emissions or actual net GHG removals by sinks

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As per the ACM0001 version 11 Project Emissions was evaluated with the following formula:

$$PE_y = PE_{EC,y} + PE_{FC,y} \quad (12)$$

Where:

$PE_{EC,y}$ = Emissions from consumption of electricity in the Project. The project emissions from electricity consumption ($PE_{EC,y}$) have been calculated following the version 01 of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".

$PE_{FC,y}$ = Emissions from consumption of heat in the Project. For this Project is equal to 0 since no heat will be consumed.

Determination of $PE_{EC,y}$ in equation (12) - Application of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"

The tool is applicable because the "Scenario A: Electricity consumption from the grid." applies to the sources of electricity for this Project and no baseline or leakage emissions have to be evaluated for this Project since no electricity is consumed in the baseline and no leakage have to be taken into account.

The general formula is:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \cdot EF_{EL,j,y} \cdot (1 + TDL_y) \quad (13)$$

Where:

- $PE_{EC,y}$ = Project emissions from electricity consumption in year y (tCO₂/y)
- $EC_{PJ,j,y}$ = Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/y)
- $EF_{EL,j,y}$ = Emission factor for electricity generation for source j in year y (tCO₂/MWh)
- $TDL_{j,y}$ = Average technical transmission and distribution losses for providing electricity to source j in year y , for the Project the 20% default value has been used
- j = Sources of electricity consumption in the project, in this case is only the National grid

For the calculation of the $EF_{EL,j,y}$, the Scenario A applies to the Project as a grid energy consumer. Proceeding, the methodology Option A1 has been selected to "Calculate the combined margin emission factor of the applicable electricity system using the procedures in the approved version 2 of the "Tool to calculate the emission factor for an electricity system" ($EF_{EL,j,y} = CEF_{elec,BL,y}$)"

Therefore, Project emission for electricity consumption was calculated in the Table 6 below.

Table 8: Project emissions for electricity consumption from the national grid

Project emission for electricity consumption from the national grid				
Month	$EC_{PJ,j,y}$ (kWh)	$EF_{EL,j,y}$ (tCO ₂ /MWh)	$TDL_{j,y}$ (-)	$PE_{EC,y}$ (tCO ₂ e)
2011 Oct	1,119	0.1988	0.2	0.267
2011 Nov	375	0.1988	0.2	0.090
2011 Dec	709	0.1988	0.2	0.169
2012 Jan	436	0.3593	0.2	0.188
2012 Feb	213	0.3593	0.2	0.092
2012 Mar	314	0.3593	0.2	0.135
2012 Apr	281	0.3593	0.2	0.121
2012 May	193	0.3593	0.2	0.083
2012 Jun	168	0.3593	0.2	0.072
2012 Jul	962	0.3593	0.2	0.415
2012 Ago	947	0.3593	0.2	0.408
2012 Sep	82	0.3593	0.2	0.035
2012 Oct	72	0.3593	0.2	0.031
2012 Nov	388	0.3593	0.2	0.167
2012 Dec	496	0.3593	0.2	0.214
2013 Jan	428	0.4322	0.2	0.222
2013 Feb	386	0.4322	0.2	0.200
2013 Mar	216	0.4322	0.2	0.112

2013 Apr	435	0.4322	0.2	0.226
2013 May	241	0.4322	0.2	0.125
2013 Jun	34	0.4322	0.2	0.018
2013 Jul	73	0.4322	0.2	0.038
2013 Ago	1,969	0.4322	0.2	1.021
2013 Sep	1,175	0.4322	0.2	0.609
2013 Oct	277	0.4322	0.2	0.144
2013 Nov	177	0.4322	0.2	0.092
2013 Dec	180	0.4322	0.2	0.093
2014 Jan	56	0.4400	0.2	0.030
2014 Feb	85	0.4400	0.2	0.045
2014 Mar	89	0.4400	0.2	0.047
2014 Apr	176	0.4400	0.2	0.093
2014 May	89	0.4400	0.2	0.047
2014 Jun	171	0.4400	0.2	0.090
2014 Jul	630	0.4400	0.2	0.333
2014 Ago	46	0.4400	0.2	0.024
2014 Sep	117	0.4400	0.2	0.062
2014 Oct	133	0.4400	0.2	0.070
2014 Nov	82	0.4400	0.2	0.043
2014 Dec	114	0.4400	0.2	0.060
2015 Jan	208	0.4400	0.2	0.110
2015 Feb	387	0.4400	0.2	0.204
2015 Mar	376	0.4400	0.2	0.199
2015 Apr	315	0.4400	0.2	0.166
2015 May	235	0.4400	0.2	0.124
2015 Jun	396	0.4400	0.2	0.209
2015 Jul	542	0.4400	0.2	0.286
2015 Ago	142	0.4400	0.2	0.075
2015 Sep	509	0.4400	0.2	0.269
2015 Oct	1,519	0.4400	0.2	0.802
2015 Nov	2,201	0.4400	0.2	1.162
2015 Dec	542	0.4400	0.2	0.286
Total				10.224

E.3. Calculation of leakage

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No leakage effects need to be accounted under ACM0001 methodology.

E.4. Summary of calculation of emission reductions or net GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO ₂ e)	Project emissions or actual net GHG removals by sinks (t CO ₂ e)	Leakage (t CO ₂ e)	GHG emission reductions or net GHG removals by sinks (t CO ₂ e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
Total	600,833	10	0	281,437	319,386	600,823

E.5. Comparison of actual emission reductions or net GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO ₂ e)	618,892	600,823

E.6. Remarks on difference from estimated value in registered PDD

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Not applicable.

Appendix 1. Contact information of project participants and responsible persons/entities

Project participant and/or responsible person/ entity	<input checked="" type="checkbox"/> Project participant <input type="checkbox"/> Person/entity responsible for completing the CDM-MR-FORM
Organization name	Consórcio Horizonte Asja
Street/P.O. Box	Rod. BR.040, 1200, Bairro Califórnia
Building	
City	Belo Horizonte
State/region	Minas Gerais
Postcode	30855-500
Country	Brazil
Telephone	+ 55 31 32863311
Fax	
E-mail	
Website	www.asja.biz
Contact person	Emerson Rafael da Cruz
Title	Director
Salutation	Mr.
Last name	da Cruz
Middle name	
First name	Emerson Rafael
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	e.cruz@asja.biz

Project participant and/or responsible person/ entity	<input checked="" type="checkbox"/> Project participant <input checked="" type="checkbox"/> Person/entity responsible for completing the CDM-MR-FORM
Organization name	Asja Brasil Serviços para o Meio Ambiente Ltda.
Street/P.O. Box	Av. Prof. Mário Werneck, 26, sala 801, Bairro Estoril
Building	Edifício Souto Lima
City	Belo Horizonte
State/region	Minas Gerais
Postcode	30455-610
Country	Brazil
Telephone	+ 55 131 32863311
Fax	
E-mail	
Website	www.asja.biz
Contact person	Emerson Rafael da Cruz
Title	Director
Salutation	Mr.
Last name	da Cruz
Middle name	
First name	Emerson Rafael
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	e.cruz@asja.biz

Attachment. Instructions for filling out the monitoring report form

1. General instructions

1. When monitoring the project activity and completing the CDM-MR-FORM, in addition to following the the "[CDM Project standard](#)" (Project standard), the applied approved baseline and monitoring [methodology\(ies\)](#) (hereinafter referred to as the applied methodology(ies)) and, where applicable, the applied approved [standardized baseline\(s\)](#) (hereinafter referred to as the applied standardized baseline(s)), consult the "[Rules and Reference](#)" section of the UNFCCC CDM website. This section contains all regulatory documents for the CDM, such as [standards](#) (including [methodologies](#), [tools](#) and [standardized baselines](#)), [procedures](#), [guidelines](#), [clarifications](#), [forms](#) and the "[Glossary: CDM terms](#)". Make any data, values and formulae included in electronic spreadsheets provided accessible and verifiable.
2. Complete the CDM-MR-FORM and all attached documents in English, or include a full translation of relevant sections in English.
3. Complete the CDM-MR-FORM using the same format without modifying its font, headings or logo, and without any other alteration to the form.
4. Do not modify or delete tables and their columns in the CDM-MR-FORM. Add rows to the tables as needed. Add additional appendices as needed.
5. If a section of the CDM-MR-FORM is not applicable, explicitly state that the section is left blank intentionally.
6. Use an internationally recognized format for presentation of values in the CDM-MR-FORM, for example use digit grouping in thousands and mark a decimal point with a dot (.), not with a comma (,).
7. Complete the CDM-MR-FORM deleting this "Attachment: Instructions for filling out the monitoring report form".

2. Specific instructions

1. Indicate on the cover page the following information:
 - (a) Title of the project activity;
 - (b) Reference number of the project activity;
 - (c) Version number of the monitoring report;
 - (d) Completion date of the monitoring report (DD/MM/YYYY);
 - (e) Monitoring period number and duration of this monitoring period. The monitoring period number is an ordinal number referring to the chronological order of monitoring periods (e.g. "first monitoring period"). For the monitoring period dates, first and last days are included (DD/MM/YYYY – DD/MM/YYYY);
 - (f) Project participant(s);
 - (g) Host Party;
 - (h) Sectoral scope(s). List all sectoral scopes applicable to the project activity;
 - (i) Selected methodology(ies). List all the selected methodologies and combination of methodologies applicable to the project activity;
 - (j) Selected standardized baseline(s). List all the selected standardized baseline applicable to the project activity;
 - (k) Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD;
 - (l) Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period - GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012 (if applicable); GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards (if applicable).

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

1. Provide a brief summary of the detailed description given in section B.1 in terms of:
 - (a) Purpose of the project activity and the measures taken for GHG emission reductions or net GHG removals by sinks;
 - (b) Brief description of the installed technology and equipment;
 - (c) Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.);
 - (d) Total GHG emission reductions or net GHG removals by sinks achieved in this monitoring period.

A.2. Location of project activity

1. Provide the following information on the location of the project activity:
 - (a) Host Party;
 - (b) Region/state/province, etc.;
 - (c) City/town/community, etc.;
 - (d) Physical/geographical location.

A.3. Parties and project participant(s)

1. List in the table Party(ies) and project participant(s) involved in the project activity.

A.4. Reference of applied methodology and standardized baseline

1. Indicate the exact reference (number, title, version) of:
 - (a) The applied methodology(ies) (e.g. ACM0001: "Large-scale consolidated methodology: Flaring or use of landfill gas" (version 15.0));
 - (b) Any tools and other methodologies to which the applied methodology(ies) refers (e.g. "Methodological tool: Tool for the demonstration and assessment of additionality" (version 07.0.0));

- (c) The applied standardized baseline(s), where applicable (e.g. ASB0001 "Standardized baseline: Grid emission factor for the Southern African power pool" (version 01.0)).
- 2. Refer to the UNFCCC CDM website for the exact reference of the applied methodologies, tools and standardized baselines.

A.5. Crediting period of project activity

- 1. Provide the type, start date and length of the crediting period corresponding to this monitoring period.

A.6. Contact information of responsible persons/entities

- 1. Provide contact information of the person(s)/entity(ies) responsible for completing the CDM-MR-FORM and indicate whether the person(s)/entity(ies) is(are) also a project participant(s) in Appendix 1

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

- 1. Provide information on the implementation status of the project activity during this monitoring period in accordance with the applicable provision for description of implemented registered CDM project activity in the Project standard.
- 2. For the description of the installed technology(ies), technical process and equipment, include diagrams, where appropriate.
- 3. If applicable, present information on any request for prior approval by the Board of changes to the registered CDM project activity in section B.2.1, B.2.2, B.2.3, B.2.4, B.2.5 and/or B.2.6.

B.2. Post-registration changes

B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

- 1. Indicate whether any temporary deviations have been applied during this monitoring period. If applied, provide a description of the deviation(s) in accordance with applicable provisions for temporary deviations from the registered monitoring plan, applied methodologies or applied standardized baseline in the Project standard.
- 2. Include the reasons for the deviation(s), how it deviates from the monitoring plan, applied methodology(ies) and/or applied standardized baseline, the duration for which the deviation(s) is(are) applicable and justification on the conservativeness of the approach.
- 3. For deviation(s) that require prior approval by the Board, include the date of approval and reference number. Otherwise, provide the version number and the completion date of the revised PDD and DOE assessment opinion on the request for post-registration changes that is being submitted with this monitoring report.

B.2.2. Corrections

- 1. Indicate whether any corrections to project information or parameters fixed at validation have been approved during this monitoring period or submitted with this monitoring report.
- 2. In cases where the correction(s) and the revised PDD are approved prior to the submission of this monitoring report for request for issuance, provide the approval date and reference number. Otherwise, provide the version number and the completion date of the revised PDD and the DOE assessment opinion on the request for post-registration changes that is being submitted with this monitoring report.

B.2.3. Changes to start date of crediting period

- 1. Indicate whether any changes to the start date of the crediting period have been approved during this monitoring period or submitted with this monitoring report.
- 2. In cases where the changes and the revised PDD are approved prior to the submission of this monitoring report for request for issuance, provide the approval date and reference number.

B.2.4. Inclusion of a monitoring plan to the registered PDD that was not included at registration

1. Indicate whether the inclusion of a monitoring plan into the PDD for which the delayed submission of the monitoring plan was chosen by the project participants at the time of the registration of the project activity, has been approved by the Board prior to the submission of this monitoring report or is being submitted together with this monitoring report.
2. If the inclusion of a monitoring plan into the registered PDD has been approved by the Board prior to the submission of this monitoring report, provide the date of approval and reference number.

B.2.5. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

1. Indicate whether any permanent changes from the registered monitoring plan, applied methodologies or applied standardized baseline have been approved during this monitoring period or submitted with this monitoring report.
2. In cases where the change(s) and the revised PDD are approved prior to the submission of this monitoring report for request for issuance, provide the approval date and reference number. Otherwise, provide the version number and the completion date of the revised PDD and DOE assessment opinion on the request for post-registration changes that is being submitted with this monitoring report.

B.2.6. Changes to project design of registered project activity

1. Indicate whether any changes to the project design of the project activity have been approved during this monitoring period or submitted with this monitoring report.
2. In cases where the change(s) and the revised PDD are approved prior to the submission of this monitoring report for request for issuance, provide the approval date and reference number. Otherwise, provide the version number and the completion date of the revised PDD and DOE assessment opinion on the request for post-registration changes that is being submitted with this monitoring report.

B.2.7. Types of changes specific to an afforestation or reforestation project activity

1. Indicate whether any changes specific to afforestation or reforestation project activities have been applied during this monitoring period based on applicable provisions in the Project standard that do not require prior approval by the Board. If changes were applied, provide the version number and the completion date of the revised PDD and DOE assessment opinion on the request for post-registration changes that is being submitted with this monitoring report.

SECTION C. Description of monitoring system

1. Provide a description of the monitoring system based on the applicable provision for description of monitoring system in the Project standard. Include diagrams of the monitoring system and the information flow where appropriate.

SECTION D. Data and parameters

1. Provide information on all data and parameters in accordance with applicable provisions for data and parameters in the Project standard, using the tables provided in sections D.1 and 0.
2. For "Purpose of data" in the tables in D.1 and 0, choose one of the following options:
 - (a) Calculation of baseline emissions or baseline net GHG removals by sinks;
 - (b) Calculation of project emissions or actual net GHG removals by sinks;
 - (c) Calculation of leakage.
3. Where the applied standardized baseline(s) standardizes baseline emissions, apply the standardized value(s) of the parameter(s) in section D.1 and/or 0 in accordance with applicable provisions related to data and parameters in the Project standard.

D.1. Data and parameters fixed ex ante or at renewal of crediting period

1. Include data that are fixed before registration and/or at the renewal of crediting period and are used during this monitoring period under section D.1.
2. For "Value(s) applied", use one table to report multiple values referring to the same data and parameter, if applicable. Use reference(s) to electronic spreadsheets, if necessary.

D.2. Data and parameters monitored

1. For "Monitoring equipment" in the table, provide information on type, accuracy class, serial number, calibration frequency, date of last calibration and validity.
2. For "Value(s) of monitored parameter", use one table to report multiple values referring to the same data and parameter, if applicable. Use reference(s) to electronic spreadsheets, if necessary.

D.3. Implementation of sampling plan

1. If data and parameters monitored described in section D.2 above are determined by a sampling approach, provide a description on how project participants implemented the sampling efforts and surveys for those data and parameters according to the sampling plan. Include:
 - (a) Description of implemented sampling design;
 - (b) Collected data (attach and provide reference to electronic spreadsheets, if necessary);
 - (c) Analysis of the collected data;
 - (d) Demonstration on whether the required confidence/precision has been met.

SECTION E. Calculation of emission reductions or GHG removals by sinks

1. For the parameter global warming potentials (GWPs), from 1 January 2013, include the values adopted by decision 4/CMP.7 to calculate the emission reductions achieved in the second commitment period of the Kyoto Protocol in accordance with the applicable provisions in the Project standard.

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

1. Provide sample calculations for all formulae used and calculation of baseline emissions or baseline net GHG removals by sinks, applying actual values. Attach electronic spreadsheets to present full calculations in the monitoring report.

E.2. Calculation of project emissions or actual net GHG removals by sinks

1. Provide sample calculations for all formulae used and calculation of project emissions or actual net GHG removals by sinks, applying actual values. Attach electronic spreadsheets to present full calculations in the monitoring report.

E.3. Calculation of leakage

1. Provide sample calculations for all formulae used and calculation of leakage, applying actual values. Attach electronic spreadsheets to present full calculations in the monitoring report.

E.4. Summary of calculation of emission reductions or net GHG removals by sinks

1. Summarize the results of sections E.1, E.2, E.3 above and provide GHG emission reductions or net GHG removals by sinks for this monitoring period, using the table.
2. If the monitoring period starts before 31 December 2012 and ends anytime thereafter, provide actual GHG emission reductions or net GHG removals by sinks achieved for the following two periods respectively:
 - a) Up to 31 December 2012 (first commitment period); and
 - b) From 1 January 2013 onwards.
3. Calculate the achieved GHG emission reductions or net GHG removals by sinks proportionally for each period. In cases where annual caps were applied in the calculations, prorate the annual caps to each period.

E.5. Comparison of actual emission reductions or net GHG removals by sinks with estimates in registered PDD

1. Provide a comparison of actual GHG emission reductions or net GHG removal of the project activity achieved during this monitoring period with the estimates in the registered PDD.

E.6. Remarks on difference from estimated value in registered PDD

1. Explain the cause of any increase in the actual GHG emission reductions achieved during this monitoring period based on the applicable provision for calculation of GHG emission reductions in the Project standard.

Appendix 1. Contact information of project participants and responsible persons/entities

1. In accordance with section A.6 above, complete the table, with the following mandatory fields: Project participant and/or responsible person/entity, Organization, Street/P.O. Box, City, Postcode, Country, Telephone, Fax, E-mail and Name of contact person. Copy and paste the table as needed.

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Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: <ul style="list-style-type: none"> • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: <ul style="list-style-type: none"> • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from <i>F-CDM-MR</i> to <i>CDM-MR-FORM</i>; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.
Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: monitoring report		