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 3	
Completion date of the monitoring report	31/07/2017	
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_2e	
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
	281,864 tCO_2e	327,702 tCO_2e

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 CO_2, 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 collect 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 leads 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

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 609,566 tCO_2e.

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:

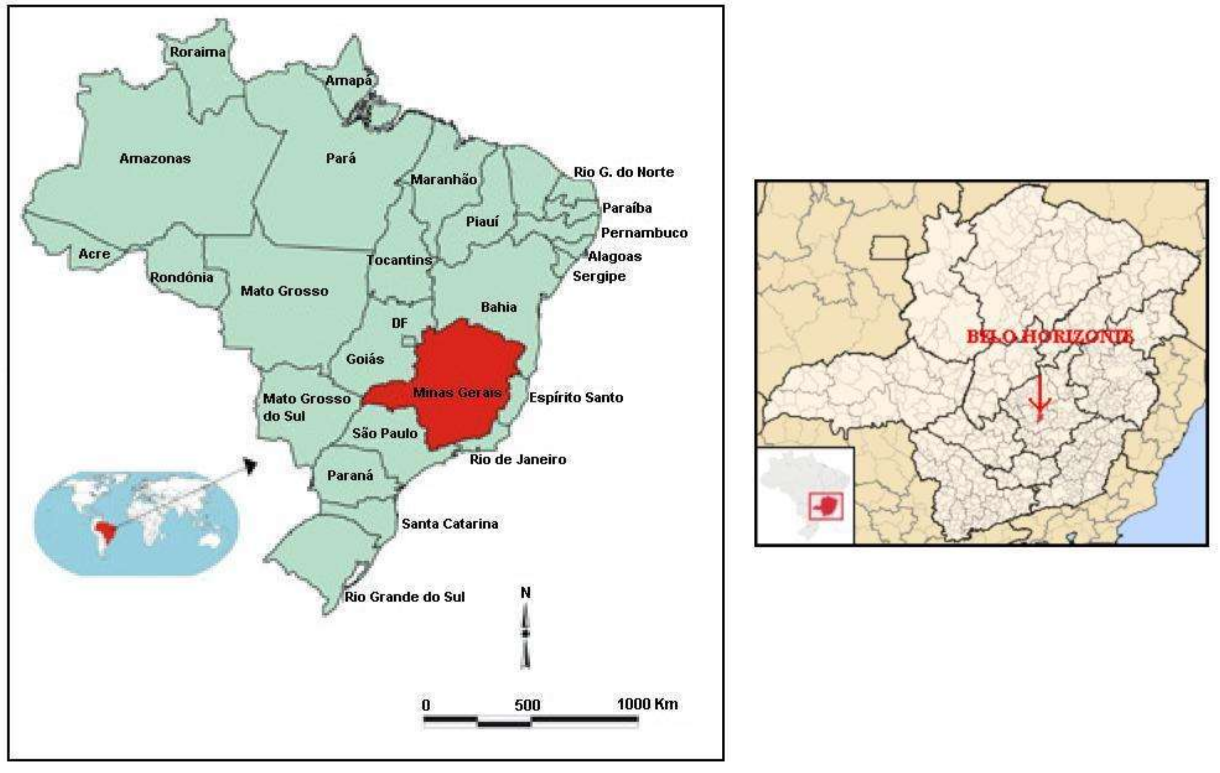

Figure 1: Project location.

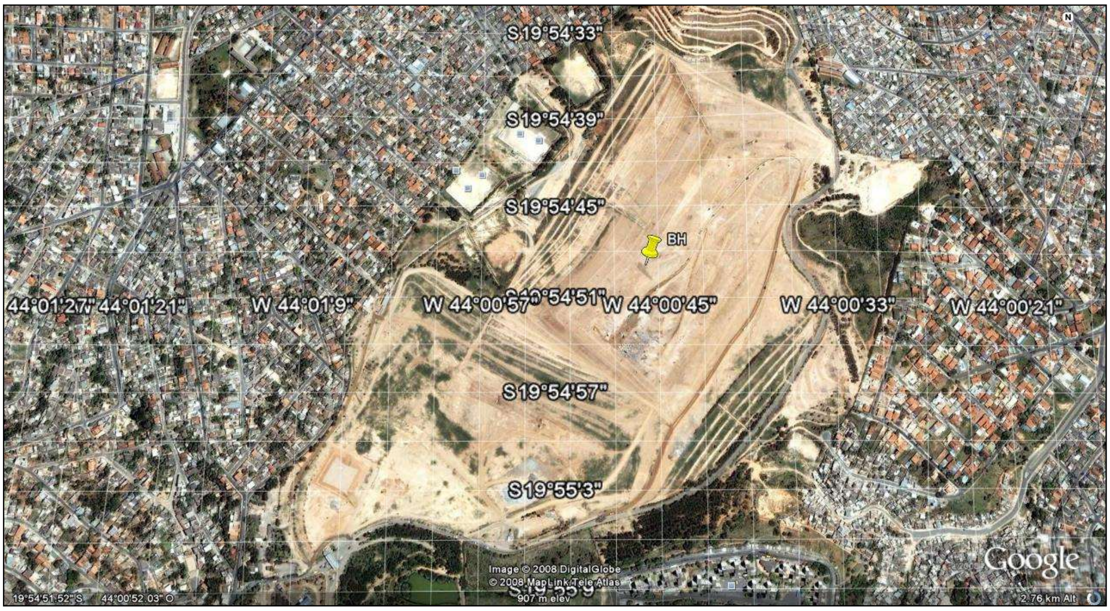

Figure 2: CTRS / BR.040 landfill location. (Source: Google Earth)

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

>>

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 CO_2 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.
Melina Yurie Uchida
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+55 31 32863311
www.asja.energy

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

>>

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 Nm^3/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 has been requested and approved by EB on 04/04/2017 for such period and emission reductions will be claimed according to a conservative estimation.

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

>>
In the registered monitoring plan described in the PDD, direct monitoring is conducted on the LFG captured, the LFG destroyed by flare, the LFG used for power generation and the methane content in the LFG, among others. The measuring equipment 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. Those data directly measured by the equipment installed at the plant and registered by the PLC are used to calculate the ERs generated by flaring and generation of electricity.
In January 2014 and from October 2014 to September 2016, 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 was requested for the whole month of January 2014 and from 01/10/2014 to 04/09/2016, 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. The temporary deviation was approved in 04/04/2017 (PRC-3464-002).

<u>Description of the proposed deviation</u>

All the LFG collected in the Project is preferably used to generate electricity, so the enclosed flare works as a security device that aims to destroy the amount of LFG exceeding the engines' capacity or when the engines are turned off for maintenance. Indeed, as the production of LFG by the waste decomposition in the landfill is strongly decreasing year by year (the landfill stopped receiving new waste in 2007, December), part of the engines' installed capacity has been idle and one of the three engines has been operated as stand-by. Therefore, even during maintenance, it has been possible to destroy all the LFG collected in the remaining engines instead of using the enclosed flare. In fact, since before January 2014 all the LFG collected in the Project is being used to generate electricity. Nevertheless, the flare is operative and can be turned on if needed.

As an electricity producer connected to the Brazilian grid, the data measured by the electricity meter responsible for directly measuring both the electricity exported by the Project to the grid and imported by the Project from the grid is registered and monitored also by the Electric Energy Commercialization Chamber – CCEE (Câmara de Comercialização de Energia Elétrica). So, doubled recording of the same data is made, by the plant's supervisory system and by the CCEE's system to which the Project manager has access too. For this reason, even during the outage of the supervisory system, the Project manager could easily monitor the power plant operation through the CCEE's system.

Given that all electricity exported by the Project to the grid is generated using exclusively the LFG collected from the landfill, it is possible to estimate the amount of ERs generated in the period of outage of the supervisory system by making a reverse calculation. The engines simply convert the chemical energy of the LFG methane content (calorific power of methane) into electric energy. Therefore, the amount of methane destroyed by generation of electricity can be estimated by reversely converting the amount of electricity exported to the grid into the amount of kilocalories processed by the engines, and then the amount of methane processed by the engines, considering the electrical efficiency of engines and physical constants. This approach is conservative as demonstrated in the PRC approved.

Calculation of emission reductions generated

To calculate the amount of emission reductions generated by the Project during the period of outage of the supervisory system the following steps will be applied:

1. Estimation of volume of methane fed to the engines (Nm^3);
2. Calculation of methane destroyed by the project (tCH_4);
3. Calculation of methane destroyed in the baseline (tCH_4);
4. Calculation of baseline emissions (tCO_2e);
5. Calculation of project emissions (tCO_2);
6. Calculation of emission reductions (tCO_2e).

1. Estimation of volume of methane fed to the engines (Nm^3)

The amount of methane fed to the engines was estimated according to the formula below.

$$CH4_{electricity,y} = \frac{EL_{LFG,y} \times Energy\ conversion\ rate}{Eff.engine \times Methane\ calorif\ value}$$

Where:

$CH4_{electricity,y}$	=	Amount of methane fed to the electricity generators during the monitoring period measured in cubic meters (m^3)
$EL_{LFG,y}$	=	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 the monitoring period, in kilowatt hours (kWh). This is conservative as a small portion of the electricity generated using LFG is self-consumed in the Project itself.
Energy conversion rate	=	Energy conversion rate (kcal/kWh thermal). Value is 860 kcal/kWh thermal[1].
Eff. engine	=	Efficiency of engine (%). Value is 38.9% according to the engines' technical datasheet
Methane calorific value	=	Methane calorific value (kcal/m^3 CH_4). Value is 8250 kcal/m^3CH_4[2]

2. Calculation of methane destroyed by the project (tCH_4)

[1] http://www.fao.org/docrep/P2396E/p2396e01.htm (Consulted in 28/08/2016).

[2] Italian Normative UNI 10389.

Once the amount of methane fed to the engines is estimated, the amount of methane destroyed by generation of electricity is calculated according to the following:

$$MD_{electricity,y} = CH4_{electricity,y} \times D_{CH4}$$

Where:

$MD_{electricity,y}$	=	Quantity of methane destroyed by generation of electricity (tCH_4)
$CH4_{electricity,y}$	=	Amount of methane fed to the electricity generators during the monitoring period measured in cubic meters (m^3)
D_{CH4}	=	Methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4). Value is 0.0007168 tCH_4/m^3CH_4 (fixed *ex ante* parameter as per registered PDD, Section B.6.2).

As LFG was used exclusively for electricity generation, for this period, the methane destroyed by generation of electricity ($MD_{electricity,y}$) is equal to the methane destroyed by the project ($MD_{project,y}$).

3. Calculation of methane destroyed in the baseline (tCH_4)

Calculated as per the registered PDD.

4. Calculation of baseline emissions (tCO_2e)

Calculated as per the registered PDD.

5. Calculation of project emissions (tCO_2)

Calculated as per the registered PDD.

6. Calculation of emission reductions (tCO_2e)

Calculated as per the registered PDD.

B.2.2. Corrections

>>
Not applicable.

B.2.3. Changes to start date of crediting period

>>
Not applicable.

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

>>
Not applicable.

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

>>
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 15/03/2013 (PRC-3464-001).

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. On September 2012, the forth engine was removed and sold. Therefore the energy plant remained with 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

>>

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.

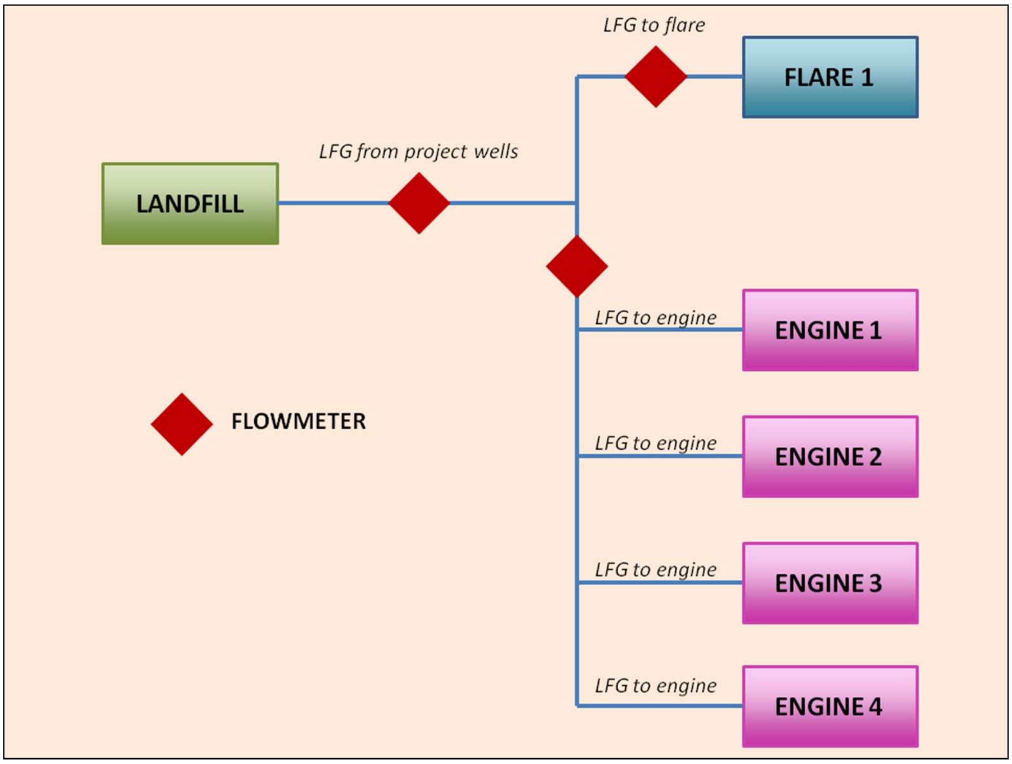

Figure 3: Flow meters' position in the landfill gas plant.

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 that 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 CO_2e 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 (tCO_2e) 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.

1.12. $MD_{project\ y}$

Amount of methane destroyed by the Project during the year y (tCH_4).

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.

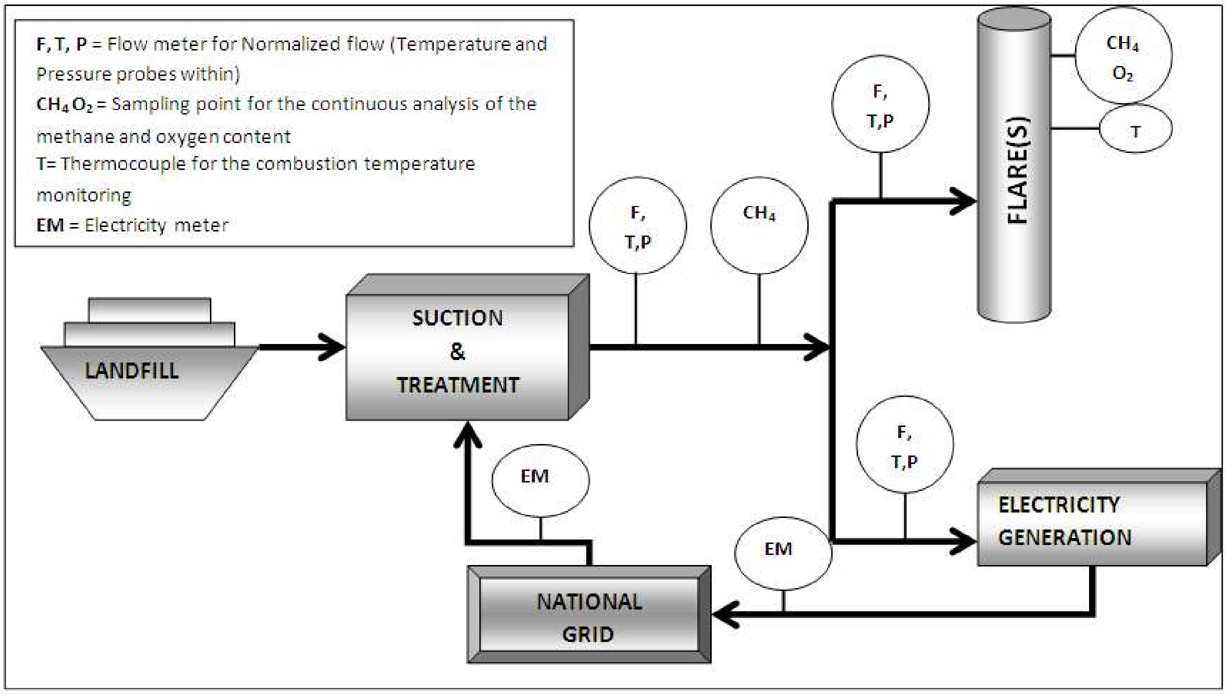

Figure 4: Monitoring points

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.

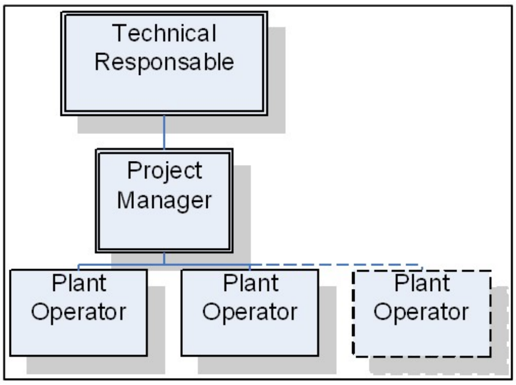

Figure 5: Organization chart

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 *Ofício nº058/2008/CIMGC*).
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	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*
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	*Version 01 of the "Tool to determine project emissions from flaring gases containing methane"*
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 *"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%.
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 *"Consolidated baseline and monitoring methodology for landfill gas project activities"*
Value(s) applied)	• 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 *CDM Project Design Document* (CDM PDD) *"Baseline information"* 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 *CDM Project Design Document* (CDM PDD) *"Baseline information"* 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.

Data/parameter:	D_{CH4}
Unit	tCH_4/m^3CH_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^3CH_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	1,020,225.79*
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	858,689.02*
2012 Sep	2,804,964	2014 Nov	844,417.13*
2012 Oct	2,739,702	2014 Dec	873,560.39*
2012 Nov	2,663,157	2015 Jan	821,058.34*
2012 Dec	2,448,280	2015 Feb	738,222.99*
2013 Jan	1,541,854	2015 Mar	806,701.82*
2013 Feb	2,240,644	2015 Apr	762,243.23*
2013 Mar	2,689,946	2015 May	779,582.01*
2013 Apr	2,574,667	2015 Jun	733,363.72*
2013 May	2,565,444	2015 Jul	756,182.35*
2013 Jun	2,144,888	2015 Aug	726,333.96*
2013 Jul	1,861,739	2015 Sep	692,252.56*
2013 Aug	817,256	2015 Oct	687,622.96*
2013 Sep	119,695	2015 Nov	651,191.22*
2013 Oct	170,671	2015 Dec	712,719.10*
2013 Nov	2,106,022		

* Value inserted for reference purposes only. Equal to the $EL_{electricity,y}$ determined as per the approved temporary deviation.

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.

<table>
<tr><td>Monitoring equipment</td><td>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”.
<table>
<tr><td><u>Flow meter</u>
Brand & Type: Rosemount Annubar 285
Accuracy: +/- 0.25%
Serial number: 78147</td><td><u>Differential pressure sensor</u>
Brand & Type : ABB 264 DS
Accuracy: +/- 0.075%

Brand & Type: Smar LD301D
Accuracy:+/- 0.075%

Details on the serial number in the QA/QC procedures.</td></tr>
<tr><td><u>Relative pressure probe</u>
Brand & Type: ABB 264 HS
Accuracy: +/- 0.075%

Brand & Type: Smar LD301M
Accuracy: +/- 0.075%

Details on the serial number in the QA/QC procedures.</td><td><u>Temperature probe</u>
Brand & Type: Ecil Pt-100
Accuracy: 0.15 ºC + 0.002*T

Details on the serial number in the QA/QC procedures.</td></tr>
</table></td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Monitoring frequency: continuous
Recording frequency: every two minutes
Aggregation frequency: hourly, daily, monthly</td></tr>
<tr><td>Calculation method
(if applicable):</td><td>Not applicable.</td></tr>
</table>

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. (see table A) **Relative pressure probe** External calibration is applied to this equipment annually. (see table B) **Temperature probe** External calibration is applied to this equipment annually. (see table C)
Purpose of data:	Calculation of baseline emissions and baseline net GHG removals by sinks.
Additional comments:	The temporary deviation was applied for the whole month of January 2014 and from October 2014 on.

Table A – Differential pressure sensor

Brand and Serial nº of equipment	Calibration date	Utilization period
ABB 6409016459	13/07/2011	13/07/2011 – 12/07/2012
Smar U319327	20/06/2012	12/07/2012 – 31/05/2013
ABB 6409016459	24/04/2013	31/05/2013 – 22/04/2014
ABB 6409016455	14/04/2014	22/04/2014 – 11/03/2015
ABB 6409016459	22/02/2015	11/03/2015 – 19/04/2016

Table B – Relative pressure probe

Brand and Serial nº of equipment	Calibration date	Utilization period
ABB 6409016561	23/03/2011	23/03/2011 – 19/03/2012
Smar U305351	16/05/2011	19/03/2012 – 15/05/2012
ABB 6409016561	11/05/2012	15/05/2012 – 12/03/2013
Smar U305351	07/08/2012	12/03/2013 – 31/05/2013
ABB 6409016561	24/04/2013	31/05/2013 – 22/04/2014
ABB 6409016558	14/04/2014	22/04/2014 – 11/03/2015
ABB 6409016561	22/02/2015	11/03/2015 – 17/12/2015
Smar U305351	10/12/2015	17/12/2015 – 31/01/2017

Table C – Temperature probe

Brand and Serial nº of equipment	Calibration date	Utilization period
Ecil 1028.138141	31/03/2011	04/06/2011 – 19/03/2012
Ecil 1003.073042	24/02/2012	19/03/2012 – 14/01/2013
Ecil 1119.509260	24/08/2012	14/01/2013 – 28/06/2013
Ecil 1003.073042	05/02/2013	28/06/2013 – 11/02/2014
Ecil 1037.157655	06/02/2014	11/02/2014 – 11/03/2015
Ecil 1003.073042	15/01/2015	11/03/2015 – 17/12/2015
Ecil 1119.509238	11/12/2015	17/12/2015 – 31/01/2017

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

<table>
<tr><td>Value(s) of monitored parameter</td><td>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.
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.
In 15/05/2013 the remaining enclosed flare was temporarily turned off due to lack of landfill gas. Emission reductions were not claimed for flaring landfill gas after that date.
As an illustrative representation of the values of this parameter, in the monitoring period, data were aggregated monthly as shown in the table below:
<table>
<tr><th>Month</th><th>$LFG_{flare,y}$ (Nm^3)</th><th>Month</th><th>$LFG_{flare,y}$ (Nm^3)</th></tr>
<tr><td>2011 Oct</td><td>466</td><td>2012 Ago</td><td>-</td></tr>
<tr><td>2011 Nov</td><td>-</td><td>2012 Sep</td><td>-</td></tr>
<tr><td>2011 Dec</td><td>7,531</td><td>2012 Oct</td><td>-</td></tr>
<tr><td>2012 Jan</td><td>-</td><td>2012 Nov</td><td>-</td></tr>
<tr><td>2012 Feb</td><td>-</td><td>2012 Dec</td><td>-</td></tr>
<tr><td>2012 Mar</td><td>-</td><td>2013 Jan</td><td>-</td></tr>
<tr><td>2012 Apr</td><td>-</td><td>2013 Feb</td><td>-</td></tr>
<tr><td>2012 May</td><td>-</td><td>2013 Mar</td><td>-</td></tr>
<tr><td>2012 Jun</td><td>6,377</td><td>2013 Apr</td><td>-</td></tr>
<tr><td>2012 Jul</td><td>920</td><td>2013 May</td><td>-</td></tr>
</table>
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.</td></tr>
<tr><td>Monitoring equipment</td><td>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”.
<table>
<tr><td><u>Flow meter</u>
Brand & Type: Rosemount Annubar 285
Accuracy: +/- 0.25%
Serial number: 78149</td><td><u>Differential pressure sensor</u>
Brand & Type: ABB 264 DS
Accuracy: +/- 0.075%

Brand & Type: Smar LD301D
Accuracy: +/- 0.075%

Details on the serial number in the QA/QC procedures.</td></tr>
<tr><td><u>Relative pressure probe</u>
Brand & Type: ABB 264 HS
Accuracy: ± 0.075%

Brand & Type: Smar LD301M
Accuracy: +/- 0.075%

Details on the serial number in the QA/QC procedures.</td><td><u>Temperature probe</u>
Brand & Type: Ecil Pt-100
Accuracy: 0.15 ºC + 0.002*T

Details on the serial number in the QA/QC procedures.</td></tr>
</table></td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Monitoring frequency: continuous
Recording frequency: every two minutes
Aggregation frequency: hourly, daily, monthly</td></tr>
<tr><td>Calculation method (if applicable):</td><td>Not applicable.</td></tr>
</table>

<table>
<tr><td>QA/QC procedures:</td><td>
<u>Flow meter</u>
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.

<u>Differential pressure sensor</u>
External calibration is applied to this equipment annually.
<table>
<tr><th>Brand and Serial nº of equipment</th><th>Calibration date</th><th>Utilization period</th></tr>
<tr><td>ABB 6409016458</td><td>13/07/2011</td><td>13/07/2011 – 05/05/2012</td></tr>
<tr><td>ABB 6409016455</td><td>13/07/2011</td><td>05/05/2012 – 12/07/2012</td></tr>
<tr><td>Smar U319328</td><td>20/06/2012</td><td>12/07/2012 – 16/05/2016</td></tr>
</table>
<u>Relative pressure probe</u>
External calibration is applied to this equipment annually.
<table>
<tr><th>Brand and Serial nº of equipment</th><th>Calibration date</th><th>Utilization period</th></tr>
<tr><td>ABB 6409016558</td><td>23/03/2011</td><td>23/03/2011 – 19/03/2012</td></tr>
<tr><td>Smar U305353</td><td>12/05/2011</td><td>18/03/2012 – 05/05/2012</td></tr>
<tr><td>ABB 6410003214</td><td>13/07/2011</td><td>05/05/2012 – 12/07/2012</td></tr>
<tr><td>Smar U318006</td><td>14/05/2012</td><td>12/07/2012 – 13/03/2013</td></tr>
<tr><td>Smar U305353</td><td>07/08/2012</td><td>12/03/2013 – 16/05/2016</td></tr>
</table>
<u>Temperature probe</u>
External calibration is applied to this equipment annually.
<table>
<tr><th>Brand and Serial nº of equipment</th><th>Calibration date</th><th>Utilization period</th></tr>
<tr><td>Ecil 1037.157644</td><td>14/12/2010</td><td>23/12/2010 – 01/12/2011</td></tr>
<tr><td>Ecil 1119.509238</td><td>27/06/2011</td><td>01/12/2011 – 26/06/2012</td></tr>
<tr><td>Ecil 1037.157644</td><td>24/02/2012</td><td>26/06/2012 – 14/01/2013</td></tr>
<tr><td>Ecil 1025.128029</td><td>24/08/2012</td><td>14/01/2013 – 16/05/2016</td></tr>
</table>
</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of baseline emissions or baseline net GHG removals by sinks.</td></tr>
<tr><td>Additional comments:</td><td>-</td></tr>
</table>

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	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 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 combusted in the power plant could not be registered. Nevertheless, the amounts were conservatively estimated based on the electricity exported to the grid. 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	$LFG_{electricity,y}$ (Nm^3)	Month	$LFG_{electricity,y}$ (Nm^3)
2011 Oct	2,890,868.90	2013 Dec	722,554.27
2011 Nov	2,655,039.90	2014 Jan	1,020,225.79*
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	858,689.02*
2012 Sep	2,741,468.97	2014 Nov	844,417.13*
2012 Oct	2,662,141.73	2014 Dec	873,560.39*
2012 Nov	2,601,770.43	2015 Jan	821,058.34*
2012 Dec	2,383,359.57	2015 Feb	738,222.99*
2013 Jan	1,466,306.37	2015 Mar	806,701.82*
2013 Feb	2,174,852.83	2015 Apr	762,243.23*
2013 Mar	2,622,930.80	2015 May	779,582.01*
2013 Apr	2,518,355.87	2015 Jun	733,363.72*
2013 May	2,507,193.13	2015 Jul	756,182.35*
2013 Jun	2,081,186.23	2015 Aug	726,333.96*
2013 Jul	1,794,502.57	2015 Sep	692,252.56*
2013 Ago	769,305.00	2015 Oct	687,622.96*
2013 Sep	112,273.33	2015 Nov	651,191.22*
2013 Oct	165,995.23	2015 Dec	712,719.10*
2013 Nov	2,051,553.40		

* Value determined as per the approved temporary deviation.

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.

<table>
<tr><td>Monitoring equipment</td><td>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”.
<table>
<tr><td><u>Flow meter</u>
Brand & Type: Rosemount 285
Accuracy:+/- 0.25%
Serial number: 78151</td><td><u>Differential pressure sensor</u>
Brand & Type: ABB 264 DS
Accuracy: +/- 0.075%

Brand & Type: Smar LD301D
Accuracy: +/- 0.0075%

Details on the serial number in the QA/QC procedures.</td></tr>
<tr><td><u>Relative pressure probe</u>
Brand & Type: Smar LD301M
Accuracy: ± 0.05%

Brand & Type: ABB 264 HS
Accuracy: +/- 0.075%

Details on the serial number in the QA/QC procedures.</td><td><u>Temperature probe</u>
Brand & Type: Ecil Pt-100
Accuracy: 0.15 ºC + 0.002*T

Details on the serial number in the QA/QC procedures.</td></tr>
</table></td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Monitoring frequency: continuous
Recording frequency: every two minutes
Aggregation frequency: hourly, daily, monthly</td></tr>
<tr><td>Calculation method
(if applicable):</td><td>Not applicable.</td></tr>
</table>

QA/QC procedures:	**<u>Flow meter</u>** 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. **<u>Differential pressure sensor</u>** External calibration is applied to this equipment annually.

Brand and Serial nº of equipment	Calibration date	Utilization period
ABB 6409016454	13/07/2011	13/07/2011 – 12/07/2012
Smar U319329	20/06/2012	12/07/2012 – 31/05/2013
ABB 6409016454	24/04/2013	31/05/2013 – 25/03/2014
Smar U319329	20/06/2012	25/03/2014 – 22/04/2014
ABB 6409016454	14/04/2014	24/04/2014 – 11/03/2015
ABB 6409016458	22/02/2015	11/03/2015 – 19/04/2016

<u>Relative pressure probe</u>
External calibration is applied to this equipment annually.

Brand and Serial nº of equipment	Calibration date	Utilization period
Smar U305352	12/05/2011	04/06/2011 – 05/05/2012
ABB 6409016558	18/04/2012	05/05/2012 – 12/03/2013
Smar U305352	07/08/2012	12/03/2013 – 31/05/2013
ABB 6409016558	24/04/2013	31/05/2013 – 25/03/2014
Smar U305352	07/08/2012	25/03/2014 – 22/04/2014
ABB 6410003214	14/04/2014	22/04/2014 – 11/03/2015
Smar U318006	22/02/2015	11/03/2015 – 17/12/2015
Smar U305352	10/12/2015	17/12/2015 – 31/01/2017

<u>Temperature probe</u>
External calibration is applied to this equipment annually.

Brand and Serial nº of equipment	Calibration date	Utilization period
Ecil 1037.157655	14/12/2010	04/06/2011 – 01/12/2011
Ecil 1119.509260	27/06/2011	01/12/2011 – 26/06/2012
Ecil 1037.157655	24/02/2012	26/06/2012 – 14/01/2013
Ecil 1028.137493	24/08/2012	14/01/2013 – 28/06/2013
Ecil 1028.138141	05/02/2013	28/06/2013 – 11/02/2014
Ecil 1037.157644	06/02/2014	11/02/2014 – 11/03/2015
Ecil 1028.138141	15/01/2015	11/03/2015 – 17/12/2015
Ecil 1028.137493	11/12/2015	17/12/2015 – 31/01/2017

Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks.
Additional comments:	The temporary deviation was applied for the whole month of January 2014 and from October 2014 on.

Data/parameter:	$\mathbf{w_{CH4,y}}$
Unit	m^3CH_4/ m^3LFG
Description	Methane fraction in the landfill gas
Measured/calculated/default	Measured
Source of data	Continuous methane analyser

Value(s) of monitored parameter	Due to an outage in the supervisory software responsible for registering the data measured by the gas analyser, in January 2014 and from October 2014 onwards, a default value for the fraction of methane was considered. 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: (see table below)

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		

* Value determined as per the approved temporary deviation.

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	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”.
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:	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. 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. 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:

Period of use	Type of gas mixture	Cylinder nº	Calibration date (validity)	Certificate nº (name of company)
19/09/2011 ~ 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)
19/09/2011~ 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)

During the monitoring period Ultramat 23 was calibrated in the following dates:

• 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	

The PP missed the deadline to calibrate the fixed gas analyser in September 2015. However, no correction was applied to the registered data as the approved temporary deviation was applied to the period.

Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks.
Additional comments:	The temporary deviation was applied for the whole month of January 2014 and from October 2014 on.

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 a gradual outage in the supervisory software responsible for registering the data measured by the counter meter, from April/2014 onwards the engine's working hours could not be automatically registered. From 01/10/2014 on, no data was automatically registered, due to the complete outage of the supervisory software. Notwithstanding, the engines operated without constraints, and the working hours were manually registered in internal maintenance forms. 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	725	724	0
2014 May	0	659	663	0
2014 Jun	0	716	702	0
2014 Jun	704	730	0	0
2014 Jul	703	720	11	0
2014 Aug	718	735	16	0
2014 Sep	168	661	582	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: continuously measured by the engine's hour counter meters Aggregation frequency: at least yearly

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	Data measured continuously with an electricity meter specifying the total amount of electricity exported in the time interval. In accordance with the local energy concessionaire CEMIG specifications, the electricity meter does not need regular maintenance to ensure its accuracy. The equipment has an accuracy of +/- 0.2%. The initial calibration done by CAM Endesa are the following: Main Electricity Meter **Brand and type:** Schneider ION 8600C **Serial nº of equipment:** PT-0912A354-01 **Calibration frequency:** none **Calibration date [dd/mm/yyyy]:** 27/01/2010 **Calibration certificate nº:** 852/2010 Standby Electricity Meter **Brand and type:** Schneider ION 8600C **Serial nº of equipment:** PT-0912A361-01 **Calibration frequency:** none **Calibration date [dd/mm/yyyy]:** 26/01/2010 **Calibration certificate nº:** 734/2010
Measuring/reading/recording frequency:	Monitoring frequency: continuous Recording and aggregation frequency: monthly
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Electricity meter is subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. .Double check by receipt of sales.
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

<table>
<tr><td>Value(s) of monitored parameter</td><td>Values measured by the electricity meter.

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		

</td></tr>
<tr><td>Monitoring equipment</td><td>Data measured continuously with an electricity meter specifying the total amount of electricity imported in that time interval.
In accordance with the local energy concessionaire CEMIG specifications, the electricity meter does not need regular maintenance to ensure its accuracy. The equipment has an accuracy of +/- 0.2%.
The initial calibration done by CAM Endesa are the following:

Main Electricity Meter
Brand and type: Schneider ION 8600C
Serial nº of equipment: PT-0912A354-01
Calibration frequency: none
Calibration date [dd/mm/yyyy]: 27/01/2010
Calibration certificate nº: 852/2010

Standby Electricity Meter
Brand and type: Schneider ION 8600C
Serial nº of equipment: PT-0912A361-01
Calibration frequency: none
Calibration date [dd/mm/yyyy]: 26/01/2010
Calibration certificate nº: 734/2010</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Monitoring frequency: continuous
Recording and aggregation frequency: monthly</td></tr>
<tr><td>Calculation method (if applicable):</td><td>Not applicable.</td></tr>
<tr><td>QA/QC procedures:</td><td>Electricity meter is subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. .Double check by receipt of sales.</td></tr>
</table>

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

Data/parameter:	**$CEF_{elecy,BL,y}$**
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 2015: 0.4067 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 *“Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.*
Value(s) of monitored parameter	Total $PE_{EC,y}$ in the monitoring period is 9.931 tCO_2e.
Monitoring equipment	Not applicable.
Measuring/reading/recording frequency:	Calculated for monitoring period as it depends on the $CEF_{elecy,BL,y}$ 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:	**TDLj,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:	Not applicable as default value from applicable tool was chosen.
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 2015: 0.4067 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 $w_{CH4,y}$.
Measuring/reading/recording frequency:	See parameter $w_{CH4,y}$.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	See parameter $w_{CH4,y}$.
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks.
Additional comments:	-

<table>
<tr><td>Data/parameter:</td><td>$t_{O2,h}$</td></tr>
<tr><td>Unit</td><td>-</td></tr>
<tr><td>Description</td><td>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)</td></tr>
<tr><td>Measured/calculated/default</td><td>Measured</td></tr>
<tr><td>Source of data</td><td>Continuous gas extractive sampling analyzer with water and particulates removal devices.</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>In 15/05/2013 the remaining enclosed flare was temporarily turned off due to lack of landfill gas. Emission reductions were not claimed for flaring landfill gas after that date.
As an illustrative representation of the values of this parameter, in the monitoring period data were aggregated monthly as shown in the table below:
<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>
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.</td></tr>
<tr><td>Monitoring equipment</td><td>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”.</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Monitoring frequency: continuous
Recording frequency: every two minutes
Aggregation frequency: hourly, daily, monthly</td></tr>
<tr><td>Calculation method (if applicable):</td><td>Not applicable.</td></tr>
</table>

<table>
<tr><td>QA/QC procedures:</td><td>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.
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.
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.
Calibrated gases cylinders’ certificate numbers are listed below:
<table>
<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>
<tr><td>17/12/2010 ~ 13/12//2011</td><td rowspan="2">2587 vpm CH_4</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>13/01/2011 ~ 10/02/2012</td><td rowspan="2">100% N_2</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>
</table>
During the monitoring period the Ultramat 23 was calibrated in the following dates:
<table>
<tr><td>• 19/09/2011
• 17/10/2011
• 16/11/2011
• 13/12/2011
• 12/01/2012
• 10/02/2012
• 09/03/2012
• 06/04/2012</td><td>• 04/05/2012
• 01/06/2012
• 29/06/2012
• 27/07/2012
• 24/08/2012
• 21/09/2012
• 19/10/2012
• 13/11/2012</td><td>• 12/12/2012
• 11/01/2013
• 05/02/2013
• 04/03/2013
• 03/04/2013
• 02/05/2013</td></tr>
</table>
In 15/05/2013 the remaining enclosed flare was temporarily turned off due to lack of landfill gas. For this reason, calibrations stopped in 02/05/2013. Emission reductions were not claimed for flaring landfill gas after that date.</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of baseline emissions or baseline net GHG removals by sinks.</td></tr>
<tr><td>Additional comments:</td><td>-</td></tr>
</table>

Data/parameter:	$fv_{CH4,FG,h}$
Unit	mg/m^3
Description	Concentration of methane in the exhaust gas of the flares in dry basis at normal conditions in the hour *h*
Measured/calculated/default	Measured
Source of data	Continuous gas extractive sampling analyzer with water and particulates removal devices.

<table>
<tr><td>Value(s) of monitored parameter</td><td>In 15/05/2013 the remaining enclosed flare was temporarily turned off due to lack of landfill gas. Emission reductions were not claimed for flaring landfill gas after that date.
As an illustrative representation of the values of this parameter, in the monitoring period, data were aggregated monthly as shown in the table below:
<table>
<tr><th>Month</th><th>$fv_{CH4,FG,h}$ (mg/m³)</th><th>Month</th><th>$fv_{CH4,FG,h}$ (mg/m³)</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>0.0</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>
</table>
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.</td></tr>
<tr><td>Monitoring equipment</td><td>Brand: Siemens
Type: Ultramat 23
Accuracy: ± 1% CH_4 and 0.5% 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”.</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Monitoring frequency: continuous
Recording frequency: every two minutes
Aggregation frequency: hourly</td></tr>
<tr><td>Calculation method (if applicable):</td><td>Ultramat 23 reads ppm values. To convert from ppmv to mg/m³ value is multiplied by 0.716.</td></tr>
</table>

QA/QC procedures:	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. 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. 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. Calibrated gases cylinders’ certificate numbers are listed below:

Period of use	Type of gas mixture	Cylinder nº	Calibration date (validity)	Certificate nº (name of company)
17/12/2010 ~ 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)
13/01/2011 ~ 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)

During the monitoring period the Ultramat 23 was calibrated in the following dates:

• 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	

Purpose of data:	Calculation of baseline emissions of baseline net GHG removals by sinks.
Additional comments:	-

Data/parameter:	T_{flare}
Unit	ºC
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	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	T_{flare} (ºC)	Month	T_{flare} (ºC)
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

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	Brand: Ecil Type: Thermocouple that withstands temperatures up to 1,600°C Accuracy: +/-1.5ºC or 0.25% of the temperature (the one which is greater) Details on the serial number in the QA/QC procedures.
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:	External calibration is applied to this equipment annually.

Brand and serial nº of equipment	Calibration date	Utilization period
Ecil 0950.064353	24/05/2011	04/06/2011 – 12/05/2012
Ecil 0950.064307	03/04/2012	12/05/2012 – 12/03/2013
Ecil 1121.513793	06/02/2013	12/03/2013 – present data

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”.*

<table>
<tr><td>Value(s) of monitored parameter</td><td>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:
<table>
<tr><th>Month</th><th>PE_{flare,y} (tCO2e)</th><th>Month</th><th>PE_{flare,y} (tCO2e)</th></tr>
<tr><td>2011 Oct</td><td>3.4041</td><td>2012 Ago</td><td>0.0000</td></tr>
<tr><td>2011 Nov</td><td>0.0000</td><td>2012 Sep</td><td>0.0000</td></tr>
<tr><td>2011 Dec</td><td>0.0007</td><td>2012 Oct</td><td>0.0000</td></tr>
<tr><td>2012 Jan</td><td>0.0000</td><td>2012 Nov</td><td>0.0000</td></tr>
<tr><td>2012 Feb</td><td>0.0000</td><td>2012 Dec</td><td>0.0000</td></tr>
<tr><td>2012 Mar</td><td>0.0000</td><td>2013 Jan</td><td>0.0000</td></tr>
<tr><td>2012 Apr</td><td>0.0000</td><td>2013 Feb</td><td>0.0000</td></tr>
<tr><td>2012 May</td><td>0.0000</td><td>2013 Mar</td><td>0.0000</td></tr>
<tr><td>2012 Jun</td><td>1.3536</td><td>2013 Apr</td><td>0.0000</td></tr>
<tr><td>2012 Jul</td><td>0.0001</td><td>2013 May</td><td>0.0000</td></tr>
</table>
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.</td></tr>
<tr><td>Monitoring equipment</td><td>Not applicable.</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Calculated for each hour using hourly aggregated data. Aggregated also daily and monthly for reporting purposes.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>Please refer to the Section E.1 of this document.</td></tr>
<tr><td>QA/QC procedures:</td><td>Internal audits are going to be performed in order to ensure correct monitoring of this parameter.</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of baseline emissions or baseline net GHG removals by sinks.</td></tr>
<tr><td>Additional comments:</td><td>-</td></tr>
</table>

Data/parameter:	**$fv_{CH4,RG,h}$**
Unit	m^3CH_4/ m^3LFG
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:

$$BE_y=(MD_{project,y} - MD_{BL,y}) \times GWP_{CH4} + EL_{LFG,y} \times CEF_{elec,BL,y} + ET_{LFG,y} \times CEF_{ther,BL,y} \quad (1)$$

Where:

BE_y	=	Baseline emissions in year y (tCO_2e)
$MD_{project,y}$	=	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_{CH4}	=	Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/tCH_4 and for the second commitment period is 25 tCO_2e/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)
$CEF_{elecy,BL,y}$	=	CO_2 emissions intensity of the baseline source of electricity displaced, in tCO_2e/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_2e/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

$$MD_{BL,\ y} = MD_{project,\ y} \times AF \tag{2}$$

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=ε_{BL} / ε_{PR}).

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

$$\varepsilon_{BL} = \frac{MD_{Hist}}{MG_{Hist}}; \tag{3}$$

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 *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site* (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:

$$MD_{Hist} = \eta_{BL} \times MG_{Hist} \tag{3.1}$$

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:

$$\eta_{BL} = \eta_{PV} \times \eta_{LFGF} \times \frac{N_{fw}}{N_{vwl}} \qquad \textbf{(3.2)}$$

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%[3]

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:

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

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:

[3] 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

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

Where:

$\varepsilon_{PR,y}$	=	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 estimated using the actual amount of waste disposed in the landfill as per the version 04 of the "*Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site*", (tCH4)

$MD_{project,y}$ 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 $MD_{project,y}$.

The $MG_{PR,y}$ is the amount of methane generated during year y of the project activity estimated using the actual amount of waste disposed in the landfill as per the version 04 of the "*Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site*" as per section B.6.1, equation 4 in the registered in the PDD.

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:

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

Where:

AF_y = Adjustment factor for year *y*, this factor was then used in equation **(2)** in place of AF

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)

$$MD_{project,y} = LFG_{total,\,y} \times W_{CH4,\,y} \times D_{CH4}$$

$LFG_{total,y}$	=	Total quantity of landfill gas captured from the Project wells during the year measured in cubic meters (m^3)
$W_{CH4,y}$	=	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)
D_{CH4}	=	Methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_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.

$$MD_{project,\ y} = MD_{flare,\ y} + MD_{electricit\ y,y} + MD_{thermal,\ y} + MD_{PL,\ y} \qquad \textbf{(6.2)}$$

Where:

$MD_{flared,y}$	=	Quantity of methane destroyed by flaring (tCH_4)
$MD_{electricity,y}$	=	Quantity of methane destroyed by generation of electricity (tCH_4).
$MD_{thermal,y}$	=	Quantity of methane destroyed for the generation of thermal energy (tCH_4), for the proposed Project this is equal to 0
$MD_{PL,y}$	=	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

$$MD_{flared,y} = LFG_{flared,\ y} \times W_{CH4,\ y} \times D_{CH4} - \left(\frac{PE_{flare,\ y}}{GWP_{CH4}}\right) \qquad \textbf{(7)}$$

Where:

$LFG_{flare,y}$	=	Quantity of landfill gas fed to the flare(s) during the year measured in cubic meters (m^3)
$W_{CH4,y}$	=	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)
D_{CH4}	=	Methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4)
$PE_{flare,y}$	=	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.

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

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:

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

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:

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

Where:

Variable	SI Unit	Description
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour *h*
$fv_{i,h}$	-	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 (N_2).

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:

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

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:

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

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*

$$V_{n,FG,h} = V_{n,CO2,h} + V_{n,O2,h} + V_{n,N2,h} \quad \textbf{(7.6)}$$

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*

$V_{n,CO2,h}$	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*
$V_{n,N2,h}$	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*
$V_{n,O2,h}$	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*

$$V_{n,O2,h} = n_{O2,h} \bullet MV_n \tag{7.7}$$

Where:

Variable	SI Unit	Description
$V_{n,O2,h}$	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*
$n_{O2,h}$	kmol/kg residual gas	Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h h*
MV_n	m^3/kmol	Volume of one mole of any ideal gas at normal temperature and pressure (22.4 L/mol)

$$V_{n,N2,h} = MV_n \bullet \left\{ \frac{fm_{N,h}}{200 AM_N} + \left(\frac{1 - MF_{O2}}{MF_{O2}} \right) \bullet \left[F_h + n_{O2,h} \right] \right\} \tag{7.8}$$

Where:

Variable	SI Unit	Description
$V_{n,N2,h}$	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_{O2}	-	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*
$n_{O2,h}$	kmol/kg residual gas	Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h*

$$V_{n,CO2,h} = \frac{fm_{C,h}}{AM_C} \bullet MV_n \tag{7.9}$$

Where:

Variable	SI Unit	Description
$V_{n,CO2,h}$	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)

$$n_{O2,h} = \frac{t_{O2,h}}{[1-(t_{O2,h}/MF_{O2})]} \bullet \left[\frac{fm_{C,h}}{AM_C} + \frac{fm_{N,h}}{2AM_N} + \left(\frac{1-MF_{O2}}{MF_{O2}} \right) \bullet F_h \right] \quad \textbf{(7.10)}$$

Where:

Variable	SI Unit	Description
$n_{O2,h}$	kmol/kg residual gas	Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h*
$t_{O2,h}$	-	Volumetric fraction of O2 in the exhaust gas in the hour *h*
MF_{O2}	-	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)

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

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:

$$TM_{FG,h} = \frac{TV_{n,FG,h} \bullet fv_{CH4,FG,h}}{1000000} \quad \textbf{(7.12)}$$

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*
$fv_{CH4,FG,h}$	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 ($fv_{CH4,RG,h}$) and the density of methane ($\rho_{CH4,n,h}$) 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.

$$TM_{RG,h} = FV_{RG,h} \bullet fv_{CH4,RG,h} \bullet \rho_{CH4,n} \quad \textbf{(7.13)}$$

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*
$fv_{CH4,RG,h}$	-	Volumetric fraction of methane in the residual gas on dry basis in hour *h* (NB: this corresponds to $fv_{i,RG,h}$ where *i* refers to methane).
$\rho_{CH4,n}$	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* :
-

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

Where:

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

$TM_{RG,h}$	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 ($TM_{RG,h}$) and the flare efficiency during each hour *h* ($\eta_{flare,h}$), as follows:

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \bullet (1-\eta_{flare,h}) \bullet \frac{GWP_{CH4}}{1000} \qquad \textbf{(7.15)}$$

Where:

$PE_{flare,y}$	=	Project emissions from flaring of the residual gas stream (tCO_2e/y)
$TM_{RG,h}$	=	Mass flow rate of methane in the residual gas in the hour *h* (kg/h)
$\eta_{flare,h}$	=	Flare efficiency in hour *h*
GWP_{CH4}	=	Global Warming Potential of methane valid for the commitment period (tCO_2e/tCH_4)

$$MD_{electricity,y} = LFG_{electricity} \bullet W_{CH4,y} \bullet D_{CH4} \qquad \textbf{(8)}$$

Where:

$MD_{electricity,y}$	=	Quantity of methane destroyed by generation of electricity
$LFG_{electricity,y}$	=	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 8[4] 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 ($EF_{grid,OM\text{-}DD,y}$) 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 $EF_{grid,OM\text{-}DD,y}$.

The emission factor is calculated as follows:

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

Where:

$EF_{grid,OM-DD,h}$	=	Dispatch data analysis operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{PJ,h}$	=	Electricity displaced by the project activity in hour *h* of year *y* (MWh)
$EF_{EL,DD,h}$	=	CO_2 emission factor for grid power units in the top of the dispatch order in hour *h* in year *y* (tCO_2/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

[4] 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/> , acessed on 01/04/2016.

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:

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

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 website[5] for the years 2011, 2012, 2013, 2014 and 2015, as demonstrated in the Table 2 below.

Table 2: Combined emission factor calculation

[5] http://www.mct.gov.br/index.php/content/view/74689.html (accessed in 01/04/2016).

$EF_{CM} = (EF_{OM} \times W_{OM}) + (EF_{BM} \times W_{BM})$					
EMISSION FACTOR (tCO_2/MWh)					
YEAR	EF_{OM}	EF_{BM}	W_{OM}	W_{BM}	EF_{CM}
2011	0.2920	0.1056	0.50	0.50	0.1988
2012	0.5176	0.2010	0.50	0.50	0.3593
2013	0.5932	0.2713	0.50	0.50	0.4322
2014	0.5837	0.2963	0.50	0.50	0.4400
2015	0.5580	0.2553	0.50	0.50	0.4067

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 3: Adjustment Factor.

Month	$MD_{project,y}$ (tCH_4)	ε_{BL} (-)	$MG_{PR,y}$ (tCH_4)	AF (%)
2011 Oct	1,024.451	0.038	1,043.417	0.060
2011 Nov	939.979	0.038	1,009.758	0.062
2011 Dec	995.376	0.038	1,043.417	0.062
2012 Jan	971.032	0.038	865.941	0.043
2012 Feb	911.542	0.038	810.074	0.040
2012 Mar	982.738	0.038	865.941	0.041
2012 Apr	903.428	0.038	838.008	0.039
2012 May	932.378	0.038	865.941	0.047
2012 Jun	852.598	0.038	838.008	0.040
2012 Jul	822.765	0.038	865.941	0.049
2012 Ago	819.268	0.038	865.941	0.052
2012 Sep	796.417	0.038	838.008	0.041
2012 Oct	793.938	0.038	865.941	0.043
2012 Nov	797.243	0.038	838.008	0.048
2012 Dec	769.020	0.038	865.941	0.053
2013 Jan	602.209	0.038	736.542	0.054
2013 Feb	717.687	0.038	665.264	0.045
2013 Mar	772.692	0.038	736.542	0.038
2013 Apr	732.697	0.038	712.783	0.050
2013 May	706.035	0.038	736.542	0.047
2013 Jun	666.289	0.038	712.783	0.043
2013 Jul	661.738	0.038	736.542	0.046
2013 Ago	320.035	0.038	736.542	0.181
2013 Sep	46.216	0.038	712.783	0.873
2013 Oct	48.132	0.038	736.542	0.933

2013 Nov	593.664	0.038	712.783	0.091
2013 Dec	213.459	0.038	736.542	0.670
2014 Jan	365.649	0.038	623.302	0.065
2014 Feb	162.396	0.038	573.780	0.705
2014 Mar	224.129	0.038	635.256	0.616
2014 Apr	40.435	0.038	614.764	0.974
2014 May	356.335	0.038	635.256	0.324
2014 Jun	415.801	0.038	614.764	0.168
2014 Jul	376.075	0.038	635.256	0.161
2014 Ago	352.397	0.038	635.256	0.161
2014 Sep	359.026	0.038	614.764	0.177
2014 Oct	307.754	0.038	623.302	0.077
2014 Nov	302.639	0.038	623.302	0.078
2014 Dec	313.084	0.038	623.302	0.076
2015 Jan	294.267	0.038	545.217	0.070
2015 Feb	264.579	0.038	545.217	0.078
2015 Mar	289.122	0.038	545.217	0.072
2015 Apr	273.188	0.038	545.217	0.076
2015 May	279.402	0.038	545.217	0.074
2015 Jun	262.838	0.038	545.217	0.079
2015 Jul	271.016	0.038	545.217	0.076
2015 Ago	260.318	0.038	545.217	0.080
2015 Sep	248.103	0.038	545.217	0.084
2015 Oct	246.444	0.038	545.217	0.084
2015 Nov	233.387	0.038	545.217	0.089
2015 Dec	255.439	0.038	545.217	0.081

Since,

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

Table 4: 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_2e)
2011 Oct	1,024.451	38.957	21	2,938.92	0.1988	21,279.578
2011 Nov	939.979	38.318	21	2,908.13	0.1988	19,512.976
2011 Dec	995.376	38.797	21	2,996.09	0.1988	20,683.721
2012 Jan	971.032	32.640	21	2,976.26	0.3593	20,775.624
2012 Feb	911.542	30.606	21	2,771.27	0.3593	19,495.398
2012 Mar	982.738	32.685	21	2,918.24	0.3593	20,999.660
2012 Apr	903.428	31.800	21	2,775.26	0.3593	19,301.352

2012 May	932.378	32.596	21	2,697.76	0.3593	19,864.740
2012 Jun	852.598	31.800	21	2,563.90	0.3593	18,157.994
2012 Jul	822.765	32.685	21	2,485.94	0.3593	17,484.905
2012 Ago	819.268	32.552	21	2,428.76	0.3593	17,393.703
2012 Sep	796.417	31.844	21	2,356.18	0.3593	16,902.620
2012 Oct	793.938	32.862	21	2,335.60	0.3593	16,821.798
2012 Nov	797.243	31.667	21	2,326.04	0.3593	16,912.855
2012 Dec	769.020	32.773	21	2,277.60	0.3593	16,279.536
2013 Jan	602.209	27.838	25	1,843.96	0.4322	15,156.317
2013 Feb	717.687	25.242	25	2,139.52	0.4322	18,235.924
2013 Mar	772.692	27.989	25	2,258.36	0.4322	19,593.740
2013 Apr	732.697	26.898	25	2,140.71	0.4322	18,570.299
2013 May	706.035	27.801	25	2,071.54	0.4322	17,851.283
2013 Jun	666.289	27.048	25	1,953.22	0.4322	16,825.283
2013 Jul	661.738	27.913	25	1,913.77	0.4322	16,672.845
2013 Ago	320.035	25.017	25	923.03	0.4322	7,774.427
2013 Sep	46.216	3.800	25	865.39	0.4322	1,434.482
2013 Oct	48.132	1.956	25	1,826.09	0.4322	1,943.726
2013 Nov	593.664	25.769	25	1,801.12	0.4322	14,975.910
2013 Dec	213.459	9.706	25	1,892.94	0.4322	5,912.047
2014 Jan	365.649	23.685	25	1,903.58	0.4400	9,386.622
2014 Feb	162.396	6.749	25	1,663.93	0.4400	4,623.286
2014 Mar	224.129	9.734	25	1,782.43	0.4400	6,144.124
2014 Apr	40.435	2.044	25	1,665.39	0.4400	1,692.518
2014 May	356.335	17.261	25	1,773.84	0.4400	9,257.294
2014 Jun	415.801	20.668	25	1,652.31	0.4400	10,605.306
2014 Jul	376.075	21.674	25	1,561.39	0.4400	9,547.007
2014 Ago	352.397	21.609	25	1,606.04	0.4400	8,976.325
2014 Sep	359.026	20.668	25	1,546.59	0.4400	9,139.415
2014 Oct	307.754	23.685	25	1,602.18	0.4400	7,806.642
2014 Nov	302.639	23.685	25	1,575.55	0.4400	7,667.050
2014 Dec	313.084	23.685	25	1,629.93	0.4400	7,952.098
2015 Jan	294.267	20.718	25	1,531.97	0.4067	7,461.707
2015 Feb	264.579	20.718	25	1,377.41	0.4067	6,656.651
2015 Mar	289.122	20.718	25	1,505.18	0.4067	7,322.180
2015 Apr	273.188	20.718	25	1,422.23	0.4067	6,890.098
2015 May	279.402	20.718	25	1,454.58	0.4067	7,058.609
2015 Jun	262.838	20.718	25	1,368.34	0.4067	6,609.425
2015 Jul	271.016	20.718	25	1,410.92	0.4067	6,831.193
2015 Ago	260.318	20.718	25	1,355.23	0.4067	6,541.104
2015 Sep	248.103	20.718	25	1,291.63	0.4067	6,209.876
2015 Oct	246.444	20.718	25	1,283.00	0.4067	6,164.882
2015 Nov	233.387	20.718	25	1,215.02	0.4067	5,810.811
2015 Dec	255.439	20.718	25	1,329.82	0.4067	6,408.785
Total						**609,575.748**

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:

$PE_y = PE_{EC,y} + PE_{FC,y}$ **(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:

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

Where:

$PE_{EC,y}$	=	Project emissions from electricity consumption in year *y* (tCO_2/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* (tCO_2/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 5 below.

Table 5: 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_2e)**
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	0.073
2012 Jul	961	0.3593	0.2	0.414
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	427	0.4322	0.2	0.221
2013 Feb	387	0.4322	0.2	0.201
2013 Mar	216	0.4322	0.2	0.112
2013 Apr	435	0.4322	0.2	0.225
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	1,973	0.4322	0.2	1.023
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	0.4067	0.2	0.101
2015 Feb	387	0.4067	0.2	0.189
2015 Mar	376	0.4067	0.2	0.184
2015 Apr	315	0.4067	0.2	0.154
2015 May	235	0.4067	0.2	0.115
2015 Jun	396	0.4067	0.2	0.193
2015 Jul	542	0.4067	0.2	0.265
2015 Ago	142	0.4067	0.2	0.069
2015 Sep	509	0.4067	0.2	0.248
2015 Oct	1,519	0.4067	0.2	0.741
2015 Nov	2,201	0.4067	0.2	1.074
2015 Dec	542	0.4067	0.2	0.265

Total	**9.931**

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_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	GHG emission reductions or net GHG removals by sinks (t CO_2e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
Total	609,576	10	0	281,864	327,702	609,566

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_2e)	618,892	609,566

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

>>

Not applicable.

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

Project participant and/or responsible person/ entity	☒ Project participant ☐ Person/entity responsible for completing the CDM-MR-FORM
Organization name	Consórcio Horizonte Asja
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Fax	
E-mail	
Website	www.asja.energy
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Title	Director
Salutation	Ms.
Last name	Uchida
Middle name	
First name	Melina Yurie
Department	
Mobile	
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Personal e-mail	m.uchida@asja.energy

Project participant and/or responsible person/ entity	☒ Project participant ☒ Person/entity responsible for completing the CDM-MR-FORM
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Contact person	Melina Yurie Uchida
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Document information

Version	*Date*	*Description*
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • 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.

Version	*Date*	*Description*
04.0	25 June 2014	Revisions to: • 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 *F-CDM-MR* to *CDM-MR-FORM*; • 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.

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