**Programme design document form
for CDM programmes of activities
(Version 03.0)**

PART I. Programme of activities (PoA)

SECTION A. General description of PoA

A.1. Title of the PoA

Landfill gas capture, flaring and utilization program in Africa

Version 9- 14/05/2014

A.2. Purpose and general description of the PoA

1. General operating and implementing framework of PoA

Puresphere Ghana Limited (Blue Sphere and B Pure) develops, finances and participates in projects that reduce greenhouse gas emissions in accordance with and pursuant to the Kyoto Protocol to the United Nations Framework Convention on Climate Change dated 11 December 1997.

In order to undertake a voluntary, coordinated action for the construction of landfill gas (LFG) collection and use systems (by means of flaring and/or electricity generation), Puresphere Ghana Limited will act as a financial and technical intermediary in the Programme of Activities (PoA), providing assistance for the installations of LFG collection systems, taking the role of the coordinating and managing entity (CME) in charge of validation and verification activities under the CDM.

In this PoA, the landfill gas collected can be flared, used for electricity generation. The CDM activities (CPAs) will be implemented and directly managed by site owners and operators that meet the criteria set by Puresphere Ghana Limited and outlined in this PoA.

2. Policy/measure or stated goal of the PoA

Africa has 54 different countries, 17 territories belonging to non-African countries and 6 terriories non-recognized. Urbanization is on the rise in Africa, and this trend is expected to continue in the future. Of concern is the inability of infrastructure and land use planning methods (including for waste management) to cope with urban growth, (the highest in the world) at 3.5 per cent annually. This is particularly urgent in slum areas, which constitute a big part of many of the cities and towns in Africa. Waste management infrastructure is largely non-existent in rural areas of Africa. Improvements in infrastructure are urgently needed to combat the high cost of health services and thereby alleviate poverty and reduce rural-urban migration.

One of the significant environmental concerns of the growing urban areas has been the management of municipal solid wastes (MSW). So far as disposal of MSW is concerned, the common practice in Africa is to dispose the wastes in landfills (controlled dumpsites). Many of the landfills/Controlled dump sites are located adjacent to wetlands. The wetlands thus get contaminated by the leachate generated from the landfills due to heavy rainfalls. These landfills also generate and emit significant amount of methane to the atmosphere so the goal of the PoA is to avoid methane emissions from Municipal Waste landfills.

3. **Confirmation that the proposed PoA is a voluntary action by the coordinating/managing entity.**

   The implementation of this PoA is part of a voluntary initiative undertaken by Puresphere Ghana Limited to encourage and provide access to finance for low carbon technologies to be implemented in the waste sector in Africa and Ghana. Puresphere Ghana Limited will therefore voluntarily take on the role as a coordinating/managing entity for the mentioned Programme of Activities as described in this design document.

A.3. CMEs and participants of PoA

Puresphere Ghana Limited will be the Coordinating/managing entity of the PoA, entity which communicates with the Board. The CDM Consultant for the PoA and the CPA is Sergi Cuadrat, represented as ClimaLoop. Project participants are listed in below.

A.4. Party(ies)

Name of Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Ghana (host)	Puresphere Ghana Limited	Yes

A.5. Physical/ Geographical boundary of the PoA

The geographical boundary for the PoA is Ghana and it can be seen in Figure 1. All the CDM programme activities (CPAs) included in the PoA will be implemented in Ghana taking into consideration all applicable national and/or sectoral policies and regulations.

Figure 1. Map of Ghana

A.6. Technologies/measures

A typical CPA under this PoA will involve the installation of the landfill gas collection and flaring/use system to an existing or new landfill. The determination of the proportions of the landfill gas to be destined in the different uses will be determined by the availability of gas, and therefore will be described in more detail at the CPA level. A monitoring plan and data recording and archiving system will be implemented, where Puresphere Ghana Limited will keep all records for the elaboration of the monitoring reports.

The PoA "Landfill gas capture, flaring and utilization program in Africa" is defined by one type of CPA for the collection of landfill gas and use of the captured landfill gas for flaring and electricity generation considering that the legal and regulatory framework does not enforce landfill gas to be flared or used for electricity generation.

The one type of CPA consists of a LFG collecting system, pre-treatment system, electricity generation system, and flaring of any additional gas. First, the landfill gas will be collected, and then through transportation pipes, the landfill gas will reach pre-treatment system, in which the moisture and impurity of landfill gas will be removed. After increasing pressure of the landfill gas, it will be fed into an electricity generation system; the electricity generated will be connected to a local grid through transformer substation system, or be used on-site. The system will also have a flare that will be used to combust LFG when the power generation system is down (maintenance) or the quantity of gas collected exceeds the capacity of the power generation system. The technical parameters of the installed systems will be provided in each specific CPA-DD.

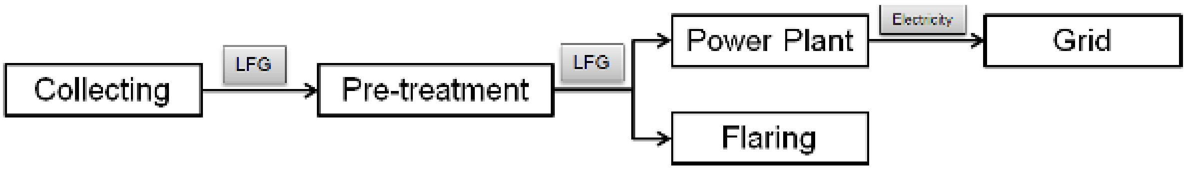

Figure 2. Scenario for Energy generation

The CPA can be summarized as follows:

- ✓ Implementation of a LFG collection system at the landfill site;
- ✓ In a first stage, flare the excess captured LFG to destroy any methane emissions; and
- ✓ In a second stage, to use the captured gas as fuel to generate electricity. The generated electricity can be used for use on-site or sold to the national grid

<u>Basic components of the CPA</u>

The components used in these scenarios are briefly described below.

Landfill gas collection system:

State-of-the-art gas collection technology includes the items listed below. Each CPA will have its LFG collection system described in a more detailed fashion.

- Vertical wells used to extract gas and leachate.
- Horizontal wells used to extract gas.
- Optimal well spacing for maximum gas collection whilst minimizing costs.
- Wellheads designed for gas measurements.
- Condensate extraction and storage systems designed at strategic low points throughout the gas system.

Landfill gas pre-treatment station:

All LFG collected will be pre-treated to remove moisture and other impurities in order to prevent the corrosion of the subsequent systems (flare system and electricity generators).

Landfill gas flaring system:

Despite the final use of the LFG gas, all CPAs must have a flaring system to destroy the LFG collected in case any problem occurs. The LFG flare system includes the items provided below.

- Flare with controlled combustion system.
- Blower system used to cause negative pressure in the pipeline (before blower) and positive pressure (after blower) to direct gas for flare.
- Continuously monitored gas composition (methane, oxygen, carbon dioxide and balance), flow and burn temperature.
- Security restart system, in case the system shuts down.
- Flare efficiency monitoring. (thermocouple)

Electricity Generation Equipment

A modular engine facility will be installed. Small modular engine generator units make it possible to adapt the equipment to the site specific gas volumes. As the gas volumes increase or decrease over time, the modules can be added or relocated to the other sites. The unit will consist of degassing installations and the powerhouse. This unit facility includes blowers, heat exchangers, chillers, and the flares that will destroy the methane not used to generate electricity.

Monitoring system

Each CPA will have state-of-the-art monitoring equipment that will be calibrated as per the applied approved monitoring methodology. Staff involved will be trained to properly operate the monitoring system. Detailed description of the monitoring system is provided in each CPA-DD.

The data of the operational and monitoring parameters will be collected by each site operator and forwarded to Puresphere Ghana Limited. Data will be recorded electronically (kept for two years after the end of the crediting period) and recorded separately. The monitoring data will be printed periodically as a backup procedure.

A.7 Public funding of PoA

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There is no public funding from Annex I Parties of UNFCCC for Puresphere Ghana Limited PoA.

SECTION B. Demonstration of additionality and development of eligibility criteria

B.1. Demonstration of additionality for PoA

As per ACM0001 "Flaring or use of landfill gas"(Version 15.0.0), project participants may either apply the simplified procedures or the procedures using the “Combined tool to identify the baseline scenario and demonstrate additionality” to select the most plausible baseline scenario and demonstrate additionality. The project participant has chosen the “Simplified procedures to identify the baseline scenario and demonstrate additionality” as per section 5.3.1 of the ACM0001 "Flaring or use of landfill gas"(Version 15.0.0) for each CPA under this PoA.

The simplified procedures are valid for three years from the date of entry into force of Version 15.0 of ACM0001 on 8 November 2013; before the end of this period, the CDM Executive Board will reassess the validity of these simplified procedures and extend or update them if needed. Any update of the simplified procedures does not affect the projects that request registration as a CDM project activity or a program of activities by 7 November 2016 and apply the simplified procedures contained in Version 15.0 of ACM0001. As per paragraphs 22 and 23 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas"(Version 15.0.0), the establishment and description of the baseline scenario of each CPA under this PoA is considered as follows:

- The baseline scenario for LFG is assumed to be the atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons. The common practice in Africa[1], and more specifically in Ghana, is to deposit waste in dumps or landfills without the controlled extraction and use of landfill gas. Gas may be vented to atmosphere to reduce its concentration below hazardous levels, but landfill gas capture is not commonly installed. Therefore, in the absence of the project activity, the current practice will be continued, defining the baseline scenario.

- If all or part of the electricity generated by the project activity is exported to the grid, the baseline scenario for all or the part of the electricity exported to the grid is assumed to be electricity generation in existing and/or new grid-connected power plants. If all or part of the electricity is supplied to off-grid application, the baseline electricity generation equipment is assumed to correspond to the default emission factor from Option B2 of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”. Each CPA under this PoA will export to the grid all or part of the electricity generated and therefore, the baseline scenario will be electricity generation in existing and/or new grid-connected power plants.

As per paragraph 21 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas" (Version 15.0.0), the following types of project activities are deemed automatically additional, if prior to the implementation of the project activity the LFG was only vented and/or flared but not utilized for energy generation:

a) The LFG is used to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW;
b) The LFG is used to generate heat for internal or external consumption;
c) The LFG is flared.

Prior to the implementation of each CPA under this PoA, the LFG was only vented and not utilized for energy generation. The project activity consists in the generation of electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW.

[1] http://www.unep.or.jp/ietc/estdir/pub/msw/ro/africa/Topic_e.asp

In a first stage of the project activity, it is planned to flare the LFG in a high efficiency flare and; in a second stage, it is planned to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW as per type (a) above. Since the project activity matches the type (a) in paragraph 21 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas"(Version 15.0.0), each CPA under this PoA is deemed automatically additional.

B.2. Eligibility criteria for inclusion of a CPA in the PoA

As per the section “Project activity under a programme of activities“ of the methodology ACM0001 Version 15.0.0, “Flaring or use of landfill gas”, in addition to the requirements set out in the latest approved version of the “Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities”, the following shall be applied for the use of the methodology ACM0001 Version 15.0.0 in a project activity under a programme of activities (PoAs).

The PoA may consist of one or several types of CPAs. CPAs are regarded to be of the same type if they are similar with regard to the demonstration of additionality, emission reduction calculations and monitoring. The CME shall describe in the CDM-PoA-DD for each type of CPAs separately:

(a) Eligibility criteria for CPA inclusion used for each type of CPAs. In case of combinations of the types of use of the captured landfill gas in one CPA, the eligibility criteria shall be defined for each type of use of the LFG separately

(b) Emission reduction calculations for each type of CPAs;

(c) Monitoring provisions for each type of CPAs.

As per the above requirement, the PoA “Landfill gas capture, flaring and utilization program in Africa” consist of one type of CPA which complies with the following characteristics:

a) Demonstration of additionality: As explained in Section B.1, prior to the implementation of each CPA under this PoA, the LFG was only vented and not utilized for energy generation. The project activity consists in the generation of electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW. In a first stage of the project activity, it is planned to flare the LFG in a high efficiency flare and; in a second stage, it is planned to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW as per type (a) above. Since the project activity matches the type (a) in paragraph 21 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas"(Version 15.0.0), each CPA under this PoA is deemed automatically additional.
b) Emission reduction calculations: are conducted as per ACM0001 Version 15.0.0, “Flaring or use of landfill gas” for the use of the captured landfill gas for flaring and electricity generation considering that the legal and regulatory framework does not enforce landfill gas to be flared or used for electricity generation, and
c) Monitoring: is conducted as per ACM0001 Version 15.0.0, “Flaring or use of landfill gas” for the use of the captured landfill gas for flaring and electricity generation considering that the legal and regulatory framework does not enforce landfill gas to be flared or used for electricity generation.

Other than the one type of CPA defined above, no other type of CPA or combination is planned or considered in the PoA “Landfill gas capture, flaring and utilization program in Africa”.

The following paragraphs describe how the eligibility criteria for CPA inclusion, emission reduction calculations and monitoring will be conducted:

(a) **Eligibility criteria for CPA inclusion used for each type of CPAs;** As per the Standard “Demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programmes of activities” Version 3.0 (EB74, Annex 5), the eligibility criteria shall cover as a minimum the following:

(a) The geographical boundary of the CPA including any time-induced boundary [2] consistent with the geographical boundary set in the PoA;
(b) Conditions that avoid double counting of emission reductions like unique identifications of product and end-user locations (e.g. programme logo);
(c) The specifications of technology/measure [3] including the level [4] and type of service, performance specifications including compliance with testing/certifications;
(d) Conditions to check the start date of the CPA through documentary evidence;
(e) Conditions that ensure compliance with applicability and other requirements of single or multiple methodologies applied by CPAs;
(f) The conditions that ensure that CPAs meet the requirements pertaining to the demonstration of additionality as specified in Section A above;
(g) The PoA-specific requirements stipulated by the CME including any conditions related to undertaking local stakeholder consultations and environmental impact analysis[5];
(h) Conditions to provide an affirmation that funding from Annex I parties, if any, does not result in a diversion of official development assistance;
(i) Where applicable, target group (e.g. domestic/commercial/industrial, rural/urban grid connected/off-grid) and distribution mechanisms (e.g. direct installation)[6];
(j) Where applicable, the conditions related to sampling requirements for the PoA in accordance with the "Standard for sampling and surveys for CDM project activities and programme of activities";
(k) Where applicable, the conditions that ensure that every CPA (in aggregate if it comprises of independent sub units) meets the small-scale or microscale threshold[7] and remains within those thresholds throughout the crediting period of the CPA;;
(l) Where applicable, the requirements for the debundling check, in case the CPAs belongs to small-scale or microscale project categories[8].

(b) **Emission reduction calculations for each type of CPAs;** The calculation of the emission reduction calculations of the only type of CPA will be:
(a) following methodology ACM0001 Version 15.0.0, "Flaring or use of landfill gas"
(b) for the use of the captured landfill gas for flaring and electricity generation,
(c) considering that the legal and regulatory framework does not enforce landfill gas to be flared or used for electricity generation.

(c) **Monitoring provisions for each type of CPAs:** The monitoring of the only type of CPA will be:
(a) following methodology ACM0001 Version 15.0.0, "Flaring or use of landfill gas"
(b) for the use of the captured landfill gas for flaring and electricity generation,
(c) considering that the legal and regulatory framework does not enforce landfill gas to be flared or used for electricity generation.

The CME shall describe transparently and justify in the CDM-PoA-DD which CPAs are regarded to

2 For example, an emission factor for electricity generation is dependent on the boundaries of regional or state or sub-regional grids.
3 Specifications of the technology/measure shall include the type, capacity and other key features of the design of the systems. For example, indicating the kW capacity, size or dimensions, fixed/portable operation, and other key design features that makes the project cook stoves efficient, would be appropriate; however, only indicating that all cook stoves will have an efficiency X% would not be sufficient.
4 The level of service shall be defined in comparison with the baseline system being replaced.
5 See also relevant paragraphs of "Clean Development Mechanism Project Cycle Procedure".
6 This is to re-test the validity of assumptions made at the PoA level. For example, in a lighting efficiency application, lighting usage hours of 3.5 hours per day would be valid if the target group is residences/households. Usage hours would be different in commercial applications and vice versa.
7 Please refer to the latest approved version of the "Guidelines for demonstrating additionality of microscale project activities" and the latest approved version of the "General Guidelines to SSC CDM methodologies".
8 Please refer to the latest approved version of the "Guidelines on assessment of debundling for SSC project activities".

be of the same type. CPAs shall not be regarded to be of the same type if one of the following conditions is different:

(a) The baseline scenario with regard to any of the following aspects:
- (i) Partial release of the LFG from the SWDS;
- (ii) Total release of the LFG from the SWDS;
- (iii) In case of electricity generation in the project activity:
  - The grid;
  - Captive fossil fuel fired power plants;

(b) In case of heat generation, fossil fuel fired on-site equipment;

(c) The project activity with regard to any of the following aspects of the use of the captured landfill gas:
- (i) Flaring;
- (ii) Flaring; and
  - Electricity generation;
  - Heat generation;
    - o Boiler;
    - o Air heater;
    - o Kiln;
    - o Glass melting furnace;
  - Supplying the LFG to consumers through a natural gas distribution network or using trucks;
- (iii) Combinations of types of use of the landfill gas;

(d) The legal and regulatory framework.

Following the requirement that “CME shall describe transparently and justify in the CDM-PoA-DD which CPAs are regarded to be of the same type”, the only type of CPA is described in the following table:

<table>
<tr><th colspan="4">Conditions for the type of CPA</th><th>One Type only</th></tr>
<tr><td rowspan="4">(a) The baseline scenario with regard to any of the following aspects:</td><td colspan="3">(i) Partial release of the LFG from the SWDS;</td><td>Not applicable</td></tr>
<tr><td colspan="3">(ii) Total release of the LFG from the SWDS;</td><td>Applicable</td></tr>
<tr><td rowspan="2">(iii) In case of electricity generation in the project activity:</td><td colspan="2">The grid;</td><td>Applicable</td></tr>
<tr><td colspan="2">Captive fossil fuel fired power plants;</td><td>Not applicable</td></tr>
<tr><td colspan="4">(b) In case of heat generation, fossil fuel fired on-site equipment;</td><td>Not applicable</td></tr>
<tr><td rowspan="8">(c) The project activity with regard to any of the following aspects of the use of the captured landfill gas:</td><td colspan="3">(i) Flaring;</td><td>Not applicable</td></tr>
<tr><td rowspan="6">(ii) Flaring; and</td><td colspan="2">Electricity generation;</td><td>Applicable</td></tr>
<tr><td rowspan="4">Heat generation;</td><td>o Boiler;</td><td>Not applicable</td></tr>
<tr><td>o Air heater;</td><td>Not applicable</td></tr>
<tr><td>o Kiln;</td><td>Not applicable</td></tr>
<tr><td>o Glass melting furnace;</td><td>Not applicable</td></tr>
<tr><td colspan="2">Supplying the LFG to consumers through a natural gas distribution network or using trucks;</td><td>Not applicable</td></tr>
<tr><td colspan="3">(iii) Combinations of types of use of the landfill gas;</td><td>Not applicable</td></tr>
<tr><td>(d) The legal and regulatory framework.</td><td colspan="3">Do not require LFG to be flared nor used</td><td>Applicable</td></tr>
</table>

As tabulated above, the PoA “Landfill gas capture, flaring and utilization program in Africa”

consist of one type of CPA as explained and justified below:

- prior to the implementation of each CPA under this PoA, the LFG was only vented and not utilized for energy generation. The project activity consists in the generation of electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW. In a first stage of the project activity, it is planned to flare the LFG in a high efficiency flare and; in a second stage, it is planned to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW as per type (a) above. Since the project activity matches the type (a) in paragraph 21 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas"(Version 15.0.0), each CPA under this PoA is deemed automatically additional.
- the emission reduction calculations are conducted as per ACM0001 Version 15.0.0, “Flaring or use of landfill gas” for the use of the captured landfill gas for flaring and electricity generation considering that the legal and regulatory framework does not enforce landfill gas to be flared or used for electricity generation, and
- the monitoring is conducted as per ACM0001 Version 15.0.0, “Flaring or use of landfill gas” for the use of the captured landfill gas for flaring and electricity generation considering that the legal and regulatory framework does not enforce landfill gas to be flared or used for electricity generation.

Other than the one type of CPA defined above, no other type of CPA or combination is planned or considered in the PoA “Landfill gas capture, flaring and utilization program in Africa”.

When defining eligibility criteria for CPA inclusion for a distinct type of CPAs, the CME shall consider relevant technical and economic parameters, such as:

(a) Ranges of certain design specifications (ranges of sizes of landfill and amounts of waste disposed);

(b) Ranges of efficiency of the landfill gas capture system;

(c) Type of solid waste disposal site:

(i) New solid waste disposal site;

(ii) Existing solid waste disposal site;

(d) Ranges of costs (capital investment, operating and maintenance costs, etc.);

(e) Ranges of revenues (income from electricity, heat or LFG sale, subsidies/fiscal incentives, ODA).

The eligibility criteria related to the costs and revenues parameters shall be updated every 2 years in order to correctly reflect the technical and market circumstances of a CPA implementation. In case the PoA contains several types of CPAs, the actual CPA-DD submitted for the purpose of registration of the PoA shall contain all information required as per the latest approved version of the “Guidelines for completing the component project activity design document form” for each type of actual CPA, to be validated by a DOE and submitted for the registration to the Board.

Since the project type in the PoA “Landfill gas capture, flaring and utilization program in Africa” applies to one type of CPA, the above requirements for eligibility criteria in paragraph 76 of ACM0001 Version 15.0.0 “Flaring or use of landfill gas”, have not found to be applicable.

As per paragraph 21 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas" (Version 15.0.0), the one type of CPA is deemed automatically additional under the PoA, if prior to the implementation of the project activity the LFG was only vented and/or flared but not utilized for energy generation.

B.3. Application of methodologies

The baseline and monitoring methodology to be applied for the proposed project activity is the approved consolidated baseline methodology ACM0001, version 15.0.0[9] ***"Flaring or use of landfill gas"*** from the EB65 using the latest versions of:

- ***"Emissions from solid waste disposal sites" version 06.0.1.***
- ***"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" version 01.***
- **"*Project emissions from flaring" version 02.0.0,***
- ***"Tool to calculate the emission factor for an electricity system", version 4.0***,
- ***"Tool to calculate project or leakage CO2 emissions from fossil fuel combustion". version 02***
- ***"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" Version 02.0.0,***
- ***"Tool to determine the baseline efficiency of thermal or electric energy generation systems", version 1.***

The methodology ACM0001 Version 15.0.0, ***"Flaring or use of landfill gas",*** is applicable to project activities which:

(a) Install a new LFG capture system in a new or existing SWDS where no LFG capture system was installed prior to the implementation of the project activity; or

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

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

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

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

(i) Generating electricity;

(ii) Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace;[10] and/or

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

(iv) Supplying compressed/liquefied LFG to consumers using trucks;[11]

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

Moreover, the methodology ACM0001 Version 15.0.0, ***"Flaring or use of landfill gas"*** is only applicable if the application of the procedure to identify the baseline scenario confirms that the

[9] http://cdm.unfccc.int/methodologies/DB/D44X8FH8SFCXREE6037AXJSBGGFVDO

[10] For claiming emission reductions for other heat generation equipment (including other products in kilns), project participants may submit a revision to this methodology.

[11] In case other means of transportation are used a revision to this methodology may be requested.

most plausible baseline scenario is:

(a) Atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons; and

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

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

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

SECTION C. Management system

Puresphere Ghana Limited, the coordinating/managing entity of this PoA, has established the operational and management plan which includes the following:

a) **Letter of Intent**: If a landfill site operator is interested in joining this PoA, it shall submit a letter of intent (LoI) to participate in Puresphere Ghana Limited's PoA. The LoI will indicate their voluntary participation within the PoA, their authorization to give the financial information relevant for the projects evaluation, and confirmation that they are not part of any other registered CDM project or PoA. Then the CPA proponent will be briefed by Puresphere Ghana Limited about the criteria for inclusion under the PoA.

b) **Procedure to avoid double counting:** After receiving the LoI, Puresphere Ghana Limited will proceed to confirm that the project is not part of another Program, or contained as another registered CDM project, by double checking the projects geographical coordinates with the The Ghanaians DNA and with published information from the UNFCCC website. At this point, a unique number will be assigned to the CPA, which will serve for reference within Puresphere Ghana Limited's database which will contain the projects location (GPS coordinates) and private operator's name, among other details.

c) **Eligibility assessment**: Puresphere Ghana Limited will collect the necessary information to conduct an analysis of the project design as per the eligibility criteria established in Section A.4.2.2 of the POA-DD.

d) **Memorandum of agreement**: if the CPA proponent qualifies, a Memorandum of Agreement (MOA) shall be negotiated and signed. The MOA will outline responsibilities for the development of the project to meet basic technical and financial criteria, as well as the criteria and documentation requirements under the CPA. This will include the role Puresphere Ghana Limited and the CPA operator in the PoA.

e) **Data gathering and documentation:** After the MOA is signed, the detailed project information necessary to elaborate the CPA-DD will be collected. This includes the project additional technical and financial information on the CPA, feasibility study, evidences etc. Puresphere Ghana Limited will make itself available to the landfill site operator to provide this service.

f) **CPA-DD preparation**: After the necessary information and documentation requirements have been incorporated in the CPA-DD and Puresphere Ghana Limited has approved the final version of the document, Puresphere Ghana Limited will submit the information to the DOE for inclusion as per the rules and procedures of inclusions

of CPAs under registered PoAs.

g) **Inclusion of CPA in the PoA:** After the DOE confirms that the CPA is eligible for inclusion under the PoA, Puresphere Ghana Limited will finalize the arrangements for carbon finance and the monitoring arrangements for the specific CPA-DD. During project activity operation, the monitoring plan (as outlined in Sections A.4.4.2 and E.7.2 of this PoA) will be strictly followed by Puresphere Ghana Limited and the CPA project implementer. Training of the CPA project implementer staff will also be provided at this time to ensure that data monitoring and recording, reporting, internal quality control, operation, calibration, and maintenance are followed by the CPA Project Implementer.

Puresphere Ghana Limited will maintain the monitoring reports for each of the CPA included in the PoA, including a list of all projects that are under review for inclusion in the PoA and approved for inclusion in the PoA and the status of verification. A database will be developed to contain the major project features important for identifying the CPA and quantifying the emission reductions. This documentation will ensure no double counting occurs in the claiming of emission reductions since each CPA will list the location (GPS coordinates), ownership and a copy of the letter of confirmation from the CPA proponent that the CPA is not a component of another CDM programme or project activity. Monitored data will be kept by project implementers. Recorded data will be kept for two years after the end of the crediting period.

All relevant parameters included in the monitoring plan shall be recorded and monitored for each CPA under this PoA, being the responsibility of each CPA proponent with guidance set by Puresphere Ghana Limited. With this data recorded, Puresphere Ghana Limited will prepare a separate monitoring report for each CPA with verification and CER issuance purposes. Puresphere Ghana Limited will maintain a database for all CPAs and data will be kept for at least 2 years after the end of the crediting period.

Under this PoA, 100% of the CPAs will be monitored and verified, where the project implementers will be responsible for collecting and recording all the information and Monitoring Reports will be sent to Puresphere Ghana Limited. The monitoring reports will be made available to the DOE for verification, as Puresphere Ghana Limited will be the main interlocutor with the DOE, taking responsibility of quality assurance of monitored data and making Monitoring Reports available to the DOE.

Data Collection: The CPA proponents are required to submit a monthly Monitoring Report to Puresphere Ghana Limited through their local lending centers. The data will be checked for completeness and quality and placed in a central database located at the Puresphere Ghana Limited Head Quarters. Hardcopies of the monthly reports will also be kept on file.

Field visits: Puresphere Ghana Limited will undertake bi-annual field visits, or as necessary depending on CPA evaluated needs. This will serve as an additional quality check of the monthly monitoring report, to view the operation of the installed monitoring devices to ensure they are working properly and a means of following up on any questions on the data and any monitoring issues.

Calculation of emission reductions: Puresphere Ghana Limited will use the aggregated data to calculate the emission reductions achieved based on the formulas for ex-post emission reduction calculations outlined in ACM0001 version 15.0.0. This database will be updated monthly based on the reports received.

Database for CPAs to prevent double counting and status of verification: In order to have control over the individual calculations for emission reductions in each CPA, the database will always refer to the uniquely assigned reference number for each project, associated with its geographical location and private operator's name. For each project, the database will also contain information on the status of verification and issuance of CERs, as well as project

information, to provide transparent and verifiable means of preventing double counting.

Training: Puresphere Ghana Limited will provide technical support/training to assist the landfill site operators establishing their system of monitoring and reporting with the proper quality controls, troubleshooting on monitoring issues, and in undertaking calibration by identifying service providers.

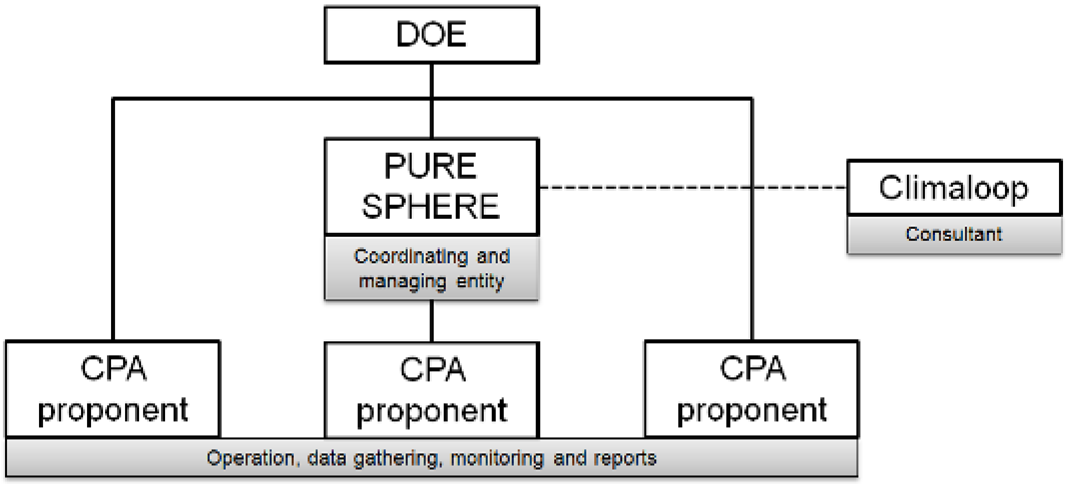

Figure 3. Schematic representation of the monitoring plan

Each CPA will be in charge of their record keeping system for monitored raw data, while Puresphere Ghana Limited will keep records of the monitoring reports for each CPA; for quality assurance monitoring reports will be crossed checked with raw data upon site visits conducted by Puresphere Ghana Limited. Puresphere Ghana Limited will hire ClimaLoop (www.climaloop.com) as the CDM consultant to develop all the above tasks.

SECTION D. Duration of PoA

D.1. Start date of PoA

The starting date of the PoA is 28/04/2012, on which the PoA has been submitted in the Global Stakeholders Consultation.

D.2. Duration of the PoA

28 years

SECTION E. Environmental impacts

E.1. Level at which environmental analysis is undertaken

1. Environmental Analysis is done at PoA level ☐
2. Environmental Analysis is done at CPA level ✔

The host country as well as state laws and regulations require that an environmental analysis should be performed for any kind of landfill. So the analysis will be done at the CPA level as most of the impacts are confined to each CPA landfill site.

E.2. Analysis of the environmental impacts

Overall, by collecting and combusting landfill gas, the Puresphere Ghana Limited PoA will reduce both global and local environmental effects of uncontrolled GHG releases. The major components of landfill gas, methane and carbon dioxide, are colorless and odorless. Although the majority of landfill gas emissions are quickly diluted in the atmosphere, in confined spaces there is a risk of asphyxiation and/or toxic effects if landfill gas is present in high concentrations. Landfill gas also contains over 150 trace components that can cause other negative local and global environment effects such as odor nuisances, stratospheric ozone layer depletion, and ground level ozone creation. The Puresphere Ghana Limited PoA will contribute to reduce the LFG risks of toxic effects on the local community and local environment. This PoA is not expected any negative transboundary impacts in the host country.

E.3. Environmental impact assessment

The most part of the host countries regulations require that an environmental analysis must be made for each landfill (CPA) to operate in the country. This documentation is going to be provided in each individual CPA-DD.

SECTION F. Local stakeholder comments

F.1. Solicitation of comments from local stakeholders

1. Local stakeholder consultation is done at PoA level ☐
2. Local stakeholder consultation is done at CPA level ✔

Due to the wide range of CPAs geographical positions, local consultation will be done at CPA level to ensure full participation and consultation of local stakeholders of the landfill sites participating in the PoA. A local stakeholder consultation will be conducted for every CPA.

F.2. Summary of comments received

To be done at CPA level. All comments received will be included in the specific CPA-DD.

F.3. Report on consideration of comments received

To be done at CPA level. All clarifications requested by local attending stakeholders will be addressed during the meetings and recorded on each specific CPA-DD.

SECTION G. Approval and authorization

The letter of approval from Ministry of Environment, Science and Technology of Ghana was received on 20/12/2012.

PART II. Generic component project activity (CPA)

SECTION A. General description of a generic CPA

A.1. Purpose and general description of generic CPAs

The present CPA is to be implemented as part of the CDM PoA: "Landfill gas capture, flaring and utilization program in Africa". It aims at avoiding methane emissions from municipal waste treated in [*name of the landfill*].

[*add further information on the landfill: location, operations, area etc.*]

SECTION B. Application of a baseline and monitoring methodology

B.1. Reference of the approved baseline and monitoring methodology(ies) selected

The baseline and monitoring methodology to be applied for the CPAs of this PoA is the approved consolidated baseline methodology ACM0001, version 15.0.0[12] ***"Flaring or use of landfill gas"*** from the EB65 using the latest versions of:

- ***"Emissions from solid waste disposal sites" version 06.0.1.***
- ***"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" version 01.***
- **"*Project emissions from flaring" version 02.0.0,***
- ***"Tool to calculate the emission factor for an electricity system", version 4.0***,
- ***"Tool to calculate project or leakage CO2 emissions from fossil fuel combustion". version 02***
- ***"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" Version 02.0.0,***
- ***"Tool to determine the baseline efficiency of thermal or electric energy generation systems", version 1.***

B.2. Application of methodology(ies)

ACM0001 – "Flaring or use of landfill gas – Version 15.0.0" is applicable to landfill gas capture project activities, where the baseline scenarios are the partial or total atmospheric release of the gas and the project activities include situations such as:

a) The captured gas is flared; and/or
b) The captured gas is used to produce energy (e.g. electricity)

The ACM0001 V.15.0.0 methodology is applicable to the Puresphere Ghana Limited PoA because the baseline scenario in each CPA is the partial or total atmospheric release of the gas and the project activity comprises the scenarios outlined above. Methodology ACM0001 (version 15.0.0) is, therefore, applicable to the CPAs. The application of the methodology ACM0001 Version *15.0.0*, ***"Flaring or use of landfill gas",*** is for project activities which:

(a) Install a new LFG capture system in a new or existing SWDS where no LFG capture system was installed prior to the implementation of the project activity; or

[12] http://cdm.unfccc.int/methodologies/DB/EYUD9R1ZAUZ2XNZXD3HQH18OK3VWIV

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

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

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

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

(v) Generating electricity;

(vi) Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace;[13] and/or

(vii) Supplying the LFG to consumers through a natural gas distribution network;

(viii) Supplying compressed/liquefied LFG to consumers using trucks;[14]

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

The following paragraphs describe how each of the applicability conditions of the methodology ACM0001 Version 15.0.0, “Flaring or use of landfill gas” are met by the project activity:

(a) Prior to the implementation of the project activity, the LFG in the CPAs of this PoA was vented to the atmosphere because the landfill site does not have any LFG capture system installed in place. Since the project activity implies the installation of a new LFG capture system in the existing SWDS, corresponding to the applicability criteria (a) set above, the application of the methodology is met by the project activity in the CPAs of this PoA.

(b) Since there will not be an existing LFG capture system in place, the CPAs of this PoA will not make an investment into an existing LFG capture system so applicability criteria (b) is not fully applicable for the proposed project activity. However,

(i) The LFG was only vented and not used prior to the implementation of the CPAs. Since the CPAs will capture the LFG to be flared or used, the applicability criteria (b) (i) is applicable to the project activity in CPAs of this PoA.

(ii) There will not be an existing active LFG capture system so the applicability criteria (b) (ii) is not applicable to the project activity in CPAs of this PoA.

(c) The CPAs of this PoA will flare the LFG and will use the captured LFG as follows:

(iii) The CPAs in the PoA will generate electricity so the applicability criteria (c) (i) is applicable to the CPAs of this PoA.

(iv) The CPAs in this PoA will not use the captured LFG to generate heat in a boiler, air heater nor kiln (brick firing only) or glass melting furnace so the applicability criteria (c) (ii) is not applicable to the CPAs of this PoA.

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[13] For claiming emission reductions for other heat generation equipment (including other products in kilns), project participants may submit a revision to this methodology.

[14] In case other means of transportation are used a revision to this methodology may be requested.

(v) The CPAs in this PoA will not supply the LFG to consumers through a natural gas distribution network so the applicability criteria (c) (iii) is not applicable to the CPAs of this PoA.

(vi) The CPAs in this PoA will not supply compressed/liquefied LFG to consumers using trucks so the applicability criteria (c) (iv) is not applicable to the CPAs of this PoA.

(d) The CPAs under this PoA will not reduce the amount of organic waste that would be recycled in the absence of the project activity so the CPAs will meet the applicability criteria (d). This condition will be evidenced with the local and national waste management practices prior to the implementation of the CPA including the corresponding contracts in place, where there would be no obligation neither requirement to recycle the waste prior to the implementation of the project.

Moreover, the methodology ACM0001 Version *15.0.0,* ***"Flaring or use of landfill gas"*** is only applicable if the application of the procedure to identify the baseline scenario confirms that the most plausible baseline scenario is

(c) Atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons; and

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

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

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

The sensitivity analysis of the investment analyisis will confirmm that the most economically or financially attractive alternatives are the ones highlighted above and as such will be considered as the most plausible baseline scenario for each CPA included under this PoA.

The methodology ACM0001 Version 15.0.0, "Flaring or use of landfill gas" is not applicable to the project activity under the following two conditions:

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

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

The above conditions will not be applicable to the CPAs of this PoA as clarified below:

(a) The CPAs of this PoA will not apply in combination with other approved methodologies, and the purpose of the CPAs is not to implement energy efficiency measures at a kiln or glass melting furnace;. Since condition (a) will not be applicable to the CPAs, ACM0001 Version 15.0.0, "Flaring or use of landfill gas" is applicable for the CPAs in this PoA.

(b) The CPAs in this PoA will not change the management of the SWDS in order to increase methane generation compared to the situation prior to the implementation of the project activities. Since condition (b) is not applicable to the CPAs, ACM0001

Version 15.0.0, “Flaring or use of landfill gas” is applicable for the CPAs in this PoA.

The following paragraphs describe how each of the applicability conditions of the tools required by methodology ACM0001 Version 15.0.0, “Flaring or use of landfill gas” are met by the project activity:

- The “Emissions from solid waste disposal sites” version 06.0.1. is applicable for waste disposal sites where the waste would be dumped and can be clearly identified. For the cases of the CPAs of this PoA, the waste disposal sites where the waste is deposited will beclearly identified thus the tool will be applicable to the CPAs.The second applicability condition states that the tool is not applicable to hazardous wastes, and at the CPAs there will not be hazardous wastes, thus the CPAs will also meet the tool’s applicability conditions.
- The “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” Version 01. is applicable for the purpose of calculating project emissions in case where a project activity consumes electricity from the grid (Scenario A of Section I of the Tool). For the CPAs of the PoA, the tool will be applied to situations where electricity is consumed in the project, thus this tool is applicable to the CPAs that may use electricity from the gird to power equipment such as blowers or pumps.
- The “Project emissions from flaring” version 02.0.0 is used to determine PEflare,y as required by the ACM0001 Version 15.0.0.
- The “Tool to calculate the emission factor for an electricity system”, version 4.0, is applicable for the purpose of calculating project and leakage emissions in case where a project activity consumes electricity from the grid or results in increase of consumption of electricity from the grid outside the project boundary. For the CPAs of this PoA, since electricity will be sourced from the grid, then the tool will be applicable.
- The “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion”. version 02 is applicable for the purpose of calculating the project CO_2 emissions from the combustion of fossil fuels in cases where CO_2 emissions from fossil fuel combustion are calculated based on the quantity of fuel combusted and its properties. For the CPAs in this PoA, since may use fossil fuel for the operation of the project activities, the tool is applicable.
- The “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” Version 02.0.0, is applicable for the purpose to determine to determine the mass flow of greenhouse gases such CO2, CH4, N2O, SF6 or PFC. The mass flow of a particular greenhouse gas is calculated based on measurements of: (a) the total volume flow or mass flow of the gas stream, (b) the volumetric fraction of the gas in the gas stream and (c) the gas composition and water content. Typical applications of this tool are methodologies where the flow and composition of residual or flared gases or exhaust gases are measured for the determination of baseline or project emissions, which is the case of the present project activity, then the tool is applicable..
- The "Tool to determine the baseline efficiency of thermal or electric energy generation systems”, version 1 is applicable for the purpose to determine the baseline efficiency of the energy generation system. For the CPAs of this PoA is only electricity generation (no heat), then the tool is applicable.

B.3. Sources and GHGs

	Source	Gas	Included	Justification/Explanation
Baseline	Emissions from decomposition of waste at the SWDS site	CH_4	Yes	The major source of emissions in the baseline
		N_2O	No	N_2O emissions are small compared to CH_4 emissions from landfills. Exclusion of this gas is conservative.
		CO_2	No	CO_2 emissions from the decomposition of organic waste are not accounted
	Emissions from electricity generation	CO_2	Yes	Electricity may be consumed from the grid or generated onsite/offsite in the baseline scenario
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
	Emissions from heat generation	CO_2	No	Since heat generation is not included in the project activity, these are excluded.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
	Emissions from the use of natural gas	CO_2	No	Excluded for simplification. This is conservative.
		CH_4	No	Since supply of LFG through a natural gas distribution network or using trucks is not included in the project activity, these are excluded.
		N_2O	No	Excluded for simplification. This is conservative.
Project	Emissions from fossil fuel consumption for purposes other than electricity generation or transportation due to the project activity	CO_2	Yes	May be an important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from electricity consumption due to the project activity	CO_2	Yes	May be an important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from flaring	CO_2	No	Emissions are considered negligible
		CH_4	Yes	May be an important emission source
		N_2O	No	Emissions are considered negligible
	Emissions from distribution of LFG using trucks	CO_2	No	Distribution of LFG using trucks is not included in the project activity.
		CH_4	No	Distribution of LFG using trucks is not included in the project activity.
		N_2O	No	Emissions are considered negligible

B.4. Description of baseline scenario

For project activities that either flare the landfill gas, and/or generate electricity, baseline scenario assessment and description is performed according to approved baseline methodology ACM0001 V.15.0.0.

Baseline scenario assessment and description for all CPAs

As per ACM0001 "Flaring or use of landfill gas"(Version 15.0.0), project participants may either apply the simplified procedures or the procedures using the “Combined tool to identify the baseline scenario and demonstrate additionality” to select the most plausible baseline scenario and demonstrate additionality. The project participant has chosen the “Simplified procedures to identify the baseline scenario and demonstrate additionality” as per section 5.3.1 of the ACM0001 "Flaring or use of landfill gas"(Version 15.0.0) for the CPA -[XX Landfill name]

The simplified procedures are valid for three years from the date of entry into force of Version 15.0 of ACM0001 on 8 November 2013; before the end of this period, the CDM Executive Board will reassess the validity of these simplified procedures and extend or update them if needed. Any update of the simplified procedures does not affect the projects that request registration as a CDM project activity or a program of activities by 7 November 2016 and apply the simplified procedures contained in Version 15.0 of ACM0001. As per paragraphs 22 and 23 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas"(Version 15.0.0), the establishment and description of the baseline scenario of each CPA under this PoA is considered as follows:

- The baseline scenario for LFG is assumed to be the atmospheric release of the LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons. The common practice in Africa[15], and more specifically in Ghana, is to deposit waste in dumps or landfills without the controlled extraction and use of landfill gas. Gas may be vented to atmosphere to reduce its concentration below hazardous levels, but landfill gas capture is not commonly installed. Therefore, in the absence of the project activity, the current practice will be continued, defining the baseline scenario.

- If all or part of the electricity generated by the project activity is exported to the grid, the baseline scenario for all or the part of the electricity exported to the grid is assumed to be electricity generation in existing and/or new grid-connected power plants. If all or part of the electricity is supplied to off-grid application, the baseline electricity generation equipment is assumed to correspond to the default emission factor from Option B2 of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”. Each CPA under this PoA will export to the grid all or part of the electricity generated and therefore, the baseline scenario will be electricity generation in existing and/or new grid-connected power plants.

As per paragraph 21 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas" (Version 15.0.0), the following types of project activities are deemed automatically additional, if prior to the implementation of the project activity the LFG was only vented and/or flared but not utilized for energy generation:

a) The LFG is used to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW;
b) The LFG is used to generate heat for internal or external consumption;
c) The LFG is flared.

[15] http://www.unep.or.jp/ietc/estdir/pub/msw/ro/africa/Topic_e.asp

Prior to the implementation for the CPA -[XX Landfill name] under this PoA, the LFG was only vented and not utilized for energy generation. The project activity consists in the generation of electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW.

In a first stage of the CPA -[XX Landfill name], it is planned to flare the LFG in a high efficiency flare and; in a second stage, it is planned to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW as per type (a) above. Since the CPA -[XX Landfill name], matches the type (a) in paragraph 21 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas"(Version 15.0.0), the CPA is deemed automatically additional.

B.5. Demonstration of eligibility for a generic CPA

The CPA -[XX Landfill name] is eligible to be included in the “Landfill gas capture, flaring and utilization program in Africa” PoA because complies with the eligibility criteria for inclusion of a CPA in the PoA as set in section B.2 of the PoA-DD as per the “Standard for Demonstration of Additionality, Development of Eligibility Criteria and Application of Multiple Methodologies for PoA” (EB65, Annex 3) and as per the section “Project activity under a programme of activities“of the methodology ACM0001 Version 15.0.0, “Flaring or use of landfill gas”.

The CPA -[XX Landfill name] matches the only type of CPA described in the PoA-DD “Landfill gas capture, flaring and utilization program in Africa” as can be derived from the following assessment:

<table>
<tr><th colspan="4">Conditions for the type of CPA</th><th>Justification check for CPA</th><th>One Type only</th></tr>
<tr><td rowspan="4">(a) The baseline scenario with regard to any of the following aspects:</td><td colspan="3">(i) Partial release of the LFG from the SWDS;</td><td></td><td></td></tr>
<tr><td colspan="3">(ii) Total release of the LFG from the SWDS;</td><td></td><td></td></tr>
<tr><td rowspan="2">(iii) In case of electricity generation in the project activity:</td><td colspan="2">The grid;</td><td></td><td></td></tr>
<tr><td colspan="2">Captive fossil fuel fired power plants;</td><td></td><td></td></tr>
<tr><td colspan="4">(b) In case of heat generation, fossil fuel fired on-site equipment;</td><td></td><td></td></tr>
<tr><td rowspan="8">(c) The project activity with regard to any of the following aspects of the use of the captured landfill gas:</td><td colspan="3">(i) Flaring;</td><td></td><td></td></tr>
<tr><td rowspan="6">(ii) Flaring; and</td><td colspan="2">Electricity generation;</td><td></td><td></td></tr>
<tr><td rowspan="4">Heat generatio n;</td><td>o Boiler;</td><td></td><td></td></tr>
<tr><td>o Air heater;</td><td></td><td></td></tr>
<tr><td>o Kiln;</td><td></td><td></td></tr>
<tr><td>o Glass melting furnace;</td><td></td><td></td></tr>
<tr><td colspan="2">Supplying the LFG to consumers through a natural gas distribution network or using trucks;</td><td></td><td></td></tr>
<tr><td colspan="3">(iii) Combinations of types of use of the landfill gas;</td><td></td><td></td></tr>
<tr><td>(d) The legal and regulatory framework.</td><td colspan="3">Do not require LFG to be flared nor used</td><td></td><td></td></tr>
</table>

As tabulated above, the CPA -[XX Landfill name] matches the only type of CPA described in

the PoA “Landfill gas capture, flaring and utilization program in Africa” as explained and justified below:

ID	CPA Type criteria	Assessment	Comments
a	Demonstration of additionality;		*Provide confirmation that prior to the implementation for the CPA under this PoA, the LFG was only vented and not utilized for energy generation. Moreover, provide confirmation that in a first stage of the CPA, it is planned to flare the LFG in a high efficiency flare and in a second stage, it is planned to generate electricity in one or several power plants with a total nameplate capacity that equals or is below 10 MW as per type (a) above. Since the CPA -[XX Landfill name], matches the type (a) in paragraph 21 in section 5.3.1 of the ACM0001 "Flaring or use of landfill gas"(Version 15.0.0), the CPA is deemed automatically additional.*
b	Emission reduction calculations:		*Provide confirmation that as per the section D.6 of the CPA-DD, emission reduction calculations are conducted as per ACM0001 Version 15.0.0, “Flaring or use of landfill gas” for the use of the captured landfill gas for flaring and electricity generation considering that the legal and regulatory framework does not enforce landfill gas to be flared or used for electricity generation*
c	Monitoring:		*Provide confirmation that as per the section D.7 of the CPA-DD, monitoring is conducted as per ACM0001 Version 15.0.0, “Flaring or use of landfill gas” for the use of the captured landfill gas for flaring and electricity generation considering that the legal and regulatory framework does not enforce landfill gas to be flared or used for electricity generation*

The following paragraphs describe how the eligibility criteria for CPA inclusion, emission reduction calculations and monitoring have been conducted:

(a) Eligibility criteria for CPA inclusion used for each type of CPAs. As per the Standard “Demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programmes of activities” Version 3.0 (EB74, Annex 5), the following table summarizes the assessment conducted for each eligibility criteria conducted for the inclusion of the CPA -[XX Landfill name]

ID	Eligibility criteria	Assessment	Comments

a	The geographical boundary of the CPA including any time-induced boundary consistent with the geographical boundary set in the PoA;		*[Provide the geographic coordinates of the CPA and confirm if falls within the borders of PoA]*
b	Conditions that avoid double counting of emission reductions like unique identifications of product and end-user locations (e.g. programme logo);		*Provide confirmation that the CME has verified the CDM UNFCCC databases and confirms that the CPA has not been registered already under the CDM. Provide unique identification number of the CPA*
c	The specifications of technology/measure[16] including the level[17] and type of service, performance specifications including compliance with testing/certifications;		*Provide confirmation that the technology to be installed in the proposed CPA will enable the recovery, flaring and/or use of LFG and will have a proven track records in the LFG sector. The technology for the destruction of LFG should involve an enclosed flare system while the technology for the utilization of LFG should involve an electricity generator system (with capacity from 0.25 MW to 10.00 MW). The level of service should be continuous (there is not baseline system being replaced).*
d	Conditions to check the start date of the CPA through documentary evidence;		*Indicate the start date and demonstrate that it is in accordance with the CDM Glossary*
e	Conditions that ensure compliance with applicability and other requirements of single or multiple methodologies applied by CPAs;		*Provide confirmation that the proposed CPA complies with the applicability criteria of ACM0001 as demonstrated in section D.2. of the CPA-DD.*
f	The conditions that ensure that CPAs meet the requirements pertaining to the demonstration of additionality as specified in Section A above;		*Provide confirmation that the additionality of the CPA is demonstrated in secion D.4. and D.5 of the CPA-DD*
g	The PoA-specific requirements stipulated by the CME including any conditions related to undertaking local		*Provide confirmation that g (1) Local stakeholders have been consulted (see section C of the CPA-DD) g (2) The CPA is compliant with the host country legislation in terms of environmental*

[16] Specifications of the technology/measure shall include the type, capacity and other key features of the design of the systems. For example, indicating the kW capacity, size or dimensions, fixed/portable operation, and other key design features that makes the project cook stoves efficient, would be appropriate; however, only indicating that all cook stoves will have an efficiency X% would not be sufficient.

[17] The level of service shall be defined in comparison with the baseline system being replaced.

	stakeholder consultations and environmental impact analysis;		*impact analysis (see details in section B of the CPA-DD) .*
h	Conditions to provide an affirmation that funding from Annex I parties, if any, does not result in a diversion of official development assistance;		*Provide confirmation that the CPA does not involve any public funding, and refer to Appendix 2.*
i	Where applicable, target group (e.g. domestic/commercial/industrial, rural/urban gridconnected/off-grid) and distribution mechanisms (e.g. direct installation);		*The target group is prospective landfills in the host country.* *There are no specific distribution mechanisms.*
j	Where applicable, the conditions related to sampling requirements for a PoA in accordance with the approved guidelines/standard from the Board pertaining to sampling and surveys;		*No sampling applies for validation.* *For verification, the DOE will determine whether a site assessment will be required.*
k	Where applicable, the conditions that ensure that every CPA in aggregate meets the small scale or microscale threshold criteria and remains within those thresholds throughout the crediting period of the CPA;		*Not applicable since the PoA is designed for CPAs that belongs to Large Scale project categories hence no need to apply the small scale or microscale threshold criteria.*
l	Where applicable, the requirements for the debundling check, in case CPAs belong to small-scale (SSC) or microscale project categories		*Not applicable since the PoA is designed for CPAs that belongs to Large Scale project categories hence no need to apply the debundling check.*

(b) The assessment of the emission reduction calculations conducted for the inclusion of the CPA -[XX Landfill name] is shown in the following table:

ID	Emission reduction calculations criteria	Assessment	Comments
a	Following methodology ACM0001 Version 15.0.0, “Flaring or use of landfill gas”		*Provide confirmation that in section D.6, emission reduction calculations are conducted as per ACM0001 Version 15.0.0, “Flaring or use of landfill gas”*
b	For the use of the captured landfill gas for flaring and electricity generation		*Provide confirmation that in section D.6, emission reduction calculations are conducted as per ACM0001 Version 15.0.0, “Flaring or use of landfill gas” for the use of the captured landfill gas for flaring and electricity generation*
c	Considering that the legal and regulatory framework does not enforce landfill gas to be flared or used for electricity generation.		*Provide confirmation that in section D.6, emission reduction calculations are conducted as per ACM0001 Version 15.0.0, “Flaring or use of landfill gas” considering that the legal and regulatory framework does not enforce landfill gas to be flared or used for electricity generation.*

(c) The assessment of the monitoring provisions conducted for the inclusion of the CPA -[XX Landfill name] is shown in the following table:

ID	Monitoring provisions criteria	Assessment	Comments
a	Following methodology ACM0001 Version 15.0.0, “Flaring or use of landfill gas”		*Provide confirmation that in section D.7, monitoring provisions are conducted as per ACM0001 Version 15.0.0, “Flaring or use of landfill gas”*
b	For the use of the captured landfill gas for flaring and electricity generation		*Provide confirmation that in section D.7, monitoring provisions are conducted as per ACM0001 Version 15.0.0, “Flaring or use of landfill gas” for the use of the captured landfill gas for flaring and electricity generation*
c	Considering that the legal and regulatory framework does not enforce landfill gas to be flared or used for electricity generation.		*Provide confirmation that in section D.7, monitoring provisions are conducted as per ACM0001 Version 15.0.0, “Flaring or use of landfill gas” considering that the legal and regulatory framework does not enforce landfill gas to be flared or used for electricity generation.*

B.6. Estimation of emission reductions of a generic CPA

B.6.1, Explanation of methodological choices

>>
Emission Reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$ **(25) equation of the ACM0001 V.15.0.0**

Variable		Definition
ER_y	=	Emission reductions in year *y* (tCO2e/yr)
BE_y	=	Baseline emissions in year *y* (tCO2e/yr)
PE_y	=	Project emissions in year *y* (tCO2/yr)

Baseline emissions

To estimate the baseline scenario the ACM0001 V.15.0.0 uses:

$$BE_y = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y}$$ **(1) equation of the ACM0001 V.15.0.0**

Where:

Variable		Definition
BE_y	=	Baseline emissions in year *y* (tCO_2e/yr)
$BE_{CH4,y}$	=	Baseline emissions of methane from the SWDS in year *y* (t CO_2e/yr)
$BE_{EC,y}$	=	Baseline emissions associated with electricity generation in year *y* (t CO_2/yr)
$BE_{HG,y}$	=	Baseline emissions associated with heat generation in year *y* (t CO_2/yr)
$BE_{NG,y}$	=	Baseline emissions associated with natural gas use in year *y* (t CO_2/yr)

Step (A): Baseline emissions of methane from the SWDS ($BE_{CH4,y}$)

$$BE_{CH4,y} = (1 - OX_{top\_layer}) \times (F_{CH4,PJ,y} - F_{CH4,BL,y}) \times GWP_{CH4}$$ **(2) equation of the ACM0001 V.15.0.0**

Where:

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

Step A.1: Ex post estimation of $F_{CH4,PJ,y}$

During the crediting period, $F_{CH4,PJ,y}$ is determined as per methodology ACM0001 Version 15.0.0, considering the sum of the quantities of methane flared and used (as applicable) in power plant(s), boiler(s), air heater(s), kiln(s) and natural gas distribution network, as follows:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} + F_{CH4,HG,y} + F_{CH4,NG,y}$$ **(3) equation of the ACM0001 V.15.0.0**

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

Since the project activity includes neither heat generation nor use of landfill gas as natural gas, the
equation (3) above can be simplified to:

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

The working hours of the power plant(s) should be monitored and no emission reduction should be claimed for methane destruction during non-working hours.

$F_{CH4,EL,y}$ is determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 2.0.0. This is taken into account by monitoring the hours that the equipment utilizing the LFG is operating in year *y* ($Op_{j,h,y}$).

The following requirements apply:

- The gaseous stream the tool shall be applied to the LFG delivery pipeline to each item of electricity generation. $F_{CH4,EL,y}$ is then calculated as the sum of mass flows to each item of electricity generation ;
- CH_4 is the greenhouse gases for which the mass flow should be determined;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 or 17 in the tool);
- The mass flow should be calculated on an hourly basis for each hour *h* in year *y*;
- The mass flow calculated for hour *h* is 0 if the equipment is not working in hour *h* ($Op_{j,h}$=not working), the hourly values are then summed to a yearly unit basis.

$F_{CH4,flared,y}$ and $F_{CH4,EL,y}$ are determined ex post as per the following procedures a) and b), respectively:

a) Amount of methane destroyed by flaring ($F_{CH4,flared,y}$)

$F_{CH4,flared,y}$ is determined as the difference between the amount of methane supplied to the flare(s) and any methane emissions from the flare(s), as follows:

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

(4) equation of the ACM0001 V.15.0.0

Variable		*Definition*
$F_{CH4,flared,y}$	=	Amount of methane in the LFG which is destroyed by flaring in year y (t CH4/yr)
$F_{CH4,sent\_flare,y}$	=	Amount of methane in the LFG which is sent to the flare in year y (t CH4/yr)
$PE_{flare,y}$	=	Project emissions from flaring of the residual gas stream in year y (t CO2e/yr)
GWP_{CH4}	=	Global warming potential of CH4 (t CO2e/t CH4)

The amount of methane in the LFG which is destroyed by flaring in year y ($F_{CH4,sent\_flare,y}$) will be determined using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 2.0.0, applying the requirements described above where the gaseous stream is the LFG delivered to the flare(s). The Option 2 of the mentioned “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 2.0.0 under the name “Simplified calculation without measurement of the moisture content” will be applied as a simple and conservative approach to determine the absolute humidity of the gaseous stream of $F_{CH4,sent\_flare,y}$ by assuming the gaseous stream is dry or saturated depending on which is the conservative situation. Since the gaseous stream flow will be measured on volume basis and the volumetric fraction of methane will be measured in dry basis, two options will be used in the project activity:

- Option A will be used in case of dry basis of the gas, demonstrating that the temperature of the gaseous stream (T_t) is less than 60ºC (333.15 K) at the flow measurement point (way b of Option A), and
- Option B will be used in case of wet basis of the gas, demonstrating that the temperature of the gaseous stream (T_t) is more than 60ºC (333.15 K) at the flow measurement point and by converting the measured volumetric flow from wet basis to dry basis.

To determine $F_{CH4,sent\_flare,y}$, the volumetric flow of landfill gas which is sent to flare will be measured on volume basis with a flowmeter which also measures the temperature of the gaseous stream (T_t). Depending on the temperature of the gaseous stream (T_t), the flowmeter will be measuring $V_{LFG,sent\_flare,y,db}$ (m³ dry gas/h) or $V_{LFG,sent\_flare,y,wb}$ (m³ wet gas/h) and and Option A (T_t > 60ºC) or B (T_t < 60ºC) will be used accordantly. Therefore, the parameters $V_{LFG,sent\_flare,y,db}$ (m³ dry gas/h) or $V_{LFG,sent\_flare,y,wb}$ (m³ wet gas/h) will be measured at the same sample point.

Under normal operation conditions, the volumetric flow of landfill gas which is sent to flare will be monitored as $V_{LFG,sent\_flare,y,db}$ (m³ dry gas/h) since the temperature of the landfill gas (T_t) will be less than 60ºC at the flow measurement point most of the time. The values applied ex ante for this volumetric flow are considered to be in dry basis following way b) of Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, version 2.0.0 since this is the expected basis of the gas under normal operating conditions. Under abnormal operating conditions, the same volumetric flow will be named as $V_{LFG,sent\_flare,y,wb}$ (m³ wet gas/h) in case of wet basis of the gas, demonstrating that the temperature of the gaseous stream (T_t) is more than 60ºC at the flow measurement point following Options B of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, version 2.0.0., and by converting the measured volumetric flow from wet basis to dry basis for calculation purposes ex

post.

PEflare,y will be determined using the *“Project emissions from flaring” V.2.0.0*. If LFG is flared through more than one flare, then $PE_{flare,y}$ is the sum of the emissions for each flare determined separately.

b) Amount of methane in the LFG which is used for electricity generation ($F_{CH4,EL,y}$)

The amount of methane in the LFG which is used for electricity generation in year y (FCH4,EL, y) will be determined using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 2.0.0, applying the requirements described above where the gaseous stream is the LFG delivered to electricity generation. The Option 2 of the mentioned “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 2.0.0 under the name “Simplified calculation without measurement of the moisture content” will be applied as a simple and conservative approach to determine the absolute humidity of the gaseous stream of $F_{CH4,EL,\ y}$ by assuming the gaseous stream is dry or saturated depending on which is the conservative situation. Since the gaseous stream flow will be measured on volume basis and the volumetric fraction of methane will be measured in dry basis, two options will be used in the project activity:

- Option A will be used in case of dry basis of the gas, demonstrating that the temperature of the gaseous stream (T_t) is less than 60ºC (333.15 K) at the flow measurement point (way b of Option A), and
- Option B will be used in case of wet basis of the gas, demonstrating that the temperature of the gaseous stream (T_t) is more than 60ºC (333.15 K) at the flow measurement point and by converting the measured volumetric flow from wet basis to dry basis.

To determine $F_{CH4,EL,y,}$ the volumetric flow of landfill gas which is used for electricity generation will be measured on volume basis with a flowmeter which also measures the temperature of the gaseous stream (T_t). Depending on the temperature of the gaseous stream (T_t), the flowmeter will be measuring $V_{LFG,EL,y,db}$ (m^3 dry gas/h) or $V_{LFG,EL,y,wb}$ (m^3 wet gas/h) and Option A ($T_t > 60ºC$) or B ($T_t < 60ºC$) will be used accordantly. Therefore, the parameters $V_{LFG,EL,y,db}$ (m^3 dry gas/h) or $V_{LFG,EL,wb}$ (m^3 wet gas/h) will be measured at the same sample point.

Under normal operation conditions, the volumetric flow of landfill gas which is used for electricity generation will be monitored as $V_{LFG,EL,y,db}$ (m^3 dry gas/h) since the temperature of the landfill gas (T_t) will be less than 60ºC at the flow measurement point most of the time. The values applied ex ante for this volumetric flow are considered to be in dry basis following way b) of Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, version 2.0.0 since this is the expected basis of the gas under normal operating conditions. Under abnormal operating conditions, the same volumetric flow will be named as $V_{LFG,EL,y,wb}$ (m^3 wet gas/h) in case of wet basis of the gas, demonstrating that the temperature of the gaseous stream (T_t) is more than 60ºC at the flow measurement point following Options B of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream”, version 2.0.0., and by converting the measured volumetric flow from wet basis to dry basis for calculation purposes ex post.

The following paragraphs show the formulae which will be used to determine the absolute humidity of the gaseous streams applying the Option 2 “Simplified calculation without measurement of the moisture content” and to determine the flow and volumetric fraction of the gaseous stream applying the Option A and Option B as per the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 2.0.0:

- **Option 2: Simplified calculation without measurement of the moisture content**

This option provides a simple and conservative approach to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation. If it is conservative to assume that the gaseous stream is dry, then $m_{H2O,t,db}$ is assumed to equal 0. If it is conservative to assume that the gaseous stream is saturated, then $m_{H2O,t,db}$ is assumed to equal the saturation absolute humidity ($m_{H2O,t,db,sat}$) and calculated using equation (4) of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 2.0.0 as follows:.

$$m_{H2O,t,db,Sat} = \frac{p_{H2O,t,Sat} * MM_{H2O}}{(P_t - p_{H2O,t,Sat}) * MM_{t,db}}$$

(4) equation of "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 2.0.0

Where:

Variable		*Definition*
$m_{H2O,t,db,sat}$	=	Saturation absolute humidity in time interval *t* on a dry basis (kg H2O/kg dry gas)
$p_{H20,t,Sat}$	=	Amount of methane in the LFG which is sent to the flare in year y (t CH4/yr)
T_t	=	Temperature of the gaseous stream in time interval *t* (K)
P_t	=	Absolute pressure of the gaseous stream in time interval *t* (Pa)
MM_{H2O}	=	Molecular mass of H2O (kg H2O/kmol H2O)
$MM_{t,db}$	=	Molecular mass of the gaseous stream in a time interval *t* on a dry basis (kg dry gas/kmol dry gas)

Parameter $MM_{t,db}$ is estimated using equation (3) of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 2.0.0 as follows:

$$MM_{t,db} = \sum_{k} (v_{k,t,db} * MM_k)$$

(3) equation of "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 2.0.0

Where:

Variable		*Definition*
$MM_{t,db}$	=	Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)
$v_{k,t,db}$	=	Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis (m³ gas k/m³ dry gas)
MM_k	=	Molecular mass of gas *k* (kg/kmol)
k	=	All gases, except H2O, contained in the gaseous stream (e.g. N2, CO2, O2, CO, H2, CH4, N2O, NO, NO2, SO2, SF6 and PFCs). See available simplification below

The determination of the molecular mass of the gaseous stream ($MM_{t,db}$) requires measuring the volumetric fraction of all gases (k) in the gaseous stream. However as a simplification, the volumetric fraction of only the gases k that are greenhouse gases and are considered in the emission reduction calculation in the underlying methodology must be monitored and the difference to 100% may be considered as pure nitrogen. The simplification is not acceptable if it is differently specified in the underlying methodology.

Since the methodology ACM0001 version 15.0.0 states that the simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 or 17 in

the tool), only the volumetric fraction of methane (CH_4) contained in the gaseous stream ($v_{CH4,t,db}$) will be measured because it is the greenhouse gas considered in the emission reduction calculation. Therefore, the difference to 100% will be considered as pure nitrogen.

- **Option A**

Flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it is necessary to demonstrate that the gaseous stream is dry to use this option. There are two ways to do this:

a) Measure the moisture content of the gaseous stream ($C_{H2O,t,db,n}$) and demonstrate that this is less or equal to 0.05 kg H_2O/m3 dry gas; or

b) Demonstrate that the temperature of the gaseous stream (T_t) is less than 60ºC (333.15 K) at the flow measurement point.

For the project activity, the way b) from above will be used so it will be demonstrated that the temperature of the gaseous stream (Tt) is less than 60ºC (333.15 K) at the flow measurement point. If it cannot be demonstrated that the gaseous stream is dry, then the flow measurement should be assumed to be on a wet basis and the corresponding option from Table 1 should be applied instead. For the project activity, Option B will be used.

The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined as follows:

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t}$$

(5) equation of "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 2.0.0

With:

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t}$$

(6) equation of "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 2.0.0

Where:

Variable		*Definition*
$F_{i,t}$	=	Mass flow of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas/h)
$V_{t,db}$	=	Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m³ dry gas/h)
$v_{i,t,db}$	=	Volumetric fraction of greenhouse gas *i* in the gaseous stream in a time interval *t* on a dry basis (m³ gas *i*/m³ dry gas)
$\rho_{i,t}$	=	Density of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas *i*/m³ gas *i*)
P_t	=	Absolute pressure of the gaseous stream in time interval *t* (Pa)
MM_i	=	Molecular mass of greenhouse gas *i* (kg/kmol)
R_u	=	Universal ideal gases constant (Pa.m3/kmol.K)
T_t	=	Temperature of the gaseous stream in time interval *t* (K)

- **Option B**

The mass flow of greenhouse gas i ($F_{i,t}$) is determined using equations (5) and (6) of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version

2.0.0. The volumetric flow of the gaseous stream in time interval t on a dry basis ($V_{t,db}$) is determined by converting the measured volumetric flow from wet basis to dry basis using equation (7) of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 2.0.0 as follows:

$$V_{t,tb} = V_{t,wb}/(1 + v_{H2O,t,db})$$

(7) equation of "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 2.0.0

Where:

Variable		*Definition*
$V_{t,db}$	=	Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m³ dry gas/h)
$V_{t,wb}$	=	Volumetric flow of the gaseous stream in time interval *t* on a wet basis (m³ wet gas/h)
$v_{H2O,t,db}$	=	Volumetric fraction of H2O in the gaseous stream in time interval *t* on a dry basis (m³ H_2O/m³ dry gas)

The volumetric fraction of H_2O in time interval t on a dry basis ($v_{H2O,t,db}$) is estimated using equation (8) of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 2.0.0 as follows:

$$v_{H2O,t,db} = \frac{m_{H2O,t,db} * MM_{t,db}}{MM_{H2O}}$$

(8) equation of "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 2.0.0

Where:

Variable		*Definition*
$v_{H2O,t,db}$	=	Volumetric fraction of H2O in the gaseous stream in time interval *t* on a dry basis (m³ H2O/m³ dry gas)
$m_{H2O,t,db}$	=	Absolute humidity in the gaseous stream in time interval *t* on a dry basis (kg H2O/kg dry gas)
$MM_{t,db}$	=	Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)
MM_{H2O}	=	Molecular mass of H_2O (kg H_2O/kmol H_2O)

The absolute humidity of the gaseous stream ($m_{H2O,t,db}$) in the project activity is determined using Option 2 "Simplified calculation without measurement of the moisture content" as specified in the sections above and the molecular mass of the gaseous stream ($MM_{t,db}$) is determined using equation (3) of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 2.0.0.

Step A.1.1: Ex ante estimation of $F_{CH4,PJ,y}$

The *ex ante* estimation of the amount of methane that would have been destroyed/combusted during the year, in tonnes of methane ($F_{CH4,PJ,Y}$) has been carried using the latest version of the approved "Emissions from solid waste disposal sites" V.6, considering the following additional equation:

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

(5) equation of the ACM0001

V.15.0.0

Variable		Definition	Comments
$BE_{CH4,SWDS,y}$	=	Methane generation from the landfill in the absence of the project activity at year *y* (tCO_2e), calculated as per the “Emissions from solid waste disposal sites” V6. The tool estimates methane generation adjusted for, using adjustment factor (f) any landfill gas in the baseline that would have been captured and destroyed to comply with relevant regulations or contractual requirements, or to address safety and odor concerns. As this is already accounted for in equation 2, “f” in the tool shall be assigned a value 0.	• In the tool, x will refer to the year since the landfill started receiving wastes [x runs from the first year of landfill operation (x=1) to the year for which emissions are calculated (x=y)]; • A study developed by the project participant reports the waste composition.
η_{PJ}	=	Efficiency of the LFG capture system that will be installed in the project activity	

The methane generation from the landfill in the absence of the project activity at year *y* ($BE_{CH4,SWDS,y}$), is calculated as per the “Emissions from solid waste disposal sites” V6 as follows:

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

Where:

$BE_{CH4,SWDS,y}$	=	Methane emissions avoided during the year y from preventing waste disposa the solid waste disposal site (SWDS) during the period from the start of project activity to the end of the year y (tCO_2e)
Φ	=	Model correction factor to account for model uncertainties
f	=	Fraction of methane captured at the SWDS and flared, combusted or use another manner
GWP_{CH4}	=	Global Warming Potential (GWP) of methane, valid for the relevant commitm period
OX	=	Oxidation factor (reflecting the amount of methane from SWDS that is oxidi in the soil or other material covering the waste)
F	=	Fraction of methane in the SWDS gas (volume fraction)
DOC_f	=	Fraction of degradable organic carbon (DOC) that can decompose
MCF	=	Methane correction factor
$W_{j,x}$	=	Amount of organic type j prevented from disposal in the SWDS in the ye (tonnes)
DOC_j	=	Fraction of degradable organic carbon (by weight) in the waste type j
k_j	=	Decay rate for the waste type j
j	=	Waste type category (index)
x	=	Year since the landfill started receiving wastes [x runs from the first yea landfill operation (x=1) to the year for which emissions are calculated (x Note: this definition represents a correction of the Tool as given in ACM0(

	V.15.0.0.
y	Year for which methane emissions are calculated

Since ACM0001, V.15.0.0 further clarifies that "*Sampling to determine the different waste types is not necessary; the waste composition can be obtained from previous studies*", this option has been used in this occasion.

ACM0001, V.15.0.0 also states: "*The efficiency of the degassing system which will be installed in the project activity should be taken into account while estimating the ex-ante estimation*." This is taken into consideration through the utilization of capture efficiency value for the total of biogas generated..

At the renewal of the crediting period, the following data should be updated according to default values suggested in the most recently published IPCC Guidelines for National Greenhouse Gas Inventories:

- Oxidation factor (*OX*);
- Fraction of methane in the SWDS gas (*F*);
- Fraction of degradable organic carbon (*DOC*) that can decompose (DOC_f);
- Methane correction factor (*MCF*);
- Fraction of degradable organic carbon (by weight) in each waste type *j* (*DOCj*);
- Decay rate for the waste type *j* (k_j).

Respectively, if the most recent IPCC Guidelines suggest different categorization of waste types, solid waste disposal sites or climate conditions, these should be applied respectively.

Determining the amounts of waste types j disposed in the SWDS (Wj,x or Wj,i)

Since only one type of waste is disposed in the landfill site (in this case municipal solid waste) then $W_{j,x} = W_x$ and $W_{j,i} = W_i$ and the waste sampling is not required. For such reason, Application A of the Methodological Tool "Emissions from solid waste disposal sites." (Version 06.0.1) will be used in the PoA as follows:

Since the administration of the landfill site had the specific information on historic information on amounts, composition and origin of the waste in SWDS administration documents, such data is used as a more reliable data

Step A.2: Determination of $F_{CH4,BL,y}$

This step provides a procedure to determine the amount of methane that would have been captured and destroyed (by flaring) in the baseline due to regulatory or contractual requirements, or to address safety and odour concerns (collectively referred to as requirement in this step). The four cases in Table 8 are distinguished. The appropriate case should be identified and the corresponding instructions followed.

Table 7: Cases for determining methane captured and destroyed in the baseline

Situation at the start of the project activity	**Requirement to destroy methane**	**Existing LFG capture and destruction system**
Case 1	No	No
Case 2	Yes	No
Case 3	No	Yes
Case 4	Yes	Yes

For the CPAs of this PoA, Case 1 “No requirement to destroy methane exists and no existing LFG capture system” is applicable. Therefore, in this situation:

$$F_{CH4,BL,y} = 0$$

Step B: Baseline emissions associated with electricity generation ($BE_{EC,y}$)

The baseline emissions associated with electricity generation in year y ($BE_{EC,y}$) has been calculated using the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” V.1. When applying the tool:

- The electricity sources *k* in the tool correspond to the sources of electricity generated identified in the selection of the most plausible baseline scenario; and
- $EC_{BL,k,y}$ in the tool is equivalent to the net amount of electricity generated using LFG in year *y* ($EG_{PJ,y}$).
- $EF_{EL,k,y}$ in the tool is equivalent to the emission factor for electricity generation ($CEF_{electricity,y}$ = $EF_{grid,CM,y}$).

$$BE_{EC,y} = \sum_k EC_{BL,k,y} \times EF_{EL,k,y} \times (1 + TDL_{k,y})$$

(2) equation of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”V.1

Variable		Definition
$BE_{EC,y}$		Baseline emissions from electricity consumption in year *y* (tCO_2/yr)
$EC_{BL,k,y}$		Quantity of electricity that would be consumed by the baseline electricity consumption source *k* in year *y* (MWh/yr)
$EF_{EL,k,y}$		Emission factor for electricity generation for source *k* in year *y* (tCO_2/MWh)
$TDL_{k,y}$		Average technical transmission and distribution losses for providing electricity to source *k* in year *y*

Net quantity of electricity produced using LFG ($EG_{PJ,y}$)

Since the project activity has as it purpose to generate electricity using LFG, during the crediting period, it will be measured the electricity produced in power plant station at the site. In the absence of the project activity, this electricity would have been produced by power plants connected to the grid.

Emission factor for electricity generation ($CEF_{electricity,y} = EF_{EL,k,y}$)

The "Tool to calculate the emission factor for an electricity system", version 4.0, will be used to calculate the CO2 emission factor for electricity generation ($CEF_{electricity,y}$). When applying this tool for a programme of activities (PoA), the CME shall describe in the CDM-PoA-DD the following information:

a. *Electricity system(s) covered by the PoA (e.g. the name of the grid(s) connected to the CPAs);* The proposed project activity will be connected to the national grid of Ghana. The generated electricity is to be used either in the landfill or injected into the national grid. Thus the project electricity system is the national electricity grid.

b. *Sources of data used to determine the emission factor(s) for all electricity system(s) to be covered in the PoA (e.g. the yearbook of the electricity/energy sector);* The national grid emission factor is calculated based on the most recent data developed by the Energy Commission of Ghana.

c. *Equations and options used to calculate the emission factor (e.g. ex-ante or ex-post, various options used for determining the OM and BM).*

The method which has been elected for determining the OM is the average OM emission factor ($EF_{grid,OM\ ave,y}$). The average OM emission factor is calculated as the average emission rate of all power plants serving the grid, using the guidance for the simple OM calculation of the UNFCCC methodology tool, but including in all equations also low cost/must run power plants. The *ex ante* option is chosen given the accessibility of data and simplification with respect to project monitoring and further emission reduction verification. Under this option, the average OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, including low-cost/must run resources and the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i \left(FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}\right)}{EG_y}$$

Where:

$EF_{grid,OMsimple,y}$ = Average operating margin CO2 emission factor in year *y* (tCO2/MWh)
$FC_{i,y}$ = Amount of fossil fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit)
$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$ = CO2 emission factor of fossil fuel type *i* in year *y* (tCO2/GJ)
EG_y = Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year *y* (MWh)
i = All fossil fuel types combusted in the project electricity system in year *y*
y = The relevant year as per the data vintage chosen in Step 3

The method which has been elected for determining the BM emission factor in terms of vintage of data is the 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 submission to the DOE for validation. Under this option, the Build Margin emissions factor (BM) is calculated as the generation-weighted average emission factor of the most recently built plants, using the following formula:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where

$EF_{grid,BM,y}$ = Build margin CO2 emission factor in year *y* (tCO_2/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)

m = Power units included in the build margin

y = Most recent historical year for which power generation data is available

The final step in applying the tool is to calculate the combined margin emissions factor. This has been calculated as the weighted average of the emissions factor of the OM and the BM. The formula that has been used to calculate this weighted average emission factor is as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

Where

- $EF_{grid,CM,y}$ = Combined 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)
- $EF_{grid,OM,y}$ = Operating 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 (%)

As recommended by the tool for projects other than wind and solar projects, the default values of weighted factors w_{OM} = 0.5 w_{BM} = 0.5 are used.

Step C: Baseline emissions associated with heat generation ($BE_{HG,y}$)

Since the project will not generate heat, the baseline emissions associated with heat generation in year y ($BE_{HG,y}$) are 0.

Step D: Baseline emissions associated with natural gas use ($BE_{NG,y}$)

Since the project will not use LFG in natural gas distribution, the baseline emissions associated with natural gas generation in year y ($BE_{NG,y}$) are 0.

Project emissions

To estimate the project emissions, the ACM0001 V.15.0.0, considers “**Project Emissions from flaring”** and “**Project Emissions from consumption of electricity and heat”,** which are calculated as follows:

Project Emissions from flaring:

Project emissions from flaring will be calculated and monitored according to the procedures described in *“Project emissions from flaring” V.2.0.0.* The procedure to determine the flare efficiency in the project activity will be applied as an enclosed flare with Option A “Apply a default value for flare efficiency”.

The CPAs under this PoA will either use enclosed flares defined as low height flares, for which the flame enclosure has a height between 10 and two times the diameter of the enclosure or not. In case a low height flare is used, the flare efficiency shall be adjusted, by subtracting 0.1 from the efficiency as determined in Option A.

The following steps will be applied ex-post to calculate the methane destruction efficiency of the flare:

Project emissions from flaring, version 2.0.0.

STEP 1: Determination of the methane mass flow in the residual gas

The “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 2.0.0 shall be used to determine the following parameter:

Variable	***Description***
$F_{CH4,m}$	Mass flow of methane in the residual gaseous stream in the minute *m* (kg)

The mass flow of methane in the residual gaseous stream in the minute m (kg) ($F_{CH4,m}$) will be determined using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 2.0.0, applying the requirements described above where the gaseous stream is the LFG delivered to the flare. The Option 2 of the mentioned “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 2.0.0 under the name “Simplified calculation without measurement of the moisture content” will be applied as a simple and conservative approach to determine the absolute humidity of the gaseous stream of $F_{CH4,m}$, by assuming the gaseous stream is dry or saturated depending on which is the conservative situation. Since the gaseous stream flow will be measured on volume basis and the volumetric fraction of methane will be measured in dry basis, two options will be used in the project activity:

- Option A will be used in case of dry basis of the gas, demonstrating that the temperature of the gaseous stream (T_t) is less than 60ºC (333.15 K) at the flow measurement point (way b of Option A), and
- Option B will be used in case of wet basis of the gas, demonstrating that the temperature of the gaseous stream (T_t) is more than 60ºC (333.15 K) at the flow measurement point and by converting the measured volumetric flow from wet basis to dry basis.

The following requirements apply:

- The gaseous stream tool shall be applied to the residual gas;
- The flow of the gaseous stream shall be measured continuously;
- CH4 is the greenhouse gas i for which the mass flow should be determined;

- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 and 17 in the tool); and
- The time interval t for which mass flow should be calculated is every minute m.

STEP 2: Determination of flare efficiency

The flare efficiency depends on the efficiency of combustion in the flare and the time that the flare is operating. For determining the efficiency of combustion of enclosed flares there is the option to apply a default value or determine the efficiency based on monitored data. For open flares a default value must be applied. The time the flare is operating is determined by monitoring the flame using a flame detector and, for the case of enclosed flares, in addition the monitoring requirements provided by the manufacturer's specifications for operating conditions shall be met.

Open flare

In the case of open flares, the flare efficiency in the minute *m* ($\eta_{flare,m}$) is 50% when the flame is detected in the minute *m* ($Flame_m$), otherwise $\eta_{flare,m}$ is 0%.

Enclosed flare

In the case of enclosed flares, project participants may choose between the following two options to determine the flare efficiency for minute *m* ($\eta_{flare,m}$) and shall document in the CDM-PDD which option is selected:

Option A: Apply a default value for flare efficiency.
Option B: Measure the flare efficiency.

For enclosed flares that are defined as low height flares, the flare efficiency in the minute *m* ($\eta_{flare,m}$) shall be adjusted, as a conservative approach, by subtracting 0.1 from the efficiency as determined in Options A or B. For example, the default value applied should be 80%, rather than 90%, and if for example the measured value was 99%, then the value to be used shall correspond to 89%.

Option A: Default value

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

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

(2) The flame is detected in minute m ($Flame_m$).

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

Option B: Measured flare efficiency

The flare efficiency in the minute *m* is a measured value ($\eta_{flare,m} = \eta_{flare,calc,m}$) when the following three conditions are met to demonstrate that the flare is operating:

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

(2) The flame is detected in minute m ($Flame_m$); and

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

The procedure to determine the flare efficiency in the project activity will be applied as an enclosed flare with option A "Apply a default value for flare efficiency".

STEP 3: Calculation of project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions for each minute m in year y, based on the methane mass flow in the residual gas (FCH4,RG,m) and the flare efficiency (ηflare,m), as follows:

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

Tool equation (15)

Var□able	*Description*
$PE_{flare,y}$	Project emissions from flaring of the residual gas in year *y* (tCO2e)
GWPCH4	Global warming potential of methane valid for the commitment period (tCO2e/tCH4)
$F_{CH4,RG,m}$	Mass flow of methane in the residual gas in the minute *m* (kg)
$\eta_{flare,m}$	Flare efficiency in minute m

Project Emissions from consumption of electricity and heat

Possible CO2 emissions coming from other fuels than the recovered methane (contained in the landfill gas), should be accounted for as project emissions. The general equation for project emissions in the project activity are calculated as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y}$$ **(22) equation of the ACM0001 V.15.0.0**

Variable		Definition	Comments
$PE_{EC,y}$	=	Emissions from consumption of electricity in the project case. The project emissions from electricity consumption ($PE_{EC,y}$) will be calculated following the latest version of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption. V.1". If in the baseline a part of LFG was captured then the electricity quantity used in calculation is electricity used in project activity net of that consumed in the baseline	The tool is applicable because the source of electricity consumption is the scenario A: Electricity consumption from the grid.
$PE_{FC,y}$	=	Emissions from consumption of heat in the project case. The project emissions from fossil fuel combustion ($PE_{FC,y}$) will be calculated following the latest version of "*Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion*"V.2. For this purpose, the processes j in the tool corresponds to all fossil fuel combustion in the landfill, as well as	

			any other on-site fuel combustion for the purposes of the project activity. If in the baseline part of a LFG was captured then the heat quantity used in calculation is fossil fuel used in project activity net of that consumed in the baseline.	

Tool to calculate baseline, project and/or leakage emissions from electricity consumption. V.1

The project emissions from consumption of electricity are calculated based on the quantity of electricity consumed, an emission factor for electricity generation and a factor to account for transmission losses, as follows:

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

$PE_{EC,y}$ Are the project emissions from electricity consumption by the project activity during the year y (tCO_2 / yr)

$EC_{PJ,y}$ Is the quantity of electricity consumed by the project activity during the year y (MWh),

$EF_{EL,j,y}$ Is the emission factor for the grid in year y (tCO_2/MWh)

$TDL_{j,y}$ Are the average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.

When the project does not generate electricity in the first project stage, the assumption made was that the electricity needed for the operation of the project activity will be supplied by the national grid. When the project generates electricity, there is a net export of electricity to the grid (scenario A). For these reasons, the emissions coming from the electricity use are deducted from the overall emissions reductions (this means that only emissions reductions for the net electricity generation are claimed).

For scenario A: Electricity consumption from the grid option A1 was chosen for the determination of the emission factors for electricity generation ($EF_{EL,j,y}$). The combined margin emission factor of the applicable electricity system is estimated using the procedures of the latest approved version of the. "*Tool to calculate the emission factor for an electricity system*"***V 4.0***. ($EF_{EL,j,y}$ = $EF_{grid,CM,y}$). When applying this tool for a programme of activities (PoA), the CME shall describe in the CDM-PoA-DD the following information:

a. *Electricity system(s) covered by the PoA (e.g. the name of the grid(s) connected to the CPAs);* The proposed project activity will be connected to the national grid of Ghana. The generated electricity is to be used either in the landfill or injected into the national grid. Thus the project electricity system is the national electricity grid.

b. *Sources of data used to determine the emission factor(s) for all electricity system(s) to be covered in the PoA (e.g. the yearbook of the electricity/energy sector);* The national grid emission factor is calculated based on the most recent data developed by the Energy Commission of Ghana.

c. *Equations and options used to calculate the emission factor (e.g. ex-ante or ex-post, various options used for determining the OM and BM).*

The method which has been elected for determining the OM is the average OM emission factor ($EF_{grid,OM\ ave,y}$). The average OM emission factor is calculated as the average emission rate of all power plants serving the grid, using the guidance for the simple OM calculation of the UNFCCC methodology tool, but including in all equations also low cost/must run power plants. The *ex ante* option is chosen given the accessibility of data

and simplification with respect to project monitoring and further emission reduction verification. Under this option, the average OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, including low-cost/must run resources and the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_{i}\left(FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}\right)}{EG_{y}}$$

Where:

$EF_{grid,OMsimple,y}$ = Average operating margin CO2 emission factor in year *y* (tCO2/MWh)
$FC_{i,y}$ = Amount of fossil fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit)
$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$ = CO2 emission factor of fossil fuel type *i* in year *y* (tCO2/GJ)
EG_{y} = Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year *y* (MWh)
i = All fossil fuel types combusted in the project electricity system in year *y*
y = The relevant year as per the data vintage chosen in Step 3

The method which has been elected for determining the BM emission factor in terms of vintage of data is the 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 submission to the DOE for validation. Under this option, the Build Margin emissions factor (BM) is calculated as the generation-weighted average emission factor of the most recently built plants, using the following formula:

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where
$EF_{grid,BM,y}$ = Build margin CO2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m = Power units included in the build margin
y = Most recent historical year for which power generation data is available

The final step in applying the tool is to calculate the combined margin emissions factor. This has been calculated as the weighted average of the emissions factor of the OM and the BM. The formula that has been used to calculate this weighted average emission factor is as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

Where

- $EF_{grid,CM,y}$ = Combined 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)
- $EF_{grid,OM,y}$ = Operating 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 (%)

As recommended by the tool for projects other than wind and solar projects, the default values of weighted factors w_{OM} = 0.5 w_{BM} = 0.5 are used.

$PE_{FC,y}$ will be calculated using the "*Tool to calculate project or leakage CO2 emissions from fossil fuel combustion". V.2.*

Tool to calculate project or leakage CO2 emissions from fossil fuel combustion. V.2"

CO2 emissions from fossil fuel combustion in process j are calculated based on the quantity of fuels combusted and the CO2 emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = \sum_{i} FC_{i,j,y} \times COEF_{i,y} \quad \textbf{(1)}$$

Where:

$PE_{FC,j,y}$	CO_2 emissions from fossil fuel combustion in process *j* during the year *y* (tCO_2/yr)
$FC_{i,j,y}$	Is the quantity of fuel type *i* combusted in process *j* during the year *y* (mass volume unit/yr);
$COEF_{i,y}$	Is the CO_2 emission coefficient of fuel type *i* in year *y* (tCO_2 / mass or volume unit are the fuel types combusted in process *j* during the year *y*.

The CO_2 emission coefficient $COEF_{i,y}$ will be calculated using option B based on net calorific value and CO_2 emission factor of the fuel(s) type(s) used. Option A can not be applied because the necessary data is not available.
The type(s) of fossil fuel(s) to be used will depend on the choice of the developer (i.e. natural gas, fuel oil, diesel, etc.), and the corresponding emission factors will be taken from the IPCC 2006 default values, in case there is no data available.

B.6.2. Data and parameters that are to be reported ex-ante

Data / Parameter:	**OX_{top_layer}**
Data unit:	Dimensionless
Description:	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data:	Consistent with how oxidation is accounted for in the methodological tool “Emissions from solid waste disposal sites”
Value(s) applied:	*Specific for each CPA*
Choice of data or Measurement methods and procedures:	According to the “Emissions from solid waste disposal sites” –Version 6.
Purpose of data	Calculation of baseline emissions
Additional comment:	Applicable to Step A.

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO_2e/tCH_4
Description:	Global warming potential of CH_4
Source of data:	IPCC
Value(s) applied:	A value of 25 tCO2e/tCH4 is used being valid for the 2nd Commitment period for PoA-DDs submitted before 01/01/2013 as per Annex 3 of EB69
Choice of data or Measurement methods and procedures:	Shall be updated accordingly to any future COP/MOP decisions
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	**D_{CH4}**
Data unit:	tCH_4/m^3CH_4
Description:	Methane density
Source of data:	IPCC
Value(s) applied:	0.0007168
Choice of data or Measurement methods and procedures:	At standard T and P (0 degrees C and 1,013 bar)
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	**Wx**
Data unit:	t
Description:	Total amount of waste disposed in a SWDS in year x
Source of data:	Landfill's owner
Value(s) applied:	*Specific for each CPA*
Choice of data or Measurement methods and procedures:	Application A of the Methodological Tool “Emissions from solid waste disposal sites.” (Version 06.0.1) will be used in the CPA-DD
Purpose of data	Calculation of baseline emissions
Additional comment:	NA

Data / Parameter:	**$\varphi_{default}$**
Data unit:	-
Description:	Default value for the model correction factor to account for model
Source of data:	As per the "Emissions from solid waste disposal sites" –Version 6.0.1
Value(s) applied:	*Specific for each CPA*
Choice of data or Measurement methods and procedures:	<table><tr><th></th><th>Humid/wet conditions</th><th>Dry conditions</th></tr><tr><td>Application A</td><td>0.75</td><td>0.75</td></tr><tr><td>Application B</td><td>0.85</td><td>0.80</td></tr></table>
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	**F**
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	*Specific for each CPA*
Choice of data or Measurement methods and procedures:	According to the "Emissions from solid waste disposal sites" –Version 6
Purpose of data	Calculation of baseline emissions
Additional comment:	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0.5 is recommended by IPCC.

Data / Parameter:	**f**
Data unit:	-
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data:	According to the "Emissions from solid waste disposal sites" –Version 6
Value(s) applied:	*Specific for each CPA*
Choice of data or Measurement methods and procedures:	All the methane generated was directly vented to the atmosphere prior to the project activity. Upon the implementation of the project activity, methane captured will only be flared.
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	η_{PJ}
Data unit:	-
Description:	The efficiency of the degassing system which will be installed in the project activity, in year y
Value(s) applied:	*Specific for each CPA*
Choice of data or Measurement methods and procedures:	*Specific for each CPA*
Purpose of data	Calculation of baseline emissions
Additional comment:	The efficiency of the planned LFG collection, flaring, and utilization system is taken into account for the ex ante estimation of emission reductions.

Data / Parameter:	OX
Data unit:	-
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data:	As per the "*Emissions from solid waste disposal sites".V6.*
Value(s) applied:	*Specific for each CPA*
Choice of data or Measurement methods and procedures:	According to the "Emissions from solid waste disposal sites" –Version 6.
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	MCF
Data unit:	-
Description:	Methane correction factor
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	*Specific for each CPA*
Choice of data or Measurement methods and procedures:	The SWDS does not have a water table above the bottom of the SWDS. According to the "Emissions from solid waste disposal sites" –Version 6, the value MCF=1 is to be applied for "anaerobic managed solid waste disposal sites". This is applicable to the Oti Kumasi Landfill as it has controlled placement of waste (i.e. waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and includes: (i) cover material; (ii) mechanical compacting; and (iii) leveling of the waste.
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	**DOC_j**	
Data unit:	-	
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*.	
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted	
Value(s) applied:	The following values for the different waste types *j* are applied:	
	Waste type j	**DOC_j (%wet waste)**
	Wood and wood products	43
	Pulp, paper and cardboard (other than sludge)	40
	Food, food waste, bevarages and tobacco (other	15
	Textiles	24
	Garden, yard and park waste	20
	Glass, plastic, metal, other inert waste	0
Choice of data or Measurement methods and procedures:	In accordance with *"Emissions from solid waste disposal sites" –Version 6*	
Purpose of data	Calculation of baseline emissions	
Additional comment:	The values applied are for wet waste.	

Data / Parameter:	**DOC_f**
Data unit:	-
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	*Specific for each CPA*
Choice of data or Measurement methods and procedures:	According to the "Emissions from solid waste disposal sites" –Version 6
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	**k_j**
Data unit:	1/yr
Description:	Decay rate for the waste type *j*.
Source of data:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted
	Volume 5, Table 3.3)
Value(s) applied:	The following values for the different waste types *j* are applied:

		Boreal/Temperate (MAT<20C)		Tropical/Temperate (MAT>20C)	
		Dry (MAP/PET<1)	Wet (MAP/PET>1)	Dry (MAP<1000mm)	Wet (Dry (MAP>1000mm)
Slowly Degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0.06	0.045	**0.07**
	Wood,wood products and straw	0.02	0.03	0.025	**0.035**
Moderately Degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.1	0.065	**0.17**
Rapidly Degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	**0.4**

Choice of data or Measurement methods and procedures:	*Specific for each CPA*
Purpose of data	Calculation of baseline emissions
Additional comment:	*Specific for each CPA*

Data / Parameter:	**Carbon Emission Factor ($CEF_{electricity,y}$=$EF_{EL,j,y}$ = $EF_{grid,CM,y}$)**
Data unit:	tCO2/GWh
Description:	CO2 emissions intensity of the electricity displaced
Source of data:	The national grid emission factor is calculated based on the most recent data developed by the Energy Commission of Ghana.
Value(s) applied:	*Specific for each CPA*
Choice of data or Measurement methods and procedures:	As per the "Tool to calculate the emission factor for an electricity system" (Version 4.0), the method which has been elected for determining the OM is ex ante option of the average OM emission factor. The method which has been elected for determining the BM emission factor in terms of vintage of data is the Option 1. The combined margin (CM) emissions factor has been calculated as the weighted average of the emissions factor of the OM and the BM.
Purpose of data	Calculation of baseline emissions and Calculation of project emissions
Additional comment:	*Specific for each CPA*

Data / Parameter:	**MM_{CH4}**
Data unit:	kg/kmol
Description:	Molecular mass of methane
Source of data:	Constant
Value(s) applied:	16.04
Choice of data or Measurement methods and procedures:	As per the tool *“Project emissions from flaring” version 2.*
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	**MM_{CO}**
Data unit:	kg/kmol
Description:	Molecular mass of carbon monoxide
Source of data:	Constant
Value(s) applied:	28.01
Choice of data or Measurement methods and procedures:	As per the tool *“Project emissions from flaring” version 2.*
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	**MM_{CO2}**
Data unit:	kg/kmol
Description:	Molecular mass of carbon dioxide
Source of data:	Constant
Value(s) applied:	44.01
Choice of data or Measurement methods and procedures:	As per the tool *“Project emissions from flaring” version 2.*
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	**MM_{O2}**
Data unit:	kg/kmol
Description:	Molecular mass of oxygen
Source of data:	Constant
Value(s) applied:	32
Choice of data or Measurement methods and procedures:	As per the tool *“Project emissions from flaring” version 2.*
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	**MM_{H2}**
Data unit:	kg/kmol
Description:	Molecular mass of hydrogen
Source of data:	Constant
Value(s) applied:	2.02
Choice of data or Measurement methods and procedures:	As per the tool *“Project emissions from flaring” version 2.*
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	MM_{N2}
Data unit:	kg/kmol
Description:	Molecular mass of nitrogen
Source of data:	Constant
Value(s) applied:	28.01
Choice of data or Measurement methods and procedures:	As per the tool *“Project emissions from flaring” version 2.*
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	MM_{H2O}
Data unit:	kg/kmol
Description:	Molecular mass of water
Source of data:	Constant
Value(s) applied:	18.0152
Choice of data or Measurement methods and procedures:	As per the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” version 2.0.0
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	AM_c
Data unit:	kg/kmol
Description:	Atomic mass of carbon
Source of data:	Constant
Value(s) applied:	12
Choice of data or Measurement methods and procedures:	As per the tool *“Project emissions from flaring” version 2.*
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	AM_H
Data unit:	kg/kmol
Description:	Atomic mass of hydrogen
Source of data:	Constant
Value(s) applied:	1.01
Choice of data or Measurement methods and procedures:	As per the tool *“Project emissions from flaring” version 2.*
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	AM_O
Data unit:	kg/kmol
Description:	Atomic mass of oxygen
Source of data:	Constant
Value(s) applied:	16
Choice of data or Measurement methods and procedures:	As per the tool *“Project emissions from flaring” version 2.*
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	AM_N
Data unit:	kg/kmol
Description:	Molecular mass of nitrogen
Source of data:	Constant
Value(s) applied:	14.01
Choice of data or Measurement methods and procedures:	As per the tool *"Project emissions from flaring" version 2.*
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	P_n
Data unit:	Pa
Description:	Atmospheric pressure at normal conditions
Source of data:	Constant
Value(s) applied:	101,325
Choice of data or Measurement methods and procedures:	As per the tool *"Project emissions from flaring" version 2.*
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	R_u
Data unit:	$Pa.m^3/kmol.K$
Description:	Universal ideal gas constant
Source of data:	Constant
Value(s) applied:	8,314.472
Choice of data or Measurement methods and procedures:	As per the tool *"Project emissions from flaring" version 2.*
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	T_n
Data unit:	K
Description:	Temperature at normal conditions
Source of data:	Constant
Value(s) applied:	273.15
Choice of data or Measurement methods and procedures:	As per the tool *"Project emissions from flaring" version 2.*
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	MF_{O2}
Data unit:	Dimensionless
Description:	O_2 volumetric fraction of air
Source of data:	Constant
Value(s) applied:	0.21
Choice of data or Measurement methods and procedures:	As per the tool *"Project emissions from flaring" version 2.*
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	MV_n
Data unit:	m^3/Kmol
Description:	Volume of one mole of any ideal gas at normal
Source of data:	Constant
Value(s) applied:	22.414
Choice of data or Measurement methods and procedures:	As per the tool *"Project emissions from flaring" version 2.*
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	**ηflare,m**
Data unit:	%
Description:	Flare Efficiency in the minute m
Source of data:	As per "Project emissions from flaring" (Version 02.0.0)
Value(s) applied:	*Specific for each CPA*
Choice of data or Measurement methods and procedures:	The default value flare efficiency will be used to calculate the amount of methane destroyed by flaring ex post as per Option A (1) of "Project emissions from flaring" version 02.0.0.
Purpose of data	Calculation of project emissions
Additional comment:	N/A

Data / Parameter:	$SPEC_{flare}$
Data unit:	Temperature - °C Flow rate - Nm3/h
Description:	Manufacturer's flare specifications for temperature and flow rate
Source of data:	Flare manufacturer
Value(s) applied:	Temperature - Specific for each CPA Flow rate - Specific for each CPA
Choice of data or Measurement methods and procedures:	The flare specifications set by the manufacturer for the correct operation of the flare for the following parameters: (a) Minimum and maximum inlet flow rate, if necessary converted to flow rate at reference conditions or heat flux; and (b) Minimum and maximum operating temperature
Purpose of data	N/A
Additional comment:	Only applicable in case of enclosed flares. The maintenance schedule is not required since Option A is selected to determine flare efficiency of an enclosed flare.

B.6.3. Ex-ante calculations of emission reductions

Baseline emissions

The following tables provide the results obtained of applying the above calculation process:

The methane emissions avoided during the year from preventing waste disposal at the solid waste disposal in the site have been calculated as follows applying the inputs values specified in Appendix 4:

Table 8: Calculation for $BE_{CH4,SWDS,y}$[18]

Period			$BE_{CH4,SWDS,y}$ (tonnes of CO2)
Period Year	Start Date	End Date	
1			
2			
3			
4			
5			
6			
7			
Total			
Annual average			

The next table contains the $F_{CH4,PJ,y}$ values obtained from the application of the equation (5) for the ACM0001 V.15.0.0:

Table 9: Calculation for $F_{CH4,PJ,y}$

Period			$F_{CH4,PJ,y}$ (tonnes of CH4)
Period Year	Start Date	End Date	
1			
2			
3			
4			
5			
6			
7			
Total			
Annual average			

Therefore, the following tables below contains the $BE_{CH4,y}$ values obtained from the application of the equation (2) for the ACM0001 V.15.0.0:

[18] The values of the table have been recalculated to match the crediting period timing instead of natural years

Table 10: Annual calculation for $BE_{CH4,y}$

Period			$BE_{CH4,y}$ (tonnes of CO2)
Period Year	**Start Date**	**End Date**	
1			
2			
3			
4			
5			
6			
7			
Total			
Annual average			

The $\boldsymbol{BE_{EC,y}}$ is calculated with the equation (2) as per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"V.1, as follows:

Table 11: Annual calculation for $BE_{EC,y}$

Period			$BE_{EC,y}$ (tonnes of CO2)
Period Year	**Start Date**	**End Date**	
1			
2			
3			
4			
5			
6			
7			
Total			
Annual average			

The table above has been calculated with the input values of the following table with the values of the expected electricity generation in a yearly basis ($ELE_{LFG,y}$:

Table 12: Annual calculation for $ELE_{LFG,y}$

Period			$ELE_{LFG,y}$ (MWh)
Period Year	**Start Date**	**End Date**	
1			
2			
3			
4			
5			
6			
7			
Total			
Annual average			

Finally, the following tables below contains the BE_y values obtained from the application of the equation (1) for the ACM0001 V.15.0.0:

Table 13: Annual calculation for $BE_{,y}$

Period			BEy (tCO2e)
Period Year	**Start Date**	**End Date**	
1			
2			
3			
4			
5			
6			
7			
Total			
Annual average			

Project emissions

Project emissions from flaring

Project emissions from flaring will be calculated and monitored according to the procedures described in *"Project emissions from flaring" V.2.0.0.* , with the following results:

Table 14: Annual calculation for $PE_{,flare,y}$

Period			$PE_{flare,y}$ (tCO2)
Period Year	**Start Date**	**End Date**	
1			
2			
3			
4			
5			
6			
7			
Total			
Annual average			

Project emissions from consumption of electricity

The project emissions from consumption of electricity are calculated as per the equation (1) of the "*Tool to calculate baseline, project and/or leakage emissions from electricity consumption. V.1"* based on the quantity of electricity consumed, an emission factor for electricity generation and a factor to account for transmission losses, with the following results:

Table 15: Annual calculation for $PE_{EC,y}$

Period			$PE_{EC,y}$ (tCO2)
Period Year	**Start Date**	**End Date**	
1			
2			
3			
4			
5			
6			
7			
Total			
Annual average			

Project emissions from consumption of fossil fuel

The project emissions from fossil fuel combustion are calculated as per the equation (1) of the "*Tool to calculate project or leakage CO2 emissions from fossil fuel combustion. V.2* "based on the quantity of fuels combusted and the CO2 emission coefficient of those fuels, with the following results:

Table 16: Annual calculation for $PE_{FC,y}$

Period			$PE_{FC,y}$ (tCO2)
Period Year	**Start Date**	**End Date**	
1			
2			
3			
4			
5			
6			
7			
Total			
Annual average			

The project emissions in the project activity are calculated as per **equation (21) of the ACM0001 V.15,0.0** with the following results:

Table 17: Annual calculation for $PE_{,y}$

Period			$PE_{,y}$ (tCO2)
Period Year	Start Date	End Date	
1			
2			
3			
4			
5			
6			
7			
Total			
Annual average			

Leakage

No leakage effects need to be accounted under this methodology.

Emission Reduction

The emissions reductions expected from the project activity are calculated as per equation (22) of the ACM0001 V.15.0.0, with the results shown in the following table:

Period		Baseline emissions (t CO2e)	Project emissions (t CO2e)	Leakage (t CO2e)	Emission reductions (t CO2e)
Start Date	End Date				
Total					
Annual average					

B.7. Application of the monitoring methodology and description of the monitoring plan

B.7.1. Data and parameters to be monitored by each generic CPA

Data / Parameter:	**Management of SWDS**
Data unit:	-
Description:	Management of SWDS
Source of data:	Use different sources of data: • Original design of the landfill; • Technical specifications for the management of the SWDS; • Local or national regulations
Value(s) applied:	Not applicable
Measurement methods and procedures	Project participants should refer to the original design of the landfill to ensure that any practice to increase methane generation have been occurring prior to the implementation of the project activity. Any change in the management of the SWDS after the implementation of the project activity should be justified by referring to technical or regulatory
Monitoring frequency	Annually
QA/QC procedures:	Not applicable
Purpose of data	Not applicable
Additional comment:	Not applicable

Data / Parameter:	**$Vt_{, db, total}$**
Data unit:	m³ dry gas/h
Description:	Volumetric flow of total landfill gas which is sent to flare and used for electricity generation in year y on a dry basis
Source of data:	Measured by a flow meter
Value(s) applied:	*Specific for each CPA*
Measurement methods and procedures	Volumetric flow measurement should always refer to the actual pressure and temperature. Instruments with recordable electronic signal (analogical or digital) are required
Monitoring frequency	Continuous
QA/QC procedures:	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications
Purpose of data	Calculation of baseline emissions
Additional comment:	This parameter will be monitored in Options A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 2.0.0. Under normal operation conditions, the volumetric flow of total landfill gas which is sent to flare and used for electricity generation will be monitored as Vt, db, total (m³ dry gas/h) since the temperature of the landfill gas (Tt) will be less than 60ºC at the flow measurement point most of the time. The values applied ex ante for this volumetric flow are considered to be in dry basis following way b) of Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 2.0.0 since this is the expected basis of the gas under normal operating conditions. Under abnormal operating conditions, the same volumetric flow will be named as Vt, wb, total (m³ wet gas/h) in case of wet basis of the gas, demonstrating that the temperature of the gaseous stream (Tt) is more than 60ºC at the flow measurement point following Options B of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 2.0.0., and by converting the measured volumetric flow from wet basis to dry basis for calculation purposes ex post. No separate monitoring of temperature and pressure is necesseary since flowmeters that automatically express LFG volumes in normalized cubic meters will be used. The accuracy of the mass flow meter will be ± 1% Full Scale.

Data / Parameter:	**$Vt_{, db, flare}$**
Data unit:	m³ dry gas/h
Description:	Volumetric flow of landfill gas which is sent to flare in year y on a dry basis
Source of data:	Measured by a flow meter
Value(s) applied:	*Specific for each CPA*
Measurement methods and procedures	Volumetric flow measurement should always refer to the actual pressure and temperature. Instruments with recordable electronic signal (analogical or digital) are required
Monitoring frequency	Continuous
QA/QC procedures:	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is
Purpose of data	Calculation of baseline emissions
Additional comment:	This parameter will be monitored in Options A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 2.0.0. Under normal operation conditions, the volumetric flow of landfill gas which is sent to flare will be monitored as Vt, db, flare (m³ dry gas/h) since the temperature of the landfill gas (Tt) will be less than 60ºC at the flow measurement point most of the time. The values applied ex ante for this volumetric flow are considered to be in dry basis following way b) of Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 2.0.0 since this is the expected basis of the gas under normal operating conditions. Under abnormal operating conditions, the same volumetric flow will be named as Vt, wb, flare (m³ wet gas/h) in case of wet basis of the gas, demonstrating that the temperature of the gaseous stream (Tt) is more than 60ºC at the flow measurement point following Options B of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 2.0.0., and by converting the measured volumetric flow from wet basis to dry basis for calculation purposes ex post. No separate monitoring of temperature and pressure is necesseary since flowmeters that automatically express LFG volumes in normalized cubic meters will be used. The accuracy of the mass flow meter will be ± 1% Full Scale.

Data / Parameter:	**$Vt_{, db, electricity}$**
Data unit:	m³ dry gas/h
Description:	Volumetric flow of landfill gas which is used for electricity generation in year y on a dry basis
Source of data:	Measured by a flow meter
Value(s) applied:	*Specific for each CPA*
Measurement methods and procedures	Volumetric flow measurement should always refer to the actual pressure and temperature. Instruments with recordable electronic signal (analogical or digital) are required
Monitoring frequency	Continuous
QA/QC procedures:	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications
Purpose of data	Calculation of baseline emissions
Additional comment:	This parameter will be monitored in Options A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 2.0.0. Under normal operation conditions, the volumetric flow of landfill gas which is used for electricity generation will be monitored as Vt, db, electricity (m³ dry gas/h) since the temperature of the landfill gas (Tt) will be less than 60ºC at the flow measurement point most of the time. The values applied ex ante for this volumetric flow are considered to be in dry basis following way b) of Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 2.0.0 since this is the expected basis of the gas under normal operating conditions. Under abnormal operating conditions, the same volumetric flow will be named as Vt, wb, electricity (m³ wet gas/h) in case of wet basis of the gas, demonstrating that the temperature of the gaseous stream (Tt) is more than 60ºC at the flow measurement point following Options B of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 2.0.0., and by converting the measured volumetric flow from wet basis to dry basis for calculation purposes ex post. No separate monitoring of temperature and pressure is necesseary since flowmeters that automatically express LFG volumes in normalized cubic meters will be used. The accuracy of the mass flow meter will be ± 1% Full Scale.

Data / Parameter:	$v_{CH4,t,db}$
Data unit:	m³ CH4/m³ dry gas
Description:	Volumetric fraction of CH4 in a time interval t on a dry basis
Source of data:	Measured continuously by the project participant using certified equipment
Value(s) applied:	50%
Measurement methods and procedures	Continuous gas analyser operating in dry-basis. Volumetric flow measurement should always refer to the actual pressure and temperature
Monitoring frequency	Continuous
QA/QC procedures:	Calibration should include zero verification with an inert gas (e.g. N2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period
Purpose of data	Calculation of baseline emissions
Additional comment:	This parameter will be monitored in Options A and B of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 2.0.0. The accuracy of the meter will be ±0.2 to 1% Full Scale. Its calibration frequency would be 6 months. The meter has been installed in this first phase of the project activity in the main line between the flare and the booster.

Data / Parameter:	$EG_{PJ,y}$
Data unit:	MWh
Description:	Amount of electricity generated using LFG by the project activity in year y
Source of data:	Electricity meter
Value(s) applied:	*Specific for each CPA*
Measurement methods and procedures	Monitor net electricity generation by the project activity using LFG
Monitoring frequency	It will be measured continuously with electricity meter.
QA/QC procedures:	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double checked by the electricity distribution company
Purpose of data	Calculation of baseline emissions
Additional comment:	This parameter is required for calculating baseline emissions associated with electricity generation (BEEC,y) using the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"

Data / Parameter:	**$Op_{flare,h}$**
Data unit:	-
Description:	Operation of the flare that consumes the LFG
Source of data:	Project participants
Value(s) applied:	*Specific for each CPA*
Measurement methods and procedures	For the enclosed flare using the LFG monitor that the plant is operating in hour h by the monitoring any one or more of the following three parameters: • Temperature. Determine the location for temperature measurements and minimum operational temperature based on manufacturer's specifications of the burning equipment. The minimum threshold of the flare temperature of the project activity will be 500ºC as per the applicable methodology. • Flame. Flame detection system is used to ensure that the equipment is in operation; • Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnances. This option is not applicable to brick kilns) Opflare,h=0 when: • One of more temperature measurements are missing or below the minimum threshold in hour h (instantaneous measurements are made at least every minute); • Flame is not detected continuously in hour h (instantaneous measurements are made at least every minute); • No products are generated in the hour h Otherwise, Opflare,h=1
Monitoring frequency	Hourly
QA/QC procedures:	Not applicable
Purpose of data	Calculation of baseline emissions
Additional comment:	Data will be kept for at least two years after the end of the crediting period.

Data / Parameter:	$Op_{engine,h}$
Data unit:	-
Description:	Operation of the engine that consumes the LFG
Source of data:	Project participants
Value(s) applied:	*Specific for each CPA*
Measurement methods and procedures	For the engine using the LFG monitor that the plant is operating in hour h by the monitoring any one or more of the following three parameters: • Temperature. Based on manufacturer's specifications of the burning equipment, as per page 5 of the evidence "30. Technical Specifications JGC316GS", for biogas exhaust gas, minimum operational outlet temperature 180°C • Flame. Flame detection system is used to ensure that the equipment is in operation; • Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnances. This option is not applicable to brick kilns) Opengine,h=0 when: • One of more temperature measurements are missing or below the minimum threshold in hour h (instantaneous measurements are made at least every minute); • Flame is not detected continuously in hour h (instantaneous measurements are made at least every minute); • No products are generated in the hour h Otherwise, Opengine,h=1
Monitoring frequency	Hourly
QA/QC procedures:	Not applicable
Purpose of data	Calculation of baseline emissions
Additional comment:	Data will be kept for at least two years after the end of the crediting period.

Data / Parameter:	$Flame_m$
Data unit:	Flame on or Flame off
Description:	Flame detection of flare in the minute m
Source of data:	Project participants
Value(s) applied:	*Specific for each CPA*
Measurement methods and procedures	Measured using a Ultra Violet detector.
Monitoring frequency	Once per minute. Detection of flame recorded as a minute that the flame was on, otherwise recorded as a minute that the flame was off
QA/QC procedures:	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations
Purpose of data	Calculation of baseline emissions
Additional comment:	Data will be kept for at least two years after the end of the crediting period.

Data / Parameter:	**$EG_{EC,y}$**
Data unit:	MWh/yr
Description:	Amount of electricity consumed by the project activity in year y
Source of data:	For ex-ante purpose the value has been calculated with the value of the electrical consumption for ignition from the supplier. For expost estimation , electricity meter.
Value(s) applied:	*Specific for each CPA*
Measurement methods and procedures	The calculation procedures and methods will be defined according to the case presented during the crediting period for the project activity, according to one of the following possible scenarios: a) Electricity consumption from the grid; or b) Electricity consumption from (an) off-grid captive power plant(s); or c) Electricity consumption from the grid and (a) captive power plant(s).
Monitoring frequency	It will be measured continuously
QA/QC procedures:	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double checked by the electricity distribution company
Purpose of data	Calculation of project emissions
Additional comment:	For ex-ante purposes, it was followed case a) in order to estimate project emissions from electricity consumption from the grid.

Data / Parameter:	**$T_{EG,m}$**
Data unit:	°C
Description:	Temperature in the exhaust gas of the flare.
Source of data:	On-site measurements
Value(s) applied:	No value was estimated.
Measurement methods and procedures	Measure the temperature of the exhaust gas stream in the flare by a thermocouple. A temperature above 500 ºC indicates that a significant amount of gases are still being burned and that the flare is operating,
Monitoring frequency	It will be measured at least once per minute using a thermocouple.
QA/QC procedures:	Thermocouples will be replaced or calibrated every year.
Purpose of data	Calculation of baseline emissions
Additional comment:	An excessively high temperature at the sampling point may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow. The point of measurements (sampling points) are four, distributed along the flare stack. The accuracy of the meter will be ± 99.8% accuracy. Its calibration frequency would be 12 months. The thermocupless will be installed along the flare stack.

Data / Parameter:	**TDL_y**
Data unit:	%
Description:	Average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.
Source of data:	Use as default values of 20% for project or leakage electricity consumption sources as per "*Tool to calculate project emissions from electricity consumption" version 01.*
Value(s) applied:	Specific for each CPA
Measurement methods and procedures	TDL 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).
Monitoring frequency	Default value of average technical transmission and distribution losses will be used so its monitoring frequency is not relevant for its accuracy.
QA/QC procedures:	N/A
Purpose of data	Calculation of baseline emissions and Calculation of project emissions
Additional comment:	N/A

Data / Parameter:	**$FC_{i,j,y}$**
Data unit:	m^3/year
Description:	Quantity of fuel type i combusted in process j during the year y
Source of data:	Onsite measurements for ex post estimation. No value has been estimated ex ante.
Value(s) applied:	*Specific for each CPA*
Measurement methods and procedures	As per the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion": -Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); -Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; -In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions.
Monitoring frequency	Continuously as per the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion".
QA/QC procedures:	The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Purpose of data	Calculation of project emissions
Additional comment:	For ex-ante calculation purposes, there will be no fossil fuel consumption at project scenario, but any eventual fossil fuel consumption during project activity will be accounted for with purchase receipts or invoices.

<table>
<tr><td>Data / Parameter:</td><td colspan="2">$NCV_{i,y}$</td></tr>
<tr><td>Data unit:</td><td colspan="2">GJ/m3</td></tr>
<tr><td>Description:</td><td colspan="2">Weighted average net calorific value of fuel type i in year y</td></tr>
<tr><td rowspan="6">Source of data:</td><td colspan="2">The following data sources may be used if the relevant conditions apply:</td></tr>
<tr><td>Data source</td><td>Conditions for using the data source</td></tr>
<tr><td>a) Values provided by the fuel supplier in invoices</td><td>a) will be available.</td></tr>
<tr><td>b) Measurements by the project participants</td><td>b) will not be applied, because a) will be available</td></tr>
<tr><td>c) Regional or national default values</td><td>c) will not be applied, because a) will be available</td></tr>
<tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If a) is not available, IPCC default values will be used according to left column.</td></tr>
<tr><td>Value(s) applied:</td><td colspan="2">Specific for each CPA</td></tr>
<tr><td>Measurement methods and procedures</td><td colspan="2">For a) Measurements should be undertaken in line with national or international fuel standards</td></tr>
<tr><td>Monitoring frequency</td><td colspan="2">For a) : The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For d): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>QA/QC procedures:</td><td colspan="2">Verify if the values under a) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a) should have ISO17025 accreditation or justify that they can comply with similar quality standards.</td></tr>
<tr><td>Purpose of data</td><td colspan="2">Calculation of project emissions</td></tr>
<tr><td>Additional comment:</td><td colspan="2">Applicable where Option B is used</td></tr>
</table>

Data / Parameter:	**$EF_{CO2,i,y}$**	
Data unit:	tCO2/GJ	
Description:	Weighted average CO2 emission factor of fuel type i in year y	
Source of data:	The following data sources may be used if the relevant conditions apply:	
	Data source	Conditions for using the data source
	a) Values provided by the fuel supplier in invoices	a) will be available.
	b) Measurements by the project participants	b) will not be applied, because a) will be available
	c) Regional or national default values	c) will not be applied, because a) will be available
	d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If a) is not available, IPCC default values will be used according to left column.
Value(s) applied:	*Specific for each CPA*	
Measurement methods and procedures	For a) Measurements should be undertaken in line with national or international fuel standards	
Monitoring frequency	For a) : The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For d): Any future revision of the IPCC Guidelines should be taken into account	
QA/QC procedures:	Applicable where option B is used. For a): If the fuel supplier does provide the NCV value and the CO2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO2 factor should be used. If another source for the CO2 emission factor is used or no CO2 emission factor is provided, Option d) should be used.	
Purpose of data	Calculation of project emissions	
Additional comment:	Applicable where Option B is used	

Data / Parameter:	**T_t**
Data unit:	K
Description:	Temperature of the gaseous stream in time interval t
Source of data:	NA
Value(s) applied:	NA
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required. Monitoring frequency, continuous unless differently specified in the underlying methodology. Under Option B of the the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 2.0.0, the parameter is used to determine the saturation pressure of H2O at temperature Tt (mH2O,t,db), which in turn will be used to calculate the volumetric fraction of H2O in time interval t on a dry basis (vH2O,t,db) for the calculation of the volumetric flow of the gaseous stream in time interval t on a dry basis (Vt,db).
Monitoring frequency	It will be measured continuosly using a thermo resistance.
QA/QC procedures:	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications. The accuracy of the temperature meter will be ± 1% Full Scale.
Purpose of data	Calculation of baseline and project emissions
Additional comment:	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being below 60° C is adopted, this parameter must be monitored continuously to assure the applicability condition is met.

Data / Parameter:	**P_t**
Data unit:	Pa
Description:	Pressure of the gaseous stream in time interval t
Source of data:	NA
Value(s) applied:	NA
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required. Monitoring frequency, continuous unless differently specified in the underlying methodology. Under Option B of the the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", version 2.0.0, the applicability condition related to the gaseous stream flow temperature being above 60ºC is adopted and therefore, this parameter must be monitored continuously to calculate the absolute humidity (mH2O,t,db).
Monitoring frequency	It will be measuredat least once per hour using a continuous gas analyser.
Purpose of data	Calculation of baseline and project emissions
QA/QC procedures:	Periodic calibration against a primary must be performed periodically and records of calibration procedures must be kept available as well as the primary device and its calibration certificate. Pressure transducers (either capacitive or resistive) must be calibrated monthly.
Additional comment:	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency).

Data / Parameter:	**$p_{H20,t,Sat}$**
Data unit:	Pa
Description:	Saturation pressure of H2O at temperature Tt in time interval t
Source of data:	[1] Fundamentals of Classical Thermodynamics; Gordon J. Van Wylen, Richard E. Sonntag and Borgnakke; 4º Edition 1994, John Wiley & Sons, Inc. That documantations has been provided with the document attached "41.Tables_Tsat_Fundamentals of Classical Thermodynamics; Gordon J."
Value(s) applied:	N/A
Measurement methods and procedures	This parameter is solely a function of the gaseous stream temperature Tt and can be found at reference [1] for a total pressure equal to 101,325 Pa
Monitoring frequency	N/A
Purpose of data	Calculation of baseline and project emissions
QA/QC procedures:	N/A
Additional comment:	[1] Fundamentals of Classical Thermodynamics; Gordon J. Van Wylen, Richard E. Sonntag and Borgnakke; 4º Edition 1994, John Wiley & Sons, Inc. That documantations has been provided with the document attached "41.Tables_Tsat_Fundamentals of Classical Thermodynamics; Gordon J."

B.7.2. Description of the monitoring plan for a generic CPA

Each CPA under this PoA will develop an operational plan that defines a standard against which the project performance will be measured in terms of its emission reductions and compliance with all standards and criteria under the PoA. Monitoring will be the responsibility the landfill operators at each individual site. The monitoring plan has the following purposes:

- Establish and maintain a reliable and accurate monitoring system
- Provide guidance for the participants on the implementation of necessary measurement and record management procedures;
- Provide guidance for properly transmit monitoring reports to Puresphere Ghana Limited;
- Guidance for meeting or exceeding CDM requirements for verification and certification purposes

The monitoring plan covers:

1) Monitoring team members' duties and routine reminders;
2) Monitoring schedules;
3) QA/QC procedures;
4) Service forms for data reporting;
5) Corrective action and maintenance plans;

The monitoring methodology is based on direct measurement of the amount of landfill gas captured and destroyed at the flare platform(s) and the electricity generating unit(s) to determine the amount of LFG destroyed. The monitoring plan provides for continuous measurement of the quantity of LFG used and quality of LFG flared.

Flow meters and gas analyzers will be recording continuously the amount of LFG destroyed/used in each CPA. This equipment is very sensitive, so rigid QA/QC procedures for equipment maintenance and calibration will be developed and performed by each landfill manager[19], who also will ensure that proper monitoring procedures are performed and monitoring information is sent on a regular basis to Puresphere Ghana Limited.

All landfill facilities will have all monitoring devices on-site.

Devices and Methods for Data Collection:

Electricity consumption: Standard electricity meters will be used for monitoring electric consumption.

Biogas measurements: Flow meters, gas analyzers, thermocouples, and pressure meters will be used to determine the amount of methane that is flared/used at each CPA. Meters shall be subject to regular maintenance, testing and calibration.

Monitored Data:

Each CPA staff has operational and data collection obligations to fulfill, in order to maximize the GHG emissions reductions, ensuring that sufficient information is available to calculate ERs in a transparent and verifiable manner, allowing a fast and successful verification of these ERs.

[19] Regular calibration of the monitoring devices will be undertaken by those responsible for the measurements, as per manufacturer specifications. Archiving of calibration report will be done both in hard copies and in soft copies.

Puresphere Ghana Limited will take responsibility for the collection of monitored data in each CPA, the emission reduction estimates, producing the monitoring reports and reporting to the DOE. Puresphere Ghana Limited will also maintain all necessary data to undertake this PoA monitoring plan, such as a list of all projects under review for inclusion in the PoA and the performing data and parameters for each registered CPA. All data provided by CPA operators will be checked for completeness and quality and placed on a central database owned by Puresphere Ghana Limited. All data recording of the monitored data will include paper and electronic versions, backup systems and periodic checking for data entry mistakes. All records will be kept for at least 2 years after the end of the crediting period.

Appendix 1. Contact information on entity/individual responsible for the PoA

Organization	Puresphere Ghana Limited
Street/P.O. Box	Effia-Anaji
Building	CKMAN
City	Takoradi
State/Region	Western Region
Postcode	
Country	Ghana
Telephone	+233 243 432 269
Fax	
E-mail	mark@bluespherecorporate.com
Website	
Contact person	Mark Radom
Title	Director of Puresphere Ghana Limited
Salutation	Mr.
Last name	Radom
Middle name	
First name	Mark
Department	
Mobile	+233 243 432 269
	+233 243 432 269
	mfradom@gmail.com

Appendix 2. Affirmation regarding public funding

There is no public funding from Annex I countries for the proposed PoA.

Appendix 3. Application of methodology(ies)

Refer to sections B.2 of Parts I. and II. and B.6.1 of Part II.

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

Further background information on methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site

The methane generation from the landfill in the absence of the project activity at year y (BECH4,SWDS,y), is calculated as per the "Emissions from solid waste disposal sites" V6.0.1 as follows:

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

Where:

$BE_{CH4,SWDS,y}$	=	Methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)
Φ	=	Model correction factor to account for model uncertainties
f	=	Fraction of methane captured at the SWDS and fla□ed, combusted or used in another manner
GWP_{CH4}	=	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
OX	=	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
F	=	Fraction of methane in the SWDS gas (volume fraction)
DOC_f	=	Fraction of degradable organic carbon (DOC) that can decompose
MCF	=	Methane correction factor
$W_{j,x}$	=	Amount of organic type j prevented from disposal in the SWDS in the year x (tonnes)
DOC_j	=	Fraction of degradable organic carbon (by weight) in the waste type j
k_j	=	Decay rate for the waste type j
j	=	Waste type category (index)
x	=	Year since the landfill started receiving wastes [x runs from the first year of landfill operation (x=1) to the year for which emissions are calculated (x=y)] Note: this definition represents a correction of the Tool as given in ACM0001, V.15.0.0.
y		Year for which methane emissions are calculated

Since ACM0001, V.15.0.0 further clarifies that "*Sampling to determine the different waste types is not necessary; the waste composition can be obtained from previous studies*", this

option has been used in this occasion.

ACM0001, V.15.0.0 also states: "*The efficiency of the degassing system which will be installed in the project activity should be taken into account while estimating the ex-ante estimation*." This is taken into consideration through the utilization of capture efficiency value for the total of biogas generated..

At the renewal of the crediting period, the following data should be updated according to default values suggested in the most recently published IPCC Guidelines for National Greenhouse Gas Inventories:

- Oxidation factor (*OX*);
- Fraction of methane in the SWDS gas (*F*);
- Fraction of degradable organic carbon (*DOC*) that can decompose (DOC_f);
- Methane correction factor (*MCF*);
- Fraction of degradable organic carbon (by weight) in each waste type *j* (*DOCj*);
- Decay rate for the waste type *j* (k_j).

Respectively, if the most recent IPCC Guidelines suggest different categorization of waste types, solid waste disposal sites or climate conditions, these should be applied respectively.

Determining the amounts of waste types j disposed in the SWDS (Wj,x or Wj,i)

Since only one type of waste is disposed in the landfill site (in this case municipal solid waste) then Wj,x = Wx and Wj,i = Wi and the waste sampling is not required. For such reason, Application A of the Methodological Tool "Emissions from solid waste disposal sites." (Version 06.0.1) will be used in the PoA as follows:

The administration the site had the specific information on historic information on amounts, composition and origin of the waste in SWDS administration documents, such data is used as a more reliable data

The following inputs have been used to calculate the BECH4,SWDS,y.using equation (1) of the tool "Emissions from solid waste disposal sites" version 06.0.1.:

Table () Baseline determination information

DATA	VALUE	UNIT	SOURCE
Year of opening			
Year of closure			
Waste composition			
MCF			
K (decay rate) Wood and wood products Pulp, paper and cardboard Food waste Textiles			

Garden waste Inert waste			
DOCf			
DOCj Wood and wood products Pulp, paper and cardboard Food waste Textiles Garden, Yard and Park Waste Inert waste			

Table (). Domestic waste to be deposited annually in the landfill

Waste deposition data	
Year	**Domestic waste load (tons)**

Table () Mean annual meteorological values: temperature and rainfall.

Month	**Mean temperature (Celsius)**	**Mean precipitation (mm)**
Jan		
Feb		
Mar		

Apr		
May		
Jun		
Jul		
Aug		
Sep		
Oct		
Nov		
Dec		
Mean annual		

As a result of the calculation explain above, the following table are the results of the BECH4,SWDS,y:

Table (). Methane in the LFG that is generated from the SWDS

Year	$BE_{CH4,SWDS,y}$

Further background information on baseline emissions:

The ex ante estimation of the amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (FCH4,PJ,Y) has been carried using the latest version of the approved “Emissions from solid waste disposal sites” V.6, considering the following additional equation:

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

(5) equation of the ACM0001 V.15.0.0

Variable		Definition	Comments
$BE_{CH4,SWDS,y}$	=	Methane generation from the landfill in the absence of the project activity at year *y* (tCO_2e), calculated as per the “Emissions from solid waste disposal sites” V6. The tool estimates methane generation adjusted for, using adjustment factor (f) any landfill gas in the baseline that would have been captured and destroyed to comply with relevant regulations or contractual requirements, or to address safety and odor concerns. As this is already accounted for in equation 2, “f” in the tool shall be assigned a value 0.	• In the tool, x will refer to the year since the landfill started receiving wastes [x runs from the first year of landfill operation (x=1) to the year for which emissions are calculated (x=y)]; • A study developed by the project participant reports the waste composition.
η_{PJ}		Efficiency of the LFG capture system that will be installed in the project activity	

As a result of the calculation explain above, the following table are the results of the FCH4,PJ,y.

Table (). Amount of methane in the LFG which is flared and/or used in the project activity.

Period			**$BE_{CH4,SWDS,y}$ (tonnes of CO2)**	**$\eta_{,PJ}$**	**$F_{CH4,PJ,y}$ (tonnes of CH4)**
Period Year	**Start Date**	**End Date**			

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

(2) equation of the ACM0001 V.15.0.0

Where:

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

$F_{CH4,BL,y}$	=	Amount of methane in the LFG that would be flared in the baseline in year *y* (t CH_4/yr)
GWP_{CH4}	=	Global warming potential of CH4 (t CO_2e/t CH_4)

Finally the result of obtain the baseline emission in the project activity are the following table

Table (). Baseline emissions of LFG

Period			$F_{CH4,PJ,y}$ (tonnes of CH4)	$F_{CH4,BL,y}$ (tonnes of CH4)	$BE_{CH4,y}$ (tonnes of CO2)
Period Year	Start Date	End Date			

<u>Further background information on project emissions due to electricity consumed on site</u>

Project emissions reductions due to electricity displaced from the grid are estimated through the "Tool to calculate the emission factor for an electricity system"– Version 4.0.

Appendix 5. Further background information on the monitoring plan

Please refer to section B.7.2. – Description of the monitoring plan for a CPA

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Document information

Version	*Date*	*Description*
03.0	3 December 2012	Revision to clarify the determination of the start date for a PoA and the documentation requirement for generic CPA-DDs. (EB 70, Annex 6).
02.0	11 May 2012	EB 66, Annex 12 Revision required to ensure consistency with the "Guidelines for completing the programme design document form for CDM programmes of activities".
01.0	2 March 2012	EB 33, Annex 41 Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: issuance
Keywords: project design document, programmes of activities