CLEAN DEVELOPMENT MECHANISM
PROGRAMME OF ACTIVITIES DESIGN DOCUMENT FORM
(CDM-PoA-DD) Version 01

CONTENTS

Annexes

NOTE:

This form is for the submission of a CDM PoA whose CPAs apply a large scale approved methodology.

At the time of requesting registration this form must be accompanied by a CDM-CPA-DD form that has been specified for the proposed PoA, as well as by one completed CDM-CPA-DD (using a real case).

SECTION A. General description of programme of activities (PoA)

A.1 Title of the programme of activities:

Landfill Gas Utilisation Programme of South Africa

Version 01
Date: 21/11/2011

A.2. Description of the programme of activities:

1. General operating and implementing framework of PoA

Under this PoA, landfill gas (LFG) will be captured at participating landfills in South Africa. LFG consists mainly of carbon dioxide (CO_2) and methane (CH_4). CH_4 is a strong greenhouse gas (GHG) having 21 times the global warming potential of CO_2. The captured LFG will be flared and/or used in electricity generating units. In both processes LFG is combusted and the methane fraction within the LFG is destroyed.

The CDM project activities (CPAs) will be implemented within the proposed PoA by landfill gas owners/operators/concessionaires (end-users) who meet the criteria set by the coordinating entity (CME) as outlined in this PoA-DD. These end-users will enter into an inclusion agreement with the CME.

2. Policy/measure or stated goal of the PoA

The goal of the proposed PoA is:

- to contribute to the sustainable development of South Africa;
- to reduce Greenhouse Gas (GHG) emissions and adverse environmental effects of landfill gas; and
- to increase the use of renewable energy sources in South Africa.

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

The implementation of this PoA is a voluntary action by the coordinating entity. There are no mandatory requirements in South Africa stipulating capturing and utilisation of the landfill gas[1],and the PoA requires interested parties to take voluntary action to participate in the programme activities.

Contribution to sustainable development

The proposed PoA will contribute to the region's sustainable development in the following ways:

- The programme will reduce greenhouse gas (GHG) emissions by avoiding emissions:
    - of landfill gas (LFG) to the atmosphere; and/or
    - through the substitution of grid electricity use.

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[1] Department of Water Affairs and Forestry Republic of South Africa (1998): Minimum requirements for waste disposal by landfill, available at: http://www.sawic.org.za/documents/266.PDF

- Apart from the greenhouse gas effect, uncontrolled landfill gas emissions are responsible for odour nuisance and create risk of explosion. By implementing the proposed PoA, odour nuisance and explosion probability will be significantly reduced and safety conditions will be improved;
- Utilisation of the LFG for generation of electricity will increase the use of renewable sources in South Africa;
- The proposed PoA involves the transfer of technology for efficient capture and utilisation of the LFG. In addition, there will also be knowledge transfer and capacity building related to implementation of the proposed PoA.
- The implementation of the proposed PoA will require additional workforce, especially during the set-up of a particular CPA, but also during the operation of the programme for monitoring and operation gas capture system and therefore will create new job opportunities.

A.3. Coordinating/managing entity and participants of PoA:

Name of Party involved (*) ((host) indicates a host Party)	**Private and/or public entity (ies) project participant (*) (as applicable)**	**Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)**
The Republic of South Africa (host)	Landfill Carbon(Pty) Ltd.	No
Netherlands	Do-inc. business B.V.	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

ENER-G Systems (Pty) Ltd. (Ener-G) is a partnership between ENER-G Plc Group and General Energy Systems (Pty) Ltd. Ener-G finances, designs, builds, and operates landfill gas to energy projects in South Africa. To this end ENER-G Systems has establish a company called Landfill Carbon (PTY) LTD to act as the coordinating and managing entity (CME) for the PoA.

Do-inc.– Project Consultant - offers consultancy for the development and documentation of the PoA project. Do-inc will furthermore provide guidance to the monitoring plan and the documentation and presentation of the monitoring results to the validator and the UNFCCC.

Full contact information for the project participants is provided in Annex 1.

A.4. Technical description of the programme of activities:

Under each CDM Project Activity (CPA) of this PoA, systems to capture landfill gas (LFG) are installed. Captured landfill gas is flared and/or used to generate electricity.

A.4.1. Location of the programme of activities:

Boundary of the Republic of South Africa. Anywhere in the document where it is stated "South Africa" as a reference to the geographic boundary of the PoA it could also mean "other countries added post registration".[2]

A.4.1.1. Host Party(ies):

The Republic of South Africa

A.4.1.2. Physical/ Geographical boundary:

The boundary of the proposed PoA is the Republic of South Africa. Anywhere in the document where it is stated "South Africa" as a reference to the geographic boundary of the PoA it could also mean "other countries added post registration"

Figure 1. Map of the Republic of South Africa[3]

A.4.2. Description of a typical CDM programme activity (CPA):

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[2] EB60/Annex 26 (II.6), Clarifications regarding the "Procedures for Registration of a Programme of Activities as a single CDM Project Activity and issuance of Certified Emission Reductions for a Programme of Activities (version 01). Available at: http://cdm.unfccc.int.

[3] Source: http://www.thecommonwealth.org/YearbookHomeInternal/139444/

All CDM project activities (CPAs) under the proposed PoA consist of capturing landfill gas and of its efficient flaring and of the intentional energetic utilisation of the gas for the purpose of electricity production.

A.4.2.1. Technology or measures to be employed by the CPA:

The technology installed under the project activity consists of:
1) Network of vertical and/or horizontal wells;
2) Collection piping system;
3) Gas pre-treatment system;
4) Enclosed flare;
5) Electricity generation unit*;
6) Transformers and grid connection*.

*) optional – dependent on size, location and state of the respective landfill.

The general design of the installation for capturing and utilisation of the landfill gas is presented on the scheme below.

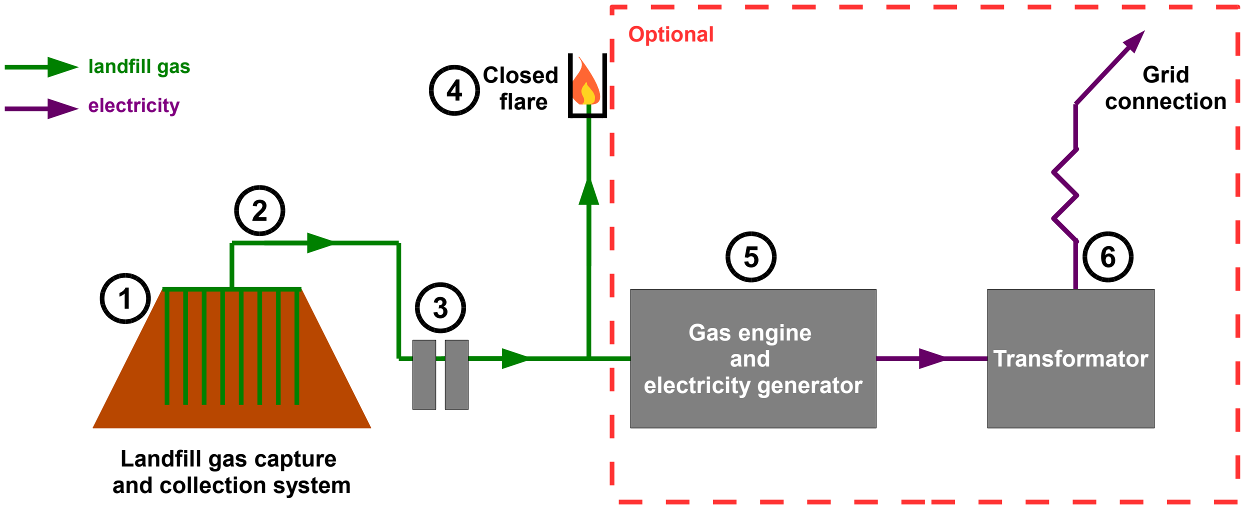

Figure 2. Scheme of the installation

A.4.2.2. Eligibility criteria for inclusion of a CPA in the PoA:

Each CPA proponent must fulfil the following eligibility criteria in order to be registered under the proposed PoA:

1. The CPA is within the Republic of South Africa and hence it's boundary is consistent with the geographical boundary of the PoA.
2. Documentary evidence that the start date of the CPA is not prior to the commencement of validation of the programme of activities.
3. In the baseline scenario the landfill gas is (baseline scenario LFG2):
    a. released into the air OR

   b. partially captured and/or vented to comply with regulations or contractual requirements, or to address safety and odour concerns OR
   c. partially captured and/or inefficiently flared to comply with regulations or contractual requirements, or to address safety and odour concerns.
4. In the baseline scenario the electricity is:
   a. Obtained from an existing/ new fossil based captive power plant (baseline scenario P4) OR
   b. Obtained from the grid (baseline scenario P6).
5. The project scenario comprises of the capturing of landfill gas and the subsequent:
   a. flaring in an enclosed flare OR
   b. usage for energy generation with an enclosed emergency flare.
6. The CPA owner assures unique identification of the location by erecting a sign on site stating that the CPA is part of the 'Landfill Gas Utilisation Programme of South Africa'.
7. The CME has checked and confirmed that the CPA is neither registered as an individual CDM project nor included under another registered PoA.
8. The CPA complies with applicability criteria of methodology ACM0001 Consolidated baseline and monitoring methodology for landfill gas projects activities (Version 11.0) used in the PoA.
9. The CPA owner has evidenced ownership of and/or permit for the use of the landfill gas produced at project site.
10. A stakeholder consultation has been performed at CPA level.
11. An additionality analysis has been performed at CPA level.
12. If required by relevant South African legislation, an Environmental Impact Assessment (EIA) has been performed.
13. No diversion of official development assistance has taken place in case the CPA receives funding from an Annex I parties.
14. The CPA owner has contractually ceded any claims to the CERs generated to the CME.
15. The CPA complies with either scenario A, B or C of the *Tool to calculate baseline, project and/or leakage emissions from electricity consumption* (Version 01)
16. The CPA uses
   a. the *Tool to calculate the emission factor for an electricity system* (Version 02.2.1) when supplying electricity to the national grid OR
   b. the emission factor of a captive power plant when replacing the electricity of that plant

A.4.3. Description of how the anthropogenic emissions of GHG by sources are reduced by a CPA below those that would have occurred in the absence of the registered PoA (assessment and demonstration of additionality):

The following arguments evidence the additionality of the proposed PoA as a whole:

- The proposed programme is a voluntary coordinated action;
- No mandatory standards exist in the Republic of South Africa concerning the destruction of LFG.

A.4.4. Operational, management and monitoring plan for the programme of activities:

A.4.4.1. Operational and management plan:

The operational set-up of the PoA is depicted in Figure 3.

Each CPA-owner will be responsible for providing the raw data, workbooks and supporting documents for its CPA to the CME. For the main parameters in the CPA a third party monitoring service provider is

to collect the monitoring data from the CPA projects activities (telemetry). The raw monitoring data will be provided back to each CPA and will be compiled in a workbook together with the project activity's monitoring data. The workbook combined with the supporting documents will be provided to the CME. The CME obtains the raw monitoring data directly from the third party monitoring service provider too, to ensure the integrity of the monitoring data of the CPA.
The CME will be responsible for the regular collection and storage of the monitoring data for each CPA under the PoA. The CME checks this data for quality and consistency. The raw data from the monitoring service provide can be disclosed directly to the verifying DOE for verification purposes.

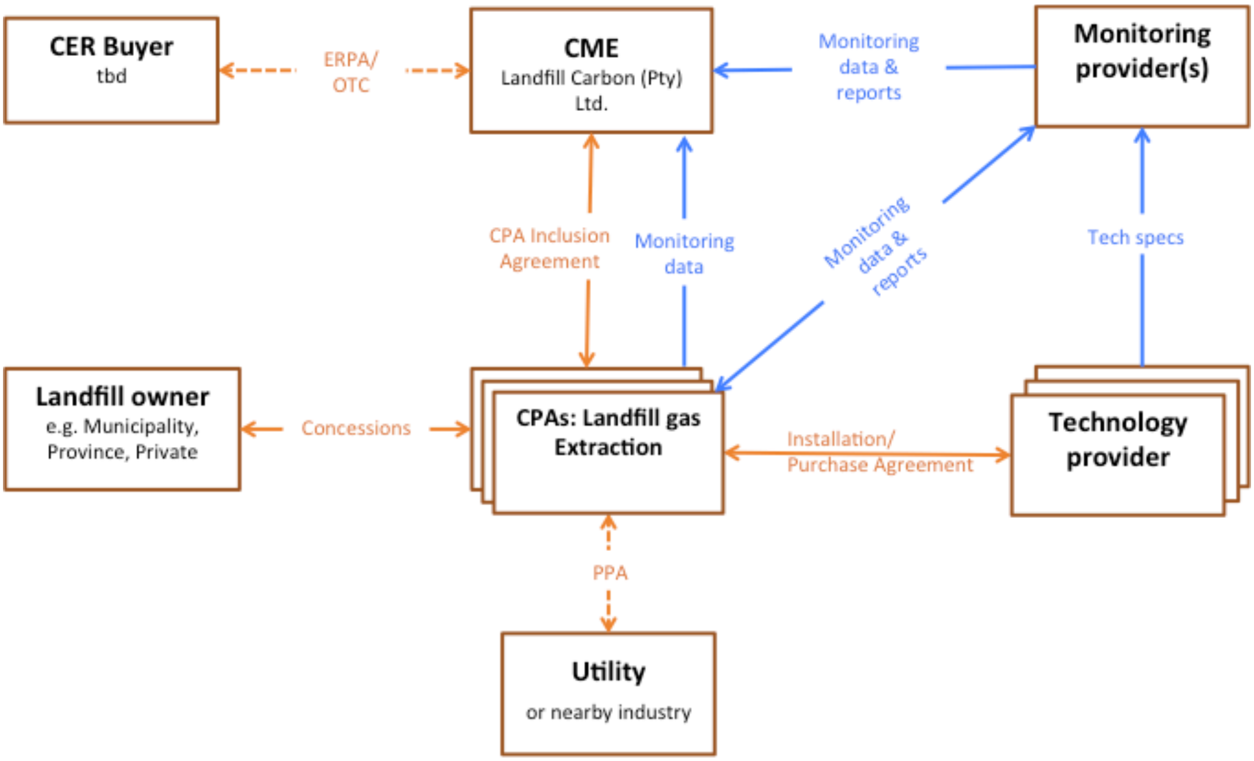

Figure 3. Organisation of the PoA

Inclusion procedure for new CPAs

The process of including a CPA into the proposed PoA is as follows:

1) Letter of Intent – A Letter of Intent (LoI) is signed by the CME and a landfill gas operator/owner confirming the intention to become a part of the proposed PoA;
2) Inclusion criteria check – After signing of the LoI, the CME checks if the CPA can meet the criteria for inclusion as a CPA under the PoA;
3) Inclusion Agreement – after successful inclusion criteria check, an inclusion agreement shall be negotiated and signed. The inclusion agreement is the contractual document defining responsibilities and requirements for the development of the CPA and amongst others the inclusion criteria mentioned in section A.4.2.2;
4) Data gathering and documentation – after signing the inclusion agreement, the CPA proponent will provide the CME with all documents& support that are necessary to prepare CPA-DD;

5) CPA-DD preparation – the CME together with the CPA owner will develop the CPA-DD. The CPA-DD will be submitted to the DOE for inclusion under the PoA.
6) Inclusion of the CPA under the PoA– the DOE includes the CPA under the PoA after it confirms its eligibility and compliance with the UNFCCC PoA regulations.

As required by the PoA rules the CME has furthermore established an operational and management plan, which includes:

a) Record keeping system for each CPA under the PoA;
b) System/procedure to avoid double accounting e.g. to avoid the case of including a new CPA that has been already registered either as CDM project activity or as a CPA of another PoA.

CPA record keeping

Detailed information of each CPA included in the proposed PoA will be stored in a database according to record keeping requirements established by the CME. These requirements cover the following variables:

1) Name and ID number of the CPA
2) Details of the CPA landfill (i.e. GPS coordinates, area, waste mix)
3) Name and address of the CPA owner
4) Technical details of the system installed at the landfill (i.e. electricity/heat generators, power capacity)
5) Monitoring results (i.e. the amount of LFG captured, electricity generated, CH_4 content)

Procedure to avoid double counting

In order to avoid double counting the CME will verify and confirm that the proposed CPA has not yet been registered either as CDM project activity or as a CPA of another PoA by checking this information in the UNFCCC CDM database and with the South African DNA and erect a sign on site stating that the CPA is part of the PoA. These are two of the inclusion criteria mentioned above in A.4.2.2 and are prerequisite for an inclusion agreement to be signed between the CME and a CPA proponent.

A.4.4.2. Monitoring plan:

The coordinating entity will implement a verification system on the PoA level to determine the GHG abatement created by the PoA as a whole. The resulting programme database includes the data sets that can be directly attributed to each CPA within the PoA. Thereby it allows for unambiguous determination of the emission reductions achieved by each CPA. Monitoring reports will be prepared separately for each of the CPAs for the purpose of verification and request for issuance of CERs.

The general scheme of the monitoring plan is presented below and covers all CPAs included in the PoA. Parameters related with electricity generation will be collected and entered manually into a Workbook. Flare monitored parameters will be collected via telemetry to the Monitoring Provider (as CSV files), and then included in the Workbook.
Secondary data (e.g. replacement of defaulting measuring units, calibration reports, on-site energy consumption is also aggregated in the monthly data report.
The Workbook will be checked by the CME to ensure correctness and consistency of aggregated data. The CME will be responsible for compiling a Monthly Data Report which will sent back to the CPA owners for comments and final check. All monitored parameters will be archived electronically by the CPA owners & CME.

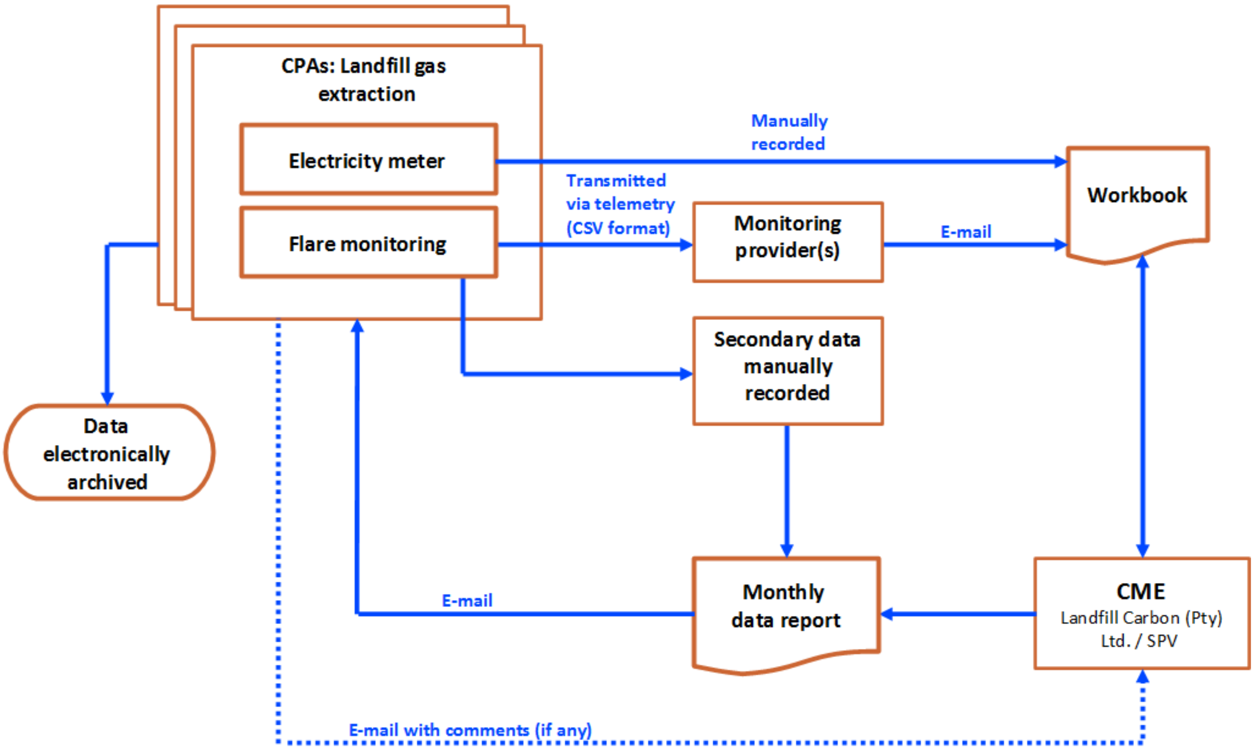

Figure 4. General scheme of the monitoring plan

A.4.5. Public funding of the programme of activities:

The PoA does not obtain public funding.

SECTION B. Duration of the programme of activities

B.1. Starting date of the programme of activities:

01/05/2012

B.2. Length of the programme of activities:

28 years

C.1. Please indicate the level at which environmental analysis as per requirements of the CDM modalities and procedures is undertaken. Justify the choice of level at which the environmental analysis is undertaken:

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

C.2. Documentation on the analysis of the environmental impacts, including transboundary impacts:

Not Applicable. Analysis is done at CPA level.

C.3. Please state whether in accordance with the host Party laws/regulations, an environmental impact assessment is required for a typical CPA, included in the programme of activities (PoA),:

Yes, a basic environmental assessment (EIA) is required for a typical CPA included under the PoA as per Environmental Impact Assessment Regulations (GN 385, 21 April 2006) of the National Environmental Management Act (NEMA) No 107 of 1998. However this act is currently being redrafted and it is expected that – when approved – landfill gas utilisation projects will be exempted from performing an EIA.

SECTION D. Stakeholders' comments

D.1. Please indicate the level at which local stakeholder comments are invited. Justify the choice:

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

Note: If local stakeholder comments are invited at the PoA level, include information on how comments by local stakeholders were invited, a summary of the comments received and how due account was taken of any comments received, as applicable.

D.2. Brief description how comments by local stakeholders have been invited and compiled:

Not applicable.

D.3. Summary of the comments received:

Not applicable.

D.4. Report on how due account was taken of any comments received:

Not applicable.

SECTION E. Application of a baseline and monitoring methodology

E.1. Title and reference of the approved baseline and monitoring methodology applied to each CPA included in the PoA:

The proposed PoA uses the approved large-scale baseline and monitoring methodology:

- ACM0001 *Consolidated baseline and monitoring methodology for landfill gas projects activities* (Version 11.0)

The programme will use the following tools:

- *Tool for the demonstration and assessment of additionality* (Version 05.2.1);
- *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site* (Version 05.1.0);
- *Tool to calculate baseline, project and/or leakage emissions from electricity consumption* (Version 01);
- *Tool to determine project emissions from flaring gases containing methane* (Version 01);
- *Tool to calculate the emission factor for an electricity system* (Version 02.2.1);
- *Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion* (Version 02).

E.2. Justification of the choice of the methodology and why it is applicable to each CPA:

The methodology ACM0001 *Consolidated baseline and monitoring methodology for landfill gas projects activities* (Version 11.0) is applicable because the project activities fulfil the following criteria:

a) the captured gas is flared and/or
b) the captured gas is used to produce electricity.

Applicability of *Tool for the demonstration and assessment of additionality* (Version 05.2.1):
The tool for demonstration and assessment of additionality provides a general framework demonstrating and assessing additionality and is applicable to a wide range of project types. As referred in methodology ACM0001 (Version 11.0), the additionality tool is applicable for the proposed project activity.

Applicability of *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site* (Version 05.1.0):
The tool calculates baseline emissions of methane from waste that would in the absence of the project activity be disposed at solid waste disposal sites (SWDS). The tool is applicable as the solid waste disposal site where the waste would be dumped can be clearly identified. Project participants will not use the tool for determining any methane emissions from hazardous wastes.

Applicability of *Tool to calculate baseline, project and/or leakage emissions from electricity consumption* (Version 01):
This tool provides procedures to estimate the baseline, project and/or leakage emissions associated with the consumption of electricity. The tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption:

Ref	Applicability Criteria
A	**Electricity consumption from the grid**. The electricity is purchased from the grid only. Either no captive power plant is installed at the site of electricity consumption or, if any on-site captive power plant exists, it is not operating or it can physically not provide electricity to the source of electricity consumption.
B	**Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s).** One or more fossil fuel fired captive power plants are installed at the site of electricity consumption source and supply the source with electricity. The captive power plant(s) is/are not connected to the electricity grid.
C	**Electricity consumption from the grid and (a) fossil fired captive power plant(s).** One or more fossil fuel fired captive power plants operate at the site of electricity consumption source. The captive power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumption source can be provided with electricity from the captive power plant(s) and the grid.

No CPA will install captive renewable power generation technologies to provide electricity in the project activity, in the baseline scenario or to sources of leakage. Each CPA will justify that it will comply with the applicability criteria related to this tool and that hence the *Tool to calculate baseline, project and/or leakage emissions from electricity consumption* (Version 01) is applicable to the project activity.

Applicability of *Tool to determine project emissions from flaring gases containing methane* (Version 01):

The tool provides procedures to calculate project emissions from flaring of a residual gas stream containing methane. Applicability of *Tool to determine project emissions from flaring gases containing methane* (Version 01) is discussed below:

Ref	Applicability Criteria	Justification
a	The residual gas stream to be flared contains no other combustible gases than methane, carbon dioxide and hydrogen.	In the proposed project activities under this PoA only the captured LFG, which contains no other combustible gases than methane, carbon dioxide or hydrogen is flared in case of emergency or unavailability of the project equipment for electricity production.
b	The residual gas stream to be flared shall be obtained from decomposition of organic material (through landfills, bio-digesters or anaerobic lagoons, among others) or from gases vented in coal mines (coal mine methane and coal bed methane).	In the proposed project activity, the residual gas stream to be flared is obtained from decomposition of organic material in a landfill.

Based on the above arguments it can be concluded that the *Tool to determine project emissions from flaring gases containing methane* (Version 01) is applicable to the project activity.

Applicability of *Tool to calculate the emission factor for an electricity system* (Version 02.2.1):

This methodological tool determines the CO_2 emission factor for displacement of electricity generated by power plants in an electricity system, by calculating the "combined margin" emission factor (CM) of the electricity system. This tool maybe applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity. For those CPAs which proposed to supplies electricity to the national grid, the *Tool to calculate the emission factor for an electricity system* (Version 02.2.1) is applicable to the project activity. In case the CPA supplies electricity in replacement of a captive power plant the Emission Factor of that power plant will be used. Each CPA will justify if this tool is applicable.

E.3. Description of the sources and gases included in the CPA boundary

In accordance with the methodology ACM0001 (Version 11.0) the CPA boundary is the site of the projects where the gas is captured and destroyed or used. In addition, as the proposed project can involve energetic use of landfill gas all grid-connected power plants or a captive power plant shall be included in the project boundary.

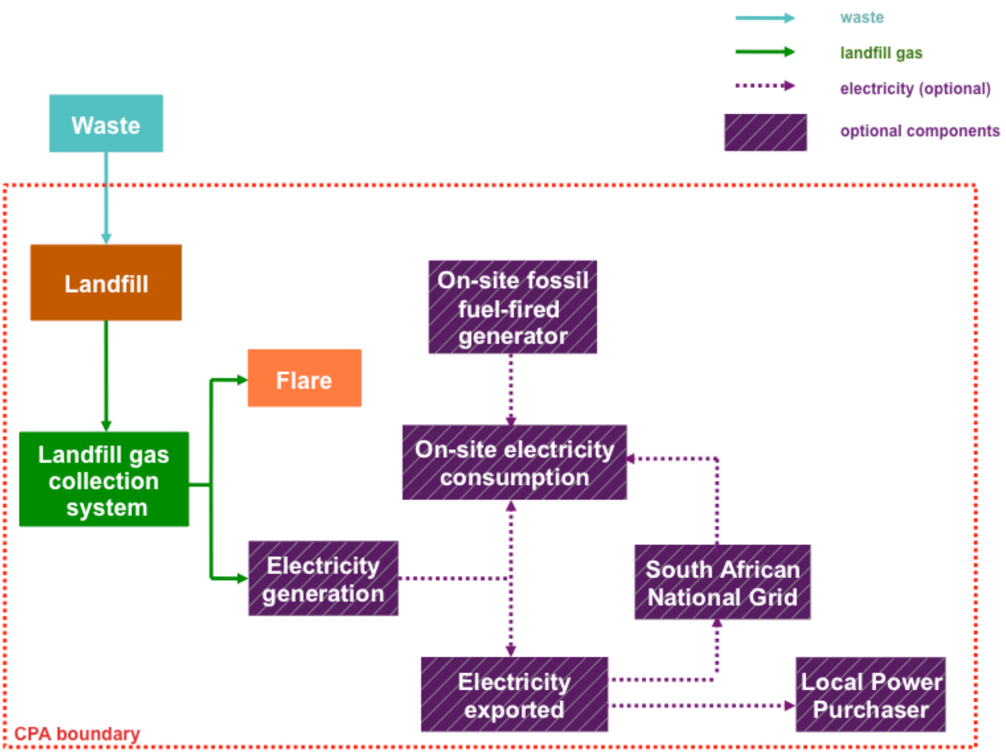

Figure 5. Graphical representation of the project boundary

Based on the methodology ACM0001 (Version 11.0) the following sources of emissions and respective greenhouse gases are identified for each CPA.

Table 1. Sources and gases included in the CPA boundary

	Source	Gas	Included	Justification
Baseline	Emissions from decomposition of waste at the landfill 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	CO2 emissions from the decomposition of organic waste are not accounted
	Emissions from electricity consumption	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.
Project Activity	On-site fossil fuel consumption due to the project activity other than for electricity generation	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 on-site electricity use	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.

E.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

Procedures for the selection of most plausible baseline scenario

***Step 1: Identification of alternative scenarios*[4]**

In accordance with the methodology ACM0001 (Version 11.0) the following baseline options and alternative scenarios are applicable to the proposed PoA:

LFG1: The project activity (i.e. capture of landfill gas and its flaring and/or its use) undertaken without being registered as a CDM project activity;
LFG2: Atmospheric release of the landfill gas or partial capture of landfill gas and destruction to comply with regulations or contractual requirements, or to address safety and odour concerns.

If LFG is used for generation of electric or heat energy for export to a grid and/or to a nearby industry or used on-site, realistic and credible alternatives should also be separately determined for:

- Power generation in the absence of the project activity;
- Heat generation in the absence of the project activity.

For power generation, the realistic and credible alternative(s) may include, inter alia:

P1: Power generated from landfill gas undertaken without being registered as CDM project activity;
P2: Existing or construction of a new on-site or off-site fossil fuel fired cogeneration plant;
P3: Existing or construction of a new on-site or off-site renewable based cogeneration plant;
P4: Existing or construction of a new on-site or off-site fossil fuel fired captive power plant;
P5: Existing or construction of a new on-site or off-site renewable based captive power plant;
P6: Existing and/or new grid-connected power plants.

As the proposed PoA does not include any CPAs involving thermal energy generation, all the alternatives for heat generation are not included in the analysis.

Step 2: Identify the fuel for the baseline choice of energy source taking into account the national and/or sectoral policies as applicable

The electricity generation in South Africa is mainly based on fossil fuel fired power plants and the baseline fuel is available in abundance (see figure 6).

Step 3: Assessment of which of these alternatives should be excluded from further consideration

For each CPA included under the programme LFG1 is not the most plausible scenarios, which will be demonstrated in the additionality section of the respective CPA-DD.

For each CPA included under the programme P1 is not the most plausible scenarios, which will be demonstrated in the additionality section of the respective CPA-DD.

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[4] This section also refers to sub-step 1a defined under the *Tool for the demonstration and assessment of additionality* (Version 05.2.1)

As heat is not considered as part of the proposed programme cogeneration plants are not a viable alternative and thus P2 and P3 can be discarded.

Since there are no viable renewable sources other than LFG available for the CPA sites included under the PoA, alternative P5 may also be discarded.

The only alternatives remaining for power generation are therefore P4 and P6.

Table 2.Baseline options and scenarios applicable to this PoA

ID	Scenario Description	
LFG1	The project activity (i.e. capture of landfill gas and its flaring and/or its use) undertaken without being registered as a CDM project activity	Each CPA will prove that LFG1 is not applicable in its respective additionality section
LFG2	Atmospheric release of the landfill gas or partial capture of landfill gas and destruction to comply with regulations or contractual requirements, or to address safety and odour concerns	To be considered as Baseline option for each CPA
P1	Power generated from landfill gas undertaken without being registered as CDM project activity	Each CPA will prove that P1 is not applicable in its respective additionality section
P4	Existing or construction of a new on-site or off-site fossil fuel fired captive power plant	To be considered as Baseline option for each CPA
P6	Existing and/or new grid-connected power plants	To be considered as Baseline option for each CPA

Step 4: Selection of the lowest baseline emissions as the most likely baseline scenario
Step 4 is completed at CPA level and will result in LFG2 with optionally either P4 or P6 as most likely baseline scenario if it is to be included in this PoA.

E.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the CPA being included as registered PoA (assessment and demonstration of additionality of CPA):

E.5.1. Assessment and demonstration of additionality for a typical CPA:

For this PoA, additionality is assessed at CPA level. To demonstrate additionality the *Tool for the demonstration and assessment of additionality* (Version 05.2.1) is used. The tool comprises the following four steps:

- STEP 1. Identification of alternative scenarios;
- STEP 2. Investment analysis;
- STEP 3. Barrier analysis (optional);
- STEP 4. Common practice analysis.

According to the *Tool for demonstration and assessment of additionality* (Version 05.2.1) the CPA proponents have a choice to demonstrate that the proposed CPA is additional to the baseline scenario either by using a) investment analysis or b) barrier analysis.

Step 1. Identification of alternative scenarios

Sub-step 1a. Define alternative scenarios to the proposed CDM project activity

Alternative scenarios for the disposal/treatment of the waste in the absence of the project activity are identified based on the methodology ACM0001 (Version 11.0):

ID	Scenario Description
LFG1	The project activity (i.e. capture of landfill gas and its flaring and/or its use) undertaken without being registered as a CDM project activity
LFG2	Atmospheric release of the landfill gas or partial capture of landfill gas and destruction to comply with regulations or contractual requirements, or to address safety and odour concerns

According to the methodology ACM0001 (Version 11.0) and the analysis under section E.4 above, in the absence of the project the following alternative scenarios are identified for electricity generation within the proposed programme:

ID	Scenario Description
P1	Power generated from landfill gas undertaken without being registered as CDM project activity
P4	Existing or construction of a new on-site or off-site fossil fuel fired captive power plant
P6	Existing and/or new grid-connected power plants

The CPA proponent shall identify alternative scenarios to the proposed CPA based on the scenarios listed above.

Sub-step 1b. Consistency with mandatory laws and regulations

All scenarios listed above are in compliance with the following South African waste regulations[5]:

- Atmospheric Pollution Prevention Act, 1965 (Act 45 of 1965)
- Hazardous Substances Act (Act 5 of 1973)
- Health Act (Act 63 of 1977)
- Environment Conservation Act (Act 73 of 1989)
- Occupational Health and Safety Act (Act 85 of 1993)
- National Water Act (Act 36 of 1998)
- The National Environmental Management Act (Act 107 of 1998)
- Air Quality Act (Act 39 of 2004)
- National Environmental Management: Waste Act, 2008 (Act 59 of 2008)

Step 2. Investment analysis

As per *Tool for the demonstration and assessment of additionality* (Version 05.2.1) CPA may opt to prove additionality either through a barrier analysis or through an investment analysis.

When opting investment analysis, the CPA is required to determine whether the proposed project activity is not:

a) the most economically or financially attractive; or
b) economically or financially feasible without the revenue from the sale of CERs.

The following sub-steps are used to conduct investment analysis.

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[5] South African Waste Information Centre (2011): Legislation. Available at: http://www.sawic.org.za/?menu=13 (website accessed on 21.09.2011)

Sub-step 2a. Determine appropriate analysis method

The CPA proponent has to determine the most suitable method for the project and its business case.

- If the proposed CPA and scenarios identified in Step 1 generate no financial or economic benefits apart from CDM revenues then in Sub-step 2a the simple cost analysis (Option I) shall be applied. This is the case if the landfill gas is flared only and the project doesn't intend to implement electricity generation – or another source of revenue – in any later stage either.
- If the proposed CPA and alternative scenarios generate benefits other than CDM revenues then the investment comparison analysis (Option II) or the benchmark analysis (Option III) shall be undertaken, which is the case when landfill gas is utilized for the generation of electricity.

Sub-step 2b. Option I - Apply simple cost analysis

When the simple cost analysis is chosen the CPA proponent shall document the costs associated with the proposed CPA and alternative scenarios and demonstrate that at least one scenario is less costly than the proposed CPA. If it is concluded that the proposed CPA is more costly than at least one alternative scenario, then the CPA proponent shall carry out common practice analysis (Step 4).

Sub-step 2b. Option II - Apply investment comparison analysis

In this option the CPA proponent has to identify the financial indicator (IRR or NPV), cost benefit ratio or unit cost of service (e.g. levelized cost of electricity production in $/kWh) that is applicable for the CPA and decision-making context.

Sub-step 2b. Option III - Apply benchmark analysis

This option requires determination of the financial indicator (e.g. IRR), which is the most suitable for the CPA and decision context, and compare it with a benchmark. The benchmark shall be derived from e.g. government bond rates, commercial lending rates, a company's internal benchmark or other appropriately justified indicator and benchmark.

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

A clear comparison must be provided that shows the financial indicator for the proposed CDM activity and

a) The alternative scenarios, if Option II (investment comparison analysis) is used. If one of the other scenario has the best indicator (e.g. highest IRR), then the CDM project activity cannot be considered as the most financially attractive;
b) The financial benchmark, if Option III (benchmark analysis) is used. If the CDM project activity has a less favourable indicator (e.g. lower IRR) than the benchmark, then the CDM project activity cannot be considered as financially attractive.

Guidance on selecting some of the parameters when using investment analysis

Price of electricity

The Tariff offered under the REFIT (renewable energy feed in tariff) scheme does not have to be considered for the CPAs under this PoA. A CPA may use the MEGAFLEX tariff published by Eskom in their annual Tariff Book[6] (or it's subsequent officially published document). The CPA will use the tariff published at the time when the investment decision was made or at the time of inclusion of the CPA.

Rationale

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[6] www.eskom.co.za/content/Tariffbrochure2011.pdf

In March 2008 the National Energy Regulator of South Africa (NERSA) published regulatory guidelines for a new renewable energy feed in tariff scheme (REFIT)[7].
The REFIT tariff is not considered in the baseline selection and in the financial additionality test as the REFIT scheme is a national policy with the purpose of giving comparative advantages to less emission intensive technologies and was established after 11 November 2001 and hence qualifies as an E- policy as defined by the EB (EB 16, EB 22 Annex 3 Paragraph 7) and taking into account the discussion on this topic in EB 54 (Annex 3 of the proposed agenda) and EB 55 (§27).

In addition REFIT is experiencing delays[8]. Until REFIT is implemented, the potential loss of revenue from electricity sales under REFIT is a real risk to CPAs under the PoA. The state of REFIT will be evaluated under each CPA as a potential Prevailing Practice barrier.

Sub-step 2d. Sensitivity analysis

The CPA proponent has to undertake a sensitivity analysis and present its results in the CPA-DD.

Step 3. Barrier analysis

As per *Tool for the demonstration and assessment of additionality* (Version 05.2.1) CPA may opt to prove additionality either through a barrier analysis or through an investment analysis.

If the CPA opts to prove additionality through barrier analysis, but the proof is inconclusive, CPA will use investment analysis (Step 2 above) to prove additionality.

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[7] http://www.nersa.org.za/UploadedFiles/ElectricityDocuments/REFIT%20Guidelines.pdf

[8] http://www.nersa.org.za/ReadNews.aspx?NewsID=202 published May 24.

Step 4. Common practice analysis

Sub-step 4a. Analyse other activities similar to the proposed project activity

In South Africa landfilling is considered the most viable option for disposal of solid waste[9]. Landfill gas, apart from containing the strong GHG methane, is also considered hazardous in terms of fire and explosion risk and may cause odour problems. National waste management guidelines in South Africa only suggests passive venting or flaring. It does not require flaring or landfill gas destruction. At most waste dumps & landfills in South Africa no landfill gas collection nor venting measures of any kind are implemented. Only a few active gas management systems have been installed so far[10]. In the recent years systems for capturing and energetic use of landfill gas were developed under CDM only[11].

Sub-step 4b. Discuss any similar options that are occurring

As demonstrated in Sub-step 4a, the prevailing practice in South Africa is either to simply dump waste without any further management of the landfill gas, vent landfill gas to lower its concentration below hazardous levels, and/or to not install any system for capturing landfill gas. Accordingly, it can be concluded that the CPAs under this PoA do not constitute common practice within the programme boundary, i.e. the territory of South Africa.

E.5.2. Key criteria and data for assessing additionality of a CPA:

Each CPA should demonstrate additionality based on the analysis presented in the section E.5.1 of this PoA-DD and meet the following key criteria:

1) In the baseline scenario the landfill gas is:
    a) released into the air OR
    b) partially captured and/or vented OR
    c) inefficiently flared to comply with regulations or contractual requirements, or to address safety and odour concerns;
2) The common practice for waste disposal in South Africa should be landfilling;
3) The development of the LFG capture and utilisation system should be prohibitive without support of CDM. This should be demonstrated either by applying investment analysis or barrier analysis.

E.6. Estimation of Emission reductions of a CPA:

E.6.1. Explanation of methodological choices, provided in the approved baseline and monitoring methodology applied, selected for a typical CPA:

The methodological choices that will be applied in relation to each of the CPAs to be developed under this PoA are based on the methodology ACM0001 (Version 11.0) and referred tools (see Section E.1 of this PoA-DD).

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[9] Bogner and Lee: Landfill Gas Recovery in South Africa: Status, Issues, and Markets; available at: http://www.go-worldlee.com/resources/landfill_south_africa.pdf (website accessed on 21.09.2011)

[10] Department of Water Affairs and Forestry Republic of South Africa (2005): Minimum requirements for waste disposal by landfills. Available at: http://www.gk-it.co.za/legislation/RequirementsWasteDisposalLandfillSep05Full.pdf, page 99 (website accessed on 21.09.2011)

[11] 5 LFG CDM projects registered, 3 at validation, 1 rejected – source: CDM pipeline 11.2011. Available at: http://cd4cdm.org/

Determination of Baseline Emissions
The methodology ACM0001 (Version 11.0) is applicable when the baseline scenario is the partial or total atmospheric release of the landfill gas. This condition is listed as one of the inclusion criteria for new CPA.

The *ex-ante* baseline emissions are calculated taking into account the amount of methane generated from the landfill, which are determined as per the *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site* (Version 05.1.0), and baseline energy consumption (electricity and/or heat).

The *ex-post* baseline emissions will be calculated based on monitoring of the amount of methane captured, flared and used for electricity generation.

Determination of Project Emissions
The project emissions consist of emissions related to consumption of electricity and/or heat of each CPA. Those will be calculated following the *Tool to calculate baseline, project and/or leakage emissions from electricity consumption* (Version 02.2.0) and/or the *Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion* (Version 02). In case of flaring of LFG the project emissions related to flaring will be determined *ex-post* using the *Tool to determine project emissions from flaring gases containing methane* (Version 01).

Determination of Leakage
With reference to the methodology ACM0001 (Version 11.0) no leakage effects need to be accounted for each of the CPAs.

Calculation of Emissions Reductions
Emission Reductions are calculated by subtracting project emissions from baseline emissions.

E.6.2. Equations, including fixed parametric values, to be used for calculation of emission reductions of a CPA:

Baseline emissions (ex-ante)

In accordance with the methodology ACM0001 (Version 11.0) baseline emissions are calculated using the following equations:

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

Where:
BE_y = Baseline emissions in year y (tCO_2e)
$MD_{project,y}$ = The amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (tCH_4) in the project scenario
$MD_{BL,y}$ = The amount of methane that would have been destroyed/combusted during the year in the absence of the project due to regulatory and/or contractual requirement, in tonnes of methane (tCH_4)
GWP_{CH4} = Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/tCH_4

$EL_{LFG,y}$ = Net quantity of electricity produced using LFG, which in the absence of the project activity would have been produced by power plants connected to the grid or by an on-site/off-site fossil fuel based captive power generation, during year y, in megawatt hours (MWh)

$CEF_{elecy,BL,y}$ = CO_2 emissions intensity of the baseline source of electricity displaced, in tCO_2e/MWh. This is estimated as per equation (XX) below.

$ET_{LFG,y}$ = The quantity of thermal energy produced utilizing the landfill gas, which in the absence of the project activity would have been produced from onsite/offsite fossil fuel fired boiler/air heater, during the year y in TJ = 0 (zero) under this PoA.

$CEF_{ther,BL,y}$ = CO_2 emissions intensity of the fuel used by boiler/air heater to generate thermal energy which is displaced by LFG based thermal energy generation, in tCO_2e/TJ = 0 (zero) under this PoA

The amount of methane that would have been destroyed/combusted during the year in the project scenario ($MD_{project,y}$) is determined *ex-ante* using the latest version of the approved *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site* (Version 05.1.0), considering the following additional equation:

$$MD_{project,y} = BE_{CH4,SWDS,y}/GWP_{CH4} \quad \textbf{(2)}$$

Where:

$BE_{CH4,SWDS,y}$ = Methane generation from the landfill in the absence of the project activity at year *y*(tCO_2e), calculated as per the *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site* (Version 05.1.0). 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 odour concerns. As this is already accounted for in equation 5, “f” in the tool shall be assigned a value 0

GWP_{CH4} = Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/tCH_4

According to the methodology ACM0001 (Version 11.0) 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*)]. Moreover sampling to determine the different waste types is not necessary, the waste composition can be obtained from previous studies. 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.

With reference to the *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site* (Version 05.1.0) the methane generation from the landfill in the absence of the project activity ($BE_{CH4,SWDS,y}$) is calculated using the following equation:

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

(3)

Where:

$BE_{CH4,}$ = Methane emissions avoided during the year y from preventing waste disposal at the solid

$_{SWDS,y}$ 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 (0.9)

f = Fraction of methane captured at the SWDS and flared, combusted or used in another manner

GWP_{CH4} = Global Warming Potential of methane valid for the commitment period (tCO_2e/tCH_4)

OX = Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)

F = Fraction of methane in the SWDS gas (volume fraction) (0.5)

DOC_f = Fraction of degradable organic carbon (DOC) that can decompose

MCF = Methane correction factor

$W_{j,x}$ = Amount of organic waste type j prevented from disposal in the SWDS in the year x (tons)

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

k_j = Decay rate for the waste type j

j = Waste type category (index)

x = Year during the crediting period: x runs from the first year of the first crediting period (x=1) to the year y for which avoided emissions are calculated (x=y)

y Year for which methane emissions are calculated

Where different waste types of j are prevented from disposal, the amount of different waste types ($W_{j,x}$) will be determined through sampling and calculation of the mean from the samples, as follows:

$$W_{j,x} = W_x \cdot \frac{\sum_{n=1}^{z} p_{n,j,x}}{z} \quad \textbf{(4)}$$

Where:

$W_{j,x}$ = Amount of organic waste type j prevented from disposal in the SWDS in year x (tons)

W_x = Total amount of organic waste prevented from disposal in year x (tons)

$P_{n,j,x}$ = Weight fraction of the waste type j in the sample n collected during the year x

z = Number of samples collected during the year x

In the case where in the baseline the LFG is captured and destroyed, for reasons other than regulation and/or contract, historic data on actual amount captured shall be used as $MD_{BL,y}$.

In case where regulatory or contractual requirements do not specify $MD_{BL,y}$ or no historic data exist for the LFG captured and destroyed an "Adjustment Factor" (AF) shall be used and justified, taking into account the project context and the following equation:

$$MD_{BL,y} = MD_{project,y} * AF \quad \textbf{(5)}$$

Where:

$MD_{BL,y}$ = The amount of methane that would have been destroyed/combusted during the year y, in absence of the project due to regulatory and/or contractual requirement, in tonnes of methane (tCH_4)

$MD_{project,y}$ = The amount of methane that would have been destroyed/combusted during year y, in

tonnes of methane (tCH_4) in project scenario
AF = Adjustment factor for $MD_{project,y}$ (%) estimated based on the methodology ACM0001 (Version 11.0)

Since there is no regulatory and/or contractual requirement regarding destroying/combusting the landfill gas in South Africa, all the landfill gas would be emitted into the atmosphere in the absence of the project. Therefore, $MD_{BL,y}$= 0 tCH_4/year under this PoA.

In case of landfills equipped with inefficient system for capture and utilisation of LFG historic data on actual amount captured shall be used as $MD_{BL,y}$. For further guidance the CPA participants shall refer to page 6 of the methodology ACM0001 (Version 11.0).

Since the project scenario involves generation of electricity only, the quantity of thermal energy produced utilising the landfill gas, which in the absence of the project activity would have been produced ($ET_{LFG,y}$) and corresponding CO_2 emissions intensity parameter ($CEF_{ther,BL,y}$) are assumed zero (0) under this PoA.

The CO_2 emissions intensity of the baseline source of electricity displaced ($CEF_{elecy,BL,y}$) is determined by using the *Tool to calculate the emission factor for an electricity system* (Version 2.2.1).

Baseline emissions (*ex-post*)

Ex-post determination of the amount of methane destroyed/combusted in the project scenario will be done using the following equations:

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y} + MD_{PL,y} \quad \textbf{(6)}$$

Where:
$MD_{project,y}$ = The amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (tCH_4) in the project scenario
$MD_{flared,y}$ = Quantity of methane destroyed by flaring (tCH_4)
$MD_{electricity,,y}$ = Quantity of methane destroyed by generation of electricity (tCH_4)
$MD_{thermal,,y}$ = Quantity of methane destroyed for the generation of thermal energy (tCH_4)
$MD_{PL,,y}$ = Quantity of methane sent to the pipeline for feeding to the natural gas distribution network (tCH_4)

The project activity consists of methane destruction by electricity generation and flaring of excess gas. Thermal energy generation and/or injection of upgraded landfill gas into the natural gas grid is not part of the proposed PoA. Therefore, $MD_{thermal,,y}$ = 0 tCH_4/year and $MD_{PL,y}$= 0 tCH_4/year.

To calculate the quantity of methane destroyed by flaring the following formula will be used:

$$MD_{flared,y} = \{LFG_{flare,y} * w_{CH4,y} * D_{CH4}) - (PE_{flare,y} / \mathrm{GWP}_{\mathrm{CH4}}) \quad \textbf{(7)}$$

Where:
$MD_{flared,y}$ = Quantity of methane destroyed by flaring (tCH_4)
$LFG_{flare,y}$ = Quantity of landfill gas fed to the flare(s) during the year measured in cubic meters (m^3)
$w_{CH4,y}$ = Average methane fraction of the landfill gas as measured during the year and expressed as

a fraction (in m³ CH_4/m³ LFG)

D_{CH4} = Methane density expressed in tonnes of methane per cubic meter of methane (t CH_4/m^3 CH_4)

$PE_{flare,y}$ = Project emissions from flaring of the residual gas stream in year y (tCO_2e) determined following the procedure described in the *Tool to determine project emissions from flaring gases containing methane* (Version 01). If methane is flared through more than one flare, the $PE_{flare,y}$ shall be determined for each flare using the tool

GWP_{CH4} = Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/tCH_4

The emissions resulting from the flaring of the landfill gas ($PE_{flare,y}$) will be calculated *ex-post* with the *Tool to determine project emissions from flaring gases containing methane* (Version 01). This tool is applicable since:

- The residual gas stream to be flared contains no other combustible gases than methane, carbon monoxide and hydrogen;
- The residual gas stream to be flared is recovered from decomposition of organic materials through a landfill.

Emissions from flaring of the landfill gas are calculated based on the flare efficiency and the flow rate of methane in the residual gas stream that is flared. The flare efficiency depends on both the actual efficiency of combustion in the flare and the time that the flare is operating. Steps 5-7 of the *Tool to determine project emissions from flaring gases containing methane* (Version 01) will be used to determine default values and project emissions from flaring.

Step 5. Determination of methane mass flow rate in the residual gas on a dry basis

To determine of methane flow rate in the residual gas the following equation will be used:

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH4,RG,h} \times \rho_{CH4,n} \quad \textbf{(8)}$$

Where:

$TM_{RG,h}$ = Mass flow rate of methane in the residual gas in the hour *h* (kg/h)

$FV_{RG,h}$ = Volumetric flow rate of the residual gas in dry basis at normal conditions in hour h(m^3/h)

$fv_{CH4,RG,h}$ = Volumetric fraction of methane in the residual gas on dry basis in hour *h*

$\rho_{CH4,n}$ = Density of methane at normal conditions (kg/m^3)

Step 6. Determination of the hourly flare efficiency

According to this step of the *Tool to determine project emissions from flaring gases containing methane* (Version 01) the determination of the hourly flare efficiency depends on the operation of flare (e.g. temperature), the type of flare used (open or enclosed) and, in case of enclosed flares, the approach selected by project participants to determine the flare efficiency (default value or continuous monitoring).

Under this PoA enclosed flares should be installed in each CPA. For enclosed flares the *Tool to determine project emissions from flaring gases containing methane* (Version 01) stipulates two options:

a) to use default values of the flare efficiency; or
b) continuous monitoring of the methane destruction efficiency of the flare (flare efficiency).

For determination of the flare efficiency option a) – use of default values – has been chosen for all CPAs.

In case of enclosed flares and use of default values the following flare efficiency values shall be applied:

- 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500 °C for more than 20 minutes during the hour *h*;
- 50%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour *h*, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour *h*;
- 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour *h* and the manufacturer's specifications on proper operation of the flare are met continuously during the hour *h*.

Step 7. Calculation of annual project emissions from flaring

The following equation will be applied to calculate project emissions from flaring:

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times \left(1 - \eta_{flare,h}\right) \times \frac{GWP_{CH4}}{1000} \quad \textbf{(9)}$$

Where:

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

$TM_{RG,h}$ = Mass flow rate of methane in the residual gas in the hour *h* (kg/h)

$\eta_{flare,h}$ = Flare efficiency in hour *h*

GWP_{CH4} = Global Warming Potential of methane valid for the commitment period (tCO_2e/tCH_4)

The amount of methane destroyed by electricity generation will be determined using the following equation:

$$MD_{electricity,y} = LFG_{electricity,y} * w_{CH4,y} * D_{CH4} \quad \textbf{(10)}$$

Where:

$MD_{electricity,y}$ = Quantity of methane destroyed by generation of electricity (tCH_4)

$LFG_{electricity,y}$ = Quantity of landfill gas fed into electricity generator (m^3)

$w_{CH4,y}$ = Average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m^3 CH_4/m^3 LFG)

D_{CH4} = Methane density expressed in tonnes of methane per cubic meter of methane (t CH_4/m^3 CH_4)

Grid emission factor

Grid emission factor is calculated in accordance with the *Tool to calculate the emission factor for an electricity system* (Version 02.2.1). The following six steps are required to calculate combined margin emission factor:

Step 1. Identify the relevant electric power system;
Step 2. Choose whether to include off-grid power plants in the project electricity system (optional);
Step 3. Select an method to determine the operating margin (OM);
Step 4. Calculate the operating margin emission factor according to the selected method;

Step 5. Calculate the build margin (BM) emission factor;
Step 6. Calculate the combined margin (CM) emissions factor.

Step 1. Identification of the relevant electric power system

According to the *Tool to calculate the emission factor for an electricity system* (Version 02.2.1), a project's electricity system has to be defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints. Accordingly, as soon as in the project activity electricity is generated, the project electricity system includes all power plants attached to the Republic of South Africa national grid.

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

With reference to the *Tool to calculate the emission factor for an electricity system* (Version 02.2.1) project participants may choose between the following options:
Option I: Only grid power plants are included in the calculation.
Option II: Both grid power plants and off-grid power plants are included in the calculation.

For the purpose of calculating the combined emission factor Option I is applied since off-grid power plants play a very minor role in South Africa's power generation.

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

According to the *Tool to calculate the emission factor for an electricity system* (Version 02.2.1), the calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

a) Simple OM, or
b) Simple adjusted OM, or
c) Dispatch Data Analysis OM, or
d) Average OM.

The below figure is based on average values of the five most recent years and shows that coal-fired power plants constitute approximately 93% of the South African generation capacity, whereas hydro and nuclear, both classified as low-cost and must-run power plants, constitute almost 6% of the national grid Therefore, option a) Simple OM is applied for the calculation of the operating margin, since the low-cost/must-run resources constitute less than 50% of total South African grid generation.

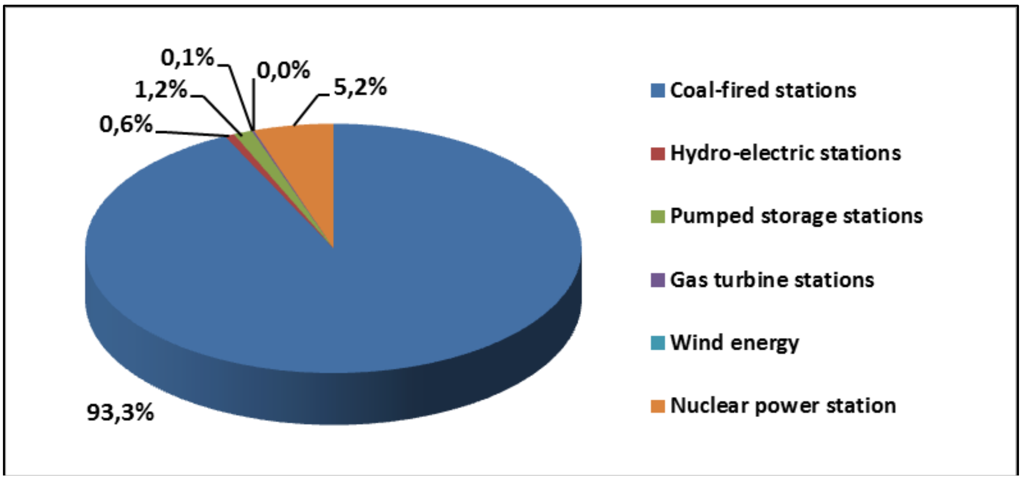

Figure 6. Energy sources used in electricity generation in South Africa - average values of the five most recent years (2007-2011) "2011 ESKOM Annual Report"[12].

With reference to the *Tool to calculate the emission factor for an electricity system* (Version 02.2.1), *ex-ante* option is applied to calculate the OM emission factor, i.e. based on the most recent 3-year generation-weighted average data available at the moment of submission. The latest data available from Eskom website[13] covers the electricity generation and fuel consumption from South African coal power plants for the years 2007/2008, 2008/2009 and 2009/2010.

Step 4. Calculation of the operating margin emission factor according to the selected method

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost / must run power plants / units. It is calculated based on data on fuel consumption and net electricity generation of each power plant/unit with the following equation:

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad \textbf{(11)}$$

Where:

$EF_{grid,OMsimple,y}$ = Simple operating margin CO_2 emission factor in year *y* (t CO_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* (t CO_2/MWh)

m = All power plants/units serving the grid in the year *y* except low-cost/must-run power plants/units

y Three most recent years for which data is available at the time of submission of the

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[12] http://financialresults.co.za/2011/eskom_ar2011/downloads/eskom-ar2011.pdf (website accessed on 22.09.2011) Years in Eskom report do not coincide with calendar year (July to June instead).

[13] http://www.eskom.co.za/content/calculationTable.htm (website accessed on 16.09.2011)

project (2007/2008, 2008/2009 and 2009/2010)

The emission factor of each power unit m ($EF_{EL,m,y}$)is calculated using the following equation:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_{m,y}} \quad \textbf{(12)}$$

Where:

$EF_{EL,m,y}$ = Simple operating margin CO_2 emission factor in year *y* (t CO_2/MWh)

$FC_{i,m,y}$ = Amount of fossil fuel type *i* consumed by power plant/unit m 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)

$EF_{CO2,\,i}$ = CO_2 emission factor of fossil fuel type *i* in year *y* (t CO_2/GJ)

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

m = All power units serving the grid in the year *y* except low-cost/must-run power units

i = All fossil fuel types combusted in power unit *m* in the year *y*

y = Three most recent years for which data is available at the time of submission of the project (2007/2008, 2008/2009 and 2009/2010)

The calorific values of coal were taken from the Eskom 2010 Annual Report for three most recent years, i.e. 2008, 2009 and 2010[14] that correspond with the electricity generation and fuel consumption data. According to the Eskom 2010 Annual Report gas/liquid fuel turbine stations are used for peaking or emergency supplies only[15]. Moreover no data for three most recent years is available for these power stations and therefore are excluded from the calculations.

Table 3.Overview of the data used to calculate the operating margin emission factor.

Power Station Name	3 year average electricity generation [MWh]	Weight [%]	EF [tCO_2/MWh]	$EF_{OM,simple,y}$ [tCO_2/MWh]
Arnot	12 373 402	5,7%	0,94	0,053
Duvha	22 657 816	10,4%	0,94	0,098
Hendrina	12 732 110	5,9%	1,02	0,060
Kendal	24 555 284	11,3%	1,10	0,124
Kriel	17 275 300	8,0%	0,93	0,074
Lethabo	24 934 884	11,5%	1,27	0,147
Matimba	27 747 317	12,8%	0,94	0,120
Majuba	22 899 325	10,6%	0,98	0,104
Matla	22 789 256	10,5%	1,02	0,107
Tutuka	20 777 419	9,6%	0,93	0,089

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[14] Eskom (2010): Integrated Report 2010. Available at: http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf

[15] See footnote 11. Eskom (2010), page 308

Camden (re-instated '2005-06)	6 384 069	2,9%	1,11	0,033
Grootvlei (re-instated '2007-06)	1 380 975	0,6%	1,07	0,007
Komati	338 674	0,2%	1,19	0,002
TOTAL	**216 845 832**	**100,0%**		**0,977**

The calculated operating margin emission factor is **0.977 tCO_2/MWh.**

Step 5. Calculation of the build margin (BM) emission factor

In terms of data vintage Option 1 is selected: for the first crediting period, the build margin emission factor is calculated *ex ante* based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation. The most recent data available is from 2010. For further crediting periods the build margin emission factor will be calculated according to the respective provisions for option 1.

According to the *Tool to calculate the emission factor for an electricity system* (Version 02.2.1), the sample group of power units *m* is determined by:

a) Identifying $SET_{5\text{-units}}$: the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently, and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-units}}$, in MWh);

The following five power plants have been identified:

Name of power plant	Date of commisioning	Electricity generation [MWh]
Majuba	1996-04-01	22 340 081
Kendal	1988-10-01	23 307 031
Matimba	1987-12-04	27 964 141
Lethabo	1985-12-22	25 522 698
Tutuka	1985-06-01	19 847 894

$AEG_{SET\text{-}5\text{-units}}$	**118 981 845**

b) Identifying $SET_{\geq 20\%}$: the set of power units, excluding power units registered as CDM project activities, that started to supply the grid most recently and that comprise 20% of the annual electricity generation of the project activity system (AEG_{total}, in MWh), and determine their annual electricity generation ($AEG_{SET \geq 20\%}$, in MWh);

	Electricity generation [MWh]
AEG_{total}	215 939 904
20% of AEG_{total}	43 187 981
$AEG_{SET \geq 20\%}$	**45 647 112**

The annual electricity generation $AEG_{SET \geq 20\%}$ includes two power plants – Majuba and Kendal.

c) Determining SET_{sample} from $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$, by selecting the set of power units that comprises the larger electricity generation;

The values in sub-steps a) and b) shows that $AEG_{SET\geq20\%}$ is lower than $AEG_{SET\text{-}5\text{-}units}$. Therefore SET_{sample} equals $AEG_{SET\text{-}5\text{-}units}$. However, since all power plants included in SET_{sample} started to supply electricity to the grid more than 10 years ago steps d), e) and f) have to be applied.

d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activities, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Determine for the resulting set ($SET_{sample\text{-}CDM}$) the annual electricity generation ($AEG_{SET\text{-}sample\text{-}CDM}$, in MWh);

Since data provided by ESKOM does not include CDM projects steps e) and f) are applied.

e) Include in the sample group $SET_{sample\text{-}CDM}$ the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation);
f) The sample group of power units *m* used to calculate the build margin is the resulting set ($SET_{sample\text{-}CDM\text{->}10yrs}$)

In order to determine $SET_{sample\text{-}CDM\text{->}10yrs}$ two power plants Majuba and Kendal have been included, since both started to supply electricity to the grid more than 10 years ago and their total electricity generation comprises 20% of the annual electricity generation of the grid.

In accordance to the *Tool to calculate the emission factor for an electricity system* (Version 02.2.1) the build margin emissions factor is the generation-weighted average emission factor (t CO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \qquad \textbf{(13)}$$

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emissions factor in year *y* (t CO_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 the power unit *m* in year *y* (t CO_2/MWh)
m = Power units included in the build margin
y = Most recent historical year for which power generation data is available

The power units included in the build margin *m* correspond to the sample group $SET_{sample\text{-}CDM\text{->}10yrs}$. Therefore, in accordance with the *Tool to calculate the emission factor for an electricity system* (Version 02.2.1), only option A2 from guidance in Step 4 (a) can be used as a conservative approach and the default values provided in Annex 1 of the *Tool to calculate the emission factor for an electricity system*

(Version 02.2.1) shall be used to determine the parameter $\eta_{m,y}$. The following equation from option A2 is applied to determine the CO$_2$ emission factor of each power unit *m* ($EF_{EL,m,y}$):

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}} \quad \textbf{(14)}$$

Where:

$EF_{EL,m,y}$ = CO$_2$ emission factor of the power unit *m* in year *y* (t CO$_2$/MWh)

$EF_{CO2,m,y}$ = Average CO$_2$ emission factor of fuel type i used in power unit *m* in year *y* (tCO$_2$/GJ)

$\eta_{m,y}$ = Average net energy conversion efficiency of power unit *m* in year *y* (ratio)

m = Power units included in the build margin

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

The calculated built margin emission factor is **0.920 tCO$_2$/MWh**.

Step 6. Calculation of the combined margin emission factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad \textbf{(15)}$$

Where:

$EF_{grid,CM,y}$ = Combined Margin emission factor in year *y* (t CO$_2$/MWh)

$EF_{grid,OM,y}$ = Operating margin emission factor in year *y* (t CO$_2$/MWh)

$EF_{grid,BM,y}$ = Build margin emission factor in year *y* (t CO$_2$/MWh)

w_{OM} = Weighting of operating margin emission factor (%)

w_{BM} = Weighting of build margin emission factor (%)

According to the *Tool to calculate the emission factor for an electricity system* (Version 02.2.1), for projects other than wind and solar the following default values are used for weights for the operating margin and build margin emission factors: w_{OM} = 0.5 and w_{BM} = 0.5. The calculated combined emission factor for the first crediting period is **0.949 tCO$_2$/MWh**.

In case the baseline scenario is not grid connected electricity, i.e. electricity is generated by an on-site/off-site fossil fuel captive power plant, a default value of 0.8 tCO$_2$/MWh may be applied or the project participants can make estimations of CO$_2$ emissions intensity of the baseline source of electricity displaced ($CEF_{elec,BL,y}$) based on the following equation:

$$CEF_{elec,BL,y} = \frac{EF_{fuel,BL}}{\varepsilon_{gen,BL} . NCV_{fuel,BL}.} * 3.6 \cdot \quad \textbf{(16)}$$

Where:

$EF_{fuel,BL}$ = Emission factor of baseline fossil fuel used, as identified in the baseline scenario identification procedure, expressed in t CO_2/mass of volume unit

$NCV_{fuel,BL}$ = Net calorific value of fuel, as identified through the baseline identification procedure, in GJ per unit of volume or mass

= Efficiency of baseline power generation plant

3.6 = Equivalent of GJ energy in a MWh of electricity

To estimate electricity generation efficiency, project participants may use the highest value among the following three values as a conservative approach:

- Measured efficiency prior to project implementation;
- Measured efficiency during monitoring;
- Data from manufacturer for efficiency at full load;
- Default efficiency of 60%.

Project emissions

With reference to the methodology ACM0001 (Version 11.0) the following equation is applied in order to calculate project emissions:

$$PE_y = PE_{EC,y} + PE_{FC,j,y} \quad \textbf{(17)}$$

Where:

PE_y = Project emissions from methane capture and utilization in year *y* (tCO_2/year)

$PE_{EC,y}$ = Emissions from consumption of electricity in the project case (tCO_2/year). 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* (Version 01).

$PE_{FC,j,y}$ = Emissions from consumption of heat in the project case (tCO_2/year). The project emissions from fossil fuel combustion ($PE_{FC,j,y}$) will be calculated following the latest version of *Tool to calculate project or leakage CO2 emissions from fossil fuel combustion* (Version 02). 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.

The project emissions from electricity usage are calculated according to the ACM0001 (Version 11.0), using the equation given in the *Tool to calculate baseline, project and/or leakage emissions from electricity consumption* (Version 1).

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y}) \quad \textbf{(18)}$$

Where:

$PE_{EC,y}$ = Emissions from electricity consumption due to the project activity in year *y* (tCO2e)

$EC_{PJ,j,y}$ = Quantity of electricity consumed by the project electricity consumption source *j* in year *y* (MWh/year)

$EF_{ELj,y}$ = Emission factor for electricity generation for source *j* in year *y*(tCO_2/MWh)

$TDL_{j,y}$ = Average technical transmission and distribution losses for providing electricity for source *j*, in year *y*

j = Sources of electricity consumption in the project

Determination of the emission factor for electricity generation ($EF_{EL,j,y}$) depends on which scenario (A, B, C) described in the *Tool to calculate baseline, project and/or leakage emissions from electricity consumption* (Version 1) applies to the source of electricity. This parameter will be decided on the CPA level and described in the CPA-DD.

CO_2 emissions from fossil fuel combustion in the project scenario are calculated as per the *Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion* (Version 02) based on the following equation:

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y} \quad \textbf{(19)}$$

Where:

$PE_{FC,j,y}$ = Emissions from fossil fuel consumption on-site due to the project activity in year *y* (tCO_2e)

$FC_{i,j,y}$ = Quantity of fuel type *i* combusted in process *j* in year y (mass or volume unit/year)

$COEF_{i,y}$ = CO_2 emission coefficient of fuel type *i* in year *y* (tCO_2/ mass or volume unit)

i = Fuel types combusted in process *j* during the year *y*

The CO_2 emission coefficient ($COEF_{i,y}$) can be calculated based on the *Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion* (Version 02) using two options (A or B). A decision will be made on the CPA level depending on the availability of data on the fossil fuel type *i* and described in the CPA-DD.

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \textbf{(20)}$$

Where:

ER_y = Emission reductions in year y (tCO_2/year)

BE_y = Baseline emissions in year y (tCO_2/year)

PE_y = Project emissions in year y (tCO_2/year)

E.6.3. Data and parameters that are to be reported in CDM-CPA-DD form:

Data / Parameter:	**ID. 1. / Regulatory requirements relating to landfill gas**
Data unit:	-
Description:	Regulatory requirements relating to landfill gas
Source of data used:	Publicly available information of the host country's regulatory requirements relating to landfill gas
Value applied:	Will be reflected in $MD_{BL,y,}$ which for the first crediting period is zero
Justification of the choice of data or	Draft 'Minimum Requirements for Waste Disposal by Landfill', Department of Water Affairs & Forestry, 2005 and Landfill Permits for all Landfill Sites or

description of measurement methods and procedures actually applied :	similar
Any comment:	The information though recorded annually, is used for changes to the adjustment factor (AF) or directly $MD_{BL,y}$ at renewal of the credit period.

Data / Parameter:	**ID. 2. / GWP_{CH4}**
Data unit:	tCO_2e/tCH_4
Description:	Global warming potential of CH_4
Source of data used:	IPCC
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	21 for the first commitment period. Shall be updated according to any future COP/MOP decisions
Any comment:	

Data / Parameter:	**ID. 3. / D_{CH4}; $\rho_{CH4,n}$**
Data unit:	tCH_4/m^3CH_4
Description:	Methane density
Source of data used:	
Value applied:	At standard temperature and pressure (0 degree Celsius and 1,013 bar) the density of methane is 0.0007168 tCH_4/m^3 CH_4
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	The parameter $\rho_{CH4,n}$ refers to density of methane that will be used to calculate *ex-post* project emissions from flaring

Data / Parameter:	**ID. 4. / $BE_{CH4,SWDS,y}$**
Data unit:	tCO_2e
Description:	Methane generation from the landfill in the absence of the project activity at year *y*
Source of data used:	Calculated as per the *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site*
Value applied:	Please refer to CPA-DD
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per the *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site*

Any comment:	Used for *ex ante* estimation of the amount of methane that would have been destroyed/combusted during the year

Data / Parameter:	**ID. 5. / MD_{Hist}**
Data unit:	tCH_4
Description:	Amount of methane destroyed historically for the previous year before the start of project activity.
Source of data used:	Project participant
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	This parameter could be used for the estimation of AF

Data / Parameter:	**ID. 6. / $FC_{i,m,y}$**
Data unit:	Mass or volume unit
Description:	Amount of fossil fuel type *i* consumed by power plant / unit *m* in year *y* or hour *h*
Source of data used:	ESKOM CDM calculation table (http://www.eskom.co.za/c/article/236/cdm-calculations/)
Value applied:	Please refer to Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	ESKOM is the official source for the related data, hence providing the most up-to-date and representative information
Any comment:	

Data / Parameter:	**ID. 7. / $NCV_{i,y}$**
Data unit:	GJ/mass or volume unit
Description:	The net calorific value for fossil fuel *i* in year *y*
Source of data used:	ESKOM Annual Report 2010, Table I, page 296
Value applied:	Please refer to Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	ESKOM is the official source for the related data, hence providing the most up-to-date and representative information
Any comment:	

Data / Parameter:	**ID. 8. / $EF_{CO2,i,y}$**
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of fossil fuel type *i* used in power unit *m* in year *y*
Source of data used:	IPPC

Value applied:	0.0946
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC is the preferable source of default values if other reliable sources are not available

Data / Parameter:	**ID. 9. / $EG_{m,y}$**
Data unit:	GWh
Description:	Net electricity generated by power plant/unit *m* in year *y* or hour *h*
Source of data used:	ESKOM CDM calculation table (http://www.eskom.co.za/c/article/236/cdm-calculations/)
Value applied:	Please refer to Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	ESKOM is the official source for the related data, hence providing the most up-to-date and representative information
Any comment:	

Data / Parameter:	**ID. 10. /** $\eta_{m,y}$
Data unit:	%
Description:	Average net energy conversion efficiency of power unit *m* in year *y*
Source of data used:	Annex I of the *Tool to calculate the emission factor for an electricity system* (Version 02.2.1)
Value applied:	37
Justification of the choice of data or description of measurement methods and procedures actually applied :	Value for supercritical coal power plants built before and in 2000 as per Annex I of the *Tool to calculate the emission factor for an electricity system* (Version 02.2.1)
Any comment:	

Data / Parameter:	**ID. 11. / $CEF_{elecy,BL,y}$; $EF_{grid,CM,y}$**
Data unit:	tCO_2e/MWh
Description:	CO_2 emissions intensity of the baseline source of electricity displaced
Source of data used:	See calculations in Section E.6.2. of the PoA-DD
Value applied:	0.949
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated using the *Tool to calculate the emission factor for an electricity system* (Version 02.2.1)
Any comment:	This parameter refers to the combined margin emission factor of the South African grid ($EF_{grid,CM,y}$) and is determined ex-ante for the whole crediting

	period. It is also used as $CEF_{elecy,BL,y}$ in calculations of baseline emissions.

Data / Parameter:	**ID. 12. / φ**
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	*Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site* (Version 05.1.0)
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default value is used according to the *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site* (Version 05.1.0)
Any comment:	

Data / Parameter:	**ID.13. / f**
Data unit:	-
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data used:	Written information from the operator of the solid waste disposal site and/or site visits at the solid waste site
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Value is applied since there is no regulatory and/or contractual requirement regarding destroying/combusting the landfill gas in South Africa, and all the landfill gas would be emitted into the atmosphere in the absence of the project. The default value is used according to the *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site* (Version 05.1.0)
Any comment:	

Data / Parameter:	**ID. 14. / 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 used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.1 for managed solid waste disposal sites that are covered with oxidizing material such as soil or compost 0 for other types of solid waste disposal sites
Justification of the choice of data or description of measurement methods and procedures actually applied :	Appropriate value will be selected for each CPA based on the landfill site conditions
Any comment:	

Data / Parameter:	**ID. 15. / F**
Data unit:	-

Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default value is used according to the *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site* (Version 05.1.0)
Any 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:	**ID. 16. / DOC_f**
Data unit:	-
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default value is used according to the *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site* (Version 05.1.0)
Any comment:	

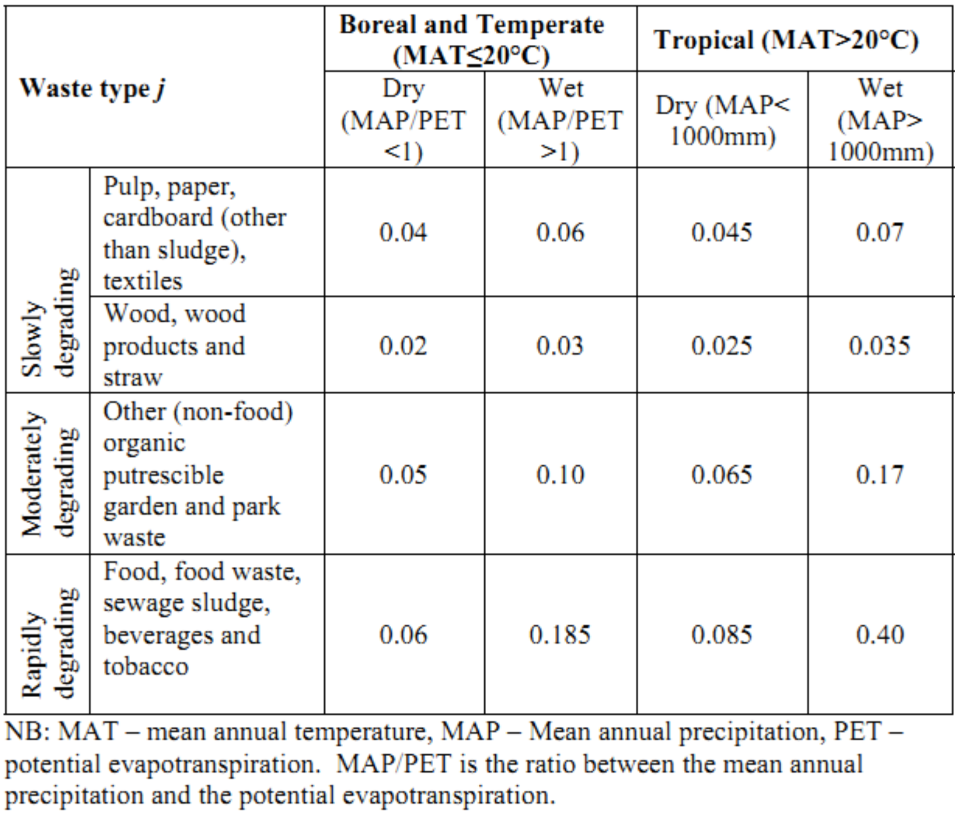
Data / Parameter:	**ID. 17. / MCF**
Data unit:	-
Description:	Methane correction factor
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	The following values of MCF can be applied based on the CPA landfill specific conditions: • 1.0 for anaerobic managed solid waste disposal sites. These must have controlled placement of waste (i.e. waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste; • 0.5 for semi-aerobic managed solid waste disposal sites. These must have controlled placement of waste and will include all of the following structures for introducing air to the waste layers: (i) permeable cover material; (ii) leachate drainage system; (iii) regulating pondage; and (iv) gas ventilation system; • 0.8 for unmanaged solid waste disposal sites ñ deep and/or with high water table. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 meters and/or high water table at near ground level. Latter situation corresponds to filling inland water, such as pond, river or wetland, by waste; • 0.4 for unmanaged-shallow solid waste disposal sites. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths

	of less than 5 metres
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default value is used according to the *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site* (Version 05.1.0)
Any comment:	The methane correction factor (MCF) accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS.

<table>
<tr><td>Data / Parameter:</td><td>ID. 18. / DOC$_j$</td></tr>
<tr><td>Data unit:</td><td>-</td></tr>
<tr><td>Description:</td><td>Fraction of degradable organic carbon (by weight) in the waste type <i>j</i></td></tr>
<tr><td>Source of data used:</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)</td></tr>
<tr><td>Value applied:</td><td>The following values of DOC$_j$ can be applied based on the CPA landfill specific conditions:
<table>
<tr><th>Waste type <i>j</i></th><th>DOC$_j$
(% wet waste)</th><th>DOC$_j$
(% dry waste)</th></tr>
<tr><td>Wood and wood products</td><td>43</td><td>50</td></tr>
<tr><td>Pulp, paper and cardboard (other than sludge)</td><td>40</td><td>44</td></tr>
<tr><td>Food, food waste, beverages and tobacco (other than sludge)</td><td>15</td><td>38</td></tr>
<tr><td>Textiles</td><td>24</td><td>30</td></tr>
<tr><td>Garden, yard and park waste</td><td>20</td><td>49</td></tr>
<tr><td>Glass, plastic, metal, other inert waste</td><td>0</td><td>0</td></tr>
</table>
If a waste type, prevented from disposal by the proposed CDM project activity, cannot clearly be attributed to one of the waste types in the table above, project participants should choose, among the waste types that have similar characteristics, the waste type where the values of DOC$_j$ and k$_j$ result in a conservative estimate (lowest emissions), or request a revision of/deviation from this methodology.</td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures actually applied :</td><td>The default value is used according to the <i>Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site</i> (Version 05.1.0)</td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

Data / Parameter:	**ID. 19. / k$_j$**
Data unit:	-
Description:	Decay rate for the waste type *j*
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
Value applied:	The following values of DOC$_j$ can be applied based on the CPA landfill specific

conditions:



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

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

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

Justification of the choice of data or description of measurement methods and procedures actually applied :	The default value is used according to the *Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site* (Version 05.1.0)
Any comment:	The climatic conditions at the SWDS site (temperature, precipitation and, where applicable, evapotranspiration) shall be documented in the CPA-DD. Long-term averages based on statistical data, shall be used where available.

Data / Parameter:	**ID. 20. / W_x**
Data unit:	tonnes
Description:	The amount of waste disposed in the CPA landfill in year *x*
Source of data used:	Landfill operator
Value applied:	Please refer to CPA-DD
Justification of the choice of data or	Data is taken from historical records of landfill operation.

description of measurement methods and procedures actually applied :	
Any comment:	This is determined once ex-ante for the purpose of estimating emission reductions.

Data / Parameter:	**ID. 21. / p_j**
Data unit:	%
Description:	Weight fraction of the waste type *j* in the sample *n* collected during the year *x*
Source of data used:	Landfill operator
Value applied:	Please refer to CPA-DD
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to the ACM0001 (Version 11.0; page 7): "Sampling to determine the different waste types is not necessary. The waste composition can be obtained from previous studies".
Any comment:	This is determined once ex-ante for the purpose of estimating emission reductions.

Data / Parameter:	**ID. 22. / $\eta_{flare,h}$**
Data unit:	-
Description:	Flare efficiency in the hour *h*
Source of data used:	*Tool to determine project emissions from flaring gases containing methane*
Value applied:	The following default values for enclosed flare are used: • 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500 °C for more than 20 minutes during the hour *h* . • 50%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour *h,* but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour *h*. • 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour *h* and the manufacturer's specifications on proper operation of the flare are met continuously during the hour *h*.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Please revert to Section E.6.2 of the PoA-DD (Step 6. Determination of the hourly flare efficiency, page 24)
Any comment:	

E.7. Application of the monitoring methodology and description of the monitoring plan:

E.7.1. Data and parameters to be monitored by each CPA:

Data / Parameter:	**ID.23. / $LFG_{total,y}$**

Data unit:	m^3
Description:	Total amount of landfill gas captured at Normal Temperature and Pressure
Source of data to be used:	CPA owner
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Please refer to CPA-DD
Description of measurement methods and procedures to be applied:	Measured continuously by a flow meter (average value in a time interval not greater than an hour shall be used in the calculations of emission reductions). Data to be aggregated monthly and yearly
QA/QC procedures to be applied:	Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy
Any comment:	

Data / Parameter:	**ID.24. / $LFG_{flare,y}$; $FV_{RG,h}$**
Data unit:	m^3
Description:	Amount of landfill gas flared at Normal Temperature and Pressure
Source of data to be used:	CPA owner
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Please refer to CPA-DD
Description of measurement methods and procedures to be applied:	Measured continuously by a flow meter (average value in a time interval not greater than an hour shall be used in the calculations of emission reductions). Data to be aggregated monthly and yearly.
QA/QC procedures to be applied:	Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy
Any comment:	The parameter $FV_{RG,y}$ refers to volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h* that will be used to calculate *ex-post* project emissions from flaring

Data / Parameter:	**ID.25. / $LFG_{electricity,y}$**
Data unit:	m^3
Description:	Amount of landfill gas combusted in power plant at Normal Temperature and Pressure
Source of data to be used:	CPA owner
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Please refer to CPA-DD

Description of measurement methods and procedures to be applied:	Measured continuously by a flow meter (average value in a time interval not greater than an hour shall be used in the calculations of emission reductions). Data to be aggregated monthly and yearly.
QA/QC procedures to be applied:	Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy
Any comment:	

Data / Parameter:	**ID.26. / T_{flare}**
Data unit:	^oC
Description:	Temperature in the exhaust gas of the flare
Source of data to be used:	CPA owner
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Please refer to CPA-DD
Description of measurement methods and procedures to be applied:	Continuous monitoring of the temperature in the exhaust gas with a type N thermocouple as described in the "*Tool to determine project emissions from flaring gases containing methane*".
QA/QC procedures to be applied:	The thermocouple will be subject to exchange and/or calibration on an annual basis to ensure accuracy.
Any comment:	

Data / Parameter:	**ID.27. / w_{CH4}; $fv_{CH4,RG,y}$**
Data unit:	m^3 CH_4/m^3 LFG
Description:	Methane fraction in the landfill gas
Source of data to be used:	not applicable
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Please refer to CPA-DD
Description of measurement methods and procedures to be applied:	Measured by continuous gas quality analyser (average value in a time interval not greater than an hour shall be used in the calculations of emission reductions)
QA/QC procedures to be applied:	The gas analyser should be subject to a regular maintenance and testing regime to ensure accuracy
Any comment:	The parameter $fv_{CH4,RG,y}$ refers to volumetric fraction of methane in the residual gas on dry basis in hour *h* that will be used to calculate *ex-post* project emissions from flaring

Data / Parameter:	**ID. 28. / T**
Data unit:	^oC
Description:	Temperature of the landfill gas

Source of data to be used:	not applicable
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Please refer to CPA-DD
Description of measurement methods and procedures to be applied:	Continuously measured to determine the density of methane D_{CH4}. No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters.
QA/QC procedures to be applied:	Measuring instruments should be subject to a regular maintenance and testing regime in accordance to appropriate national/international standards
Any comment:	In case of the use of a flow meter that automatically measure temperature and pressure, this parameter will not be monitored.

Data / Parameter:	**ID. 29. / P**
Data unit:	Mbar
Description:	Pressure of the landfill gas
Source of data to be used:	Project Participant
Value of data applied for the purpose of calculating expected emission reductions in section B.5	not applicable
Description of measurement methods and procedures to be applied:	Measured continuously to determine the density of methane D_{CH4}. No separate monitoring of pressure is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters.
QA/QC procedures to be applied:	Maintenance of equipment will be carried out according to the instructions of the manufacturer.
Any comment:	In case of the use of a flow meter that automatically measure temperature and pressure, this parameter will not be monitored.

Data / Parameter:	**ID. 30. / EL_{LFG}**
Data unit:	MWh
Description:	Net amount of electricity generated using LFG
Source of data to be used:	Defined in the CPA
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Please refer to CPA-DD
Description of measurement methods and procedures to be applied:	Measured by continuous electricity meter (average value in a time interval not greater than an hour shall be used in the calculations of emission reductions)

QA/QC procedures to be applied:	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy
Any comment:	

Data / Parameter:	**ID.31. / $EC_{PJ,j,y}$**
Data unit:	MWh/year
Description:	Quantity of electricity consumed by the project electricity consumption source *j* in year *y*
Source of data to be used:	Defined in the CPA
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Please refer to CPA-DD
Description of measurement methods and procedures to be applied:	Measured by continuous electricity meter
QA/QC procedures to be applied:	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy
Any comment:	

Data / Parameter:	**ID.32. / $EF_{fuel,BL}$**
Data unit:	tCO_2/mass or volume
Description:	CO_2 emission factor of fossil fuel.
Source of data to be used:	The source of data should be the following, in order of preference: project specific data, country specific data or IPCC default values. As per guidance from the Board, IPCC default values should be used only when country or project specific data are not available or difficult to obtain
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Please refer to CPA-DD
Description of measurement methods and procedures to be applied:	Annually
QA/QC procedures to be applied:	
Any comment:	Parameter only to be used if the power generation baseline scenario is P4

Data / Parameter:	**ID.33. / $NCV_{fuel,BL}$**
Data unit:	GJ/mass or volume units of fuel
Description:	Net calorific value of fossil fuel
Source of data to be used:	The source of data should be the following, in order of preference: project specific data, country specific data or IPCC default values. As per guidance from

	the Board, IPCC default values should be used only when country or project specific data are not available or difficult to obtain
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Please refer to CPA-DD
Description of measurement methods and procedures to be applied:	Annually
QA/QC procedures to be applied:	
Any comment:	Parameter only to be used if the power generation baseline scenario is P4

Data / Parameter:	**ID.34. /** $\varepsilon_{\text{gen,BL}}$
Data unit:	-
Description:	Efficiency of the baseline captive power plant
Source of data to be used:	The source of data should be the following, in order of preference: project specific data, country specific data or IPCC default values. As per guidance from the Board, IPCC default values should be used only when country or project specific data are not available or difficult to obtain
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Please refer to CPA-DD
Description of measurement methods and procedures to be applied:	Monitored annually. To estimate electricity generation efficiency, project participants may use the highest value among the following three values as a conservative approach: 1. Measured efficiency prior to project implementation; 2. Measured efficiency during monitoring; 3. Data from manufacturer for efficiency at full load; 4. Default efficiency of 60%.
QA/QC procedures to be applied:	
Any comment:	Parameter only to be used if the power generation baseline scenario is P4

Data / Parameter:	**ID.35. / Operating time of the power plant**
Data unit:	Hours
Description:	Operation of the power plant
Source of data to be used:	CPA owner
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Please refer to CPA-DD

Description of measurement methods and procedures to be applied:	Monitored annually.
QA/QC procedures to be applied:	
Any comment:	This is monitored to ensure methane destruction is claimed for methane used in electricity plant when it is operational

Data / Parameter:	**ID.36. / $PE_{EC,y}$**
Data unit:	tCO_2
Description:	Project emissions from electricity consumption by the project activity during the year *y*
Source of data to be used:	Calculated as per the *Tool to calculate baseline, project and/or leakage emissions from electricity consumption* (Version 01)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Please refer to CPA-DD
Description of measurement methods and procedures to be applied:	As per the *Tool to calculate baseline, project and/or leakage emissions from electricity consumption* (Version 01)
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**ID.37. / $PE_{FC,j,y}$**
Data unit:	tCO_2
Description:	Project emissions from fossil fuel combustion in process *j* during the year *y*
Source of data to be used:	Calculated as per the *Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion* (Version 01).
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Please refer to CPA-DD
Description of measurement methods and procedures to be applied:	As per the *Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion* (Version 01)
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**ID.38. / $TDL_{j,y}$**
Data unit:	-
Description:	Average technical transmission and distribution losses for providing electricity to

	source *j* in year *y*
Source of data to be used:	Sam In case of scenario B and scenario C, case C.II, assume $TDL_{j/k/l,y}$= 0 as a simplification. In case of other scenarios (scenario A and scenario C, cases C.I and C.III), choose one of the following options: • Use recent, accurate and reliable data available within the host country; • Use as default values of 20% for a) project or leakage electricity consumption sources; b) baseline electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is larger than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies. • Use as default values of 3% for a) baseline electricity consumption sources; project and leakage electricity consumption sources if the electricity consumption by all project and leakage electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies is smaller than the electricity consumption of all baseline electricity consumption sources to which scenario A or scenario C (cases C.I or C.III) applies.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Please refer to CPA-DD
Description of measurement methods and procedures to be applied:	Monitored annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years. For a): $TDL_{j/k/l,y}$ should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed CDM project activity is connected to. The technical distribution losses should not contain other types of grid losses (e.g. commercial losses/theft). The distribution losses can either be calculated by the project participants or be based on references from utilities, network operators or other official documentation
QA/QC procedures to be applied:	
Any comment:	This parameter only needs to be monitored if the waste prevented from disposal includes several waste categories *j*, as categorized in the tables for DOC_j and k_j

E.7.2. Description of the monitoring plan for a CPA:

Monitoring is performed at CPA level. See Section A.4.4.2 for detailed overview of the monitoring plan.

E.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

The final draft of this baseline section has been completed on 19.11.2011 by Mr. Geert Eenhoorn, Ms. Katrin Heer and Mr. Janusz Mizerny.

The baseline and monitoring methodology has been prepared by Do-inc business B.V.

Company name: Do-inc.
Visiting Address: Mauritskade 55-D
1092 AD Amsterdam
The Netherlands
Contact Person: Geert Eenhoorn
Telephone number: +31 6 5242 1926
e-mail: g.eenhoorn@do-inc.net

Annex 1

CONTACT INFORMATION ON COORDINATING/MANAGING ENTITY and PARTICIPANTS IN THE PROGRAMME of ACTIVITIES

Organization:	Landfill Carbon (PTY) LTD
Street/P.O.Box:	5 Humber Street
Building:	Unit 2, The Firs
City:	Johannesburg
State/Region:	Gauteng
Postfix/ZIP:	2128
Country:	South Africa
Telephone:	+27 (0) 11 8038245
FAX:	+27 (0) 11 8037131
E-Mail:	dcornish@gessa.co.za
URL:	
Represented by:	David Cornish
Title:	
Salutation:	Mr
Last Name:	Cornish
Middle Name:	Rodney
First Name:	David
Department:	N/A
Mobile:	+27 (0)833850661
Direct FAX:	+27 (0)31 564 3802
Direct tel:	+27 (0)31 5640222
Personal E-Mail:	dcornish@gessa.co.za

Organization:	Do-inc business B.V.
Street/P.O.Box:	Mauritskade 55-D
City:	Amsterdam
Postfix/ZIP:	1092 AD
Country:	The Netherlands
Telephone:	+31 6 5242 1926
FAX:	+31 8 7784 2538
E-Mail:	do-it@do-inc.net
URL:	http://www.do-inc.net
Represented by:	Geert Eenhoorn
Title:	
Salutation:	Mr
Last Name:	Eenhoorn
First Name:	Geert
Department:	N/A
Mobile:	+31 6 5242 1926
Direct FAX:	+31 8 7784 2538
Direct tel:	+31 6 5242 1926
Personal E-Mail:	g.eenhoorn@do-inc.net

Annex 2

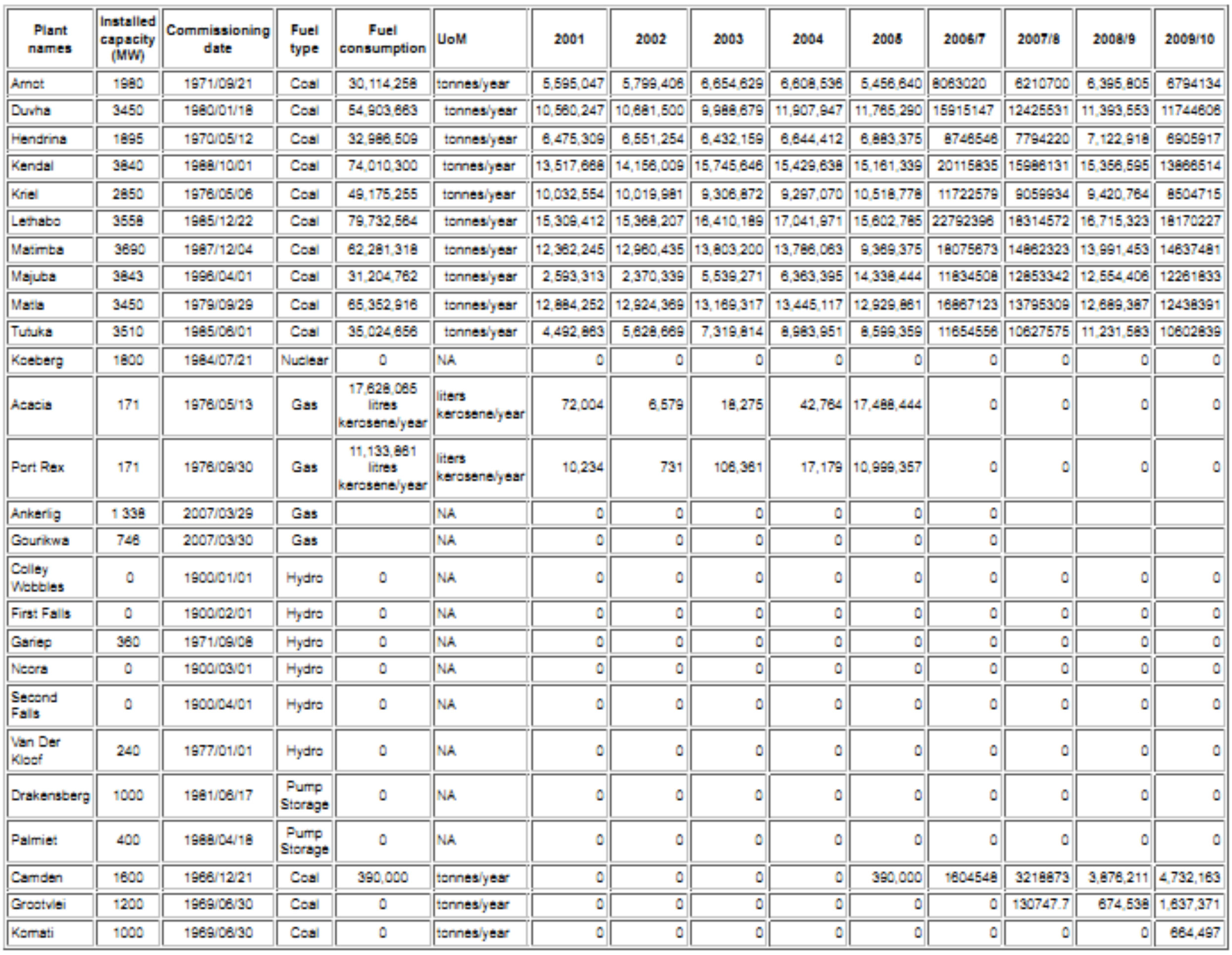
INFORMATION REGARDING PUBLIC FUNDING

The Landfill Gas Utilisation Programme of South Africa does not make use of public funding.

Annex 3

BASELINE INFORMATION

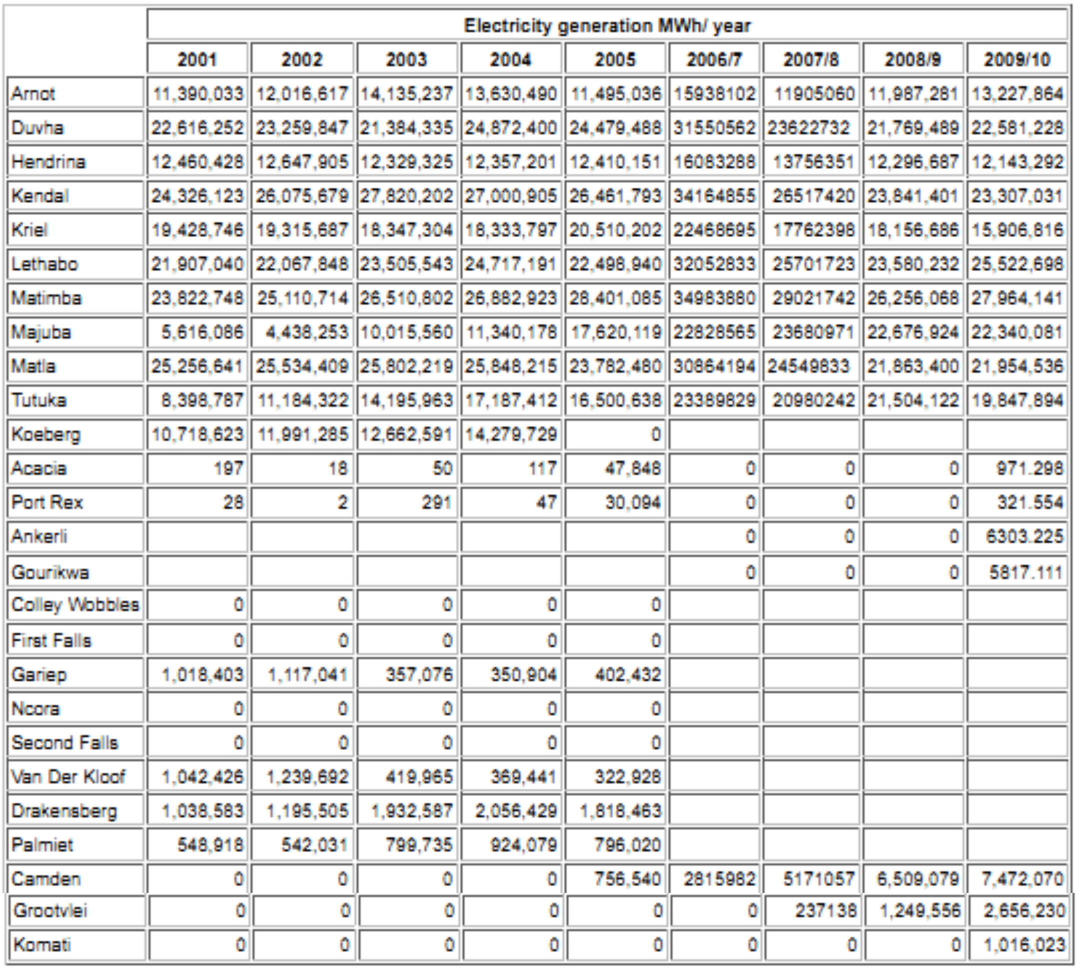
Fuel consumption of power plants



Plant names	Installed capacity (MW)	Commissioning date	Fuel type	Fuel consumption	UoM	2001	2002	2003	2004	2005	2006/7	2007/8	2008/9	2009/10
Arnot	1980	1971/09/21	Coal	30,114,258	tonnes/year	5,595,047	5,799,406	6,654,629	6,608,536	5,456,640	8063020	6210700	6,395,805	6794134
Duvha	3450	1980/01/18	Coal	54,903,663	tonnes/year	10,560,247	10,681,500	9,988,679	11,907,947	11,765,290	15915147	12425531	11,393,553	11744606
Hendrina	1895	1970/05/12	Coal	32,986,509	tonnes/year	6,475,309	6,551,254	6,432,159	6,644,412	6,883,375	8746546	7794220	7,122,918	6905917
Kendal	3840	1988/10/01	Coal	74,010,300	tonnes/year	13,517,688	14,156,009	15,745,646	15,429,638	15,161,339	20115835	15986131	15,356,595	13866514
Kriel	2850	1976/05/06	Coal	49,175,255	tonnes/year	10,032,554	10,019,981	9,306,872	9,297,070	10,518,778	11722579	9059934	9,420,764	8504715
Lethabo	3558	1985/12/22	Coal	79,732,564	tonnes/year	15,309,412	15,368,207	16,410,189	17,041,971	15,602,785	22792396	18314572	16,715,323	18170227
Matimba	3690	1987/12/04	Coal	62,281,318	tonnes/year	12,362,245	12,960,435	13,803,200	13,786,063	9,369,375	18075673	14862323	13,991,453	14637481
Majuba	3843	1996/04/01	Coal	31,204,762	tonnes/year	2,593,313	2,370,339	5,539,271	6,363,395	14,338,444	11834508	12853342	12,554,406	12261833
Matla	3450	1979/09/29	Coal	65,352,916	tonnes/year	12,884,252	12,924,369	13,169,317	13,445,117	12,929,861	16867123	13795309	12,689,387	12438391
Tutuka	3510	1985/06/01	Coal	35,024,656	tonnes/year	4,492,863	5,628,669	7,319,814	8,983,951	8,599,359	11654556	10627575	11,231,583	10602839
Koeberg	1800	1984/07/21	Nuclear	0	NA	0	0	0	0	0	0	0	0	0
Acacia	171	1976/05/13	Gas	17,628,065 litres kerosene/year	liters kerosene/year	72,004	6,579	18,275	42,764	17,488,444	0	0	0	0
Port Rex	171	1976/09/30	Gas	11,133,861 litres kerosene/year	liters kerosene/year	10,234	731	106,361	17,179	10,999,357	0	0	0	0
Ankerlig	1 338	2007/03/29	Gas		NA	0	0	0	0	0	0			
Gourikwa	746	2007/03/30	Gas		NA	0	0	0	0	0	0			
Colley Wobbles	0	1900/01/01	Hydro	0	NA	0	0	0	0	0	0	0	0	0
First Falls	0	1900/02/01	Hydro	0	NA	0	0	0	0	0	0	0	0	0
Gariep	360	1971/09/08	Hydro	0	NA	0	0	0	0	0	0	0	0	0
Ncora	0	1900/03/01	Hydro	0	NA	0	0	0	0	0	0	0	0	0
Second Falls	0	1900/04/01	Hydro	0	NA	0	0	0	0	0	0	0	0	0
Van Der Kloof	240	1977/01/01	Hydro	0	NA	0	0	0	0	0	0	0	0	0
Drakensberg	1000	1981/06/17	Pump Storage	0	NA	0	0	0	0	0	0	0	0	0
Palmiet	400	1988/04/18	Pump Storage	0	NA	0	0	0	0	0	0	0	0	0
Camden	1600	1966/12/21	Coal	390,000	tonnes/year	0	0	0	0	390,000	1604548	3218873	3,876,211	4,732,163
Grootvlei	1200	1969/06/30	Coal	0	tonnes/year	0	0	0	0	0	0	130747.7	674,538	1,637,371
Komati	1000	1969/06/30	Coal	0	tonnes/year	0	0	0	0	0	0	0	0	664,497

Source: http://www.eskom.co.za/content/calculationTable.htm (website visited on 16.09.2011)

Electricity generation of power plants



	Electricity generation MWh/ year								
	2001	2002	2003	2004	2005	2006/7	2007/8	2008/9	2009/10
Arnot	11,390,033	12,016,617	14,135,237	13,630,490	11,495,036	15938102	11905060	11,987,281	13,227,864
Duvha	22,616,252	23,259,847	21,384,335	24,872,400	24,479,488	31550562	23622732	21,769,489	22,581,228
Hendrina	12,460,428	12,647,905	12,329,325	12,357,201	12,410,151	16083288	13756351	12,296,687	12,143,292
Kendal	24,326,123	26,075,679	27,820,202	27,000,905	26,461,793	34164855	26517420	23,841,401	23,307,031
Kriel	19,428,746	19,315,687	18,347,304	18,333,797	20,510,202	22468695	17762398	18,156,686	15,906,816
Lethabo	21,907,040	22,067,848	23,505,543	24,717,191	22,498,940	32052833	25701723	23,580,232	25,522,698
Matimba	23,822,748	25,110,714	26,510,802	26,882,923	28,401,085	34983880	29021742	26,256,068	27,964,141
Majuba	5,616,086	4,438,253	10,015,560	11,340,178	17,620,119	22828565	23680971	22,676,924	22,340,081
Matla	25,256,641	25,534,409	25,802,219	25,848,215	23,782,480	30864194	24549833	21,863,400	21,954,536
Tutuka	8,398,787	11,184,322	14,195,963	17,187,412	16,500,638	23389829	20980242	21,504,122	19,847,894
Koeberg	10,718,623	11,991,285	12,662,591	14,279,729	0				
Acacia	197	18	50	117	47,848	0	0	0	971.298
Port Rex	28	2	291	47	30,094	0	0	0	321.554
Ankerli						0	0	0	6303.225
Gourikwa						0	0	0	5817.111
Colley Wobbles	0	0	0	0	0				
First Falls	0	0	0	0	0				
Gariep	1,018,403	1,117,041	357,076	350,904	402,432				
Ncora	0	0	0	0	0				
Second Falls	0	0	0	0	0				
Van Der Kloof	1,042,426	1,239,692	419,965	369,441	322,928				
Drakensberg	1,038,583	1,195,505	1,932,587	2,056,429	1,818,463				
Palmiet	548,918	542,031	799,735	924,079	796,020				
Camden	0	0	0	0	756,540	2815982	5171057	6,509,079	7,472,070
Grootvlei	0	0	0	0	0	0	237138	1,249,556	2,656,230
Komati	0	0	0	0	0	0	0	0	1,016,023

Source: http://www.eskom.co.za/content/calculationTable.htm(website visited on 16.09.2011)

	Year	2008	2009	2010
NCV (ESKOM)	GJ/t Coal	18,51	19,1	19,22

Source: ESKOM Annual Report 2010, Table I, page 296

EF	0,0946	$tonCO_2/GJ$	Coal emission factor (IPCC default value 2006)

Annex 4

MONITORING INFORMATION

Table: Monitoring System Procedures

Procedure	Description	Scope
CPA Staff training	This procedure outlines the steps to ensure that staff receives adequate training to collect and archive complete and accurate data necessary for CPA monitoring.	This procedure should be followed by all staff on site prior to performing monitoring duties for the CPA.
CPA data and record keeping arrangements / day-to-day record handling	This procedure provides details of the site data and record keeping arrangements. The arrangements ensure that complete and accurate records are retained. Data and records will be stored and archived by CME and CPA owners according to this procedure.	All relevant data and records should be managed following this procedure. All staff is responsible for ensuring that any data or records are dealt with according to this procedure.
CPA data quality control and quality assurance	Data and records will be checked prior to being stored and archived. Data from all CPAs will be checked by CME to identify possible errors or omissions. All records will be checked for completeness on a regular basis.	The staff is responsible for ensuring the collection and archiving of complete and accurate data and records.
Internal audits	This procedure will outline the process of internal audits, where the performance of the project will be assessed. It will also provide details on the follow-up of forward actions arising after third party verification.	This procedure should be followed by all CPA staff involved in internal audits.
Equipment failure	This procedure details the process of data collection in the case that a problem with relevant monitoring equipment occurs.	This procedure should be established by the CME.

Equipment calibration	This procedure details the process of organising and managing the calibration process as per recommendation by the manufacturer.	The calibration of the meters will be conducted according to manufacturer’s recommendations. The CPA owner is responsible for organising the calibration and ensuring that records are retained.

The above procedures will be documented as part of the monitoring support documentation.