



**PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1**

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Manufacture and utilization of bio-coal briquettes in Stutterheim, South Africa
Version number of the PDD	03
Completion date of the PDD	31/08/2012
Project participant(s)	Bio-Coal Manufacturers and Distributors (Pty) Ltd
Host Party(ies)	Republic of South Africa (host)
Sectoral scope and selected methodology(ies)	<p><u>Sectoral Scope 13</u>: Waste Handling and Disposal and</p> <p><u>Sectoral Scope 1</u>: Energy industries (renewable/non-renewable sources)</p> <p>Methodology : AM0025/version-13: “Avoided emissions from organic waste through alternative waste treatment processes”</p>
Estimated amount of annual average GHG emission reductions	The total annual average emission reductions of the project activities over the crediting period of 10 years are expected to be 133,599 tonnes CO _{2e}

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The project activity involves setting up a production facility to manufacture bio-coal pellets and briquettes in Sutterheim, Eastern Cape of South Africa. The briquettes shall be sold to existing and/or new facilities wherein fossil fuel - coal is either presently used or would have been used as the primary fuel for generation of thermal energy in absence of project activity. Thus the project activity will replace coal combustion in coal-fired boilers.

The major raw materials that may be used for bio-coal briquette production include:

- Sawdust, bark, wood chips and off cuts from saw mills;
- Forestry wastes-thinning, pruning, branches, top and dried leaves collected by communities in the surrounding commercial and municipal forests; and
- Agricultural waste from agricultural activities in the area;

Sutterheim has a large forest area where tons of biomass waste is generated by way of thinning, pruning and harvesting of logs for producing timber, in the form of off cuts, shavings and saw dust.

All solid biomass waste, in any form is first chipped into smaller pieces in wood chipper followed by grinder to convert to saw dust. Once the biomass waste enters the briquette machines it will be compacted under high pressure, liquefying the “lignin” in biomass waste to bind the material. This process is called as Binder less ram/piston extrusion technology. The size of the briquette is determined by the use of dies through which the briquettes are extruded. Briquettes are then chopped mechanically or manually to required lengths, which are conveyed via conveyor belt and stored in feeder hopper for packing.

In the palletizing process, the dry material will be injected with steam. The steam softens; the material and help to liquefy the lignin in the biomass waste, which then become binder. This steam will be produced on-site using a small portion of the bio coal produced. The biomass waste will be pushed through tapered disk die to produce the pallets.

The bio-coal produced will be packed in HDPE woven sling bags of 1 ton capacity and delivered to the customers.

The Table A.1.1 below provides a list dedicated and potential customers which have been using coal as fuel source for generating steam/hot air but post project implementation would use bio-coal instead of coal.

Table A.1.1: Estimated Fuel Demand (T/yr) of the Customers:

SL. No	Customer Details	Type of Fuel used at Present	Heat Generation Equipment	Efficiency	Estimated Fuel Demand (T/yr)
1	Summer pride	Coal	Stroker Fired Boiler	80%	8,680
2	Brick & Clay	Coal	Stroker Fired Boiler	80%	2,100
3	Blueberry Hill Farm	Coal	Boiler	80%	2,100
4	Da Gama Textiles	Coal	Stroker Fired Boiler	80%	30,000
5	Stutt Bricks	Coal	Stroker Fired Boiler	80%	1,800
6	Frier Hospital	Coal	Stroker Fired Boiler	80%	2,500
7	National Correction Services	Coal	Stroker Fired Boiler	80%	2,500
8	Nestle	Coal	Stroker Fired Boiler	80%	10,000
9	Parmalat	Coal	Stroker Fired Boiler	80%	1,250
10	Nestle Port Elizabeth	Coal	Stroker Fired Boiler	80%	12,000

The bio-coal delivered to the customers (T/yr) will be based on the 57,000 tons of bio-coal produced every year.

Pre-project scenario: Biomass waste disposal on landfill with Fossil fuel – coal combustion in industrial facilities for thermal energy generation



Prior to the project activity the above biomass waste was being dumped in landfill resulting in methane emissions due to development of anaerobic conditions. Moreover, coal is used as primary fuel for generation of thermal energy in coal fired boilers (Stoker Fired) in various industrial facilities resulting in GHG emissions.

Baseline scenario: The project is a green field project activity. Baseline scenario as identified in section B.4 is the continuation of the pre-project scenario detailed above.

This project activity will result in reduction of greenhouse gas (GHG) emission due to avoidance of methane that would have been generated from the wood waste disposed off in the existing landfill undergoing anaerobic decomposition, in the absence of the project activity. The project activity will also result in emission reduction due to avoidance of carbon dioxide equivalent by combustion of bio-coal briquettes instead of coal for thermal energy generation. Please refer to section B.3 for details of sources and gases included in the project boundary.

The total estimate of annual average and total GHG emission reductions of the project activities over the crediting period of 10 years are expected to be **133,599** and **1,335,994** tonnes CO_{2e} respectively.

The project makes positive contributions to sustainable development. The South African Designated National Authority (DNA) evaluates sustainability in three categories: Economic, environmental and social.

<http://www.energy.gov.za/files/esources/kyoto/dnaapproval.pdf>

The contributions of the project towards sustainable development are discussed in terms of these three categories:

1. Environmental Impact:

- Impact of the project on community access to natural resources- Positive impact on resource conservation - this project activity will utilize the amount of biomass waste that is discarded; as a result there will be conservation of coal – natural resource that is presently being used as fossil fuel source by the potential users of bio-coal briquettes.
- Impact of the project on water pollution- No negative impact; there is neither release of any toxic gases, fumes or chemicals and compounds nor releases any hazardous solid or liquid effluents which will cause water pollution.
Impact of the project on the generation or disposal of solid waste - Positive impact; the project will avoid the solid waste disposal occurring in the pre-project scenario and in turn avoid release of methane generated through anaerobic decomposition of biomass waste. The project will not generate any solid waste that would require disposal.
- Any other positive or negative environmental impacts of the project (such as impacts on noise, safety, visual impacts, or traffic)- No negative impact; the process does not create any noise pollution that can be heard outside of factory premises nor cause any underground pollution or contamination.

Change in the usage of natural resources:

- Impact of the project on community access to natural resources- No negative impact. The bio coal manufacturing facility will be established on an approved demarcated industrial site. Thus, it has no negative effect on the natural resources of the region.

- Impact of the project on the sustainability of use of water, minerals or other non-renewable natural resources – Positive impact. The briquettes and pallets that are manufactured from the biomass waste, which is much cleaner fuel than coal will replace coal consumption and thereby conserve coal.
- Impact of the project on the efficiency of resource utilisation - Positive impact – The bio coal manufactured by the project activity is produced out of waste material which has no use. In absence of project activity the biomass waste is dumped in landfill without LFG capture system. The project activity therefore contributes towards efficient resource utilization. Further, bio coal produces less ash than coal and this ash can be used as an organic fertilizer.

Impacts on biodiversity and ecosystem:

- Changes in local or regional biodiversity arising from the project- No negative impact. The bio coal manufacturing facility will be established on an approved demarcated industrial site. Thus, it has no negative impacts on the biodiversity and ecosystem of the region.

2. Economic :

Economic Impacts

- Impact of the project on foreign exchange requirements –Positive impact through increased spending of foreign exchange through services like banking, general retail, plant hire firms, transport companies, hotels,
- Impact of the project on existing economic activity in the area- Positive impact. The project activity is a new industry in the area and will therefore contribute to the local economy. Both Direct and in-direct jobs opportunities can be generated for technicians, semi-skilled & skilled workers, harvesters, labourers and transporters. The project activity will give local people an opportunity to collect forest and timber waste from the surrounding industries and sell this to the bio coal manufacturing plant.
- Impact of the project on the cost of energy- Positive impact. The project activity will provide the communities with economical and safer sources of energy for heat generation, thereby reducing dependence on coal
- Impact of the project on foreign direct investment –No impact.

Appropriate Technology Transfer:

- Positive or negative implications for the transfer of technology to South Africa arising from the project –The project will have no negative impacts for the transfer of technology to South Africa.
- Impacts of the project on local skills development- The project activity will bring job creation strategy which will aid in the development of the local communities. Indirectly there will be positive impact through increased spending on services of local businesses such as banking, general retail, plant hire firms, transport companies, hotels, catering, property etc.
- Demonstration and replication potential of the project- the project activity has a large replication potential.

3. Social:

- Alignment with national provincial and local development priorities- Positive impact. The project is established on an approved demarcated industrial site after receiving clearances from the Municipality abiding the national provincial and local development priorities. The project activity will not create any relocation of communities and contributes towards use of bio-coal as a direct replacement of Grade-A coal used for domestic and commercial purposes
- Social equity and poverty alleviation- Positive impact. The project activity will be in line with government's growth, poverty eradication and job creation strategy which will aid in the



development of the local communities. The communities surrounding Stutterheim will be given an opportunity to collect forest and timber waste from the surrounding industries and sell this to the bio coal manufacturing plant. This will be coordinated through community trusts.

4. General:

- General project acceptability: The distributions of the project benefits are fair and reasonable to all the stakeholders. The project will bring increased spending of foreign exchange through services as specified above, create job opportunities to skilled and unskilled workers and also minimize the dependence on fossil fuel sources & its associated fossil fuel emissions.

A.2. Location of project activity

A.2.1. Host Party(ies)

Republic of South Africa

A.2.2. Region/State/Province etc.

Amahlathi Municipality in Eastern Cape Province

A.2.3. City/Town/Community etc.

Stutterheim

A.2.4. Physical/Geographical location

The location of the project is provided below: Latitude: $32^{\circ}34'40.67''$ S; Longitude: $27^{\circ}25'18.75''$ E



Figure 1: Political Map of South Africa



Figure 2: Plant Location

A.3. Technologies and/or measures

The project activity involves the establishment (design, construction and erection) and the operation of a new manufacturing plant in Stutterheim (Eastern Cape) which will produce Bio Coal in the form of briquettes & Pallets. Stutterheim has a forestry and timber industry that generates tremendous amount of timber waste. Bio Coal which is obtained by compressing plant material; where incoming raw materials are first chemically analyzed to ascertain values of the contents and composition. It is then tested for calorific value, moisture and ash content. Depending on the findings of the content, combination and percentage of biomass waste is determined to achieve maximum calorific value of the actual briquette.

Bio-coal briquette is a type of solid fuel prepared by compacting pulverized biomass. The high pressure applied in the process ensures liquefying of inherent lignin in the biomass particles which becomes binder and holds biomass together, as a result of which it does not separate during transportation, storage and combustion. The briquettes and pallets are then packaged in one ton sling bags, and delivered to clients. Each shift production of briquettes and pallets are tested in random for their calorific values before dispatch to ensure consistent Calorific values to end users. Bio-coal briquette has a favourable ignition, better thermal efficiency, and emits less dust and soot.

The manufacturing facility will be a typical warehouse structure, which will comprise of a floor slab, steel supporting structure with cladding, storage facilities, and an office and administration block. The manufacturing equipment is an entire bio-coal processing unit comprising of conveyors, boilers, meters, chippers and grinders, dryers and a briquette press which compresses the biomass waste (under pressure) into pallets of bio coal.

Table A.3.1: Technical Specifications for the major equipments used in the project activity:

Briquette Press (ATG-BRQ 6090)		
Particulars	Unit	Value
Briquettes Diameter	mm	60-90
Briquette Length	mm	15-150
Production Capacity	Ton/hr	2.5
Raw-Material size	mm	0.5-25
Average Lifetime of Equipment	Years	10
Electricity/Power (Press Model: ATG-BRQ 6090)		
Power consumption	Units/Hr	35-40
Required power connection (One Machine)	HP	88.5
Average Lifetime of Equipment	Years	10
Electromagnetic Flow meter (Full Bore) with Remote Transmitter		
Line Size	Inches	6
Flow Range	M3/Hr	500
Output	mA	4-20
Average Lifetime of Equipment	Years	10
Orifice based Flow Metering System with Density Compensation		
Line Size	NB	100
Flow range	Kg/hr	3,000
Pressure	Bar	3.5
Temperature	⁰ C	140

Suitability of Bio-coal for use in Coal-fired Boilers:-

In order for industry to replace steam coal with Bio Coal pellets to fuel their boilers, the new fuel needs to be suitable for use in those boilers. The criteria that is used to determine the suitability of the pellets is to determine their specifications with respect to the Calorific value, moisture content, ash content, volatile matter and supply content. The ideal situation is to have a high calorific / heating value, low ash, moisture and sulphur content and high volatile matter.

In order to determine the specifications for the Bio Coal pellets tests were done at the Parmalat factory, where other potential clients witnessed the trials and the report was published on 27th February 2009. The results of these tests indicated, that the Bio-coal pellets are suitable for use in coal-fired boilers. Moreover, as per the contract agreements with the suppliers, calorific value for bio-coal produced will be checked and verified at random by South African Bureau of Standard (SABS).

Table A.3-2: Comparison between bio-coal and steam coal specifications:

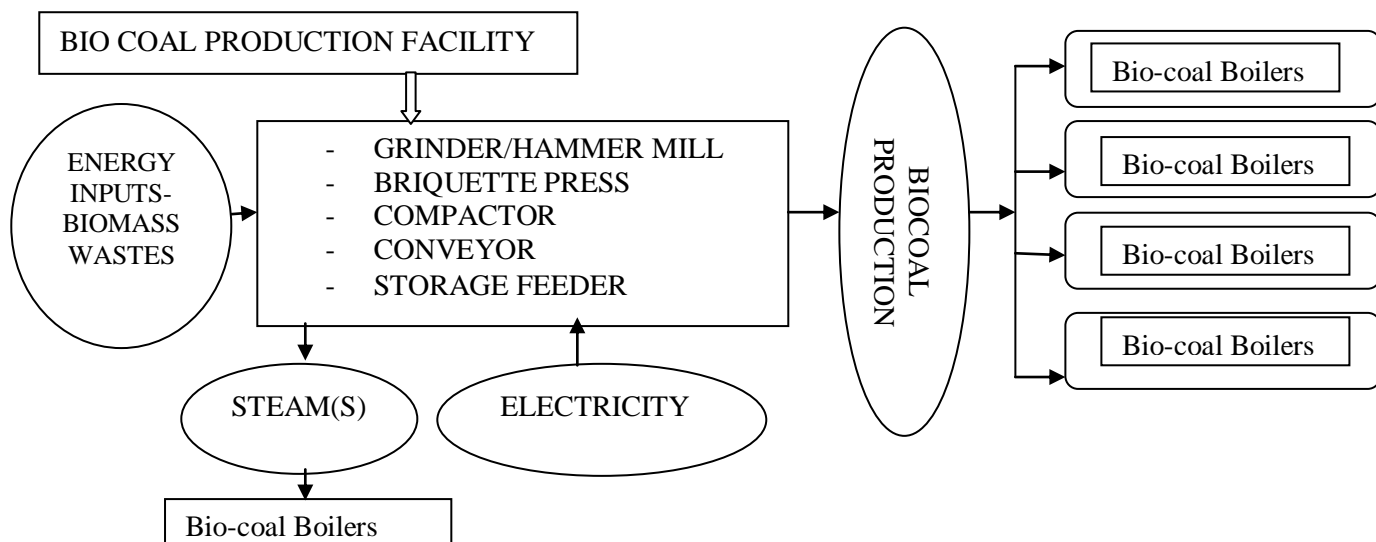
Specifications	Bi-Coal	Steam Coal (A Grade)	Description
Calorific value (kcal/Kg)	4135	6210	Amount of heat released during combustion.
Moisture (%)	Less than 3%	12%	Excess moisture lowers temperature inside combustion zone leading to poor gas quality.
Ash Content	Less than 3%	15%	Biomass ash content above 5-6% may lead to excessive blockage problems in combustion zone.
Volatile matter	70%	22%	Gas/vapour released when coal is heated at high temperatures.
Sulphur	0%	1%	Major cause of acid rain and air pollution

The results indicated that (under full production and with the correct settings and firing of the boiler using Bio-Coal pellets) the boiler produced more than enough steam to satisfy all the production plants steam requirements.

Agro-Technologies, an Indian manufacturing company, will supply the briquetting plant and render after-sale-services. The Project Team is of the opinion that the supplier is well established and offers a good product and service. The technology will be transferred to the host country through ocean freight.

Moreover, the project activity will also lead to emission reduction due to avoidance of methane by manufacturing of bio-coal and due to avoidance of carbon dioxide by combustion of bio-coal in coal fired boilers in industrial facilities for generation of thermal energy. Refer section B.3 of the PDD for details on sources and gases included in the in the project boundary.

The mass & energy flow diagram for the project activity is provided below:



The Project activity is a “First of its Kind”; so there was no facility, system and equipments existing prior to the implementation of the project activity.

The facility of Bio-coal production, along with its system and equipments in the baseline scenario, as established in section B.4 below:

- Grinder, Hammer Mill
- Briquette Press
- Compactor & Conveyor
- Storage feeder

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of South Africa (host)	Bio-Coal Manufacturers and Distributors (Pty) Ltd (Private)	No

A.5. Public funding of project activity

No public funding has been used in the development of this project from Parties included in Annex I.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

Following approved baseline & monitoring methodology is applied;

AM0025: “Avoided emissions from organic waste through alternative waste treatment processes”

Reference: Version-13.0.0, EB 65; valid from 25 Nov 11 onwards

<http://cdm.unfccc.int/methodologies/DB/60GTPUC1H2NA5A72E9CEI393DTA7KB>

The Tools to which the selected methodology refers:

Tool for the demonstration and assessment of additionality

Reference: Version 6.0.0, EB 65

<http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-01-v6.0.0.pdf>

Emissions from solid waste disposal sites

References: Version 06.0.1, EB 66

<http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-04-v6.0.1.pdf>

Combined tool to identify the baseline scenario and demonstrate additionality

References: Version 04.0.0 EB 66

<http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-02-v4.0.0.pdf>

Tool to calculate the emission factor for an electricity system

Reference: Version 2.2.1, EB 63

<http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-07-v2.2.1.pdf>

B.2. Applicability of methodology

Applicability criteria of the methodology AM0025 and the suitability of project activity are discussed in following table;

Table: Applicability justification of the methodology AM0025

Applicability criteria	Project activity/status
<p>The project activity involves one or a combination of the following waste treatment options for the fresh waste that in a given year would have otherwise been disposed of in a landfill:</p> <ul style="list-style-type: none">(a) A composting process in aerobic conditions;(b) Gasification to produce syngas and its use;(c) Anaerobic digestion with biogas collection and flaring and/or its use. The anaerobic digester processes only the waste for which emission reductions are claimed in this methodology. If the biogas is processed and upgraded to the quality of natural gas and it is distributed as energy via natural gas distribution grid, project activities may use approved methodology AM0053 in conjunction with this methodology. In such cases the baseline scenario identification procedure and additionality assessment shall be undertaken for the combination of the two components of the project activity i.e. bio-	<p>The project activity involves high pressure mechanical treatment process of the biomass waste sourced from saw mills/timber industry and forest to produce bio-coal briquettes and pallets (stabilized biomass hereon referred to as SB) as end product and thereafter its use for thermal energy generation. The physical and chemical properties are homogeneous and constant over time interval as evidenced from Process Description & Quotation for supply & erection of Briquette Manufacturing Unit by Agro Technologies. So this applicability condition is met for the project activity.</p>

<p>methane emission avoidance and displacement of natural gas;</p> <p>(d) Mechanical/thermal treatment process to produce refuse-derived fuel (RDF)/stabilized biomass (SB) and its use. The thermal treatment process (dehydration) occurs under controlled conditions (up to 300 degrees Celsius). In case of thermal treatment process, the process shall generate a stabilized biomass that would be used as fuel or raw material in other industrial process. The physical and chemical properties of the produced RDF/SB shall be homogenous and constant over time;</p> <p>(e) Incineration of fresh waste for energy generation, electricity and/or heat. The thermal energy generated is either consumed on-site and/or exported to a nearby facility. Electricity generated is either consumed on-site, exported to the grid or exported to a nearby facility. The incinerator is rotating fluidized bed or circulating fluidized bed or hearth or grate type.</p>	
<p>In case of anaerobic digestion, gasification or RDF processing of waste, the residual waste from these processes is aerobically composted and/or delivered to a landfill;</p>	<p>The proposed project activity involves SB processing of waste. It may be noted that, there will not be any residual waste generated from the project activity. All the raw material will be completely converted into SB. So this applicability condition is not applicable for the project activity.</p>
<p>In case of composting, the produced compost is either used as soil conditioner or disposed of in landfills;</p>	<p>The proposed project activity does not involve any composting; so this criterion is not applicable for the proposed project activity.</p>
<p>In case of RDF/stabilized biomass processing, the produced RDF/stabilized biomass should not be stored in a manner that may result in anaerobic conditions before its use;</p>	<p>The bio-coal briquettes are temporarily stored in feeder hoppers after processing; thereafter they are packaged and dispatched to the industrial facilities & other customers for use. Bio-coal will be packed in laminated water proof sacks/bags that will protect Bio-Coal from moisture & water contact followed by transport and storage. The bio-coal briquettes will not be stored longer than 2-3 days before its use. The storage conditions both at the manufacturing facility and at the industrial facility will not result in decomposition in anaerobic</p>



	conditions. So this applicability condition is met for the project activity.
If RDF/SB is disposed of in a landfill, project proponent shall provide degradability analysis on an annual basis to demonstrate that the methane generation, in the life-cycle of the SB is below 1% of related emissions. It has to be demonstrated regularly that the characteristics of the produced RDF/SB should not allow for re-absorption of moisture of more than 3%. Otherwise, monitoring the fate of the produced RDF/SB is necessary to ensure that it is not subject to anaerobic conditions in its lifecycle;	The SB produced shall be completely combusted for generation of thermal energy in various industrial facilities and shall not be disposed of in a landfill. This may be evidenced during verification, based on the production and sale records. It shall also be ensured that the SB is not subjected to anaerobic conditions and that the produced SB doesn't absorb more than 3% of moisture. So this applicability condition is met for the project activity.
In the case of incineration of the waste, the waste should not be stored longer than 10 days. The waste should not be stored in conditions that would lead to anaerobic decomposition and, hence, generation of CH ₄ ;	No incineration of the waste will be implied in the project activity. Therefore, this criterion is not applicable for project activity.
The proportions and characteristics of different types of organic waste processed in the project activity can be determined, in order to apply a multiphase landfill gas generation model to estimate the quantity of landfill gas that would have been generated in the absence of the project activity;	The project activity utilizes only one organic waste type – 'Wood and wood products' Therefore, this criterion is not applicable for project activity.
The project activity may include electricity generation and/or thermal energy generation from the biogas, syngas captured, RDF/stabilized biomass produced, combustion heat generated in the incineration process, respectively, from the anaerobic digester, the gasifier, RDF/stabilized biomass combustor, and waste incinerator. The electricity can be exported to the grid and/or used internally at the project site. In the case of RDF/SB produced, the emission reductions can be claimed only for the cases where the RDF/SB used for electricity and/or thermal energy generation can be monitored;	The proposed project activity involves bio-coal manufacturing which in turn is utilized to generate thermal energy for industrial applications. As required by the methodology applicability condition, the emission reductions associated to energy reduction will be claimed only for the cases where the SB is used for thermal energy generation which can be monitored. So this applicability condition is met for the project activity.
Waste handling in the baseline scenario shows a continuation of current practice of disposing the waste in a landfill despite environmental regulation that mandates the treatment of the waste, if any, using any of the project activity treatment options mentioned above;	Waste handling in the baseline scenario shows continuation of current practice of disposing the waste in a landfill without the capturing of landfill gas. Please refer to Section B.4. Establishment and description of baseline scenario. Further there is no rules & mandate for treatment of the wastes. So this applicability condition is met for the



	project activity.
The compliance rate of the environmental regulations during (part of) the crediting period is below 50%; if monitored compliance with the MSW rules exceeds 50%, the project activity shall receive no further credit, since the assumption that the policy is not enforced is no longer tenable;	In the current scenario, there is no relative environmental regulation in host country regarding treatment of the waste. Therefore, this criterion is not applicable for project activity.
Local regulations do not constrain the establishment of RDF production plants/thermal treatment plants nor the use of RDF/stabilized biomass as fuel or raw material;	There are no local regulations that constrain either the establishment of SB production plants or the use of SB as fuel. So this applicability condition is met for the project activity.
In case of RDF/stabilized biomass production, project proponent shall provide evidences that no GHG emissions occur, other than biogenic CO ₂ , due to chemical reactions during the thermal treatment process (such as Chimney Gas Analysis report);	It may be noted that the project activity does not require any thermal treatment process – therefore This criterion is not applicable for project activity.
The project activity does not involve thermal treatment process of neither industrial nor hospital waste;	The project activity does-not involve thermal treatment process of industrial or hospital waste. The project activity involves mechanical treatment process of biomass waste. This criterion is not applicable for project activity.
In case of waste incineration, if auxiliary fossil fuel is added into the incinerator, the fraction of energy generated by auxiliary fossil fuel is no more than 50% of the total energy generated in the incinerator.	The project activity does not involve incineration of wastes. Hence, this criterion is not applicable for project activity.

The project activity corresponds to the criteria regarding the mechanical treatment process to produce Stabilised Biomass (SB) and its use described above and is therefore applicable to the latest version of AM0025.

B.3. Project boundary

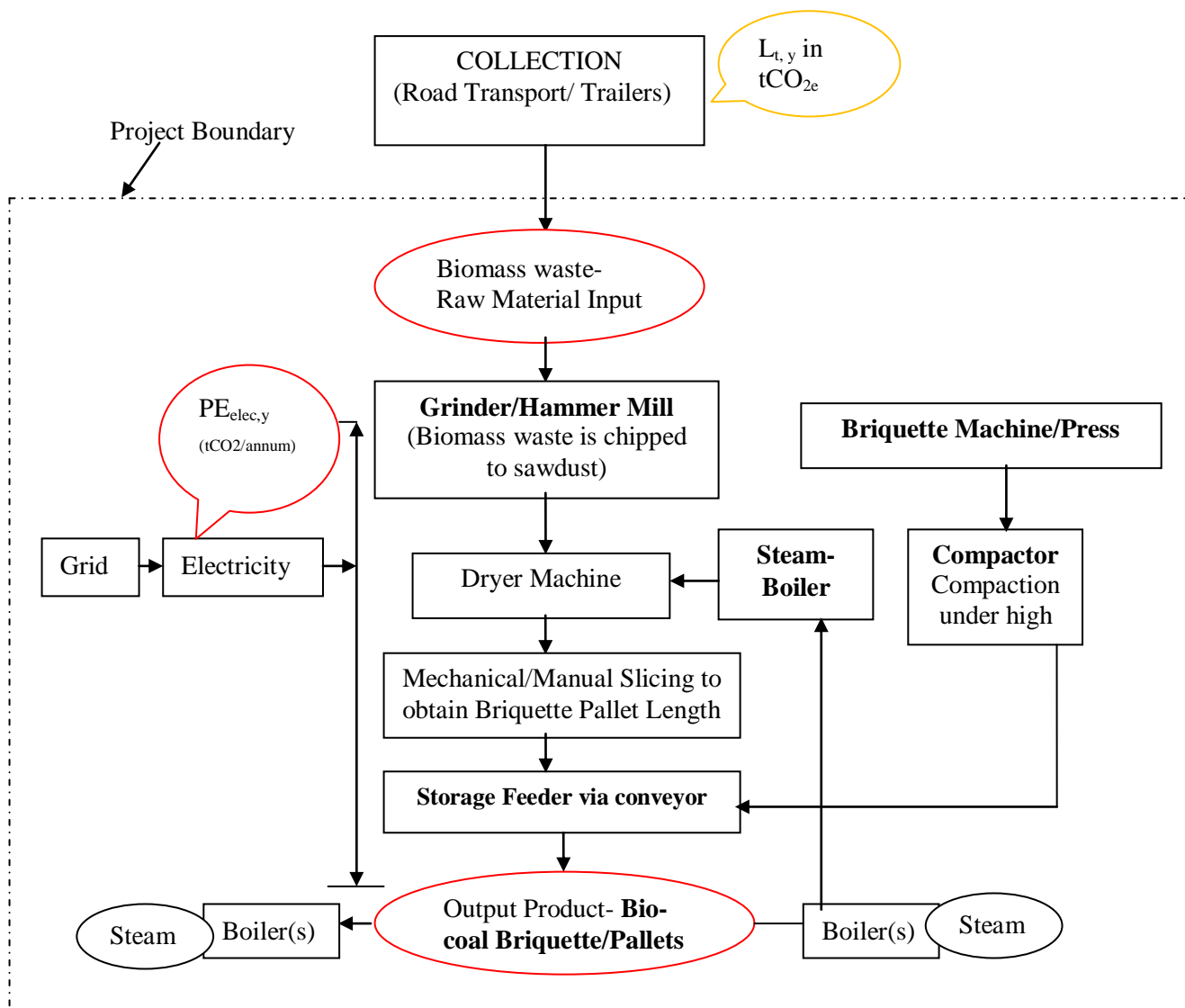
	Source	GHGs	Included?	Justification/Explanation
Baseline scenario	Emissions from decomposition of waste at the landfill site	CH ₄	Included	The major source of emissions in the baseline
		N ₂ O	Excluded	N ₂ O emissions are small compared to CH ₄ emissions from landfills. Exclusion of this gas is conservative
		CO ₂	Excluded	CO ₂ emissions from the decomposition of organic waste are not accounted
	Emissions from electricity consumption	CO ₂	Excluded	Electricity is not consumed from the grid or generated onsite/offsite in the baseline scenario
		CH ₄	Excluded	Excluded for simplification. This is conservative
		N ₂ O	Excluded	Excluded for simplification. This is conservative
	Emissions from thermal energy generation	CO ₂	Included	Thermal energy generation is included in the project activity
		CH ₄	Excluded	Excluded for simplification. This is conservative
		N ₂ O	Excluded	Excluded for simplification. This is conservative
Project scenario	On-site fossil fuel consumption due to the project activity other than for electricity generation	CO ₂	Included	May be an important emission source. It includes vehicles used on-site.
		CH ₄	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N ₂ O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Emissions from on-site electricity use	CO ₂	Included	May be an important emission source. Project use electricity from grid. The electricity used from grid is adjusted in the Net export of electricity calculation.
		CH ₄	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N ₂ O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Emissions from thermal energy generation	CO ₂	Included	If thermal energy generation is included in the project activity
		CH ₄	Excluded	Excluded for simplification. This emission source is assumed to be very small
		N ₂ O	Excluded	Excluded for simplification. This emission source is assumed to be very small
	Direct emissions from the waste treatment processes.	N ₂ O	Included	N ₂ O can be emitted from stabilized biomass combustion
		CO ₂	Excluded	The proposed project activity does not involve incineration, gasification or combustion of fossil fuel waste. CO ₂ emissions from the decomposition or



				combustion of organic waste are not accounted.
		CH ₄	Excluded	CH ₄ is excluded since the magnitude of emission sources omitted in the calculation of project emissions and leakage effects (if positive) is less than the magnitude of emission sources omitted in the calculation of baseline emissions.
	Emissions from waste water treatment	CO ₂	Excluded	The proposed project activity does not involve treatment of wastewater, hence CO ₂ emissions from the decomposition of organic waste are not accounted
		CH ₄	Excluded	The proposed project activity does not involve treatment of wastewater, hence CH ₄ emissions from the wastewater treatment are not accounted
		N ₂ O	Excluded	The proposed project activity does not involve treatment of wastewater, hence N ₂ O emissions from the wastewater treatment are not accounted

According to AM0025, the spatial extent of the project boundary is the site of the project activity where the waste is treated. This includes the facilities for processing the waste, on-site electricity consumption, onsite fuel use, the baseline biomass waste landfill site and the industrial facilities that consume the SB for thermal energy generation. The project boundary does not include facilities for waste collection, sorting and transport to the project site. The project boundary includes:

1. The waste disposal sites where the raw materials would have been left to decompose in the absence of the project activity.
2. The bio-coal manufacturing facility.
3. The buyers/purchasers of the bio coal including the consumption point of the SB. The project boundary and the sources and gases included are shown in the figure and table below:



B.4. Establishment and description of baseline scenario

As required by the methodology, Step 1 of the latest version of the “Tool for demonstration and assessment of additionality (Version 06.0)” is used to identify all realistic and credible baseline alternatives.

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

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

Sub-Step1b: Consistency with mandatory laws and regulations:

As per Para 16 of the Tool for demonstration and assessment of additionality (Version 06.0) the following alternatives were identified as realistic and credible alternatives available to the project participant or similar project developers that provide outputs or services comparable with the proposed CDM project activity and consistent with mandatory laws and regulations as per Para 19.

For the approved methodology AM0025 version 13.0.0 the Alternatives for the disposal/treatment of the fresh waste in the absence of the project activity is provided in table below:

Table B.1: Scenario relevant for estimating baseline methane emissions, to be analysed should include, *inter alia*:

Representation	Parameters	Realistic and credible alternative?	Reason with Justification
M1	The project activity (i.e. composting, gasification, anaerobic digestion, RDF processing/thermal treatment without incineration of organic waste or incineration of waste) not implemented as a CDM project;	Yes	There are no mandatory regulatory or contractual requirements in the host country that require PP or any other authority to undertake the project activity. Neither do the regulations prevent /prohibit implementation of the project activity. Therefore this alternative has been considered as realistic and credible.
M2	Disposal of the waste at a landfill where landfill gas captured is flared;	No	There are no mandatory regulatory or contractual requirements in the host country that require PP or any other authority to undertake the project activity, and the disposal of the waste at the landfill site requires huge investment. Further Installation of landfill gas collection and flaring system facilities requires huge capital investment without any monetary benefit, since there is no revenue inflow. Therefore this alternative is not considered as realistic and credible.
M3	Disposal of the waste on a landfill without the capture of landfill gas.	Yes	There are no mandatory regulatory or contractual requirements in the host country that require PP or any other authority to undertake the alternative. Neither do the regulations prevent /prohibit saw mill owners who generate the waste in their process to implement this alternative using their own area to dispose these wastes without the capture of landfill gas. Further it may be noted that this alternative is the current practice. Therefore this alternative has been considered as realistic and credible.

Therefore, M1 and M3 are among the credible and realistic alternatives considered for the disposal/treatment of fresh waste.

Table B.2: For Power Generation, the realistic and credible alternative(s) may include, *inter alia*:



Representation	Parameters	Realistic and credible alternative?	Reason with Justification
P1	Power generated from by-product of one of the options of waste treatment as listed in M1 above, not undertaken as a CDM project activity;	No	The proposed project activity, a fresh waste treatment activity will produce Bio-coal briquettes and pallets, which will be utilized in boilers to generate thermal energy in the form of steam for industrial application. The bio-coal briquettes/pallets will not be utilized for power generation. Since the bio-coal's use is limited to only steam generation and not electricity generation, these alternatives for power generation do not have outputs or services comparable with the proposed CDM project activity. Therefore this alternative is not considered as realistic and credible.
P2	Existing or Construction of a new on-site or off-site fossil fuel fired cogeneration plant	No	
P3	Existing or Construction of a new on-site or off-site renewable based cogeneration plant;	No	
P4	Existing or Construction of a new on-site or off-site fossil fuel fired captive power plant;	No	
P5	Existing or Construction of a new on-site or off-site renewable based captive power plant;	No	
P6	Existing and/or new grid-connected power plants	No	

Table B.3: For Heat generation, the realistic and credible alternative(s) may include, *inter alia*:

Representation	Parameters	Realistic and credible alternative?	Reason with Justification
H1	Heat generated from by-product of one of the options of waste treatment as listed in M1 above, not undertaken as a CDM project activity;	Yes	As stated above, the proposed project activity, a fresh waste treatment activity will produce Bio-coal briquettes and pallets, which will be utilized in boilers to generate thermal energy in the form of steam for industrial application. There are no regulations that prevent /prohibit implementation of the project activity. There this alternative has been considered as realistic and credible.
H2	Existing or Construction of a new on-site or off-site fossil fuel fired cogeneration plant;	No	The project activity only involves steam generation and not electricity generation as in case for cogeneration plant; Since the bio-coal's use is limited to only steam generation and not steam and electricity generation, this alternative for steam and power generation does not have outputs or services comparable with the proposed CDM project activity. Therefore this alternative is not considered as realistic and credible.
H3	Existing or Construction of a new on-site or off-site renewable based cogeneration plant;	No	The project activity only involves steam generation and not electricity generation as in case for cogeneration plant; Since the bio-coal's use is limited to only steam generation and not steam and electricity generation, this alternative for steam and power generation does not have outputs or services comparable with the proposed CDM project activity. Therefore this alternative is not considered as realistic and credible.
H4	Existing or new construction of on-site or off-site fossil fuel based boilers;	Yes	The project activity equivalent thermal energy in the form of steam may be generated through this alternative. Further it may be noted that this alternative is the current practice. There this alternative has been considered as realistic and credible.

H5	Existing or new construction of on-site or off-site renewable energy based boilers;	No	The project activity equivalent thermal energy in the form of steam may be generated through this alternative. Further it may be noted that this alternative cannot be a plausible and credible due to technical limitation.
H6	Any other source such as district heat;	No	No other heat generation sources are available as alternatives in South Africa. Therefore this alternative is not considered as realistic and credible.
H7	Other heat generation technologies (e.g. heat pumps or solar energy)	No	No other heat generation technologies available. Therefore this alternative is not considered as realistic and credible.

So, among the alternative for heat generation, alternative **H1** and **H4** are the only options available for Plausible Baseline scenario selection.

Outcome of Step 1a & 1b:

M1 and M3 were found to be the realistic and credible alternatives either of which could be plausible baseline alternatives applicable for further discussion;

H1 and H4 were found to be the realistic and credible alternatives either of which could be plausible baseline alternatives applicable for further discussion;

In conjunction the above may be referred as

Alternative 1: M1 (The project activity (i.e. composting, gasification, anaerobic digestion, RDF processing/thermal treatment without incineration of organic waste or incineration of waste) not implemented as a CDM project) & **H1** (Heat generated from by-product of one of the options of waste treatment as listed in M1 above, not undertaken as a CDM project activity): Biomass waste processing through mechanical treatment and utilization – bio-coal combustion in industrial facilities for thermal energy generation; It may be noted that this alternative is the project activity under discussion.

Alternative 2: M3 (Disposal of the waste on a landfill without the capture of landfill gas) and **H4** (**Existing or new construction of on-site or off-site fossil fuel based boilers**): Biomass waste disposal on landfill with Fossil fuel – coal combustion in industrial facilities for thermal energy generation; It may be noted that this alternative is the current practice.

National and/or sectoral policies and circumstances have been taken into account in the following ways:

- In Sub-step 1b of the “Tool for the demonstration and assessment of additionality (Version 06.0)”, the project developer must show that the project activity is not the only alternative that is in compliance with all regulations (e.g. because it is required by law);

From the above analysis it is evident that both Alternative 1: project activity and Alternative 2: pre-project scenarios are in compliance with all regulations, therefore the proposed project activity is not the only alternative amongst the ones considered by the PP that is in compliance with mandatory regulations.

- Via the adjustment factor (AF) in the baseline emissions, which is based on the approved consolidated baseline methodology ACM0001 “Consolidated baseline methodology for landfill gas project activities”, project developers must take into account that some of the methane generated in the baseline may be captured and destroyed to comply with regulations or contractual requirements;

It may be worthwhile to note that there are no mandatory regulatory or contractual requirements in the host country that require PP or any other authority to install landfill gas collection and flaring system to capture and destroy landfill gas. Therefore the project developer has not factored the Adjustment factor in the baseline emissions.

- The project developer must monitor all relevant policies and circumstances at the beginning of each crediting period and adjust the baseline accordingly.

PP has opted for a fixed crediting period and has monitored all relevant policies and circumstances at the beginning of each crediting period.

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

Demonstrate that the identified baseline fuel is available in abundance in the host country and there is no supply constraint. In case of partial supply constraints (seasonal supply), the project participants may consider an alternative fuel that result in lowest baseline emissions during the period of partial supply.

Detailed justification shall be provided for the selected baseline fuel. As a conservative approach, the lowest carbon intensive fuel such as natural gas throughout the period may be used.

Bio-coal can will be used in Chain and Stoker fired type boilers, which are the common boiler in the host country designed to fire coal as fuel. So the comparison will only be with Thermal Energy Generation using Coal. Therefore the identified baseline fuel for thermal energy generation is coal. Moreover, around 77% of South Africa's energy needs are directly derived from coal and 81% of all coal consumed domestically goes towards electricity production

References: http://en.wikipedia.org/wiki/List_of_power_stations_in_South_Africa

Coal currently provides 73% of South Africa’s primary energy; 95% of the country’s electricity is coal-fired thermal generation, although natural gas, renewable energy sources and nuclear energy are forecast to increasingly contribute to the primary energy supply, coal remains as the major energy source into the foreseeable future, due to its relative abundance and low cost.. Further it is worthwhile to note that it is the current practice for industries to use coal to generate thermal energy in the form of steam. Therefore coal has been identified as the baseline fuel source.

References: <http://www.saimm.co.za/Journal/v105n02p095.pdf>

Step 3: Step 2 and/or Step 3 of the latest approved version of the “Tool for demonstration and assessment of additionality” shall be used to assess which of these alternatives should be excluded from further consideration (e.g. alternatives facing prohibitive barriers or those clearly economically unattractive).

As specified in the Tool for (“***Proceed to Step 2 (Investment analysis) or Step 3 (Barrier analysis)***”), the Project participants decided to select Step 2 as the appropriate analysis approach.

Step 2: Investment analysis

As per Para 22 of the Methodological Tool PP need to *determine 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 certified emission reductions (CERs)*

Alternative 1: M1 (The project activity (i.e. composting, gasification, anaerobic digestion, RDF processing/thermal treatment without incineration of organic waste or incineration of waste) not implemented as a CDM project) **& H1** (Heat generated from by-product of one of the options of waste treatment as listed in M1 above, not undertaken as a CDM project activity): Biomass waste processing through mechanical treatment and utilization – bio-coal combustion in industrial facilities for thermal energy generation; It may be noted that this alternative is the project activity under discussion.

The proposed project activity generates financial and economic benefits (sale of bio coal to the Buyer facility) other than CER revenues, so the simple cost analysis (Option I) is not applicable.

Out of the two remaining options, investment comparison analysis (Option II) and benchmark analysis (Option III), however investment comparison analysis is inapt as there is no investment requirement in Alternative 2: **M3** (Disposal of the waste on a landfill without the capture of landfill gas) **and H4 (Existing or new construction of on-site or off-site fossil fuel based boilers):** Biomass waste disposal on landfill with Fossil fuel – coal combustion in industrial facilities for thermal energy generation; apart from Alternative 2 a no investment option and Alternative 1:project activity, a capital intensive investment option, there are no other credible and realistic baseline scenario alternatives in order to conduct an investment analysis.

Thus, the **benchmark analysis (Option III)** has been selected to conduct investment analysis.

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

The project proponent chose the Equity IRR (Internal Rate of Return) as the most appropriate financial indicator computed in nominal terms. *The financial analysis is based on parameters that are standard in the market, considering the specific characteristics of the project type, but not linked to the subjective profitability expectation or risk profile of a particular project developer.*

In situations where an investment analysis is carried out in nominal terms, project participants can convert the real term values provided in the table below to nominal values by adding the inflation rate. The inflation rate shall be obtained from the inflation forecast of the central bank of the host country for the duration of the crediting period. If this information is not available, the target inflation rate of the central bank shall be used. If this information is also not available, then the average forecasted inflation rate for the host country published by the IMF (International Monetary Fund World Economic Outlook) or the World Bank for the next five years after the start of the project activity shall be used.”

The benchmark value was derived based on the default real term value for the expected return on equity and the average target inflation rate of the central bank (South African Reserve Bank) as provided in the table below:

Default Value as per the Guidelines on the Assessment of Investment Analysis/Version 05’*	Average Target Inflation Rate** (2011-2015)	Benchmark Value
10.9% (Group-I: Energy Industries)	To be between 3-6%; Average value = 4.5%	15.4%

*The default value for the expected return on equity calculated after taxes has been extracted from the Table in Appendix: Default values for the expected return on equity of Guidelines on the Assessment of Investment Analysis which provides default values for the approximate expected return on equity for different project types and host countries. The expected return on equity is composed of four elements: (a)

a risk free rate of return; (b) an equity risk premium; (c) a risk premium for the host country; and (d) an adjustment factor to reflect the risk of projects in different sectoral scopes. All values are expressed in real terms.

**Average Target Inflation Rate has been obtained from Southern African Reserve Bank - <http://www.resbank.co.za/MonetaryPolicy/DecisionMaking/Pages/InflationMeasures.aspx>

Sub-step 2c: Calculation and comparison of financial indicators (only applicable to Option II and III)

An investment analysis of the project activity was conducted based on the techno-economic assumptions detailed in section B.5 considering the Equity IRR computed in nominal terms as the most suitable financial indicator. The Equity IRR was computed over a period of 10 years by taking into account the cash outflows (equity investment in the project, expenses) and cash inflows comprising profit after tax, depreciation and salvage value (in the terminal year).

The Equity IRR is compared with benchmark value to assess the project activity's financial feasibility.

The Equity IRR was **1.11%** and the same is lower against the benchmark value of **15.4%**. Therefore the Alternative 1 – project activity was found to be financially non-viable. Refer to Section B.5 of the PDD for elaboration on the Investment analysis for the proposed project activity.

Therefore under such circumstances, the only other credible and realistic alternative which requires no investment remains – Alternative 2: **M3** (Disposal of the waste on a landfill without the capture of landfill gas) and **H4 (Existing or new construction of on-site or off-site fossil fuel based boilers)**: Biomass waste disposal on landfill with Fossil fuel – coal combustion in industrial facilities for thermal energy generation;

As per the methodology AM0025 - *Note: The methodology is only applicable if:*

- (a) *The most plausible baseline scenario for the waste treatment component is identified as either the disposal of the waste in a landfill without capture of landfill gas (M3) or the disposal of the waste in a landfill where the landfill gas is partially captured and subsequently flared (M2);*
- (b) *The most plausible baseline scenario for the energy component of the baseline scenario is one of the following scenarios described in Table 1 below.*

Table 1: Combinations of baseline options and scenarios applicable to this methodology

Scenario	Baseline			Description of situation
	Waste	Electricity	Heat	
1	M2/M3	P4 or P6	H4	The disposal of the waste in a landfill site without capturing landfill gas or the disposal of the waste in a landfill site where the landfill gas is partly captured and subsequently being flared. The electricity is obtained from an existing/new fossil based captive power plant or from the grid and heat from an existing/new fossil fuel based boiler
2	M2/M3	P2	H2	The disposal of the waste in a landfill site without capturing landfill gas or the disposal of the waste in a landfill site where the landfill gas is partly captured and subsequently being flared



				<i>The electricity and/or heat are generated by an existing/new fossil fuel based cogeneration plant</i>
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The most plausible baseline scenario for the waste treatment component is **M3** and for the energy component is **H4** which is identified as Scenario 1.

Step 4: Where more than one credible and plausible alternative remains, project participants shall, as a conservative assumption, use the alternative baseline scenario that results in the lowest baseline emissions as the most likely baseline scenario.

Not applicable since there is only one alternative scenario.

B.5. Demonstration of additionality

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AM0025 Version 13.0.0 requires that the Project's additionality should be demonstrated and assessed using the latest version of "Tool for the demonstration and assessment of additionality". Prohibitive barriers that the Project activity faces are clearly identified using the *Tool for the demonstration and assessment of additionality (version 06.0.0)*. The following steps from the additionality tool are completed below:

- STEP 1 – Identification of alternatives to the project activity consistent with current laws and regulations
- STEP 2 – Investment analysis
- STEP 3 – Barriers analysis
- STEP 4 – Common practice analysis

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

As per the approved methodology, the project proponent has identified the following realistic and credible alternative(s) that were available to them and that would provide output and services comparable to the project activity (refer section B.4).

Alternative 1: M1 (The project activity (i.e. composting, gasification, anaerobic digestion, RDF processing/thermal treatment without incineration of organic waste or incineration of waste) not implemented as a CDM project) **& H1** (Heat generated from by-product of one of the options of waste treatment as listed in M1 above, not undertaken as a CDM project activity): Biomass waste processing through mechanical treatment and utilization – bio-coal combustion in industrial facilities for thermal energy generation; It may be noted that this alternative is the project activity under discussion.

Alternative 2: **M3** (Disposal of the waste on a landfill without the capture of landfill gas) **and H4 (Existing or new construction of on-site or off-site fossil fuel based boilers)**: Biomass waste disposal on landfill with Fossil fuel – coal combustion in industrial facilities for thermal energy generation;

These alternatives are in compliance with all applicable legal and regulatory requirements.

Please refer to section B4 for establishment of credible and realistic alternatives.

As per the Tool for the demonstration and assessment of additionality, (Version 06.0.0) PP may evidence additionality through Step 2 (Investment analysis) or Step 3 (Barrier analysis). PP may also select to complete both Step 2 and Step 3.

In the project activity case PP has opted to demonstrate additionality through Step 2 (Investment Analysis). However it is also worthwhile to note that the project activity is the first of its kind and would face prevailing practice barriers too. Therefore PP has considered application of Step 3 also.

Step 2. Investment analysis

The tool requires project proponent 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 certified emission reductions (CERs).

To conduct the investment analysis, used the following sub-steps:

Sub-step 2a. Determine appropriate analysis method

In the “Tool for the demonstration and assessment of additionality” (Version 06.0), three options are available for investment analysis: the simple cost analysis (Option I), the investment comparison analysis (Option II) and the benchmark analysis (Option III).

Option I - Simple Cost Analysis - The proposed project activity generates financial and economic benefits (sale of bio coal to the Buyer facility) other than CER revenues, so the simple cost analysis (Option I) is not applicable.

Option II - Investment Comparison Analysis –The Analysis is based on the comparison of returns of the project investment with the investment required for an alternative to the project. In this case, none of the credible alternatives to the CDM project activity involve investments and returns that could be compared to the project. Therefore, Option-II is also not applicable to this project.

According to the Additionality Tool, if the alternative to the CDM project activity does not include investments of comparable scale to the project, then Option III must be used.

Given that the project proponent does not have alternative and comparable investment choices, benchmark analysis (**Option III**) is more appropriate than investment comparison analysis (Option II) for assessing the financial attractiveness of the project activity. Thus, the benchmark analysis (Option III) has been selected to conduct investment analysis.

References: http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf

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

The project proponent chose the Equity IRR (Internal Rate of Return) as the most appropriate financial indicator computed in nominal terms. *The financial analysis is based on parameters that are standard in the market, considering the specific characteristics of the project type, but not linked to the subjective profitability expectation or risk profile of a particular project developer.*

In situations where an investment analysis is carried out in nominal terms, project participants can convert the real term values provided in the table below to nominal values by adding the inflation rate. The inflation rate shall be obtained from the inflation forecast of the central bank of the host country for the duration of the crediting period. If this information is not available, the target inflation rate of the central bank shall be used. If this information is also not available, then the average forecasted inflation rate for the host country published by the IMF (International Monetary Fund World Economic Outlook) or the World Bank for the next five years after the start of the project activity shall be used.”

The benchmark value was derived based on the default real term value for the expected return on equity and the average target inflation rate of the central bank (South African Reserve Bank) as provided in the table below:

Default Value as per the Guidelines on the Assessment of Investment Analysis/Version 05’*	Average Target Inflation Rate** (2011-2015)	Benchmark Value
10.9% (Group-I: Energy Industries)	To be between 3-6%; Average value = 4.5%	15.4%

*The default value for the expected return on equity calculated after taxes has been extracted from the Table in Appendix: Default values for the expected return on equity of Guidelines on the Assessment of Investment Analysis which provides default values for the approximate expected return on equity for different project types and host countries. The expected return on equity is composed of four elements: (a) a risk free rate of return; (b) an equity risk premium; (c) a risk premium for the host country; and (d) an adjustment factor to reflect the risk of projects in different sectoral scopes. All values are expressed in real terms.

**Average Target Inflation Rate has been obtained from Southern African Reserve Bank - <http://www.resbank.co.za/MonetaryPolicy/DecisionMaking/Pages/InflationMeasures.aspx>

Sub-step 2c: Calculation and comparison of financial indicators (only applicable to Option II and III)

As stated earlier investment analysis of the project activity was conducted at the time of investment decision based on the techno-economic assumptions detailed below considering the Equity IRR computed in nominal terms as the most suitable financial indicator. The Equity IRR was computed over a period of 10 years by taking into account the cash outflows (equity investment in the project, expenses) and cash inflows comprising profit after tax, depreciation and salvage value (in the terminal year).

The Equity IRR is compared with benchmark value to assess the project activity’s financial feasibility.

Sub-step 2c: Assumptions for Financial Analysis:

Particulars	Value	Source
Project cost (including IDC & Margin for WC)	41.33 Rand Million	As per the price quotations received from the Suppliers
Debt: Equity	50:50	-
Working Capital	9.008 Rand Million	2 Months Working capital for inventory & receivables
Interest rate	11.50%	Indicative Term Sheet
No of operating days	250 days	Project Appraisal Report
Plant Utilization factor	95%	As per the certificate dated 24/10/2011 by Agro-Technologies & Venture Pvt. Ltd.
Production per annum	57000 tons	Calculated
Sale price of Bio coal	800 Rand/ton	Bio-Coal Buyers Contract -Agreement for the Supply of Bio-fuels by Bio-Coal Manufacturers & Distributors(Pty) Ltd(Suppliers)
Escalation in sale price	5.94%	http://www.statssa.gov.za/keyindicators/CPI/CPIHistory_rebased.pdf
Required Units Per Hour Per Machine	108.05 kW	Quotation for supply & Erection of Briquette/Pellet Manufacturing Unit-Agro-Technologies & Ventures Pvt. Ltd.
Annual Total electricity	2.46 Million kWh	Calculated;



consumption		
Annual electricity charges	1.62 Rand Million	Calculated as per the quotation received
Escalation per unit	5.94%	http://www.statssa.gov.za/keyindicators/CPI/CPIHistory_rebased.pdf
Cost of lubricants per litre	72 Rands/Lt	Industrial Oil & Lubricant quotation send by Unicure dated 31/10/2011
Annual lubricant charges	0.484 Rand Million	Calculated
Escalation per unit	5.94%	http://www.statssa.gov.za/keyindicators/CPI/CPIHistory_rebased.pdf
Cost per bag/ton	57 Rands	As per quotation of Wildace Commodity Trades document dated 23/10/2011
Total packaging cost	3.249 Rand Million	Calculated
Escalation per unit	5.94%	http://www.statssa.gov.za/keyindicators/CPI/CPIHistory_rebased.pdf
Delivery Charges	253.08 Rand/ton	The delivery charges for East London is 200 Rand/ton; other places have higher delivery charges as per Ner IP' CARRIERS quotation dated 24/09/2011
Annual transportation cost	14.43 Rand Million	Calculated
Escalation per unit	5.94%	http://www.statssa.gov.za/keyindicators/CPI/CPIHistory_rebased.pdf
Annual raw material cost	8.447 Rand Million	Calculated
Escalation per unit	5.94%	http://www.statssa.gov.za/keyindicators/CPI/CPIHistory_rebased.pdf
Administrative Expenses	4.63 Rand Million	Project Appraisal Report crossed checked with the Average salary Survey 2011/12 of South Africa
Management Salary	2.94 Rand Million	Project Appraisal Report crossed checked with the Average salary Survey 2011/12 of South Africa
Escalation in salary	5.94%	http://www.statssa.gov.za/keyindicators/CPI/CPIHistory_rebased.pdf
Insurance	1%	www.oldmutual.co.za
Depreciation rates: Capital cost- Buildings Capital cost-P&M	9.97 Rand Million 27.33 Rand Million	Calculated
Income Tax rate	28%	Income Tax rate-As per Old Mutual rates in South Africa;

Low return on Investment

The Equity IRR is compared with benchmark value to prove that the project activity is unlikely to be financially attractive without CER revenue.

The Equity IRR was **1.11%** and the same is lower against the benchmark value of **15.4%**. Therefore it may conclude that the project activity is not “economically or financially feasible without the revenue from the sale of certified emission reductions” and is additional.

Sub-step 2d: Sensitivity analysis:

As per “Guidance on the assessment on investment analysis, version 5” EB 62, Annex 5, sensitivity analysis is required to be conducted for variables that constitute more than 20% of either total project cost or total project revenue and they should be subjected to reasonable variations.

Following variables constitute more than 20% of either total project cost or total project revenue and are subjected to reasonable variations:

1. Project Cost
2. Bio-coal price
3. Electricity Tariff
4. Fuel price
5. Transportation cost
6. Inventory cost

All the above variables, affecting the project IRR were subject to variations +10% to –10%. The variations in the project IRR based on the changes in the variable parameter are summarized below:

Parameters	Post Tax project Equity IRR	
	-10%	+10%
Project cost	4.01%	-1.24%
Bio-coal price	#NUM!	12.39%
Electricity Tariff	2.35%	-0.16%
Fuel price	1.49%	0.74%
Transportation cost	11.23%	#NUM!
Inventory cost	6.37%	-4.63%

The results of the sensitivity analysis conducted for circumstances which could bring about variations in the critical factor used for the IRR computations confirm that the project IRR for the project activity without CDM revenues is lower than the investment benchmark.

Since the start date of the project activity will be post the date of publication of the PDD for the global stakeholder consultation, therefore no evidence for prior consideration of the CDM will be required in accordance with applicable provisions related to the demonstration of prior consideration of the CDM in the Project standard.

Step 3 – Barriers analysis

As mentioned earlier, in the project activity case PP has opted to demonstrate additionality through Step 2 (Investment Analysis) as detailed above. However it is may be noted that the project activity is the first of its kind and would face prevailing practice barriers too. Therefore PP has considered application of Step 3 also. The same has been captured in the following paragraphs.

Step 3 – Barrier analysis *serves to identify barriers and to assess which alternatives are prevented by these barriers.*

If this Step is used, PP is required to determine whether the proposed project activity faces barriers that:

- (a) Prevent the implementation of this type of proposed project activity; and
- (b) Do not prevent the implementation of at least one of the alternatives, if the project is not first of its kind according to the definition provided in paragraph 40(c) (i).

However it may be worthwhile to note that the project is the ‘first of its kind’ according to the definition provided in paragraph 40(c) (i) of Tool for the demonstration and assessment of additionality (Version 06.0.0), therefore PP is not required to apply the above mentioned step

Sub-step 3a: Identify barriers that would prevent the implementation of the proposed CDM project activity:

PP is required to ‘Establish that there are realistic and credible barriers that would prevent the implementation of the proposed project activity from being carried out if the project activity was not registered as a CDM activity. Such realistic and credible barriers may include, among others:

Barriers due to prevailing practice, inter alia: The project activity is the first of its kind.

- (a) For the measures identified under paragraph 6, a proposed project activity is the First-of-its-kind in the applicable geographical area if:
 - (ii) The project is the first in the applicable geographical area that applies a technology that is different from any other technologies able to deliver the same output and that have started commercial operation in the applicable geographical area before the start date of the project; and
 - (iii) Project participants selected a crediting period for the project activity that is a maximum of 10 years with no option of renewal;
- (b) For the measures identified under paragraph 6, a proposed project activity that was identified as the First-of-its-kind project activity is additional and Sub-step 3 b does not apply.’

The Measures as provided in paragraph 6 of the tool under discussion is defined as the ‘**Measure** (for emission reduction activities) is a broad class of greenhouse gas emission reduction activities possessing common features. Four types of measures are currently covered in the framework:

- (a) Fuel and feedstock switch;
- (b) Switch of technology with or without change of energy source (including energy efficiency improvement as well as use of renewable energies);
- (c) Methane destruction;
- (d) Methane formation avoidance - An example of methane formation avoidance is the use (e.g. for energy generation) of biomass that would have been left to decay in a solid waste disposal site. The measure prevents the formation of methane.’

The project activity falls in measure (d) Methane formation avoidance. Therefore as per the applicability point (a) the PP herein establishes that the proposed project activity is the First-of-its-kind in the applicable geographical area since the technology applied in the project activity is different from any other technologies able to deliver the same output (*i.e.* waste disposal with thermal energy generation in the form of steam with fossil fuel consumption) and that have started commercial operation in the applicable geographical area before the start date of the project; and

- (iii) Project participants selected a crediting period for the project activity that is a maximum of 10 years with no option of renewal;

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

As per point (b) stated above, For the measures identified under paragraph 6, a proposed project activity that was identified as the First-of-its-kind project activity is additional and Sub-step 3 b does not apply. Sub-step 3b is not applicable since the proposed project activity measure has been identified under paragraph 6(d) Methane formation avoidance and is First-of-its-kind.

Step 4 – Common practice analysis

As per Para 43, of the tool under discussion, ‘Unless the proposed project type has demonstrated to be first-of-its kind (according to Sub-step 3a), and for measures different from those listed in paragraph 6 the above generic additionality tests shall be complemented with an analysis of the extent to which the proposed project type (e.g. technology or practice) has already diffused in the relevant sector and region.’

Therefore Step 4 is not applicable since the proposed project activity measure has been identified under paragraph 6(d) Methane formation avoidance and is First-of-its-kind.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

The methodology & Tools which are applicable for explanation of methodological choices in this section includes:

- Methodology-AM0025/Version-13 valid from 25th Nov, 2011 onwards
<http://cdm.unfccc.int/methodologies/DB/60GTPUC1H2NA5A72E9CEI393DTA7KB>
- Methodology Tool “Emissions from solid waste disposal sites (Version 6.0.1)” valid from 2 Mar 2012 onwards; EB 66 annex 46
<http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-04-v6.0.1.pdf>
- Tool to calculate the emission factor for an electricity system Version 02.2.1, Annex 19 of EB 63 Report (<http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-07-v2.2.1.pdf>)

The project activity includes bio-coal production from biomass waste in form of wood and wood products which will be directly replacing coal combustion in industrial thermal energy generation applications.

As per the methodology, the Emission reductions obtained from the project activity will be given as:

$$ER_y = BE_y - PE_y - L_y$$

Where,

ER_y = Is the emission reduction in the year y ($t\ CO_2e$)

BE_y = Is the emissions in the baseline scenario in the year y ($t\ CO_2e$)

PE_y = Is the emissions in the project scenario in the year y ($t\ CO_2e$)

L_y = Is the leakage in the year y ($t\ CO_2e$)

The baseline scenario for the project activity has been determined as the biomass waste (utilized in the project activity) would be dumped in landfill resulting in methane emissions due to development of anaerobic conditions. Moreover, bio-coal equivalent input energy would be sourced from coal being the primary fuel for generation of thermal energy for industrial applications resulting in GHG emissions.

Baseline Emissions (BE_y):

As per the methodology AM0025 baseline emissions are calculated using the following equation:

$$BE_y = (MB_y - MD_{reg,y}) + BE_{EN,y}$$

Where:

BE_y = Is the baseline emissions in year y (tCO_2e)

MB_y = Is the methane produced in the landfill in the absence of the project activity in year y (t_4CO_2e)

$MD_{reg,y}$ = Is methane that would be destroyed in the absence of the project activity in year y (t_4CO_2e)

However it may be noted that there are no regulations that mandate the requirement

of capturing and destroying/using the methane in the absence of the project activity
 $MD_{reg,y} = 0$;

$BE_{EN,y}$ = Baseline emissions from generation of energy displaced by the project activity in year y (tCO₂e)

Rate of compliance

In cases where there are regulations that mandate the use of one of the project activity treatment options and which is not being enforced, the baseline scenario is identified as a gradual improvement of waste management practices to the acceptable technical options expected over a period of time to comply with the MSW Management Rules.

However it may be noted that there are no regulations that mandate the use of the project activity treatment options, therefore the baseline emissions may not be adjusted for rate of compliance.

2.1. Methane generation from the landfill in the absence of the project activity (MB_y)

The amount of methane that is generated each year (MB_y) is calculated as per the “Tool to determine methane emissions avoided from disposal of waste at solid waste disposal site” (version 06.0.1) as per the following equation.

$$MB_y = BE_{CH4, SWDS, y}$$

Where,

$BE_{CH4, SWDS, y}$ = Is the methane generation from the landfill in the absence of the project activity at year y that is methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site during the period from the start of the project activity to the end of the year y (tCO₂e) as calculated using Application B in the methodological tool “Emissions from solid waste disposal sites”.

The tool estimates methane generation adjusted for, using adjustment factor (f_y), 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 20 of the methodology, AM0025, version 13, “ f_y ” in the tool shall be assigned a value 0.

$$MB_y = BE_{CH4, SWDS, y}$$

Baseline emissions have been computed as per the Tool “Emissions from solid waste disposal sites (Version 06.0.1)” the procedures to calculate baseline, project or leakage emissions of methane from solid waste disposed or prevented from disposal at a SWDS

The tool can be used to determine emissions for the following types of applications:

• **Application A: The CDM project activity mitigates methane emissions from a specific existing SWDS.** Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g. ACM0001). The methane is generated from waste disposed in the past, including prior to the start of the CDM project activity. In these cases, the tool is only applied for an *ex-ante* estimation of emissions in the CDM-PDD. The emissions will then be monitored during the crediting period using the applicable approaches in the relevant methodologies (e.g. measuring the amount of methane captured from the SWDS).

• **Application B: The CDM project activity avoids or involves the disposal of waste at a SWDS.** An example of this application of the tool is AM0025, in which MSW is treated with an alternative option, such as composting or anaerobic digestion, and is then prevented from being disposed of in a SWDS. The methane is generated from waste disposed or avoided from disposal during the crediting period. In these cases, the tool can be applied for both *ex-ante* and *ex-post* estimation of emissions.

For the calculation of baseline emissions from the project activity **Application B** is chosen since the project activity involves mechanical treatment of the biomass waste (in form of wood & wood products) as a result of which the biomass waste is then prevented from being disposed in disposal site; and the methane emissions are avoided from disposal during the crediting period.

The amount of methane generated from disposal of waste at the SWDS is calculated based on a first order decay model. The model calculates the methane generation occurring in year y (a period of 12 consecutive months) or month m based on the waste streams of waste types disposed in the SWDS over a specified time period (years or months).

The project activity calculates the methane generation occurring in year y since there is only one type of waste stream disposed in the SWDS over the last 10 years

In cases where at the SWDS methane is captured and flared, combusted or used in another manner that prevents emissions of methane to the atmosphere the emissions are adjusted for fraction of methane captured (f_y). However it may be noted that there are no regulations that mandate the requirement of capturing and destroying/using the methane in the absence of the project activity $f_y = 0$;

The amount of methane generated from disposal of waste at the SWDS is calculated for year y using the following equation

$$BE_{CH_4, SWDS, y} = \Phi_y \cdot (1-f_y) \cdot GWP_{CH_4} \cdot (1-OX) \cdot (16/12) \cdot F \cdot DOC_{f,y} \cdot MCF_y \cdot \sum \sum W_{j,x} \cdot DOC_j \cdot e^{-k_j(y-x)} \cdot (1-e^{-k_j})$$

Where:

$BE_{CH_4, SWDS, y}$	-	Baseline methane emissions occurring in year y generated from waste disposal at a SWDS during a time period ending in year y (tCO ₂ e/yr)
x	-	Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period ($x = 1$) to year y ($x = y$)
y	-	Year of the crediting period for which methane emissions are calculated (y is a consecutive period of 12 months)
$DOC_{f,y}$	-	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y (weight fraction)
$W_{j,x}$	-	Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x
Φ_y	-	Model correction factor to account for model uncertainties for year y
f_y	-	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y
GWP_{CH_4}	-	Global Warming Potential of methane
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)
MCF_y	-	Methane correction factor for year y
DOC_j	-	Fraction of degradable organic carbon in the waste type j (weight fraction)
k_j	-	Decay rate for the waste type j (1 / yr)
j	-	Type of residual waste or types of waste in the MSW

Determining the parameters required to apply the FOD model

Table 1 summarizes how the parameters required in this tool can be determined. This includes the use of default values, one time measurements or monitoring throughout the crediting period.

Table 1: Overview of the option to determine parameters

Parameters	Application B
Φ_y	Baseline emissions: default values or project specific value estimated yearly
OX	Default value
F	Default value
$DOC_{f,y}$	In the case of residual waste: estimated once
MCF_y	Monitored for SWDS with a water table above the bottom of the SWDS; Default values (based on SWDS type) for SWDS without a water table above the bottom of the SWDS; Default values have been used for project activity since there is n water table above the bottom of the SWDS
k_j	Default values (based on waste type)
$W_{j,x}$	Calculated based on monitored data
DOC_j	Default values or waste specific value estimated once
f_y	Monitored

Determining the model correction factor (ϕ_y)

The model correction factor (ϕ_y) depends on the uncertainty of the parameters used in the FOD model. If baseline emissions are being calculated, then PP may choose between the following two options to calculated ϕ_y

Option 1: Use a default value; Default values for different applications and climatic conditions are provided in the section “Data and parameters not monitored”

Option 2: Determine based on specific situation of the project activity.

PP has opted for Option 1: Use of default values = 0.80 for Application B under dry conditions.

Determining the amounts of waste types j disposed in the SWDS ($W_{j,x}$):

Where different waste types’ j are disposed or prevented from disposal in the SWDS (for example, in the case of MSW) it is necessary to determine the amount of different waste types. In the case that only one type of waste is disposed then $W_{j,x} = W_x$ and the procedures for determining the amounts of waste types j do not need to be applied. Since project activity involves only one type of waste the procedures for determining the amounts of waste types j will not need to be applied.

Determining the fraction of DOC that decomposes in the SWDS ($DOC_{f,y}$):

As per **Application B** of the Tool, the tool can be applied for MSW & residual waste. For residual waste type, PP shall determine $DOC_{f,y}$ based on the measurement of the biochemical methane potential of the residual waste type j (BMP_j) as follows:

$$DOC_{f,y} = DOC_{f,m} = 0.7*(12/16)* BMP_j/(F*DOC_j)$$

Where,

$DOC_{f,y}$ = Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y (weight fraction)

BMP_j = Biochemical methane potential for the residual waste type j disposed or prevented from disposal (t CH_4 / t waste)

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

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

j = Residual waste type applied to the tool

y = Year of the crediting period for which methane emissions are calculated (y is a consecutive period of 12 months)

$DOC_{f,y}$ is given as a default value ($DOC_{f,y} = DOC_{f, default} = 0.5$ provided in section B.6.2 of the PDD).

Determining the methane correction factor (MCF_y)

Application A

The MCF should be selected as a default value ($MCF_y = MCF_{default}$)

Application B

In case of a water table above the bottom of the SWDS (for example, due to using waste to fill inland water bodies, such as ponds, rivers or wetlands), the MCF should be determined as follows:

$$MCF_y = \text{MAX} \{ (1 - 2/d_y), h_{w,y}/d_y \}$$

Where,

MCF_y = Methane correction factor for year y

$h_{w,y}$ = Height of water table measured from the base of the SWDS (m)

d_y = Depth of SWDS (m)

In other situations, the MCF should be selected as a default value ($MCF_y = MCF_{default}$).

$MCF_{default}$ is determined as follows:

In case that the SWDS does not have a water table above the bottom of the SWDS which is the project case and in case of application A, then PP may select the applicable value from the following:

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 . deep. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 meters;

0.4 for unmanaged-shallow solid waste disposal sites or stockpiles that are considered SWDS. This comprises all SWDS not meeting the criteria of managed SWDS and which have depths of less than 5 meters. This includes stockpiles of solid waste that are considered SWDS (according to the definition given for a SWDS)

In the project case since SWDS has controlled placement of waste and includes mechanical compacting and leveling waste the MCF default value has been taken as 1.0.

Please refer to Section B.6.3 for detailed ex-ante computations.

2.2 Baseline emissions from generation of energy displaced by the project activity

The Project activity corresponds to the scenario 1 described in AM0025.

$$BE_{EN,y} = BE_{elec,y} + BE_{thermal,y}$$

Where:

$BE_{elec, y}$ = Baseline emissions from electricity generated utilizing the combustion heat from incineration in the project activity and exported to the grid (tCO₂e)

$BE_{thermal, y}$ = Baseline emissions from thermal energy produced utilizing the combustion heat from incineration in the Project activity displacing thermal energy from onsite/offsite fossil fuelled boilers (tCO₂e).

Since there is no power generation in the project activity, $BE_{elec, y} = 0$.

Since there is thermal energy generation in the project activity $BE_{thermal, y}$ is calculated as follows:

$$BE_{thermal, y} = \frac{Q_y}{\epsilon_{boiler} \cdot NCV_{fuel}} \cdot EF_{fuel, b}$$

Where:

- Q_y = The quantity of thermal energy produced utilizing the biogas/syngas collected/RDF/stabilized biomass/combustion heat from incineration/stabilized biomass co-fired with fossil fuel in the project activity displacing thermal energy from onsite/offsite fossil fuel fuelled boiler during the year y in GJ
- ϵ_{boiler} = The energy efficiency of the boiler used in the absence of the project activity to generate the thermal energy
- NCV_{fuel} = Net calorific value of fuel, as identified through the baseline identification procedure, used in the boiler to generate the thermal energy in the absence of the project activity in GJ per unit of volume or mass
- $EF_{fuel, b}$ = Emission factor of the fuel, as identified through the baseline identification procedure, used in the boiler to generate the thermal energy in the absence of the project activity in tons CO₂ per unit of volume or mass of the fuel

To estimate boiler efficiency, project participants may choose between the following two options:

Option A:

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) Manufacturer's information on the boiler efficiency.

Option B:

Assume a boiler efficiency of 100% based on the net calorific values as a conservative approach.

In determining the CO₂ emission factors (EF_{fuel}) of fuels, reliable local or national data shall be used if available. Where such data is not available, IPCC default emission factors shall be chosen in a conservative manner.

The detailed calculation for Baseline Emissions (BE_y) is provided in section B.6.3 of PDD.

Project Emissions (PE_y):

As per the Methodology AM0025/version 13 the project emissions in year y are:

$$PE_y = PE_{elec,y} + PE_{fuel, on-site,y} + PE_{c,y} + PE_{a,y} + PE_{g,y} + PE_{r,y} + PE_{i,y} + PE_{w,y} + PE_{co-firing,y}$$

Where:

- PE_y = Is the project emissions during the year y (tCO₂e)
- $PE_{elec,y}$ = Is the emissions from electricity consumption on-site due to the project activity in year y (tCO₂e)
- $PE_{fuel, on-site,y}$ = Is the emissions on-site due to fuel consumption on-site in year y (tCO₂e)
- $PE_{c,y}$ = Is the emissions during the composting process in year y (tCO₂e)
- $PE_{a,y}$ = Is the emissions from the anaerobic digestion process in year y (tCO₂e)
- $PE_{g,y}$ = Is the emissions from the gasification process in year y (tCO₂e)
- $PE_{r,y}$ = Is the emissions from the combustion of RDF/stabilized biomass in year y (tCO₂e)
- $PE_{i,y}$ = Is the emissions from waste incineration in year y (tCO₂e)
- $PE_{w,y}$ = Is the emissions from waste water treatment in year y (tCO₂e)
- $PE_{co-firing,y}$ = Is the emissions from thermal energy generation/electricity generation from on-site fossil fuel consumption during co-firing in year y (tCO₂e)

The parameters which are applicable for calculating the project emissions for the proposed project activity are summarized in the table below:

Table-2: Parameters applicable for calculating the Project Emissions

Symbols	Parameters	Applicable	Justifications
$PE_{elec,y}$	Emissions from electricity consumption on-site due to the project activity in year y (tCO ₂ e)	Yes	Since, the equipment involved in the project activity requires power; so electricity is consumed on-site due to project activity.
$PE_{fuel, on-site,y}$	Emissions on-site due to fuel consumption on-site in year y (tCO ₂ e)	No	Steam is required for palletization, however it may be noted that the fuel consumed in the process is the Bio-coal itself which is manufactured from biomass waste and has zero emissions.
$PE_{c,y}$	Emissions during the composting process in year y (tCO ₂ e)	No	Project activity does not involve any process where composting occurs, so the parameter is not included
$PE_{a,y}$	Emissions from the anaerobic digestion process in year y	No	Project activity does not involve any process where anaerobic digestion occurs, so this parameter is not included
$PE_{g,y}$	Emissions from the gasification process in year y (tCO ₂ e)	No	Project activity does not involve any process where gasification occurs, so this parameter is not included.
$PE_{r,y}$	Emissions from the combustion of RDF/stabilized biomass in	Yes	The project activity involves process of combustion of Stabilized Biomass; The stack gas from the combustion of SB may contain amounts of methane and nitrous oxide. Further

	year y (tCO ₂ e)		there are no emissions from fossil-based waste since the bio-coal composition is 100% biomass based and has 0% fossil-derived carbon content.
PE _{i,y}	Emissions from waste incineration in year y (tCO ₂ e)	No	The project activity does not involve any process where waste incineration occurs; so this parameter is not included
PE _{w,y}	Emissions from waste water treatment in year y (tCO ₂ e)	No	The project activity does not involve any process where waste water treatment occurs; so this parameter is not included
PE _{co-firing,y}	Emissions from thermal energy generation/ electricity generation from on-site fossil fuel consumption during co-firing in year y (tCO ₂ e)	No	Test Reports for the project activity clarifies that there is no co-firing during thermal energy generation, bio coal is the only fuel used on site; so this parameter is excluded

Based on the parameters applicable for the proposed project activity, the Project Emissions are calculated based on the following basis:

$$PE_y = PE_{elec,y} + PE_{r,y}$$

(i) Emissions from electricity use on site (PE_{elec,y})

Where the project activity involves electricity consumption, CO₂ emissions are calculated as follows:

$$PE_{elec,y} = EG_{PJ,FF,y} * CEF_{elec}$$

Where:

EG_{PJ,FF,y} - is the amount of electricity generated in an on-site fossil fuel fired power plant or consumed from the grid as a result of the project activity, measured using an electricity meter (MWh).

CEF_{elec} - is the carbon emissions factor for electricity generation in the project activity (tCO₂/MWh).

Since, the project activity will consume electricity from the grid, therefore, the CEF_{elec} represents the CO₂ emission factor of the relevant grid

As per the “Tool to calculate the emission factor for an electricity system, version 02.2.1 of EB-63, Annex 19”, the combined margin emission factor is calculated as per the following steps:

STEP 1: Identify the relevant electricity systems;

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

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

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

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

STEP 6: Calculate the combined margin (CM) emission factor.

Step 1: Identify the relevant electricity systems

*For determining the electricity emission factors, identify the relevant **project electricity system***

*Similarly, identify any **connected electricity systems**. If a connected electricity system is located partially or totally in Annex-I countries, then the emission factor of that connected electricity system should be considered zero.*

If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used. If this information is not available, project participants should define the project electricity system and any connected electricity system, and justify and document their assumptions in the CDM-PDD.

The relevant electrical system of South Africa is determined from data sources received from Eskom power station is provided in Appendix-4 below.

As per the ESKOM generation and fuel consumption details the year refers to a single year (e.g. 2007), it is representative of Eskom financial year which ends 31 March. Therefore '2012' refers to the financial year 2011/2012. Since, the date of Board Decision for the project is January, 2012; hence the last three years data has been considered till March, 2011 from April, 2008. The table below provides the details of the type of power plants along with their respective years of installation, energy generated and fuel consumed per financial year.

Generation & Fuel Consumption details:										
Plant Name not registered under CDM	Low Cost/must run	Commissioning Month	Commissioning Year	Capacity(MW)	Net Generation(MWh)			Fuel Consumption(Tonnes/Yr)		
	Yes/No?				2008-09	2009-10	2010-11	2008-09	2009-10	2010-11
Majuba-Coal	No	April	1996	3843	2,26,76,924	2,23,40,081	2,46,32,385	1,25,54,406	1,22,61,833	1,30,20,512
Kendal-Coal	No	October	1988	3840	2,38,41,401	2,33,07,031	2,36,48,258	1,53,56,595	1,38,66,514	1,51,74,501
Palmiet-Pump Storage	Yes	April	1988	400	-	-	-	-	-	-
Matimba-Coal	No	December	1987	3690	2,62,56,068	2,79,64,141	2,81,63,040	1,39,91,453	1,46,37,481	1,45,96,842
Lethabo-Coal	No	December	1985	3558	2,35,80,232	2,55,22,698	2,55,00,366	1,67,15,323	1,81,70,227	1,77,74,699
Tutuka-Coal	No	June	1985	3510	2,15,04,122	1,98,47,894	1,90,67,501	1,12,31,583	1,06,02,839	1,01,91,709
Colley Wobbles-Hydro	Yes	January	1985	42	-	-	-	-	-	-
Koeberg-Nuclear	Yes	July	1984	1800	-	-	-	0	0	0
Ncora-Hydro	Yes	March	1983	2	-	-	-	-	-	-
Drakensberg-Pump Storage	Yes	June	1981	1000	-	-	-	-	-	-
Duvha-Coal	No	January	1980	3450	2,17,69,489	2,25,81,228	2,02,67,508	1,13,93,553	1,17,44,606	1,06,39,393
Second Falls-Hydro	Yes	April	1979	11	-	-	-	-	-	-
First Falls-Hydro	Yes	February	1979	6	-	-	-	-	-	-
Van Der Kloof-Hydro	Yes	January	1977	240	-	-	-	-	-	-
Port Rex-Gas(Kerosene)	Yes	September	1976	171	-	-	5,507	-	-	2,81,941
Acacia-Gas(kerosene)	Yes	May	1976	171	-	-	992	-	-	4,44,957
Kriel-Coal	No	May	1976	2850	1,81,56,686	1,59,06,816	1,82,04,910	94,20,764	85,04,715	95,27,185
Malta-Coal	No	September	1976	3450	2,18,63,400	2,19,54,536	2,15,04,422	1,26,89,387	1,24,38,391	1,21,55,421
Gariep-Hydro	Yes	September	1971	360	-	-	-	-	-	-
Amot-Coal	No	September	1971	1980	1,19,87,281	1,32,27,864	1,21,94,878	63,95,805	67,94,134	65,25,670
Hendrina-Coal	No	May	1970	1895	1,22,96,687	1,21,43,292	1,19,38,206	71,22,918	69,05,917	71,39,198
Grootvlei-Coal	No	June	1969	1200	12,49,556	26,56,230	35,46,952	6,74,538	16,37,371	21,32,979
Komati-Coal	No	June	1969	1000	0	10,16,023	20,60,141		6,64,497	12,71,010
Camden-Coal	No	December	1966	1600	65,09,079	74,72,070	74,90,836	38,76,211	47,32,163	46,29,763
Total Electricity Generation:					21,16,90,925	21,59,39,904	22,02,26,102			

References:

<http://www.eskom.co.za/c/article/236/cdm-calculations/>

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

Although this step is optional, Option-I: Only grid power plants are included in the calculation, is selected here.

Step 3: Select a method to determine the Operating Margin (OM)

As per the tool the calculation of the operating margin emission factor ($EF_{grid, OM, y}$) is based on one of the following methods:

- Simple OM; or
- Simple adjusted OM; or
- Dispatch data analysis OM; or
- Average OM

The tool allows the use of any of the above mentioned methods to calculate the operating margin emission factor; however, in order to use the simple OM method, it must be ensured that low-cost/must-run resources constitute less than 50% of the total grid generation in:

- Average of the five most recent years or
- Based on long term averages for hydroelectricity production

The table below refers to the Low cost/must run hydro resources generation details for the recent 5 years.

Plant Name not registered under CDM	Low Cost/must run Yes/No?	Net Generation(MWh)				
		2006-07	2007-08	2008-09	2009-10	2010-11
Majuba-Coal	No	2,28,28,565	2,36,80,971	2,26,76,924	2,23,40,081	2,46,32,585
Kendal-Coal	No	3,41,64,855	2,65,17,420	2,38,41,401	2,33,07,031	2,56,48,258
Palmiet-Pump Storage	Yes			-	-	-
Matimba-Coal	No	3,49,83,880	2,90,21,742	2,62,56,068	2,79,64,141	2,81,63,040
Lethabo-Coal	No	3,20,52,833	2,57,01,723	2,35,80,232	2,55,22,698	2,55,00,366
Tutuka-Coal	No	2,33,89,829	2,09,80,242	2,15,04,122	1,98,47,894	1,90,67,501
Colley Wobbles-Hydro	Yes			-	-	-
Koeberg-Nuclear	Yes	-	-	-	-	-
Ncora-Hydro	Yes			-	-	-
Drakensberg-Pump Storage	Yes			-	-	-
Duvha-Coal	No	3,15,50,562	2,36,22,732	2,17,69,489	2,25,81,228	2,02,67,508
Second Falls-Hydro	Yes			-	-	-
First Falls-Hydro	Yes			-	-	-
Van Der Kloof-Hydro	Yes			-	-	-
Port Rex-Gas(Kerosene)	Yes			-	-	5,507
Acacia-Gas(kerosene)	Yes			-	-	992
Kriel-Coal	No	2,24,68,695	1,77,62,398	1,81,56,686	1,59,06,816	1,82,04,910
Malta-Coal	No	3,08,64,194	2,45,49,833	2,18,63,400	2,19,54,536	2,15,04,422
Gariep-Hydro	Yes			-	-	-
Amot-Coal	No	1,59,38,102	1,19,05,060	1,19,87,281	1,32,27,864	1,21,94,878
Hendrina-Coal	No	1,60,83,288	1,37,56,351	1,22,96,687	1,21,43,292	1,19,38,206
Grootvlei-Coal	No	0	2,37,138	12,49,556	26,56,230	35,46,952
Komati-Coal	No	0	0	0	10,16,023	20,60,141
Camden-Coal	No	28,15,982	51,71,057	65,09,079	74,72,070	74,90,836
Total Electricity Generation:		26,71,40,785	22,29,06,667	21,16,90,925	21,59,39,904	22,02,26,102

The Low cost/must run generation as obtained from the above datasheet:

Year	2006-07	2007-08	2008-09	2009-10	2010-11
Net Generation (MWh)	267140785	22290667	211690925	215939904	220233652
Low cost/must run generation	-	-	-	-	-6499
% of low run/must run	0.00%	0.00%	0.00%	0.00%	0.003%

From the above data it is evidenced that low-cost/must-run resources constitute less than 50% of the total grid generation, therefore simple OM method may be used.

Further, according to the tool, for the simple OM, the simple adjusted OM and the average OM, the emission factor can be calculated using either of the two following data vintages:

- **Ex ante option:** *If the ex ante option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation. For off-grid power plants, use a single calendar year within the five most recent calendar years prior to the time of submission of the CDM-PDD for validation., or*
- **Ex post option:** *If the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required calculating the emission factor for year y is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year (y-1) may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year proceeding the previous year (y-2) may be used. The same data vintage (y, y-1, or y-2) should be used throughout all crediting periods.*

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

The project proponent has adopted the **ex-ante** option for calculating the Simple OM. The Simple OM will be fixed for the entire crediting period of the project activity.

Step 4: Calculate the operating margin emission factor according to the selected method

The simple OM may be calculated by one of the following two options:

- Option A: Based on the net electricity generation and a CO₂ emission factor of each power unit; or
- Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

Here Option A is used since Option B is not met.

Option A: Based on the net electricity generation and a CO₂ emission factor of each power unit of the Simple OM method is utilized.

$$EF_{\text{Grid, OM, simple, y}} = \frac{\sum EG_{m,y} \times EF_{\text{EL, m,y}}}{\sum EG_{m,y}}$$

Where:

$EF_{\text{grid,OM,simple,y}}$ = Simple operating margin CO₂ emission factor in year y (tCO₂/MWh)

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

$EF_{EL,m,y}$ = CO₂ emission factor of power unit m in year y (tCO₂/MWh)

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

y = The relevant year as per the data vintage chosen in Step 3

Determination of $EF_{EL,m,y}$

The emission factor of each power unit m should be determined as follows:

- **Option A1.** If for a power unit m data on fuel consumption and electricity generation is available, the emission factor ($EF_{EL,m,y}$) should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum FC_{i,m,y} \times NCV_{i,y} \times EF_{CO_2,i,y}}{EG_{m,y}}$$

Where,

$EF_{EL,m,y}$ CO₂ emission factor of power unit m in year y (tCO₂/MWh)

$FC_{i,m,y}$ Amount of fossil fuel type i consumed by power 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)

$EF_{CO_2,m,y}$ CO₂ emission factor of fossil fuel type i in year y (tCO₂/GJ)

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

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

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

y The relevant year as per the data vintage chosen in Step 3

The Weighted Average Operating Margin (OM) for the Last 3 years are provided in the table below:

Weighted Average Operating Margin for 2008-09:

Plant Name	Unit No./Capacity	Fuel Used	Net Electricity Generation (MWh)	Fuel Consumption (MT/Yr)	Net Calorific Value(GJ/tonne)	Emission Factor for Fuel(IPCC Data source) tCO ₂ /GJ	CO ₂ emission coefficient of fuel(tCO ₂ /tonne)	CO ₂ Emission from Power Plant (tCO ₂)	CO ₂ Emission Factor (tCO ₂ /MWh)
			2008-09	2008-09				2008-09	2008-09
Majuba	3843	Coal	2,26,76,924.00	12554406.00	25.80	0.0946	2.44	30641287.64	1.35
Kendal	3840	Coal	23841401.00	15356595.00	25.80	0.0946	2.44	37480534.28	1.57
Matimba	3690	Coal	2,62,56,068.00	13991453.00	25.80	0.0946	2.44	34148659.51	1.30
Lethabo	3558	Coal	2,35,80,232.00	16715323.00	25.80	0.0946	2.44	40796754.54	1.73
Tutuka	3510	Coal	2,15,04,122.00	11231583.00	25.80	0.0946	2.44	27412700.00	1.27
Duvha	3450	Coal	2,17,69,489.00	0.00	25.80	0.0946	2.44	0.00	0.00
Kriel	2850	Coal	1,81,56,686.00	11393553.00	25.80	0.0946	2.44	27808016.94	1.53
Malta	3450	Coal	2,18,63,400.00	9420764.00	25.80	0.0946	2.44	22993070.28	1.05
Amot	1980	Coal	1,19,87,281.00	12689387.00	25.80	0.0946	2.44	30970733.06	2.58
Hendrina	1895	Coal	1,22,96,687.00	6395805.00	25.80	0.0946	2.44	15610113.35	1.27
Grootvlei	1200	Coal	12,49,556.00	7122918.00	25.80	0.0946	2.44	17384763.50	13.91
Komati	1000	Coal	0.00	674538.00	25.80	0.0946	2.44	1646331.41	0.00
Camden	1600	Coal	65,09,079.00	0.00	25.80	0.0946	2.44	0.00	0.00
TOTAL			21,16,90,925.00					286892964.50	1.3475



Weighted Average Operating Margin for 2009-10:

Plant Name	Unit No./Capacity	Fuel Used	Net Electricity	Fuel	Net Calorific	Emission Factor	CO ₂ emission co-	CO ₂ Emission	CO ₂
			Generation (MWh)	Consumption (MT/Yr)				Value(GJ/tonne)	for Fuel(IPCC Data source) tCO ₂ /GJ
			2009-10	2009-10				2009-10	2009-10
Majuba	3843	Coal	2,23,40,081.00	12261833.00	25.80	0.0946	2.44	29927210.57	1.34
Kendal	3840	Coal	2,33,07,031.00	13866514.00	25.80	0.0946	2.44	33843723.39	1.45
Matimba	3690	Coal	2,79,64,141.00	14637481.00	25.80	0.0946	2.44	35725407.13	1.28
Lethabo	3558	Coal	2,55,22,698.00	18170227.00	25.80	0.0946	2.44	44347709.63	1.74
Tutuka	3510	Coal	1,98,47,894.00	10602839.00	25.80	0.0946	2.44	25878137.09	1.30
Duvha	3450	Coal	2,25,81,228.00	0.00	25.80	0.0946	2.44	0.00	0.00
Kriel	2850	Coal	1,59,06,816.00	11744606.00	25.80	0.0946	2.44	28664824.97	1.80
Malta	3450	Coal	2,19,54,536.00	8504715.00	25.80	0.0946	2.44	20757287.81	0.95
Amot	1980	Coal	1,32,27,864.00	12438391.00	25.80	0.0946	2.44	30358132.15	2.30
Hendrina	1895	Coal	1,21,43,292.00	6794134.00	25.80	0.0946	2.44	16582306.97	1.37
Grootvlei	1200	Coal	26,56,230.00	6905917.00	25.80	0.0946	2.44	16855133.50	6.35
Komati	1000	Coal	10,16,023.00	1637371.00	25.80	0.0946	2.44	3996298.65	3.93
Camden	1600	Coal	74,72,070.00	664497.00	25.80	0.0946	2.44	1621824.54	0.22
TOTAL			21,59,39,904.00					288557996.40	1.3363

Weighted Average Operating Margin for 2010-11:

Plant Name	Unit No./Capacity	Fuel Used	Net Electricity	Fuel	Net Calorific	Emission Factor	CO ₂ emission co-	CO ₂ Emission	CO ₂
			Generation (MWh)	Consumption (MT/Yr)				Value(GJ/tonne)	for Fuel(IPCC Data source) tCO ₂ /GJ
			2010-11	2010-11				2010-11	2010-11
Majuba	3843	Coal	24632585.00	13020512.00	25.80	0.0946	2.44	31778903.23	1.29
Kendal	3840	Coal	25648258.00	15174501.00	25.80	0.0946	2.44	37036101.10	1.44
Matimba	3690	Coal	28163040.00	14596842.00	25.80	0.0946	2.44	35626220.33	1.26
Lethabo	3558	Coal	2,55,00,366.00	17774699.00	25.80	0.0946	2.44	43382352.36	1.70
Tutuka	3510	Coal	1,90,67,501.00	10191709.00	25.80	0.0946	2.44	24874700.32	1.30
Duvha	3450	Coal	2,02,67,508.00	0.00	25.80	0.0946	2.44	0.00	0.00
Kriel	2850	Coal	1,82,04,910.00	10639393.00	25.80	0.0946	2.44	25967353.71	1.43
Malta	3450	Coal	2,15,04,422.00	9527185.00	25.80	0.0946	2.44	23252809.89	1.08
Amot	1980	Coal	1,21,94,878.00	12155421.00	25.80	0.0946	2.44	29667492.93	2.43
Hendrina	1895	Coal	1,19,38,206.00	6525670.00	25.80	0.0946	2.44	15927072.26	1.33
Grootvlei	1200	Coal	35,46,952.00	7139198.00	25.80	0.0946	2.44	17424497.77	4.91
Komati	1000	Coal	20,60,141.00	2132979.00	25.80	0.0946	2.44	5205919.19	2.53
Camden	1600	Coal	74,90,836.00	1271010.00	25.80	0.0946	2.44	3102128.69	0.41
TOTAL			22,02,19,603.00					293245551.76	1.3316

Weighted Average Operating Margin(OM) Emission Factor (tCO ₂ /MWh)				
Particulars	Unit	2008-09	2009-10	2010-11
Weighted Average OM	tCO ₂ /MWh	1.3475	1.3363	1.3316
Average OM	tCO ₂ /MWh	1.3385		

Step 5: Calculate the build margin emission factor

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

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

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

For calculating BM, the Option 1 is chosen, hence the BM Emission factor calculations for the first crediting period is ex-ante based on the most recent information available on units already built for sample group at time of CDM-PDD.

As per the “**Tool to calculate the emission factor for an electricity system**”

The sample group of power units *m* used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently (*SET*_{5-units}) and determine their annual electricity generation (*AEG*_{*SET*-5-units}, in MWh);

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (*AEG*_{total}, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of *AEG*_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) (*SET*_{≥20%}) and determine their annual electricity generation (*AEG*_{*SET*≥20%}, in MWh);

(c) From *SET*_{5-units} and *SET*_{≥20%} select the set of power units that comprises the larger annual electricity generation (*SET*_{sample});

Identify the date when the power units in *SET*_{sample} started to supply electricity to the grid.

If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin.

Option (a): Set of 5 recent power units not registered as CDM project activities:

Power Plant not registered under CDM	Commissioning Dates		Annual Electricity Generation (MWh)
	Month	Year	
Majuba-Coal	April	1996	24632585
Kendal-Coal	October	1988	25648258
Palmiet-Pump storage	April	1988	-
Matimba-Coal	December	1987	28163040
Lethabo-Coal	December	1985	25500366
TOTAL:			103944249

Option (b): 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation)

Total grid generation for 2010-11	220233652
20% of Total Grid Generation	44045221
Total Grid Generation (20% selection connected to grid most recently):	50280843

Source:

<http://www.eskom.co.za/c/article/236/cdm-calculations/>

Hence, as per Option-c; $SET5$ -units that comprises the larger annual electricity generation (SET_{sample}) is chosen for calculation.

Plant Name	Unit No./Capacity(MW)	Fuel Used	Net Electricity Generation (MWh)-2010-11	Specific Gravity of Fuel Used (Kg/Lt)	Fuel Consumption (MT/yr)	Net Calorific value(GJ/tonne)	Emission Factor for Fuel(IPCC Data source) tCo2/GJ	CO ₂ emission co-efficient of fuel(tCO ₂ /tonne)	CO ₂ Emission from Power Plant (tCO ₂)
Majuba	3,843.00	Coal	2,46,32,585.00	0.83	13020512.00	25.80	0.0946	2.44	31778903.23
Kendal	3,840.00	Coal	2,56,48,258.00	0.83	15174501.00	25.80	0.0946	2.44	37036101.10
Palmiet-Pump Storage	400.00	Pump Storage	2,81,63,040.00		0.00	0.00	0.00	0.00	0.00
Matimba-Coal	3690.00	Coal	2,55,00,366.00	0.83	17774699.00	25.80	0.0946	2.44	43382352.36
Lethabo-Coal	3558.00	Coal	1,90,67,501.00	0.83	10191709.00	25.80	0.0946	2.44	24874700.32
TOTAL:			12,30,11,750.00						137072057.01

Build Margin (tCO ₂ /MWh)	
2010-11	
As per ESCOM datasheet	1.1143

Step 6: Calculate the combined margin emissions factor

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

- Weighted average CM; or
- Simplified CM.

The weighted average CM method (option A) should be used as the preferred option.

The simplified CM method (option b) can only be used if:

- The project activity is located in a Least Developed Country (LDC) or in a country with less than 10 registered CDM projects at the starting date of validation; and
- The data requirements for the application of step 5 above cannot be met

For the calculation of Combined Margin (CM) the first option is used.

(a) Weighted average CM

The combined margin emissions factor is calculated as follows:

$$EF_{Grid, CM, y} = EF_{Grid, OM, y} \times W_{OM} + EF_{Grid, BM, y} \times W_{BM}$$

Where:

$EF_{grid,CM,y}$	Combined margin CO ₂ emission factor for the year y (tCO ₂ /MWh)
$EF_{grid,BM,y}$	Build margin CO ₂ emission factor for the year y (tCO ₂ /MWh)
$EF_{grid,OM,y}$	Operating margin CO ₂ emission factor for the year y (tCO ₂ /MWh)
W_{OM}	Weighting of operating margin emission factors (%)
W_{BM}	Weighting of build margin emission factors (%)

Hence,

Emission Factor for Grid:				
Simple Operating Margin (tCO ₂ /MWh)	W_{OM}	Build Margin(tCO ₂ /MWh)	W_{BM}	Emission factor (EF _{grid,CM,y})
2008-09 to 2010-11		2010-11		
1.3385	0.5000	1.1143	0.5000	1.2264

Emissions from gasification (PE_{g,y}) or combustion of RDF/Stabilized Biomass (PE_{r,y}) or waste incineration(PE_{i,y})

The stack gas from the gasification process and the combustion of Stabilized Biomass may contain small amounts of methane and nitrous oxide.

$$PE_{g/r/i,y} = PE_{g/r/i,f,y} + PE_{g/r/i,s,y}$$

Where,

- | | |
|------------------|---|
| $PE_{g/r/i,f,y}$ | - Is the fossil-based waste CO ₂ emissions from gasification, waste incineration or RDF/stabilized biomass combustion in year y (tCO ₂ e) |
| $PE_{g/r/i,s,y}$ | - Is the N ₂ O and CH ₄ emissions from the final stacks from gasification, waste |

incineration or RDF/stabilized biomass combustion in year y (tCO_2e)

Since, the project activity involves 100% solid biomass and does not use any fossil based waste so $PE_{g/r/i,y}$ is not applicable. Hence, $PE_{g/r/i,y} = PE_{g/r/i,s,y}$

In the project case the stabilized biomass is used offsite, N_2O and CH_4 emissions should be accounted for as leakage however since it has been considered under the project boundary and in direct control of the PP the same has been considered under the project emissions. Emissions of N_2O and CH_4 may be estimated from either of the options given below:

Option 1:

$$PE_{g/r/i,s,y} = SG_{g/r,y} * MC_{N_2O,g/r/i,y} * GWP_{N_2O} + SG_{g/r,i,y} * MC_{CH_4,g/r/i,y} * GWP_{CH_4} \quad (1)$$

Where:

- $PE_{g/r/i,s,y}$ = Is the total emissions of N_2O and CH_4 from gasification, waste incineration or RDF/stabilized biomass combustion in year y (tCO_2e)
- $SG_{g/r,i,y}$ = Is the total volume of stack gas from gasification, waste incineration or RDF/stabilized biomass combustion in year y (m^3/yr)
- $MC_{N_2O,g/r/i,y}$ = Is the monitored content of nitrous oxide in the stack gas from gasification, waste incineration or RDF/stabilized biomass combustion in year y (tN_2O/m^3)
- GWP_{N_2O} = Is the Global Warming Potential of nitrous oxide (tCO_2e/tN_2O)
- $MC_{CH_4,g/r/i,y}$ = Is the monitored content of methane in the stack gas from gasification, waste incineration or RDF/stabilized biomass combustion in year y (tCH_4/m^3)
- GWP_{CH_4} = Is the Global Warming Potential of methane (tCO_2e /tCH_4)

Option 2:

$$PE_{g/r/i,s,y} = Q_{biomass,y} * (EF_{N_2O} * GWP_{N_2O} + EF_{CH_4} * GWP_{CH_4}) * 10^{-3} \quad (2)$$

Where:

- $Q_{biomass,y}$ = Is the amount of waste gasified, incinerated or RDF/stabilized biomass combusted in year y (tonnes/yr)
- EF_{N_2O} = Is the aggregate N_2O emission factor for waste combustion ($kgN_2O/tonne$ of waste)
- EF_{CH_4} = Is the aggregate CH_4 emission factor for waste combustion ($kgCH_4/tonne$ of waste)

Tables 5.4 and 5.3, chapter 5, volume 5 of IPCC 2006 guidelines should be used to estimate EF_{N_2O} and EF_{CH_4} , respectively.

CH₄ Emission Factor FACTORS FOR INCINERATION OF MSW		
Type of incineration/technology		CH₄ Emission Factors (kg/Gg waste incinerated on a wet weight basis)
Continuous incineration	stoker	0.2
	fluidized bed	~0
Semi-continuous incineration	stoker	6
	fluidized bed	188
Batch type incineration	stoker	60
	fluidized bed	237

Note 1: In the study cited for this emission factor, the measured CH_4 concentration in the exhaust air was lower than the Concentration in ambient air.

Source: Greenhouse Gas Inventory Office of Japan, GIO 2004.

Since the boilers utilizing Bio-coal briquettes/pallets (Stabilized Biomass) in the project activity are stoker fired boilers and undergo continuous incineration Emission Factor of CH₄ has been assumed as 0.2kg/Gg waste.

Table 5.5 shows the example of N₂O emission factors used for estimate emissions from incineration of sludge and industrial waste.

TABLE 5.5				
N₂O EMISSION FACTORS FOR INCINERATION OF SLUDGE AND INDUSTRIAL WASTE				
Country	Type of Waste	Type of Incineration / Technology	Emission factor for Industrial Waste (g N₂O / t waste)	Weight basis
Japan ¹	Waste paper, waste wood		10	wet weight
	waste oil		9.8	wet weight
	waste plastics		170	wet weight
	sludge (except sewage sludge)		450	wet weight
	dehydrated sewage sludge		900	wet weight
	high molecular weight flocculants	fluidized bed incinerator at normal temperature	1508	wet weight
	high molecular weight flocculants	fluidized bed incinerator at high temperature	645	
	high molecular weight flocculants	multiple hearth	882	
	other flocculants		882	
	lime sludge		294	
Germany ²	sewage sludge		990	
	industrial waste		420	
¹ GIO 2005.				
² Johnke 2003.				

Since the waste comprises of Waste wood Emission Factor for N₂O has been assumed as 10g/t waste.

Since IPCC default emission factor is used, a conservativeness factor should be applied to account for the high uncertainty of the IPCC default values. The level of the conservativeness factor depends on the uncertainty range of the estimate for the IPCC default N₂O and CH₄ emission factor. Project participants shall select the appropriate conservativeness factor from Table 3 below and shall multiply the estimate for the N₂O/CH₄ emission factor with the conservativeness factor.

Table 3: Conservativeness factors

Estimated uncertainty range (%)	Assigned uncertainty band (%)	Conservativeness factor where higher values are more conservative
Less than or equal to 10	7	1.02
Greater than 10 and less than or equal to 30	20	1.06
Greater than 30 and less than or equal to 50	40	1.12
Greater than 50 and less than or equal to 100	75	1.21
Greater than 100	150	1.37

The conservativeness factor has been assumed at 1.21;

The detailed calculations of Project Emissions (PE_y) are provided in section B.6.3 of the PDD

Leakage Emissions (L_y):

As per Methodology AM0025/version 13 “*The sources of leakage considered in the methodology are CO₂ emissions from off-site transportation of waste materials in addition to CH₄ and N₂O emissions from the residual waste from the anaerobic digestion, gasification processes and processing/combustion of RDF. In case of waste incineration, leakage emissions from residual waste of MSW incinerator should be accounted for. Positive leakages that may occur through the replacement of fossil-fuel based fertilizers with organic composts are not accounted for*”

Leakage emissions should be estimated from the following equation:

$$L_y = L_{t,y} + L_{r,y} + L_{i,y} + L_{s,y} + L_{COMP,y}$$

Where:

L _{t,y}	=	Is the leakage emissions from increased transport in year y (tCO ₂ e)
L _{r,y}	=	Is the leakage emissions from the residual waste from the anaerobic digester, the gasifier, the processing/combustion of RDF/stabilized biomass, in case it is disposed of in landfills in year y (tCO ₂ e)
L _{i,y}	=	Is the leakage emissions from the residual waste from MSW incinerator in year y (tCO ₂ e)
L _{s,y}	=	Is the leakage emissions from end use of stabilized biomass
L _{COMP,y}	=	Leakage emissions associated with composting in year y (t CO ₂ e / yr)

The parameters which are applicable for the project activity for calculation of Leakage are provided in the table below:

Table 3: Parameters for calculating Leakage Emissions:

Symbols	Parameters	Applicable	Justification
L _{t,y}	Leakage emissions from increased transport in year y (tCO ₂ e)	Yes	Since, the raw material needs to be brought to the project site via transport; leakage from transport is present
L _{r,y}	Leakage emissions from the residual waste from the anaerobic digester,	No	The raw material used in the project activity is utilized fully and does not leave any residual waste to be disposed off. So, this parameter is excluded.

	the gasifier, the processing/combustion of RDF/stabilized biomass, in case it is disposed of in landfills in year y		
$L_{i,y}$	Leakage emissions from the residual waste from MSW incinerator in year y (tCO ₂ e)	No	The raw material used in the project activity is utilized fully and does not leave any residual waste. So, this parameter is excluded.
$L_{s,y}$	Leakage emissions from end use of stabilized biomass	No	The end product in form of bio-coal is used for direct replacement of coal. So there is no leakage from end product
$L_{COMP,y}$	Leakage emissions associated with composting in year y (t CO ₂ e / yr)	No	The project activity does not involve the process of composting of the raw material to be used. So, this parameter is not included

Based on the parameter applicable for calculation of Leakage Emission:

Emissions from transportation ($L_{t,y}$)

The project may result in a change in transport emissions. This would occur when the waste is transported from waste collecting points, in the collection area, to the treatment facility, instead of to existing landfills. When it is likely that the transport emissions will increase significantly, such emissions should be incorporated as leakage. In this case, project participants shall document the following data in the CDM-PDD: an overview of collection points from where the waste will be collected, their approximate distance (in km) to the treatment facility, existing landfills and their approximate distance (in km) to the nearest end-user.

For calculations of the emissions, IPCC default values for fuel consumption and emission factors may be used. The CO₂ emissions are calculated from the quantity of fuel used and the specific CO₂-emission factor of the fuel for vehicles i to n , as follows:

$$L_{t,y} = \sum_i NO_{\text{vehicles},i,y} * DT_{i,y} * VF_{\text{cons},i} * NCV_{\text{fuel}} * D_{\text{fuel}} * EF_{\text{fuel}}$$

Where:

- $NO_{\text{vehicles},i,y}$ = Is the number of vehicles for transport with similar loading capacity
- $DT_{i,y}$ = Is the average additional distance travelled by vehicle type i compared to baseline in year y (km)
- $VF_{\text{cons},i}$ = Is the vehicle fuel consumption in litres per kilometre for vehicle type i (l/km)
- NCV_{fuel} = Is the Calorific value of the fuel (MJ/Kg or other unit)
- D_{fuel} = Is the fuel density (kg/l), if necessary
- EF_{fuel} = Is the Emission factor of the fuel (tCO₂/MJ)

The detailed calculation of Leakage Emissions (L_y) is provided in section B.6.3 of the PDD

B.6.2. Data and parameters fixed ex ante

Data / Parameter	Φ_{default}									
Unit	-									
Description	Default value for the model correction factor to account for model uncertainties									
Source of data	“Tool to determine emissions avoided from solid waste disposal site”, version-6.0									
Value(s) applied	<p>For project or leakage emissions: $\Phi_{\text{default}} = 1$.</p> <p>For baseline emissions: refer to Table 3 to identify the appropriate factor based on the application of the tool (A or B) and the climate where the SWDS is located</p> <p>Table 3: Default values for the model correction factor:</p> <table border="1" data-bbox="580 719 1458 824"> <thead> <tr> <th></th> <th>Humid/Wet condition</th> <th>Dry Condition</th> </tr> </thead> <tbody> <tr> <td>Application A</td> <td>0.75</td> <td>0.75</td> </tr> <tr> <td>Application B</td> <td>0.85</td> <td>0.80</td> </tr> </tbody> </table>		Humid/Wet condition	Dry Condition	Application A	0.75	0.75	Application B	0.85	0.80
	Humid/Wet condition	Dry Condition								
Application A	0.75	0.75								
Application B	0.85	0.80								
Choice of data or Measurement methods and procedures	Default value of 0.80 taken (as specified in “Tool to determine emissions avoided from solid waste disposal site.”) based on Application B and Dry condition.									
Purpose of data	Calculation of baseline emissions									
Additional comment	Table 3 is applicable to Option 1 in the procedure “Determining the model correction factor (ϕ_{γ})”									

Data / Parameter	OX
Unit	-
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other materials covering the waste)
Source of data	Based on an extensive review of published literature on this subject, including the IPCC 2006 Guidelines for National Greenhouse Gas
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	Default value adopted on the basis of an extensive review of published literature on this subject, including the IPCC 2006 Guidelines for National Greenhouse Gas
Purpose of data	Calculation of baseline emissions
Additional comment	When methane passes through the top-layer, part of it is oxidized by methanotrophic bacteria to produce CO ₂ . The oxidation factor represents the proportion of methane that is oxidized to CO ₂ . This should be distinguished from the methane correction factor (MCF) which is to account for the situation that ambient air might intrude into the SWDS and prevent methane from being formed in the upper layer of SWDS.



Data / Parameter	F
Unit	-
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	Default value adopted from IPCC guidelines.
Purpose of data	Calculation of baseline emissions
Additional comment	Upon biodegradation, organic material is converted to a mixture of methane and carbon dioxide.

Data / Parameter	DOC _{f, default}
Unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	Default value adopted from IPCC guidelines.
Purpose of data	Calculation of baseline emissions
Additional comment	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, in the SWDS. This default value can only be used for i) Application A; or ii) Application B if the tool is applied to MSW.



Data / Parameter	MCF_{default}
Unit	-
Description	Methane correction factor
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	1.0
Choice of data or Measurement methods and procedures	As per the methodology, AM0025 version 13, a default value of 1.0 shall be used 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) levelling of the waste;
Purpose of data	Calculation of baseline emissions
Additional comment	MCF accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS.

Data / Parameter	DOC _j														
Unit	-														
Description	Fraction of degradable organic carbon in the waste type <i>j</i> (weight fraction)														
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 2.4 and 2.5)														
Value(s) applied	<p>For MSW, the following values for the different waste types <i>j</i> should be applied: Default values for DOC_j:</p> <table border="1"> <thead> <tr> <th>Waste type <i>j</i></th> <th>DOC_j (% wet waste)</th> </tr> </thead> <tbody> <tr> <td>Wood and wood products</td> <td>43</td> </tr> <tr> <td>Pulp, paper and cardboard (other than sludge)</td> <td>40</td> </tr> <tr> <td>Food, food waste, beverages and tobacco (other than sludge)</td> <td>15</td> </tr> <tr> <td>Textiles</td> <td>24</td> </tr> <tr> <td>Garden, yard and park waste</td> <td>20</td> </tr> <tr> <td>Glass, plastic, metal, other inert waste</td> <td>0</td> </tr> </tbody> </table> <p>In case of the project activity, the waste is primarily saw dust and wooden chips from wood mills. Hence, the project applies the default value of 43 corresponding to “wood and wood products”.</p>	Waste type <i>j</i>	DOC _j (% wet waste)	Wood and wood products	43	Pulp, paper and cardboard (other than sludge)	40	Food, food waste, beverages and tobacco (other than sludge)	15	Textiles	24	Garden, yard and park waste	20	Glass, plastic, metal, other inert waste	0
Waste type <i>j</i>	DOC _j (% wet waste)														
Wood and wood products	43														
Pulp, paper and cardboard (other than sludge)	40														
Food, food waste, beverages and tobacco (other than sludge)	15														
Textiles	24														
Garden, yard and park waste	20														
Glass, plastic, metal, other inert waste	0														
Choice of data or Measurement methods and procedures	Since, the project includes only wood waste so the default value for wood and wood products is taken. For cross checking the default value, an ignition loss test will be conducted by the company according to the procedure in EN15169 or similar national or international standards which is valid during the entire crediting period.														
Purpose of data	Calculation of baseline emissions														
Additional comment	-														



Data / Parameter	k_j					
Unit	1/yr					
Description	Decay rate for the waste type j					
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)					
Value(s) applied	Following default values for different waste types j :					
	Waste Type j		Boreal and Temperate (MAT $\leq 20^{\circ}\text{C}$)		Tropical (MAT $> 20^{\circ}\text{C}$)	
			Dry (MAP/P ET < 1)	Wet (MAP/P ET > 1)	Dry (MAP $< 1000\text{mm}$)	Wet (MAP $> 1000\text{mm}$)
	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 (nonfood) 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.						
Choice of data or Measurement methods and procedures	Since the MAT and MAP for the region is above 20°C and falls within 1000mm respectively, so the value taken as per the default value provided in the table above. http://www.tutiempo.net/en/Climate/East_London/688580.htm					
Purpose of data	Calculation of baseline emissions					
Additional comment	-					



Data / Parameter	GWP_{CH4}
Unit	tCO ₂ e/t CH ₄
Description	Global Warming Potential of methane
Source of data	IPCC
Value(s) applied	For the next commitment period value of 25 is taken. 21 for the first commitment period. Shall be updated for future commitment periods according to any future COP/MOP decisions.
Choice of data or Measurement methods and procedures	The value post first commitment period is considered for the project. http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	NCV_{fuel}
Unit	MJ/Kg of fuel
Description	Net calorific value of fuel i.e. coal
Source of data	Bio Coal Brick & Clay Test Report dated 27th February, 2009
Value(s) applied	26.0
Choice of data or Measurement methods and procedures	Calorific value are confirmed report from Mondi Richards Bay Biomass Project
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	EF_{fuel,b}
Unit	tCO ₂ /MJ
Description	Emission factor of baseline fossil fuel i.e. coal used in the boiler, as identified in the baseline scenario identification
Source of data	Volume 2 ,Table-1.4:Default CO2 Emission factors for combustion of 2006 IPCC Guidelines for National Greenhouse gas Inventories;Page-23
Value(s) applied	0.0000961
Choice of data or Measurement methods and procedures	The value shall be updated in accordance with further revision of IPCC guidelines.
Purpose of data	Calculations of baseline emissions
Additional comment	-

Data / Parameter	CEF_{elec}
Unit	tCO ₂ /MWh
Description	Emission factor for the production of electricity in the project activity
Source of data	Data sources received from Eskom power station http://www.eskom.co.za/c/article/236/cdm-calculations/
Value(s) applied	1.2264
Choice of data or Measurement methods and procedures	The value for CM is derived based on the values published in ESKOM for power station which is the nodal agency for all power related activities in the country. Fixed value has been taken from ESKOM which was the latest available database at the time of PDD webhosting.
Purpose of data	Calculation of project emissions
Additional comment	As per ESKOM calculation, all the values are considered based on financial year i:e from April to March for the year.

Data / Parameter	ξ_{boiler}
Unit	%
Description	Energy Efficiency of each of the boilers used for generating thermal energy for the customers which are covered in the purview of the project activity in the absence of the project activity
Source of data	Reference data or country specific data
Value(s) applied	80.0
Choice of data or Measurement methods and procedures	For determining the boiler efficiency, project participant is considering Option A i:e Use the highest value among the following three values as a conservative approach. <ul style="list-style-type: none"> - Measured Efficiency prior to project implementation; if there is any existing boiler operating on coal - Measured Efficiency during Monitoring; - The manufacturer's information (John Thompson) on Boiler Efficiency
Purpose of data	Annual
Additional comment	-
	Calculation of baseline emissions
	The figure has been estimated conservatively.

B.6.3. Ex ante calculation of emission reductions

As described in section B.6.1, the emission reductions are calculated according to methodology AM0025, the “Tool to calculate the emission factor for an electricity system” and the “Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site” therein. The ex-ante calculation of emission reductions are completed with the following steps:

Baseline Emissions (BE_y):

The baseline emissions in year y for the process as per section B.6.1 of PDD includes:

$$BE_y = \phi(1 - f) GWP_{CH_4} (1 - OX) \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^y \sum_{j=A}^D W_{j,x} \cdot DOC_j \cdot (1 - e^{-k_j}) \cdot e^{-k_j \cdot (y-x)}$$

- x - Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period (x = 1) to year y (x = y)
- y - Year of the crediting period for which methane emissions are calculated (y is a consecutive period of 12 months)
- DOC_{f,y} - Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year y (weight fraction)
- W_{j,x} - Amount of solid waste type j disposed or prevented from disposal in the SWDS in the year x
- Φ_y - Model correction factor to account for model uncertainties for year y
- f_y - Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y
- GWP_{CH₄} - Global Warming Potential of methane
- 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)
- MCF_y - Methane correction factor for year y
- DOC_j - Fraction of degradable organic carbon in the waste type j (weight fraction)
- k_j - Decay rate for the waste type j (1 / yr)
- j - Type of residual waste or types of waste in the MSW

The Table below depicts the baseline emission calculations:

Table-B.6.3.1 Baseline Emissions Calculations:

Parameters:	Unit	Value	References
φ _y	–	0.80	Methodological Tool-"Emission from Solid waste disposal sites", version 06.0, EB-65,Annex-19
f _y	–	0	Methodological Tool-"Emission from Solid waste disposal sites", version 06.0, EB-65,Annex-19
(1-f _y)	–	1	Calculated

GWP_{CH4}	tCO ₂ /tCH ₄	25	IPCC Fourth Assessment report: Climate Change 2007; Table-2.14: Lifetimes, radiative efficiencies and direct (except for CH ₄) GWPs relative to CO ₂ . For ozone-depleting substances and their replacements, data are taken from IPCC/TEAP (2005) unless otherwise indicated
OX	–	0.1	Methodological Tool-"Emission from Solid waste disposal sites", version 06.0, EB-65,Annex-19
(1-OX)	–	0.9	Calculated
F	–	0.5	Methodological Tool-"Emission from Solid waste disposal sites", version 06.0, EB-65,Annex-19
DOC_{f,y}	Weight fraction	0.5	Methodological Tool-"Emission from Solid waste disposal sites", version 06.0, EB-65,Annex-19
MCF_y	–	1.0	Methodological Tool-"Emissions from Solid waste disposal sites", version-06,EB-65,Annex-19
DOC_j	Percent	0.43	Methodological Tool-"Emissions from Solid waste disposal sites", version-06,EB-65,Annex-19;
k_j	1/yr	0.025	Climate East London-Historical weather records as reported by the weather station:688580(FAEL)-Average annual climate values; Methodological Tool-"Emissions from Solid waste disposal sites", version-06,EB-65,Annex-19
(1-e^{-k_j})	–	0.025	Calculated
Pdt of [$\phi_y, (1-f_y), GWP, (1-OX), F, DOC_{f,y}, MCF_y, DOC_j, (1-e^{-k_j})$]	–	0.048	Calculated
Production per hr	Tonnes/hour	10	Quotation to Bio-Coal Manufacturers & Distributors(Pty) Ltd. South Africa by Agro-Technologies & Ventures Private Limited dated 24th October,2011;Quotation for supply & Erection of Briquette/Pellet Manufacturing Unit-Agro-Technologies & Ventures Pvt. Ltd.
Plant Utilization Factor	Percent	95%	Quotation to Bio-Coal Manufacturers & Distributors(Pty) Ltd. South Africa by Agro-Technologies & Ventures Private Limited dated 24th October,2011
No of shifts per day	No	3	Financial Projections and Forecasts-The Business of: Bio-Coal Manufacturers & Distributors(Pty) Ltd



No of hours/shift	Hours	8	Financial Projections and Forecasts-The Business of: Bio-Coal Manufacturers & Distributors(Pty) Ltd
Annual Operating Days	Days	250	Financial Projections and Forecasts-The Business of: Bio-Coal Manufacturers & Distributors(Pty) Ltd
Total amount of solid waste disposed or prevented from disposal of SWDS (W_{j,x})	Tonnes	57000	Calculated with 100% composition by wt & operating days of 250 as obtained from the Raw Waste Quantity work sheet

Computation of Baseline Emissions						
Crediting Period	y	x	Wood and wood products			
			$W_{j,x}$	$k_j(y-x)$	$(e^{-k_j(y-x)})$	$BE_{CH_4,y}$
$BE_{y=1}$	1	1	57000	0.000	1.000	3630.92
$BE_{y=2}$	2	1	57000	0.025	0.975	3541.28
	2	2		0.000	1.000	3630.92
$BE_{y=3}$	3	1	57000	0.050	0.951	3453.84
	3	2		0.025	0.975	3541.28
	3	3		0.000	1.000	3630.92
$BE_{y=4}$	4	1	57000	0.075	0.928	3368.57
	4	2		0.050	0.951	3453.84
	4	3		0.025	0.975	3541.28
	4	4		0.000	1.000	3630.92
$BE_{y=5}$	5	1	57000	0.100	0.905	3285.40
	5	2		0.075	0.928	3368.57
	5	3		0.050	0.951	3453.84
	5	4		0.025	0.975	3541.28
	5	5		0.000	1.000	3630.92
$BE_{y=6}$	6	1	57000	0.125	0.882	3204.28
	6	2		0.100	0.905	3285.40
	6	3		0.075	0.928	3368.57
	6	4		0.050	0.951	3453.84
	6	5		0.025	0.975	3541.28
	6	6		0.000	1.000	3630.92
$BE_{y=7}$	7	1	57000	0.150	0.861	3125.17
	7	2		0.125	0.882	3204.28
	7	3		0.100	0.905	3285.40
	7	4		0.075	0.928	3368.57
	7	5		0.050	0.951	3453.84
	7	6		0.025	0.975	3541.28
	7	7		0.000	1.000	3630.92
$BE_{y=8}$	8	1	57000	0.175	0.839	3048.00
	8	2		0.150	0.861	3125.17
	8	3		0.125	0.882	3204.28
	8	4		0.100	0.905	3285.40
	8	5		0.075	0.928	3368.57
	8	6		0.050	0.951	3453.84
	8	7		0.025	0.975	3541.28
	8	8		0.000	1.000	3630.92
Computation of Baseline Emissions						

Crediting Period	y	x	Wood and wood products			
			$W_{j,x}$	$k_j(y-x)$	$(e^{-k_j(y-x)})$	$BE_{CH_4,y}$
$BE_{y=9}$	9	1	57000	0.200	0.819	2972.75
	9	2		0.175	0.839	3048.00
	9	3		0.150	0.861	3125.17
	9	4		0.125	0.882	3204.28
	9	5		0.100	0.905	3285.40
	9	6		0.075	0.928	3368.57
	9	7		0.050	0.951	3453.84
	9	8		0.025	0.975	3541.28
	9	9		0.000	1.000	3630.92
$BE_{y=10}$	10	1	57000	0.225	0.799	2899.35
	10	2		0.200	0.819	2972.75
	10	3		0.175	0.839	3048.00
	10	4		0.150	0.861	3125.17
	10	5		0.125	0.882	3204.28
	10	6		0.100	0.905	3285.40
	10	7		0.075	0.928	3368.57
	10	8		0.050	0.951	3453.84
	10	9		0.025	0.975	3541.28
	10	10		0.000	1.000	3630.92

$BE_{elec,y}$	tCO ₂ /yr	0	As project involves thermal use only
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Baseline Emissions from Thermal Energy Production utilizing the SB

$$BE_{thermal,y} = \frac{Q_y}{\epsilon_{boiler} \cdot NCV_{fuel}} \cdot EF_{fuel,b}$$

Where,

Q_y	Quantity of Thermal energy produced utilizing the Stabilized during the year in GJ
ϵ_{boiler}	Energy Efficiency of Boiler (%)
NCV_{fuel}	Net Calorific value of fuel in GJ/tonne
$EF_{fuel,b}$	Emission factor of fuel in tCO ₂ /ton

Table B.6.3.2: Baseline Emissions from Thermal Energy Production utilizing the SB

Parameters	Unit	Values	References
Tons of SB	tons	57000	Project Appraisal Report
GCV of SB	kcal/Kg	4135	As per Table B.6.3.1 above
GCV of SB	GJ/tonne	17.3	Calculated
Q _y	GJ/year	986855.0	Calculated
ε _{boiler}	Percentage	0.80	Boiler Manufacturers' data
NCV _{fuel}	TJ/Gg	26.0	Test Report
NCV _{fuel}	GJ/ton	26.0	Calculated
EF _{fuel,b}	Kg/TJ	96100	Volume 2 ,Table-1.4:Default CO2 Emission factors for combustion of 2006 IPCC Guidelines for National Greenhouse gas Inventories;Page-23 http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf
EF _{fuel,b}	Tonnes/GJ	0.0961	Calculated; 1Kg=10 ⁻³ Tonnes;1TJ=1000 GJ
EF _{fuel,b}	tCO ₂ /ton	2.50	Calculated
BE_{Thermal,y}	tCO₂/yr	118545.95	Calculated

The Total Baseline Emission Calculation will be given as:

$$BE_y = BE_{CH_4,y} + BE_{Thermal,y}$$

The baseline emission for the **first year** is provided below:

BE _{CH₄,y}	BE _{Thermal,y}	Baseline Emissions (BE _y) tCO _{2e}
3630.92	118545.95	122177

Project Emissions (PE_y):

The project emissions in year y for the process as per section B.6.1 of PDD includes:

$$PE_y = PE_{elec,y} + PE_{r,y}$$

(i). Project emissions from electricity use :

$$PE_{elec,y} = EG_{PJ,FF,y} * CEF_{elec}$$

Where:

$EG_{PJ,FF,y}$ is the amount of electricity generated in an on-site fossil fuel fired power plant or consumed from the grid as a result of the project activity, measured using an electricity meter (MWh).

CEF_{elec} is the carbon emissions factor for electricity generation in the project activity (tCO₂/MWh). Estimated values are used to ex-ante calculate the emission reduction. The actual emission reduction will be replaced by the ex-post measured values.

Furthermore, the methodology states that in cases where the electricity is purchased from the grid, the emission factor is to be calculated according to the Tool to Calculate Emission Factor for an Electricity System Version 01.1. Accordingly, the emission factor has been calculated using the “Tool to Calculate the Emission Factor for an Electricity System”.

Table B.6.3.3 Data used for ex-ante calculation of PE_{electricity, y}

Parameters	Values	Units	References :
$EG_{PJ,FF,y}$	2463.54	MWh	Quotation for Supply & Erection of Briquette/Pellet Manufacturing Unit dated 24th September, 2011-Agro-Technologies & ventures Private Limited (Considered for conversion 1HP=0.746KW)
CEF_{elec}	1.2264	tCO ₂ /MWh	Data Requirement for Calculating the Grid Emission Factor for South African Grid
$PE_{electricity,y}$	3021	tCO₂/annum	Calculated

ii. Emissions from gasification (PE_{g,y}) or combustion of RDF/Stabilized Biomass (PE_{r,y}) or waste incineration(PE_{i,y})
Emissions from gasification stacks or RDF/stabilized biomass combustion or waste incineration (PE_{g/r/i,s,y})

$$PE_{g/r/i,s,y} = Q_{biomass,y} \cdot (EF_{N2O} \cdot GWP_{N2O} + EF_{CH4} \cdot GWP_{CH4}) \cdot 10^{-3}$$

Where,

$Q_{biomass,y}$	Is the amount of waste gasified, incinerated or RDF/stabilized biomass combusted in year y (tonnes/yr)
EF_{N2O}	Is the aggregate N ₂ O emission factor for waste combustion (kgN ₂ O/tonne of waste)
EF_{CH4}	Is the aggregate CH ₄ emission factor for waste combustion (kgCH ₄ /tonne of waste)

Parameters	Units	Values	References:
Amount of RDF combusted in year y	t/yr	57000	Project Appraisal Report
N ₂ O emission factor for waste combustion	KgN ₂ O/tonne	0.0121	TABLE 5.5: N ₂ O EMISSION FACTORS FOR INCINERATION OF SLUDGE AND INDUSTRIAL WASTE; Chapter 5: Incineration and Open Burning of Waste; 2006 IPCC Guidelines for National Greenhouse Gas Inventories http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_5_Ch5_IOB.pdf
GWP N ₂ O	KgCO ₂ /N ₂ O	298	IPCC Fourth Assessment report: Climate Change 2007; Table-2.14: Lifetimes, radiative efficiencies and direct (except for CH ₄) GWPs relative to CO ₂ . For ozone-depleting substances and their replacements, data are taken from IPCC/TEAP (2005) unless otherwise indicated
CH ₄ emission factor for waste combustion	KgCH ₄ /tonne	0.0002	TABLE 5.3: CH ₄ EMISSION FACTORS FOR INCINERATION OF MSW; Chapter 5: Incineration and Open Burning of Waste; 2006 IPCC Guidelines for National Greenhouse Gas Inventories http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_5_Ch5_IOB.pdf
GWP _{CH₄}	tCO ₂ /CH ₄	25	IPCC Fourth Assessment report: Climate Change 2007; Table-2.14: Lifetimes, radiative efficiencies and direct (except for CH ₄) GWPs relative to CO ₂ . For ozone-depleting substances and their replacements, data are taken from IPCC/TEAP (2005) unless otherwise indicated
Emission from RDF combustion	tCO₂/annum	206	Calculated

Table B.6.3-4. Summary of ex ante project emissions in the first crediting period

Year	PE _{elec, v}	PE _{g/r/i.s.v}	Total
2012-2013	3021	206	3227
2013-2014	3021	206	3227
2014-2015	3021	206	3227
2015-2016	3021	206	3227
2016-2017	3021	206	3227
2017-2018	3021	206	3227
2018-2019	3021	206	3227
2019-2020	3021	206	3227
2020-2021	3021	206	3227
2021-2022	3021	206	3227
Total:	30210	2060	32270

For Leakage Emission (L_v) Calculations:

The Leakage emission calculations as per section B.6.1 of PDD includes:

$$L_y = L_{t,y}$$

Where,

$NO_{\text{vehicles},i,y}$	Is the number of vehicles for transport with similar loading capacity
$DT_{i,y}$	Is the average additional distance travelled by vehicle type i compared to baseline in year y (km)
$VF_{\text{cons},i}$	Is the vehicle fuel consumption in litres per kilometre for vehicle type i (l/km)
NCV_{fuel}	Is the Calorific value of the fuel (MJ/Kg or other unit)
D_{fuel}	Is the fuel density (kg/l), if necessary
EF_{fuel}	Is the Emission factor of the fuel (tCO ₂ /MJ)

Parameters	Value	Unit	References
No of vehicle for transport	1900	Number	Table-8:Empty weight and payload capacity of selected transport vessels;Page-17 of Ecological transport Information Tool for Worldwide Transports
Average additional distance travelled by vehicle compared to baseline	263.60	Km	Distance from Client end to Bio-Coal Manufacturers & Distributors(Pty) Ltd
Vehicle fuel consumption	0.2	Lt/km	Assumed Fuel Economy for Heavy Duty Vehicles-Page 16 of Good Practice Guidance & Uncertainty Management in National Greenhouse Gas Inventories
calorific value of fuel(NCV) of diesel oil	43	TJ/Gg	Volume-2;Table-1.2:Default Net Calorific Values(NCVs) and Lower and Upper Limits of the 95% Confidence Interval of 2006 IPCC Guidelines for National Greenhouse Gas Inventories;Page-18
calorific value of fuel(NCV) of diesel oil	43	MJ/Kg	Calculated
Fuel density	0.88	Kg/Lt	Specific Gravity of Liquids
Emission factor of fuel(Diesel)	74100	KgCO ₂ /TJ	Volume-2; Table-1.4: Default CO ₂ emission factors for combustion of 2006 IPCC Guidelines for National Greenhouse Gas Inventories;Page-23
Emission factor of fuel (Diesel)	0.0000741	tCO ₂ /MJ	Calculated
Leakage emission from increased transport in year y	281	tCO₂e	Calculated

Table B.6.3-5: Ex-ante estimates of Leakage:

Year	Leakage (tCO _{2e})
2012-2013	281
2013-2014	281
2014-2015	281
2015-2016	281
2016-2017	281
2017-2018	281
2018-2019	281
2019-2020	281
2020-2021	281
2021-2022	281
Total:	2810

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO _{2e})	Project emissions (t CO _{2e})	Leakage (t CO _{2e})	Emission reductions (t CO _{2e})
2012-2013	122177	3227	281	118669
2013-2014	125718	3227	281	122210
2014-2015	129172	3227	281	125664
2015-2016	132541	3227	281	129033
2016-2017	135826	3227	281	132318
2017-2018	139030	3227	281	135522
2018-2019	142155	3227	281	138647
2019-2020	145203	3227	281	141695
2020-2021	148176	3227	281	144668
2021-2022	151076	3227	281	147568
Total	1371074	32270	2810	1335994
Total number of crediting years	10			
Annual average over the crediting period	137107	3227	281	133599

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	$EG_{PJ,FF,y}$
Unit	MWh
Description	Amount of electricity consumed from the grid as a result of the project activity
Source of data	Monthly electricity bills
Value(s) applied	2463.54
Measurement methods and procedures	<p>The parameter shall be monitored continuously using an energy meter. The electronic meters will be provided for both main and check meter having Accuracy Class: 0.2 S</p> <p>The main meter shall be installed and owned by the Company, whereas check meters shall be installed and owned by the ESCOM. The metering equipment shall be maintained in accordance with electricity standards. Such equipment shall have the capability of recording half-hourly and monthly readings. The Company shall provide such metering results to the ESCOM. Each meter shall be jointly inspected and sealed by ESCOM on behalf of the Parties and shall not be interfered with by either Party except in the presence of the other Party or its accredited representatives.</p>
Monitoring frequency	Calibration frequency: All the main and check meters shall be tested for accuracy every calendar quarter with reference to a portable standard meter
QA/QC procedures	Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double checked by the electricity distribution company.
Purpose of data	Calculation of project emissions
Additional comment	The data will archived for the entire crediting period and 2 years post crediting period.

Data / Parameter	f_y
Unit	-
Description	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year y
Source of data	Maximum value from the following: (a) contract or regulation requirements specifying the amount of methane that must be destroyed/used (if available) and (b) historic data on the amount captured
Value(s) applied	0
Measurement methods and procedures	
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	The data will archived for the entire crediting period and 2 years post crediting period.



Data / Parameter	W_x
Unit	Tons
Description	Total amount of waste disposed in a SWDS in year x
Source of data	Plant records and purchase invoices
Value(s) applied	57000
Measurement methods and procedures	Measured on wet basis. Every consignment of waste shall be measured using a weigh bridge.
Monitoring frequency	Calibration frequency of weigh bridge: The machine should be calibrated fully at least once a year, unless sufficient evidence has been obtained to show that the machine has remained well within acceptance limits and that the interval can be extended.
QA/QC procedures	The parameter shall be measured with the weigh bridge and cross checked with the invoices
Purpose of data	Calculation of baseline emissions
Additional comment	The data will archived for the entire crediting period and 2 years post crediting period.

Data / Parameter	$Q_{\text{biomass},y}$
Unit	Tonnes/yr
Description	Amount of waste gasified, incinerated or RDF/stabilized biomass combusted in year y
Source of data	Project Appraisal Report
Value(s) applied	57000
Measurement methods and procedures	All produced stabilized biomass will be trucked off from site. All trucks leaving the site will be weighted. Possible temporary storage of stabilized biomass will be weighed as well or not taken into account for calculated carbon credits
Monitoring frequency	Annually
QA/QC procedures	Procedure will be checked by DoE
Purpose of data	Calculation of Baseline Emissions
Additional comment	-

Data / Parameter	$NO_{\text{vehicles},i,y}$
Unit	-
Description	Vehicles per carrying capacity per year
Source of data	Counting
Value(s) applied	1900
Measurement methods and procedures	The number of trucks per carrying capacity annually shall be accumulated. The average carrying capacity of the trailers (Trucks or other heavy vehicle) carrying saw dust is 25-30 tons as per the Transportation Company records.
Monitoring frequency	Annually
QA/QC procedures	Procedure will be checked regularly be DoE
Purpose of data	Calculation of Leakage emissions
Additional comment	The data will archived for the entire crediting period and 2 years post crediting period.



Data / Parameter	$DT_{i,y}$
Unit	Km
Description	Average additional distance travelled by vehicle type i compared to the baseline in year y
Source of data	Expert estimate
Value(s) applied	263.60
Measurement methods and procedures	Based on the average distance covered to and fro from supply of raw materials to the plant site & delivery of bio-coal from site to the client end. The distance is arrived based on the location specified in the contracts & specified by the customers.
Monitoring frequency	Annually
QA/QC procedures	Assumption to be approved by DoE
Purpose of data	Calculation of Leakage emissions
Additional comment	The data will archived for the entire crediting period and 2 years post crediting period.

Data / Parameter	$VF_{cons,i}$
Unit	L/km
Description	Vehicle fuel consumption in litres per kilometre for vehicle type i
Source of data	Fuel consumption record
Value(s) applied	0.2
Measurement methods and procedures	As per the standard records obtained from the Transportation Company, the average vehicle fuel consumption of trucks carrying the raw material to site measured is recorded on annual basis. The value is cross checked from <i>Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories</i> ; Assumed Fuel economy for Heavy Duty Vehicles http://www.ipcc-nggip.iges.or.jp/public/gp/bgp/2_3_Road_Transport.pdf
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of Leakage emissions
Additional comment	The data will archived for the entire crediting period and 2 years post crediting period.

Data / Parameter	D_{fuel}
Unit	kg/L
Description	Density of fuel
Source of data	1. Project specific data, country specific data or IPCC default values
Value(s) applied	0.88
Measurement methods and procedures	Based on the specific gravity of liquid fuels http://www.simetric.co.uk/si_liquids.htm
Monitoring frequency	Annually or <i>ex-ante</i>
QA/QC procedures	-
Purpose of data	Calculation of Leakage emissions
Additional comment	Not necessary if NCV_{fuel} is demonstrated on a per liter basis

Data / Parameter	EF _{N₂O}
Unit	KgN ₂ O/tonne waste (dry)
Description	Aggregate N ₂ O emission factor for waste incineration
Source of data	Chapter 5: Incineration and Open Burning of Waste; 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.0121
Measurement methods and procedures	TABLE 5.5: N ₂ O EMISSION FACTORS FOR INCINERATION OF SLUDGE AND INDUSTRIAL WASTE; http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_5_Ch5_IOB.pdf
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of Project Emission
Additional comment	-

Data / Parameter	EF _{CH₄}
Unit	KgCH ₄ /tonne waste (dry)
Description	Aggregate CH ₄ emission factor for waste incineration
Source of data	Chapter 5: Incineration and Open Burning of Waste; 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.0002
Measurement methods and procedures	TABLE 5.3: CH ₄ EMISSION FACTORS FOR INCINERATION OF MSW; http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_5_Ch5_IOB.pdf
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data / Parameter	R _t
Unit	tonnes/yr
Description	Total weight of RDF/stabilized biomass produced (t/yr)
Source of data	Project participants
Value(s) applied	57000
Measurement methods and procedures	Weighbridge The frequency of calibration will depend on the type of machine and its use. The machine should be calibrated fully at least once a year, unless sufficient evidence has been obtained to show that the machine has remained well within acceptance limits and that the interval can be extended.
Monitoring frequency	Annually
QA/QC procedures	Weighbridge will be subject to periodic calibration (in accordance with stipulation of the weighbridge supplier)
Purpose of data	Calculation of baseline emissions
Additional comment	-



Data / Parameter	Q_y
Unit	TJ
Description	Net quantity of thermal energy supplied by the project activity in year y
Source of data	Steam meter
Value(s) applied	986855
Measurement methods and procedures	Heat generation is determined as the difference of the enthalpy of the steam or hot fluid and/or gases generated by the heat generation equipment and the sum of the enthalpies of the feed-fluid and/or gases blow-down and if applicable any condensate returns. The respective enthalpies should be determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure.
Monitoring frequency	Quantity of Steam/Quantity of Hot Air - Continuous monitoring, integrated hourly and at least monthly recordings Pressure and Temperatures are set and are monitored on a daily basis.
QA/QC procedures	Calibration Frequency of steam meter, pressure meter and temperature meter is once in 3 years as per the General Guidelines to SSC CDM methodologies Version 17
Purpose of data	Calculation of baseline emissions
Additional comment	The dedicated quantity of thermal energy generated for heat supply or cogeneration by the project activity if included

Data / Parameter	Degradability Analysis
Unit	-
Description	Project proponent shall provide degradability analysis on an annual basis to demonstrate that the methane generation in the life-cycle of the SB is negligible.
Source of data	Project site
Value(s) applied	
Measurement methods and procedures	Measurement of absorption capacity for moisture of SB according to appropriate standards
Monitoring frequency	Annually
QA/QC procedures	
Purpose of data	Calculation of baseline emissions
Additional comment	If the PPs produce different types of SB, they should provide this analysis for each SB type separately

Data / Parameter	Amount of RDF/stabilized biomass used outside the project boundary
Unit	Tons
Description	Project proponent shall monitor the amount of RDF/stabilized biomass sold for use outside of the project boundary
Source of data	Project site
Value(s) applied	
Measurement methods and procedures	Sale invoices of the stabilized biomass at the project site. A list of customers and delivered SD amount should be kept at the project site.
Monitoring frequency	Weekly
QA/QC procedures	-
Purpose of data	-
Additional comment	-

B.7.2. Sampling plan

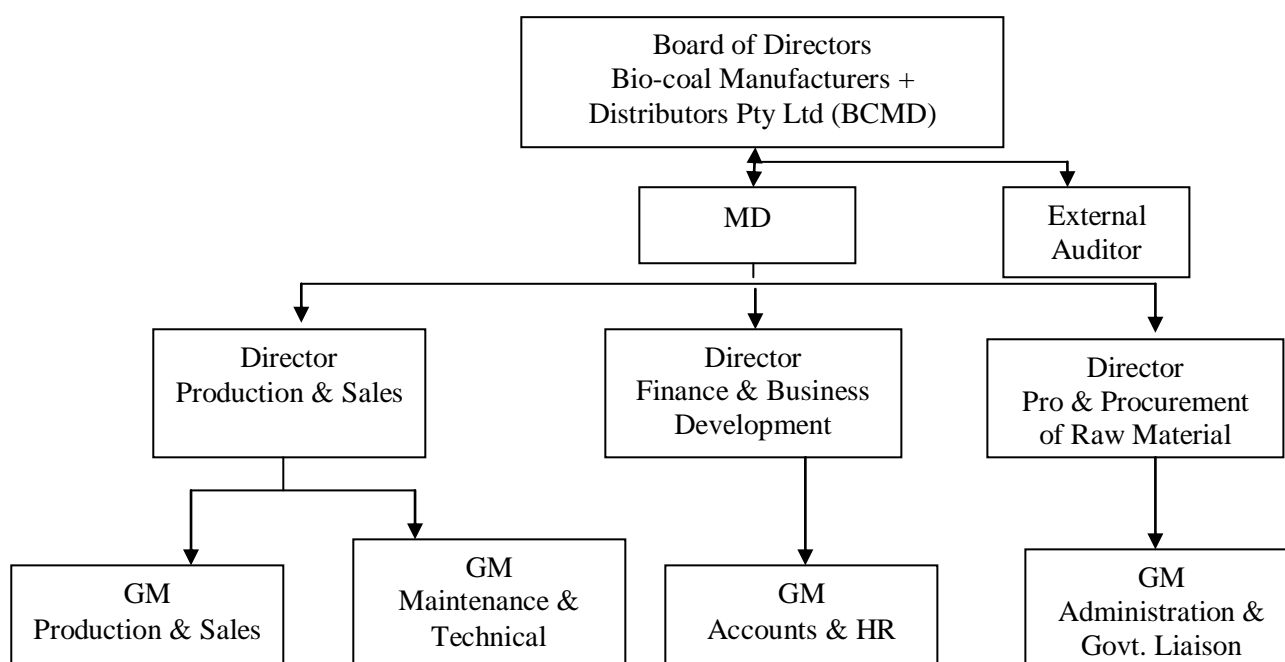
No Sampling plan is applicable

B.7.3. Other elements of monitoring plan

Programme monitoring will be conducted by the DBSA project team to assess implementation of the project in terms of the objectives set out during the planning stages. The major indicators that will be assessed by the project team are:

- Review of involvement of local communities as raw material suppliers for the Bio-Coal production facility and socio-economic benefits resulting from such involvement.
- Review of local community potential logistical constraints in the supply of the raw materials to the production facility.
- Review contracts with raw material suppliers to ensure that there will be sufficient supplies for the plant and provision for reserve stockpiles.

The detail flowchart of the strategic/control structure include



Prior to the start of the crediting period, the organization of the monitoring team will be established. Clear roles and responsibilities will be assigned to all staff involved in the CDM project.

The Managing Director will coordinate and endorse the overall responsibility for all CDM monitoring of the project, including:

- Develop, plan, approve, execute, and improve the CDM Monitoring/Reporting Procedures with the help of external auditor;
- Ensure that instrumentations and devices are available and properly suited to efficiently perform the monitoring;
- Communicate and coordinate the monitoring work of all business units;
- Validate and electronically archive all monitoring data on a monthly basis throughout the crediting period (and conserve it at least for 2 further years);

The **Production/Engineering Department** General Manager will undertake the technical actions required by the monitoring plan, under the Plant Manager's authority, to collect and record related data.

The **Finance/Business Development Department** will crosscheck, reconcile or consolidate data with multiple sources whenever possible.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

25/01/2012-Date of Board Decision for the Project

C.1.2. Expected operational lifetime of project activity

10 Years 00 Months

C.2. Crediting period of project activity

C.2.1. Type of crediting period

Fixed Crediting Period

C.2.2. Start date of crediting period

01/12/2012 or date of registration (whichever is earlier)

C.2.3. Length of crediting period

10 Years 00 Months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

The project activity has positive environmental impacts. According to Province of the Eastern Cape, Economic Development & Environmental Affairs, the project activity is not subject to an Environmental Impact Assessment (EIA) process.. No other clearances are required related to the proposed project activity. A substantial stakeholder consultation was conducted in order to take into account any concerns around the project activity.

D.2. Environmental impact assessment

The project has positive environmental impacts. The project is a potential GHG abatement project. The waste that was left to decompose is used to make bio coal and, hence, the methane emissions are avoided. The waste also posed a fire risk, which is reduced as a result of the project activity. The proposed project has received no objection certificate from Economic Development & Environmental Affairs, Province of Eastern Cape.

Bio Coal Production Facility will be established on an approved demarcated industrial site. The bio coal is much cleaner to burn than coal. The bio coal releases less sulphur dioxide and generates less ash than coal when combusted.

This project activity will also result in positive environmental impacts through:

- Reduced mining activity
- Reduced ash disposal transport
- Avoidance of sulphur leaching from coal stockpiles
- Avoidance of SO₂ emissions in the combustion of coal to generate steam

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

The project proponent has identified the people, groups and organizations that are interested or have got involved with the project implementation as stakeholder. The project proponent has sent a communication to all the identified stakeholders about the project activity. They sent a written notification to all the stakeholders requesting them to present their views regarding the project activity.

Moreover, a stakeholder meeting was also held where all the stakeholders attended the meeting from various communities, including the municipality, local business, saw mill owners, local NGO's, black-wattle harvesters, government departments, local funding organizations and prospective entrepreneurs.

The initial stakeholder meeting consisted of a public meeting where a presentation was given on the Bio Coal Project. After the presentation all participants were encouraged to ask questions and raise any concerns that they might have.

Below is the table for details on the process followed by BCMDL for conducting stakeholders' consultation:

Stakeholder	Mode and details of Invitation
Municipality	Written and meeting. A letter was sent to the Municipality for any clarifications on the project and their comments. The letter specified that the technology shall result in reduction of methane, CO ₂ and other green house gases. Also the project will create local employment during construction and operational stages.
Equipment Supplier	Written and Meeting. An invitation was sent to the equipments supplier for a discussion on the project.
Employees of BCMDL	Written. The invitation for comments from the employees was put up as notice. The details of the project were included in the notice and they were invited for any discussion on the project.
Saw mill owners	Written and Meeting. An invitation was sent to the equipments supplier for a discussion on the project.

**E.2. Summary of comments received**

>>

The feedbacks from different stakeholders of the project activity are positive and encouraging. A summary of the same is given below:

SI No.	Name of Stakeholders	Mode of Communication	Feedback
1	Municipality	Written communication	The municipality has appreciated in writing the project's potential to promote employment opportunities, along with its core objective of clean power generation.
2	Equipment Supplier	Written and Oral Communication	The equipment suppliers have acknowledged through letter and also orally in the meeting that the project activity will result in reduction of consumption of coal and will thereby also reduce GHG emission and help in abatement of global warming.
3	Employees of BCMDL	Written communication	Employees of BCMDL have appreciated the effort of their Company toward the project activity.
4	Saw Mill Owners	Written and Oral	Saw Mill owners have appreciated the effort of their Company toward the project activity.

E.3. Report on consideration of comments received

BCMDL has received positive comments from the local stakeholders on the project activity. All the necessary clearance, permission and agreement have been obtained for the project activity. As per UNFCCC requirement this Project Design Document (PDD) will be published at the validator's web site for international stakeholder consultation.

SECTION F. Approval and authorization

The letter(s) of approval from Party for carrying out the project activity will be available after the Draft Validation Report is submitted by the DoE to the DNA of South Africa.

**Appendix 1: Contact information of project participants**

Organization name	Bio-Coal Manufacturers and Distributors (Pty) Ltd
Street/P.O. Box	15 Breezy Ridge , P.O. Box 281
Building	-
City	Kidds Beach
State/Region	Eastern Cape
Postcode	5264
Country	South Africa
Telephone	+27 43 781 1987
Fax	+27 85 1503539
E-mail	agro_technologies@yahoo.co.in
Website	-
Contact person	-
Title	-
Salutation	Mr.
Last name	Sarda
Middle name	-
First name	Avinash
Department	-
Mobile	+27 794752345
Direct fax	-
Direct tel.	+27 43 781 1987
Personal e-mail	-

Appendix 2: Affirmation regarding public funding

No public funding is involved in the project activity.

Appendix 3: Applicability of selected methodology

Referring to Section B.2 of PDD, the Applicability criterion has been arrived with the aid of the following documentations and references:

- (a) Quotation to Bio-Coal Manufacturers and Distributors (Pty) Ltd. South Africa by Agro-Technologies & Ventures Private Limited dated 24th October, 2011
- (b) Final Appraisal report for the Bio-coal project

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

The grid emission factor (GEF) for the South African grid, is calculated utilizing version 2.2.1, EB-63 Annex19 of the “Tool to calculate the emission factor for an electrical system”.

The national grid of RSA (Eskom electricity network) is calculated as per ESCOM’s data available which is provided in section B.6.1 of PDD.

The diagrammatic representation of national grid of RSA (Eskom electricity network)



Source: <http://www.escom.co.za/content/2008EscomPoster.jpg>

Eskom CDM Grid information for application within the CDM:

Source: <http://www.eskom.co.za/c/article/236/cdm-calculations/>



#	Plant names	Installed Capacity (MW)	Commissioning date	Fuel Type	UoM	Fuel Consumption 2008	Fuel Consumption 2009	Fuel Consumption 2010	Fuel Consumption 2011	Fuel Consumption 2012	Electricity generation 2008 (MWh)	Electricity generation 2009 (MWh)	Electricity generation 2010 (MWh)	Electricity generation 2011 (MWh)	Electricity generation 2012 (MWh)
1	Arnot	1980	21/09/1971	Coal	Tonnes/Year	6,210,700	6,395,805	6,794,134	6,525,670	7,035,460	11,905,060	11,987,281	13,227,864	12,194,878	12,229,098
2	Ankelig	1327	01/10/2007	Gas	Liters diesel/year			7,459,437	41,305,580	121,853,656			23,367	130,241	391,049
3	Gourikwa	740	01/10/2007	Gas	Liters diesel/year			6,884,155	19,144,089	96,165,992			22,612	62,233	314,651
4	Duvha	3450	18/01/1980	Coal	Tonnes/Year	12,425,531	11,393,553	11,744,606	10,639,393	9,154,172	23,622,732	21,769,489	22,581,228	20,267,508	17,556,459
5	Hendrina	1895	12/05/1970	Coal	Tonnes/Year	7,794,220	7,122,918	6,905,917	7,139,198	6,849,996	13,756,351	12,296,687	12,143,292	11,938,206	11,412,357
6	Kendal	3840	01/10/1988	Coal	Tonnes/Year	15,986,131	15,356,595	13,866,514	15,174,501	15,938,407	26,517,420	23,841,401	23,307,031	25,648,258	27,309,297
7	Kriel	2850	06/05/1976	Coal	Tonnes/Year	9,059,934	9,420,764	8,504,715	9,527,185	8,360,504	17,762,398	18,156,686	15,906,816	18,204,910	15,289,169
8	Lethabo	3558	22/12/1985	Coal	Tonnes/Year	18,314,572	16,715,323	18,170,227	17,774,699	17,293,334	25,701,723	23,580,232	25,522,698	25,500,366	24,274,937
9	Matimba	3690	04/12/1987	Coal	Tonnes/Year	14,862,323	13,991,453	14,637,481	14,596,842	14,953,397	29,021,742	26,256,068	27,964,141	28,163,040	27,899,475
10	Majuba	3843	01/04/1996	Coal	Tonnes/Year	12,853,342	12,554,406	12,281,833	13,020,512	13,529,252	23,680,971	22,676,924	22,340,081	24,632,585	25,325,348
11	Matla	3450	29/09/1979	Coal	Tonnes/Year	13,795,309	12,689,387	12,438,391	12,155,421	11,367,521	24,549,833	21,863,400	21,954,536	21,504,422	20,650,022
12	Tutuka	3510	01/06/1985	Coal	Tonnes/Year	10,627,575	11,231,583	10,602,839	10,191,709	11,368,184	20,980,242	21,504,122	19,847,894	19,067,501	20,504,886
13	Koeborg	1800	21/07/1984	Nuclear	N/A										
14	Acacia	171	13/05/1976	Gas	Liters Kerosene/Year			1,132,973	444,957	462,819			2,187	992	1,163
15	Port Rex	171	30/09/1976	Gas	Liters Kerosene/Year			375,078	281,941	828,014			889	5,507	2,162
16	Colley Wobbles	42	01/01/1985	Hydro	N/A										
17	First Falls	6	01/02/1979	Hydro	N/A										
18	Gariep	360	08/09/1971	Hydro	N/A										
19	Ncora	2	01/03/1983	Hydro	N/A										
20	Second Falls	11	01/04/1979	Hydro	N/A										
21	Van Der Kloof	240	01/01/1977	Hydro Pump	N/A										
22	Drakensburg	1000	17/06/1981	Storage Pump	N/A										
23	Palmiet	400	18/04/1988	Storage Pump	N/A										
24	Camden	1600	21/12/1966	Coal	Tonnes/Year	3,218,873	3,876,211	4,732,163	4,629,763	4,329,462	5,171,057	6,509,079	7,472,070	7,490,836	7,267,648
25	Grootvlei	1200	30/06/1969	Coal	Tonnes/Year	130,748	674,538	1,637,371	2,132,979	3,821,963	237,138	1,249,556	2,656,230	3,546,952	6,094,910
26	Komati	1000	06/11/1961	Coal	Tonnes/Year	-		664,497	1,271,010	1,390,186	-	-	1,016,023	2,060,141	2,398,132



Appendix 5: Further background information on monitoring plan

No further information is mentioned

Appendix 6: Summary of post registration changes

No changes will be incurred yet for the project activity.

History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03	EB 25, Annex 15 26 July 2006	
02	EB 14, Annex 06b 14 June 2004	
01	EB 05, Paragraph 12 03 August 2002	Initial adoption.
Decision Class: Regulatory Document Type: Form Business Function: Registration		