PROGRAMME DESIGN DOCUMENT FORM FOR SMALL-SCALE CDM PROGRAMMES OF ACTIVITIES (F-CDM-SSC-PoA-DD) Version 02.0

PROGRAMME OF ACTIVITIES DESIGN DOCUMENT (PoA-DD)

PART I. Programme of activities (PoA)

SECTION A. General description of PoA
A.1. Title of the PoA

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Biomass Energy Generation through Gasification or Direct Combustion in South Africa.

Version 4
Date: 20/09/2012

A.2. Purpose and general description of the PoA

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Policy/measure or stated goal of the PoA

This PoA will involve renewable energy projects in South Africa where energy is derived from renewable biomass through gasification or direct combustion, thereby mitigating GHG emissions by displacing energy generated primarily from coal

The further goal of this PoA is to ensure that all potential renewable energy projects from renewable biomass will be able to quality under the CDM process of the Kyoto Protocol in order to make these projects economically viable.

The project will contribute to sustainable development in South Africa by promoting the development of renewable energy in the country. The project generates both local and global environmental benefits and also contributes to socio-economic development, as summarized below:.

Social benefits:

- Creating job opportunities.
  - This project activity will increase local employment for skilled labour during production, installation, operation and maintenance of equipment and systems.
  - It will also increase jobs for un-skilled labour as it is required for the harvesting and transportation of biomass to the renewable energy plant
- Local people will be empowered with skills pertaining to the project activity.

Economic benefits:

- The programme will provide business opportunities for biomass suppliers, local labour contractors and equipment suppliers which will help increase the income of the people who are directly or indirectly connected with the programme.
- The programme provides the potential for new sources of revenue from renewable energy, raising the economic benefits for the agricultural industry.
- The project provides the potential for new sources of revenue from renewable energy, raises the economic benefits for the agricultural industry, and promotes utilization of agricultural waste, hence building a sustainable and circular economy.

Environment benefits:

- Renewable energy from renewable biomass reduces greenhouse gas emissions (GHG) emissions.

- Where energy is generated from waste, the advanced waste management system employed will reduce the air and water emissions thereby , leading to better environmental conditions and quality of life for the local community.

Technological benefits:

- Improve technological transfer. The PoA aims to:
  - Share technology, knowledge and expertise with local communities.
  - Promote research on gasification/direct combustion as well as the collection and pre-treatment of the feedstock.
  - Provide technological support, thus ensuring safe conditions to adopt and operate the equipment, processes and systems required to implemt these renewable energy projects. .

Income-generating capacity benefits

- One of the more important benefits of the Program is that the Coordinating/managing entity CME would obtain funds (where necessary) from the banks for development of projects, thus enabling small and medium rural biomass producers to participate in the program.
- In addition, the CME will be in charge of marketing the Certified Emission Reductions (CERs) created from the project and thus ensure that this process is managed optimally.

Framework for the implementation of the proposed PoA

The programme of activities (PoA), Biomass Energy Generation through Gasification or Direct Combustion in South Africa, will be coordinated and managed by Farmsecure Carbon (Pty) Ltd.

The Farmsecure Group is an innovative service provider to the agricultural sector whose primary focus is to empower farmers with precision farming skills, agricultural knowledge, cost effective supply chain management and hands on support to assist them in achieving their maximum potential whilst creating above average Stakeholder wealth. The Farmsecure Group vision is to be a meaningful contributor to securing the world's food supply through the creation of sustainable and profitable farming enterprises whose produce is managed from the farm to the store shelf.

This focus inspired the Farmsecure Group to establish a subsidiary company, Farmsecure Carbon (Pty) Ltd (henceforth referred to as Farmsecure Carbon), with the mission to promote renewable energy projects and mitigate GHG emissions. This enables the Farmsecure Group to fulfil its wider purpose of promoting sustainable agriculture and to contribute to local development in the communities in which it operates.

Farmsecure Carbon is serving as CME of the PoA. Farmsecure Carbon will have overall responsibility for the PoA and the subsequent inclusion and monitoring of SSC-CPAs.

There are no mandatory policies or regulations in South Africa mandating the adoption of renewable energy and methane recovery measures. All of the key players consisting of the CME, the CPA implementer and the CPA participant, are voluntarily participants in the PoA. The CME signed a confirmation that the PoA is a voluntary action by the CME, see confirmation letter (Ref.PoA.Confirmation).

A.3. CMEs and participants of PoA

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The Coordinating/managing entity for this PoA will be Farmsecure Carbon (Pty) Ltd. The CME will the the entity which communicates with the Board. Farmsecure Carbon (Pty) Ltd will also be the project participant to the PoA.

A.4. Party(ies)

Name of Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
South Africa	Farmsecure Carbon (Pty) Ltd	No

A.5. Physical/ Geographical boundary of the PoA
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The boundary of the PoA is the Rebublic of South Africa.

A.6. Technologies/measures
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Technology eligibility criteria:

Renewable energy from renewable biomass through gasification or direct combustion is the principle technology to be applied in each CPA. The maximum output capacity for these renewable energy project activities is limited to 15MW. The process description is outlined below.

The CPA implementer shall demonstrate that the performance of the equipment used in the proposed CPA comply with the technology eligibility criteria (a) to (c) below, in that order of preference. In the event that the CPA implementer can not demonstrate compliance with this technology criteria, the proposed project activity is not eligible under the PoA.

Technology eligibility criteria for PoA

a)	The national standard for the performance of the equipment type (project participants shall identify the standard used)
b)	An international standard for the performance of the equipment type, such as International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) standards (CPA implementer shall identify the standard used) if the value specified in subparagraph (a) is not available;
c)	The manufacturer's specifications, provided that they are tested and certified by national or international certifiers, if the value specified in subparagraph (b) is not available;

CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.

<u>Gasification process description;</u>

Gasification is the process where carbonaceous materials are converted to combustible gases consisting of Carbon monoxide (CO), Hydrogen (H_2) and traces of Methane (CH_4). The raw material is reacted at high temperatures with a controlled amount of oxygen and/or steam. The amount of oxygen used is generally between 20% and 70% of the stoichiometric required amount for complete combustion of the carbonaceous material (Hutchison, 2006) [1]. Pure oxygen or air may be used.

The resulting gas mixture is known as producer gas. The producer gas can be burned in an internal combustion engine or be used in highly efficient integrated combined gasification cycle processes for energy production.

[1] Hutchison, F.H. (2006) "Facts about gasification", *http://www.cleanenergy.us/facts* [2007, December 15].

Gasification relies on chemical processes at elevated temperatures > 700ºC. Four distinct processes take place in a gasifier as the fuel makes its way to gasification.
They are:

- Drying of fuel
- Pyrolysis – a process in which tar and other volatiles are driven off
- Combustion
- Reduction

Though the processes overlap and cannot be separated completely, each can be assumed to occupy a separate zone where fundamentally different chemical and thermal reactions take place (Rajvanshi, 1986).[2]

Drying Zone
Drying of the feedstock involves evaporation of water. The moisture content of the biomass is directly proportional to the efficiency of the gasifier; the drier the feedstock the more beneficial it is to the process as less energy is consumed for the removal of condensates. Typical gasifier feedstock has moisture content between 10% and 20% and the formation of condensates is 6-10% of the feed on a mass basis. Some organic acids are also formed during the drying process which is mainly responsible for the corrosion of gasifiers (Rajvanshi, 1986)

Pyrolysis Zone
Pyrolysis is the thermochemical decomposition of organic material at elevated temperatures in the absence of oxygen. It is an endothermic process and a special case of thermolysis (thermal decomposition) that yields gas and liquid products and a solid residue rich in carbon content. It differs from other high-temperature processes like combustion and hydrolysis in that it does not involve reactions with oxygen, water, or any other reagents (Lehmann, 2008)[3].

Pyrolysis which occurs primarily between 280ºC and 500ºC, produces large quantities of tar and CO_2. Between 500ºC and 700ºC the gas production is small and contains hydrogen.

Combustion Zone
Combustion is a sequence of exothermic chemical reactions between a fuel and oxidant accompanied by the production of heat and conversion of chemical compounds. . In this zone a calculated quantity of air drawn through the nozzles provided for the purpose. The hydrocarbon chains are converted to water/steam, carbon dioxide (CO_2) and carbon monoxide (CO). Complete combustion is not physically realisable and hence the formation of minor species such as CO and pure carbon (soot or ash). The combustion reaction yields a theoretical oxidation temperature of 1450ºC.

Reduction Zone
The products of partial combustion pass through a hot charcoal bed. This charcoal is initially supplied from external sources. Later it is in the continuous process of being consumed by the reduction reaction and being simultaneously replenished by the char produced in the pyrolysis zone

Typical reduction zone temperatures are 800ºC – 1000ºC. The hearth (combustion/reduction zone) should therefore be designed around the temperature at which the tar compounds in the feedstock are cracked/broken down into simpler molecules to produce a low tar producer gas suitable for use in an internal combustion engine.

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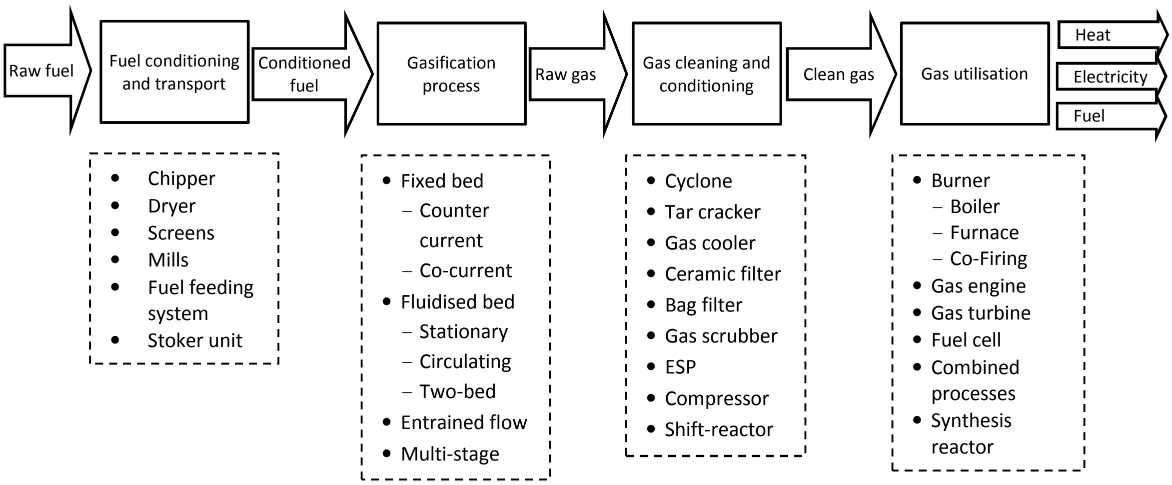
[2] Rajvanshi, A.K. (1986) “Biomass Gasification”, Nimbkar Agricultural Research Institute, Maharashtra, India.
[3] Lehmann, J. (2008) "Biochar: the new frontier"

Overall Process
The gasification plant shown in the block diagram below consists of several processes/unit operations. These processes are dependent on the application, fuel characteristics and gasification technology. Multi – stage gasification provides the opportunity for integrated combined cycle processes and combined heat and power applications with overall plant efficiencies as high as 85% (Bios-Bioenergy, 2010)[4].



Type of Gasifiers
There are three main type of gasifiers namely:

- Fixed Bed
  - Counter-Current fixed bed ("Up draft")
  - Co-Current fixed bed ("Down draft")
  - Cross Current fixed bed ("Cross draft")
- Fluidized bed
  - Bubbling fluidized bed
  - Circulating fluidized bed
  - Atmospheric fluidized bed
  - Compact Bed Reactor
  - Pressurized Circulating Fluidized Bed Combustor
- Entrained Flow

<u>Direct combustion process description:</u>

A direct combustion system burns the biomass to generate hot flue gas, which is either used directly to provide heat or fed into a boiler to generate steam. In a boiler system, the steam can be used to provide heat for industrial processes or space heating and a steam turbine can be used to generate electricity.

Type of Boiler systems
The two main types of direct combustion boiler systems that utilize biomass are fixed-bed (stoker) and fluidized bed systems. In a fixed bed, the biomass is fed onto a grate where it is combusted with air. The hot flue gas is released into the heat exchanger section of the boiler where water is converted to steam. A fluidized bed system feeds the biomass into a hot bed of suspended, incombustible particles (such as sand), where the biomass combusts to release hot flue gas (Peterson, 2009)[5]. Fluidized bed systems in general, have greater parasitic loads than stokers. The advantages of a fluidized bed system are:

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[4] Bios-Bioenergy Systems (2010), "Gasification processes", http://www.bios-bioenergy.at [2010 September 7].
[5] Peterson, D. and Haase, S. (2009) "Market Assessment of Biomass Gasification and Combustion Technology for small- and medium scale applications", National Renewable Energy Laboratory.

- Complete combustion of the feedstock, which reduces atmospheric emissions and
- Improves the process efficiency.
- Utilize a wider range of feedstock.

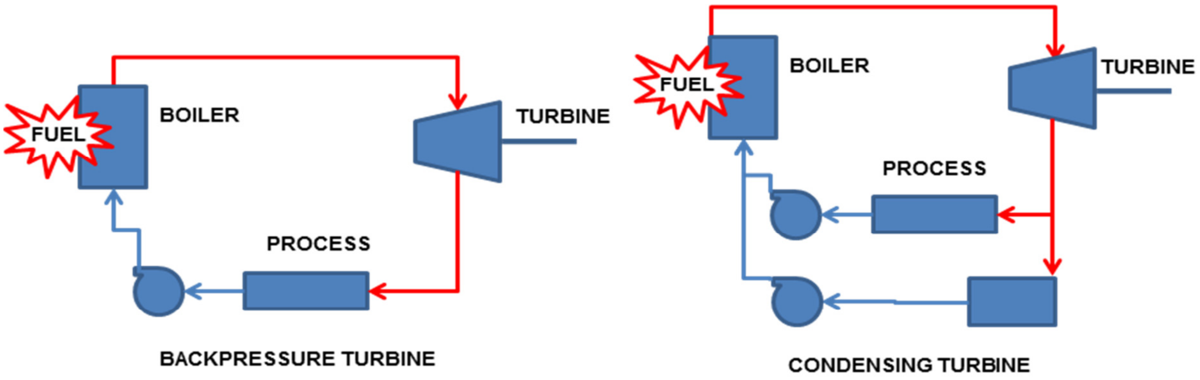
The efficiency of a direct combustion biomass system is influenced by a number of factors including:

- Moisture content of the feed
- Combustion air distribution and quantity
- Operating temperature and pressure
- Furnace retention time

Direct combustion of biomass that are implemented exclusively for power generation through a steam turbine have typical conversion efficiencies of 15% - 35%. A CHP system depending on the vendor can have an overall efficiency of as much as 85%.

Two different boiler/turbine configurations can be used for direct combustion:

- Condensing turbine
- Back pressure turbine



Back pressure steam turbines are used in combination with industrial processes where there is a need for low to medium pressure steam. Condensing turbines are used primarily for electricity generation (as full condensing turbines) and not for CHP applications. All/Some of the outlet steam exiting the turbine is condensed to a liquid and used again in a closed loop known as a Rankine Cycle.

A.7. Public funding of PoA

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There no public funding involved at PoA level.

SECTION B. Demonstration of additionality and development of eligibility criteria

B.1. Demonstration of additionality for PoA

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There are no regulations in South Africa that require the implementation of renewable energy projects. All the key players, including the CME, the CPA implementers and the CPA participants, are voluntarily participants in the PoA.

Renewable energy generation from renewable biomass could not be successfully implemented in the past mainly due to high investment cost and limited access to financing. Without the Clean Development Mechanism to provide additional financial incentives from the sale of CERs the potential participants would not be interested in pursuing such projects. The Clean Development Mechanism is however an expensive and time consuming process. The PoA aims to simplify and speed up the CDM process and also lower the cost.

Additionality will be assessed at CPA level, see the additionality criteria in Part II, Section B.5.

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

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The CME has developed the following eligibility criteria according to the "Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities" (Version 01.0).

Eligibility criteria	
a)	The proposed CPA must be located in the geographical boundary of South Africa.
b)	The CME must implement precaution measures to avoid double counting of emission reductions.
c)	The proposed CPA must comply with performance specifications including compliance with certification.
d)	The starting date of the project activity must not be before the date of commencement of validation of the PoA.
e)	The proposed CPA must implement one of the eligible methodologies or methodology combinations for the PoA. Also, the proposed CPA must comply with the applicability conditions of the applicable methodology.
f)	The CPA must demonstrate additionality as per eligibility criteria.
g)	The CPA must comply with PoA conditions related to undertaking local stakeholder consultations and environmental impact analysis.
h)	The CPA must confirm that no Official Development Aid will be involved or diverted.
i)	The PoA has no specific target group or distribution mechanism, therefore there is no eligibility criteria for target groups or distribution mechanisms
j)	All relevant parameters will be monitored for each CPA, therefore there is no eligibility criteria for sampling.
k)	CPA in aggregate must meet the small-scale or micro-scale threshold criteria
l)	The proposed CPA must pass the de-bundling check.

B.3. Application of methodologies

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Biomass-based renewable energy generation through gasification or direct combustion is the principal technology/measure to be applied for each CPA. CPAs may apply this renewable energy differently and therefore displace fossil fuels using different technology/measures. The following table shows the eligible measures/technologies and methodologies under this PoA.

Description of applicable technologies/measures and methodologies chosen for this PoA

Technologies/measures	Methodology
Biomass based renewable energy generation units (gasifiers or boilers): (a) Supplying electricity to a national or a regional grid; or (b) Supplying electricity to an identified consumer facility via the national/regional grid through a contractual arrangement such as wheeling	AMS-I.D
Biomass based renewable energy generation units (gasifiers or boilers) that supply electricity to user(s). The users would have been supplied electricity form a national grid.	AMS-I.F
Biomass based renewable energy generation units (gasifiers or boilers) that provide thermal energy that displaces fossil fuel. Biomass-based cogeneration systems are included.	AMS-I.C

Multiple methodology justification for the PoA

According to the “Standard for application of multiple CDM methodologies for a programme of activities”, the following situation is eligible: *A principle technology/measure is applied consistently in each CPA using multiple combinations of methodologies. For example, biomass/biogas projects with different fuel displacement (AMS-I.C and AMS-I.I for fossil fuel, AMS-I.E for non-renewable biomass, or both).*

Under this PoA, renewable energy from biomass is the principal technology/measure applied consistently in each CPA using methodology AMS-I.D, AMS-I.F or AMS-I.C for fossil fuel displacements.

The eligible methodologies and methodology combinations for this PoA are indicated below:

Methodologies		
AMS-I.D	AMS-I.F	AMS-I.C
✓		
	✓	
		✓
✓	✓	

SECTION C. Management system

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The CME has developed an CME Quality manual according to the “Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities” (Version 01.0) that includes the following.

a) A clear definition of roles and responsibilities of personnel involved in the process of inclusion of CPAs, including a review of their competencies
b) Records of arrangements for training and capacity development for personnel
c) Procedures for technical review of inclusion of CPAs
d) A procedure to avoid double counting
e) Records and documentation control process for each CPA under the PoA
f) Measures for continuous improvements of the PoA management system;

Please see the “CME Quality manual” document and Annexes.

SECTION D. Duration of PoA

D.1. Start date of PoA

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The start date of the PoA is the registration date, 29/12/2012. The date on which the PoA-DD was first published for global stakeholder consultation was 29/12/2011. The CME trust that the PoA will be registered within one year of global stakeholder publication.

D.2. Length of the PoA

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As per the “Procedures for registration of a programme of activities as a single CDM project activity and issuance of certified emission reductions for a programme of activities (EB 55 Report Annex 38), the length of the PoA shall not exceed 28 years. Therefore, the length of the PoA is 28 years.

SECTION E. Environmental impacts
E.1. Level at which environmental analysis is undertaken
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There is no technical or administrative advantage of doing an environmental analysis at the PoA level as the impacts are confined to each project activity site and managed at that level.

E.2. Analysis of the environmental impacts
>>
Not applicable

SECTION F. Local stakeholder comments
F.1. Solicitation of comments from local stakeholders
>>
Local consultation is done at SSC-CPA level for each SSC-CPA to ensure full participation and consultation of local stakeholders.

F.2. Summary of comments received
>>
Not applicable

F.3. Report on consideration of comments received
>>
Not applicable

SECTION G. Approval and authorization
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In the Republic of South Africa the DNA only issues a letter of approval after submission of a draft validation report by the DOE. The CME authorization of its coordination of the PoA will be included in the letter of approval.

PART II. Generic component project activity (CPA)

SECTION A. General description of a generic CPA
A.1. Purpose and general description of generic CPAs
>>
Biomass-based renewable energy generation through gasification or direct combustion is the principal technology/measure to be applied in each CPA. CPAs may apply this renewable energy differently and therefore displace fossil fuels using different technology/measures.

The following tables show the eligible measures/technologies and methodologies and specific project activity (e.g. new plant, addition, retrofit) under this PoA.

Description of applicable technologies/measures and methodologies chosen for this PoA

Project scenarios	Applicable technologies/measures	Applicable Methodology
A.	Biomass based project activities that install new power plants that supply renewable electricity to the grid.	AMS-I.D
B.	Biomass based project activities that involve capacity addition to renewable electricity plants that supply electricity to the grid.	AMS-I.D
C.	Biomass based project activities that install new power plants that produce renewable electricity for captive use that displace electricity from the grid.	AMS-I.F
D.	Biomass based project activities that involve capacity addition to renewable	AMS-I.F

	electricity plants that produce electricity for captive use that displace electricity from the grid.	
E.	Biomass based project activities that install thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities and displaces fossil fuel use.	AMS-I.C
F.	Biomass based project activities that install cogeneration plants that produce renewable electricity for supply to the grid and/or for captive use and/or renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use.	AMS-I.C
G.	Biomass based project activities that involve the addition of renewable thermal energy units at an existing renewable energy production facility.	AMS-I.C
H.	Biomass based project activities that seek to retrofit or modify an existing facility for the purpose of fuel switch from fossil fuels to biomass in heat generation equipment.	AMS-I.C
I.	For household or commercial applications/systems, whose maximum output capacity is less than 45 kW thermal and where it can be demonstrated that the metering of thermal energy output is not plausible.	AMS-I.C

SECTION B. Application of a baseline and monitoring methodology
B.1. Reference of the approved baseline and monitoring methodology(ies) selected
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AMS-I.D. “Grid connected renewable electricity generation” (Version 17).
AMS-I.F. “Renewable electricity generation for captive use and mini-grid” (Version 2).
AMS-I.C. “Thermal energy production with or without electricity” (Version 19).

The following tools are applicable to the PoA, each CPA will apply the relevant tools:
“Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” (Version 2)
“Tool to determine the baseline efficiency of thermal or electric energy generation systems” (Version 1)
“Tool to determine the remaining lifetime of equipment” (Version 1)
“Tool to calculate the emission factor for an electricity system” (Version 02.2.1)
“Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities” (Version 1)

B.2. Application of methodology(ies)
>>
<u>Multiple methodology demonstration:</u>

CPAs shall indicate the applicable methodology or methodology combination in the table below.
Eligibility for the multiple methodologies have been established in Part I, section B.3 of the PoA-DD:

Methodologies			CPA indication
AMS-I.D	AMS-I.F	AMS-I.C	
✓			
	✓		
		✓	
✓	✓		

<u>Type I or micro-scale threshold demonstration:</u>

Demonstration that CPA meets the threshold criteria

Project type	Threshold criteria	PoA demonstration
Type 1	Type 1: Renewable energy project	All CPAs shall demonstrate that every CPA in

	activities with a maximum output capacity of 15 MW (or an appropriate equivalent).	aggregate meets the threshold criteria and remains within those thresholds throughout the crediting period of the CPA.
Microscale Type 1	Type1: Project activities up to 5 MW that employ renewable energy as their primary technology.	

Methodology applicability conditions demonstration:

For a CPA to apply a specific methodology, it should comply with the methodology's applicability conditions. The tables below show the applicability conditions for each methodology eligible under the PoA.

Applicability conditions for methodology AMS-I.D

Applicability conditions	PoA confirmation
2. This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass:. (a) Supplying electricity to a national or a regional grid; or (b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.	All CPAs shall comprise renewable biomass gasification or direct combustion technology. CPAs that apply methodology AMS-I.D will either supply electricity to a national or regional grid or supply electricity to an identified consumer via national grid through a contractual arrangement such as wheeling.
3. This methodology is applicable to project activities that: (a) Install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); (b) Involve a capacity addition; (c) Involve a retrofit of (an) existing plant(s); or (d) Involve a replacement of (an) existing plant(s).	CPAs that apply methodology AMS-I.D will apply project activities that: (a) Install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant) or (b) Involve a capacity addition.
4. Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology:	Hydro power plants are not eligible under the PoA.
5. If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	For CPAs that has both renewable and non-renewable components, the renewable component shall not exceed 15MW. For CPAs that co-fires fossil fuel, the capacity of the entire unit shall not exceed 15 MW.
6. Combined heat and power (co-generation) systems are not eligible under this category.	CPAs that involve co-generation systems will be applicable under methodology AMS-I.C.
7. In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	For CPAs that involve the addition of renewable energy generation units, the added capacity of the units added by the project shall be lower than 15MW and be physically distinct from the existing units.
8. In the case of retrofit or replacement, to	Retrofit or replacement project activities are not

qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.	eligible to use methodology AMS-I.D under this PoA.
9. Project activity under a Programme of Activities must comply with stipulated conditions	All CPAs will comply with stipulated conditions, see PoA applicability table below.

Applicability conditions for methodology AMS-I.F

Applicability conditions	PoA confirmation
1. This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass that supply electricity to user(s). The project activity will displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit i.e. in the absence of the project activity, the users would have been supplied electricity from one or more sources listed below: (a) A national or a regional grid (grid hereafter); (b) Fossil fuel fired captive power plant; (c) A carbon intensive mini-grid.	All CPAs shall comprise renewable biomass gasification or direct combustion technology. CPAs that apply methodology AMS-I.F shall displace electricity from the South African national grid.
2. For the purpose of this methodology, a mini-grid is defined as small-scale power system with a total capacity not exceeding 15 MW (i.e. the sum of installed capacities of all generators connected to the mini-grid is equal to or less than 15 MW) which is not connected to a national or a regional grid.	Mini-grids are not eligible under the PoA
4. Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology:	Hydro power plants are not eligible under this PoA.
5. For biomass power plants, no other biomass other than renewable biomass are to be used in the project plant.	All CPAs will use no other biomass other than renewable biomass and comply with applicable conditions for renewable biomass, see table below.
6. This methodology is applicable for project activities that: (a) Install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); (b) Involve a capacity addition, (c) Involve a retrofit of (an) existing plant(s); or (d) Involve a replacement of (an) existing plant(s).	CPAs that apply methodology AMS-I.F shall apply project activities that: (a) Install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant) or (b) Involve a capacity addition
7. In the case of project activities that involve the capacity addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	For CPAs that involve capacity addition of renewable energy generation units, the added capacity of the units added by the project shall be lower than 15MW.
8. In the case of retrofit or replacement, to qualify as a small-scale project, the total output of	Retrofit or replacement project activities are not eligible to use methodology AMS-I.F under this

the retrofitted or replacement unit shall not exceed the limit of 15 MW.	PoA.
9. If the unit added has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	For CPAs that add both renewable and non-renewable components, the eligibility limit of 15MW will only apply to the renewable component. If the unit added co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.
10. Combined heat and power (co-generation) systems are not eligible under this category.	CPAs that apply co-generation systems will be applicable under methodology AMS-I.C.
11. If electricity and/or steam/heat produced by the project activity is delivered to a third party i.e. another facility or facilities within the project boundary, a contract between the supplier and consumer(s) of the energy will have to be entered that ensures that there is no double counting of emission reductions.	For CPAs where electricity and/or steam/heat produced by the project activity is delivered to a third party i.e. another facility or facilities within the project boundary, a contract between the supplier and consumer(s) of the energy will have to be entered ensures that there is no double counting of emission reductions
12. Project activity under a Programme of Activities must comply with stipulated conditions	All CPAs will comply with stipulated conditions, see PoA applicability table below.

Applicability conditions for methodology AMS-I.C

Applicability conditions	PoA confirmation
1. This methodology comprises renewable energy technologies that supply users with thermal energy that displaces fossil fuel use. These units include technologies such as solar thermal water heaters and dryers, solar cookers, energy derived from renewable biomass and other technologies that provide thermal energy that displaces fossil fuel.	All CPAs shall comprise renewable biomass gasification or direct combustion technology. CPAs that apply methodology AMS-I.C shall generate thermal energy or electricity and thermal energy through cogeneration.
2. Biomass-based cogeneration systems are included in this category. For the purpose of this methodology "cogeneration" shall mean the simultaneous generation of thermal energy and electrical energy in one process.	
3. Emission reductions from a biomass cogeneration system can accrue from one of the following activities: a) Electricity supply to a grid; b) Electricity and/or thermal energy (steam or heat) production for on-site consumption or for consumption by other facilities; c) Combination of (a) and (b).	CPAs that apply methodology AMS-I.C shall involve either: a) Electricity supply to a grid; b) Electricity and/or thermal energy (steam or heat) production for on-site consumption or for consumption by other facilities; c) Combination of (a) and (b).
4. The total installed/rated thermal energy generation capacity of the project equipment is equal to or less than 45 MW thermal (see paragraph 6 for the applicable limits for cogeneration project activities).	For CPAs that involve thermal energy generation, the capacity of the project equipment shall be equal to or less than 45MW thermal.
5. For co-fired systems, the total installed thermal energy generation capacity of the project equipment, when using both fossil and renewable fuel, shall not exceed 45 MW thermal (see	For CPAs that involve a co-firing system, the total installed thermal energy generation capacity of the project equipment, when using both fossil and renewable fuel, shall not exceed 45 MW thermal.

paragraph 6 for the applicable limits for cogeneration project activities).	
6. The following capacity limits apply for biomass cogeneration units:	.
(a) If the project activity includes emission reductions from both the thermal and electrical energy components, the total installed energy generation capacity (thermal and electrical) of the project equipment shall not exceed 45 MW thermal. For the purpose of calculating this capacity limit the conversion factor of 1:3 shall be used for converting electrical energy to thermal energy (i.e. for renewable energy project activities, the maximal limit of 15 MW(e) is equivalent to 45 MW thermal output of the equipment or the plant);	For CPAs where the emission reductions include both the thermal and electrical energy components, the total installed energy generation capacity (thermal and electrical) of the project equipment shall not exceed 45 MW thermal.
(b) If the emission reductions of the cogeneration project activity are solely on account of thermal energy production (i.e. no emission reductions accrue from the electricity component), the total installed thermal energy production capacity of the project equipment of the cogeneration unit shall not exceed 45 MW thermal;	For CPAs where the emission reductions of the cogeneration project activity are solely on account of thermal energy production, the total installed thermal energy production capacity of the project equipment of the cogeneration unit shall not exceed 45 MW thermal.
(c) If the emission reductions of the cogeneration project activity are solely on account of electrical energy production (i.e. no emission reductions accrue from the thermal energy component), the total installed electrical energy generation capacity of the project equipment of the cogeneration unit shall not exceed 15 MW.	For CPAs where the emission reductions of the cogeneration project activity are solely on account of electrical energy production, the total installed electrical energy generation capacity of the project equipment of the cogeneration unit shall not exceed 15 MW.
7. The capacity limits specified in the above paragraphs apply to both new facilities and retrofit projects. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy facility, the total capacity of the units added by the project should comply with capacity limits in paragraphs 4 to 6, and should be physically distinct from the existing units.	The capacity limits specified in the above paragraphs apply to both new facilities and retrofit projects. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy facility, the total capacity of the units added by the project should comply with capacity limits in paragraphs 4 to 6, and should be physically distinct from the existing units.
8. Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category.	CPAs that seek to retrofit or modify an existing facility for renewable thermal energy generation shall apply methodology AMS-I.C.
9. New facilities (Greenfield projects) and project activities involving capacity additions compared to the baseline scenario are only eligible if they comply with the related and relevant requirements in the "General Guidelines to SSC CDM methodologies".	The requirements refer to national and/or sectoral policies and circumstances that shall be taken into account in the establishment of a baseline scenario. The national and/or sectoral policies in South Africa was introduced after 2009 and falls under E-policy and need not be taken into account in establishing a baseline scenario for projects under

	this PoA. See section B.4, Part II of this PoA-DD.
10. If solid biomass fuel (e.g. briquette) is used, it shall be demonstrated that it has been produced using solely renewable biomass and all project or leakage emissions associated with its production shall be taken into account in the emissions reduction calculation.	CPAs that use solid biomass shall demonstrate that it has been produced using slowly renewable biomass. The biomass will comply with applicable conditions for renewable biomass, see table below.
11. Where the project participant is not the producer of the processed solid biomass fuel, the project participant and the producer are bound by a contract that shall enable the project participant to monitor the source of the renewable biomass to account for any emissions associated with solid biomass fuel production. Such a contract shall also ensure that there is no double-counting of emission reductions.	For CPAs that do not produce the processed solid biomass fuel, the producer will be bound by a contract that shall enable the project participant to monitor the source of renewable biomass to account for any emissions associated with solid biomass fuel production.
12. If electricity and/or steam/heat produced by the project activity is delivered to a third party i.e. another facility or facilities within the project boundary, a contract between the supplier and consumer(s) of the energy will have to be entered into that ensures there is no double-counting of emission reductions.	CPAs that deliver electricity and/or steam/heat to a third party, a contract between the supplier and the consumer(s) shall be entered into to ensure there is no double-counting of emission reductions.
13. If the project activity recovers and utilizes biogas for power/heat production and applies this methodology on a stand alone basis i.e. without using a Type III component of a SSC methodology, any incremental emissions occurring due to the implementation of the project activity (e.g. physical leakage of the anaerobic digester, emissions due to inefficiency of the flaring), shall be taken into account either as project or leakage emissions.	Not applicable to the PoA, the PoA does not involve the utilization of biogas for power/heat production.
14. Charcoal based biomass energy generation project activities are eligible to apply the methodology only if the charcoal is produced from renewable biomass sources provided:	CPAs that use charcoal shall demonstrate that it has been produced using solely renewable biomass. The biomass shall comply with applicable conditions for renewable biomass, see table below.
15. Project activity under a Programme of Activities must comply with stipulated conditions	All CPAs shall comply with the stipulated PoA conditions, see PoA applicability table below.

Applicability conditions for biomass project activities under a PoA

Applicability conditions	PoA confirmatio
a) In the specific case of biomass project activities the applicability of the methodology is limited to either project activities that use biomass residues or processed biomass (e.g. briquette) only or biomass from dedicated plantations complying with the applicability conditions of methdology AM0042 or paragraph 5 in methodology AMS-III.AQ, see F-CDM-SSCwg ver 01 SSC_577.	All CPAs that use biomass residues shall comply with the stipulated conditions; see renewable biomass applicable conditions in table below. All CPAs that use biomass from dedicated plantations shall comply with stipulated conditions. First check compliance with renewable biomass applicable conditions and then check compliance with dedicated plantation applicable conditions in tables below. All CPAs that use solid biomass shall demonstrate

	that it complies with all renewable biomass conditions below.
b) In the specific case of biomass project activities the determination of leakage shall be done following the general guidance for leakage in small-scale biomass project activities (attachment C of Appendix B of simplified modalities and procedures for small-scale clean development mechanism project activities; decision 4/CMP.1) or following the procedures included in the leakage section of AM0042	For all CPAs the determination of leakage shall be done following the general guidance for leakage in small-scale biomass project activities (attachment C of Appendix B of simplified modalities and procedures for small-scale clean development mechanism project activities; decision 4/CMP.1) Leakage emissions shall be calculated as in Section D.6.3 of the CPA-DD.
c) In case the project activity involves the replacement of equipment, and the leakage from the use of the replaced equipment in another activity is neglected, because the replaced equipment is scrapped, an independent monitoring of scrapping of replaced equipment needs to be implemented. The monitoring should include a check if the number of project activity equipment distributed by the project and the number of scrapped equipment correspond with each other. For this purpose scrapped equipment should be stored until such correspondence has been checked. The scrapping of replaced equipment should be documented and independently verified.	In case the project activity involves the replacement of equipment, an independent monitoring of scrapping of replaced equipment will be implemented.

Applicability conditions for renewable biomass

Applicability condition	PoA confirmation
1. The biomass is woody and non-biomass and originates from croplands and/or grasslands where: a) The land area remains cropland and/or grasslands or is reverted to forest; and b) Sustainable management practices are undertaken on these land areas to ensure in particular that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and c) Any national or regional forestry, agriculture and nature conservation regulations are complied with. d) Biomass complies with the dedicated plantation applicability conditions described in Methodology AM0042 or Methodology AMS-III.AQ (see F-CDM-SSCwg ver 01 SSC_577). Applicability conditions are describe in tables below.	All CPAs using biomass from dedicated plantations shall demonstrate that the CPA comply with conditions (a) to (d).
2. The biomass is a biomass residue, that means biomass by-products, residues and waste streams from agriculture, forestry and related	All CPAs using biomass residues shall demonstrate that the baseline (current practice) is one of the following:

industries. a) Where, the use of that biomass residue in the project activity does not involve a decrease of carbon pools, in particular dead wood, litter or soil organic carbon, on the land areas where the biomass residues are originating from	1. The biomass residues are dumped or left to decay under mainly aerobic conditions. 2. The biomass residues are dumped or left to decay under clearly anaerobic conditions. 3. The biomass residues are burnt in an uncontrolled manner without utilizing them for energy purposes All CPAs using biomass residues shall demonstrate that the use of biomass residue in the project activity does not involve a decrease of carbon pools.

Applicability conditions for dedicated plantations as in methodology AM0042

Applicability conditions	PoA confirmation
a) Biomass used by the project facility is not stored for more than one year; b) The dedicated plantation must be newly established as part of the project activity for the purpose of supplying biomass exclusively to the project; c) The biomass from the plantation is not chemically processed (e.g. esterification to produce biodiesel, production of alcohols from biomass, etc) prior to combustion in the project plant but it may be processed mechanically or be dried; d) The site preparation does not cause longer-term net emissions from soil carbon. Carbon stocks in soil organic matter, litter and deadwood can be expected to decrease more due to soil erosion and human intervention or increase less in the absence of the project activity; e) The land area of the dedicated plantation will be planted by direct planting and/or seeding; f) After harvest, regeneration will occur either by direct planting or natural sprouting; g) Grazing will not occur within the plantation; h) No irrigation is undertaken for the biomass plantations; i) The land area where the dedicated plantation will be established is, prior to project implementation, severely degraded and in absence of the project activity would have not been used for any other agricultural or forestry activity. The land degradation can be demonstrated using one or more of the following indicators: a) Vegetation degradation, e.g. ➢ Crown cover of pre-existing trees has decreased in the recent past for reasons other than sustainable harvesting activities; b) Soil degradation, e.g. ➢ Soil erosion has increased in the recent past; c) Anthropogenic influences, e.g. ➢ There is a recent history of loss of soil and vegetation due to anthropogenic actions; and ➢ Demonstration that there exist anthropogenic actions/activities that prevent possible occurrence of natural regeneration.	All CPAs using biomass from dedicated plantations shall demonstrate that the CPA complies with all the dedicated plantation applicability conditions in methodology AM0042.

Applicability conditions for dedicated plantations as in methodology ASM-III.AQ, paragraph 5 (see F-CDM-SSCwg ver 01 SSC_577)

Applicability conditions	Confirmation record
a) The project activity does not lead to a shift of pre-project activities outside the project boundary i.e. the land under the proposed project	All CPAs using biomass from dedicated

activity can continue to provide at least the same amount of goods and services as in the absence of the project;	plantations shall demonstrate that the project activity does not lead to a shift of pre-project activities outside of the project boundary.
b) The plantations are established on a land: i. Which was at the start of the project implementation, classified as degraded or degrading as per the "Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities" (Version 01); or ii. Area that is included in the project boundary of one or several registered A/R CDM project activities. iii. Plantations established on the peatlands are not eligible even if qualifying under condition (i) and (ii) above.	All CPAs shall using biomass from dedicated shall demonstrate that the CPA complies with conditions (i) to (iii).

B.3. Sources and GHGs

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The spatial extent of the project boundary encompasses:

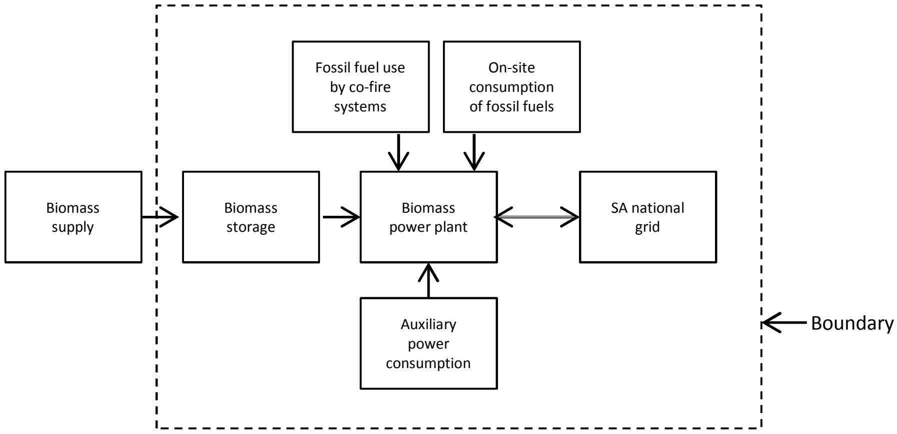
(a) All plants generating power and/or heat located at the project site, whether fired with biomass, fossil fuels or a combination of both;

(b) All power plants connected physically to the electricity system (grid) that the project plant is connected to;

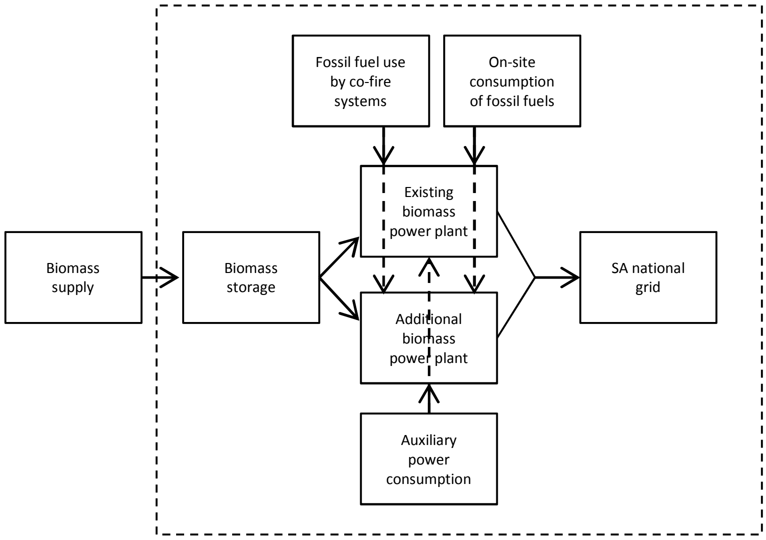
(c) Industrial, commercial or residential facility, or facilities, consuming energy generated by the system and the processes or equipment affected by the project activity;

Associated emissions from transportation of biomass and the processing plant of biomass residues for project activities using solid biomass fuel (e.g. briquette) shall be accounted for as leakage.

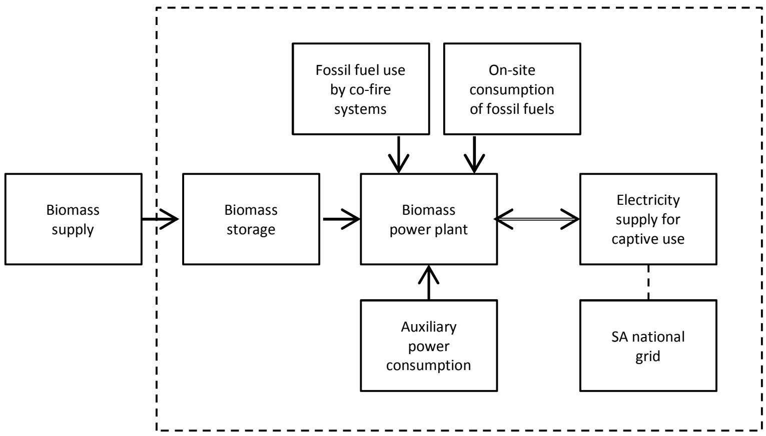
The project boundary for the different project scenarios are given below:



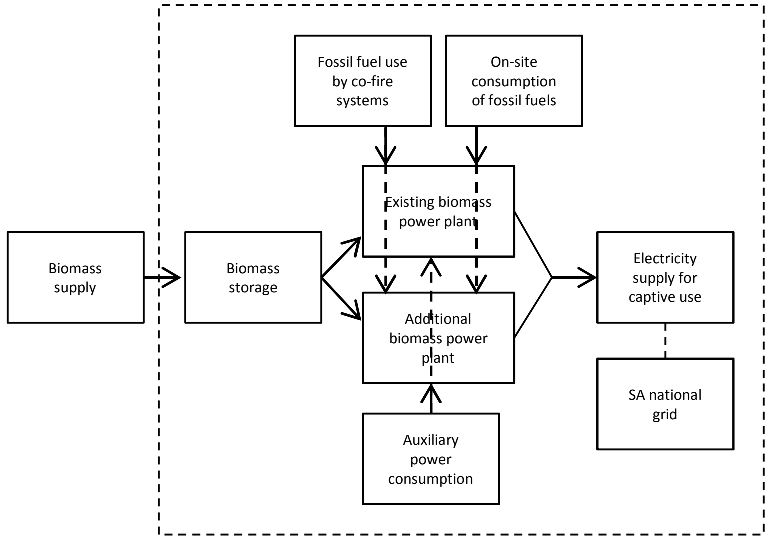
Scenario A. Biomass based project activities that install new power plants that supply renewable electricity to the grid.



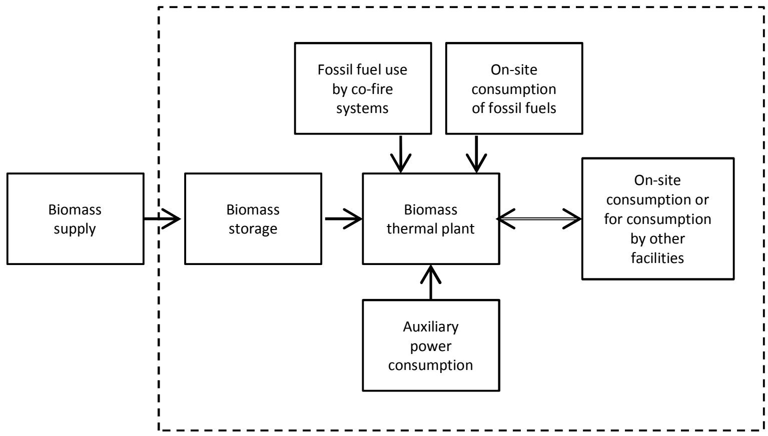
Scenario B. Biomass based project scenarios that involve capacity addition to renewable electricity plants that supply electricity to the grid.



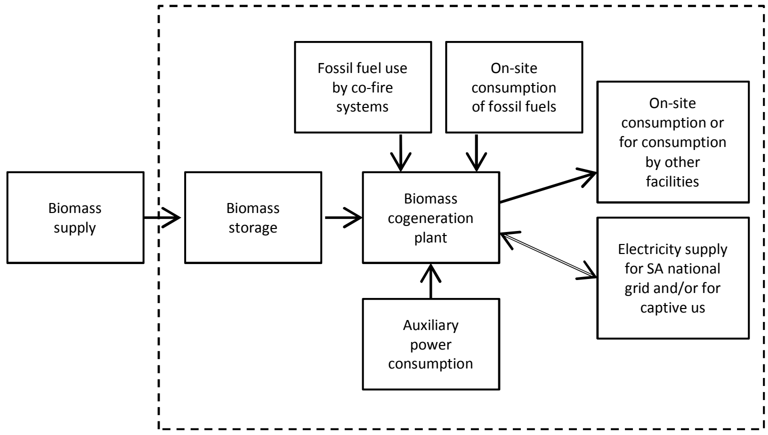
Scenario C. Biomass based project activities that install new power plants that produce renewable electricity for captive use that displace electricity from the grid.



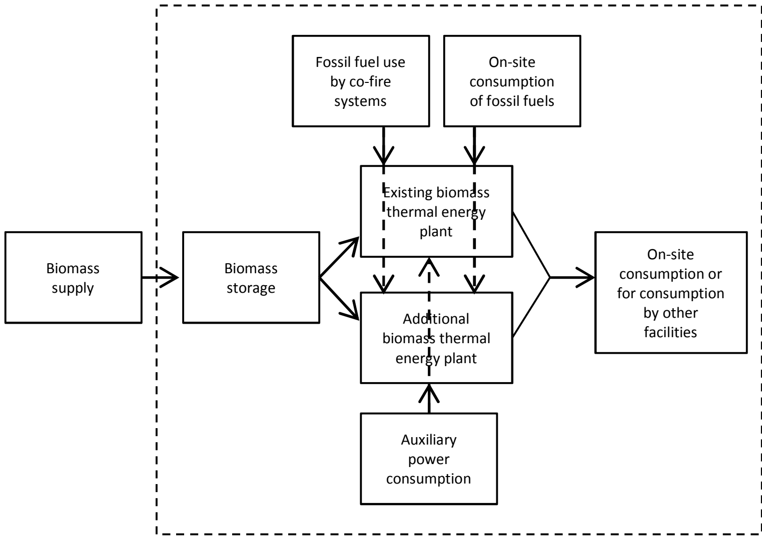
Scenario D. Biomass based project activities that involve capacity addition to renewable electricity plants that produce electricity for captive use that displace electricity from the grid.



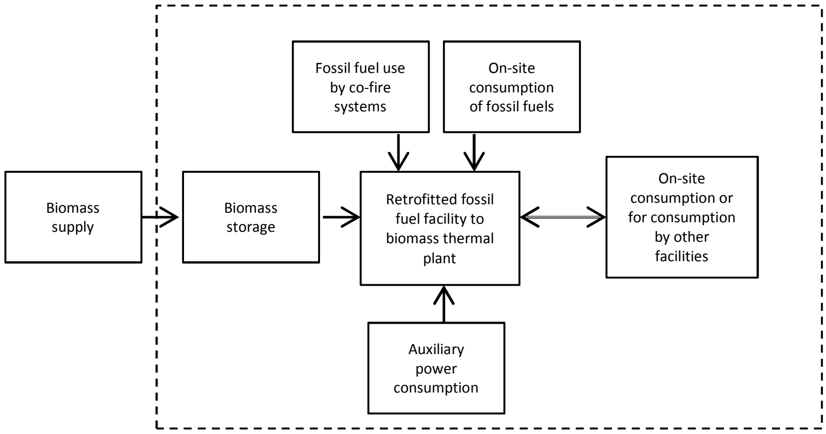
Scenario E. Biomass based project activities that install thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use.



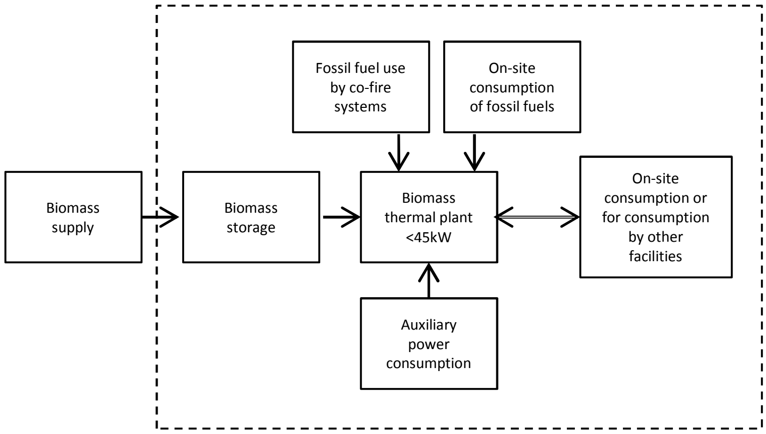
Scenario F. Biomass based project activities that install cogeneration plants that produce renewable electricity for supply to the grid and/or for captive use and/or renewable thermal energy for on-site consumption or for consumption by other facilities and displace fossil fuel use.



Scenario G. Biomass based project activities that involve the addition of renewable thermal energy units at an existing renewable energy production facility and displace fossil fuel use..



Scenario H. Biomass based project activities that seek to retrofit or modify an existing facility for the purpose of fuel switch from fossil fuels to biomass in heat generation equipment.



Scenario I. For household or commercial applications/systems, whose maximum output capacity is less than 45 kW thermal and where it can be demonstrated that the metering of thermal energy output is not plausible.

The combination of the greenhouse gases and emission sources included in or excluded from the project boundary are shown in table below:

Table E.3 Overview on emission sources included in or excluded from the AMS-I.D, AMS-I.F and AMS-I.C project boundary

	Source	Gas	Included	Justification / Explanation
Baseline	Emissions from electricity and/or thermal energy generation	CO_2	Yes	Main emission source.
		CH_4	No	Excluded for simplification. This emission source is assumed to be small
		N_2O	No	Excluded for simplification. This emission source is assumed to be small
Project Activity	Emissions for biomass based plants	CO_2	No	CO_2 emissions due to the burning of biogas are neutralized by the sequestration that took place during the growth cycle of the biomass crop.
		CH_4	No	Excluded for simplification. This emission source is assumed to be small
		N_2O	No	Excluded for simplification. This emission source is assumed to be small
	Emissions from on-site electricity use	CO_2	Yes	May be an important emission source where electricity is imported from the grid. If electricity is generated from collected biogas, these emissions are not accounted for
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small
	Emissions from the use of fossil fuel for the operation of the facilities	CO_2	Yes	May be an important emission source where fossil fuel is used in the project activity
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small

B.4. Description of baseline scenario
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The following table describe the baseline scenario for each project scenario:

Project scenario	Applicable technologies/measures and methodology	Description of the baseline scenario
A.	Biomass based project activities that install new power plants that that supply renewable electricity to the grid. Applicable methodology: AMS-I.D	The baseline scenario is that the electricity delivered to the grid by the project or displaced from the grid by the project activity would have otherwise been generated by the operation of grid connected power plants. The CO_2 emission factor for the South African national grid is calculated below. For project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility (project scenario B and D), where the existing and new units share the use of common and limited renewable resources (e.g. biomass residues), the potential for the project activity to reduce the amount of renewable resource available to, and thus electricity generation by, existing units must be considered in the determination of baseline emissions, project emissions, and/or leakage, as relevant.
B.	Biomass based project activities that involve capacity addition to renewable electricity plants that supply electricity to the grid. Applicable methodology: AMS-I.D	
C.	Biomass based project activities that install new power plants that produce renewable electricity for captive use that displace electricity from the grid. Applicable methodology: AMS-I.F	
D.	Biomass based project activities that involve capacity addition to renewable electricity plants that produce electricity for captive use that displace electricity from the grid. Applicable methodology: AMS-I.F	
E.	Biomass based project activities that install thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities. Applicable methodology: AMS-I.C	The simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. See below the criteria on determining the thermal energy baseline emissions.
F.	Biomass based project activities that install cogeneration plants that produce renewable electricity for supply to the grid and/or for captive use and/or renewable thermal energy for on-site consumption or for consumption by other facilities. Applicable methodology: AMS-I.C	One of the following baseline scenarios should be applicable: • Electricity is imported from a grid and thermal energy (steam/heat) is produced using fossil fuel (project activity (a) in paragraph 19, methodology AMS-I.C). • Electricity is imported from a grid and thermal energy (steam/heat) is produced from biomass. Emission reduction from heat generation are not eligible (project activity (e) in paragraph 19, methodology AMS-I.C). For electricity, the baseline scenario is that the electricity displaced from the grid by the project

		activity would have otherwise been generated by the operation of grid connected power plants. The CO_2 emission factor for the South African national grid is calculated below. For thermal energy, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. See below the criteria on determining the thermal energy baseline emissions.
G.	Biomass based project activities that involve the addition of renewable thermal energy units at an existing renewable energy production facility. Applicable methodology: AMS-I.C	The simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. See below the criteria on determining the thermal energy baseline emissions. In the case of project activities that involve the addition of renewable energy units at an existing renewable energy production facility, where the existing and new units share the use of common and limited renewable resources (e.g. biomass residues), the potential for the project activity to reduce the amount of renewable resource available to, and thus thermal energy production by, existing units must be considered in the determination of baseline emissions, project emissions, and/or leakage, as relevant.
H.	Biomass based project activities that seek to retrofit or modify an existing facility for the purpose of fuel switch from fossil fuels to biomass in heat generation equipment. Applicable methodology: AMS-I.C	The simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. See below the criteria on determining the thermal energy baseline emissions.
I.	Project activities with capacity les than 45 kW thermal Applicable methodology: AMS-I.C	The simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity, times an emission factor for the fossil fuel displaced. See below the criteria on determining the thermal energy baseline emissions

The grid emission factor calculation

Application of the UNFCCC methodological tool: “Tool to calculate the emission factor for an electricity system”(UNFCCC tool version 02.2.1)

Step 1: Identify the relevant electricity systems
Step 2: Chose whether to include off-grid power plants in the project electricity system
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

This tool will serve project activities that will displace grid electricity in South Africa.

The **project electricity system** is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be displaced without significant transmission constraints.

Similarly, a **connected electricity system**, e.g. national or international, is defined as an electricity system that is connected by transmission lines to the project electricity system. Power plants within the connected electricity system can be dispatched without significant transmission constraints, but transmission to the project electricity system has significant transmission constraints.

The DNA of South Africa has not published a delineation of the project electricity system and connected electricity systems. Also, the application of the criteria with regards to determining significant transmission constraints does not result in a clear grid boundary due to a lack of sufficient data. For these reasons the following was chosen for the reference system of this project:

- The **project electricity system** entails all the Eskom power plants in the South African electricity grid.
- Due to a lack of data available in the public domain (in order to evaluate significant transmission constraints), all other power stations (non-Eskom) and countries with power grids connected to South Africa, are treated as **connected electricity systems**, and emission factors for imports from these systems are conservatively assumed to be 0 tCO_2/MWh.

All electricity generated by the Eskom power stations is taken into consideration when calculating the grid emission factor; exports are not subtracted.

All the data for the Eskom power stations are obtained from the Eskom website, where they have a specific webpage dedicated to CDM grid emission factor related data[6]. This data includes commissioning dates, electricity generated, and fuel consumed.

Data for the imported electricity are obtained from the Eskom annual report, where "*Total purchased for the Eskom system (GWh)*" is shown in the "*Statistical overview*" table on pg. 324 of the report[7].

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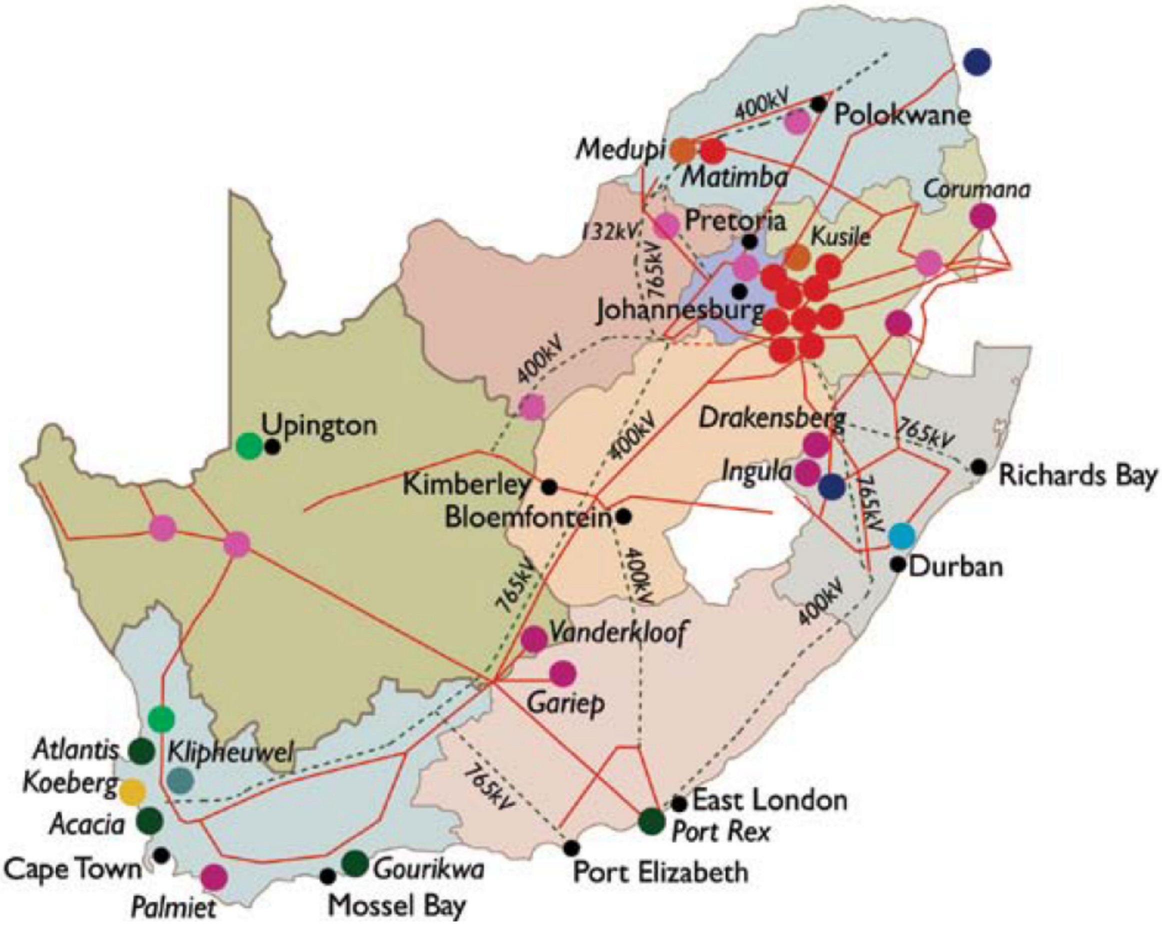
[6] Eskom Holdings SOC Limited . (2011). *CDM Calculations*. Retrieved October 06, 2011, from Eskom: http://www.eskom.co.za/c/article/236/cdm-calculations/

[7] Eskom Holdings SOC Limited. (2011). *Annual Report 2011*.



Step 2: Chose whether to include off-grid power plants in the project electricity system

This step is optional according to the tool. The grid emission factor is calculated from only grid power plants (**Option I**). Off-grid power plants are not included in the calculations.

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

The OM is calculated using the **simple OM method (Option a)**. The simple OM method can be used provided that the low-cost/must-run resources constitute less than 50% of the total grid generation in average of the five most recent years.

The average percentage of low-cost/must-run resources amount to 0.00% of the total grid generation for this project electricity system. Therefore, Option (a) is applicable.

In terms of data vintages, the *ex ante* option were chosen to calculate the simple OM. In this option a 3 year generation-weighted average are used for the grid power plants. Using this option also means that the emission factor is determined only once at the validation stage, thus no monitoring and recalculation is required during the crediting period.

The data used in OM calculations are for the 3 year period of 1 April 2008 – 31 March 2011 (Eskom financial year runs from 1 April – 31 March). This is the latest available data.

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

The simple OM emission factor ($EF_{grid,OMsimple,y}$) is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units. Hence, the hydro and nuclear power plants are excluded from the calculation of the OM.

Option A is used for calculating the simple OM. The calculations in this option are based on the total net electricity generation and a CO2 emission factor of each power plant.

Option A – Calculation based on average efficiency and electricity generation of each plant

Under this option, the simple OM emission factor is calculated based on the net electricity generation of each power plant and an emission factor of each power plant, as follows:

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

Where:

$EF_{grid,\ OMsimple,y}$	=	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit m in the year y (MWh)
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
m	=	All power units serving the grid in year y except low-cost/must-run power units
y	=	The relevant year as per data vintage chosen in Step 3

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

The emission factor for each power plant *m* were determined as follows (**Option A1**):

$$EF_{grid,OMsimple,y} = \frac{\sum_i \left(FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y} \right)}{EG_y} \quad \textbf{(6)}$$

Where:

$EF_{grid,\ OMsimple,y}$	=	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$FC_{i,y}$	=	Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) fossil fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$	=	CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ)
EG_y	=	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year y (MWh)
i	=	All fossil fuel types combusted in power sources in the project electricity system in year y
y	=	The relevant year as per data vintage chosen in Step 3.

Electricity imports are treated as one power plant, as per the tool guidance.

The parameters used in calculations appear in Table 1.

Table 1: Constants used in calculations

Constants		
$NCV_{other\ bituminous\ coal,\ 2009}$[8]	19.10	GJ/T
$NCV_{other\ bituminous\ coal,\ 2010}$[9]	19.22	GJ/T
$NCV_{other\ bituminous\ coal,\ 2011}$[10]	19.45	GJ/T
$NCV_{other\ kerosene}$[11]	42.4	GJ/T
$EF_{CO2other\ bituminous\ coal}$[12]	0.0895	tCO_2/GJ
$EF_{CO2,other\ kerosene}$[13]	0.0708	tCO_2/GJ

The fuel used for coal power stations is other bituminous coal. In *"Eskom Fact Sheet – Formation of Coal"*[14] it is stated that coal in South Africa is "mostly classified as 'bituminous' coals". The article *"What is the carbon emission factor for the South African electricity grid? (Spaldin-Fecher, 2011)"*[15] also specifies the use of "other bituminous coal" as the fuel used in the Eskom power stations.

The fuel used for Acacia and Port Rex power stations is kerosene. This is stated in *"Eskom Fact Sheet – Port Rex and Acacia Power Stations"*[16]. Also, in the source data for electricity generation and fuel consumption the fuel consumption for these two power stations are specified in units of "liters kerosene/year"[17].

Using equation 6, the OM is calculated as **0.92** tCO_2e/MWh.

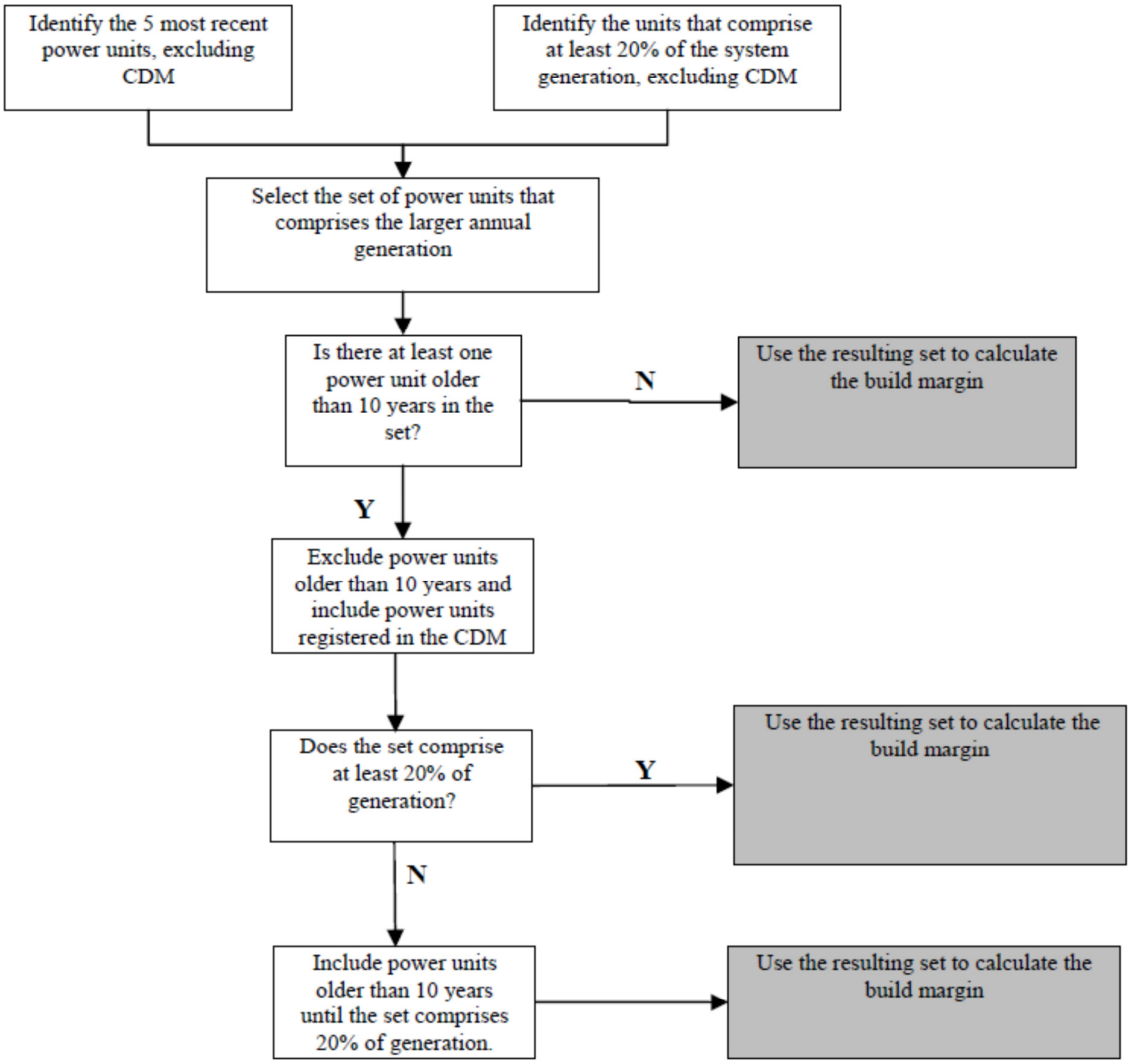
Step 5: Calculate the build margin (BM) Emission Factor

In terms of vintage of data, one **Option 1** was selected: 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.

The sample group of power units *m* used to calculate the build margin were determined as per the procedure delineated in the tool, consistent with the data vintages selected.

The following diagram summarizes the procedure of identifying the sample group:

[8] Eskom Holdings SOC Limited. (2011). *Annual Report 2011*.
[9] Eskom Holdings SOC Limited. (2011). *Annual Report 2011*.
[10] Eskom Holdings SOC Limited. (2011). *Annual Report 2011*.
[11] IPCC, 2006
[12] IPCC, 2006
[13] IPCC, 2006
[14] http://recruitment.eskom.co/live/content.php?Category_ID=60
[15] Supplied to validators.
[16] http://www.eskom.co.za/content/GS_0001GasTurbAcaciaPortRexRev6~1~1.pdf
[17] Eskom Holdings SOC Limited . (2011). *CDM Calculations*. Retrieved October 06, 2011, from Eskom: http://www.eskom.co.za/c/article/236/cdm-calculations/



According to the above diagram, the only two power stations that are included in the build margin are Majuba (1996) and Kendal (1988). There is no power generation data available for power units registered in the CDM, therefore these could not be included. Majuba and Kendal comprises 23% of generation.

The sample group of power units m used to calculate the build margin is the resulting set **SETsample-CDM->10yrs**.

The build margin emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

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

Where:

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

According to the tool: *If the power units included in the build margin m correspond to the sample group* ***SETsample-CDM->10yrs****, then, as a conservative approach, only option A2 from guidance in Step 4 (a) can be used and the default values provided in Annex 1 shall be used to determine the parameter* $\eta_{m,y}$. The CO_2 emission factor of each power unit m ($EL_{EL,m,y}$) should be determined as per the guidance in Step 4 (a) for the simple OM, using **Option A2**:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}} \qquad \textbf{(3)}$$

Where:

$EF_{EL,m,y}$	= CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$EF_{CO2,m,i,y}$	= Average CO2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/GJ)
$\eta_{m,y}$	= Average net energy conversion efficiency of power unit *m* in year *y* (ratio)
m	= All power plants/units serving the grid in year y except low-cost/must-run power plants/units
i	= All fossil fuel types combusted in power plant/unit m in year y
y	= The relevant year as per data vintage chosen in Step 3.

The default value for $\eta_{m,y}$ for the coal power stations in the BM were obtained from Annex 1 of the tool. The value used is 37%.

Using equation 13, the BM is calculated as **0.87** tCO_2e/MWh.

Step 6: Calculate the combined margin (CM) emission factor

The combined margin factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \qquad \textbf{(14)}$$

Where:

$EF_{grid,BM,y}$	= Build Margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	= Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	= Weighting of operating margin emissions factor (%)
w_{BM}	= Weighting of build margin emissions factor (%)

The emission factors for the final combined margin appear in Table 8.

Table 1: CM emission factor

	w_{OM}	w_{BM}	**Combined Margin Emission Factor**
Wind and solar power generation project activities for the first crediting period and for subsequent crediting periods.	0.75	0.25	**0.91**

All other projects for the first crediting period.	0.5	0.5	**0.90**
All other projects for the second and third crediting period.	0.25	0.75	**0.88**

BIBLIOGRAPHY

Eskom Holdings SOC Limited . (2011). *CDM Calculations*. Retrieved October 06, 2011, from Eskom: http://www.eskom.co.za/c/article/236/cdm-calculations
Eskom Holdings SOC Limited. (2011). *Annual Report 2011*

Criteria on determining the thermal energy baseline emissions

Existing facilities are those that have been in operation for at least three years immediately prior to the start date of the project activity. For project activities implemented in existing facilities, baseline calculations shall be based on historical data on energy use (fossil fuel) and plant output (e.g. steam) in the baseline plant for at least three years prior to project implementation. For existing facilities with less than three years of operational data, all historical data shall be available (a minimum of one year data would be required). For existing facilities having no historical data/information on baseline parameters such as efficiency, energy consumption and output (e.g. the available data is not reliable due to various factors such as the use of imprecise or non-calibrated measuring equipment), the baseline parameters can be determined using a performance test/measurement campaign to be carried out prior to the implementation of the project activity. The project proponent may follow the relevant provisions from the "Tool to determine baseline efficiency of thermal or electric energy generation systems" (Version 01). In the case of project activities that export to other facilities within the project boundary, historical data from the recipient plants is also required.

For project activities implemented in existing facilities where the additionality is demonstrated based on a baseline scenario that is not the continuation of the current practice (e.g. continued use of the fossil fuel that was used prior to the implementation of the project activity), the baseline emission factor is chosen as lower of the two: (a) the emission factor of the fossil fuel that would have been used in the identified baseline scenario; and (b) the emission factor of the fossil fuel that was used prior to the implementation of the project activity.

Efficiency of the baseline units (excluding cogeneration plants) shall be determined by adopting one of the following criteria (in preferential order):

(a) Highest measured operational efficiency over the full range of operating conditions of a unit with similar specifications, using baseline fuel. The efficiency tests shall be conducted following the guidance provided in relevant national/international standards;
(b) Highest of the efficiency values provided by two or more manufacturers for units with similar specifications, using the baseline fuel;
(c) Default efficiency of 100%.

For household or commercial applications/systems, whose maximum output capacity is less than 45 kW thermal and where it can be demonstrated that the metering of thermal energy output is not plausible, as in the case of cooking stoves, gasifiers, driers, water heaters etc., efficiency of the baseline units shall be determined by adopting one of the following criteria:

(a) Highest measured operational efficiency over the full range of operating conditions of a representative sample of units with similar specifications, using baseline fuel. The efficiency tests shall be conducted following the guidance provided in relevant national/international standards;
(b) Highest of the efficiency values provided by two or more manufacturers for units with similar specifications using the baseline fuel;
(c) Highest efficiency from referenced literature values or default efficiency of 100%.

National and/or sectoral policies

According to the CDM Project standard (Version 01.0), when establishing the baseline scenario, project participants shall take into account the following two types of national and/or sectoral policies:

a) National and/or sectoral policies or regulations that give comparative advantages to more emissions-intensive technologies or fuels over less emissions-intensive technologies or fuels (so called type E+);
b) National and/or sectoral policies or regulations that give comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies (e.g. public subsidies to promote the diffusion of renewable energy or to finance energy efficiency programs) (so called type E-).

Project participants shall address the two types of policies described in above above as follows:
(a) Only national and/or sectoral policies or regulations described in (a) above that have been implemented before adoption of the Kyoto Protocol by the Conference of the Parties (hereinafter referred to as the COP) (decision 1/CP.3, 11 December 1997) shall be taken into account when establishing a baseline scenario. If such national and/or sectoral policies were implemented since the adoption of the Kyoto Protocol, the baseline scenario should refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place;
(b) National and/or sectoral policies or regulations described in (b) above that have been implemented since the adoption by the COP of the CDM M&P (decision 17/CP.7, 11 November 2001) need not be taken into account in establishing a baseline scenario (i.e. the baseline scenario could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place).

In South Africa, the National Electricity Regulator South Africa (NERSA SA) has effectively introduced the Renewable Energy Feed-In Tariff program (REFIT) in 2009. The REFIT was established due to national and/or sectorial policies that give comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies.

The REFIT policy pursued by NERSA was introduced after 2001 and falls under E- policy and therefore need not be taken into account in establishing a baseline scenario. The baseline scenario could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place.

B.5. Demonstration of eligibility for a generic CPA

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Eligibility criteria for inclusion of a SSC-CPA in the PoA

Eligibility criteria	Confirmation method
a) The proposed CPA must be located in the geographical boundary of South Africa.	Demonstrate that CPA is located in the geographical boundary of South Africa. See demonstration in Section A.7 of the CPA-DD.
b) The CME must implement precaution measures to avoid double counting of emission reductions.	The CME shall follow the procedure to avoid double counting in Section C (d) in the PoA-DD. Confirmation by the CPA implementer that the CPA is neither registered as an individual CDM project activity nor is part of another registered PoA. See confirmation in Section A.13 of the CPA-DD.
c) The proposed CPA must comply with performance specifications including compliance with certification.	Demonstration that the CPA will comply with the performance specifications set out in PoA-DD, Part I, Section A.6. See demonstration in Section A.5 of the CPA-DD

d)	The starting date of the project activity must not be before the date of commencement of validation of the PoA.	The staring date of the project activity means the earliest date at which either the implementation or construction or real action of a project activity begins. The CPA implementer will provide the CME with any significant purchase order, contract or payment evidence related to the construction of the project activity. See documentation in Section A.8.1 of the CPA-DD.
e)	The proposed CPA must implement one of the eligible methodologies or methodology combinations for the PoA. Also, the proposed CPA must comply with the applicability conditions of the applicable methodology.	Indicate that the CPA will apply one of the eligible methodologies or methodology combinations. Also, assess compliance with the specific methodology applicability conditions. See assessment in Section D.2 of the CPA-DD
f)	The CPA must demonstrate additionality as per eligibility criteria.	Assess additionality according to the eligibility criteria below. See assessment in Section D.5 of the CPA-DD
g)	The CPA must comply with PoA conditions related to undertaking local stakeholder consultations and environmental impact analysis.	Provide necessary environmental impact assessment and local stakeholder consultation information and documentation. See Section B and C of the CPA-DD.
h)	The CPA must confirm that no Official Development Aid will be involved or diverted.	Provide information on sources of public funding from countries included in Annex I which shall affirm that such funding does not result in diversion of official development assistance. See affirmation Section A.11 of the CPA-DD.
i)	The PoA has no specific target group or distribution mechanism, therefore there is no eligibility criteria for target groups or distribution mechanisms	-
j)	All relevant parameters will be monitored for each CPA, therefore there is no eligibility criteria for sampling.	-
k)	CPA in aggregate must meet the small-scale or micro-scale threshold criteria	Demonstration that the installed capacity of the small-scale or micro-scale CPA in aggregate will remain within the threshold criteria throughout the crediting period of the CPA See demonstration in Section D.2 of the CPA-DD
l)	The proposed CPA must pass the de-bundling check.	Demonstrate that the CPA is not a debundled component of a large scale activity by following the “Guidelines on assessment of debundling for SSC project activities” (Version 03). See de-bundling check in Section A.12 of the CPA-DD

<u>**ADDITIONALITY OF THE GENERIC CPA**</u>

Additonality shall be demonstrated based on one of the following two approaches:

Approach 1: Demonstration of additionality for microscale project activities

Project activities up to five megawatts that employ renewable energy technology are additional if any one of the conditions in the 'Guidelines for demonstrating additionality of microscale' (Version 04.0) is satisfied.

Guidelines for demonstrating additionality of microscale project activities (Version 04.0)

a)	The geographic location of the project activity is in one of the least developed countries or the small island developing States (LDCs/SIDS) or in a special underdeveloped zone of the host country identified by the government before 28 May 2010
b)	The project activity is an off-grid activity supplying energy to households/communities (less than 12 hours grid availability per 24 hrs is also considered .off-grid. for this assessment)
c)	The project activity is designed for distributed energy generation (not connected to a national or regional grid) with both conditions (i) and (ii) satisfied i. Each of the independent subsystems/measures in the project activity is smaller than or equal to 1500kW electrical installed capacity ii. End users of the subsystems or measures are households/communities/small and medium enterprises (SMEs).
d)	The project activity employs specific renewable energy technologies/measures recommended by the host country designated national authority (DNA) and approved by the Board to be additional in the host country.

Approach 2: Demonstration of additionality for project activities above 5mw and less than 15mw

According to "Attachment A of Appendix B" and the "Non-binding best practice examples to demonstrate additionality for SSC project activities" (Version 01.0), the CPA participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

a) Investment barrier
b) Access-to-finance barrier
c) Technological barrier
d) Barrier due to prevailing practice
e) Other barriers

The following guidelines will be followed to prove the additionality:

- "Guidelines for objective demonstration and assessment of barriers" (Version 01.0)
- "Guidelines on the assessment of investment analysis" (Version 05.0)
- "Guidelines on additionality of first-of-its-kind project activities" (Version 01.0)
- "Non-binding best practice examples to demonstrate additionality for SSC project activities" (Version 01.0)

a) <u>INVESTMENT BARRIER</u>

Eligibility criteria for the investment barrier

1.	Demonstrate that a financially more viable alternative to the project activity would have led to higher emissions.
2.	Best practice examples include but are not limited to, the application of investment comparison analysis using a relevant financial indicator or the benchmark analysis or a simple cost analysis (where CDM is the only revenue stream such as end-use energy efficiency).
3.	All the applicable conditions in the '*Guidelines on the assessment of investment analysis*' (Version 05.0) should be satisfied. The CME shall indicate their assessment of the guideline conditions in the CPA-DD.

Option II. Comparison analysis

The comparison analysis is used to determine whether the proposed project activity is not the most economically or financially attractive. Where the comparison analysis is chosen as the applicable financial analysis approach, the following steps will be followed.

1. Identify alternatives to the project activity
2. Identify and calculate the financial indicator, most suitable for the project type
3. Comparison of financial indicators
4. Sensitivity analysis
5. Outcome of the comparison analysis

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

Sub-step 1a: Define alternatives to the proposed CPA

The following alternatives to the project activity have been identified:
Alternative 1: The project activity is undertaken without being registered as a CPA
Alternative 2: The project participants continue with the identified energy baseline scenario

Sub-Step 1b: Consistency with mandatory applicable laws and regulation

All the alternatives to the proposed project activity are consistent with current laws and regulations.

2. Identify and calculate the financial indicator, most suitable for the project type

Identify the financial indicator, such as IRR, NPV, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in R/kWh or levelized cost of delivered heat in R/GJ) most suitable for the project type and decision-making context.

Calculate the suitable financial indicator for the proposed CDM project activity and for the other alternatives. Include all relevant costs (including, for example, the investment cost, the operations and maintenance costs), and revenues (excluding CER revenues, but possibly including inter alia subsidies, etc, where applicable), and, as appropriate, non-market cost and benefits in the case of public investors if this is standard practice for the selection of public investments in the host country.

3. Comparison of financial indicators:

If one of the other alternatives has the best indicator (e.g. highest IRR), then the CDM project activity can not be considered as the most financially attractive.

4. Sensitivity analysis

Include a sensitivity analysis that shows whether the conclusion regarding the financial/economic attractiveness is robust to reasonable variations in the critical assumptions. The investment analysis provides a valid argument in favour of additionality only if it consistently supports (for a realistic range of assumptions) the conclusion that the project activity is unlikely to be the most financially/economically attractive

In cases where a scenario will result in the project activity becoming the most financially attractive alternative the CPA implementer shall provide an assessment of the probability of the occurrence of this scenario in comparison to the likelihood of the assumptions in the presented investment analysis, taking into consideration correlations between the variables as well as the specific socio-economic and policy context of the project activity.

5. Outcome of the comparison analysis.

The outcome of the comparison analysis should demonstrate that the proposed CPA is not the most economically or financially attractive. Alternative 2, the continuation of the identified energy baseline scenario, will lead to higher emissions. Therefore, a financial more viable alternative to the CPA would have led to higher emissions

Option III. Apply benchmark analysis

The benchmark analysis can be considered an applicable financial analysis approach for this PoA due to the following reasons. According to the "Guidelines on the assessment of investment analysis" (Version 05), the benchmark approach is suited to circumstances where the baseline is outside the direct control of the project developer and where the choice of the developer is to invest or not to invest. Under this PoA, the baseline scenario for most projects is the supply of electricity from the grid, which is outside the direct control of the project developer and therefore the benchmark approach can be considered applicable.

Where the benchmark analysis was chosen as the applicable financial analysis approach the following steps will be followed.

1. Identify alternatives to the project activity
2. Determine the appropriate benchmark for the project
3. Calculate the appropriate benchmark for the project
4. Identify and calculate the financial indicator, most suitable for the project type
5. Compare the financial indicators
6. Conduct sensitivity analysis
7. Outcome of the benchmark analysis.

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

Sub-step 1a: Define alternatives to the proposed CPA

The following alternatives to the project activity have been identified:
Alternative 1: The project activity is undertaken without being registered as a CPA
Alternative 2: The project participants continue with the identified energy baseline scenario

Sub-Step 1b: Consistency with mandatory applicable laws and regulation

All the alternatives to the proposed project activity are consistent with current laws and regulations.

2. Determine the appropriate benchmark for the project

The chosen benchmark shall be appropriate to the type of IRR calculated. Local commercial lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR. Required/expected returns on equity are appropriate benchmarks for an equity IRR. Benchmarks supplied by relevant national authorities are also appropriate if the DOE can validate that they are applicable to the project activity and the type of IRR calculation presented.

CPA implementer indicate the appropriate benchmark with a X:

Weighted average costs of capital (WACC)	

Local commercial lending rates	
Required/expected return on equity	
Benchmarks supplied by relevant national authorities	

3. Benchmark calculation

The benchmark for this PoA is based on parameters that are standard in the market, internal company benchmarks are not applicable. The CPA may chose to apply one of the following benchmark approaches:

Approach 1: WACC

Renewable energy projects in South Africa are typically financed using a combination of debt and equity finance. Hence, comparison of the investment analysis (IRR) with the weighted average cost of capital (WACC) represents a valid approach for many CPAs under the PoA. The WACC is be determined on a pre-tax basis as follows:

$$WACC = CD \times Debt\% + CE \times Equity\%$$
$$= X \times X + X \times X$$
$$= X$$

Where:
CD = Cost of Debt
%Debt = Debt ratio compared to total investment
CE = Cost of Equity
%Equity = Equity ratio as compared to total investment

The following table indicates the benchmark calculation parameters and the type of supporting documentation to be supplied to the DOE. New CPAs to be included under the PoA will use parameter values and documents specific to that year. The parameters for each CPA will be indicated in Section D.5 of the CPA-DD.

Parameters for the calculation of the benchmark

Parameter	Value	Supporting documentation
a) *CD*	X	Confirmation letter from a commercial bank.
b) *EC*	X	Calculated from the table in the Appendix to EB 62, Annex5.
c) *Debt: Equity*	X:X	Confirmation letter from a commercial bank.

Approach 2: Local commercial lending rates

The local commercial lending rate is equal to the Cost of Debt explained above.

Approach 3: Required/expected returns on equity

The required/expected returns on equity is equal to the Cost of Equity explained above.

Approach 4: Benchmarks supplied by relevant national authorities

In the event that the CPA implementer chose benchmarks supplied by relevant national authorities, it should be described at CPA level.

4. Identify and calculate the financial indicator, most suitable for the project type

CPA implementer indicates the most suitable financial indicator for the project:

Equity IRR	
Project IRR	

The time period considered should be clearly defined and it should be consistent with the technical life of the project.

The CPA implementer shall supply the CME with all the necessary information and supporting documentation to complete the financial indicator calculations in. The main parameters are listed below.

Parameters for the calculation of financial indicators (IRR)

Parameter	Unit	Value
1. Investment decision date	Date	
2. Project lifetime	Years	
3. Total Capex	ZAR	
4. Total Opex	ZAR	
4.1. Cost of sales	ZAR	
4.2. Operating expenses	ZAR	
5. Net electricity generation	kWh	
6. Net thermal energy gen.	TJ/yr	
7. Electricity price	ZAR/kWh	
8. Thermal energy price	ZAR/TJ	
9. CER price	EUR/ton	
10. Exchange Rate	ZAR:EUR	
11. Inflation rate	%	

5. Comparison of financial indicators:

If the CPA has a less favourable indicator (IRR) than the benchmark, then the CPA cannot be considered as financially attractive and the CPA implementer may continue to the sensitivity analysis.

Comparison of financial indicators

Benchmark	
IRR (xx years) without CDM revenues	
IRR (xx years) with CDM revenues	

6. Sensitivity analysis

Variables that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation. The following parameters are considered in the financial sensitivity analysis:

Sensitivity analysis

Variation	Variation	IRR (xx years)
	±10%	
	±10%	
	±10%	
	±10%	

The sensitivity analysis provides a valid argument in favour of additionality only if it consistently supports the conclusion that the project activity is unlikely to be financially attractive.

In cases where a scenario will result in the project activity passing the benchmark the CPA implementer shall provide an assessment of the probability of the occurrence of this scenario in comparison to the likelihood of the assumptions in the presented investment analysis, taking into consideration correlations between the variables as well as the specific socio-economic and policy context of the project activity.

7. *Outcome of Benchmark analysis*

The outcome of the benchmark analysis should demonstrate that the proposed CPA is unlikely to be financially attractive. Alternative 2, the continuation of the identified energy baseline scenario, is a more viable alternative to the project activity since continued operations do not require financial input from the project developer. The continued operations do however lead to higher emissions. Therefore, a financial more viable alternative to the CPA would have led to higher emissions

b) ACCESS-TO-FINANCE BARRIER

Eligibility criteria for the Access-to-finance barrier

1.	Demonstrate that the project activity could not access appropriate capital without consideration of the CDM revenues.
2.	Best practice examples include but are not limited to, the demonstration of limited access to capital in the absence of the CDM, such as a statement from the financing bank that the revenues from the CDM are critical in the approval of the loan.
3.	All the applicable conditions in the '*Guidelines for objective demonstration and assessment of barriers*' (Version 01.0) should be satisfied. The CME shall indicate their assessment of the guideline conditions in the CPA-DD.

c) TECHNOLOGICAL BARRIER

Eligibility criteria for the Technological barrier

1.	Demonstrate that a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions.
2.	Best practice examples include but are not limited to, the demonstration of non availability of human capacity to operate and maintain the technology, lack of infrastructure to utilize the technology, unavailability of the technology and high level of technology risk.
3.	All the applicable conditions in the '*Guidelines for objective demonstration and assessment of barriers*' (Version 01.0) should be satisfied. The CME shall indicate their assessment of the guideline conditions in the CPA-DD.

d) BARRIER DUE TO PREVAILING PRACTICE:

Eligibility criteria for the Barrier due to prevailing practice

1.	Demonstrate that the prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions.
2.	Best practice examples include but are not limited to, the demonstration that project is among the first of its kind in terms of technology, geography, sector, type of investment and investor, market etc.
3.	All the guideline conditions in the '*Guidelines for objective demonstration and assessment of barriers*' and '*Guidelines on additionality of first-of-its-kind project activities*' (Version 01.0) should be satisfied. The CME shall indicate their assessment of the guideline conditions in the CPA-DD.

e) OTHER BARRIERS

Such as institutional barriers or limited information, managerial resources, organizational capacity, or capacity to absorb new technologies.

B.6. Estimation of emission reductions of a generic CPA
B.6.1. Explanation of methodological choices
>>
Baseline emission equation choices

Baseline emission equation choices for project scenarios A - D, applying methodology AMS-I.D and AMS-I.F are as follows:

Scenarios A and C: Project activities that install new power plants that supply electricity to the grid or displace electricity from the grid will use the following equations from Methodology AMS-I.D:

$$BE_{,y} = EG_{BL,,y} \times EF_{CO2,grid,y} \quad (1)$$

For the purpose of clarification under the PoA, BE_y as in methodology AMS-I.D has been replaced with $BE_{elec,y}$.

Scenarios B and D: Project activities that involve capacity addition that produce renewable electricity that supply electricity to the grid or displace electricity from the grid will use the following equations from Methodology AMS-I.D:

$$BE_{add,CO2,y} = (EG_{PJ,add,y} - EG_{BL,existing,y}) \times EF_{CO2,grid,y} \quad (8)$$

$$EG_{BL,existing,y} = MAX\ (EG_{actual,y}, EG_{estimated,y})\ until\ DATE_{BaselineRetrofit} \quad (9)$$

Baseline emission equation choices for project scenarios E to I, applying methodology AMS-I.C are as follow:

Scenario E: Project activities that install biomass thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities will use the following equation from methodology AMS-I.C:

$$BE_{thermal,CO2,y} = (EG_{thermal,y}/\eta_{BL,thermal}) \times EF_{FF,CO2} \quad (2)$$

Scenario F: Project activities that install biomass cogeneration plants that produce renewable electricity for supply to the grid or for captive use and/or renewable thermal energy for on-site consumption or for consumption by other facilities will use the equation (1) from Methodology AMS-I.D for electricity baseline emission calculations and equation (2) from methodology AMS-I.C for thermal energy baseline emission calculations. See equations above.

Scenario G: Project activities that involve the addition of renewable thermal energy units at an existing renewable energy production facility will use the following equations from Methodology AMS-I.C:

$$EG_{thermal,add,y} = EG_{thermal,PJ,y} - EG_{thermal,old,y} \quad (5)$$

$$EG_{thermal,old,y} = MAX(EG_{thermal,actual,y}, EG_{thermal,estimated,y}) \quad (6)$$

$$EG_{thermal,old,y} = MAX(EG_{HY,thermal,retrofit,y}, EG_{estimated,thermal,y})\ until\ DATE_{BaselineRetrofit} \quad (7)$$

Scenario H: Project activities that seek to retrofit or modify an existing facility for the purpose of fuel switch from fossil fuels to biomass in heat generation equipment will use equation (2) from Methodology AMS-I.C, see above.
Scenario I: Project activities with capacity less than 45 kW thermal will use the following equation from methodology AMS-I.C: $BEy = \{B_{biomass,PJ,y} \times NCV_{biomass} \times \eta_{PJ}]/\eta_{BL}\} \times EF_{FF,CO2}$ (9)

Grid emission factor choices

The grid emission factor ($EF_{CO2,grid,y}$) will be calculated as follows: A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the Emission Factor for an electricity system" (Version 02.2.1). The grid emission factor will be calculated using the e*x ante* option: 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 the calculations see PoA-DD, Part II, Section B.4.

CO_2 emission coefficient

The CO_2 emission coefficient ($COEF_{i,y}$) shall be calculated using Option B in the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 02). In Option B $COEF_{i,y}$ is calculated based on net calorific value and CO_2 emission factor of the fuel type *i*.

Approaches to rule out leakage choice

CPA participants shall demonstrate that the use of the biomass residues does not result in increased use of fossil fuels or other GHG emissions elsewhere. For this purpose, CPA participants shall assess as part of the monitoring the supply situation for each type of biomass residue *k* used in the project plant. The table below outlines the options (methodology AM0042) that may be used to demonstrate that the biomass residues used in the plant did not increase fossil fuel consumption or other GHG emissions elsewhere.

Approaches to rule out leakage according to methodology AM0042

L_1	Demonstrate that at the sites where the project activity is supplied from with biomass residues, the biomass residues have not been collected or utilized (e.g. as fuel, fertilizer or feedstock) but have been dumped and left to decay, land-filled or burnt without energy generation (e.g. field burning) prior to the implementation of the project activity. Demonstrate that this practice would continue in the absence of the CDM project activity, e.g. by showing that in the monitored period no market has emerged for the biomass residues considered or by showing that it would still not be feasible to utilize the biomass residues for any purposes (e.g. due to the remote location where the biomass residue is generated)
L_2	Demonstrate that there is an abundant surplus of the in the region of the project activity which is not utilized. For this purpose, demonstrate that the quantity of available biomass residues of type *k* in the region is at least 25% larger than the quantity of biomass residues of type *k* that are utilized (e.g. for energy generation or as feedstock), including the project plant.
L_3	Demonstrate that suppliers of the type of biomass residue in the region of the project activity are not able to sell all of their biomass residues. For this purpose, CPA participants shall demonstrate that the ultimate supplier of the biomass residue (who supplies the project) and a representative sample of suppliers of the same type of biomass residue in the region had a surplus of biomass residues (e.g. at the end of the period during which biomass residues are sold), which they could

	not sell and which are not utilized
L_4	Identify the consumer that would use the biomass residue in the absence of the project activity (e.g. the former consumer). Demonstrate that this consumer has substituted the biomass residue diverted to the project with other types of biomass residues (and not with fossil fuels or other types of biomass than biomass residues) by showing that the former user only fires biomass residues for which leakage can be ruled out using approaches L_2 or L_3. Provide credible evidence and document the types and amounts of biomass residues used by the former user as replacement for the biomass residue fired in the project activity and apply approaches L_2 or L_3 to these types of biomass residues. Demonstrate that the substitution of the biomass residues used in the project activity with other types of biomass residues does not require a significant additional energy input except for the transportation of the biomass residues

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

Data / Parameter	*IC*
Unit	MW
Description	Installed capacity of the power plant
Source of data	Design capacity of the equipment installed
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	*CP*
Unit	MW
Description	Captive power
Source of data	Design capacity of the equipment installed
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	*TC*
Unit	MW
Description	Installed capacity of the thermal plant
Source of data	Design capacity of the equipment installed
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	*PA*
Unit	%
Description	Plant availability
Source of data	Manufacture's specifications
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$\eta_{project}$
Unit	%
Description	Efficiency of the project equipment for project activity
Source of data	Manufacture's specifications
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EF_{CO2,grid,y}$
Unit	tCO_2e/MWh
Description	CO_2 emission factor of the grid in year *y*
Source of data	See section B.4 of the PoA-DD
Value(s) applied	0.9
Choice of data or Measurement methods and procedures	A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the Emission Factor for an electricity system" (Version 02.2.1).
Purpose of data	Calculation of baseline emissions
Additional comment	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.

Data / Parameter	$EG_{estimated,y}$
Unit	MWh/yr
Description	Estimated net electrical energy that would have been produced by the existing units under the observed availability of the renewable resource in year *y*
Source of data	Estimation - Plant records / Manufacturer's specification
Value(s) applied	CPA specific value
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$DATE_{BaselineRetrofit}$
Unit	-
Description	Date at which the existing generation facility is likely to be replaced or retrofitted in the absence of the CDM project activity
Source of data	According to the "Tool to determine the remaining lifetime of equipment" (Version 01).
Value(s) applied	CPA specific
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EG_{thermal,estimated,y}$
Unit	TJ/yr
Description	The estimated thermal energy that would have been produced by the existing units under the observed availability of the renewable resource for year *y*
Source of data	Estimation - Plant records / Manufacturer's specification
Value(s) applied	CPA specific value
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	

Data / Parameter	$EG_{HY,thermal,retrofit,y}$
Unit	TJ
Description	Average of historical thermal energy levels delivered by the existing facility, spanning all data from the most recent available year (or month, week or other time period) to the time at which the facility was constructed, retrofitted, or modified in a manner that significantly affected output (i.e. by 5% or more)
Source of data	Plant records
Value(s) applied	Specific to CPA
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$EG_{estimated,thermal,y}$
Unit	TJ
Description	Estimated thermal energy that would have been produced by the existing units under the observed availability of renewable resources in year *y*
Source of data	Estimated
Value(s) applied	CPA specific
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of Baseline emissions
Additional comment	-

Data / Parameter	$\eta_{BL,thermal}$
Unit	%
Description	Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity.
Source of data	Plant records / Manufacturer's specification
Value(s) applied	CPA specific value
Choice of data or Measurement methods and procedures	The value shall be calculated according to paragraph 28 – 31 in Methodology AMS-I.C (Version 19).
Purpose of data	Calculation of baseline emissions
Additional comment	

<table>
<tr><td>Data / Parameter</td><td>$EF_{FF,CO2}$</td></tr>
<tr><td>Unit</td><td>tCO_2e/TJ</td></tr>
<tr><td>Description</td><td>The CO_2 emission factor of the fossil fuel that would have been used in the baseline plant.</td></tr>
<tr><td>Source of data</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><td>Data source</td><td>Conditions for using the data source</td></tr>
<tr><td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr>
<tr><td>b) Measurements by the project participants</td><td>If a) is not available</td></tr>
<tr><td>c) Regional or national default values</td><td>If a) is not available. These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)</td></tr>
<tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If a) is not available</td></tr>
</table></td></tr>
<tr><td>Value(s) applied</td><td>CPA specific value</td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td>For a) and b): Measurements should be undertaken in line with national or international fuel standards. For a) and b): The CO_2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comment</td><td></td></tr>
</table>

Data / Parameter	GWP_{N2O}
Unit	($kgCO_2/kg\ N_2O$)
Description	Global Warming Potential for N_2O
Source of data	IPCC default = 310, valid for the first commitment period
Value(s) applied	310
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comment	-

Data / Parameter	EF_1
Unit	ton N_2O-N/ton N input
Description	Emission Factor for emissions from N inputs
Source of data	IPCC 2006 Guidelines Table 11.1
Value(s) applied	1%
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comment	-

Data / Parameter	MW_{N2O}
Unit	ton N_2O/ton N
Description	Ratio of molecular weights of N_2O and N
Source of data	Chemistry mass balance
Value(s) applied	44/28
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comment	-

Data / Parameter	*$Frac_{GASF}$*
Unit	%
Description	Fraction that volatilises as NH_3 and NO_x for synthetic fertilizers
Source of data	2006 IPCC guidelines Table 11.3
Value(s) applied	10% volatilises as NO_x and 20% as NH_3
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comment	-

Data / Parameter	*$Frac_{GASM}$*
Unit	%
Description	Fraction that volatilises as NH_3 and NO_x for organic fertilizers
Source of data	IPCC default
Value(s) applied	10% volatilises as NO_x and 20% as NH_3
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of leakage emissions
Additional comment	-

B.6.3. Ex-ante calculations of emission reductions
>>
Emission reductions shall be calculated *ex ante* as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (1)$$

Where:
ER_y Emission reductions in year *y* (tCO_2e/yr)
BE_y Baseline emissions in year *y* (tCO_2e/yr)
PE_y Project emissions in year *y* (tCO_2e/yr)
LE_y Leakage emissions in year *y* (tCO_2e/yr)

<u>BASELINE EMISSIONS</u>

Baseline emissions will be calculated for the applicable scenarios:

Scenario		Description
A and C	$BE_{elec,y}$	Baseline emissions from project activities that supply electricity to the grid or displace electricity from the grid (tCO_2e/yr). For the purpose of clarification under the PoA, BE_y as in methodology AMS-I.D has been replaced with $BE_{elec,y}$.
B and D	$BE_{add,CO2,y}$	Baseline emissions from project activities that involve capacity addition to renewable electricity plants that supply electricity to the grid or displace electricity from the grid (tCO_2e/yr).

E	$BE_{thermal,CO2,y}$	Baseline emissions from project activities that install biomass thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities (tCO_2e/yr).
F	$BE_{cogen,y}$	Baseline emissions from project activities that install biomass cogeneration plants that produce renewable electricity for supply to the grid or for captive use and/or renewable thermal energy for on-site consumption or for consumption by other facilities (tCO_2e/yr).
G	$BE_{thermal,add,y}$	Baseline emissions from project activities that involve the addition of renewable thermal energy units at an existing renewable energy production facility (tCO_2e/yr).
H	$BE_{thermal,retrofit,y}$	Baseline emissions from project activities that seek to retrofit or modify an existing facility for the purpose of fuel switch from fossil fuels to biomass in heat generation equipment (tCO_2e/yr).
I	$BE_{<45kW,y}$	Baseline emissions from thermal energy displaced by the project activity <45kW using renewable biomass during the year *y* (tCO_2)

Project scenario A and C:Project activities that install new power plants that supply electricity to the grid or displace electricity from the grid.

Baseline emissions shall be calculated as follows:

$$BE_{elec,y} = EG_{BL,y} \times EF_{CO2,grid,y} \qquad (2)$$

Where:

$BE_{elec,y}$ Baseline emissions from project activities that supply electricity to the grid or displace electricity from the grid (tCO_2e/yr).
$EG_{BL,y}$ The amount of net renewable electricity supplied to the grid or displaced from the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)
$EF_{CO2,grid,y}$ CO_2 emission factor of the grid in year *y* (tCO_2e/MWh)

Where:

$$EG_{BL,y} = EG_{elec,gross,y} - EG_{elec,captive,y} \qquad (3)$$

Where:

$EG_{elec,gross,y}$ The gross amount of renewable electricity generated from the project activity (MWh/yr)
$EG_{elec,captive,y}$ Captive electricity consumption (MWh/yr)

With:

$$EG_{elec,gross,y} = IC \times 8\,760 \times PA \qquad (4)$$

Where:

IC Installed capacity (MW)
8 760 Conversion factor to convert MW to MWh (24 ×365 hours/yr)
PA Plant availability (%)

And:

$$EG_{elec,captive,y} = CP \times 8\,760 \times PA \qquad (5)$$

Where:

CP Captive power (MW)
8 760 Conversion factor to convert MW to MWh (24 ×365 hours/yr)
PA Plant availability (%)

For co-fired projects activities the gross amount of renewable electricity generated from the project activity is calculated as follows:

$$EG_{elec,gross,co-fire,y} = MIN\left[\sum\left(\frac{B_{biomass,k,y}}{SFC_{elec,biomass,k}}\right) and \left(EG_{elec,total,y} - \sum\frac{FC_{FF,k,y}}{SFC_{elec,FF,k}}\right)\right] \quad (6)$$

Where:

$EG_{elec,gross,co\text{-}fire,y}$	Gross quantity of renewable electricity generated from the co-fire project activity in year *y* (MWh/yr)
$B_{biomass,k,y}$	Quantity of biomass type *k* consumed in year *y* (ton/yr)
$SFC_{elec,biomass,k}$	Specific fuel consumption for electricity production for biomass type *k* (ton/MWh)
$EG_{elec,total,y}$	The total amount of electricity generated from the co-fired projects activity in year (MWh/yr) Where $EG_{elec,total,y} = EG_{BL,y}$
$FC_{FF,k,y}$	Quantity of fossil fuel type *k* consumed in co-fired system in year *y* (ton/yr)
$SFC_{elec,FF,k}$	Specific fuel consumption for electricity production for fossil fuel type *k* (ton/MWh)

Specific fuel consumption for electricity production from biomass is calculated as follows:

$$SFC_{elec,biomass,k} = B_{biomass,k,y} / (EG_{elec,gross,biomass,y} \times 8\,760) \quad (7)$$

$EG_{elec,gross,biomass,y}$	Gross amount of electricity generated from biomass (MW)
8 760	Conversion factor to convert MW to MWh (24 ×365 hours/yr)

The gross amount of electricity generated from biomass is calculated as follows:

$$EG_{elec,gross,biomass,y} = \{B_{biomass,k,y} \times (1 - \%\ water) \times NCV_{biomass,k,y}\} / 31\,536\,000 \times \eta_{project} \quad (8)$$

Where:

$B_{biomass,k,y}$	Quantity of biomass type *k* consumed in year *y* (ton/yr)
% water	Moisture content of the biomass type *k* (%)
$NCV_{biomass,k,y}$	Net calorific value of the biomass type *k* consumed in year *y* (MJ/kg)
$\eta_{project}$	Efficiency of the project equipment (%)
31 536 000	Conversion factor to convert MJ/yr to MW (60×60×24×365 seconds/year)

The specific fuel consumption for electricity production from fossil fuel is calculated as follow:

$$SFC_{elec,FF,k} = FC_{FF,k,y} / (EG_{elec,gross,FF,y} \times 8\,760) \quad (9)$$

Where:

$EG_{elec,gross,FF,y}$	Gross amount of electricity generated from fossil fuel (MW)
8 760	Conversion factor to convert MW to MWh (24 ×365 hours/yr)

The gross amount of electricity generated from fossil fuel is calculated as follows:

$$EG_{elec,gross,FF,y} = (FC_{FF,k,y} \times NCV_{FF,k,y}) / 31\,536\,000 \times \eta_{project} \quad (10)$$

Where:

$NCV_{FF,k,y}$	Net calorific value of the fossil fuel type *k* consumed in year *y* (MJ/kg)
31 536 000	Conversion factor to convert MJ/yr to MW (60×60×24×365 seconds/year)
$\eta_{project}$	Efficiency of the project equipment (%)

Project scenario B and D: Project activities that involve capacity addition that produce renewable electricity that supply electricity to the grid or displace electricity from the grid.

The baseline scenario is the existing facility that would continue to supply electricity to the grid at historical levels, until the time at which the generation facility would likely be replaced or retrofitted ($DATE_{BaselineRetrofit}$). From that point of time onwards, the baseline scenario is assumed to correspond to the project activity, and no emission reductions are assumed to occur. The energy baseline corresponds to the net increase in electricity production associated with the project should be calculated as follows:

$$BE_{add,CO2,y} = (EG_{PJ,add,y} - EG_{BL,existing,y}) \times EF_{CO2,grid,y} \tag{11}$$

Where:

$BE_{add,CO2,y}$	Baseline emissions from project activities that involve capacity addition to renewable electricity plants that supply electricity to the grid or displace electricity from the grid (tCO_2e/yr).
$EG_{PJ,add,y}$	The total net electrical energy supplied to a grid or displaced from the grid in year *y* by all units, existing and new project units (MWh/yr).
$EG_{BL,existing,y}$	The estimated net amount of electricity that would have been supplied to a grid or to a captive plant by existing units (installed before the project activity) in year *y* in the absence of the project activity (MWh/yr).

Where:

$$EG_{BL,existing,y} = MAX\ (EG_{actual,y}\ ;\ EG_{estimated,y})\ until\ DATE_{BaselineRetrofit} \tag{12}$$

and

$EG_{BL,existing,y} = 0$; on/after $DATE_{BaselineRetrofit}$

Where:

$EG_{actual,y}$	The actual, measured net electrical energy supplied to the grid or displaced from the grid by the existing units in year *y* (MWh/yr).
$EG_{estimated,y}$	Estimated net electrical energy that would have been produced by the existing units under the observed availability of the renewable resource in year *y* (MWh/yr).
$DATE_{BaselineRetrofit}$	Date at which the existing generation facility is likely to be replaced or retrofitted in the absence of the CDM project activity. Calculated according to the "Tool to determine the remaining lifetime of equipment" (Version 01).

If the existing units shut down, are derated, or otherwise become limited in production, the project activity should not get credit for generating electricity from the same renewable resources that would have otherwise been used by the existing units (or their replacements). Therefore, the equation for $EG_{elec,existing,y}$ still holds, and the value for $EG_{elec,estimated,y}$ should continue to be estimated assuming the capacity and operating parameters are the same as that at the time of the start of the project activity.

Project scenario E: Project activities that install thermal energy plants that produce renewable thermal energy for on-site consumption or for consumption by other facilities.

Baseline emissions shall be calculated as follows:

$$BE_{thermal,CO2,y} = (EG_{thermal,y}/\eta_{BL,thermal}) \times EF_{FF,CO2} \tag{13}$$

Where:

$BE_{thermal,CO2,y}$ The baseline emissions from steam/heat displaced by the project activity during the year *y* (tCO_2)
$EG_{thermal,y}$ Net quantity of thermal energy supplied by the project activity during the year *y* (TJ/yr)
$\eta_{BL,thermal}$ Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity (%).
$EF_{FF,CO2}$ The CO_2 emission factor of the fossil fuel that would have been used in the baseline plant obtained from reliable local or national data if available, alternatively, IPCC default emission factors can be used (tCO_2/TJ)

Where:

$$EG_{thermal,y} = TC \times (31\,536\,000 / 1000\,000) \times PA \quad (14)$$

Where:
TC Thermal installed capacity (MW)
31 536 000 Conversion factor to convert MW to MJ/yr (60×60×24×365 seconds/year)
PA Plant Availability (%)

For co-fired projects activities, the net quantity of renewable thermal energy supplied by the project activity is calculated as follows:

$$EG_{thermal,y} = EG_{thermal,gross,co\text{-}fire,y} \times PA \quad (15)$$

The gross quantity of renewable thermal energy supplied by the co-fire project activity is calculated as follows:

$$EG_{thermal,gross,co-fine,y} = MIN\left[\sum\left(\frac{B_{biomass,k,y}}{SFC_{thermal,biomass,k}}\right) and \left(EG_{therml,total,y} - \sum\frac{FC_{FF,k,y}}{SFC_{thermal,FF,k}}\right)\right] \quad (16)$$

Where:
$EG_{thermal,gross,co\text{-}fire,y}$ Gross quantity of renewable thermal energy supplied by the co-fired project activity in the year *y* (TJ/yr)
$B_{biomass,k,y}$ Quantity of biomass type *k* consumed in year *y* (ton/yr)
$SFC_{thermal,biomass,k,}$ Specific fuel consumption for thermal energy production for biomass type *k* (ton/TJ)
$EG_{thermal,total,y}$ Total amount of thermal energy supplied by the co-fired project activity in year *y* (TJ/yr). Where $EG_{thermal,total,y} = EG_{thermal,y}$
$FC_{FF,k,y}$ Quantity of fossil fuel type *k* consumed in co-fired system in year *y* (ton/yr)
$SFC_{thermal,FF,k}$ Specific fuel consumption for thermal energy production for fossil fuel type *k* (ton/TJ)

Specific fuel consumption for thermal energy production from biomass is calculated as follows:

$$SFC_{thermal,biomass,k} = B_{biomass,k,y} / EG_{thermal,gross,biomass,y} \quad (17)$$

Where:
$EG_{thermal,gross,biomass,y}$ Gross amount of thermal energy generated from biomass (TJ/yr)

The gross amount of thermal energy generated from biomass is calculated as follows:

$$EG_{thermal,gross,biomass,y} = B_{biomass,k,y} \times (1 - \%\ water) \times NCV_{biomass,k,y} \times \eta_{project} \quad (18)$$

Where:
$B_{biomass,k,y}$ Quantity of biomass type *k* consumed in year *y* (ton/yr)
% water Moisture content of the biomass (%)
$NCV_{biomass,k,y}$ Net calorific value of the biomass type *k* consumed in year *y* (TJ/ton)

$\eta_{project}$ Efficiency of the project equipment (%)

Specific fuel consumption for thermal energy production from fossil fuel is calculated as follows:

$$SFC_{thermal,FF,k} = FC_{FF,k,y} / EG_{thermal,gross,FF,y} \quad (19)$$

Where:

$EG_{thermal,grossFF,y}$ Gross amount of thermal energy generated from fossil fuel (MW)

The gross amount of thermal energy generated from fossil fuel is calculated as follows:

$$EG_{thermal,gross,FF,y} = FC_{FF,k,y} \times NCV_{FF,k,y} \times \eta_{project} \quad (20)$$

Where:

$FC_{FF,k,y}$	Quantity of fossil fuel type *k* consumed in year *y* (ton/yr)
$NCV_{FF,k,y}$	Net calorific value of the fossil fuel type *k* consumed in year *y* (MJ/kg)
$\eta_{project}$	Efficiency of the project equipment (%)

For projects where it can be demonstrated that the metering of thermal energy output is not plausible, the project output energy shall be estimated with the equations described above.

Project scenario F: Project activities that install cogeneration plants that produce renewable electricity for supply to the grid or for captive use and/or renewable thermal energy for on-site consumption or for consumption by other facilities.

Baseline emissions shall be calculated as follows:

$$BE_{cogen,y} = BE_{elec,y} + BE_{cogen,thermal,y} \quad (21)$$

Where:

$BE_{cogen,y}$	Baseline emissions from project activities that install biomass cogeneration plants that produce renewable electricity for supply to the grid or for captive use and/or renewable thermal energy for on-site consumption or for consumption by other facilities (tCO_2e/yr).
$BE_{elec,y}$	Baseline emissions from project activities that supply electricity to the grid or displace electricity from the grid (tCO_2e/yr).
$BE_{thermal,CO2,y}$	The baseline emissions from steam/heat displaced by the project activity during the year *y* (tCO_2)

Project scenario G: Project activities that involve the addition of renewable thermal energy units at an existing renewable energy production facility.

Baseline emissions shall be calculated as follows:

$$BE_{thermal,add,y} = (EG_{thermal,add,y} / \eta_{BL,thermal}) \times EF_{FF,CO2} \quad (22)$$

Where:

$BE_{thermal,add,y}$	Baseline emissions from project activities that involve the addition of renewable thermal energy units at an existing renewable energy production facility (tCO_2e/yr).
$EG_{thermal,add,y}$	Net increase in thermal energy generation at existing plant in year y that should be considered as energy baseline (TJ/yr)

Where

$$EG_{thermal,add,y} = EG_{thermal,PJ,y} - EG_{thermal,old,y} \quad (23)$$

Where:

$EG_{thermal,PJ,y}$ Total actual thermal energy produced in year *y* by all units, existing and new project units (TJ/yr).

$EG_{thermal,old,y}$ Estimated thermal energy that would have been produced by existing units (installed before the project activity) in year *y* in the absence of the project activity (TJ/yr)

The value $EG_{thermal,old,y}$ is given by:

$$EG_{thermal,old,y} = MAX(EG_{thermal,actual,y} ; EG_{thermal,estimated,y}) \quad (24)$$

Where:

$EG_{thermal,actual,y}$ The actual, measured thermal energy production of the existing units in year *y* (TJ/yr)

$EG_{thermal,estimated,y}$ The estimated thermal energy that would have been produced by the existing units under the observed availability of the renewable resource for year *y* (TJ/yr).

If the existing units shut down, are derated, or otherwise become limited in production, the project activity should not get credit for generating energy from the same renewable resources that would have otherwise been used by the existing units (or their replacements). Therefore, the equation for $EG_{thermal,old,y}$ still holds, and the value for $EG_{thermal,estimated,y}$ should continue to be estimated assuming the capacity and operating parameters are the same as that at the time of the start of the project activity.

If the existing units are subject to modifications or retrofits that increase production, then $EG_{thermal,old,y}$ can be estimated using the procedures described below.

$$EG_{thermal,old,y} = MAX\left(EG_{HY,thermal,retrofit,y}, EG_{estimated,thermal,y}\right) \quad until \quad DATE_{BaselineRretrofit} \quad (25)$$

Where:

$EG_{HY,thermal,retrofit,y}$ Average of historical thermal energy levels delivered by the existing facility, spanning all data from the most recent available year (or month, week or other time period) to the time at which the facility was constructed, retrofitted, or modified in a manner that significantly affected output (i.e. by 5% or more) (TJ)

$EG_{estimated,thermal,y}$ Estimated thermal energy that would have been produced by the existing units under the observed availability of renewable resources in year *y* (TJ)

$DATE_{BaselineRetrofit}$ Date at which the existing generation facility is likely to be replaced or retrofitted in the absence of the CDM project activity. Calculated according to the "Tool to determine the remaining lifetime of equipment" (Version 01)

Project scenario H: Project activities that seek to retrofit or modify an existing facility for the purpose of fuel switch from fossil fuels to biomass in heat generation equipment

Baseline emissions shall be calculated as follows:

$$BE_{thermal,retrofit,y} = (EG_{thermal,retrofit,y} / \eta_{BL,thermal}) \times EF_{FF,CO2} \quad (26)$$

Where:

$BE_{thermal,retrofit,y}$ Baseline emissions from project activities that seek to retrofit or modify an existing facility for the purpose of fuel switch from fossil fuels to biomass in heat generation equipment (tCO_2e/yr).

$EG_{thermal,retrofit,y}$ The net quantity of thermal energy supplied by the retrofit project activity during the year *y* (TJ). Where $EG_{thermal,retrofit,y} = EG_{thermal,y}$

$\eta_{BL,thermal}$ Efficiency of the plant using fossil fuel that would have been used in the absence of the project activity (%). Efficiency shall be calculated as described in methodology AMS-I.C.

$EF_{FF,CO2}$	The CO_2 emission factor of the fossil fuel that would have been used in the baseline plant (tCO_2e/TJ), obtained from reliable local or national data if available, otherwise, IPCC default emission factors are used

Project scenario I: For household or commercial applications/systems, whose maximum output capacity is less than 45 kW thermal

Where it can be demonstrated that the metering of thermal energy output is not plausible, the project output energy shall be estimated based on consumption of the biomass (in terms of energy quantity) times the efficiency of the project equipment. The equation below shall be used :

$$BE_{<45kW,y} = [HG_{PJ,y} / \eta_{BL}] \times EF_{FF,CO2}$$
$$= \{[B_{biomass,PJ,y} \times NCV_{biomass} \times \eta_{PJ}] / \eta_{BL}\} \times EF_{FF,CO2} \quad (27)$$

Where:

$BE_{<45kW,y}$	The baseline emissions from thermal energy displaced by the project activity < 45kW using renewable biomass during the year y (tCO_2)
$HG_{PJ,y}$	The net quantity of thermal energy supplied by the project activity using renewable biomass during the year y (TJ)
η_{BL}	Efficiency of the baseline equipment being replaced (determined as per paragraph 30 or 31) Where, $\eta_{BL} = \eta_{BL,thermal}$ under project activity E.
η_{PJ}	Efficiency of the project equipment measured using representative sampling methods or based on referenced literature values. The efficiency tests shall be conducted following the guidance provided in the relevant national/international standards.
$FF_{FF,CO2}$	The CO_2 emission factor of the fossil fuel that would have been used in the baseline (tCO_2/TJ)
$B_{biomass,PJ,y}$	The net quantity of the biomass consumed in year y (tons) Where, $B_{biomass,PJ,y} = B_{biomass,k,y}$ under project activity E.
$NCV_{biomass}$	The net calorific value of the biomass (TJ/tons). Where, $NCV_{biomass} = NCV_{biomass,k,y}$ under project activity E.

PROJECT EMISSIONS

Project activity emissions consist of the following:

$$PE_y = PE_{FC,i,j,y} + PE_{elec,y} \quad (28)$$

Where:

PE_y	Project emissions in yeary y (tCO_2e/yr).
$PE_{FC,i,j,y}$	Emissions from the use of fossil fuel for the operation of the project in the year y (tCO_2e/yr).
$PE_{elec,y}$	Emissions from the use of electricity for the operation of the project in the year y (tCO_2e/yr).

Emissions from fossil fuel:

Emissions from fossil fuel combustion in the project activity are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = FC_{i,j,,y} \times COEF_{i,y} \quad (29)$$

Where:

$FC_{i,j,y}$	Quantity of fossil fuel type *i* combusted in process *j* inside the project boundary in year *y* (ton/yr)
$COEF_{i,y}$	The CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit)
i	Fossil fuel types combusted in process *j* inside the project boundary in year y

With:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y} \quad (30)$$

Where:

$NCV_{i,y}$	Weighted average net calorific value of the fossil fuel type *i* combusted inside the project boundary in year *y* (TJ/ton)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* combusted inside the project boundary (tCO_2e/TJ)

Emissions from electricity use:

Project emissions from grid electricity consumption will be calculated as follows:

$$PE_{elec,y} = EC_{elec,y} \times EF_{CO2,grid,y} \quad (31)$$

Where:

$EC_{elec,y}$	Quantity of electricity consumed in the project boundary in year *y* (MWh/yr)
$EF_{CO2,grid,y}$	CO_2 emission factor of the grid in year *y* (tCO_2e/MWh)

<u>LEAKAGE EMISSIONS</u>

Leakage emissions from the renewable energy project activity consist of:

$$LE_y = LE_{FC,j,y} + LE_{transp,y} + LE_{renewable\ biomass,y} \quad (32)$$

Where:

$LE_{FC,j,y}$	Leakage emissions from collection/processing of biomass outside the project boundary during year *y* (tCO_2e/yr).
$LE_{transp,y}$	Leakage emissions from transportation of biomass outside the project boundary during year *y* (tCO_2e/yr).
$LE_{renewable\ biomass,y}$	Leakage emissions from project activities involving renewable biomass during year *y* (tCO_2e/yr).

Leakage emissions from collection/processing of biomass shall be calculated as follows:

Leakage emissions from fossil fuel combustion outside the project boundary are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

$$LE_{FC,j,y} = FC_{c,j,,y} \times COEF_{c,y} \quad (33)$$

Where:

$FC_{c,j,y}$	Quantity of fossil fuel type *c* combusted in process *j* outside the project boundary in year *y* (ton/yr)
$COEF_{c,y}$	The CO_2 emission coefficient of fuel type *c* in year y (tCO_2/mass or volume unit)
c	Fossil fuel types combusted in process *j* outside the project boundary in year y

With:

$$COEF_{c,y} = NCV_{c,y} \times EF_{CO2,c,y} \quad (34)$$

Where:

$NCV_{c,y}$	Weighted average net calorific value of the fossil fuel type *c* combusted outside the project boundary in year *y* (TJ/ton)
$EF_{CO2,c,y}$	CO_2 emission factor of fossil fuel type *c* combusted outside the project boundary (tCO_2e/TJ)

Leakage emissions from incremental transportation shall be calculated as follows:

If the biomass is transported over a distance of more than 200 kilometres due to the implementation of the project activity then this leakage source attributed to transportation shall be considered, otherwise it can be neglected.

$$LE_{transp,y} = (Q_y / CT_y) \times DAF_w \times EF_{CO2} \quad (35)$$

Where:

$Q_{y,}$	Quantity of biomass transported outside the project boundary in the year *y* (ton or m^3/yr)
CT_y	Average truck capacity for transportation outside the project boundary (ton or m^3/truck)
DAF_w	Average incremental distance for biomass transportation outside the project boundary (km/truck)
$EF_{CO2/km}$	CO_2 emission factor from fossil fuel use due to transportation outside the project boundary (tCO_2e/km)

CO_2 emission factor from fossil fuel use due to transportation

$$EF_{CO2/km} = VF_{cons} \times D_{fuel,y} \times NCV_{fuel} \times EF_{fuel} \quad (36)$$

Where:

VF_{cons}	Vehicle fuel consumption in litres per kilometre (ℓ/km)
D_{fuel}	Fuel density (kg/ℓ), if necessary
$NCV_{fuel,y}$	Net calorific value of the fuel used for transport outside the project boundary in year *y* (TJ/kg or other unit)
EF_{fuel}	Emission factor of the fuel for transport outside the project boundary (tCO_2e/TJ)

Leakage emissions from project activities involving renewable biomass:

For small scale CDM project activities involving renewable biomass there are three types of emissions sources that are potentially significant (>10% of emission reductions) and attributable to the project activities.

$$LE_{renewable\ biomass} = LE_{shift} + LE_{production} + LE_{competing} \quad (37)$$

Where:

LE_{shift}	Leakage due to shifts of pre-project activities (tCO_2e/yr).
$LE_{production}$	Leakage due to emissions related to the production of the biomass (tCO_2e/yr).
$LE_{competing}$	Leakage due to competing uses for the biomass (tCO_2e/yr)

Leakage due to shifts of pre-project activities:

Demonstrate that the project activity does not lead to a shift of pre-project activities outside the project boundary i.e. the land under the proposed project activity can continue to provide at least the same amount of goods and services as in the absence of the project.

Therefore, $LE_{shift} = 0$

Leakage due to emissions related to the production of the biomass

Potentially significant emission sources from the production of renewable biomass can be:

(a) Emissions from application of fertilizer; and

(b) Project emissions from clearance of lands.

These emissions sources should respectively be included. All other emission sources are likely to be smaller than 10% (each) - including transportation of raw materials and biomass, fossil fuel consumption for the cultivation of plantations - and can therefore be neglected in the context of SSC project activities.

Potentially significant emission sources from the production of renewable biomass can be:

$$LE_{production} = LE_{N2O} + LE_{clearance} \tag{38}$$

Where:

LE_{N2O}	Direct N_2O emission as a result of nitrogen application (tCO_2e/yr)
$LE_{clearance}$	Emissions from clearance of lands (tCO_2e/yr)

(a) Emissions from application of fertilizer

The direct nitrous oxide emissions from nitrogen fertilization can be estimated using equations as follows:

$$LE_{N2O} = (F_{SN,y} + F_{ON,y}) \times FE_1 \times MW_{N20} \times GWP_{N20} \tag{39}$$

$F_{SN,y}$	Mass of synthetic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NO_x (ton N/yr)
$F_{ON,y}$	Mass of organic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NO_x (ton N/yr)
EF_1	Emission Factor for emissions from N inputs (ton N_2O-N/tN input)
MW_{N2O}	Ratio of molecular weights of N_2O and N (44/28) (ton N_2O/tN)
GWP_{N2O}	Global Warming Potential for N_2O ($kgCO_2$/kg N_2O) (IPCC default = 310, valid for the first commitment period)

Mass of fertilizer nitrogen applied shall be calculated as follows:

$$F_{SN,y} = \sum_i M_{SFi,y} \times NC_{SFi} \times (1 - Frac_{GASF}) \tag{40}$$

$$F_{ON,y} = \sum_j M_{OFj,y} \times NC_{OFj} \times (1 - Frac_{GASM}) \tag{41}$$

Where:

$M_{SFi,y}$	Mass of synthetic fertilizer type i applied (ton/yr)
$M_{OFj,y}$	Mass of organic fertilizer type j applied (ton/yr)
$Frac_{GASF}$	Fraction that volatilises as NH_3 and NO_x for synthetic fertilizers (%)
$Frac_{GASM}$	Fraction that volatilises as NH_3 and NO_x for organic fertilizers (%)
NC_{SFi}	Nitrogen content of synthetic fertilizer type i applied (gN/100 g fertilizer)
NC_{OFj}	Nitrogen content of organic fertilizer type j applied (gN/100 g fertilizer)

(b) Project emissions from clearance of lands

Demonstrate that the area where the biomass is grown is not a forest (as per DNA forest definition) and has not been deforested, according to the forest definition by the national DNA, during the last 10 years prior to the implementation of the project activity. In the absence of forest definition from the DNA, definitions provided by relevant international organisations (e.g., FAO) shall be used.

Therefore, $LE_{clearance} = 0$

Leakage due to competing uses for the biomass

An important potential source of leakage is an increase in emissions from fossil fuel combustion or other sources due to diversion of biomass residues from other uses to the project plant as a result of the project activity.

CPA participants shall demonstrate that the use of the biomass residues does not result in increased use of fossil fuels or other GHG emissions elsewhere. For this purpose, CPA participants shall assess, as part of the monitoring process, the supply situation for each type of biomass residue *k* used in the project plant. The table below outlines the options that may be used to demonstrate that the biomass residues used in the plant did not increase fossil fuel consumption or other GHG emissions elsewhere.

Which approach should be used depends on the most plausible baseline scenario for the use of the biomass residues. Where scenarios B1, B2 or B3 apply, use approaches L_1, L_2 and/or L_3. Where scenario B4 applies, use approaches L_2 or L_3. Where scenario B5 applies, use approach L_4.

Baseline scenarios:
B1: The biomass residues are dumped or left to decay under mainly aerobic conditions.
B2: The biomass residues are dumped or left to decay under clearly anaerobic conditions.
B3: The biomass residues are burnt in an uncontrolled manner without utilizing them for energy purposes
B4: The biomass residues are sold to other consumers in the market and the predominant use of the biomass residues in the region/country is for energy purposes (heat and/or power generation)
B5: The biomass residues are used as feedstock in a process (e.g. in the pulp and paper industry or fertilizer industry)

Approaches to rule out leakage

L_1	Demonstrate that at the sites where the project activity is supplied from with biomass residues, the biomass residues have not been collected or utilized (e.g. as fuel, fertilizer or feedstock) but have been dumped and left to decay, land-filled or burnt without energy generation (e.g. field burning) prior to the implementation of the project activity. Demonstrate that this practice would continue in the absence of the CDM project activity, e.g. by showing that in the monitored period no market has emerged for the biomass residues considered or by showing that it would still not be feasible to utilize the biomass residues for any purposes (e.g. due to the remote location where the biomass residue is generated)
L_2	Demonstrate that there is an abundant surplus of the in the region of the project activity which is not utilized. For this purpose, demonstrate that the quantity of available biomass residues of type *k* in the region is at least 25% larger than the quantity of biomass residues of type *k* that are utilized (e.g. for energy generation or as feedstock), including the project plant.
L_3	Demonstrate that suppliers of the type of biomass residue in the region of the project activity are not able to sell all of their biomass residues. For this purpose, CPA participants shall demonstrate that the ultimate supplier of the biomass residue (who supplies the project) and a representative sample of suppliers of the same type of biomass residue in the region had a surplus of biomass residues (e.g. at the end of the period during which biomass residues are sold), which they could not sell and which are not utilized
L_4	Identify the consumer that would use the biomass residue in the absence of the project activity

	(e.g. the former consumer). Demonstrate that this consumer has substituted the biomass residue diverted to the project with other types of biomass residues (and not with fossil fuels or other types of biomass than biomass residues) by showing that the former user only fires biomass residues for which leakage can be ruled out using approaches L_2 or L_3. Provide credible evidence and document the types and amounts of biomass residues used by the former user as replacement for the biomass residue fired in the project activity and apply approaches L_2 or L_3 to these types of biomass residues. Demonstrate that the substitution of the biomass residues used in the project activity with other types of biomass residues does not require a significant additional energy input except for the transportation of the biomass residues

Where approaches L_2, L_3 or L_4 are used to assess leakage effects, the geographical boundary of the region shall be clearly defined and document. In defining the geographical boundary of the region, the usual distances for biomass transports will be taken into account. A biomass survey needs to be done for these approaches.

Below is the calculation for estimation of the surplus biomass type *k* in the region applicable to approach *L2, L3* and *L4*.

$$BF_{diff,k,y} = BF_{available,k,y} - (BF_{utilized,k,y} \times 1.25) \qquad (42)$$

Where

$BF_{diff,k,y}$	Difference in quantity of biomass available and the required 25% larger than the quantity utilised (ton/yr)
$BF_{available,k,y}$	Quantity of available biomass residues of type *k* or *m* in the region (ton/ yr)
$BF_{utilized,k,y}$	Quantity of available biomass residues of type *k* or *m* that are utilized in the defined geographical region (ton/yr)

In case $BF_{diff,k,y}$ is positive (+) leakage can be ruled out. However, if $BF_{diff,k,y}$ is negative (-), then leakage effects cannot be ruled out.

If for a certain biomass residue type *k* used in the project leakage effects cannot be ruled out with one of the approaches above, leakage effects for the year *y* shall be calculated as follows:

$$LE_{competing,y} = EF_{CO2,LE} \times \sum_n BF_{LE,n,y} \times NCV_n \qquad (43)$$

Where:

$EF_{CO2,LE}$	CO_2 emission factor of the most carbon intensive fuel used in the country (tCO_2/TJ)
$BF_{LE,n,y}$	Quantity of biomass residue type *n* used for heat generation as a result of the project activity during the year *y* and for which leakage can not be ruled out using one of the approaches L_1, L_2, L_3 or L_4 (tons of dry matter or liter)
NCV_n	Net calorific value of the biomass residue type *n* (GJ/ton of dry matter or TJ/liter)
n	Biomass residue type *n* for which leakage can not be ruled out using one of the approaches L_1, L_2, L_3 or L_4

In case of approaches L_1, $BF_{LE,n,y}$ corresponds to the quantity of biomass residue type *n* that is obtained from the relevant source or sources.

In case of approaches L_2 or L_3, $BF_{LE,n,y}$ corresponds to the quantity of biomass residue type *k* used in the project plant as a result of the project activity during the year *y* ($BF_{LE,n,y} = B_{biomass,k,y}$, where $n=k$).

In case of approach L_4, ($BF_{LE,n,y} \times NCV_n$) corresponds to the lower value of

(a) The quantity of fuel types *m*, expressed in energy quantities, that are used by the former user of the biomass residue type *k* and for which leakage can not be ruled out because the fuels used are either (i) fuels types other than biomass residues (e.g. fossil fuels or biomass types other than biomass residues) or (ii) are biomass residues but leakage can not be ruled out for those types of biomass residues with approaches L_2 or L_3; as follows:

$$BF_{LE,n,y} \times NCV_n = \sum_m FC_{former\ user,m,y} \times NCV_m$$

$BF_{LE,n,y}$	Quantity of biomass residue type *n* used for heat generation as a result of the project activity during the year *y* and for which leakage can not be ruled out using approach L_4 (tons of dry matter or liter)
NCV_n	Net calorific value of the biomass residue type *n* (GJ/ton of dry matter or GJ/liter)
n	Biomass residue type n for which leakage can not be ruled out using approach L4
$FC_{former\ user,m,y}$	Quantity of fuel type *m* used by the former user of the biomass residue type *n* during the year *y* (mass or volume unit)
NCV_m	Net calorific value of fuel type *m* (GJ/ton of dry matter or GJ/liter)
m	Fuel type *m*, being either (i) a fuel type other than a biomass residue (e.g. fossil fuel or biomass other than biomass residues) or (ii) a biomass residues for which leakage can not be ruled out with approaches L_2 or L_3

(b) The quantity of biomass residue type *k*, expressed in energy quantities, used in the project plant during the year *y* ($BF_{LE,n,y} = B_{biomass,k,y}$, *where n=k*).

B.7. Application of the monitoring methodology and description of the monitoring plan
B.7.1. Data and parameters to be monitored by each generic CPA

Data / Parameter	$EG_{BL,y}$
Unit	MWh/yr
Description	The amount of net renewable electricity supplied to the grid or displaced from the grid as a result of the implementation of the CDM project activity in year *y*
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Measurements are taken using electricity meters. Standards to be applied: Standards used by ESKOM - SANS62053 part 11 and 21 Accuracy of measurements: As in SANS S62053 Person/entity responsible for the measurements: CPA implementer
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. If applicable, measurement results shall be cross checked with records for sold/purchased electricity (e.g. invoices/receipts). If applicable, cross check net electricity supplied to a grid as gross energy generation in the project activity power plant minus the auxiliary/station electricity consumption, technical losses and electricity import from the grid to the project power plant measured at the grid interface/connection used for billing purposes
Purpose of data	Calculation of baseline emissions
Additional comments	

Data / Parameter	$EG_{PJ,add,y}$
Unit	MWh/yr
Description	The total net electrical energy supplied to a grid or displaced from the grid in year *y* by all units, existing and new project units
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Measurements are taken using electricity meters. Standards to be applied: Standards used by ESKOM - SANS62053 part 11 and 21 Accuracy of measurements: As in SANS S62053 Person/entity responsible for the measurements: CPA implementer
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	

Data / Parameter	$EG_{actual,y}$
Unit	MWh/yr
Description	The actual, measured net electrical energy supplied to the grid or displaced from the grid by the existing units in year *y*
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Measurements are taken using electricity meters. Standards to be applied: Standards used by ESKOM - SANS62053 part 11 and 21 Accuracy of measurements: As in SANS S62053 Person/entity responsible for the measurements: CPA implementer
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	

Data / Parameter	EC_y
Unit	MWh/yr
Description	Quantity of electricity consumed in the project boundary in year *y*
Source of data	
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Measurements are taken using electricity meters. Standards to be applied: Standards used by ESKOM - SANS62053 part 11 and 21 Accuracy of measurements: As in SANS S62053 Person/entity responsible for the measurements: CPA implementer
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of project emissions (electricity)
Additional comments	-

Data / Parameter	$EG_{thermal,y}$
Unit	TJ/yr
Description	Net quantity of thermal energy supplied by the project activity during the year *y*
Source of data	Calculated as described in monitoring section of methodology AMS-I.C (version 19), paragraph 50 no. 7.
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuous monitoring, aggregated annually
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$EG_{thermal,PJ,y}$
Unit	TJ/yr
Description	Total actual thermal energy produced in year *y* by all units, existing and new project units
Source of data	Calculated as described in monitoring section of methodology AMS-I.C (version 19), paragraph 50 no. 7.
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuous monitoring, aggregated annually
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$EG_{thermal,actual,y}$
Unit	TJ/yr
Description	The actual, measured thermal energy production of the existing units in year *y*
Source of data	Calculated as described in monitoring section of methodology AMS-I.C (version 19), paragraph 50 no. 7.
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuous monitoring, aggregated annually
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$EG_{thermal,retrofit,y}$
Unit	TJ
Description	The net quantity of steam/heat supplied by the retrofit project activity during the year *y*
Source of data	Calculated as described in monitoring section of methodology AMS-I.C (version 19), paragraph 50 no. 7.
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuous monitoring, aggregated annually
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$Q_{hot\ air}$
Unit	m^3/yr
Description	Quantity of hot air
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Flow meter Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA Where it is not feasible (e.g. because of too high temperature), spot measurements can be used through sampling with a 90% confidence level and a 10% precision
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recordings
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	

Data / Parameter	Q_{steam}
Unit	m^3/yr
Description	Quantity of steam
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Flow meter Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. If applicable, measurement results shall be cross checked with records for sold/purchased electricity (e.g. invoices/receipts)
Purpose of data	Calculation of baseline emissions
Additional comments	

Data / Parameter	*T*
Unit	°C
Description	Temperature
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Temperature gauge Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	

Data / Parameter	*P*
Unit	kPa
Description	Pressure
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Pressure gauge Standards to be applied: Relevant national/international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Continuous monitoring, integrated hourly and at least monthly recording
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	

Data / Parameter	$B_{biomass,k,y}$
Unit	Mass or volume/yr
Description	Quantity of biomass type *k* consumed in year *y*
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA Adjust for the moisture content in order to determine the quantity of dry biomass. If more than one type of biomass fuel is consumed, each shall be monitored separately. For the case of processed renewable biomass (e.g. briquettes) data shall be collected for mass, moisture content, NCV of the processed biomass that is supplied to users.
Monitoring frequency	The quantity of biomass shall be measured continuously or in batches.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. Cross-check the measurements with an annual energy balance that is based on purchased quantities (e.g. with sales receipts) and stock changes. In cases where emission reductions are calculated based on energy output, check the consistency of measurements *ex post* with annual data on energy generation, fossil fuels and biomass used and the efficiency of energy generation as determined *ex ante*
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	*% water*
Unit	%
Description	Moisture content of the biomass type *k*
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: On-site measurements Standards to be applied: Relevant national or international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA On-site measurements. This applies in the case where emission reductions are calculated based on biomass energy input. In case of dry biomass, monitoring of this parameter is not necessary
Monitoring frequency	The moisture content of biomass of homogeneous quality shall be monitored for each batch of biomass. The weighted average should be calculated for each monitoring period and used in the calculations.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$NCV_{biomass,k,y}$
Unit	MJ/kg
Description	Net calorific value of the biomass type *k* consumed in year
Source of data	Measured
Value(s) applied	Specific to CPa
Measurement methods and procedures	Measurement method: Laboratory measurement. Standards to be applied: Relevant national or international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Measure quarterly, taking at least three samples for each measurement. The average value can be used for the rest of the crediting period.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. Check the consistency of the measurements by comparing the measurement results with, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. (If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements)
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data / Parameter	$FC_{FF,k,y}$
Unit	Mass or volume unit per year (e.g. ton/yr or m^3/yr)
Description	Quantity of fossil fuel type *k* consumed in co-fired system in year *y*
Source of data	On-site measurements
Value(s) applied	Specific to CPA
Measurement methods and procedures	• Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); • Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; • In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions.
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Purpose of data	Calculation of baseline emissions
Additional comments	Only applicable to co-fire projects

<table>
<tr><td>Data / Parameter</td><td>$NCV_{FF,k,y}$</td></tr>
<tr><td>Unit</td><td>MJ/kg</td></tr>
<tr><td>Description</td><td>Net calorific value of the fossil fuel type k consumed in the co-fire system in year y</td></tr>
<tr><td>Source of data</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><td>Data source</td><td>Conditions for using the data source</td></tr>
<tr><td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source if the carbon fraction of the fuel is not provided (Option A)</td></tr>
<tr><td>b) Measurements by the project participants</td><td>If a) is not available</td></tr>
<tr><td>c) Regional or national default values</td><td>If a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).</td></tr>
<tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines</td><td>If a) is not available</td></tr>
</table></td></tr>
<tr><td>Value(s) applied</td><td>Specific to CPA</td></tr>
<tr><td>Measurement methods and procedures</td><td>For a) and b): Measurements should be undertaken in line with national or international fuel standards</td></tr>
<tr><td>Monitoring frequency</td><td>For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated
For c): Review appropriateness of the values annually
For d): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>QA/QC procedures</td><td>Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comments</td><td>Only applicable to co-fire projects</td></tr>
</table>

Data / Parameter	η_{PJ}
Unit	%
Description	Efficiency of the project equipment
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Efficiency of the project equipment measured using representative sampling methods or based on referenced literature values. The efficiency tests shall be conducted following the guidance provided in the relevant national/international standards.
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	Only applicable to projects < 45kW

Data / Parameter	$SFC_{elec,biomass,k}$
Unit	ton/MWh
Description	Specific fuel consumption for electricity production for biomass type *k* (
Source of data	Calculated or manufacturer's specification
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Determine once in the first year of the crediting period
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	Only applicable to co-fire projects

Data / Parameter	$SFC_{elec,FF,k}$
Unit	ton/MWh
Description	Specific fuel consumption for electricity production for fossil fuel type *k*
Source of data	Calculated or manufacturer's specification
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Determine once in the first year of the crediting period
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	Only applicable to co-fire projects

Data / Parameter	$SFC_{thermal,biomass,k,}$
Unit	ton/TJ
Description	Specific fuel consumption for thermal energy production for biomass type *k*
Source of data	Calculated or manufacturer’s specification
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Determine once in the first year of the crediting period
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	Only applicable to co-fire projects

Data / Parameter	$SFC_{thermal,FF,k}$
Unit	ton/TJ
Description	Specific fuel consumption for thermal energy production for fossil fuel type *k*
Source of data	Calculated or manufacturer’s specification
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Determine once in the first year of the crediting period
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	Only applicable to co-fire projects

Data / Parameter	$FC_{i,j,y}$
Unit	ton/yr or m^3/yr
Description	Quantity of fossil fuel type *i* combusted in process *j* inside the project boundary in year *y*
Source of data	Onsite measurements
Value(s) applied	Specific to CPA
Measurement methods and procedures	• Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); • Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; • In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions.
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Purpose of data	Calculation of project emissions (fossil fuel)
Additional comments	

Data / Parameter	$COEF_{i,y}$
Unit	tCO_2/mass or volume unit
Description	The CO_2 emission coefficient of fuel type i in year y
Source of data	Calculated
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	-
QA/QC procedures	-
Purpose of data	Calculation of project emissions (fossil fuel)
Additional comments	-

<table>
<tr><td>Data / Parameter</td><td>$NCV_{i,y}$</td></tr>
<tr><td>Unit</td><td>TJ/ton</td></tr>
<tr><td>Description</td><td>Weighted average net calorific value of the fossil fuel type i combusted inside the project boundary in year y</td></tr>
<tr><td>Source of data</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><td>Data source</td><td>Conditions for using the data source</td></tr>
<tr><td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source if the carbon fraction of the fuel is not provided (Option A)</td></tr>
<tr><td>b) Measurements by the project participants</td><td>If a) is not available</td></tr>
<tr><td>c) Regional or national default values</td><td>If a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).</td></tr>
<tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines</td><td>If a) is not available</td></tr>
</table></td></tr>
<tr><td>Value(s) applied</td><td>Specific to CPA</td></tr>
<tr><td>Measurement methods and procedures</td><td>For a) and b): Measurements should be undertaken in line with national or international fuel standards</td></tr>
<tr><td>Monitoring frequency</td><td>For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated
For c): Review appropriateness of the values annually
For d): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>QA/QC procedures</td><td>Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of project emissions (fossil fuel)</td></tr>
<tr><td>Additional comments</td><td></td></tr>
</table>

<table>
<tr><td>Data / Parameter</td><td>$EF_{CO2,i,y}$</td></tr>
<tr><td>Unit</td><td>tCO_2/TJ</td></tr>
<tr><td>Description</td><td>CO_2emission factor of fossil fuel type i combusted inside the project boundary</td></tr>
<tr><td>Source of data</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><td>Data source</td><td>Conditions for using the data source</td></tr>
<tr><td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr>
<tr><td>b) Measurements by the project participants</td><td>If a) is not available</td></tr>
<tr><td>c) Regional or national default values</td><td>If a) is not available. These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)</td></tr>
<tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If a) is not available</td></tr>
</table></td></tr>
<tr><td>Value(s) applied</td><td>Specific to CPA</td></tr>
<tr><td>Measurement methods and procedures</td><td>For a) and b): Measurements should be undertaken in line with national or international fuel standards</td></tr>
<tr><td>Monitoring frequency</td><td>For a) and b): The CO2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated.
For c): Review appropriateness of the values annually
For d): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>QA/QC procedures</td><td>-</td></tr>
<tr><td>Purpose of data</td><td>Calculation of project emissions (fossil fuel)</td></tr>
<tr><td>Additional comments</td><td>For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, Options b), c) or d) should be used.</td></tr>
</table>

Data / Parameter	$FC_{c,j,y}$
Unit	ton/yr or m^3/yr
Description	Quantity of fossil fuel type *c* combusted in process *j* outside the project boundary in year *y*
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	• Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift); • Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; • In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions.
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Purpose of data	Calculation of leakage (fossil fuel)
Additional comments	-

Data / Parameter	$COEF_{c,y}$
Unit	tCO_2/mass or volume unit
Description	The CO_2 emission coefficient of fuel type *c* in year y
Source of data	Calculated
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	-
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions (fossil fuel)
Additional comments	-

Data / Parameter	$NCV_{c,y}$
Unit	TJ/ton
Description	Weighted average net calorific value of the fossil fuel type *c* combusted outside the project boundary in year *y*
Source of data	The following data sources may be used if the relevant conditions apply: **Data source** / **Conditions for using the data source** a) Values provided by the fuel supplier in invoices — This is the preferred source if the carbon fraction of the fuel is not provided (Option A) b) Measurements by the project participants — If a) is not available c) Regional or national default values — If a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances). d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines — If a) is not available
Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data	Calculation of leakage emissions (fossil fuel)
Additional comments	

Data / Parameter	$EF_{CO2,c,y}$
Unit	tCO_2e/TJ
Description	CO_2emission factor of fossil fuel type *c* combusted outside the project boundary
Source of data	The following data sources may be used if the relevant conditions apply: <table><tr><td>Data source</td><td>Conditions for using the data source</td></tr><tr><td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr><tr><td>b) Measurements by the project participants</td><td>If a) is not available</td></tr><tr><td>c) Regional or national default values</td><td>If a) is not available. These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)</td></tr><tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If a) is not available</td></tr></table>
Value(s) applied	Specific to CPA
Measurement methods and procedures	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For a) and b): The CO2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, Options b), c) or d) should be used.

Data / Parameter	$Q_{y,}$
Unit	ton/yr or m^3/yr
Description	Quantity of biomass transported outside the project boundary in the year *y*
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA.
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used.
Purpose of data	Calculation of leakage emissions
Additional comments	-

Data / Parameter	CT_y
Unit	ton/truck
Description	Average truck capacity for transportation outside the project boundary
Source of data	Records, e.g. logbooks
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

Data / Parameter	DAF_w
Unit	km/truck
Description	Average incremental distance for biomass transportation outside the project boundary
Source of data	Records, e.g. logbooks
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

Data / Parameter	VF_{cons}
Unit	ℓ/km
Description	Vehicle fuel consumption in litres per kilometre
Source of data	Records (e.g. logbooks) or standard fuel consumption for type of truck or IPCC values
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

Data / Parameter	D_{fuel}
Unit	kg/ℓ
Description	Fuel density
Source of data	Oil company data for fuel type used
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

<table>
<tr><td>Data / Parameter</td><td>$NCV_{fuel,y}$</td></tr>
<tr><td>Unit</td><td>TJ/kg or other unit</td></tr>
<tr><td>Description</td><td>Net calorific value of the fuel used for transport outside the project boundary in year y</td></tr>
<tr><td>Source of data</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><td>Data source</td><td>Conditions for using the data source</td></tr>
<tr><td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source if the carbon fraction of the fuel is not provided (Option A)</td></tr>
<tr><td>b) Measurements by the project participants</td><td>If a) is not available</td></tr>
<tr><td>c) Regional or national default values</td><td>If a) is not available. These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances).</td></tr>
<tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines</td><td>If a) is not available</td></tr>
</table></td></tr>
<tr><td>Value(s) applied</td><td>Specific to CPA</td></tr>
<tr><td>Measurement methods and procedures</td><td>For a) and b): Measurements should be undertaken in line with national or international fuel standards</td></tr>
<tr><td>Monitoring frequency</td><td>For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated
For c): Review appropriateness of the values annually
For d): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>QA/QC procedures</td><td>Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of leakage emissions (transport)</td></tr>
<tr><td>Additional comments</td><td>-</td></tr>
</table>

<table>
<tr><td>Data / Parameter</td><td>EF_{fuel}</td></tr>
<tr><td>Unit</td><td>tCO_2e/TJ</td></tr>
<tr><td>Description</td><td>Emission factor of the fuel for transport outside the project boundary</td></tr>
<tr><td>Source of data</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><td>Data source</td><td>Conditions for using the data source</td></tr>
<tr><td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr>
<tr><td>b) Measurements by the project participants</td><td>If a) is not available</td></tr>
<tr><td>c) Regional or national default values</td><td>If a) is not available. These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)</td></tr>
<tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If a) is not available</td></tr>
</table></td></tr>
<tr><td>Value(s) applied</td><td>Specific to CPA</td></tr>
<tr><td>Measurement methods and procedures</td><td>For a) and b): Measurements should be undertaken in line with national or international fuel standards</td></tr>
<tr><td>Monitoring frequency</td><td>For a) and b): The CO2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated.
For c): Review appropriateness of the values annually
For d): Any future revision of the IPCC Guidelines should be taken into account</td></tr>
<tr><td>QA/QC procedures</td><td>-</td></tr>
<tr><td>Purpose of data</td><td>Calculation of leakage emissions</td></tr>
<tr><td>Additional comments</td><td>For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, Options b), c) or d) should be used.</td></tr>
</table>

Data / Parameter	$M_{SFi,y}$
Unit	ton/yr
Description	Mass of synthetic fertilizer type i applied
Source of data	On-site records
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

Data / Parameter	$M_{OFj,y}$
Unit	ton/yr
Description	Mass of organic fertilizer type j applied
Source of data	On-site records
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Continuously, aggregated monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

Data / Parameter	NC_{SFi}
Unit	gN/100 g fertilizer
Description	Nitrogen content of synthetic fertilizer type i applied
Source of data	Supplier information
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

Data / Parameter	NC_{OFj}
Unit	gN/100 g fertilizer
Description	Nitrogen content of organic fertilizer type j applied
Source of data	Supplier information
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Monthly
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

Data / Parameter	-
Unit	-
Description	Demonstration that the biomass residue type k from a specific source would continue not to be collected or utilized, e.g. by an assessment whether a market has emerged for that type of biomass residue (if yes, leakage is assumed not be ruled out) or by showing that it would still not be feasible to utilize the biomass residues for any purposes
Source of data	Information from the site where the biomass is generated
Value(s) applied	-
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	-
Additional comments	Monitoring of this parameter is applicable if approach L_1 is used to rule out leakage

Data / Parameter	-
Unit	-
Description	Availability of a surplus of biomass residue type *k* or *m* (which can not be sold or utilized) at the ultimate supplier to the project (or, in case of L_4, the former user of the biomass residue type *k*) and a representative sample of other suppliers in the defined geographical region
Source of data	Surveys
Value(s) applied	-
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	-
Additional comments	Monitoring of this parameter is applicable if approach L_3 is used to rule out leakage or if approach L_4 is used in combination with approach L_3 to rule out leakage for the substituted biomass residue type *m*

Data / Parameter	$BF_{available,k,y}$
Unit	ton/yr
Description	Quantity of available biomass residues of type *k* or *m* in the region
Source of data	Surveys or statistics from the defined geographical region
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	Monitoring of this parameter is applicable if approach L_2 is used to rule out leakage or if approach L_4 is used in combination with approach L_2 to rule out leakage for the substituted biomass residue type *m*

Data / Parameter	$BF_{utilized,k,y}$
Unit	ton/yr
Description	Quantity of available biomass residues of type *k* or *m* that are utilized in the defined geographical region
Source of data	Surveys or statistics from the defined geographical region
Value(s) applied	Specific to CPA
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	Monitoring of this parameter is applicable if approach L_2 is used to rule out leakage or if approach L_4 is used in combination with approach L_2 to rule out leakage for the substituted biomass residue type *m*

Data / Parameter	$EF_{CO2,LE}$
Unit	tCO_2/TJ
Description	CO_2 emission factor of the most carbon intensive fuel used in the country
Source of data	Identify the most carbon intensive fuel type from the national communication, other literature sources (e.g. IEA). Possibly consult with the national agency responsible for the national communication / GHG inventory. If available, use national default values for the CO_2 emission factor. Otherwise, IPCC default values may be used
Value(s) applied	-
Measurement methods and procedures	-
Monitoring frequency	Annually
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comments	-

Data / Parameter	$BF_{LE,n,y}$
Unit	Ton/yr or m3/year
Description	Quantity of biomass residue type *n* used for energy generation as a result of the project activity during the year *y* and for which leakage can not be ruled out using one of the approaches L_1, L_2, L_3 or L_4
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Use mass or volume based measurements. Standards to be applied: Relevant national/ international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA Adjust for the moisture content in order to determine the quantity of dry biomass. If more than one type of biomass fuel is consumed, each shall be monitored separately. For the case of processed renewable biomass (e.g. briquettes) data shall be collected for mass, moisture content, NCV of the processed biomass that is supplied to users.
Monitoring frequency	The quantity of biomass shall be measured continuously or in batches.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. Cross-check the measurements with an annual energy balance that is based on purchased quantities (e.g. with sales receipts) and stock changes. In cases where emission reductions are calculated based on energy output, check the consistency of measurements *ex post* with annual data on energy generation, fossil fuels and biomass used and the efficiency of energy generation as determined *ex ante*
Purpose of data	Calculation of leakage emissions
Additional comments	-

Data / Parameter	NCV_n, NCV_m
Unit	MJ/kg
Description	Net calorific value of the biomass residue type n or m
Source of data	Measured
Value(s) applied	Specific to CPA
Measurement methods and procedures	Measurement method: Laboratory measurement. Standards to be applied: Relevant national or international standard or manufacturer's specifications Accuracy of measurements: According to applicable standard or manufacturer's specifications Person/entity responsible for the measurements: Specific to CPA
Monitoring frequency	Measure quarterly, taking at least three samples for each measurement. The average value can be used for the rest of the crediting period.
QA/QC procedures	CPA implementers shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacturer's specifications. If local/national standards or the manufacturer's specifications are not available, international standards may be used. Check the consistency of the measurements by comparing the measurement results with, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC. (If the measurement results differ significantly from previous measurements or other relevant data sources, conduct additional measurements)
Purpose of data	Calculation of leakage emissions
Additional comments	-

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

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1. Management of parameters to be monitored

The Tables below show all the possible parameters to be monitored for the different project scenarios under the PoA. From these tables, the CME will compile a list of relevant parameters for each CPA in section D.7.2 of the CPA-DD. Further information on the source of date, details on the measurement methods and procedures and QA/QC procedures will be as describe in section D.7.1 of the CPA-DD

CPAs shall monitor 100% of the relevant parameters included in Section D.7.1. of each CPA-DD. Monitoring reports will be prepared separately for all CPAs, however only a sample will be verified by the DOE. See the sampling procedure proposed for verification below in "Reporting and verification".

The following tables show all the parameters to be monitored under the PoA:

Table 1.a Baseline parameters related to electricity generation to be monitored (additional parameters for co-fire projects are shown separately)

Table 1.b Baseline parameters related to thermal energy generation to be monitored (additional parameters for co-fire projects are shown separately)

Table 1.c Baseline emission parameters to be monitored for each project scenario under the PoA (project scenario A to I)

Table 2 Project emission parameters to be monitored under the PoA

Table 3. Leakage emission parameters and demonstrations to be monitored under the PoA

Baseline emissions

Table 1.a. Baseline emission parameters to be monitored for electricity generation

Parameter	Description
$EG_{BL,y}$	The amount of net renewable electricity supplied to the grid or displaced from the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)
$B_{biomass,k,y}$	Quantity of biomass type *k* consumed in year *y* (ton/yr)
$NCV_{biomass,k,y}$	Net calorific value of the biomass type *k* consumed in year *y* (MJ/kg)
% water	Moisture content of the biomass type *k* (%)
Additional parameters for co-fire project activities	
$EG_{elec,total,y}$	The total amount of electricity generated from the co-fired projects activity in year (MWh/yr)
$FC_{FF,k,y}$	Quantity of fossil fuel type *k* consumed in co-fired system in year *y* (ton/yr)
$NCV_{FF,k,y}$	Net calorific value of the fossil fuel type *k* consumed in year *y* (MJ/kg)
$SFC_{elec,biomass,k}$	Specific fuel consumption for electricity production for biomass type *k* (ton/MWh)
$SFC_{elec,FF,k}$	Specific fuel consumption for electricity production for fossil fuel type *k* (ton/MWh)

Table 1.b. Baseline emission parameters to be monitored for thermal energy generation

Parameter	Description
$EG_{thermal,y}$	Net quantity of thermal energy supplied by the project activity during the year *y* (TJ/yr)
$Q_{hot\ air}$	Quantity of hot air (m^3/yr)
Q_{steam}	Quantity of steam (m^3/yr)
T	Temperature (°C)
P	Pressure (kg/cm)
$B_{biomass,k,y}$	Quantity of biomass type *k* consumed in year *y* (ton/yr)
% water	Moisture content of the biomass (%)
$NCV_{biomass,k,y}$	Net calorific value of the biomass type *k* consumed in year *y* (TJ/ton)
Additional parameters for co-fire project activities	
$EG_{thermal,total,y}$	Total amount of thermal energy supplied by the co-fired project activity in year *y* (TJ/yr)
$FC_{FF,k,y}$	Quantity of fossil fuel type *k* consumed in co-fired system in year *y* (ton/yr)
$NCV_{FF,k,y}$	Net calorific value of the fossil fuel type *k* consumed in year *y* (MJ/kg)
$SFC_{thermal,biomass,k,}$	Specific fuel consumption for thermal energy production for biomass type *k* (ton/TJ)
$SFC_{thermal,FF,k}$	Specific fuel consumption for thermal energy production for fossil fuel type *k* (ton/TJ)

Table 1.c. Baseline emission parameters to be monitored for each project activity

Project scenario	Parameters	Description
A and C	Table 1.a	
B and D	Table 1.a $EG_{PJ,add,y}$ $EG_{actual,y}$	The total net electrical energy supplied to a grid or displaced from the grid in year *y* by all units, existing and new project units (MWh/yr). The actual, measured net electrical energy supplied to the grid or displaced from the grid by the existing units in year *y* (MWh/yr).
E	Table 1.b	
F	Table 1.a + 1.b	
G	Table 1.b $EG_{thermal,PJ,y}$ $EG_{thermal,actual,y}$	Total actual thermal energy produced in year *y* by all units, existing and new project units (TJ/yr). The actual, measured thermal energy production of the existing units in year *y* (TJ/yr)
H	Table 1.b	

	$EG_{thermal,retrofit,y}$	The net quantity of thermal energy supplied by the retrofit project activity during the year *y* (TJ).
I	Table 1.b η_{PJ}	Efficiency of the project equipment (%) Record annually the number of systems operating (evidence of continuing operation, such as on-going rental/lease payments could be a substitute), if necessary using survey methods; Estimate the annual hours of operation of an average system, if necessary using survey methods. Annual hours of operation can be estimated from total output (e.g. tonnes of grain dried) and output per hour if an accurate value of output per hour is available.

Project emissions

Table 2. Project emission parameters

Parameter	Description
$FC_{i,j,y}$	Quantity of fossil fuel type *i* combusted in process *j* inside the project boundary in year *y* (ton/yr or m^3/yr)
$NCV_{i,y}$	Weighted average net calorific value of the fossil fuel type *i* combusted inside the project boundary in year *y* (TJ/ton)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* combusted inside the project boundary (tCO_2e/TJ)
$COEF_{i,y}$	The CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit)
EC_y	Quantity of electricity consumed in the project boundary in year *y* (MWh/yr)

Leakage emissions

Table 3.a. Leakage emission parameters for collection and procession of biomass

Parameter	Description
$FC_{c,j,y}$	Quantity of fossil fuel type *c* combusted in process *j* outside the project boundary in year *y* (ton/yr or m^3/yr)
$NCV_{c,y}$	Weighted average net calorific value of the fossil fuel type *c* combusted outside the project boundary in year *y* (TJ/ton)
$EF_{CO2,c,y}$	CO_2 emission factor of fossil fuel type *c* combusted outside the project boundary (tCO_2e/TJ)
$COEF_{c,y}$	The CO_2 emission coefficient of fuel type *c* in year y (tCO_2/mass or volume unit)

Table 3.b. Leakage emission parameters for incremental transportation.

Parameter	Description
$Q_{y,}$	Quantity of biomass transported outside the project boundary in the year *y* (t)
CT_y	Average truck capacity for transportation outside the project boundary (ton/truck)
DAF_w	Average incremental distance for biomass transportation outside the project boundary (km/truck)
VF_{cons}	Vehicle fuel consumption in litres per kilometre (ℓ/km)
D_{fuel}	Fuel density (kg/ℓ), if necessary
$NCV_{fuel,y}$	Net calorific value of the fuel used for transport outside the project boundary in year *y* (TJ/kg or other unit)
EF_{fuel}	Emission factor of the fuel for transport outside the project boundary (tCO2e/TJ)
$EF_{CO2/km}$	CO_2 emission factor from fossil fuel use due to transportation outside the project boundary (tCO_2e/km)

Table 3.c. Leakage emission parameters for the application of fertilizer

Parameter	Description
$M_{SFi,y}$	Mass of synthetic fertilizer type i applied (ton/yr)
$M_{OFj,y}$	Mass of organic fertilizer type j applied (ton/yr)
NC_{SFi}	Nitrogen content of synthetic fertilizer type i applied (gN/100 g fertilizer)
NC_{OFj}	Nitrogen content of organic fertilizer type j applied (gN/100 g fertilizer)

Table 3.d. Leakage emission parameters for the competing use of biomass

Parameter	Description
L_1	Demonstration that the biomass residue type k from a specific source would continue not to be collected or utilized
$BF_{available,k,y}$	Quantity of available biomass residues of type *k* or *m* in the region (ton/yr)
$BF_{utilized,k,y}$	Quantity of available biomass residues of type *k* or *m* that are utilized in the defined geographical region (ton/yr)
$EF_{CO2,LE}$	CO_2 emission factor of the most carbon intensive fuel used in the country (tCO_2/TJ)
$BF_{LE,n,y}$	Quantity of biomass residue type *n* used for heat generation as a result of the project activity during the year *y* and for which leakage can not be ruled out using one of the approaches L_1, L_2, L_3 or L_4 (tons of dry matter or liter)/yr
NCV_n NCV_m	Net calorific value of the biomass residue type *n* or *m* (TJ/ton)

2. Data management

- The CME will ensure that a representative from each CPA will be suitable trained on the applications of data management.
- The CPA implementer will be responsible for measurement, record-keeping and storage of all data to be monitored. All data will be electronically archived on the CPA's data control system for the entire crediting period plus two years beyond the crediting period.
- The CME will manage a central database with all the monitoring information from the different CPAs and also store the information for the whole crediting period plus two years beyond the crediting period.
- The CME will conduct an inspection audito of of each CPA every six months to ensure that all the relevant data is collected and stored adequately for verification
- Data management between the CPA implementer and the CME will work as follows:

Parameter		Measurement method	Data management
Electricity	$EG_{BL,y}$ $EG_{PJ,add,y}$ $EG_{actual,y}$ EC_y	Electricity meters	The metering instruments will be connected to a monitoring system for computation and automatic data acquisition on a continuous basis. This data is logged in the plant distributed control system for history collection . This data is transferred monthly to the CME and archived.
Thermal energy	$Q_{hot\ air}$ Q_{steam}	Flow meter	
	T	Temperature meter	
	P	Pressure gauge	
	$EG_{thermal,y}$ $EG_{thermal,PJ,y}$ $EG_{thermal,actual,y}$ $EG_{thermal,retrofit,y}$	Steam tables will be used to calculate the enthalpy as a function of temperature and pressure and standard thermodynamic equations will be used to calculate the quantity of thermal energy for the various parameters	The CME will calculate quantity of thermal energy using the quantity of hot air or steam, temperature and pressure measurements.
Biomass	$NCV_{biomass,k,y}$	Accredited laboratories	The CPA implementer will do

	NCV_n NCV_m		measurements quarterly and data will be send to CME. The CPA implementer may also use calculated the *NCV* from steam production and fuel feed rate into the cogeneration plant. For this purpose the quantity of steam (Q_{steam}), steam temperature (*T*) and pressure (*P*) will be monitored.
	$B_{biomass,k,y}$	Mass or volume measurements	Data will be manually recorded by the operational/administrational staff at the project site. The data sheet will be maintained, checked and signed by the operational/administrational staff. Data will be transferred to a spreadsheet, aggregated monthly and sent to the CME.
	% water	On-site measurements	
Transport	CT_y; DAF_w; VF_{cons}	Log book	
	D_{fuel}	Suppliers information	
Fossil fuel	$FC_{i,j,y}$; $FC_{c,j,y}$ $NCV_{i,y}$; $NCV_{c,y}$; $NCV_{fuel,y}$ $EF_{CO2,i,y}$; $EF_{CO2,c,y}$; EF_{fuel}	According to "Tool to calculate CO_2 emissions from fossil fuel" (Version 02)	
Fertilizer	$M_{SFi,y}$; $M_{OFj,y}$ NC_{SFi}; NC_{OFj}	Farm records	
Biomass leakage	$BF_{available,k,y}$; $BF_{utilized,k,y}$	Biomass surveys or statistics	The CPA implementer will compile a report with information from the site where the biomass is generated and send the report to the CME on an annual basis.
	L_1: Demonstration that the biomass residues from a specific source would continue not to be collected or utilized.		

3. Reporting and verification

- The CME will process data received from the CPA implementer and calculated emission reductions.
- The CME will compile the monitoring reports from all CPAs into one summary report
- The CME QC Manager will review the CPAs' monitoring reports.
- The DOE performs a desk review on the CPAs'monitoring reports.
- The CME provides an updated monitoring report in light of the DOE desk review findings.
- The DOE approves the final monitoring report
- For on-site assessment of CPAs, the DOE will implement the sampling procedure as described below:

Sampling plan:
All CPAs included in the PoA shall monitor 100% of the relevant parameters included in Section D.7.1. of the CPA-DD unless otherwise noted. Monitoring reports will be prepared separately for all CPAs, however only a statistically acceptable sample will be verified by the DOE.

The proposed sampling method is based on the multi-stage sampling approach. In multi-stage sampling, the population is divided into units, referred to as primary sampling units. The population in the primary units is again divided into smaller sub-units, referred to as secondary sampling units. Each CPA can be assigned to only one sample unit.

For this PoA, the primary sampling units will be the CPAs under a specific CPA implementer and the secondary sample units will be the different project scenarios. For each secondary sample unit a sample will be determined that will be subject to on-site verification.

For each secondary sample unit the size of the randomly selected samples will be defined to meet the 90/10 confidence interval level. In order to ensure transparency and representativeness of the sample chosen, the CPAs to be included in a sample will be chosen randomly by the DOE for each verification period. Since the number of CPAs included in the proposed PoA will evolve during the crediting period, the sampling selection process is to be recalculated for at each verification. All CPAs included in a sampling group will be subject to on-site verification.

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

Organization	Farmsecure Carbon (Pty) Ltd
Street/P.O. Box	350 Farm Wonderfontein, Minaar Street, Sasolburg, 1947 P.O. Box 1033, Vanderbijlpark, 1900, RSA
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First name	Isabelle
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Direct tel.	-
Personal e-mail	-

Appendix 2: Affirmation regarding public funding

Not applicable

Appendix 3: Application of methodology(ies)

Not applicable

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

Not applicable

Appendix 5: Further background information on the monitoring plan

Not applicable

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History of the document

Version	Date	Nature of revision(s)
02.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the programme design document form for small-scale CDM programmes of activities" (EB 66, Annex 13).
01	EB33, Annex43 27 July 2007	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		