CLEAN DEVELOPMENT MECHANISM
SMALL-SCALE PROGRAM ACTIVITY DESIGN DOCUMENT FORM (CDM-SSC-CPA-DD)
Version 01

CONTENTS

Annexes

NOTE:

(i) This form is for submission of CPAs that apply a small scale approved methodology using the provision of the proposed small scale CDM PoA.

(ii) The coordinating/managing entity shall prepare a CDM Small Scale Programme Activity Design Document (CDM-SSC-CPA-DD)[1,2] that is specified to the proposed PoA by using the provisions stated in the SSC PoA DD. At the time of requesting registration the SSC PoA DD must be accompanied by a CDM-SSC CPA-DD form that has been specified for the proposed SSC PoA, as well as by one completed CDM-SSC CPA-DD (using a real case). After the first CPA, every CPA that is added over time to the SSC PoA must submit a completed CDM-SSC CPA-DD.

[1] The latest version of the template form CDM-CPA-DD is available on the UNFCCC CDM web site in the reference/document section.

[2] At the time of requesting validation/registration, the coordinating managing entity is required to submit a completed CDM-POA-DD, the PoA specific CDM-CPA-DD, as well as one of such CDM-CPA-DD completed (using a real case).

SECTION A. General description of small scale CDM programme activity (CPA)

A.1. Title of the small-scale CPA:

NuPlanet Small Scale Hydropower PoA - CPA1Stortemelk

Table 1: PoA DD History

Version Number and Date	Details
1.0 (24th March 2012)	Draft submitted for validation.

A.2. Description of the small-scale CPA:

CPA 001 is a 4.1 MW hydroelectric power installation registered as Stortemelk Hydro (Pty) Ltd. It is situated on the wall of an existing reservoir, the Botterkloof Dam. It has a head of 14 m, a design flow of 30 cubic metres per second and will use a vertical Kaplan type turbine.

Please note that this project has been referred to as the Botterkloof Hydro project as a result of it being located on the Farm Botterkloof 541 and the name of dam, whose flow it will be using, being the Botterkloof Dam. NuPlanet also attempted to register the name Botterkloof Hydro for the special purpose vehicle (SPV) created to ensure the project has its own legal status. However the South African institution responsible for registering names declined this proposal and so the company Stortemelk Hydro (Pty) Ltd was registered as the SPV.

A.3. Entity/individual responsible for the small-scale CPA:

NuPlanet Project Development (Pty) Ltd

A.4. Technical description of the small-scale CPA:

A.4.1. Identification of the small-scale CPA:

A.4.1.1. Host Party:

Republic of South Africa

A.4.1.2. Geographic reference or other means of identification allowing the unique identification of the small-scale CPA (maximum one page):

Located in the Republic of South Africa.

Farm Botterkloof 541 (approximately 15 km north of the town of Clarens in the Free State Province).

Latitude 28°25'49.32"S
Longitude 28°23'6.29"E

Project Location

Project Location

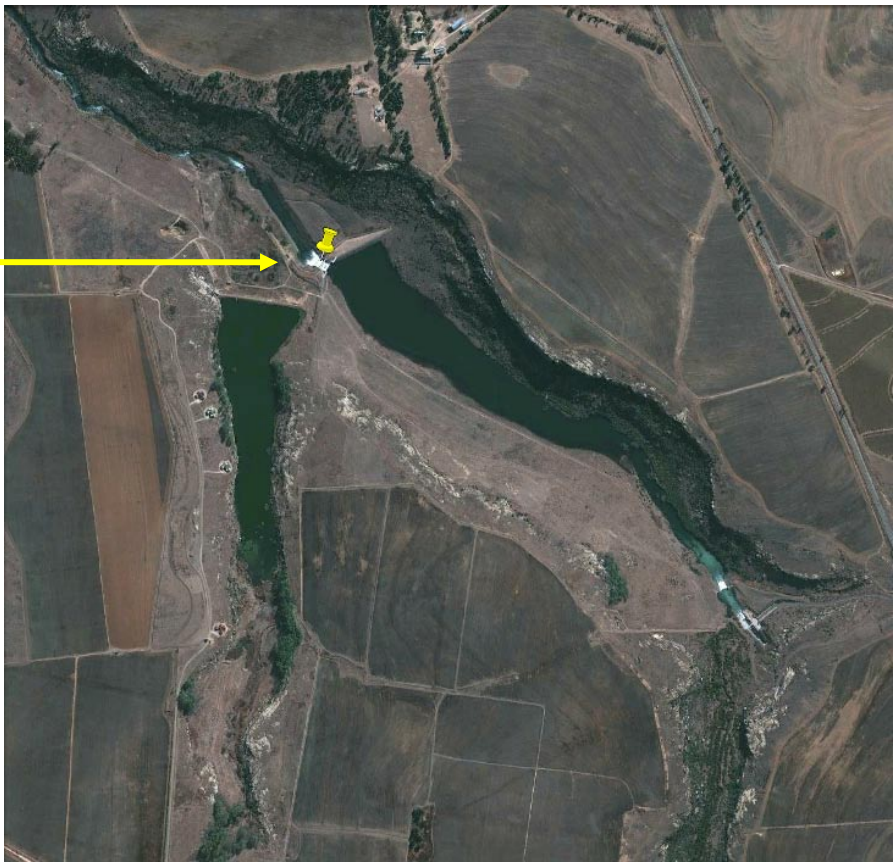


Figure 1: Botterkloof Dam – the location of the project activity

A.4.2. Duration of the small-scale CPA:

A.4.2.1. Starting date of the small-scale CPA:

The expected start date is September 2012 when the first equipment order is expected to be placed.

A.4.2.2. Expected operational lifetime of the small-scale CPA:

30 years 0 months

A.4.3. Choice of the crediting period and related information:

Fixed Crediting period

A.4.3.1. Starting date of the crediting period:

1st January 2014

A.4.3.2. Length of the crediting period, first crediting period if the choice is renewable CP:

10 years 0 months

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

172 662 tCO_2e over 10 years.

A.4.5. Public funding of the CPA:

No public funding was used in the development of the CPA.

A.4.6. Information to confirm that the proposed small-scale CPA is not a de-bundled component

The implementer is not involved with any large-scale hydro project.

The CPA 1 Stortemelk project is more than 1 km from any other hydropower projects on the same river (the As River) being implemented by the CPA's project participants and implementers.

A.4.7. Confirmation that small-scale CPA is neither registered as an individual CDM project activity or is part of another Registered PoA:

The CME confirms that the small-scale CPA is neither registered as an individual CDM project activity nor is it a part of another registered PoA.

SECTION B. Eligibility of small-scale CPA and Estimation of emissions reductions

B.1. Title and reference of the Registered PoA to which small-scale CPA is added:

NuPlanet Small Hydropower PoA

B.2. Justification of the why the small-scale CPA is eligible to be included in the Registered PoA:

The table below justifies the inclusion of the small-scale CPA in the registered PoA.

Eligibility Criteria from Registered PoA	Discussion How Small-Scale CPA Satisfies the Individual Criteria
1. Any CPA must be located within the internationally recognised boundaries of the following countries that are members of the SAPP	CPA is located within the Republic of South Africa.
2. Each CPA must be linked to specific geographical co-ordinates supported by a description of its location (the description should include a reference to a national land registry system, if such a system exists)	Done for CPA. See A.4.1 above.
3. Each CPA will use hydroelectricity renewable energy generation technology only. The technology will satisfy all relevant national testing and certification requirements.	The CPA is a hydroelectricity project.
4. Each CPA should show that the earliest date of its first real action or implementation or construction was after the date on which the CDM-PoA-DD was published for Global Stakeholder Consultation.	It is expected that the first date of real action (equipment ordering) will occur in September 2012, which will be after the date on which the CDM-PoA-DD was published for Global Stakeholder Consultation.
5. The CPA must have a capacity of less than 15MW.	The CPA has a capacity of 4.1 MW.
6. The CPA must involve either the (a) installation of either 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 or (c) involve a retrofit of an existing plant or (d) a replacement.	The CPA involves the installation of 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)

7. CPAs with reservoirs must satisfy at least one of the following conditions: • The CPA is implemented in an existing reservoir with no change in the volume of reservoir. • The CPA is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section, is greater than 4 W/m^2. • The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project emissions section, is greater than 4 W/m^2.	The CPA is implemented in an existing reservoir with no change in the volume of reservoir.
8. CPAs will demonstrate additionality using, either the requirements of the "Guidelines for demonstrating additionality of microscale project activities", or Attachment A of Appendix B of the "Simplified modalities and procedures for small-scale CDM project activities".	This CPA will demonstrate additionality using the investment barrier argument as described in Attachment A of Appendix B of the "Simplified modalities and procedures for small-scale CDM project activities".
9. CPAs will have undertaken stakeholder consultations, which will have been formally recorded.	Has been done as part of the EIA process.
10. CPAs will have undertaken an analysis of their environmental impacts, which will have been formally recorded.	A Basic Assessment as part of South Africa's Environmental Impact Assessment regulations has been undertaken on the project.
11. CPAs that have received development assistance will submit written confirmation from the assistance provider that this has not resulted in a diversion of official development assistance.	Not applicable as the CPA received no development assistance.
12. CPAs shall show that they are not debundled projects through the application of the latest approved version of the "Guidelines on assessment of debundling for SCC project activities".	No hydropower projects within 1 km from Stortemelk Hydro have been developed by the project participants in the As River. The project participants are also not involved in the development of large-scale hydro projects.

B.3. Assessment and demonstration of additionality of the small-scale CPA, as per eligibility criteria listed in the Registered PoA:

As per the eligibility criteria in the CDM-PoA-DD the additionality of a CPA can be shown using the latest version of the "Guidelines on the Assessment of Investment Analysis" (at the time of writing this document, this was version 05, EB 62, Annex 5, 15th July 2011).

The analysis will use a Benchmark analysis approach and will use the default values for the expected return on equity as detailed in Appendix to the "Guidelines on the Assessment of Investment Analysis". Hydro projects would fall under the Group 1 project category and therefore the value of South Africa is 10.9.

In terms of the financial analysis a number of key assumptions were made. These are detailed in the table below:

Table B.3.1

Variable	Parameter	Value	Source
Installed Capacity	MW	4.1	Feasibility Study
Plant Availability	%	46.2	Stortemelk Generation Estimate – NuPlanet
South African Inflation Rate	%	Variable over time	Consumer price index, South African Government Inflation Target.
Project Lifetime	Years	30	Industry Norm
Electricity Price	R/MWh	Variable over time	ESKOM Annual Report

With regard to a benchmark analysis, if the return of equity as indicated by the financial analysis is lower than the default value, then the project is considered to be additional. The table below details the comparison.

Table B.3.2

Parameter	Value
Equity IRR as a Result of Financial Analysis (excluding CDM income)	1.1%
Default Value for the Expected Return on Equity for Group 1 Projects in South Africa	10.9%

The project is therefore considered to be additional.

In terms of the "Guidelines on the Assessment of Investment Analysis" a sensitivity analysis should be performed to determine in which scenarios the project activity would pass the benchmark. This to provide a cross-check on the suitability of the assumptions used in the development of the investment analysis.

The analysis is done for those variables that constitute more than 20% of the either total project costs or total project revenues, as well as those that may be less than 20% but constitute key components of the project. The analysis covers a range of +10% and -10%.

The results of the sensitivity analysis are detailed in the table below:

Table B.3.3

Parameter	Impact on Equity IRR of Parameter Variation (%)			
	-10%	**-5%**	**+5%**	**+10%**
Electricity Revenue	-0.3	0.4	1.8	2.4
Civil Construction	1.4	1.3	0.9	0.9
Electrical and Mechanical construction	1.4	1.2	0.9	0.7
O&M Costs	1.4	1.2	0.9	0.8
General Management and Administration	1.2	1.1	1.0	0.9

As can be seen from the analysis in the table above, when varying the key cost and revenue variables, at no point does the project breach the additionality threshold required.

B.4. Description of the sources and gases included in the project boundary and proof that the small-scale CPA is located within the geographical boundary of the registered PoA.

Table E.3: Emissions sources included in or excluded from the CPA boundary

Source		Gas	Included?	Justification / Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
CPA	For hydro power plants with no reservoirs or existing reservoirs.	CO_2	No	No GHG emissions associated with the CPA.
		CH_4	No	
		N_2O	No	

The geographical co-ordinates of the project clearly indicate it is within the boundaries of the Republic of South Africa.

B.5. Emission reductions:

B.5.1. Data and parameters that are available at validation:

Data / Parameter:	$EG_{PJ,y}$
Data unit:	(MWh/yr)
Description:	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y*
Source of data used:	Estimate
Value applied:	17801

Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	$EF_{grid, CM, y}$
Data unit:	tCO_2/MWh
Description:	The Combined margin CO_2 emission factor for grid connected power generation in year *y*
Source of data used:	Calculation by Promethium Carbon (Pty) Ltd using the latest version of the "Tool to calculate the emission factor for an electricity system" (see Annex 3)
Value applied:	1.021 tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

B.5.2. Ex-ante calculation of emission reductions:

The baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.

$$BE_y = EG_{BL,y} * EF_{CO_2,grid,y}$$

Where:

BE_y	Baseline Emissions in year *y* (t CO_2e)
$EG_{BL,y}$	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y* (MWh)
$EF_{CO2,grid,y}$	CO_2 emission factor of the grid in year *y* (t CO_2/MWh)

i.e. $BE_y = 17801 * 1.021 = 18\ 175 t\ CO_2e$

The emissions reductions are then calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y Emission reductions in year *y* (t CO_2/y)

BE_y Baseline Emissions in year *y* (t CO_2/y)

PE_y Project emissions in year *y* (t CO_2/y)

LE_y Leakage emissions in year *y* (t CO_2/y)

i.e. ER_y =18 175 – 0 – 0 = 18 175 t CO_2e

B.5.3. Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity emissions (tonnes of CO_2 e)	Estimation of baseline emissions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of overall emission reductions (tonnes of CO_2 e)
2014	Zero	9087	Zero	9087
2015	Zero	18175	Zero	18175
2016	Zero	18175	Zero	18175
2017	Zero	18175	Zero	18175
2018	Zero	18175	Zero	18175
2019	Zero	18175	Zero	18175
2020	Zero	18175	Zero	18175
2021	Zero	18175	Zero	18175
2022	Zero	18175	Zero	18175
2023	Zero	18175	Zero	18175
Total (tonnes of CO_2 e)	Zero	172 662	Zero	172 662

B.6. Application of the monitoring methodology and description of the monitoring plan:

B.6.1. Description of the monitoring plan:

1. Monitoring Period

The monitoring period will start from the date of commissioning of the CPA. An annual monitoring report will be produced for full calendar years (or part thereof for the first year depending on the commissioning date).

2. Data Monitored and Sources

The quantity of net electricity generation that is produced and fed into the grid by the CPA in year *y* shall be determined on the basis of the measurements taken by the electricity meters. As an accuracy check the meters will be cross-checked with records for sold electricity. If there is a material difference (defined as being more than 1%), this would be investigated, explained and discussed in the monitoring report.

Each CPA will have two bi-directional meters recording net electricity production. The first is the Main Meter which is the primary source for all data readings. The second is a check meter, which is a back-up meter which records data concurrently with the main meter. It is used if the Main meter is considered faulty or inaccurate. Data gathering is done remotely or if the remote system is down the data is downloaded manually at the facility.

3. Monitoring Plan Management

The CPA facility manager is responsible for the effective implementation of the monitoring management plan. All elements of the monitoring plan will be supported by formal procedures and regular training of delegated personnel, as appropriate.

The CME is responsible for managing and monitoring the data set that generates the grid emission factor.

4. Storage of Data

All data collected will be archived electronically in multiple locations (at least two) to ensure no data is lost. All data will be kept for at least two years after the end of the crediting period.

5. Meter Calibration

Meters will be calibrated in accordance with the manufacturer's requirements. The results of each calibration will be recorded in a formal report and the report archived.

The monitoring of the quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CPA in year *y* and the grid emission factor will be undertaken by the CPA with assistance from the CME as follows:

- The CPA developer will monitor and record the monitoring parameters ;
- The CME will provide guidance to the CPA developer on how the monitoring should be conducted and how data should be collected with regards to the emission reduction calculations;
- The CPA developer will provide data on monitored parameters, required calculations (if any) and any documentary evidence required to the CME;
- The CME will document and store all data related to the parameters, provided by CPA developer in a central electronic database (PoA monitoring database), while primary data will be stored by the CPA developer. The data for the CPA will be kept for at least two years after the end of the last crediting period for the CPA; and,
- The CME will review relevant CPA monitoring records, prepare the monitoring report and provide the monitoring report to the DOE.

The data and parameters to be monitored by the CPA are as follows:

Data / Parameter:	$EG_{PJ,y}$
Data unit:	MWh/yr
Description:	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CPA in year *y*
Source of data to be used:	Meters at project activity site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not Applicable.
Description of measurement methods and procedures to be applied:	Electricity meters separately measure each CPA, at the boundary between the CPA and the electricity grid. The parameter will be monitored continuously and the data aggregated monthly for monitoring purposes. The meter accuracy will be determined when installed through an assessment of the appropriate national standards for the meter type to be used.
QA/QC procedures to be applied:	Cross check measurement results with records for sold electricity. Any differences to be discussed in monitoring report. Calibration schedule for electricity meters to be developed and implemented. This will be done in accordance with the manufacturer's specifications and if required by an accredited organisation.
Any comment:	

Data / Parameter:	$EF_{grid,CM,y}$
Data unit:	tCO_2/MWh
Description:	Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"
Source of data:	As per the "Tool to calculate the emission factor for an electricity system". Calculations done by Promethium Carbon (Pty) Ltd
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable.
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	
Any comment:	-

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

As the CPA required an Environmental Impact Assessment (EIA), undertaking the environmental analysis at CPA level is the appropriate level. This assists in ensuring the environmental integrity of the PoA, which is particularly important as local conditions and potential impacts will vary according to the location of the CPA.

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

The Basic Assessment Report (prepared by Ninham Shand – Report Number 4635/401944 March 2009) identified a number of key potential negative impacts associated with the project.

These were:

- The visual impact of the hydro plant infrastructure;
- Disturbance of terrestrial flora and fauna;
- Impact on the aquatic ecosystem;
- Impact of higher oxygen levels downstream of the hydro facility; and,
- Increased erosion.

None of these impacts were found to be significant by the independent environmental assessment practitioner. This is further illustrated by the fact that the project was given Environmental Authorisation to proceed by the Free State Province's Department of Economic Development, Tourism and Environmental Affairs (Authorisation Register Number EMB/1K, 1M, 4/07/93 – Dated 9th December 2009).

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

Yes. In terms of South Africa's Environmental Impact Management regulations a Basic Assessment was undertaken with regard to the CPA.

SECTION D. Stakeholders' comments

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

Stakeholder comments were invited at the level of the CPA, this to better identify and reflect the issues that concern the local communities surrounding the CPA.

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

Local stakeholder comments were invited as part of the public participation process associated with the Basic Assessment. Stakeholders were informed about the project through newspaper advertisements and direct contact. All comments were captured in a formal comments and responses report.

D.3. Summary of the comments received:

Local stakeholders raised the following concerns during the participation process:

- Noise pollution;
- Visual impact;
- Dust due to access road;
- Soil pollution;
- Light emitted from the hydro power plant at night;
- Safety of estate (access) and disturbance of game;
- Trembling of turbines during the operational stage; and,
- Disposal of solid waste.

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

These comments were formally reported in the Basic Assessment report and used to inform the identification and analysis of the impacts associated with the hydro project. None of these comments related to the CDM aspect of the project.

Annex 1

CONTACT INFORMATION ON ENTITY/INDIVIDUAL RESPONSIBLE FOR THE SMALL-SCALE CPA

Organization:	NuPlanet Project Development (Pty) Ltd
Street/P.O.Box:	PO Box 35630, Menlo Park. 0102
Building:	NuPlanet House, Persequor Technopark.
City:	Pretoria
State/Region:	Gauteng
Postfix/ZIP:	0002
Country:	South Africa
Telephone:	+27 12 349 2944
FAX:	
E-Mail:	al@nuplanet.co.za
URL:	www.nuplanet.co.za
Represented by:	Anton-Louis Olivier
Title:	Mr.
Salutation:	
Last Name:	Olivier
Middle Name:	Cornelius
First Name:	Anton-Louis
Department:	
Mobile:	+27 82 938 0682
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Annex 3

BASELINE INFORMATION

GRID EMISSION FACTOR FOR SOUTH AFRICA

(VERSION 04)

October 2011

APPLICATION OF THE UNFCCC METHODOLOGICAL TOOL:
"TOOL TO CALCULATE THE EMISSION FACTOR FOR AN ELECTRICITY SYSTEM"
(UNFCCC TOOL VERSION 02.2.1)

DEVELOPED BY PROMETHIUM CARBON (PTY) LTD

EXECUTIVE SUMMARY

This report is constructed in accordance with the UNFCCC Methodological Tool: *Tool to calculate the emission factor for an electricity system (Version 02.2.1)*, for CDM projects. It depicts the calculation of the grid emission factor for a project activity that will utilize grid electricity from Eskom, the supplier of 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 dispatched without significant transmission constraints. For this project, the project electricity system entails all the Eskom power plants in the South African electricity grid.

The calculation included grid power plants only; off-grid power stations were not included in calculations.

The *ex ante* calculations for the period of 01 April 2007 – 31 March 2010 resulted in a combined margin emissions factor of **1.021** tonne CO_2/MWh.

STEP 1: IDENTIFY THE RELEVANT ELECTRICITY SYSTEMS

This tool will serve project activities that prospect to 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 (Eskom Holdings SOC Limited , 2011). This data includes commissioning dates, electricity generated, and fuel consumed.

Data for the imported electricity was 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 (Eskom Holdings SOC Limited, 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 2007 – 31 March 2010 (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 constants used in calculations appear in Table 1.

Table 1: Constants used in calculations

Constants		
$NCV_{other\ bituminous\ coal}$	19.9	GJ/T
$NCV_{other\ kerosene}$	42.9	GJ/T
$EF_{CO2other\ bituminous\ coal}$	0.0895	tCO_2/GJ
$EF_{CO2,other\ kerosene}$	0.0708	tCO_2/GJ

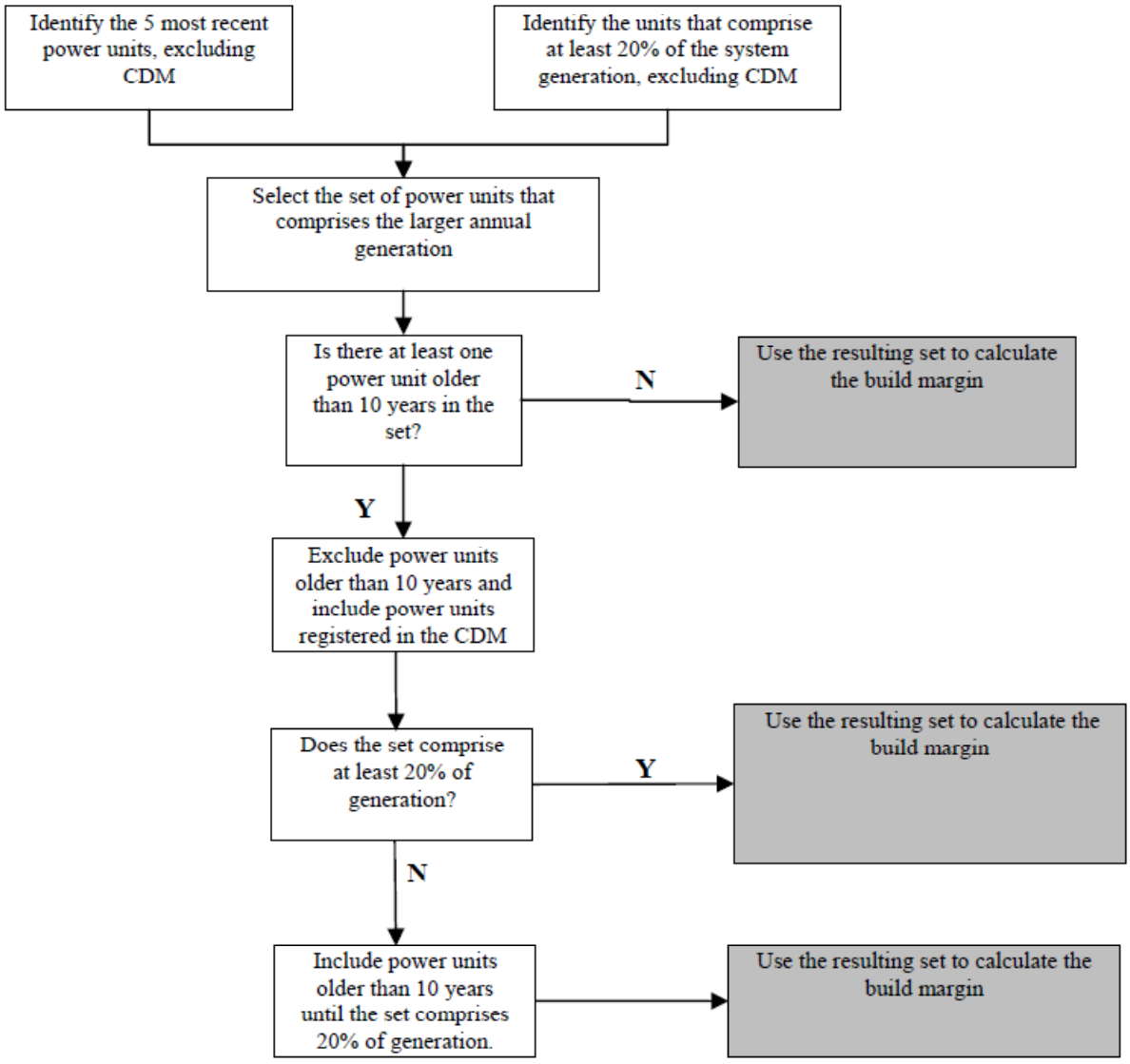
Using equation 6, the OM is calculated as **1.015** tCO_2e/MWh.

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:



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:

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

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.

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 A1** using for *y* the most recent historical year for which power generation data is available, and using for *m* the power units included in the build margin.

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

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{\sum_m EG_{m,y}} \quad \textbf{(2)}$$

Where:

$EF_{EL,m,y}$	= CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$FC_{i,m,y}$	= Amount of fossil fuel type *i* consumed by power unit *m* in year *y* (mass or volume unit)
$NCV_{i,y}$	= Net calorific value (energy content) fossil fuel type *i* in year y (GJ/mass or volume)
$EF_{CO2,i,y}$	= CO_2 emission factor of fossil fuel type *i* in year y (tCO_2/GJ)
$EG_{m,y}$	= Net electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
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.

Using equation 13, the BM is calculated as **1.019** tCO_2e/MWh.

STEP 6: CALCULATE THE COMBINED MARGIN (CM) EMISSION FACTOR

The combined margin factor is calculated as follows:

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

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 operating margin, the build margin, and the final combined margin appear in Table 1 below.

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	**1.020**
All other projects for the first crediting period.	0.5	0.5	**1.021**
All other projects for the second and third crediting period.	0.25	0.75	**1.023**

Annex 4

MONITORING INFORMATION

- - - - -