CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

SECTION A. General description of project activity

A.1. Title of the project activity:

Title: Hopefield wind energy facility in South Africa
Version number: 01
Date: 11 October 2011

A.2. Description of the project activity:

Description

Umoya Energy (Pty) Ltd (hence forth referred to as Umoya Energy) is proposing to establish a commercial wind energy facility and associated infrastructure on a site near Hopefield in the Western Cape Province. The proposed wind energy facility is expected to have the capacity of 66.6 MW and will comprise of thirty-seven 1.8 MW wind turbines. Associated infrastructure will include 132kV distribution lines, a new substation, an access road to the site and internal access roads to each wind turbine on site. The project activity will also support the South African Government's objective of fostering, facilitating and encouraging the development of new renewable energy sources[1].

Purpose

The purpose of the project activity is to generate power from wind energy in the Western Cape, South Africa. The electricity will be sold to Eskom, the national electricity utility, in order to increase the reserve margin, diversify the grid generation mix and reduce greenhouse gas emissions.

Greenhouse gas reduction

The implementation of the project activity will result in greenhouse gas emission reductions by replacing electricity generated from predominantly fossil fuel fired power plants connected to the grid.

Baseline scenario

The baseline scenario is for the Southern African Power Pool to generate the same electricity as the proposed project activity.

Contribution to Sustainable Development:

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

Economic:

This renewable energy project will create new jobs and generate new income streams within the Western Cape Province, West Coast District Municipality and the Saldanha Bay Municipality administrative area. A study on the Growth Potential of Towns in the Western Cape (2004) undertaken by the Western Cape Department of Environmental Affairs and Development Planning to provide the Department with a better understanding of the potential and challenges of the Western Cape identified Hopefield as a rural town

[1] Integrated Resource Plan for Electricity 2010 – 2030 by the South African Government, 25 March 2011, p.24, available under: http://www.energy.gov.za/IRP/irp%20files/IRP2010_2030_Final_Report_20110325.pdf

and a town with a *low growth potential / medium need*[2]. In the study Hopefield is identified as a town that qualifies for both social and economic investment.

The current electricity crisis in South Africa highlights the significant role that renewable energy can play in terms of supplementing the power available and reducing the possibility of "black-outs".

The project will also contribute to foreign reserve earnings for South Africa via carbon credit sales revenue.

Social:
Creation of employment and business opportunities. The establishment of the proposed wind energy facility will create local job opportunities during the construction and operational phases. During construction it is estimated that up to 100 workers with various skill levels will be required and during operations up to 20 people will be employed. These workers will be predominantly employed by the construction and operation and maintenance contractors and sourced locally as far as possible.

Environmental:
The project will have a positive environmental impact by displacing electricity from the South African national grid. These positive impacts relate to a reduction in the generation of coal-based electricity and its associated environmental impacts. These impacts include: the impact of coal mining; the utilisation of scarce water resources; SO_2 emissions; particulate emissions; the environmental impacts associated with the mining and transportation of coal and the impacts associated with the disposal of coal ash.

The operation of wind energy facilities does not require water as a major input. This contrasts with conventional coal fired plants, which are a major consumer of water during their requisite cooling processes. As an already water stressed nation, it is critical that South Africa engages in a variety of water conservation measures, particularly as the detrimental effects of climate change on water availability will be experienced in the future. The findings of an environmental assessment reveal that the area for the proposed wind energy facility consists of high biodiversity but low conservation activities. Umoya Energy has committed to set aside the southern part of the site (circa 1000 hectares) to be managed as a formal conservation area in order to maintain and improve the site's biodiversity value.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of South Africa (host)	Umoya Energy (Pty) Ltd	No

[2] ***"****Very Low****"*** and ***"****Low" growth potential*: Towns with a proven track record of growth, but wishing to retain their present character and therefore rejecting major development; or towns with limited economic and human resources, devoid of the potential to stimulate the urban economy

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

South Africa

A.4.1.2. Region/State/Province etc.:

Western Cape Province

A.4.1.3. City/Town/Community etc.:

West Coast District Municipality and the Saldanha Bay Municipal Administrative Area

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

The site itself covers approximately 2400 hectares (of which some 1000 hectares will be an environmental offset) roughly around the area of these coordinates:-

1) 33° 5’27.57”S 18° 25’34.69”E
2) 33° 4’51.08”S 18° 24’44.07”E
3) 33° 4’53.55”S 18° 22’40.27”E
4) 33° 5’51.57”S 18° 21’17.03”E
5) 33° 6’42.79”S 18° 23’10.36”E

The site covers the portions of land:

Koperfontein 346/25
Kerschbosch Dam 347/0
Coeratenberg 307/3

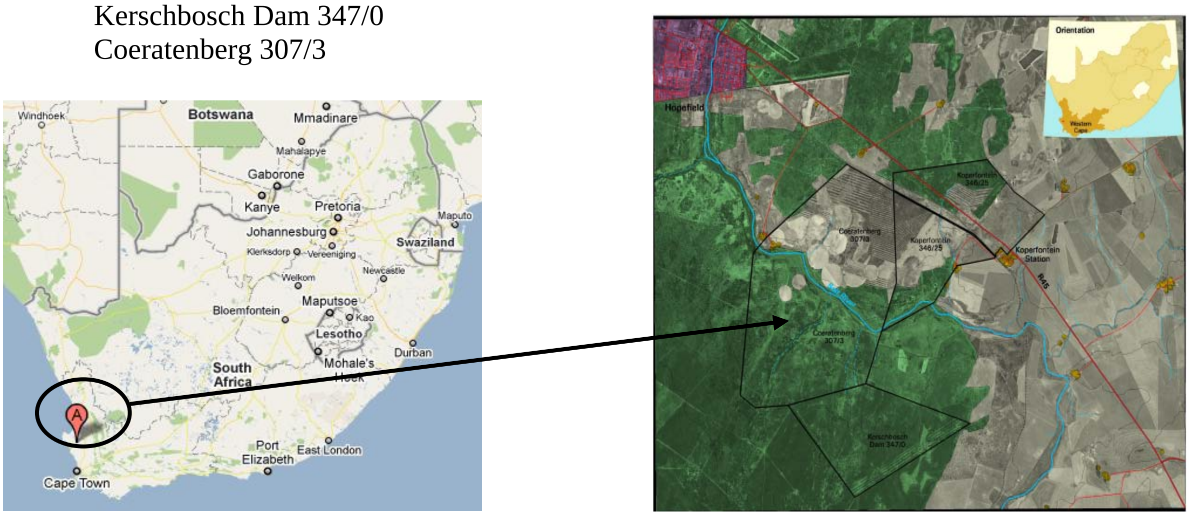

Figure 1: Location of the proposed project activity

A.4.2. Category(ies) of project activity:

Sectoral scope 1: Energy industries (renewable -/ non-renewable sources)

A.4.3. Technology to be employed by the project activity:

Wind turbines will be used to produce electricity by using the kinetic energy of the wind to drive a generator. When kinetic energy passes over the blades of the wind turbines, it is converted into mechanical energy and rotates the blades. This in turn rotates the generator, thereby producing electricity. The proposed wind energy facility will have an installed capacity of 66.6 MW and envisages the installation of thirty-seven 1.8MW wind turbines. The CDM calculation was done based on this assumption. A further option of increasing the hub height from 80 meters to 95 meters on approximately 50% of the turbines is still under review.

The baseline scenario is for the Southern African Power Pool to generate the same electricity as the proposed project activity. The baseline is the same as the scenario existing prior to the start of the implementation of the project activity.

Technical Data

The technical specifications for the 1.8MW wind turbines are detailed in the table below.

Description of	**Specification**
Nominal power	1800 kW
Hub height	80 m
Number of blades	3
Rotor diameter	100 m
Rotor swept area	7850m^2
Rated wind speed	7.5 m/s
Cut-in wind speed	4 m/s
Cut-out wind speed	20 m/s
Rated frequency	50 Hz

The project will involve both technology and knowledge transfer since there are no large wind turbines produced in South Africa and there is a shortage of experienced operating personnel available.

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

Years	**Annual estimation of emission reductions in tonnes of CO2 e**
1	153,608
2	153,608
3	153,608
4	153,608
5	153,608
6	153,608
7	153,608
8	153,608
9	153,608
10	153,608
Total estimated reductions (tonnes of CO2 e)	**1,536,080**
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO2 e)	153,608

A.4.5. Public funding of the project activity:

No public funding has been used or will be used in the development and implementation of this project.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

ACM0002: Consolidated baseline methodology for grid-connected electricity generation from renewable sources
Version 12.1.0, Sectoral Scope: 01, EB 58

Methodological tools used:

Methodological Tool: Tool for the demonstration and assessment of additionality
Version 05.2.1, EB 39 (Section B.5)

Methodological Tool: Tool to calculate the emission factor for an electricity system
Version 02.2.0, EB 61 (Section B.6.4)

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The project meets all the conditions set forth in the approved methodology ACM0002. The applicability conditions are described below. Hence, the selected methodology is appropriate for the project activity.

Applicability conditions as per ACM0002	Applicability to this project activity
This methodology is applicable to grid-connected renewable power generation project activities that (a) install a new power plant at a site where no renewable power plant was operated 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).	The project activity is a greenfield plant. The project activity is the construction of a wind energy facility at a site where no renewable power plant was operated prior to the implementation of the project activity.
The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit.	The project activity is the installation of a 66.6 MW wind energy facility
In the case of capacity additions, retrofits or replacements (except for wind, solar, wave or tidal power capacity addition projects which use Option 2: on page 10 to calculate the parameter EGPJ,y): the existing plant started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of	The project activity is a greenfield wind energy facility. It does not involve capacity additions, retrofits or replacements. Therefore this applicability criterion is not applicable.

baseline emissions and defined in the baseline emission section, and no capacity expansion or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.	
In case of hydro power plants, one of the following conditions must apply: *• The project activity is implemented in an existing reservoir, with no change in the volume of reservoir; or* *• The project activity 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/m2; or* *• 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.*	This is not a hydro power project. Therefore this applicability criterion is not applicable.
The methodology is not applicable to the following: *• Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site;* *• Biomass fired power plants;* *• Hydro power plants that result in new reservoirs or in the increase in existing reservoirs where the power density of the power plant is less than 4 W/m^2.*	This project does not involve switching from fossil fuels to renewable energy at the site of the project activity. The project activity is not a biomass fired power plant or a hydro power plant. Therefore these applicability criteria are not applicable.
In the case of retrofits, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is "the continuation of the current situation, i.e. to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance".	The project activity is a greenfield wind energy facility. It does not involve retrofits, replacements or capacity additions. Therefore this applicability criterion is not applicable.

B.3. Description of the sources and gases included in the project boundary:

ACM0002 specifies that the project boundary will be:

The spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to.

The wind energy facility (project activity) has a distinctive physical demarcated boundary.

As per the approved methodology, ACM0002, the greenhouse gases and emission sources included in or excluded from the project boundary are shown in the Table below.

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.
Project activity	Proposed activity – greenfield wind power plant	CO_2	No	Zero-emissions grid-connected electricity generation from wind power renewable energy
		CH_4	No	
		N_2O	No	

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

The proposed project activity is the construction of a greenfield wind power plant. According to ACM0002, if the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the following:

Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system". Version 2.2.0 described step wise under section B.6.

The baseline is the electricity generated and distributed through the Southern African Power Pool.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

The determination of the additionality is done by using the Tool for the demonstration and assessment of additionality Version 05.2.1, EB 39 (Section B.5) as published in Annex 10. The
CDM consolidated tool for demonstration of additionality, includes the following steps:

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

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

To provide the same output or services comparable with the proposed CDM project activity, these alternatives are to include:

Alternative 1- Proposed project activity not undertaken as a CDM project but as a commercial project; and

Alternative 2- Equivalent electricity output from the grid.

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

The above alternatives meet all legal and regulatory requirements of the host country South Africa.

Additionality of the CDM project can be demonstrated through the existence of barriers.

Step 3: Barrier Analysis

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

The following barriers have been identified:

(a) Barriers due to prevailing practice, *inter alia*:

In accordance with "Guidelines on additionality of first-of-its-kind project activities", Annex 11 EB 63, (Version 01.0), paragraph 5:

"A proposed project activity is the First-of-its-kind in the applicable geographical area if:

a) The project is the first in the applicable geographical area that applies a technology that is different from any other technologies able to deliver the same output and that have started commercial operation in the applicable geographical area before the start date of the project; and

b) Project participants selected a crediting period for the project activity that is a maximum of 10 years with no option of renewal."

The proposed wind energy facility project is the first of its kind, because there is no commercially operational wind project of this capacity that contributes to the South African Power Pool at this stage. Currently there are only two demonstration wind energy facilities in operation in South Africa:

1.) **Klipheuwel Wind Farm**: Eskom's demonstration wind farm at Klipheuwel in the Cape is exploring the use of wind energy for bulk electricity generation. Overall, the total production annually has been just more than 4GWh. The Klipheuwel wind farm has a total capacity of 3.2 MW, and is expected to generate at a load factor of between 20 and 30 percent. The wind farm consists of three units, that is two Vestas (Danish) turbines of 660kW and 1 750kW respectively, and a Jeumont (French) turbine of 750kW[3].

2.) **Darling National Demonstration Wind Farm:** The project is being developed with financial assistance from the Danish government through Danida, its funding agency, loan from the Development Bank of Southern Africa and investment by the Central Energy Fund and the Darling Independent Power Producer. Referred to as the National Demonstration Project, it will be used as an example for future public-private partnerships in the establishment of electricity generation[4]. The Darling National Demonstration Wind Farm has the installed capacity of 5.2 MW.

Other wind projects under development also require CDM funding. The project participants have also selected a crediting period for the project activity that is a maximum of 10 years with no option of renewal.

(b) Other barriers: Resource uncertainty:

Wind energy involves relatively high risks compared with fossil fuel forms of energy or hydro energy because it is an intermittent source of energy. The estimated output is based on wind measuring data and assumptions made. There is no wind energy facility operational and projects are therefore designed on generic and test data. An Energy Assessment performed for a 12 month period concluding in June 2011 for the wind energy facility near Hopefield, showed reduced wind capacity and speed to what was predicted by a 12 month Energy Assessment concluding in May 2010.

CDM income is expected to offset, to some extent, the risk concurrent with wind availability.

(c) Technological barriers

The existence of a technical barrier is linked to the required infrastructure for renewable energy, including wind. In South Africa this renewable energy sector is marginal. Wind energy contributes to less than 10% of South Africa’s electricity. The tender from the Department of Energy in South Africa, request for qualification and proposals for new generation capacity under the IPP procurement programme, highlights the need for increased localisation of manufacturing, which further proves the existence of a technological barrier. Umoya Energy is a start-up company which is proposing to bring new technology into South Africa.

The continuation of current practices (Alternative 2) does not pose any technological barriers as it does not require any additional technology (it is the business as usual scenario).

[3] http://www.energy.gov.za/files/esources/renewables/r_wind.html

[4] http://www.energy.gov.za/files/esources/renewables/r_wind.html

(d) Investment barriers

Currently there are only two non-commercial wind energy facilities in operation in South Africa. The first is the Darling National Demonstration Wind Energy Facility with a capacity of 5.2MW and Klipheuwel Wind Energy Facility with a capacity of 3.2MW. There are currently no wind energy facilities on the same scale as the proposed project activity (66.6MW) in South Africa.

Due to the regulatory uncertainty around both REFIT and Power Purchase Agreement risks[5], little private capital is available from both domestic and international markets due to risks associated with investment in new wind energy facilities in South Africa at this stage[6]. Investing in new renewable technologies, taking into account the risk premiums associated with the South African finance sector, means that this would act as a barrier for Umoya Energy to attract investors[7]. The CDM alleviates this barrier by attracting financiers that would normally not finance this project without CDM. The potential of securing carbon credit revenue will make the project more attractive to financiers, since a better return on investment would be realised.

Outcome of step 3a:

The combination of the above mentioned barriers may prevent Alternative 1 from occurring.

Sub-step 3b:
The continuation of current practices (Alternative 2) does not pose any barriers as it is the business as usual scenario.

Step 4: Common practice analysis:

Sub-step 4a - Other activities similar to the Umoya Energy project in South Africa;

At 22 June 2011 there were 34 wind projects in South Africa which had submitted Prior Consideration of the CDM forms to the UNFCCC, but none of these projects are registered. Wind power generation in South Africa is still in its infancy. Installed wind capacity in the Rest of Africa and the Middle East (which includes South Africa) was 91MW in 2009.

Currently there are only two demonstration wind energy facilities in operation in South Africa as mentioned in the barrier analysis above.

Sub-step 4b – Discussion of similar options that occur

No similar activities have proceeded without CDM financing.

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[5] IDC 2010, Presentation on Green Industries & Technology. Available at

http://www.pmg.org.za/files/docs/100824idc-edit.pdf

[6] South Africa's Designated National Authority for Clean Development Mechanism, p.11, available under: http://www.ccs-africa.org/fileadmin/ccs-africa/user/docs/Gabarone_10_9/Gaborone_Matooane_10sept07_panel.pdf

[7] South African Wind Energy Association Response to the NERSA Consultation Paper, "Review of Renewable Energy FEED – IN Tariffs", April 2011 p.3.

As a result of the above analysis it can be concluded that the project activity is additional.

Prior Consideration of CDM

The decision to develop the wind energy facility as a CDM project was taken by Umoya Energy in 2009. The Prior Consideration of the CDM Form was submitted to the UNFCCC and the DNA on the 25 of May 2011.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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Project emissions

According to the chosen baseline methodology ACM0002 Version 12.1.0, for wind energy based renewable energy project activities, PEy = 0.

Baseline emissions

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y} \qquad (1)$$

Where:

BE_y	= Baseline emissions in year y (tCO_2/yr)
$EG_{PJ,y}$	= 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 (MWh/yr)
$EF_{grid,CM,y}$	= Combined margin CO2 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" (tCO2/MWh)

Calculation of $EG_{PJ,y}$

(a) Greenfield plants

The project activity is the installation of a new grid-connected renewable power plant at a site where no renewable power plant was operated prior to the implementation of the project activity, so method (a) Greenfield renewable energy power plants is used.

$$EG_{PJ,y} = EG_{facility,y} \qquad (2)$$

Where:

$EG_{PJ,y}$	= 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 (MWh/yr)
$EG_{facility,y}$	= Quantity of net electricity generation supplied by the project plant/unit to the grid in

	year y MWh/yr)

Calculation of $EF_{grid,CM,y}$

The project activity will displace grid electricity.

The emission factor for the grid electricity was calculated in accordance with the latest approved version of the “Tool for calculation of emission factor for electricity systems,” Version 02.2.0. The steps applied to determine the emission factor for the grid can be seen in Annex 3.

Leakage
No leakage emissions are considered, according to ACM0002 (version 12.1.0). The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing and transport). These emissions sources are neglected.

Emission reductions
Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \qquad (6)$$

Where:

ER_y	= Emission reductions in year y (t CO_2e/yr)
BE_y	= Baseline emissions in year y (t CO_2/yr)
PE_y	= Project emissions in year y (t CO_2e/yr)

Since there are no project emissions this becomes:

$$ER_y = BE_y = EG_{facility,y} \cdot EF_{grid,CM,y} \qquad (7)$$

B.6.2. Data and parameters that are available at validation:

(Copy this table for each data and parameter)

Data / Parameter:	$EF_{grid,CM,y}$
Data unit:	tCO_2/MWh
Description:	Combined margin CO_2 emission factor for the SAPP
Source of data used:	The combined margin emission factor, determined according to the latest approved version of the "Tool to calculate emission factor for an electricity system".
Value applied:	1.04
Justification of the choice of data or description of measurement methods and procedures actually applied :	This figure is calculated using the "Tool to calculate emission factor for an electricity system" (Version 12.1.0) at the beginning of the project and kept constant for the life of the project.
Any comment:	

B.6.3. Ex-ante calculation of emission reductions:

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As per the description in B.6.1 the emission reductions are calculated as follows:

$$ER_y = BE_y$$

And

$$BE_y = EG_{facility,y} \cdot EF_{grid,CM,y}$$

For the proposed project activity $EF_{grid,CM,y}$ is 1.04

The proposed project activity is will be constructed in phases:

- Phase 1: 66.6 MW installed capacity

Year	**ER_y**	**$EG_{facility,y}$**	**$EF_{grid,CM,y}$**
1	153,608	147,700	1.04
2	153,608	147,700	1.04
3	153,608	147,700	1.04
4	153,608	147,700	1.04
5	153,608	147,700	1.04
6	153,608	147,700	1.04
7	153,608	147,700	1.04
8	153,608	147,700	1.04
9	153,608	147,700	1.04
10	153,608	147,700	1.04

B.6.4 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)
1	0	153,608	0	153,608
2	0	153,608	0	153,608
3	0	153,608	0	153,608
4	0	153,608	0	153,608
5	0	153,608	0	153,608
6	0	153,608	0	153,608
7	0	153,608	0	153,608
8	0	153,608	0	153,608
9	0	153,608	0	153,608
10	0	153,608	0	153,608
Total (tonnes of CO_2 e)	**0**	**1,536,080**	**0**	**1,536,080**

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

B.7.1 Data and parameters monitored:

(Copy this table for each data and parameter)

Data / Parameter:	$EG_{facility,y}$
Data unit:	MWh/yr
Description:	Quantity of net electricity generation supplied by the project plant to the grid in year y
Source of data to be used:	Measured by electricity meters with an accuracy of at least 0.5%.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**1,536,080**
Description of measurement methods and procedures to be applied:	Electricity meters will be installed at the substation, to measure the electricity generated by the project and exported to the grid and electricity imported by the project from the grid. The net electricity generation supplied by the project to the grid will be calculated.
QA/QC procedures to be applied:	The data from the meters installed at the substation will be crosschecked with sales invoices. In the case of inconsistencies, the more conservative of the two values will be used.
Any comment:	

B.7.2. Description of the monitoring plan:

Management Structure

A CDM Monitoring Team will be established responsible for data recording, data management and QA/QC. The Team Leader's role is to ensure that the data to be monitored is accurately recorded, properly archived, QA/QC procedures are carried out and the entire monitoring process is strictly in line with the CDM verification requirements.

Monitoring Training

All the relevant staff will be trained before operation of the wind energy facility. The training consists of CDM knowledge, operational regulations, quality control (QC), data monitoring requirements and data management regulation.

Data sources

The following data sources will be used in monitoring the project:

- Eskom
- Operations & Maintenance contractor
- Umoya Energy

A centralised database will be used to store and archive the data from the different sources.

Emission reduction data monitoring and management procedures will be put in place prior to the starting date of the crediting period.

Metering
Electricity supplied by the project activity to the grid will be measured by Umoya Energy.

Metering will be conducted in accordance with the power purchase agreement requirements.

Meter data will be recorded and stored by onsite devices as well as in the centralised database.

Data management
The data received, analysed and used for monitoring purposes will be stored for at least two years following the end of the project activity crediting period as per ACM0002 (Version 12.1.0). The dispatch data will be stored in a centralised database.

Quality Assurance and Quality Control

The data from the meters installed at the substation will be crosschecked with sales invoices. In the case of inconsistencies, the more conservative of the two values will be used.

In order to ensure conservativeness, deemed generated energy (electrical energy generated but not delivered to the grid due to Eskom system interruption or Eskom dispatch instruction) will not be included in emission reduction calculations.

If problems occur that may affect the quality of data, corrective action will be taken. In the case where data quality problems result in uncertainty issues, the more conservative value from an energy generation or emission factor standpoint will be used in the calculations and monitoring data for verification.

Internal audit
The records will be audited and checked annually by senior project proponent employees assigned with this responsibility.

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

Date: 06/11/2010

Entities: Coordinator ApS, Damhusvaenget 10, 2990 Nivaa, Denmark and Promethium Carbon (Pty) Ltd, P.O. Box, 131 253, Bryanston, 2021, South Africa

Contact Company: Promethium Carbon (Pty) Ltd

Coordinator ApS and Promethium Carbon (Pty) Ltd are not project participants.

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

30/06/2012 (the date when the turbine orders is expected to be placed)

C.1.2. Expected operational lifetime of the project activity:

Duration of the equipment, if maintained in accordance with manufacturer's instructions is 20 years.

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:

Not applicable

C.2.1.2. Length of the first crediting period:

Not applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

30/09/2013 or the date of registration, whichever occurs latest.

C.2.2.2. Length:

Ten years.

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

Umoya Energy has undertaken an Environmental Impact Assessment (EIA) process to determine the environmental feasibility of a proposed wind energy facility near the town of Hopefield, in the Western Cape Province. Umoya Energy has appointed Savannah Environmental, as independent environmental consultants, to undertake the EIA. The EIA process has been undertaken in accordance with the requirements of the National Environmental Management Act (NEMA); (Act No. 107 of 1998). The EIA report incorporates all issues and responses captured prior to submission to the National Department of Environmental Affairs and Tourism (DEAT). The National Department of Environmental Affairs and Tourism (DEAT) is the competent authority for this project.

Overall the proposed wind energy facility is likely to have local and regional negative impacts on the vegetation on site, prior to mitigation. The significance of the impacts can be reduced with appropriate mitigation, as recommended. The primary negative impacts are the result of both direct and indirect factors. Direct impacts include loss of natural vegetation in development footprints, and direct, long term loss of natural vegetation in areas that will be disturbed by heavy construction machinery, temporary dumping, etc. It is, however, regarded as essential mitigation that the entire area south of the Sout River be managed as a conservation area.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

The findings of the specialist studies undertaken within the EIA to assess both the benefits and potential negative impacts anticipated as a result of the proposed project conclude that there are no environmental fatal flaws that should prevent the proposed project from proceeding, provided that the recommended mitigation and management measures are implemented. None of the landowners who stand to be directly affected by the proposed wind energy facility are opposed to the development. The proposed development also represents an investment in clean, renewable energy, which, given the challenges created by climate change, represents a positive social benefit for society as a whole.

The proposed power line will have an acceptable overall Low-Medium negative impact on vegetation throughout its length. It is unlikely that significant proportions of any populations of threatened plants in these habitats will be impacted by the proposed power line. The power line does not pass through the most sensitive biodiversity areas of the site. The proposed project does not have any transboundary impacts.

A positive record of decision (RoD) has been received for the proposed project, authorised by the DEA. This was based on the nature and extent of the proposed project, the local level of disturbance predicted as a result of the construction and operation of the facility, the findings of the EIA, and the understanding of the low significance level of potential environmental impacts.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

In order to accommodate the varying needs of stakeholders, interested and affected parties (I&APs), as well as ensure the relevant interactions between stakeholders and the EIA specialist team, the following opportunities were provided for I&APs issues to be recorded and verified through the EIA process, including:

- Focus group meetings (pre-arranged and stakeholders invited to attend).
- One-on-one consultation meetings and telephonic consultation sessions (consultation with various parties, for example with directly affected landowners, by the project participation consultant as well as specialist consultants).
- Written, faxed or e-mail correspondence.

The project information was made available for public review at the following public places in the project area from **6 April 2009 to 6 May 2009**:

» Hopefield Library
» Moorreesburg Library
» Darling Library
» Saldanha Bay Municipality
» West Coast District Municipality

In order to facilitate comments and provide feedback of the findings of the studies undertaken, a public meeting was held a public meeting held on 29 April 2009 at the Hopefield Community Centre, Hopefield.

E.2. Summary of the comments received:

Issues and comments raised by I&APs have been synthesised into Comments and Response Reports.

A summary of the key issues raised includes:

- Visual impacts and aesthetics
- Site access and security of farms
- Social impacts and benefits
- Impacts on landowners and land use
- Erosion control and dust
- Noise impacts
- CWCBR and biodiversity impacts
- Impacts on birdlife
- Integration with the electricity grid
- Technology and equipment specifications and safety of turbines
- Aviation airspace and South African Airforce airspace
- Site footprint
- Construction phase timeframe
- Transportation and road access

E.3. Report on how due account was taken of any comments received:

Issues and comments received have been adequately addressed and synthesised into Comments and Response Reports as part of the EIA process. In reaching a positive ROD, the Department took all the comments from the I&AP's into consideration.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding has been used or will be used in the development and implementation of this project.

Annex 3

BASELINE INFORMATION

Grid emission factor calculations

The steps applied to determine the emission factor for the grid were as follows:

Step 1: Identify the relevant electric power system
This tool will serve project activities that prospect displace grid electricity in countries that form part of the Southern African Power pool.

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.

None of the DNAs of Southern African countries have published delineations of their project electricity systems or connected electricity systems. There is however information available on the countries that are part of the SAPP grid[8]; generated and exported electricity[9], as well as connected transmission lines between countries and the maximum ratings[10].

The countries that are *physically connected* in the SAPP are (excluding countries that are part of SAPP, but not connected) (connected utilities indicated in brackets):

- Namibia (NamPower);
- South Africa (Eskom and non-Eskom stations);
- Zimbabwe (ZESA);
- Zambia (ZESCO);
- Mozambique (EDM);
- Botswana (BPC);
- Democratic Republic of Congo (SNEL);
- Lesotho (LEC);
- Swaziland (SEB).

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[8] The Southern African Power Pool, 2007, *SAPP Grid*, http://www.sapp.co.zw/viewinfo.cfm?id=7&linkid12&siteid=1
[9] The Southern African Power Pool, *Annual Reports*, http://www.sapp.co.zw/viewinfo.cfm?id=71&linkid=2&siteid=1
[10] The Southern African Power Pool, 2007, *Interconnector limits*, http://www.sapp.co.zw/viewinfo.cfm?id=74&linkid=12&siteid=1

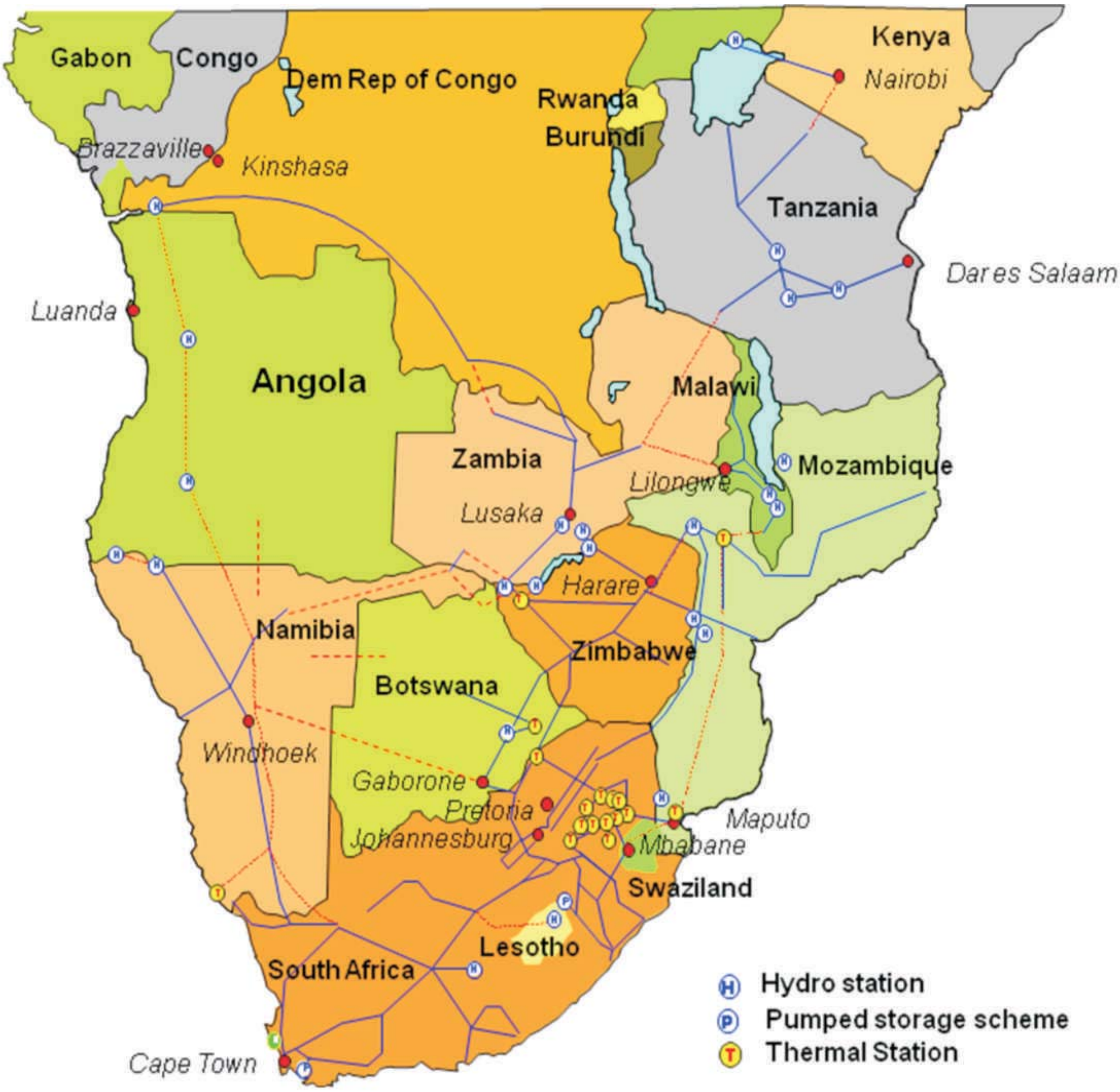

Figure 6: The SAPP Grid.

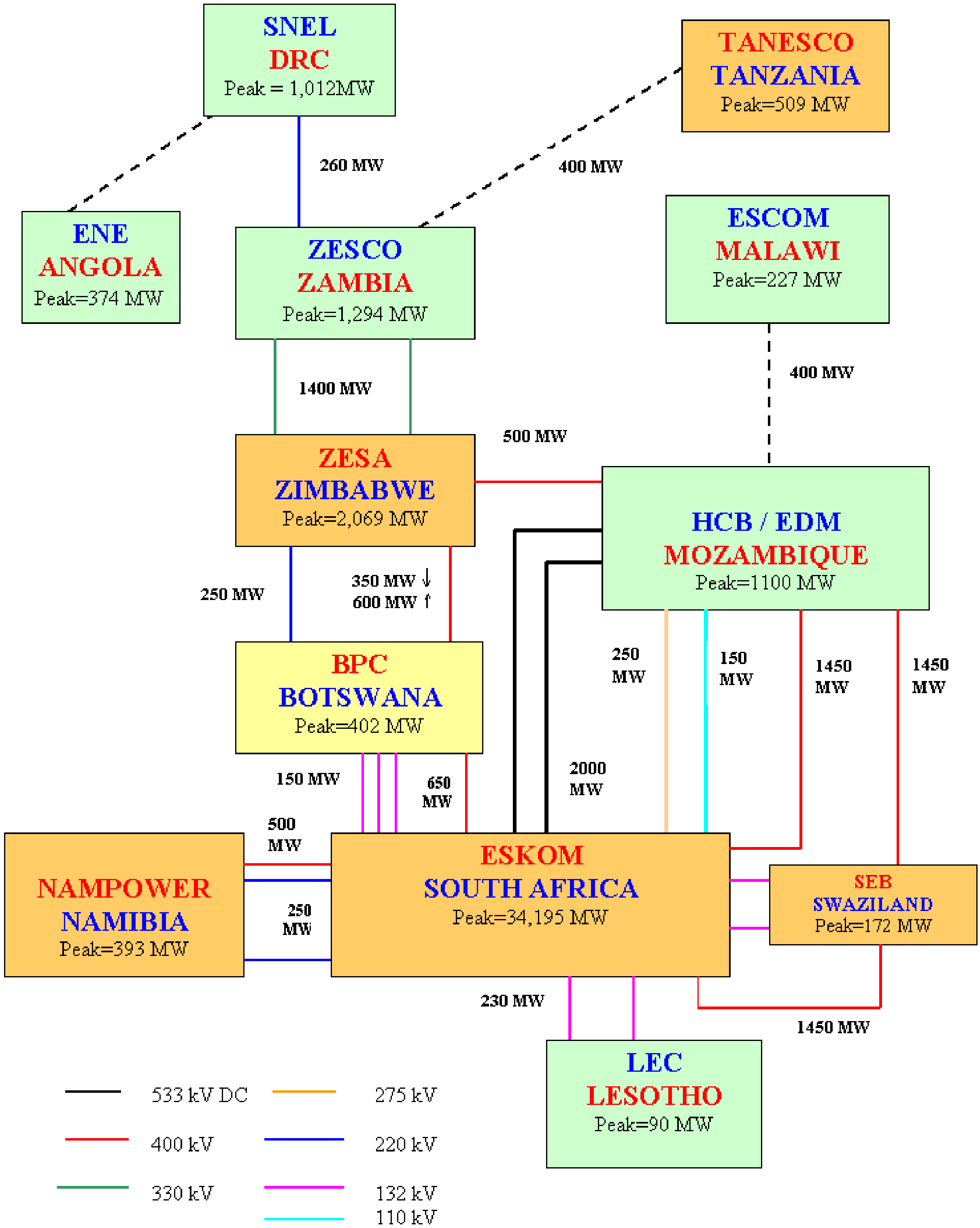

Figure 7: SAPP interconnector limits.

The Caprivi link is an interconnector (not indicated in Figure 6) that was recently commissioned between Zimbabwe and Namibia. It aims to supply 150 megawatts (MW) of electricity from Hwange power station to Namibia. The Caprivi Link is part of the ZIZABONA project and the power line from Hwange in Zimbabwe to Livingstone in Zambia has been completed by December 2010[11]. This link will not be considered in calculations as the latest consolidated information available from the SAPP is for 2009.

To determine which of the connected utilities are part of the **project electricity system** and which are **connected electricity systems**, the existence of significant transmission constraints between utilities has to be determined.

The existence of significant transmission constraints from the connected electricity system to the project electricity system are determined by the following criteria:

- In case of electricity systems with spot markets for electricity: there are differences in electricity prices (without transmission and distribution costs) of more than 5 percent between the systems during 60 percent or more of the hours of the year
- The transmission line operates at 90% or more of its rated capacity during 90% percent or more of the hours of the year.

Spot markets are not applicable for this electricity system. The SAPP does have a Short Term Energy Market (STEM). STEM is designed to be a day-ahead market and compliments the bilateral market through the provision of another technique for the pricing of electrical energy. A day-ahead market is a physical market where prices and amounts are based on supply and demand. SAPP said in 2004: "*The ambition of SAPP is to establish a regional spot market where electricity would be traded in real time and provide the necessary basis for the development of subsequent financial markets*"[12]. This has not been implemented to date as the STEM "Book of Rules" currently in use is still the 2003 version[13]

A 3-year average (2007-2009 financial years; 1 April – 31 March) for each utility's electricity combined imports and exports are obtained from the SAPP annual reports. This is used, together with 90% of the rated interconnector limits (illustrated in Figure 7) to calculate the percentage of hours in a year operated at 90% of rated capacity.

It was found that there are no significant transmission constraints between any of the connected SAPP countries, and thus no **connected electricity systems**. Therefore, all the suppliers listed above comprise the **project electricity system**, from which the project activity sources electricity.

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[11] Informante, *Simasiku on Caprivi link project and Hwange*, Administrator, 14 January 2010, http://www.informante.web.na/index.php?option=com_content&task=view&id=5570&Itemid=108&PHPSESSID=b4dcfee218fc205d8efdeb7968b06910

[12] Dr. L. Musaba, P. Naidoo, W. Balet and A. Chikova, Developing a competitive market for regional electricity cross border trading: The case for the Southern African Power Pool, http://www.sapp.co.zw/documents/P12%20-%20SAPP%20Publication%20for%20IEE%20-%20JAN%202004.pdf as accessed on 2 June 2010

[13] http://www.sapp.co.zw/docs/STEM%20Book%20of%20Rules%20-%20%20APRIL%202003.pdf as accessed on 2 June 2010

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)
The grid emission factor is calculated from grid power plants only (Option I). Off-grid power plants are not included in the calculations.

Step 3: Select an operating margin method
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 on average over the five most recent years.

The total generated electricity for the different utilities were obtained from the SAPP annual reports, but data for the electricity resources and generation capacities were not readily available in the public domain. The source and type of data that were used to establish the low-cost/must-run resources of each utility can be found in Table 2 (actual values used are shown in Table 4).

Table 2: Utility power generation resources

Country (Utility)	Data description	Source
Namibia (NamPower)	General fractions for different electricity production resources	Developing Renewables, *Country Energy Information, Namibia*, 2006, http://www.energyrecipes.org/reports/genericData/Africa/061129%20RECIPES%20country%20info%20Namibia.pdf
South Africa (Eskom)	Actual generation (GWh) for 2006-2008.	Eskom Holdings Ltd, 2009, *Eskom Annual Report 2009*, http://www.eskom.co.za/annreport09/
Zimbabwe (ZESA)	Generation capacity (MW) of different resources.	Stuart Doran, 2009, *Zimbabwe's economy*, http://www.thebrenthurstfoundation.org/Files/Brenthurst_Commisioned_Reports/BD0908-Zimbabwe.pdf
Zambia (ZESCO)	General fractions for different electricity production resources	ZESCO official website, http://www.zesco.co.zm/index.php?option=com_content&task=view&id=1&Itemid=
Mozambique (EDM)	Actual generation (GWh) for 2000-2004 (average taken).	*Brief analysis of energy sector in Mozambique*, EDM Annual Statistical Reports 2000-2004, http://www.mozergy.com/articles/MozambiqueEnergyOverview.pdf
Botswana (BPC)	General fractions for different electricity production resources	Nationmaster website, http://www.nationmaster.com/country/bc-botswana/ene-energy
Democratic Republic of Congo (SNEL)	General fractions for different electricity production resources	Geni website and SAPP, http://www.geni.org/globalenergy/library/national_energy_grid/democratic-republic-of-the-congo/demrepubliccongonationalelectricitygrid.shtml

Lesotho (LEC)	General fractions for different electricity production resources	The Southern African Power Pool, 2007, *SAPP Grid*, http://www.sapp.co.zw/viewinfo.cfm?id=7&linkid12&siteid=1

The average percentage of low-cost/must-run resources, for the entire SAPP grid, amount to 15.79% of the total grid generation. Therefore, Option (a) is applicable to the SAPP grid emission factor calculations.

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 is 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 2006 – 31 March 2009 (SAPP financial year runs from 1 April – 31 March). This is the latest available data.

Step 4: Calculation of the operating margin emission factor

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 B is used for calculating the simple OM. The calculations in this option are based on the total net electricity generation of all power plants serving the system and the fuel types and fuel consumption of the project electricity system. Option B is used seeing that:

a) The necessary data for Option A (electricity generation and emission factor for each power unit) is not available; and
b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is know; and
c) Off-grid power plants are not included in the calculation.

In addition to data and sources already provided in this report, Table 3 depicts data descriptions and sources that were used in the calculation of the simple OM (actual values used can be found in Tables 4 and 5).

Table 3: Other data used in calculations

Country (Utility)	Data description	Source
Namibia (NamPower)	Fuel efficiencies for Paratus and Van Eck power stations.	Republikein, *Namibia's power is in your hands; Use it wisely*, April 2008, www.republikein.com.na/fileadmin/pdf/2008/nampower.pdf

South Africa (Eskom)	Coal-fired stations fuel efficiency (average for all stations).	Eskom Holdings Ltd, 2009, *Eskom Annual Report 2009*, http://www.eskom.co.za/annreport09/
South Africa (Eskom)	Gas turbine stations fuel efficiency (average for all stations).	Eskom Website (data used for 2005; latest available), http://www.eskom.co.za/live/content.php?Item_ID=4226&Revision=en%2F0
Zimbabwe (ZESA)	Fuel efficiency of Hwange coal-fired station.	UNFCCC website (data used from previous project), http://unfccc.int/kyoto_mechanisms/aij/activities_implemented_jointly/items/1886.php
Zimbabwe (ZESA)	Net calorific value (NCV) and emission factor (EF) for Zimbabwean coal.	UNFCCC website (data used from previous project), http://unfccc.int/kyoto_mechanisms/aij/activities_implemented_jointly/items/1886.php
General	NCV and EF for sub-bituminous coal and heavy fuel oil (HFO) (residual fuel oil values used from IPCC).	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*

Equation 7 (in the methodological tool) is used to calculate the average OM:

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

(GEF Tool[14] Eq. 7)

Where:

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

$FC_{i,y}$ = Amount of fossil fuel type i consumed by power plant/unit m in year y (mass or volume unit)

$NCV_{i,y}$ = Net calorific value (energy content) 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_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

[14] UNFCCC methodological tool for the grid emission factor (GEF), “Tool for calculation of emission factor for electricity systems,” Version 02.

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

The constants used in calculations appear in Table 3, while all the values and final calculated operating margin emission factor can be seen in Table 4.

Table 4: Constants used in calculations (refer to Table 3 for references)

Constants		
$NCV_{sub\text{-}bituminous\ coal}$	18.9	GJ/T
$NCV_{HFO\ (Residual\ Fuel\ Oil)}$	40.4	GJ/T
$NCV_{kerosene}$	43.8	GJ/T
$EF_{CO2,\ sub\text{-}bituminous\ coal}$	0.0961	tCO_2/GJ
$EF_{CO2,HFO\ (Residual\ Fuel\ Oil)}$	0.0774	tCO_2/GJ
$EF_{CO2,kerosene}$	0.0719	tCO_2/GJ
$Density_{HFO\ (Residual\ Fuel\ Oil)}$	930	kg/m^3
$NCV_{coal,\ Zimbabwean}$	25.75	GJ/T
$EF_{CO2,coal,\ Zimbabwean}$	0.0946	tCO_2/GJ

Table 5: Electricity generation, fuel consumption, and calculated OM

Supplier	3 yr avg. (GWh)	Fuel Efficiency (T/GWh)	Fuel Consumed (T)	$EF_{grid,OMsimple}$ (tCO2/MWh)
Namibia (NamPower)	1,584.67	-	-	**1.04**
Hydro (Ruacana)	1,537.13	-	-	
Heavy Fuel Oil (Paratus)	47.54	260.40	12,379.42	
Coal (van Eck)	-	570.00	-	
South Africa (Eskom)	230,011.67	-	-	
Coal Fired	213,459.10	552.70	117,979,150.89	
Hydroelectric	1,361.91	-	-	
Pumped-storage	1,935.18	-	-	
Gas turbine (kerosene)	404.07	365.50	147,688.57	
Nuclear power	7,522.33	-	-	
Zimbabwe (ZESA)	7,781.00	-	-	
Coal (Hwange)	1,897.80	505.00	958,391.46	
Hydro (Kariba)	5,883.20	-	-	
Zambia (ZESCO)	9,771.00	-	-	
Hydro	9,761.23	-	-	
Diesel	9.77	No Data	No Data	
Mozambique (EDM)	261.67	-	-	
Hydro	223.90	-	-	

Supplier	3 yr avg. (GWh)	Fuel Efficiency (T/GWh)	Fuel Consumed (T)	$EF_{grid,OMsimple}$ (tCO2/MWh)
Diesel	37.77	No Data	No Data	
Botswana (BPC)	728.00	-	-	
Coal Fired	696.84	No Data	No Data	
Oil	31.16	No Data	No Data	
DRC (SNEL)	7,345.33	-	-	
Hydro	7,345.33	-	-	
Lesotho (LEC)	479.33	-	-	
Hydro	479.33	-	-	
Swaziland (SEB)	137.30	-	-	

Step 5: Identify the cohort of power units to be included in the build margin
The build margin must consist of either:

a) The set of five power plants most recently built; or
b) The set of power capacity additions in the electricity system that comprise 20% of the system generation and that have been most recently built.

The set of power plants that comprise the larger annual generation should be used.

Only data from NamPower, Eskom, and ZESA are available in the public domain, therefore Option (a) is used.

In order to determine the vintage of data, one of the following options must be selected:

Option 1: For the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available at the time of CDM-PDD submission to the DOE for validation.

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the project activity.

Option 1 is used for this project due to the lack consistent data from the same vintage for the NamPower, Eskom, and ZESA power plants.

The commissioning dates for the Eskom and power plants appear on the Eskom website[15]. NamPower and ZESA power plants are listed in Table 6 with their commissioning dates.

Table 6: Supplementary commissioning dates

Power Plant	Commissioning Date	Reference

[15] Eskom Holdings Ltd, 2010, *CDM Calculations, General Information,* *http://www.eskom.co.za/live/content.php?Item_ID=4226&Revision=en/0* *[Accessed 1November 2010]*

Ruacana	1977	NamPower, *http://www.nampower.com.na/pages/ruacana.asp*
Paratus	1976	NamPower, *http://www.nampower.com.na/pages/paratus.asp*
Van Eck	1979	NamPower, http://www.nampower.com.na/pages/van-eck.asp
Hwange	1984	Power plants around the world, *Coal-fired power plants in Africa*, November 2009, *http://www.industcards.com/st-coal-africa.htm*

The five most recently built power plants and their emission factors appear in Table 7. Generation and fuel consumption data for Eskom power stations were obtained from the Eskom website (for the financial year ending 31 March 2010[16]). This data is consistent with the latest data available from SAPP.

Table 7: Power plants included in the BM

Station	On-Line Year	Generation (MWh)	Fuel Consumption (Tons)	$EF_{EL,m,y}$
Kendal (Eskom)	1988	23,307,031.00	13,866,514.00	1.08
Lethabo (Eskom)	1985	25,522,698.00	18,170,227.00	1.29
Majuba (Eskom)	1996	22,340,081.00	12,261,833.00	1.00
Matimba (Eskom)	1987	27,964,141.00	14,637,481.00	0.95
Tuktuka (Eskom)	1985	19,847,894.00	10,602,839.00	0.97

Step 6: Calculate the build margin emission factor

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:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad \textbf{(GEF Tool Eq. 13)}$$

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	The relevant year as per data vintage chosen in Step 3.

[16] Eskom Holdings Ltd, 2010, *CDM Calculations, General Information*, *http://www.eskom.co.za/live/content.php?Item_ID=4226&Revision=en/0* *[Accessed 1 November 2010]*

The CO_2 emission factor of each power unit m ($EL_{EL,m,y}$) should be determined as per the guidance in Step 3 (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:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{\sum_m EG_{m,y}}$$ **(GEF Tool Eq. 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.

Emission factors for individual power plants appear in Table 7.
Using equation 13, the BM is calculated as **1.06** tCO_2e/MWh.

Step 7: Calculate the combined margin emission factor
The combined margin factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$ **(GEF Tool Eq. 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 8.

Table 1: CM emission factor

$EF_{grid,OM,y}$	1.01
$EF_{grid,BM,y}$	1.06
w_{OM}	0.5
w_{BM}	0.5
$EF_{grid,CM,y}$	**1.04**

Annex 4

MONITORING INFORMATION

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