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:

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Title: Hopefield wind energy facility in South Africa
Version number: 05
Date: 18 /10/ 2012

A.2. Description of the project activity:

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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. This proposed project will be a greenfield wind energy facility.

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 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 reduction by replacing electricity generated from predominantly fossil fuel fired power plants connected to the grid. The proposed project is estimates an emission reduction of 171 535 tCO2e per annum and a total of approximately 1 715 350 tCO2e during the 10 year crediting period.

Baseline scenario
The baseline scenario is for the South African national grid 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

[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

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 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:
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[3]. 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 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.

A.3. Project participants:

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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 (Private Entity)	No

[2] Medium need is defined as **"***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

[3] Environmental Impact Assessment, Savannah Environmental (Pty) Ltd, May 2009.

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):

>>
A representative GPS co-ordinate for the proposed project is: -33.0977°, 018.3547° [33° 5’51.57”S 18° 21’17.03”E]

The site itself covers approximately 1000 hectares roughly around the area of these coordinates:-

-33.0910°, 018.4263° [33° 5’27.57”S 18° 25’34.69”E]
-33.0809°, 018.4122° [33° 4’51.08”S 18° 24’44.07”E]
-33.0815°, 018.3778° [33° 4’53.55”S 18° 22’40.27”E]
-33.0977°, 018.3547° [33° 5’51.57”S 18° 21’17.03”E]
-33.1119°, 018.3862° [33° 6’42.79”S 18° 23’10.36”E]

The site covers the portions of land:
Koperfontein 346/25
Coeratenberg 307/3

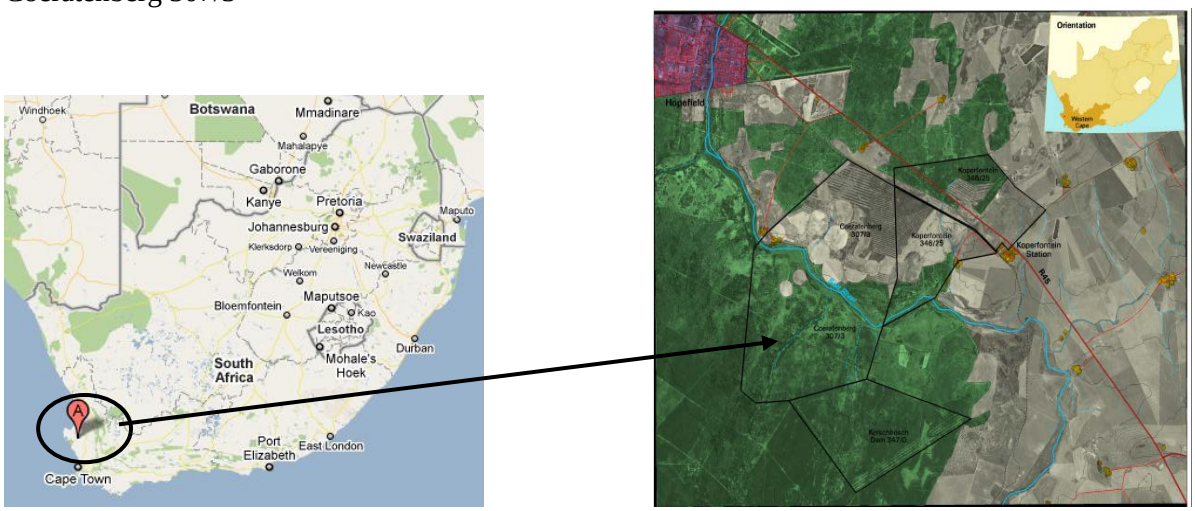

Figure 1: Location of the proposed project activity

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

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

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

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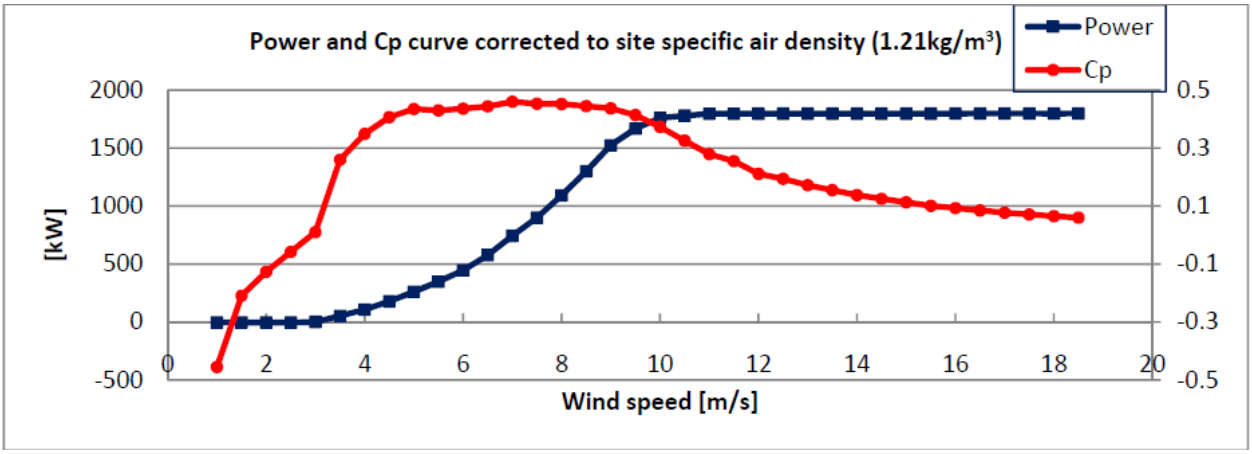
Wind turbines will be used to produce electricity by using the kinetic energy of the wind to drive a generator. When kinetic energy passes over the blades of the wind turbines, it is converted into mechanical energy and rotates the blades. This in turn rotates the generator, thereby producing electricity. 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 with hub height of 95 metres[4].
The baseline scenario is for the South African national grid 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 Vestas V100 1.8MW Mark 7 wind turbines and the power curve of this technology are provided below.

Description of	**Specification**
Nominal power	1800 kW
Hub height	95 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

[4] Hopefield Wind Farm Energy Assessment, Entura, June 2011.



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. The technology is a clean technology since there are no GHG emissions associated with the electricity generation. Therefore this project activity will install wind turbine generators that are environmentally safe and sound.

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

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Years	Annual estimation of emission reductions in tonnes of CO2 e
1	171 535
2	171 535
3	171 535
4	171 535
5	171 535
6	171 535
7	171 535
8	171 535
9	171 535
10	171 535
Total estimated reductions (tonnes of CO2 e)	**1 715 350**
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO2 e)	171 535

A.4.5. Public funding of the project activity:

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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:

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ACM0002: Consolidated baseline methodology for grid-connected electricity generation from renewable sources
Version 13.0.0, Sectoral Scope: 01, EB 67

Methodological tools used:

Methodological Tool: Tool for the demonstration and assessment of additionality
Version 06.1.0, EB 69
Methodological Tool: Tool to calculate the emission factor for an electricity system
Version 02.2.1, EB 63

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

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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).*	**Applicable** The proposed project activity will be a grid-connected renewable power generation project. 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 (Option (a) according to the methodology). Thus the methodology is applicable.
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.	**Applicable** 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	**Not Applicable** The project activity is a greenfield wind energy facility. It does not involve capacity additions,

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 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.	retrofits or replacements. Therefore this applicability criterion is not applicable.
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.*	**Not Applicable** 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.*	**Not Applicable** 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".	**Not Applicable** 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:

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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	It is conservative. Minor emission source.
		N_2O	No	It is conservative. Minor emission source.
Project activity	Proposed activity – greenfield wind power plant	CO_2	Yes	For start –up. Minor emission source; it can be taken to be negligible. As per the applied methodology ACM0002, version 13.0.0, emissions from wind power projects are excluded from the project boundary.
		CH_4	No	Zero-emissions grid-connected electricity generation from wind power renewable energy
		N_2O	No	

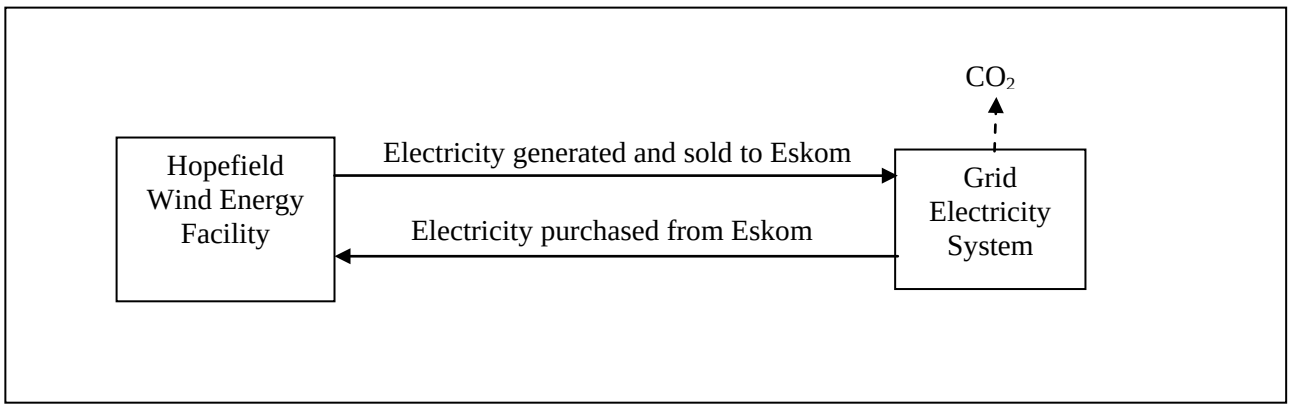

Figure 1: Flow diagram of project activity and project boundary

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

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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 2.2.1 described step wise under section B.6.

The baseline is the electricity generated and distributed through the South African national grid.

The plant load factor (PLF) using the P50 predicted output at 95 metres is 32.3%[5]. The PLF was determined by an independent third party consultancy, Entura[6]. The formula to verify the PLF is as follows: 188,500 MWh/ (66.6 MW x 8760 hours) = 32.3097%.

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):

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The determination of the additionality is done by using the following:

- Tool for the demonstration and assessment of additionality Version 06.1.0, EB 69.
- Guidelines for objective demonstration and assessment of barriers. Version 01. EB 50.
- Guidelines on additionality of first-of-its-kind project activities. Version 2.0. EB 69

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:

[5] Hopefield Wind Farm – Energy Assessment June 2011, Entura.

[6] Hopefield Wind Farm – Energy Assessment August 2011, Entura. Page 55.

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 07 EB 69, (Version 02.0), 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 technologies that are implemented by any other project, which are able to deliver the same output and have started commercial operation in the applicable geographical area before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of the proposed project activity, whichever is earlier;
(b) The project implements one or more of the measures;
(c) The project participants selected a crediting period for the project activity that is "a maximum of 10 years with no option of renewal".

Table 1: First-of-its-kind analysis for the Hopefield Wind Energy Facility:

Definitions	**Identification**	**Existing/ Alternatives (as applicable)**	**Justification for Hopefield Wind Energy Facility**
Applicable geographical area	South Africa	Southern African Power Pool.	It is the host country and can be used as the default. In addition, decisions around policies and regulations concerning the applicable geographical area (i.e. the national grid) would only relate to South Africa.
Measure	As per para2(b) of First-of-its-kind guidelines ver.2.0, Switch of technology with or without change of energy source including energy efficiency improvement as well		The proposed project is power generation based on renewable energy which is in line with paragraph 2(b) of Guidelines on additionality of first-of-its-kind project activities, ver.2.0

	as use of renewable energies (example: energy efficiency improvements, power generation based on renewable energy);		
Output	Wind turbine generators supplying electricity to the grid.	Small and micro demonstration facilities exist. The three wind farms that currently exist in South Africa are: Klipheuwel Wind Farm[7] ; Darling National Demonstration Wind Farm[8] and Coega Wind Farm[9].	A renewable energy country profile for South Africa by the International Renewable Energy Agency (IRENA) also states that energy supplied by wind only amounts to 0.002% of the country's energy supply.
Different technologies	66.6 MW of renewable energy.	(Klipheuwel (3.2MW), Darling (5.2 MW) and Coega (1.8 MW) wind farms)	The Hopefield Wind Energy Facility is differentiated from any existing renewable project due to the size of the installation. Hopefield is a large scale commercial project, while the existing projects are all small scale and less than 5.3 MW.
Timing	At the time of start of GSC i.e. 13 October 2011 which		Currently there are no grid connected wind projects of a similar size. A confirmation letter from

[7] **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.

[8] **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[8]. The Darling National Demonstration Wind Farm has the installed capacity of 5.2 MW.

[9] Coega Wind Farm The multi-billion rand investment is being undertaken by Electrawinds Belgium which will build 25 wind turbines which will provide power to the Nelson Mandela Bay Metropolitan. The construction of the first wind turbine was completed in time to provide energy for the Nelson Mandela Bay Stadium for the 2010 Soccer World Cup.

	is the earlier than start date of the project activity.		South African Wind Energy Association dated 14/02/2012 has been submitted to the DOE, which explicitly mentions that at the time of this letter been issued in RSA only three demonstration wind project were implemented as stated in row above. All these projects are less than 15 MW (i.e. small scale project) and hence considered as different technology as per paragraph 4(c) of Annex 07 EB 69. Hopefield is one the first wind farms in South Africa to receive preferred bidder status for the Independent Power Producers announced in December 2011. Therefore commercial operation of this wind energy facility is expected to be one of the first.

The Project is considered a First-of-its-kind because:

1. No other large scale (> 15 MW) wind power plants have reached commercial operation within the borders of South Africa (applicable geographical area) before the GSC (i.e. 13 October 2011).
2. *The project implements one or more of the measures;*
3. The Project participant selected a crediting period for the project activity that is a maximum of 10 years with no option of renewal.

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 13.0.0, for wind energy based renewable energy project activities, PEy = 0.

Baseline emissions

The methodological choices made regarding the 'Tool to calculate the emission factor for an electricity system' (Version 02.2.1) are as follows:

- In terms of data vintages, the ex ante option was 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 simple operating margin emission factor ($EF_{grid,OMsimple,y}$) is chosen for the calculation method, seeing as low-cost/must-run resources constitute less than 50% of total grid generation in average of the five most recent years.
- For calculating of the combined margin emission factor: w_{OM} = 0.75 and w_{BM} = 0.25 (as specified by the applied tool).

Baseline emissions include only CO2 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:

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

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.

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

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 02.2.1. 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 13.0.0). 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:

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

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:

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

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

>>

Data / Parameter:	$EF_{grid,OM,y}$
Data unit:	tCO_2/MWh
Description:	Operating Margin Emission Factor
Source of data used:	The operating margin emission factor, determined according to the latest approved version of the "Tool to calculate emission factor for an electricity system". The source of data is from Eskom Holdings SOC Limited . (2011). CDM Calculations. Retrieved October 06, 2011, from Eskom: http://www.eskom.co.za/c/article/236/cdm-calculations/ .
Value applied:	0.923
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 02.2.1) at the beginning of the project and kept constant for the life of the project.
Any comment:	Refer to Annex 3 for detailed calculation

Data / Parameter:	$EF_{grid,BM,y}$
Data unit:	tCO_2/MWh
Description:	Build margin CO_2 emission factor
Source of data used:	The build margin emission factor, determined according to the latest approved version of the "Tool to calculate emission factor for an electricity system". The source of data is from Eskom Holdings SOC Limited . (2011). CDM Calculations. Retrieved October 06, 2011, from Eskom: http://www.eskom.co.za/c/article/236/cdm-calculations/ .
Value applied:	0.871

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 02.2.1) at the beginning of the project and kept constant for the life of the project.
Any comment:	Refer to Annex 3 for detailed calculation

Data / Parameter:	$EF_{grid,CM,y}$
Data unit:	tCO_2/MWh
Description:	Combined margin CO_2 emission factor
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". The source of data is from Eskom Holdings SOC Limited . (2011). CDM Calculations. Retrieved October 06, 2011, from Eskom: http://www.eskom.co.za/c/article/236/cdm-calculations/ .
Value applied:	0.910
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 02.2.1) at the beginning of the project and kept constant for the life of the project.
Any comment:	Refer to Annex 3 for detailed calculation

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 0.910[10]

Year	ER_y	$EG_{facility,y}$	$EF_{grid,CM,y}$
1	171 535	188 500 [11]	0.910

[10] The $EF_{grid,CM,y}$ for the proposed project activity has been changed from the value in the PDD at the time of GSC. This is because a more conservative value was chosen based on updated emissions data and recent project registrations.

[11] The generation capacity of the wind farm has been updated from the value in the webhosted document during GSC. This is because the lastest wind report was updated after GSC. (Hopefield Wind Farm Energy Assessment. 20 June 2011. Entura)

2	171 535	188 500	0.910
3	171 535	188 500	0.910
4	171 535	188 500	0.910
5	171 535	188 500	0.910
6	171 535	188 500	0.910
7	171 535	188 500	0.910
8	171 535	188 500	0.910
9	171 535	188 500	0.910
10	171 535	188 500	0.910

B.6.4 Summary of the ex-ante estimation of emission reductions:

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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	171 535	0	171 535
2	0	171 535	0	171 535
3	0	171 535	0	171 535
4	0	171 535	0	171 535
5	0	171 535	0	171 535
6	0	171 535	0	171 535
7	0	171 535	0	171 535
8	0	171 535	0	171 535
9	0	171 535	0	171 535
10	0	171 535	0	171 535
Total (tonnes of CO_2 e)	**0**	**1 715 350**	**0**	**1 715 350**

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

B.7.1 Data and parameters monitored:

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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:	Electricity meters installed at the substation of the proposed wind farm.
Value of data applied for the purpose of calculating expected	188,500

emission reductions in section B.5	
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 by finding the difference between the electricity imported and exported. The meters will be bidirectional meters and any consumption of power by the wind turbines will be recorded at the meter. All electricity supplied to the grid is measured continuously. Measured by electricity meters with an accuracy of at least 0.5%.
QA/QC procedures to be applied:	The data from the meters installed at the substation will be crosschecked with sales invoices All electricity supplied to the grid is measured continuously. Data will be collated and recorded on a monthly basis for CDM purposes and compared to the sales invoices. The meters will be calibrated in accordance to manufacturers specifications.
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. The meters will be bidirectional meters and any consumption of power by the wind turbines will be recorded at the meter. All electricity supplied to the grid is measured continuously. Data will be collated on a monthly basis for CDM purposes.

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 13). The dispatch data will be stored in a centralised database.

Quality Assurance and Quality Control

The measuring equipment for the project will be calibrated in accordance to manufacturer's specifications.
Frequency of checking meters – the PPA states that "Save on reasonable grounds, including a suspected inaccuracy determined pursuant to clause 12.6.4, the Buyer shall not be entitled to call for more than one (1) test of the Facility Metering Installation in any period of twelve (12) Months, and the Seller shall not be entitled to call for more than one (1) test of the System Metering Installation in any period of twelve (12) Months."

"Without limiting clause 12.6.1, if readings taken from the Facility Metering Installation and the System Metering Installation are significantly different from one another and/or demonstrate a level of inaccuracy falling outside the particular standard and specification used for the relevant meter, or are beyond a tolerance level of ±0.5%, whichever is the lesser, then the Facility Metering Installation and the System Metering Installation shall both be tested."

The data from the meters installed at the substation will be crosschecked with sales invoices. In the case of material inconsistencies, the difference will be described in the monitoring report and the choice of the most appropriate value justified.

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: 26/11/2011

Promethium Carbon (Pty) Ltd, P.O. Box, 131 253, Bryanston, 2021, South Africa
Contact Company: Promethium Carbon (Pty) Ltd, P.O. Box, 131 253, Bryanston, 2021, South Africa

Promethium Carbon (Pty) Ltd is not a project participant.

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:

>>

15/12/2011[12]. (Payment of Bid Bond upon Announcement of preferred bidders status)

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:

>>

01/04/2014

C.2.2.2. Length:

>>

Ten years and zero months.

SECTION D. Environmental impacts

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

>>

[12] Bid requirement document., Department of Energy., "200,000/MW "Preferred bidder bond" payable within 14 days" of the preferred bidder announcement. This is considered the start date as described in section C below.

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 limited local and regional negative impacts on the vegetation on site, prior to mitigation. The significance of the impacts can be reduced with appropriate mitigation. 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. Mitigation is through managing that the area south of the Sout River 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), the following opportunities were provided for I&APs issues to be recorded:

- 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. The stakeholder comments did not affect the CDM component of the project.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Title:	Project Manager
Salutation:	Mrs
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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

This calculation 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.

All raw data used (i.e. Electricity generation and consumption of individual units) to calculate the OM and BM separately can be seen in the emission factor spreadsheet.

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 2008 – 31 March 2011 resulted in a combined margin emissions factor of **0.910** tonne CO_2/MWh.

STEP 1: IDENTIFY THE RELEVANT ELECTRICITY SYSTEMS

This tool will serve project activities that will displace grid electricity in South Africa.
The **project electricity system** is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be displaced without significant transmission constraints.

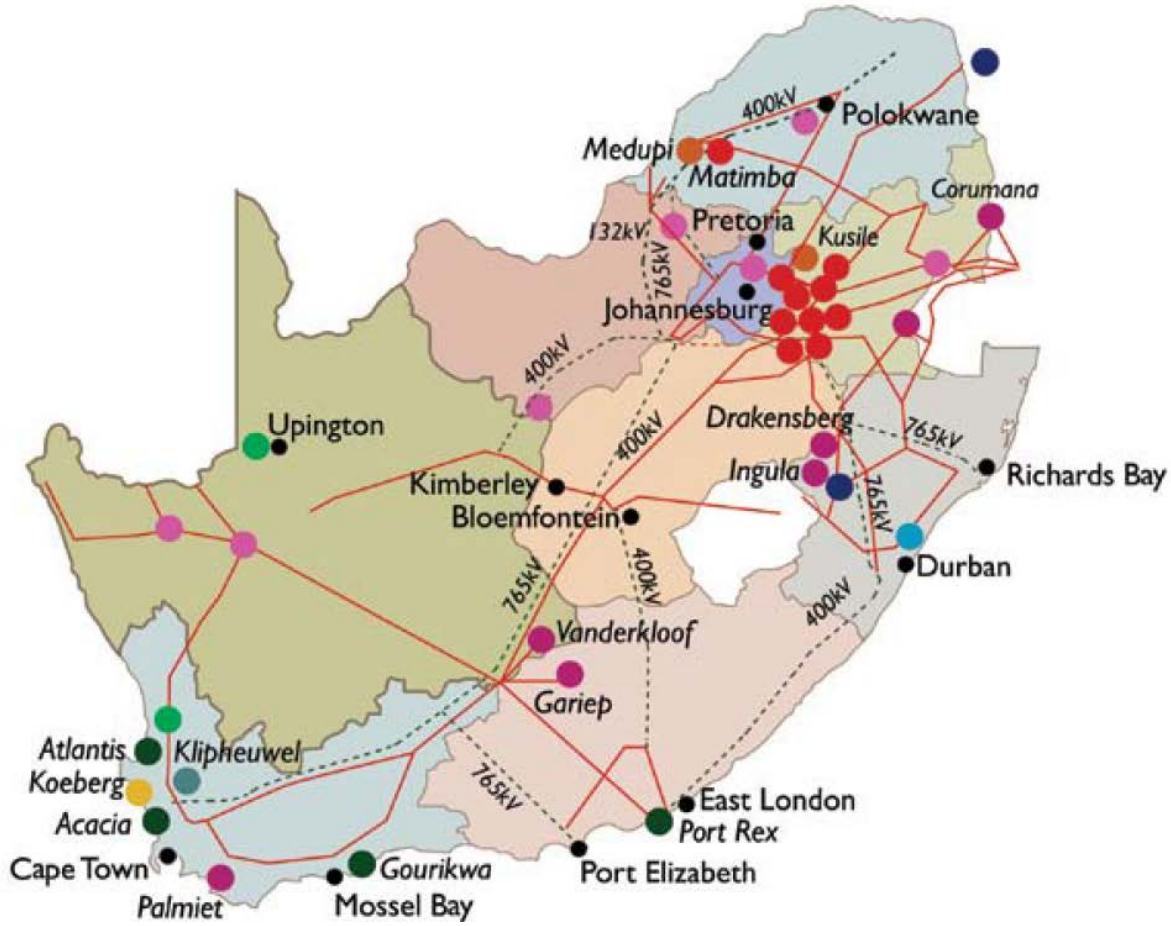
Similarly, a **connected electricity system**, e.g. national or international, is defined as an electricity system that is connected by transmission lines to the project electricity system. Power plants within the connected electricity system can be dispatched without significant transmission constraints,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

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

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

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

All the data for the Eskom power stations are obtained from the Eskom website, where they have a specific webpage dedicated to CDM grid emission factor related data[13]. This data includes commissioning dates, electricity generated, and fuel consumed.
Data for the imported electricity are obtained from the Eskom annual report, where "*Total purchased for the Eskom system (GWh)*" is shown in the "*Statistical overview*" table on pg. 324 of the report[14].



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)

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

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

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

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

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

STEP 4: CALCULATE THE OPERATING MARGIN EMISSION FACTOR ACCORDING TO THE SELECTED METHOD

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

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

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

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

Where:

$EF_{grid,OMsimple,y}$ = Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)

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

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

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

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

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

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

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

Where:

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

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

The parameters used in calculations appear in Table 1.

Table 1: Constants used in calculations

Constants		
$NCV_{other\ bituminous\ coal,\ 2009}$ [15]	19.10	GJ/T
$NCV_{other\ bituminous\ coal,\ 2010}$ [16]	19.22	GJ/T
$NCV_{other\ bituminous\ coal,\ 2011}$ [17]	19.45	GJ/T
$NCV_{other\ kerosene}$ [18]	42.4	GJ/T
$EF_{CO2other\ bituminous\ coal}$ [19]	0.0895	tCO_2/GJ
$EF_{CO2,other\ kerosene}$ [20]	0.0708	tCO_2/GJ

[15] Eskom Holdings SOC Limited. (2011). *Annual Report 2011.*
[16] Eskom Holdings SOC Limited. (2011). *Annual Report 2011.*
[17] Eskom Holdings SOC Limited. (2011). *Annual Report 2011.*
[18] IPCC, 2006
[19] IPCC, 2006
[20] IPCC, 2006

The fuel used for coal power stations is other bituminous coal. In *"Eskom Fact Sheet – Formation of Coal"*[21] it is stated that coal in South Africa is "mostly classified as 'bituminous' coals". The article *"What is the carbon emission factor for the South African electricity grid? (Spalding-Fecher, 2011)"*[22] also specifies the use of "other bituminous coal" as the fuel used in the Eskom power stations.

The fuel used for Acacia and Port Rex power stations is kerosene. This is stated in *"Eskom Fact Sheet – Port Rex and Acacia Power Stations"*[23]. Also, in the source data for electricity generation and fuel consumption the fuel consumption for these two power stations are specified in units of "liters kerosene/year"[24].

Using equation 6, the OM is calculated as **0.923** 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.

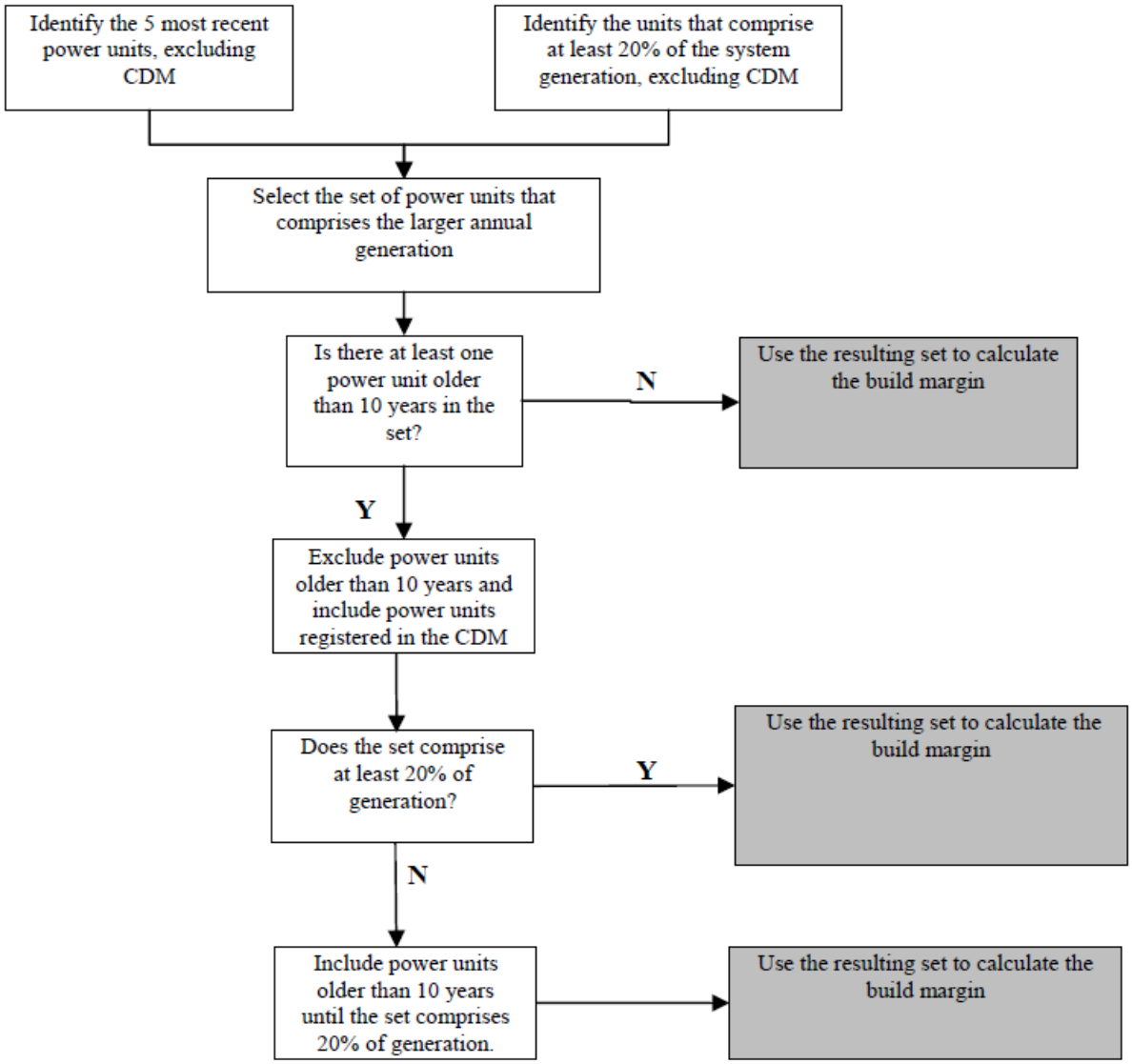
The following diagram summarizes the procedure of identifying the sample group:

[21] http://recruitment.eskom.co/live/content.php?Category_ID=60

[22] Supplied to validators.

[23] http://www.eskom.co.za/content/GS_0001GasTurbAcaciaPortRexRev6~1~1.pdf

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



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

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

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

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

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.

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

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

Where:

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

$EF_{CO2,m,i,y}$ = Average CO2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/GJ)

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

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

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

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

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

Using equation 13, the BM is calculated as **0.871** 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 final combined margin appear in Table 8.

Table 1: CM emission factor

	w_{OM}	w_{BM}	**Combined Margin Emission Factor**
Wind and solar power generation project activities for the first crediting period and for subsequent crediting periods.	0.75	0.25	**0.910**
All other projects for the first crediting period.	0.5	0.5	**0.90**
All other projects for the second and third crediting period.	0.25	0.75	**0.88**

BIBLIOGRAPHY

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

Annex 4

MONITORING INFORMATION

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