



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

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**SECTION A. General description of project activity.****A.1. Title of the project activity:**

>>Dassieklip Wind Energy Facility in South Africa

Version 01

Date: 29 February 2012

**A.2. Description of the project activity:**

The project developer BioTherm Energy is proposing to establish a commercial Wind Energy Facility and associated infrastructure on a site located near the town of Caledon in the Western Cape Province of South Africa.

**Purpose of the project activity**

The proposed project activity is an initiative to export renewable electricity produced by Dassieklip to the national grid, which is currently mostly derived from coal. The wind power generated from the project site will be replacing electricity from the national grid.

**Pre-project scenario**

The project proposed is a green field project. Currently, there are no wind turbines installed on the project site.

**Baseline scenario**

The baseline as defined by Version 12.3.0 of the Approved consolidated baseline and monitoring methodology ACM0002: “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”, is electricity generated in the national grid.

**Project activity**

The project activity proposed is a green field project. It is proposed for a cluster of up to 9 wind turbines (described as a wind energy facility) to be constructed over a broader study area approximately 350 hectares in extent. This facility would be operated as a single facility and will include: up to a maximum of 9 wind turbine generators and one substation with a “loop-in-loop-out” connection to the national grid. Ten turbines have been approved under the Environmental Impact Assessment and constitutes the maximum that can be built, but the Project participant has removed one turbine for technical reasons.

The Project Participant has entered into an Engineer, Procure and Construct “(EPC)” Agreement with a consortium of three companies being Group Five, Iberdrola and Sinovel. Heads of Terms were signed. Based on a wind turbine generator capacity of 3 MW, the 9 turbine wind energy facility represents a total installed capacity of 27 MW.

**Sustainable Development**

The project will contribute to sustainable development in South Africa in the following ways:

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Environment

The project will displace some coal-dominated power generation in South Africa with wind power, thereby reducing the carbon footprint of South Africa and leading to water savings at coal fired power plants.

Social

The proposed development also represents an investment in clean, renewable energy, which, given the challenges created by climate change, represents positive social benefit for society as a whole.

The key social issues associated with the construction phase include the creation of employment and business opportunities, and the opportunity for skills development and on-site training. The construction phase will employ up to 106 people over a 10 month period. This is broken down into up to 50 unskilled jobs, up to 21 semi-skilled jobs and up to 35 skilled jobs. There will be an effort to transfer skills and build local capacity across all roles where possible.

The developer has committed to providing tertiary training to three students in the environmental field (as it relates to wind energy) and three in the technical field (as it relates to wind energy) each year for the lifetime of the project (twenty years), adding up to over 100 people trained.

There will be approximately 20 full time jobs created due to the project by the developer or its contractual counterparts.

Economic

In terms of business opportunities for local companies, the capital expenditure of approximately ZAR 586 million during the construction phase will create business opportunities for the regional and local economy. Despite the highly technical nature of the wind turbine generators, the opportunity for South African production and local content is likely to increase over time. The sector of the local economy that is most likely to benefit from the proposed development is therefore the local service industry. Tax revenue from the operating phase of the project will benefit the fiscus.

**A.3. Project participants:**

&gt;&gt;

<b>Name of Party involved (*) ((host) indicates a host Party)</b>	<b>Private and/or public entity(ies) project participants (*) (as applicable)</b>	<b>Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)</b>
Host Party South Africa	Klipheuwel Dassiefontein Wind Energy Facility (Pty) Ltd Private entity	No
Host Party South Africa	BioTherm Energy (Pty) Ltd	No

**A.4. Technical description of the project activity:****A.4.1. Location of the project activity:**

&gt;&gt;

**A.4.1.1. Host Party(ies):**

&gt;&gt;South Africa

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

&gt;&gt;Western Cape Province

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

&gt;&gt;Near the town of Caledon

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

&gt;&gt; The proposed wind farm is to be built on the following farms:

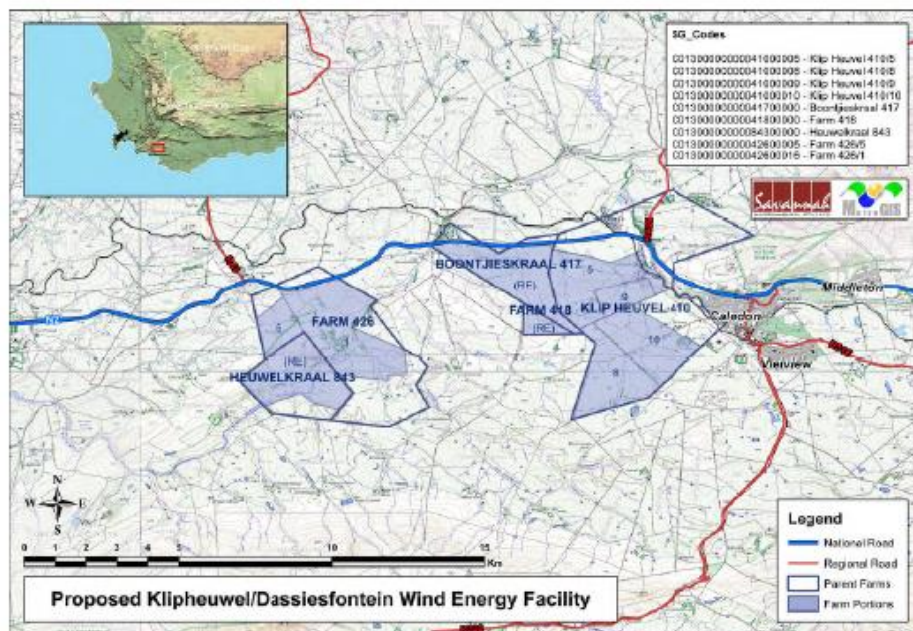
- Klip Heuvel no: 410 sections 5, 8, 9 and 10
- Boontjieskraal no 417 and 418.

The site location is shown in the figure below. The relevant site is the eastern one<sup>1</sup>

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<sup>1</sup> FEIR document page v. It should be noted that the initial EIA application was done with the purpose to build a single wind farm on both sites depicted, totalling up to 16 turbines. For technical reasons that relate to the grid connection it was decided after EIA approval to only proceed on the eastern sites mentioned above which meant limiting the wind farm to the ten turbines approved for those farms (eventually nine). Environmental approval is presently being sought to proceed with a separate (CDM) project with the development of the six turbines on the farms Heuwelkraal 843 and Kilp Heuvel Farm 426 (sections 1 and 5) - the western section on the map. These last-mentioned sites are no longer relevant for purposes of this CDM project

Figure 1: Locality map showing the Dassieklip Wind Farm site regionally and locally



The GPS co-ordinates of each turbine are as follows:

	DDMMSS.SS		UTM WGS 84s Z34	
	X	Y	X	Y
Klipheuwel				
Turbine 1	19°22'23.16"	34°13'38.30"	350153	6211444
Turbine 2	19°22'24.24"	34°13'54.86"	350189	6210934
Turbine 3	19°22'50.49"	34°13'33.25"	350850	6211610
Turbine 4	19°22'50.52"	34°13'48.36"	350858	6211145
Turbine 5	19°22'52.94"	34°14'05.95"	350929	6210604
Turbine 6	19°23'14.62"	34°13'31.42"	351467	6211676
Turbine 7	19°23'13.92"	34°13'48.36"	351457	6211154
Turbine 8	19°23'24.72"	34°14'09.25"	351743	6210515
Turbine 9	19°23'12.47"	34°14'20.04"	351435	6210178

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

>>Category: Renewable electricity in grid-connected applications  
Sectoral Scope: 1 Energy industries

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

The proposed project activity will contribute to technology transfer to the host country South Africa, since it utilises wind power technology (Sinovel) developed in China. Sinovel is one of the world's top ten wind turbine suppliers, with an installed capacity in excess of 12,000MW.<sup>2</sup> Wind energy technology is deemed to be a safe and relatively mature technology, and is established in countries worldwide with approximately 197GW of wind capacity installed globally as at the end of 2010.<sup>3</sup>

The scenario existing prior to the start of the implementation of the project activity: The project is a green field project and no wind or power technology has been implemented on the project site. A new substation will be built to loop in and out of an adjacent national gridline. Gravel roads on the site will be upgraded to the standard needed for large vehicles to use the site during the construction period.

The scope of activities/measures that are being implemented within the project activity: The proposed project is the installation of a new grid-connected zero-emission renewable (wind) power generation activity. The purpose of the proposed project is to generate electricity using wind power resources in the project region and replace the same amount of power generation in South African Power Grid.

A list of the equipment(s) and systems that will be installed and/or modified within the project activity:

- Up to 9 wind turbine units of 3 megawatts each
- A 90 meter tower and nacelle;
- Rotor blades of 54 meters with a resultant diameter of 113 meters
- Concrete foundations to support the turbine towers;
- Underground electrical distribution cabling between the turbines;
- One substation (approximately 80m x 100m in size) on the site receiving distribution cabling from each wind turbine;
- Overhead power lines linking the sub to interconnection
- New and upgraded access and internal roads (approximately 3-5 m in width);
- A small office and/or workshop building for maintenance that will occupy a footprint of approximately 400 m<sup>2</sup>

The baseline scenario

According to the ACM0002 / Version 12.3.0, 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

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<sup>2</sup> See Sinovel spread sheet as received from BioTherm (Will be made available to the validators)

<sup>3</sup> [http://www.gwec.net/fileadmin/images/Publications/GWEC\\_annual\\_market\\_update\\_2010\\_-\\_2nd\\_edition\\_April\\_2011.pdf](http://www.gwec.net/fileadmin/images/Publications/GWEC_annual_market_update_2010_-_2nd_edition_April_2011.pdf)

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the combined margin (CM) calculations described in the “Tool to calculate the emission factor for an electricity system”.

No wind turbine or electricity generation equipment and systems would have been in place in the absence of the project activity.

The baseline scenario is the same as the scenario existing prior to the start of implementation of the project activity.

The emissions sources and the greenhouse gases involved in the project activity, according to the methodology used:

Source		Gas	Included?	Justification / Explanation
Baseline	CO <sub>2</sub> emission from the power plants generating electricity in the national grid	CO <sub>2</sub>	Yes	Major source of emissions.
		CH <sub>4</sub>	No	Excluded as measure of conservativeness
		N <sub>2</sub> O	No	Excluded as measure of conservativeness
Project activity	The proposed project activity	CO <sub>2</sub>	No	Excluded as per the methodology.
		CH <sub>4</sub>	No	Excluded as per the methodology
		N <sub>2</sub> O	No	Excluded as per the methodology

In the absence of the project activity, the electricity (service) would have been provided by the national grid.

**Technology**

Table 1 describes the expected design parameters for the wind farm based on the Sinovel SL 3000-113, 3MW wind turbine generator.

**Table 1: Design parameters**

Item	Unit	Index
Rated capacity	MW	3
Number of blades	#	3
Rotor diameter	meter	113
Rotor speed	r/min	6.5 - 13.8 RPM
Cut-in wind speed	m/s	3 m/s
Rated wind speed	m/s	11
Cut-out wind speed	m/s	25
Height of hub	m	90
Rated frequency	Hz	50
Rated voltage of generator	V	690
Average lifetime	years	20 years (IEC IIIA)

Plant Load Factor: for the purpose of estimating the electricity generation for the project, the annual plant load factor has been determined by the project participant's independent wind energy consultant, Windprospect. A load factor of 31.4% applies.

#### Monitoring Equipment

The main data for calculating emission reductions of the project activity is  $EG_{\text{facility},y}$  (Net electricity supplied to grid by the wind power plant in year y). In order to determine the amount of net electricity supplied to the grid, electricity monitors will be implemented.

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

A crediting period of 10 years is selected for the project activity.

The following table represents the emission reductions.



Years	Annual estimation of emissions reductions in tonnes of CO <sub>2</sub> e
1	70,925
2	70,925
3	70,925
4	70,925
5	70,925
6	70,925
7	70,925
8	70,925
9	70,925
10	70,925
<b>Total estimated reductions</b> (tonnes CO <sub>2</sub> e )	709,250 tonnes CO <sub>2</sub> e
<b>Total number of crediting years</b>	10
<b>Annual average over the crediting period of estimated reductions (tonnes of CO<sub>2</sub> e)</b>	70,925

**A.4.5. Public funding of the project activity:**

>>There is no public funding for this project activity.

**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:****Methodology:**

Version 12.3.0 of the Approved consolidated baseline and monitoring methodology ACM0002: “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”

**Tools and Guidelines**

Version 06.0.0 of tool for the demonstration and assessment of additionality

Version 02 of tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion

Version 02.2.1 of tool to calculate the emission factor for an electricity system

For more information regarding the methodology and the tools as well as their consideration by the



Executive Board please refer to <http://cdm.unfccc.int/methodologies/PAMethodologies/approved.html>.

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

>>The following table provides a list of the Applicability Criteria as described in ACM0002 / Version 12.3.0 12.3.0 and explains why the project complies with each parameter.

**Table 2: Applicability Assessment against ACM0002 / Version 12.3.0 12.3.0**

Applicability Criteria	Comments
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).	This project activity is a 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).
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 proposed project activity is the installation of a wind power plant.
In the case of capacity additions, retrofits or replacements (except for wind, solar, wave or tidal power capacity addition projects which use Option 2 to calculate the parameter <i>EGPJ,y</i> ): 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;	Not applicable to the proposed project activity as the project activity is the new installation of a wind power plant.
In case of hydro power plants, one of the following conditions must apply:	The project is not the implementation of a Hydro plant – therefore this applicability criteria does not apply to



Applicability Criteria	Comments
<ul style="list-style-type: none"> <li>o The project activity is implemented in an existing reservoir, with no change in the volume of reservoir; or</li> <li>o 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/m<sup>2</sup>; or</li> <li>o 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<sup>2</sup>.</li> </ul>	the proposed project activity.
<p>The methodology is not applicable to the following:</p> <ul style="list-style-type: none"> <li>• 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;</li> <li>• Biomass fired power plants;</li> <li>• Hydro power plants<sup>1</sup> 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<sup>2</sup>.</li> </ul>	<p>The proposed project activity is not the switch from a fossil fuel plant to a wind power plant at the site of the project activity. The site has no power generation facility constructed at the time when the wind power plant will be established.</p> <p>The proposed project activity does not involve any biomass fired power plants.</p> <p>Not applicable as the project is not the implementation of a Hydro plant.</p>
<p>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</p>	<p>Not applicable as the project is not a retrofit, replacement or capacity addition.</p>

<b>B.3. Description of the sources and gases included in the project boundary:</b>
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>>As per ACM0002 / Version 12.3.0 and the tool, the spatial extent of the project boundary includes the project site and all the power plants connected physically to the electricity system. The project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints.

According to the methodology ACM0002 / Version 12.3.0 , a grid-connected wind power project like the proposed project is required to consider only the CO<sub>2</sub> emissions from fossil fuels fired power plants in baseline scenario.

Source		Gas	Included?	Justification / Explanation
Baseline	CO <sub>2</sub> emission from the power plants generating electricity in the national grid	CO <sub>2</sub>	Yes	Major source of emissions.
		CH <sub>4</sub>	No	Excluded as measure of conservativeness
		N <sub>2</sub> O	No	Excluded as measure of conservativeness
Project activity	The proposed project activity	CO <sub>2</sub>	No	Excluded as per the methodology.
		CH <sub>4</sub>	No	Excluded as per the methodology
		N <sub>2</sub> O	No	Excluded as per the methodology

**Table 3: Emission sources considered in the baseline and the project**

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

According to the ACM0002 / Version 12.3.0 , 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 Version 02.2.1 of the “Tool to calculate the emission factor for an electricity system”.

**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 following activities show the prior consideration of the CDM.

**Table 4: Activities demonstrating the prior consideration of CDM**

Activity	Date
Consultant appointed to develop CDM	20 May 2009



component <sup>4</sup>	
Wind monitoring started	February 2010
EIA initiated	March 2010
Record of Decision received from the Department of Environmental Affairs	June 27, 2011
PIN submitted to DNA	16 May 2011
Engineer Procure and Construct (“EPC”) Agreement Term sheet executed with technology supplier	Oct 2011
Validation initiated	March 2012

The additionality of the proposed project is demonstrated and assessed by the approved “Tool for the Demonstration and Assessment of Additionality (version 6)”.

#### **Sub-step 1a: Identify realistic and credible alternative baseline scenarios for power generation**

According to the Validation and Verification Manual (version 01): “103. The PDD shall identify credible alternatives to the proposed project activity in order to determine the most realistic baseline scenario, unless the approved methodology that is selected by the proposed CDM project activity prescribes the baseline scenario and no further analysis is required. (e.g., methodology ACM0002)”.

According to ACM0002 / Version 12.3.0 , 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 Version 02.2.1 of the “Tool to calculate the emission factor for an electricity system”.

As such, there is no need to further analyze alternatives to the proposed project activity since the methodology ACM0002 / Version 12.3.0 prescribes the baseline scenario for the proposed project activity. The baseline accounts for construction of other power sources due to calculating of a Combined Margin for the grid emission factor. The project is evaluated on its own viability and does not exclude the expansion of grid with other options.

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

There is no need to further analyze alternatives to the proposed project activity since the methodology ACM0002 / Version 12.3.0 prescribes the baseline scenario for the proposed project activity.

The baseline scenario is consistent with mandatory laws and regulations – it is legal to buy power from the national grid.

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<sup>4</sup> The initial developer of the wind farm was Overberg Wind Power (Pty) Ltd who retained CDM Africa Climate Solutions contractually in May 2009. Overberg Wind power later took in BioTherm Energy as an equity partner. The Special Project Vehicle or Project Participant is a subsidiary of BioTherm Energy with Overberg Wind Power as a minority shareholder



### Step 3. Barrier Analysis

The project accords with the criteria in paragraph 6(b) of the additionality tool as it is about renewable energy:

**(b) Switch of technology with or without change of energy source (including energy efficiency improvement as well as use of renewable energies);**

There are at present (January 2011) no large scale, grid connected wind farms exporting electricity to the grid<sup>5</sup> and the penetration of wind power into the grid is less than 0.025% of installed capacity.

(a) Barriers due to prevailing practice

- The project activity is the “first of its kind”.

Note: In terms of EB 63 annex 11 the “Applicable geographical area covers the entire host country as a default.

The geographical area is South Africa. Reference to the neighbouring countries is not appropriate as the regulatory, commercial and technical hurdles and entire procurement system within which renewables operate in South Africa is entirely unique to the country. In the context of the regulatory and procurement framework, the implementation of wind technology is country specific to South Africa.

From a geographic perspective, the South African wind regime is different from other neighbouring countries<sup>6</sup>.

Note: In terms of EB 63 annex 11, 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 (as the default it is South Africa) 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.”

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<sup>5</sup> See the supporting letter of Ms Ayanda Nakedi, Eskom representative on the South African Wind Energy Association Board (will be made available to validators). For more detail see [http://en.wikipedia.org/wiki/List\\_of\\_power\\_stations\\_in\\_South\\_Africa](http://en.wikipedia.org/wiki/List_of_power_stations_in_South_Africa). As appears from the list, there are only three installations of which the largest is a 5,2 MW wind farm. The total installed capacity for wind power in the country is 10.16 MW out of approximately 45,000 MW installed in the grid, meaning that the penetration in terms of installed capacity is presently under 0.025%.

<sup>6</sup> Renewable Energy in Africa: Prospects and Limits, Operationalizing the NEPAD Energy Initiative, United Nations, page 15



In terms of the definitions in EB63 annex 11, wind power plant will thus be a first of its kind if no other wind power plants of comparable scale have reached commercial operation within the borders of South Africa at the start date of the project.

The starting date is defined by the CDM glossary as “*In the context of a CDM project activity or PoA, the earliest date at which either the implementation or construction or real action of a CDM project activity or PoA begins*”.

In South Africa, projects presently need to go through a procurement process and be awarded “preferred bidder” before they can move toward financial close and sign a Power Purchase Agreement. When a bid is entered, a bid bond is payable that equals ZAR 100,000/MW bid. This is a very sizeable commitment of funds by the developer but not an irrevocable one as the amount is refunded in the event that the bid is compliant but unsuccessful. However, if a project is awarded with “preferred bidder status”, the developer is required to double the initial payment within two weeks. This amount is then no longer refundable – if financial close is not reached within the prescribed time, the full amount will be forfeited. In this case it equates to ZAR 5,4 million.

In terms of the definition of start date, the construction only starts after financial close – typically seven months or more after preferred bidder status. The “real action” commences when the developer chooses to pay the preferred bidder bond and thus commits itself to reaching financial close within 6-7 months thereafter. At this point the developer is committed to the project. Thus, if the earliest date is chosen in terms of the definition of Starting Date, the preferred bidder bond payment date is the Starting Date.

As stated above, there is no grid connected wind power plants of comparable scale exporting power into the South African grid, and the project activity is thus additional as first of its kind.

## Conclusion

The project activity is additional as first-of-kind.

### B.6. Emission reductions:

#### B.6.1. Explanation of methodological choices:

##### Baseline emissions

Baseline emissions include only CO<sub>2</sub> 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:

$$BE_y = EG_{PJ,y} * EF_{GRID,CM,y}$$

Equation 1

Where:



- $BE_y$  = Baseline emissions in year  $y$  (tCO<sub>2</sub>/yr)  
 $EF_{grid,CM,y}$  = Combined margin CO<sub>2</sub> 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. (tCO<sub>2</sub>/MWh)  
 $EG_{PJ,y}$  = 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)

### Greenfield renewable energy power plants

If the project activity is the installation of a new grid-connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity, then:

$$EG_{PJ,y} = EG_{Facility,y}$$

Equation 2

Where

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

Project emissions

$$PE_y = 0$$

The GHG emission calculation of the proposed project was based on the instruction of “Tool to calculate the emission factor for an electricity system”. All the data employed in the calculation is based on the available data from South African Power Grid that is publicly available. The baseline emission factor ( $EF_y$ ) is calculated as a combined margin (CM), consisting of the combination of simple operating margin (OM) and build margin (BM) factors:

The following steps are applied to calculate the emission factor for an electricity system:

- STEP 1. Identify the relevant electricity systems.
- STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional).
- STEP 3. Select a method to determine the operating margin (OM).
- STEP 4. Calculate the operating margin emission factor according to the selected method.
- STEP 5. Calculate the build margin (BM) emission factor.
- STEP 6 Calculate the combined margin (CM) emissions factor.

The procedure is applied in Annex 3.

Leakage

No leakage emissions are considered. 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, transport). These emissions sources are neglected.

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Equation 3

Where:

$ER_y$  = Emission reductions in year  $y$  (t CO<sub>2</sub>e/yr)

$BE_y$  = Baseline emissions in year  $y$  (t CO<sub>2</sub>/yr)

$PE_y$  = Project emissions in year  $y$  (t CO<sub>2</sub>e/yr)

<b>B.6.2. Data and parameters that are available at validation:</b>
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(Copy this table for each data and parameter)

<b>Data / Parameter:</b>	$FC_{i,y}$
Data unit:	Ton or litres
Description:	Amount of fossil fuel type $i$ consumed in the project electricity system in year $y$
Source of data used:	Eskom published data
Value applied:	Refer to Annex 3 for detailed information
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per “Tool to calculate the emission factor for an electricity system, Version 02.2.1” (i)Simple OM: Once for the crediting period using the most recent three historical years for which data is available at the time of submission of the CPA to the PoA ( <i>ex ante</i> option); (ii)BM: Once <i>ex ante</i> as there is only one crediting period.
Any comment:	Information is used to calculate the combined margin emission factor

<b>Data / Parameter:</b>	$NCV_{i,y}$
Data unit:	GJ/mass or volume unit
Description:	Net calorific value (energy content) of fossil fuel type $i$ in year $y$
Source of data used:	<ul style="list-style-type: none"> <li>• For coal, Eskom Holdings Limited Integrated Report 2011, page 324</li> <li>• For kerosene, IPCC default figures where Eskom does not publish data.</li> <li>• IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories.</li> </ul>



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Value applied:	Coal (GJ/ton) 2007/8 – 18.5 2008/9 – 19.1 2009/10 – 19.22 Kerosene/Diesel (TJ/l) 2007/8 – 0.0000438 2008/9 - 0.0000438 2009/10 - 0.0000438
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per “Tool to calculate the emission factor for an electricity system, Version 02.2.1”. Monitoring frequency is once for the crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation.
Any comment:	Information is used to calculate the combined margin emission factor

<b>Data / Parameter:</b>	$EG_y$
Data unit:	MWh
Description:	Net electricity generated by power plant/unit $m$ (or in the project electricity system in case of $EG_y$ ) in year $y$
Source of data used:	Eskom published data, Annual report 2010
Value applied:	Refer to Annex 3 for detailed information
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per “Tool to calculate the emission factor for an electricity system, Version 02.2.1”. Monitoring frequency is once for the crediting period using the most recent three historical years for which data is available at the time of submission of the CPA-PDD to the DOE for validation.
Any comment:	Information is used to calculate the combined margin emission factor

<b>Data / Parameter:</b>	$EF_{GRID,CM}$
Data unit:	$tCO_2 / MWh$
Description:	Emission factor of the national electrical grid
Source of data used:	Calculated based on the Eskom information and IPCC information where applicable
Value applied:	0.955
Justification of the choice of data or description of measurement methods and procedures actually applied :	The $EF_{grid,y}$ is calculated according to the ‘Tool to calculate the emission factor for an electricity system, Version 02.2.1. The Simple OM method is used to calculate the Operating margin (using the ex-ante option); with the Build Margin also calculated ex-ante based on the most recent information.
Any comment:	None

<b>Data / Parameter:</b>	$EF_{CO2,i,y}$
--------------------------	----------------



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Data unit:	tCO <sub>2</sub> /GJ
Description:	CO <sub>2</sub> emission factor of fossil fuel type <i>i</i> in year <i>y</i>
Source of data used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories. For the sake of a conservative approach the IPCC default value at the lower limit of the uncertainty at a 95% confidence interval is used. For conservativeness, it is assumed that Eskom uses kerosene at Ankerlig and Gourikwa and not diesel.
Value applied:	Coal: 2007/8 to 2010: 0.0895 (t CO <sub>2</sub> /GJ) Kerosene 2007/8 to 2010: 70.8 tCO <sub>2</sub> /TJ
Justification of the choice of data or description of measurement methods and procedures actually applied :	Some information is available about the various coal resources in South Africa, all of which is classified as bituminous. However, sufficient information is not available for each coal fired power station and therefore the IPCC default will be used.
Any comment:	

<b>Data / Parameter:</b>	EF <sub>grid,OMsimple,y</sub>
Data unit:	tCO <sub>2</sub> /MWh
Description:	Simple operating margin CO <sub>2</sub> emission factor in year <i>y</i>
Source of data used:	Calculated from the information published by Eskom, the national utility in South Africa. The years 2007/8, 2008/9 and 2009/10 were used to determine the factor.
Value applied:	0.92
Justification of the choice of data or description of measurement methods and procedures actually applied :	The three most recent years prior to the project implementation were used to calculate the simple operating margin.
Any comment:	As per the to calculate the grid emission factor, Version 02.2.1.

<b>Data / Parameter:</b>	EF <sub>grid,BM,y</sub>
Data unit:	tCO <sub>2</sub> /MWh
Description:	Build margin CO <sub>2</sub> emission factor in year <i>y</i>
Source of data used:	Calculated from the information published by Eskom, the national utility in South Africa. As per the “Tool to calculate the emission factor for an electricity system”, (Version 02.2.1), the build margin emissions factor is the generation-weighted average emission factor (tCO <sub>2</sub> /MWh) of all power units <i>m</i> during the most recent year <i>y</i> for which power generation data is available.
Value applied:	1.01



Justification of the choice of data or description of measurement methods and procedures actually applied :	The build margin is calculated according to the “Tool to calculate the emission factor for an electricity system”, (Version 02.2.1).
Any comment:	As per the Tool to calculate the grid emission factor, Version 02.2.1.

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

#### Project emissions

The project emissions from a wind farm are considered to be zero.

#### Leakage

No leakage is anticipated as a result of this project activity.

#### Baseline emissions

Baseline emissions include only CO<sub>2</sub> emissions from electricity generation in the national grid 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:

$$BE_y = EG_{PI,y} \times EF_{Grid,CM,y}$$

#### Equation 4

Where:

$EG_{PI,y}$	=	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 CO <sub>2</sub> 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” (tCO <sub>2</sub> /MWh)

#### (a) Greenfield renewable energy power plants

If the project activity is the installation of a new grid-connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity, then:

$$EG_{P,y} = EG_{f a c, y}$$

#### Equation 5

Where

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

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

**Equation 6**

Where

$ER_y$	=	Emission reductions in year y (t CO <sub>2</sub> e/yr)
$BE_y$	=	Baseline emissions in year y (t CO <sub>2</sub> e/yr)
$PE_y$	=	Project emissions in year y (t CO <sub>2</sub> e/yr)

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

For the single phased approach the following emission reductions will occur:

Year	Estimation of project activity emissions (tonnes of CO <sub>2</sub> e)	Estimation of baseline emissions (tonnes of CO <sub>2</sub> e)	Estimation of leakage (tonnes of CO <sub>2</sub> e)	Estimation of emission reductions (tonnes of CO <sub>2</sub> e)
1	0	70,925	0	70,925
2	0	70,925	0	70,925
3	0	70,925	0	70,925
4	0	70,925	0	70,925
5	0	70,925	0	70,925
6	0	70,925	0	70,925
7	0	70,925	0	70,925
8	0	70,925	0	70,925
9	0	70,925	0	70,925
10	0	70,925	0	70,925
<b>Total (tonnes of CO<sub>2</sub> e)</b>	0	709,250	0	709,250

**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)

<b>Data / Parameter:</b>	$EG_{\text{facility},y}$
Data unit:	MWh/yr
Description:	Quantity of net electricity generation supplied by the project to the grid in year $y$ .
Source of data to be used:	Readings of electricity meter installed at the project site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	74,267 MWh per annum (calculated from the Windprospect report)
Description of measurement methods and procedures to be applied:	The readings of the electricity meter will be continuously measured and monthly recorded. Data will be archived for 2 years following the end of the last crediting period by means of electronic and paper backup. The precision of the meter is not lower than 0.5s. The calibration frequency is at least once a year or as specified by the equipment supplier. The net electricity supplied to the grid by the proposed project will be calculated through electricity supplied by the project to the grid ( $EG_{\text{output},y}$ ) deducting electricity purchased from the grid.
QA/QC procedures to be applied:	The electricity supplied to the grid will be monitored and recorded at the central control room. The project operator is responsible for recording such data. Electricity sales receipts will be kept for cross checking purposes.
Any comment:	

### B.7.2. Description of the monitoring plan:

>>The monitoring plan is to serve as a guideline for the project owner to monitor the emission reduction of the project and to stay in compliance with the CDM monitoring requirements. A more detailed Monitoring and Management Manual of the project will be completed before verification. The contents of the Monitoring and Management Manual are highlighted as follows:

#### 1. Monitoring management structure

In order to obtain effective monitored data, the project owner will identify the responsible persons for monitoring, data collection and archiving.

The main data for calculating emission reductions of the project activity is  $EG_{\text{facility},y}$  (Net electricity supplied to grid by the wind power plant in year  $y$ ) monitored by electricity meters. The data of  $EG_{\text{facility},y}$  will be crosschecked against the relevant monthly electricity sale receipts (and purchases) and/or records from the grid.

#### 2. Calibration of Meters

The calibration frequency is at least once a year or as specified by the equipment supplier.

**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 of completion of the baseline study: 25 February 2012

Ciska Terblanche  
CDM Africa Climate Solutions (Pty) Ltd  
83 Mackay, Blairgowrie, Randburg, 2194, South Africa  
[Ciska@cdmafrica.com](mailto:Ciska@cdmafrica.com)  
+27(0)82 898 5750

The entity that carried out the baseline study 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:**

The start date is 19 December 2011, when the Preferred Bidder Bond was paid. As explained in section B.5 above, this date corresponds to the earliest date of “Implementation, Construction or Real Action”.

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

20 Years 0 months

**C.2. Choice of the crediting period and related information:****C.2.1. Renewable crediting period:**

Not applicable left open on purpose

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

Not applicable left open on purpose

**C.2.1.2. Length of the first crediting period:**

Not applicable left open on purpose

**C.2.2. Fixed crediting period:****C.2.2.1. Starting date:**

01/08/2013

**C.2.2.2. Length:**

10 Years 0 months

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

A full Environmental Impact Assessment was carried out with expert reports in the following fields:

- Vegetation
- Terrestrial Fauna and Habitats
- Aviflaura
- Geology and soils
- Agricultural potential
- Visual impacts
- Heritage impacts
- Noise
- Social impacts
- Cumulative impacts

See: FEIR chapter 6

No transboundary impacts were identified as a result of the project activity.

**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:**

A comprehensive discussion of all impacts appears in the FEIR Table 6.2 page 146 and further. The aspects with high impact were considered to be the following:

- Loss of vegetation within the development footprint



- Mortality of aviflaura in the operational phase
- Visual impact of the development

As stated above, a full Environmental Impact Assessment was carried out and mitigation measures suggested for each of the impacts considered significant. The Final Environmental Impact Assessment report was approved by the national authorities on June 27, 2011<sup>7</sup>.

## **SECTION E. Stakeholders' comments**

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

>> The Environmental Impact Assessment (EIA) for the proposed facility has been undertaken in accordance with the EIA Regulations published in Government Notice 28753 of 21 April 2006, in terms of Section 24(5) of the National Environmental Management Act (NEMA; Act No 107 of 1998).

These regulations stipulate that public participation has to be part of the process.

The process comprised of the following:

- Notification of the EIA process in the printed media and on site, as well as through written notification to identified stakeholders and affected landowners
- Identification and registration of Interested and Affected Parties (I & AP's") and key stakeholders
- Compilation of a Background Information Document sent to all the "I & Aps" and key stakeholders
- Later in the process, members of the public, local communities and stakeholders were invited to comment on the Draft EIA Report which was made available for public review and comment at the Caledon Library, the Bot River Library and at [www.savannahSA.com](http://www.savannahSA.com) from 4 November 2010 to 4 December 2010.
- The Draft EIA specifically mentioned the CDM on pages xxv, 18, and 126 (printed numbers, not PDF numbers)

A public feedback meeting was held on 23 November 2010 at Caledon to provide feedback on the studies undertaken.

### **E.2. Summary of the comments received:**

>>

A comprehensive record of comments and responses appears in Appendix E.2 to the FEIR which will be made available to the validators

Summary of comments received:

---

<sup>7</sup> A copy of the report and the Record of Decision will be made available to the validators



- Does the calculation of the lowering the electricity grid carbon footprint include the need for standby power? <sup>8</sup>
- The involvement of a foreign owned private equity firm the financing structure suggests that carbon credits could accrue off-shore – how will this be prevented?<sup>9</sup>

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

&gt;&gt;

The comments and responses were logged in Annexure E.2 to the FEIR. Each question was answered by the Project Participant.

Response to the first question above: The carbon footprint offset calculation is based on the projected load factor of the wind farm and not on the installed capacity running at 100%.

Response to the second question above: The project will be owned by a Special Purpose Vehicle registered in South Africa and any carbon credits would accrue to that entity.

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<sup>8</sup> Comment 82

<sup>9</sup> Comment 95

**Annex 1****CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

Organization:	Klipheuwel Dassiefontein Wind Energy Facility (RF) (Pty) Ltd
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State/Region:	Gauteng
Postcode/ZIP:	2055
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Represented by:	Uri Epstein
Title:	Development director
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Last name:	
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State/Region:	Gauteng
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Country:	South Africa
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FAX:	
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Represented by:	Uri Epstein
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**Annex 2**

**INFORMATION REGARDING PUBLIC FUNDING**

No public funding was used was involved in this project.



### Annex 3

## BASELINE INFORMATION

### South African Grid

In South Africa, our most abundant source of energy is coal<sup>10</sup>. The majority of our coal deposits which are suitable for cheap power generation are found in eastern and south-eastern Gauteng and in the northern Free State. In Gauteng it is generally found at shallow depths and in thick seams, whereas in KwaZulu-Natal, the seams are deeper and thinner, but of higher quality.

Africa's only nuclear power station, Koeberg, is also a base load station, with an installed capacity of 1 930 MW of power. Koeberg's total net output is 1 800 MW.

The generation mix further includes two conventional hydroelectric power stations and two hydro pumped storage schemes. These stations are used when there is a sudden increase, or peak, in the demand for electricity that cannot immediately be met by the base load stations. They have a combined installed capacity of 2,000 MW.

### Determination of the grid emission factor

The GHG emission calculation of the proposed project was based on the instruction of "Tool to calculate the emission factor for an electricity system (version 02.2.1)". All the data employed in the calculation is based on the available data from South African Power Grid. The baseline emission factor (EF<sub>y</sub>) is calculated as a combined margin (CM), consisting of the combination of the simple operating margin (OM) and build margin (BM) factors.

The following steps are applied to calculate the emission factor for an electricity system:

- STEP 1. Identify the relevant electricity systems.
- STEP 2. Choose whether to include off-grid power plants in the project electricity system.
- STEP 3. Select a method to determine the operating margin (OM).
- STEP 4. Calculate the operating margin emission factor according to the selected method.
- STEP 5. Calculate the build margin (BM) emission factor.
- STEP 6 Calculate the combined margin (CM) emissions factor.

### *Step 1. Identify the relevant electric power system*

For determining the electricity emission factors, a **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 (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints. Electricity generated by the proposed project activity will displace the power production in the national grid of South Africa

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<sup>10</sup> [http://www.eskom.co.za/live/content.php?Category\\_ID=96](http://www.eskom.co.za/live/content.php?Category_ID=96)



which is defined as the project electricity system by default.

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.

For the purpose of determining the operating margin emission factor, the following option is used to determine the CO<sub>2</sub> emission factor(s) for net electricity imports ( $EF_{grid,import,y}$ ) from a connected electricity system.

(a) 0 tCO<sub>2</sub>/MWh. **Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)**

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

**Option I:** Only grid power plants are included in the calculation.

**Option II:** Both grid power plants and off-grid power plants are included in the calculation.

The project developer chooses not to include off-grid power plants because the relevant information is not freely available.

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

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

- (a) **Simple OM**; or
- (b) Simple adjusted OM; or
- (c) Dispatch data analysis OM; or
- (d) Average OM.

The simple OM will be used to determine the OM. The data vintage will be ex-ante and will not be changed during the crediting period. A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, is used to calculate the OM.

#### Motivation for using Simple Operating Margin

The simple OM method may only be used if low-cost/must-run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

Low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. In South Africa, these resources include hydro, wind and nuclear.

**Table 5** shows the energy resources used in South Africa for the most recent five years for which



information is publicly available. Electricity from coal makes up over 92.7% (please refer to figures in Table 5) of the electricity produced in South Africa. Therefore, the simple operating margin can be applied.

**Table 5: Resource information for electricity production in the national grid**

Electricity production by own stations and electricity purchased by Eskom					
	2011	2010	2009	2008	2007
Coal-fired (GWh)	220 219	215 940	211 941	222 908	215 211
Hydro-electric (GWh)	1 960	1 274	1 082	751	2 443
Pumped storage (GWh)	2 953	2 742	2 772	2 979	2 947
Gas turbine (GWh)	197	49	143	1 153	62
Nuclear (GWh)	12 099	12 806	13 004	11 317	11 780
Wind energy (GWh) <sup>6</sup>	2	1	2	1	2
<b>Total own production (GWh)</b>	<b>237 430</b>	232 812	228 944	239 109	232 445

**Source of information for Table 5:** Eskom Integrated Report, page 13, copied below. The full annual report is found on [http://financialresults.co.za/2011/eskom\\_ar2011/add\\_info\\_tables.php](http://financialresults.co.za/2011/eskom_ar2011/add_info_tables.php), accessed 16 Feb. 12.

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.

The following table shows the electricity imported from neighbouring countries and also confirms that no electricity was purchased from private generators (Local IPP and co-generation).

**Figure 2: Information from page 1 of the Eskom Annual Report 2010**

Electricity production by own stations					
	2010	2009	2008	2007	2006
Coal-fired (GWh)	215 940	211 941	222 908	215 211	206 606
Hydro-electric (GWh)	1 274	1 082	751	2 443	1 141
Pumped storage (GWh)	2 742	2 772	2 979	2 947	2 867
Gas turbine (GWh)	49	143	1 153	62	78
Nuclear (GWh)	12 806	13 004	11 317	11 780	11 293
Wind energy (GWh) <sup>3</sup>	1	2	1	2	3
<b>Total production (GWh)</b>	<b>232 812</b>	228 944	239 109	232 445	221 988
Electricity purchased by Eskom					
• Foreign imports (GWh) <sup>4</sup>	10 047	9 162	10 998	10 624	9 318
• Local IPP and co-generation, (GWh)	0	0	0	0	0

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



The simple OM emission factor is calculated as the generation-weighted average CO<sub>2</sub> emissions per unit net electricity generation (tCO<sub>2</sub>/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units. **Table 6** shows a list of the power stations excluding low cost/must run sources.

#### Option A1

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

$$EF_{grid,OMsimple,y} = \frac{\sum_i EG_{m,y} \cdot EF_{EL,m,y}}{EG_{m,y}}$$

#### Equation 1

Where:

Where:

- $EF_{grid,OMsimple,y}$  = Simple operating margin CO<sub>2</sub> emission factor in year  $y$  (tCO<sub>2</sub>/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<sub>2</sub> emission factor of power unit  $m$  in year  $y$  (tCO<sub>2</sub>/MWh)
- $m$  = All power units serving the grid in year  $y$  except low-cost / must-run power units
- $y$  = The relevant year as per the data vintage chosen in Step 3

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

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_{m,y}}$$

#### Equation 2



Where:

- $EF_{ELm,y}$  = CO<sub>2</sub> emission factor of power unit  $m$  in year  $y$  (tCO<sub>2</sub>/MWh)
- $FC_{i,m,y}$  = Amount of fossil fuel type  $i$  consumed by power unit  $m$  in year  $y$  (Mass or volume unit)
- $NCV_{i,y}$  = Net calorific value (energy content) of fossil fuel type  $i$  in year  $y$  (GJ / mass or volume unit)
- $EF_{CO_2,i,y}$  = CO<sub>2</sub> emission factor of fossil fuel type  $i$  in year  $y$  (tCO<sub>2</sub> /GJ)
- $EG_{m,y}$  = Net quantity of electricity generated and delivered to the grid by power unit  $m$  in year  $y$  (MWh)
- $I$  = All fossil fuel types combusted in power sources in the project electricity system in year  $y$
- $M$  = The power plants/units delivering electricity to the grid, not including low-cost/must-run power plants/units, and including electricity imports to the grid
- $Y$  = The relevant year as per the data vintage chosen in Step 3

The simple operating margin is calculated as 0.92.



Table 6: Electricity generation of Power plants excluding low cost/must run resources

Name of power plant	Type of fuel	Unit	Years*			Total 04.2007 - 03.2010
			04.2007 - 03.2008	04.2008 - 03.2009	04.2009 - 03.2010	
Arnot	Coal	MWh	11 905 060	11 987 281	13 227 864	37 120 205
Camden	Coal	MWh	5 171 057	6 509 079	7 472 070	19 152 206
Duvha	Coal	MWh	23 622 732	21 769 489	22 581 228	67 973 449
Grootvlei	Coal	MWh	237 138	1 249 556	2 656 230	4 142 924
Hendrina	Coal	MWh	13 756 351	12 296 687	12 143 292	38 196 330
Kendal	Coal	MWh	26 517 420	23 841 401	23 307 031	73 665 852
Komati	Coal	MWh	0	0	1 016 023	1 016 023
Kriel	Coal	MWh	17 762 398	18 156 686	15 906 816	51 825 900
Lethabo	Coal	MWh	25 701 723	23 580 232	25 522 698	74 804 653
Majuba	Coal	MWh	23 680 971	22 676 924	22 340 081	68 697 976
Matimba	Coal	MWh	29 021 742	26 256 068	27 964 141	83 241 951
Matla	Coal	MWh	24 549 833	21 863 400	21 954 536	68 367 769
Tutuka	Coal	MWh	20 980 242	21 504 122	19 847 894	62 332 258
Ankerlig**	Natural gas	MWh	1 153 000	143 000	49 000	1 345 000
Gourikwa**	Natural gas	MWh				
<b>Total net electricity generation:</b>						<b>712,869,754</b>

\*A reporting year for Eskom starts on the 1<sup>st</sup> of April and finishes on the 31<sup>st</sup> of March

**Source of information:** <sup>1</sup> Data Requirements for Calculating the Carbon Emission Factor (CEF) for the South African Grid, General Information, <http://www.eskom.co.za/content/calculationTable.htm>

#### Step 5 Calculate the build margin (BM) emission factor

- (a) According to the information provided by the national utility, SET<sub>5-units</sub> consist of the following 5 units (based on the power stations most recently added to the national grid):



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SET <sub>5-units</sub>		
Plant Name	Fuel type	Commission year
***Komati	Coal	2009
**Grootvlei	Coal	2008
Gourikwa	Coal	2007
Ankerlig	Coal	2007
*Camden	Coal	2005

\***Re-commissioned power plant**, Eskom Holdings Limited Integrated Report 2011, page 148

\*\***Re-commissioned power plant**, Eskom Annual Report 2010, page 126,

\*\*\***Re-commissioned power plant**, Eskom Annual Report 2010, page 127,

[http://financialresults.co.za/2010/eskom\\_ar2010/downloads/eskom\\_ar2010.pdf](http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf)

- (b) Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of the annual electricity generation of the project electricity system, AEG<sub>total</sub> (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) (SET<sub>≥20%</sub>).

SET<sub>≥20%</sub> consist of the five power stations described in (a) plus the following units (based on the power stations most recently added to the national grid):

- Majuba (Commissioned 1996)
- Kendal (Commissioned 1988)

		Plant Name	Fuel type	Commission year (Recommissioning)	Net electricity generation (EG), MWh	Weight fraction in total net electricity generation**	Accumulated weight fraction	
SET <sub>sample</sub>	SET <sub>&gt;20%</sub>	SET <sub>5-units</sub>	Komati	Coal	2009	1,016,023	0.0044	0.0044
		Grootvlei	Coal	2008	2,656,230	0.0114	0.0158	
		Gourikwa	Gas turbine	2007	49,000	0.0002	0.0160	
		Ankerlig	Gas turbine	2007				
		Camden	Coal	2005	7,472,070	0.0321	0.0481	
	Majuba	Coal	1996	22,340,081	0.0960	0.1440		
	Kendal	Coal	1988	23,307,031	0.1001	0.2441		

- (c) From SET<sub>5-units</sub> and SET<sub>≥20%</sub> select the set of power units that comprises the larger annual generation to calculate the build margin (SET<sub>sample</sub>).



$AEG_{SET_{5\text{-units}}} = 11,193,323$  MWh (see grid emission spreadsheet, Sheet BM Power plants determination, Cell C36)

$AEG_{SET_{>20\%}} = 56,840,435$  MWh (see grid emission spreadsheet, Sheet BM Power plants determination, Cell E37)

$SET_{\text{sample}}$  is equal to  $SET_{\geq 20\%}$  because  $SET_{\geq 20\%}$  comprises the larger annual generation.

Identify the date when the power units in  $SET_{\text{sample}}$  started to supply electricity to the grid.

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

It is clear that Kendal and Majuba in  $SET_{\text{sample}}$  have started to supply electricity to the grid more than 10 years ago.

(d) Exclude from  $SET_{\text{sample}}$  the power units which started to supply electricity to the grid more than 10 years ago. This excludes the following power plants from  $SET_{\text{sample}}$ .

- Kendal (1988)
- Majuba (1996)

Determine for  $SET_{\text{sample CDM}}$ , the annual electricity generation ( $AEG_{SET\text{-sample CDM}}$ , in MWh).

The only CDM project activity that started supply electricity to the grid, is the Bethlehem Hydro plant.

$SET_{\text{sample CDM}}$  consists of one hydro plant, Bethlehem Hydro.

$AEG_{SET\text{ sample CDM}} < 0.2 \times AEG_{\text{total}}$ . Therefore, continue to the next step below:

**Table 7: Determination of Set<sub>sample,CDM</sub>**

	Plant Name	Fuel type	Commission year (Recommissioning)	Net electricity generation (EG), MWh	Weight fraction in total net electricity generation**	Accumulated weight fraction
SET <sub>sample,CDM</sub>	Bethlehem	Small scale Hydro	2009	34,031	0.0001	0.0001
	Komati	Coal	2009	1,016,023	0.0044	0.0045
	Grootvlei	Coal	2008	2,656,230	0.0114	0.0159
	Gourikwa	Gas turbine	2007	49,000	0.0002	0.0161
	Ankerlig	Gas turbine	2007			
	Camden	Coal	2005	7,472,070	0.0321	0.0482
AEG <sub>Set-sample-CDM</sub>				<b>11,227,354</b>		

**Note 1: Total net electricity generation in 2010 reporting year is 232,812 GWh**

$$AEG_{SET-sample-CDM} = 11\,227\,354 \text{ MWh}$$

(Refer to grid emission spreadsheet, Sheet BM Power plants determination, Cell L38 for the calculation)

$AEG_{SET\ sample\ CDM} < 0.2 \times AEG_{total}$ . Therefore, continue to the next step below:

- (e) The plants that have to be added to make up the set that comprises 20% of the grid are Majuba and Kendal. With these two power stations added, the total electricity comprises of 24.43% of the grid as demonstrated in **Table 8**.

**Table 8: Information for power generation plants that make up the build margin, Set<sub>sample-CDM>10yrs</sub>**

Name of power plant	Type of power plant (PP)	Type of fuel	Date of commissioning	Fuel consumption ( $FC_{i,n,y}$ ), tonnes	Net electricity generation ( $EG_{n,y}$ ), MWh	Weight fraction in total net electricity generation*	Accumulated weight fraction
Bethlehem Hydro <sup>34</sup>	Small Scale Hydro	Renewable	2009.07.18	0	34 031	0.0001	0.0001
Komati	Thermal PP	Coal	2009.01.05	664 497	1 016 023	0.0044	0.0045
Grootvlei	Thermal PP	Coal	2008.03.31	1 637 371	2 656 230	0.0114	0.0159
Gourikwa	Gas turbine PP	Natural gas	2007.03.30	N/A**	49 000	0.0002	0.0161
Ankerlig	Gas turbine PP	Natural gas	2007.03.29				
Camden	Thermal PP	Coal	2005.03.31	4 732 163	7 472 070	0.0321	0.0482
Majuba	Thermal PP	Coal	1996.04.01	12 261 833	22 340 081	0.0959	0.1442
Kendal	Thermal PP	Coal	1988.10.01	13 866 514	23 307 031	0.1001	<b>0.2443</b>

**Table 9: Total electricity generation in 2010, including power units registered as CDM projects**

Net electricity generation	Value
Total Eskom	232 812 000
Bethlehem Hydro	34 031
<b>Total</b>	<b>232 846 031</b>

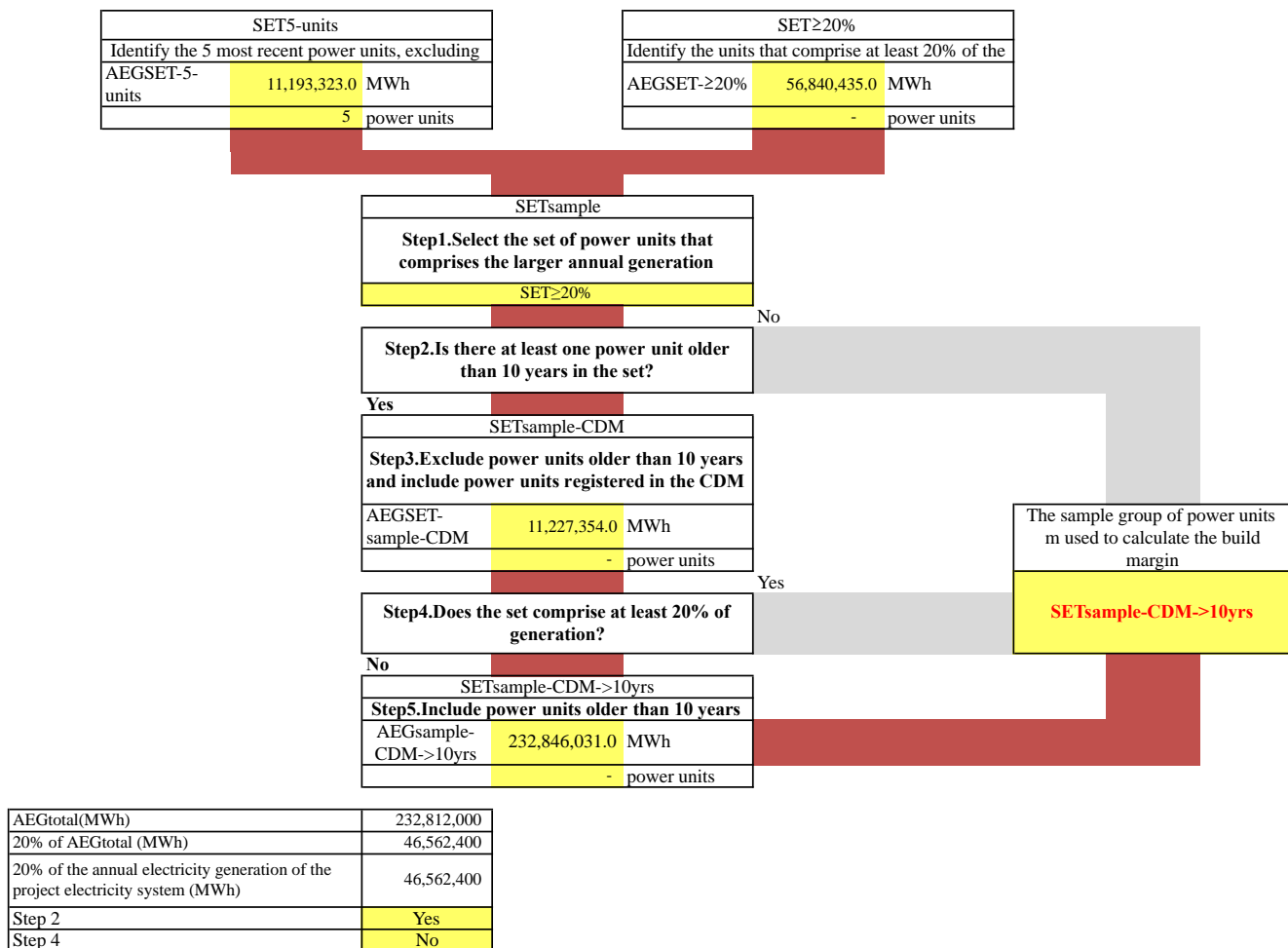
- (f) The sample group of power units m used to calculate the build margin is the resulting set ( $SET_{\text{sample-CDM->10yrs}}$ ). **Table 8** indicates the list.

The diagram below demonstrates the build margin determination process. The diagram can be found in the grid emission spreadsheet on sheet 'BM Diagram'.



**Schematic Diagram 1**

**Diagram 1: Selection of the sample group of power units for the build margin**



**Data Vintage – Option 1 is selected (ex-ante)**

**Option 1: The build margin is calculated ex ante.**

The build margin emissions factor is the generation-weighted average emission factor (tCO<sub>2</sub>/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows (Equation 12 in the Tool):

**Equation 3**

$$EF_{g, r Bi M} = \frac{\sum_m EG_{m,y} \times EF_{E, m,y}}{\sum_m EG_{m,y}}$$



Where:

- $EF_{grid,BM,y}$  = Build margin CO<sub>2</sub> emission factor in year y (tCO<sub>2</sub>/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<sub>2</sub> emission factor of power unit  $m$  in year y (tCO<sub>2</sub>/MWh)  
 $M$  = Power units included in the build margin  
 $Y$  = Most recent historical year for which power generation data is available

The emission factor for each power unit is calculated as described in the methodology under Option A1, because the electricity generation and fuel consumption information for the generating units are publicly available.

### Calculation based on total fuel consumption and electricity generation of the system

Under this option, the simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost / must-run power plants / units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{gridBM,y} = \frac{\sum_i (FC_{i,y} \times NCV_{i,y} \times EF_{CO_2,i,y})}{EG_y}$$

The BM is calculated as 1.12 tCO<sub>2</sub>/MWh. Please refer to the spreadsheet for the calculations.

### Step 6: Calculate the combined margin emissions factor

The calculation of the combined margin emission factor ( $EF_{grid,CM,y}$ ) is determined by the Weighted average CM.

#### (a) Weighted average CM

The combined margin emissions factor is calculated as follows:

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

**Equation 4**

Where:

- $EF_{grid,BM,y}$  = Build margin CO<sub>2</sub> emission factor in year y (tCO<sub>2</sub>/MWh)  
 $EF_{grid,OM,y}$  = Operating margin CO<sub>2</sub> emission factor in year y (tCO<sub>2</sub>/MWh)  
 $W_{OM}$  = Weighting of operating margin emissions factor (%)  
 $W_{BM}$  = Weighting of build margin emissions factor (%)



For wind, the methodology specifies default values of  $w_{OM} = 0.75$  and  $w_{BM} = 0.25$ .

The combined margin is therefore  $0.955 \text{ t CO}_2/\text{MWh}$ .

### **Wind Monitoring**

Following extensive meso-scale analysis, on-site wind monitoring was commenced in March 2009. On-site wind monitoring comprises two 20m and three 80m wind monitoring masts. At the end of Q2 2011 in excess of 24 months of hub-height wind data will have been collected on site.



#### **Annex 4**

### **MONITORING INFORMATION**

#### **Selection procedure:**

The Monitoring Officer will be appointed by BioTherm.

Before the Monitoring Officer commences monitoring duties, he/she will receive training on monitoring requirements and procedures.

#### **Tasks and responsibilities:**

The Monitoring Officer will be responsible for carrying out the following tasks:

##### **1. Supervise and verify metering and recording:**

The Monitoring Officer will coordinate with the plant staff to ensure and verify adequate metering and recording of data, including power delivered to the grid.

##### **2. Collection of additional data, sales / billing receipts:**

The Monitoring Officer will collect the relevant evidences for power delivered to the grid by the wind energy facility and additional data (including the amount of electricity purchased from the grid).

##### **3. Calibration:**

The Monitoring Officer will coordinate with staff of the project entity to ensure that calibration of the metering instruments is carried out at least once a year or as specified by the equipment supplier..

##### **4. Calculation of emission reductions:**

The Monitoring Officer or his appointed Consultant will calculate the annual emission reductions on the basis of net power supply to the grid. The Monitoring Officer will be provided with a calculation template in electronic form by the project's CDM advisors.

##### **5. Preparation of monitoring report:**

The Monitoring Officer or his appointed Consultant will annually prepare a monitoring report which will include metering values of power supplied to and received from the grid, copies of sales/billing receipts, a report on calibration and a calculation of emission reductions.