PROJECT DESIGN DOCUMENT FORM FOR CDM PROJECT ACTIVITIES (F-CDM-PDD) Version 04.1

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Rheboksfontein Wind Energy Facility
Version number of the PDD	2
Completion date of the PDD	29/06/2012
Project participant(s)	• Moyeng Energy (Pty) Ltd (Private Entity) • Micawber 895 (Pty) Ltd
Host Party(ies)	South Africa
Sectoral scope and selected methodology(ies)	Sectoral Scope 1: Energy industries – renewable/non renewable sources.
Estimated amount of annual average GHG emission reductions	327,982 tCO_2

SECTION A. Description of project activity
A.1. Purpose and general description of project activity

Micawber 895 (Pty) Ltd is developing the Rheboksfontein Wind Energy Facility (hereinafter the "Project") in Western Cape, South Africa. The project will comprise the installation of 35 Vestas V112 wind turbines, each turbine of 3MW with a total installed capacity of 105 MW and is expected to generate 360,500 MWh/year.

The project will use wind power to generate renewable electricity, which will be delivered to the national electricity grid of South Africa. The renewable electricity produced by the project will avoid CO_2 emissions from electricity generation in fossil fuelled power plants. Prior to the start of the implementation of the project activity, no power generation had occurred at the project site: this is a greenfield project activity.

The baseline scenario is the same as the scenario existing prior to the start of the implementation of the project activity: electricity delivered to the grid by the project activity would have 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".

The project will contribute to the sustainable development of South Africa as it will foster and stimulate the expansion of renewable energy technologies. Furthermore, by demonstrating the viability of larger grid-connected wind farms, the project will strengthen and diversify the national energy supply.

Other benefits to sustainable development in South Africa are summarized below[1]:

- Increased energy security – The renewable energy resources can play a significant role in supplementing the power currently available in South Africa. In addition, given that the renewable sources are located in a decentralised manner, they offer the opportunity for improving the grid strength and supply quality, while reducing transmission and distribution losses;
- Resource saving: Conventional coal-fired power stations are major consumers of water in South Africa. Au contraire, wind power plants do not consume water (only insignificant amount for cleaning and others), thus reducing the stress over this resource, as South Africa is already a water stressed nation;
- Pollution reduction: the project will reduce the release of by-products of fossil fuel burning for electricity generation;
- Climate friendly development: the project will support South Africa to meet its energy needs contributing to the mitigation of the climate change through the reduction of GHG emissions;
- Employment creation: the sale, development, installation, maintenance and management of renewable energy facilities have significant potential for job creation;
- Protecting the natural foundations of life for future generations: actions to reduce the country disproportionate carbon footprint can play an important part in ensuring our role in preventing dangerous anthropogenic climate change; thereby securing the natural foundations of life for generations to come.

This project is expected to reduce 327,982 tCO_2/yr and a total of 3,279,820 tCO_2 in the chosen crediting period.

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[1] Environmental impact assessment process – final environmental impact assessment report: Proposed Rheboksfontein wind energy facility and associated infrastructure on site near Darling, November 2010, prepared by Savannah Environmental (Pty) Ltd, Page 14 and 15.

A.2. Location of project activity

A.2.1. Host Party(ies)

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South Africa

A.2.2. Region/State/Province etc.

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Western Cape Province

A.2.3. City/Town/Community etc.

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Darling

A.2.4. Physical/Geographical location

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The project is located in Western Cape Province, near the town Darling. The location can be seen in Figure 1 and Figure 2 below:

Figure 1. South Africa location (source: Wikipedia)

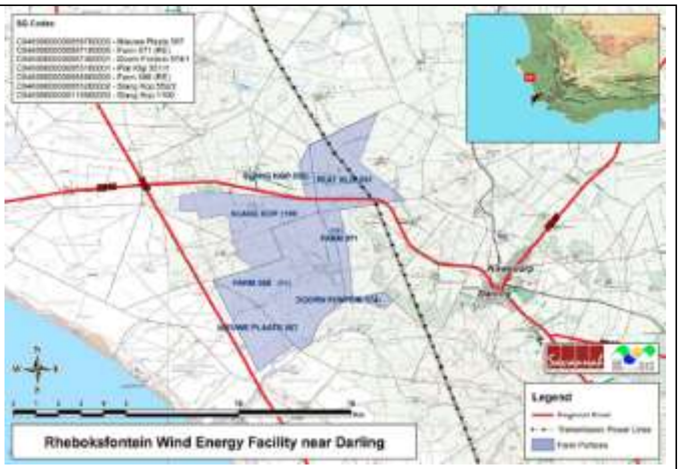

Figure 2. Project activity location

The turbine coordinates are presented in Table 1:

Table 1. Wind turbine coordinates (decimal coordinates)[2]

Equipment description (hub)	E	S
T1	18.3294	33.3089
T2	18.3248	33.3112
T3	18.3212	33.3143
T4	18.3170	33.3155
T5	18.3117	33.3176
T6	18.3244	33.3211
T7	18.3202	33.3219
T8	18.3070	33.3241

[2] WIND RESOURCE ASSESSMENT, prepared by Wind prospect Ltd in February 2012, page 25 converted from UTM 84 zone 34 to decimal coordinates.

T9	18.3067	33.3488
T10	18.2948	33.3491
T11	18.3026	33.3507
T12	18.2870	33.3522
T13	18.2986	33.3536
T14	18.2769	33.3532
T15	18.2915	33.3540
T16	18.3157	33.3550
T17	18.2830	33.3552
T18	18.3104	33.3592
T19	18.3060	33.3594
T20	18.2888	33.3601
T21	18.2959	33.3603
T22	18.3019	33.3613
T23	18.2825	33.3645
T24	18.2982	33.3667
T25	18.2864	33.3672
T26	18.2939	33.3683
T27	18.2888	33.3733
T28	18.3189	33.3761
T29	18.3075	33.3776
T30	18.3038	33.3789
T31	18.3002	33.3792
T32	18.3324	33.3808
T33	18.2933	33.3809
T34	18.3358	33.3820
T35	18.2968	33.3817

A.3. Technologies and/or measures

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The project activity involves the installation of 35 Vestas V112 wind turbines, with a rotor hub height of 84 meters, in a greenfield site. Prior to the start of the implementation of the project activity, no other power generation equipment was installed at this site. The wind turbine details are presented in Table 2 below:

Table 2. Turbine technical details[3]

Operating data	
Expected lifetime	20 years[4]
Rated Power	3000kW
Cut-in wind speed	3m/s
Cut-out wind speed	25m/s
Rotor	
Diameter	112m
Swept area	9,852m^2
Speed	6.2 – 17.7 rpm
Power regulation	Pitch regulated with variable speed
Air Brake	Full blade feathering with 3 pitch cylinders
Tower	
Construction	Tubular steel tower
Rotor hub height	84 m

Consequently, the wind farm, considering all wind turbines, will have 105 MW total installed capacity and is expected to generate 360,500 MWh/year, with an average capacity factor of approximately 39.2%, which is a P50 estimate[5].

The project will use an environmentally safe and sound technology in the electricity sector, as it uses a renewable source to produce power. The renewable 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". This is also the baseline scenario.

As the operation of the project is local, know how will be transferred from the turbine manufacturer country (Denmark) to South Africa. Personnel will be trained to onsite operations.

According to the latest version of ACM0002 page 8, the greenhouse gases accounted for are restricted to CO_2 emissions from fossil fuelled power plants.

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
South Africa (host)	• Moyeng Energy (Pty) Ltd (Private Entity) • Micawber 895 (Pty) Ltd	No

A.5. Public funding of project activity

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No Annex I public funding was used in this project activity.

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[3] Vestas brochure V 112-3.0MW, page 18, available online from http://v112.vestas.com/Vestas_V_112_web.pdf , last accessed on 30 March 2102.

[4] Vestas brochure V 112-3.0MW, page 16, available online from http://v112.vestas.com/Vestas_V_112_web.pdf , last accessed on 30 March 2102.

[5] WIND RESOURCE ASSESSMENT, prepared by Wind prospect Ltd in February 2012, page 6 converted from UTM 84 zone 34 to decimal coordinates.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

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The baseline and monitoring methodology to be applied to the project activity is: ACM0002 "*Consolidated Baseline Methodology for grid-connected electricity generation from renewable sources*", (Version 12.3.0).

The project will also make use of the following methodological tools:

- "Tool for the demonstration and assessment of additionality" (Version 06.0.0)
- "Tool to calculate the emission factor for an electricity system" (Version 02.2.1)

B.2. Applicability of methodology

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The proposed project activity meets each of the applicability criteria as set out under ACM0002. "Consolidated baseline methodology for grid-connected electricity generation from renewable resources" (Version 12.3.0).

This is demonstrated in Table 3 below:

Table 3. ACM0002 Applicability criteria

Applicability Criteria	Project
This methodology is applicable to grid-connected renewable power generated project activities that: a) Install a new power plant at the site where no renewable energy 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 d) Involve a replacement of an existing plant	The project involves the installation of a grid-connected, renewable power plant on a farm land. The Rheboksfontein wind energy facility will be installed on a site where there is currently no renewable energy power plant. The project is a 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 project is the installation of a wind power plant.
In the case of capacity additions, retrofits or replacements (except for capacity addition projects for which the electricity generation of the existing power plant(s) or unit(s) is not affected): 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 addition or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the	The project is not a capacity addition, retrofit or replacement. The project is a new (greenfield) power plant.

implementation of the project activity;	
In the case of hydro power plants, at least one of the following conditions must apply: · The project activity is implemented in an existing reservoir, with no change in the volume of the 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/m^2 after the implementation of the project activity; or · The project activity results in the new reservoirs and the power density of the power plant, as per definitions given the Project Emissions section, is greater than 4 W/m^2 after the implementation of the project activity.	The project is not a hydro power plant.
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; • A hydro power plant that results in the creation of a new single reservoir or in the increase in an existing single reservoir where the power density of the reservoir is less than 4 W/m^2.	The project is not a project activity that involves switching from fossil fuels to renewable energy sources, nor a biomass fired power plant, nor a hydro power plant.
In the case of retrofit, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is "the continuation of the current situation, i.e. to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance".	The project is not a retrofit, replacement or capacity addition.

Hence, the project activity complies with all the applicability criteria as specified in the selected methodology.

Table 4. Applicability criteria of the tool to calculate the emission factor for an electricity system

Applicability Criteria	Project

In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.	The project electricity system is not located either partially or totally in a Annex I country.

Consequently the "tool to calculate the emission factor for an electricity system" is applicable to this project activity.

In the case of the "Tool for the demonstration and assessment of additionality", the following criteria should be applied:

Table 5. Applicability criteria for the tool for the demonstration and assessment of additionality

Applicability Criteria	**Project**
Project activities that apply this tool in context of approved consolidated methodology ACM0002, only need to identify that there is at least one credible and feasible alternative that would be more attractive than the proposed project activity.	As described in section B.5, there is one credible and feasible alternative: 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.

Therefore the "Tool for the demonstration and assessment of additionality" is deemed applicable to the project activity.

B.3. Project boundary

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emissions source from the consumption of fossil-fuels (predominantly coal) to produce electricity for the South African electricity grid
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project scenario	For geothermal power plants, fugitive emissions of CH_4 and CO_2 from non-condensable gases contained in geothermal steam	CO_2	No	The project activity is not a geothermal power plant.
		CH_4	No	The project activity is not a geothermal power plant.
		N_2O	No	The project activity is not a geothermal power plant.
	CO_2 emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants	CO_2	No	The project activity is not a geothermal or solar thermal power plant
		CH_4	No	The project activity is not a geothermal or solar thermal power plant
		N_2O	No	The project activity is not a geothermal or solar thermal power plant
	For hydro power plants, emissions of CH_4 from the reservoir	CO_2	No	The project activity is not a hydro power plant
		CH_4	No	The project activity is not a hydro power plant
		N_2O	No	The project activity is not a hydro power plant

The project diagram with project boundary is presented below.

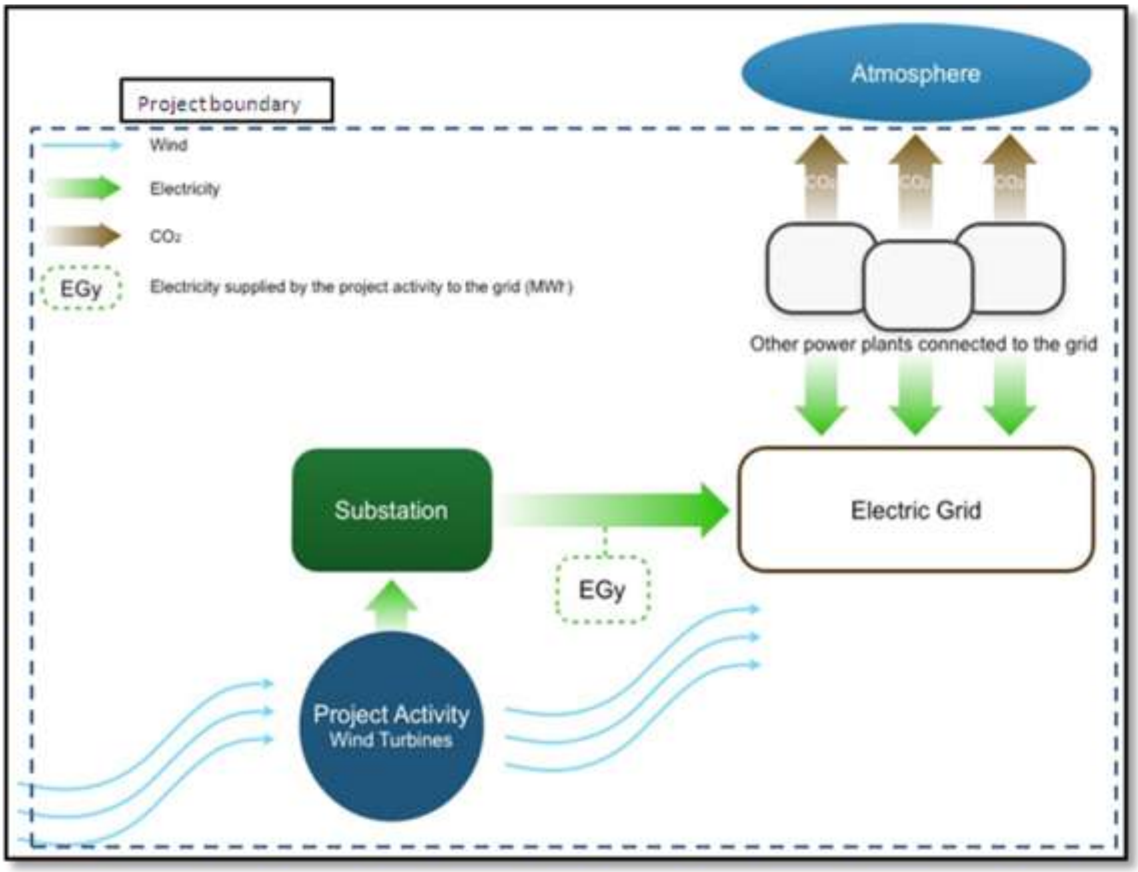

Figure 3. Flow diagram with the project boundary

B.4. Establishment and description of baseline scenario

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ACM0002 (version 12.3.0) identifies the baseline scenario for a project activity that is a new grid-connected renewable power plant as 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 emissions factor for an electricity system*".

Therefore, the baseline scenario for the Rheboksfontein Wind Energy Facility is the production of electricity by the existing fossil-fuelled power plants connected to the national electricity grid of South Africa. This is represented by the combined margin (CM) Grid Emission Factor for the South African electricity grid as calculated when applying the "*Tool to calculate the emissions factor for an electricity system*" (Version 02.2.1).

B.5. Demonstration of additionality

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Prior Consideration of the CDM

Prior Consideration was addressed accordingly in line with the "Guidelines on the demonstration and assessment of prior consideration of the CDM" version 4 (EB 62, Annex 13) that mentions: "*When validating a project activity with a start date on or after 2 August 2008, DOEs shall ensure by means of confirmation from the UNFCCC secretariat that such a notification had been provided.*"

The start date is defined as *the earliest date at which either the implementation or construction or real action of a project begins*[6]. This is generally the date on which the project participant has committed to expenditures related to the implementation or construction of the project. The date that corresponds to the project starting date is the 28/02/2012 which is the date corresponding to the date of EPC Term Sheet signature with the EPC Engineer, Vestas.

CDM has been considered from the inception of the project. The project participants lodged prior consideration with the UNFCCC secretariat and the South African DNA within the 180 days[7] of the start date of the project activity, as defined in the "Clean Development Mechanism Project Cycle Procedure". The "Prior Consideration of the CDM" form was registered by the UNFCCC on the 12/03/2012 and sent the same day to the South African DNA.

Additionality

The methodology ACM0002 stipulates the use of the "Tool for the demonstration and assessment of additionality". The latest version (v. 06.0.0, Annex 21 - EB 65) of this tool is used to assess the additionality of the proposed project. The tool follows a stepwise approach consisting of:

- Identification of alternatives to the project activity;
- Barrier analysis and
- Common practice analysis.

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

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

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 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

The alternative is in compliance with the applicable South African laws and regulations.

Step 3: Barrier Analysis

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[6] UNFCCC web site, CDM Glossary page 18, available online from: http://cdm.unfccc.int/Reference/Guidclarif/glos_CDM.pdf , last accessed on 30 March 2012.

[7] UNFCCC website, Clean Development Mechanism Project Cycle Procedure page 5, available online from: http://cdm.unfccc.int/Reference/Procedures/pc_proc01.pdf , last accessed on 30 March 2012.

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

Barriers due to prevailing practice, *inter alia*:
the project activity is the "first-of-its-kind".

According to EB 65 annex 21 (paragraph 40.2), the project activity is a "first-of-its-kind":

"(a) For the measures identified under paragraph 6, a proposed project activity is the First-of-its-kind in the applicable geographical area if:

> *(ii) The project is the first in the applicable geographical area that applies a technology that is different from any other technologies able to deliver the same output and that have started commercial operation in the applicable geographical area before the start date of the project; and*
>
> *(iii) Project participants selected a crediting period for the project activity that is .a maximum of 10 years with no option of renewal.*

(b) For the measures identified under paragraph 6, a proposed project activity that was identified as the First-of-its-kind project activity is additional and Sub-step 3 b does not apply.

(c) For other measures, the project proponents shall propose approach for demonstrating that a project is a .first-of-its-kind. and Sub-step 3 b applies."

The four types of measures identified in paragraph 6 are:

"*6. **Measure** (for emission reduction activities) is a broad class of greenhouse gas emission reduction activities possessing common features. Four types of measures are currently covered in the framework:*

(a) Fuel and feedstock switch;

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

(c) Methane destruction;

(d) Methane formation avoidance."

The project activity is covered by the framework of the paragraph 6, point (b): "*Switch of technology with or without change of energy source (including energy efficiency improvement as well as use of <u>renewable energies</u>)*", as described in the Annex 21 of the EB 65.

Different technologies in the context of first of its kind are technologies that deliver the same output and differ by at least one of the following (as appropriate in the context of the measure applied in the proposed CDM project and applicable geographical area):

(a) Energy source/fuel;

(b) Feed stock;

(c) Size of installation (power capacity):

(i) Micro (as defined in paragraph 24 of Decision 2/CMP.5 and paragraph 39 of Decision 3/CMP.6);

(ii) Small (as defined in paragraph 28 of Decision 1/CMP.2);

(iii) Large. [8]

In terms of the definitions in EB63 annex 11 "*Guidelines on additionality of first-of-its-kind project activities*", the project will thus be a first-of-its-kind project if no other large scale (> 15 MW) wind power plants have reached commercial operation within the borders of South Africa (*applicable geographical area*[9]) before 28/02/2012 (start date of the project).

The renewable energy sector in South Africa is still in the early stages of development. Even though small, government demonstration [10] wind farms (pilot projects) are operational in South Africa (Klipheuwel (3.16MW), Darling (5.2 MW) and Coega (1.8 MW) wind farms), large commercial wind farms have not yet been developed. Therefore, there are at the project starting date (February 2012) no large scale grid-connected wind farms exporting electricity to the South African electricity grid.

Table 6 gives a list of all wind farm projects currently (March 2012) in operation in South Africa and compares it with the proposed project activity (Rheboksfontein Wind Energy Facility). The list of wind farm projects in operation has been confirmed by Andre Otto[11] the former project manager of the South Africa Wind Energy Programme (SAWEP) at the South African Department of Energy.

Table 6. Comparison between the Klipheuwel Wind Farm, the Darling Wind Farm, the Coega Wind Farm and the Rheboksfontein Wind Energy Facility

	Klipheuwel Wind Farm[12]:	**Darling Wind Farm**[13]	**Coega Wind Farm (first phase)** [14:]	**Rheboksfontein Wind Energy Facility – "project activity"**
Total capacity (MW)	3.16	5.2	1.8	105
Scale of the project	Small (pilot project)	Small (pilot project)	Small (pilot project)	Large scale
Year of Operation	The first unit started generating on 16/08/2002	May-08	Jun-10	Oct-14

[8] EB63, Annex 11 "*Guidelines on additionality of first-of-its-kind project activities*" paragraph 4

[9] In terms of EB 63, annex 11, paragraph 1: "*Applicable geographical area covers the entire host country as a default".*

[10] South African Department of Energy. Wind Power, page 2. Available online from: http://www.energy.gov.za/files/windEnergyCampaign/WindEnergyEconomicsFactSheet3.pdf , last accessed on 30 March 2012. This fact sheet is part of the South African Wind Energy Awareness Campaign: Powered by Wind, launched by South Africa's Minister of Energy, Dipuo Peters together with Danish Minister for Climate, Energy and Building, Martin Lidegaard on the 08/12/2011. It is the country's first campaign focused on creating all-important awareness around wind energy and its benefits on a local environmental and economic level.

[11] Email dated 18/01/2012.

12 South African Department of Energy. Wind Power. Available online from: http://www.energy.gov.za/files/renewables_frame.html. Please select wind power tab on the left hand side of the webpage in order to access data. Last accessed on 30 March 2012.

13 Darling Wind Power (Pty) Ltd. Available online from http://www.electrawinds.be/electrawinds_powered_by_nature-projecten.asp?taal=en&artikelID=4853&rubriekID=2055 , last accessed on 30 March 2012

14 Electrawinds. Available online from http://www.electrawinds.be/electrawinds_powered_by_nature-electrawinds_artikels.asp?taal=en&paginaID=623&artikelID=11934, last accessed on 16/01/2012

	and the last unit on 20/02/2003.			

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 project start date as demonstrated in Table 6.
2. The Project participant selected a crediting period for the project activity that is a maximum of 10 years with no option of renewal.

Outcome of step 3a:

The proposed project activity was identified as a First-of-its-kind project activity and is therefore additional.

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity)

For the measures identified under paragraph 6 of the "Tool for the demonstration and assessment of additionality" version 6, a proposed project activity that was identified as the First-of-its-kind project activity is additional and Sub-step 3 b does not apply (paragraph 40 of the "Tool for the demonstration and assessment of additionality" version 6).

Step 4: Common practice analysis

The latest version (v. 06.0.0, Annex 21 - EB 65) of the " Tool for the demonstration of additionality" stipulates, in paragraph 43, that "*unless the proposed project type has demonstrated to be first-of-its kind (according to Sub-step 3a), and for measures different from those listed in paragraph 6 the above generic additionality tests shall be complemented with an analysis of the extent to which the proposed project type (e.g. technology or practice) has already diffused in the relevant sector and region.".* As Rheboksfontein Wind Energy Facility is demonstrated to be first-of-its kind (according to Sub-step 3a), no common practice analysis is required.

B.6. Emission reductions
B.6.1. Explanation of methodological choices
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Project Emissions

According to the latest version of ACM0002, the project emissions shall be calculated using the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$

Where:

PE_y = Project emissions in year *y* (tCO_2e)
$PE_{FF,y}$ = Project emissions from fossil fuel consumption in year *y* (tCO_2)
$PE_{GP,y}$ = Project emissions from the operation of geothermal power plants due to the release of non-

condensable gases in year y (tCO_2e)

$PE_{HP,y}$ = Project emissions from water reservoirs of hydro power plants in year y (tCO_2e)

As this project does not involve fuel consumption, geothermal power generation or water reservoirs, the project emissions are deemed zero; i.e.: PE = 0

Baseline emissions

According to the latest version of ACM0002, the baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

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

Where:

BE_y = Baseline emissions in year y (tCO_2e)

$EG_{PJ,y}$ = 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)

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system"

Calculation of $EG_{PJ,y}$

The calculation of $EG_{PJ,y}$ is different for (a) Greenfield plants, (b) retrofits and replacements, and (c) capacity additions. The project activity is case (a) Greenfield plants, described as follows:

(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:

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

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)

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

Therefore, the baseline emissions are calculated using the formula below:

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

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 and transport). These emissions sources are neglected.

Emission reductions

Emission reductions are calculated as follows:

$ER_y = BE_y – PE_y$
Where

ER_y	=	Emissions reductions in year *y* (tCO_2e)
BE_y	=	Baseline emissions in year *y* (tCO_2)
PE_y	=	Project emissions in year *y* (tCO_2e)

As stated above, no project emissions are considered in this project activity, thus $ER_y = BE_y$ and consequently:

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

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

According to the latest version of ACM0002, the $EF_{grid,CM,y}$ shall be calculated according to the "Tool to calculate the emission factor for an electricity system". This tool requires the project participants to apply the following six steps:

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) emission factor.

Step 1: Identify the relevant electricity system

The South African DNA has no delineation on the project electricity system and connected electricity system. Thus the project participants define the project electricity system as the complete South African electricity grid, as it is recommended in the tool to use the national grid as a default. The grid map is presented below:

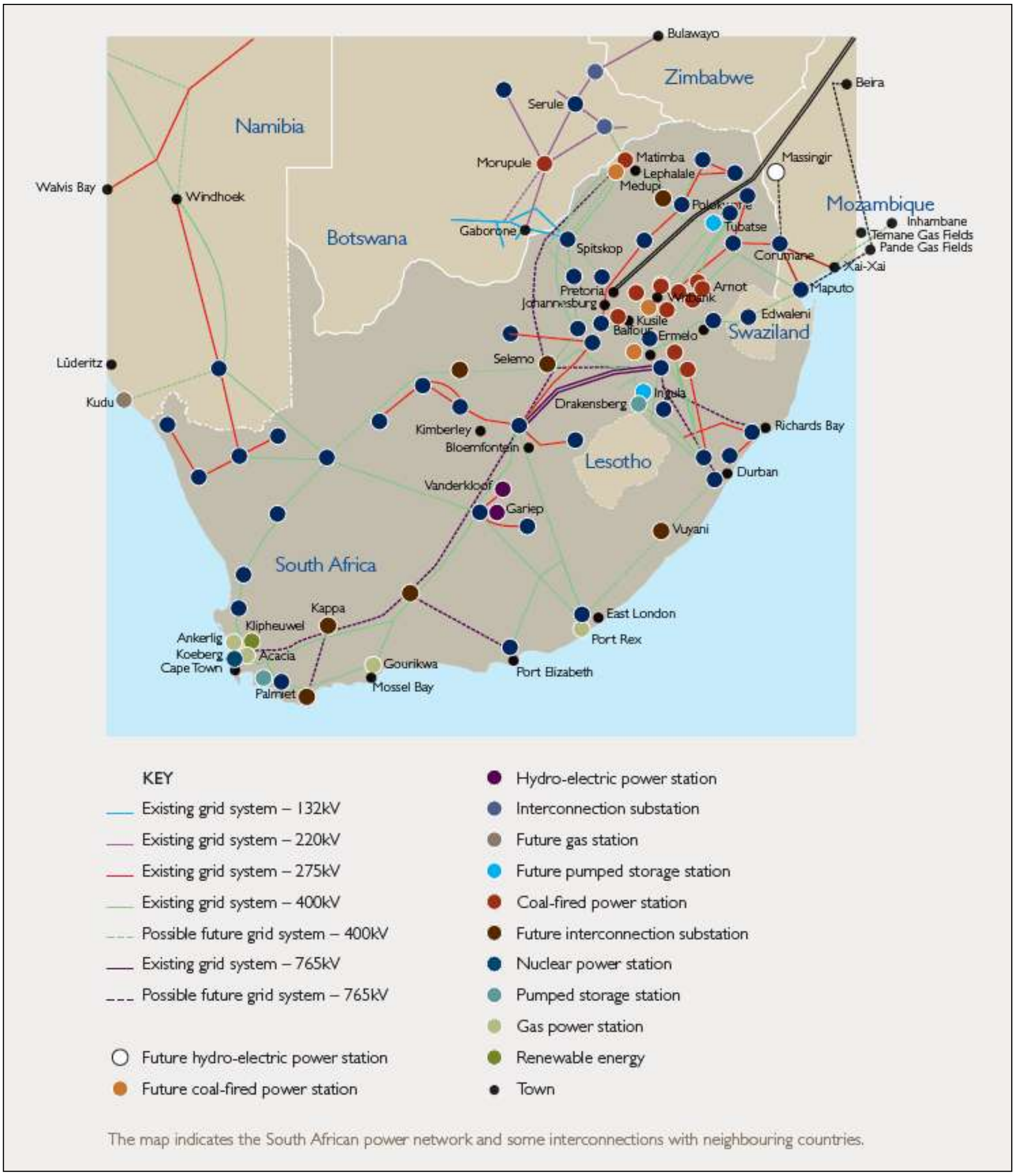

Figure 4. South African electricity grid (source: Eskom)[15]

Eskom, the grid operator, generates, transmits and distributes electricity to industrial, mining, commercial, agricultural and residential customers and also to redistributors in South Africa. This company generated 93.89% of the South African national grid generation in 2010. The remainder was imported from other neighbouring countries (5.38%) and bought from IPPs (0.72%)[16].

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[15] Eskom holding, available online from: http://financialresults.co.za/2010/eskom_ar2010/profile_sa_grid_map.htm and last accessed on 27/03/2012

[16] Eskom holding, available online fromhttp://financialresults.co.za/2011/eskom_ar2011/fact_sheets_11.php, last accessed on 30/03/2012

For the purpose of determining the operating margin emission factor, the electricity imports are considered to have an emission factor of 0 tCO_2/MWh.

STEP 2: Choose whether to include off-grid power plants in the project electricity system

Option I was chosen: Only grid-connected power plants are included in the calculation

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, which are described under step 4:

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

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

The dispatch data analysis (Option c) cannot be used if off-grid power plants are included in the project electricity system as per Step 2 above.

The South African electricity grid is mostly dependent on coal power generation, as noted in Table 7 below:

Table 7. Electricity generation by source (source: Eskom[17])

	2011	2010	2009	2008	2007
Coal fired	87.09%	87.58%	87.89%	88.94%	88.23%
Hydro-electric	0.78%	0.52%	0.45%	0.30%	1.00%
Pumped storage	1.17%	1.11%	1.15%	1.19%	1.21%
Gas Turbine	0.08%	0.02%	0.06%	0.46%	0.03%
Nuclear	4.78%	5.19%	5.39%	4.52%	4.83%
Wind Energy	0.00%	0.00%	0.00%	0.00%	0.00%
Foreign purchases	5.38%	5.58%	5.05%	4.59%	4.71%
IPP	0.72%	0.00%	0.00%	0.00%	0.00%

Hydro, Wind and Nuclear are deemed low-cost/must-run sources for this electricity grid. As it represents between 5% and 6% of the grid generation the (a) Simple OM method can be used.

For the simple OM, the emission factor can be calculated using either of the two following data vintages:

- *Ex ante* option: If the *ex ante* option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For the grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation;
- *Ex post* option: If the *ex post* option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated

[17] Eskom holding, available online from http://financialresults.co.za/2011/eskom_ar2011/fact_sheets_11.php, last accessed on 30/03/2012

annually during monitoring. If the data required to calculate the emission factor for year *y* is usually only available later than six months after the end of year *y*, alternatively the emission factor of the previous year (*y*-1) may be used. If the data is usually only available 18 months after the end of year *y*, the emission factor of the year preceding the previous year (*y-2)* may be used. The same data vintage (*y*, *y-1* or *y-2*) should be used throughout all crediting periods.

For this project activity, the *ex ante* option is chosen, using data from years 2008-2009, 2009-2010 and 2010-2011.

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

(a) Simple OM

The simple OM emission factor 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.

The simple OM may be calculated by one of the following two options:

Option A: Based on the net electricity generation and a CO_2 emission factor of each power unit; or
Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

Option B can only be used if:
(a) The necessary data for Option A is not available; and
(b) Only nuclear and renewable power generation are considered as low-cost/must run power sources and the quantity of electricity supplied to the grid by these sources is known; and
(c) Off-grid power plants are not included in the calculation.

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 unit and an emission factor for each power unit, 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_2e/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/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 $EF_{EL,m,y}$

The emission factor of each power unit m should be determined as follows:

Option A1. If for a power unit *m* data on fuel consumption and electricity generation is available (as in this project case), the emission factor ($EF_{EL,m,y}$) should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum_{i} \left(FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y} \right)}{EG_{m,y}}$$

Where:

$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2e/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)
$EF_{CO2,i,y}$	=	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
m	=	All power units serving the grid in year *y* except low-cost/must run power units
i	=	All fossil fuel types combusted in power sources in the project electricity system in year *y*
y	=	The relevant year as per the data vintage chosen in Step 3

Determination of $EG_{m,y}$

$EG_{m,y}$ is determined once for each 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 (*ex-ante*).

For this approach (simple OM) to calculate the operating margin, the subscript *m* refers to power plants/units delivering electricity to the grid, not including low-cost/must run power plants and including electricity imports to the grid. Electricity imports should be treated as one power plant *m*.

STEP 5: Calculate the build margin (BM) emission factor

In terms of vintage of data, project participants can choose between one of the following two options:

Option 1: 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. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated *ex ante*, as described in Option I above. For the third crediting period, the build margin emission factor calculated for the second period should be used.

Option 1 was chosen for the build margin calculation.

According to the “Tool to calculate the emission factor for an electricity system”, capacity additions from retrofits of power plants should not be included in the calculation of the build margin emission factor. The project participants followed this rule.

The sample group of power units *m* used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

(a) Identify the set of five power units, excluding power units registered as a CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-units}}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-units}}$, in MWh);

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities, (AEG_{total}, in MWh). Identify the set of power units, excluding power units registered as a CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET \geq 20\%}$, in MWh);

(c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

Identify the date when the power units in SET_{sample} started to supply electricity to the grid. If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. In this case ignore steps (d), (e) and (f).

Otherwise:

(d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activities, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent that this is possible. Determine for the resulting set ($SET_{sample\text{-}CDM}$) the annual electricity generation ($AEG_{SET\text{-}sample\text{-}CDM}$, in MWh);

If the annual electricity generation of that set is comprises at least 20% of the annual electricity generation of the project electricity system (i.e. $AEG_{SET\text{-}sample\text{-}CDM} \geq 0.2 \times AEG_{total}$), then use the sample group $SET_{sample\text{-}CDM}$ to calculate the build margin. Ignore steps (e) and (f).

Otherwise:

(e) Include in the sample group $SET_{sample\text{-}CDM}$ the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation);

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

In this project case, the sub-steps (a), (b), (c), (d), (e) and (f) were used. Due to the South Africa electricity grid specifics, the project participants found necessary to add CDM power plants and power plants older than 10 years to the build margin set. The set defined can be seen in the annex 3.

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 electricity generation data is available, calculated as follows:

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

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/MWh)
m	=	Power units included in the build margin
y	=	Most recent historical year for which electricity generation data is available

According to the "Tool to calculate the emission factor for an electricity system", the CO_2 emission factor of each power unit *m* ($EF_{EL,m,y}$) should be determined as per the guidance in Step 4 (a) for the simple OM using options A1, A2 or A3, using for *y* the most recent historical year for which electricity generation data is available, and using for *m* the power units included in the build margin.

However, if the power units included in the build margin *m* correspond to the sample group $SET_{sample-CDM->10yrs}$ (as in this project case), the option A2 shall be used and the default values provided in the "Tool to calculate the emission factor for an electricity system" annex I shall be used.

Option A2

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}}$$

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 CO_2 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	=	Power units included in the build margin
y	=	Most recent historical year for which electricity generation data is available

STEP 6: Calculate the combined margin emissions factor

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

(a) Weighted average CM; or
(b) Simplified CM.

The project participants followed the recommendation to use the weighted average CM method (option (a)) as the preferred option.

<u>(a) Weighted average CM</u>

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * w_{OM} + EF_{grid,BM,y} * w_{BM}$$

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 following default values should be used for w_{OM} and w_{BM}:

- Wind and solar power generation project activities: w_{OM} = 0.75 and w_{BM} = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods;
- All other projects: w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and w_{OM} = 0.25 and w_{BM}=0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool.

This is a wind power project, thus w_{OM} = 0.75 and w_{BM} = 0.25.

B.6.2. Data and parameters fixed ex ante

(Copy this table for each piece of data and parameter.)

Data / Parameter	**$FC_{i,m,y}$**
Unit	Mass or volume unit
Description	Amount of fossil fuel type *i* consumed by power plant/unit *m* in year *y*
Source of data	Eskom records[18]
Value(s) applied	see table below
Choice of data or Measurement methods and procedures	Eskom is the local utility. This data is determined only once in this crediting period (*ex-ante*), using the most recent three historical years for which data is available at the time of submission of the CDM-PDD.
Purpose of data	Calculation of baseline emissions
Additional comment	Eskom annual reports, used for fuel consumptions cover the period from April to March. Thus this is the reason each column presents two years

	Fuel consumption (ton) [1]		
Plant Name	**2008-09**	**2009-10**	**2010-11**
Arnot	6,395,805	6,794,134	6,525,670
Duvha	11,393,553	11,744,606	10,639,393
Hendrina	7,122,918	6,905,917	7,139,198
Kendal	15,356,595	13,866,514	15,174,501
Kriel	9,420,764	8,504,715	9,527,185
Lethabo	16,715,323	18,170,227	17,774,699
Matimba	13,991,453	14,637,481	14,596,842
Majuba	12,554,406	12,261,833	13,020,512
Matla	12,689,387	12,438,391	12,155,421
Tutuka	11,231,583	10,602,839	10,191,709
Acacia			381
Port Rex			242
Camden	3,876,211	4,732,163	4,629,763
Grootvlei	674,538	1,637,371	2,132,979
Komati		664,497	1,271,010

[18] Eskom holding, available online from http://www.eskom.co.za/live/click.php?u=%2Fcontent%2FCEF_CalculatorFINAL2010-2011%7E2.xls&o=Item%2B236&v=62a438 and last accessed on 19/01/2012

Data / Parameter	$NCV_{i,y}$
Unit	GJ/Mass or volume unit
Description	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data	For Kerosene: 2006 IPCC guidelines on National GHG Inventories; provided in Table 1.2 of Chapter 1 of Vol. 2 For Coal: Eskom Integrated Report 2011, page 324[19]
Value(s) applied	<table><tr><th>Fuel type</th><th>2009 NCV[GJ/ton]</th><th>2010 NCV[GJ/ton]</th><th>2011 NCV[GJ/ton]</th></tr><tr><td>Coal (from Eskom)</td><td>19.1</td><td>19.22</td><td>19.45</td></tr><tr><td>Kerosene</td><td>42.4</td><td>42.4</td><td>42.4</td></tr></table>
Choice of data or Measurement methods and procedures	Using IPCC default values at the lower limit of the uncertainty at a 95% confidence interval and data from the local utility (Eskom). Determined for the purpose of OM and BM calculation using the *ex-ante* option.
Purpose of data	Calculation of baseline emissions
Additional comment	From the relevant IPCC table; the project participants used the values of “other kerosene” for the kerosene consumption.

Data / Parameter	$EF_{CO2,i,y}$
Unit	tCO_2/GJ
Description	CO_2 emission factor of fossil fuel type *i* used in power unit *m* in year *y*
Source of data	2006 IPCC guidelines on National GHG Inventories; provided in Table 1.4 of Chapter 1 of Vol. 2
Value(s) applied	<table><tr><th>Fuel type</th><th>EF_{CO2}[tCO₂/GJ]</th></tr><tr><td>Coal</td><td>0.0895</td></tr><tr><td>Kerosene</td><td>0.0708</td></tr></table>
Choice of data or Measurement methods and procedures	Using IPCC default values at the lower limit of the uncertainty at a 95% confidence interval. Determined for the purpose of OM and BM calculation using the *ex-ante* option.
Purpose of data	Calculation of baseline emissions
Additional comment	From the relevant IPCC table; the project participants used the values of “other bituminous coal” for the coal consumption[20] and “other kerosene” for the kerosene consumption.

[19] Eskom holding, available from http://financialresults.co.za/2011/eskom_ar2011/downloads/eskom-ar2011.pdf last accessed 30/03/2012

[20] Article available from http://www.geo.tu-freiberg.de/oberseminar/os07_08/stephan_Schmidt.pdf, last accessed 30/03/2012

Data / Parameter	$\eta_{m,y}$
Unit	-
Description	Average net energy conversion efficiency of power unit *m* in year *y*
Source of data	Tool to calculate the emission factor for an electricity system version 02.2.1, annex 1.
Value(s) applied	<table><tr><th>Plant Name</th><th>$\eta_{m,y}$ [5]</th></tr><tr><td>Majub</td><td>37%</td></tr><tr><td>Kendal</td><td>37%</td></tr></table>
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

B.6.3. Ex ante calculation of emission reductions
>>
Baseline emissions

According to section B.6.1, the baseline emissions are calculated as follows:

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

Emission reductions

Emission reductions are calculated as follows:

$ER_y = BE_y – PE_y$
Where
ER_y = Emissions reductions in year *y* (tCO_2)
BE_y = Baseline emissions in year *y* (tCO_2)
PE_y = Project emissions in year *y* (tCO_2)

As stated above, no project emissions are considered in this project activity, thus $ER_y = BE_y$ and consequently:

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

<u>Calculation of $EF_{grid,CM,y}$</u>

According to the latest version of ACM0002, the $EF_{grid,CM,y}$ shall be calculated according to the “Tool to calculate the emission factor for an electricity system”. This tool requires the project participants to apply the following six steps:

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) emission factor;

STEP 1: Identify the relevant electricity system

The relevant system is described in section B.6.1.

STEP 2: Choose whether to include off-grid power plants in the project electricity system

Option I was chosen: Only grid-connected power plants are included in the calculation

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

According to section B.6.1., the method chosen is the Simple OM *ex ante*.

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

Table 10 in annex 3 summarizes the simple OM calculation. The resulting values of this calculation are:

$EF_{grid,OMsimple,2008-2009}$ = 0.9271 tCO_2/MWh;
$EF_{grid,OMsimple,2009-2010}$ = 0.9209 tCO_2/MWh;
$EF_{grid,OMsimple,2010-2011}$ = 0.9217 tCO_2/MWh;

The weighted average, $EF_{grid,OMsimple,2008-2011}$= 0.9232 tCO_2/MWh.

STEP 5: Calculate the build margin (BM) emission factor

The *ex-ante* build margin emission factor ($EF_{grid,BM,2010-2011}$) is 0.8698 tCO_2/MWh. The set of power plants and the calculation is presented in annex 3 Table 11.

STEP 6: Calculate the combined margin emissions factor

The combined margin emissions factor is calculated as follows:

$EF_{grid,CM,2008-2010}$ = 0.9232 * 0.75 + 0.8698 * 0.25 = 0.9098 tCO_2/MWh

Consequently, the Emissions Reductions are calculated in accordance with Table 8 below:

Table 8. Emission reductions calculation

	A	B	C= A x B
Year	**Estimated net generation (MWh)**	**Emission factor (tCO_2e/MWh)**	**GHG emissions reductions(tCO_2e)**
2014	90,125	0.9098	81,995
2015	360,500	0.9098	327,982
2016	360,500	0.9098	327,982
2017	360,500	0.9098	327,982
2018	360,500	0.9098	327,982
2019	360,500	0.9098	327,982
2020	360,500	0.9098	327,982
2021	360,500	0.9098	327,982
2022	360,500	0.9098	327,982

2023	360,500	0.9098	327,982
2024	270,375	0.9098	245,987

B.6.4. Summary of ex ante estimates of emission reductions

Year*	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2014	81,995	0	0	81,995
2015	327,982	0	0	327,982
2016	327,982	0	0	327,982
2017	327,982	0	0	327,982
2018	327,982	0	0	327,982
2019	327,982	0	0	327,982
2020	327,982	0	0	327,982
2021	327,982	0	0	327,982
2022	327,982	0	0	327,982
2023	327,982	0	0	327,982
2024	245,987	0	0	245,987
Total	3,279,820	0	0	3,279,820
Total number of crediting years	10			
Annual average over the crediting period	327,987	0	0	327,987

* From 3 October 2014 to 2 October 2024

B.7. Monitoring plan
B.7.1. Data and parameters to be monitored
(Copy this table for each piece of data and parameter.)

Data / Parameter	$EG_{facility,y}$
Unit	MWh
Description	Quantity of net electricity supplied by the project to the grid in year *y*.
Source of data	Measured at the project activity site
Value(s) applied	360,500
Measurement methods and procedures	The net electricity supplied to the grid from the project will be continuously measured using energy meters and recorded at least monthly. The precision of the energy meters is class 0.5s or better.
Monitoring frequency	Continuously
QA/QC procedures	The electricity meters measuring electricity supplied to the grid will be calibrated by an accredited entity in accordance with the relevant national standard (or manufacturer's recommendation where there is no national standard). The calibration frequency for the energy meters is at least once a year. The recorded data will be cross-checked against records for electricity sold/purchased.
Purpose of data	Calculation of baseline emissions
Additional comment	Data will be archived electronically for at least two years after the end of the last crediting period or the last issuance of CERs for this project activity, whichever occurs later

B.7.2. Sampling plan
>>
Not applicable.

B.7.3. Other elements of monitoring plan
>>
The monitoring plan is designed to ensure that accurate and timely data are obtained, recorded and archived. The monitoring system consists of the following components:

1. Management Structure and Responsibility

The Project Owner is responsible for daily monitoring and reporting. A staff (monitoring team) will be dedicated to execute the monitoring tasks. A detailed Monitoring Manual of the project will be completed before verification.

2. Generation of Monitoring Data

The net quantity of electricity supplied to the grid is monitored by metering equipment that is also used for billing purposes. The accuracy class of the metering equipment will be class 0.5 or better. A Facility Metering configuration (owned by the Project Owner) is used for invoicing purposes and will provide main metering data that will be used for the calculation of the emission reductions. A System Metering configuration (Back up, owned by the Grid Company) provides data for comparison purposes against the data that is provided by the Facility Metering configuration and will be installed adjoining the Facility Metering configuration at the Delivery Point.
The installation of the monitoring equipment is represented below in a Project Activity Diagram which includes the process overview with relevant information and the monitoring structure.

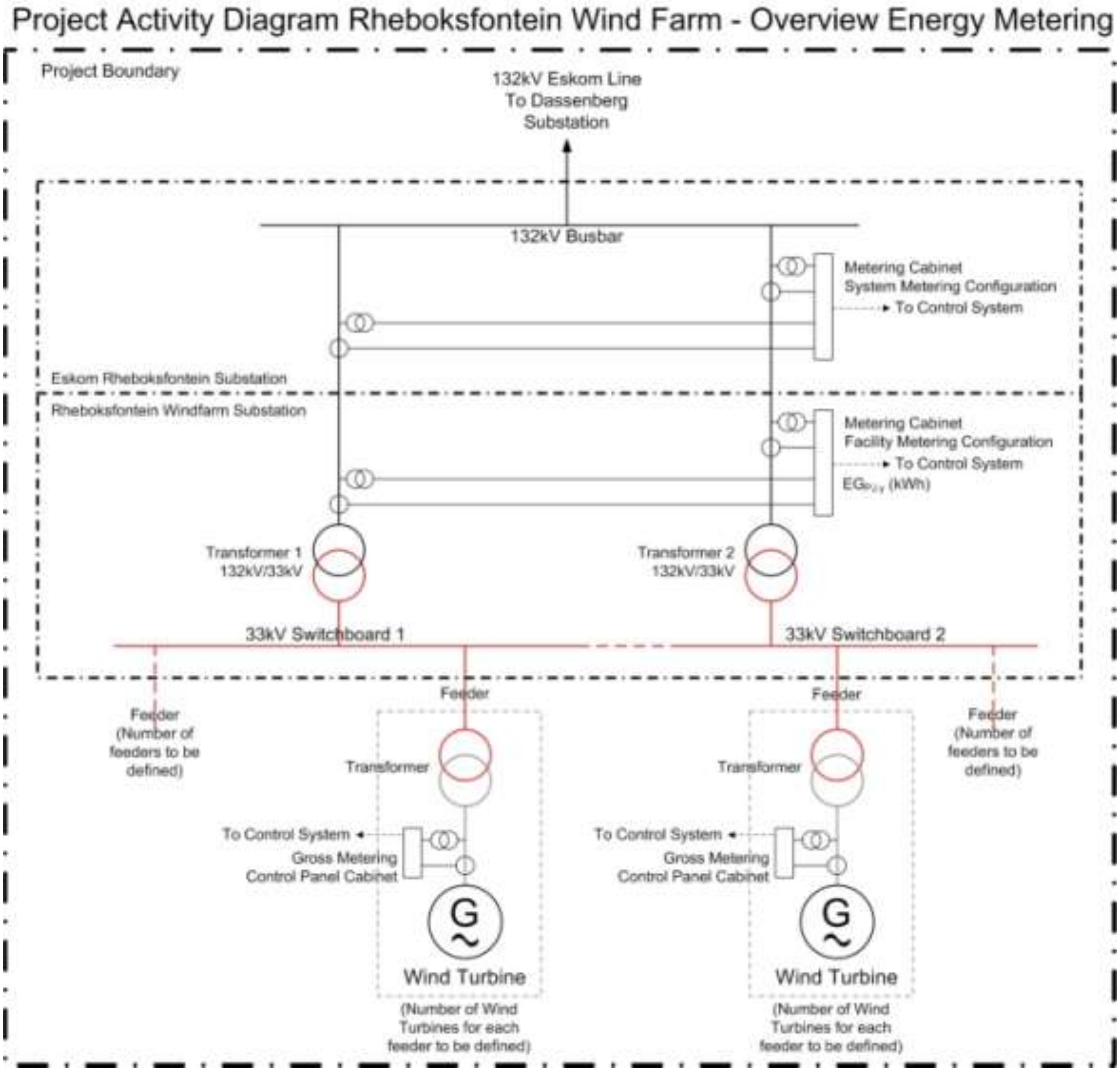

Figure 5.process overview with relevant information and the monitoring structure (Project Activity Diagram)

3. Calibration of Measuring Instruments

All measurement instruments will be regularly calibrated to ensure that, at all times, the measured values are within the specified accuracy margins. Calibration tests will be performed in accordance with relevant industry standards. Calibration frequency is at least once a year. The Parties (Project Owner and Grid Company) will provide each other with copies of calibration records. The company which will calibrate this meter should be qualified, in accordance with the industry standards or with the local regulations (if any). The Project Owner will keep these copies of calibration records for future reference and verification.
Corrective actions will be taken in a case where an erroneous measurement, deviation or equipment malfunction is recognized.

If a calibration test reveals that the reading of the Facility Metering configuration is inaccurate by more than the allowed error margin, or has functioned improperly, than the net electricity generation supplied by the project to the grid shall be determined:

- first, by reading the System Metering configuration, unless a test by either party reveals it to be inaccurate;

- second, if the System Metering configuration is not within acceptable limits of accuracy or operation is performed improperly, by the Project Owner and the Grid Operator who shall jointly prepare a reasonable and conservative estimate of the correct reading and provide sufficient evidence that this estimation is reasonable and conservative when DOE undertakes verification;
- third, if the Project Owner and the Grid Operator fail to agree on an estimate of the correct reading, by referring the matter for arbitration according to agreed procedures.

4. Data control and handling

The Project Owner will develop data control activities to guarantee the accuracy and consistency of the metering data which is used for the calculation of CER's. In accordance with the applied methodology (ACM0002), main metering data (from the Facility Metering configuration) will be cross-checked with records for sold electricity.
The Project Owner will develop and use specific spreadsheet applications to gather, aggregate, calculate, control and (internally) report the CDM relevant data.

5. Data storage and safeguarding

Data will be archived in electronic spreadsheets. For data security, a backup of the electronic spreadsheets will be stored every month at two different physical locations (one of them not being the project site). The data will be kept at least 2 years after the end of the last crediting period or the last issuance of CERs for this project activity, whichever occurs later. The Project Owner will also collect and keep electricity sales/purchase receipts from the Grid Operator for the purpose of cross-checking with the main metering data.
All physical documents such as invoices, paper-based maps, drawings, diagrams and other relevant monitoring documents will be collected and stored in a central place, together with this monitoring plan.

6. Training

Operational Staff involved in the CDM monitoring will be given proper training. The training will be organised and supervised by the Project Owner Monitoring Manager. The training will provide an overview of the CDM requirements for monitoring emission reductions and will cover all the elements of the monitoring plan in detail.
Prove of all training undertaken, together with a list of participants and the content of the training (e.g. slides) will be stored together with the CDM Documents.

SECTION C. Duration and crediting period
C.1. Duration of project activity
C.1.1. Start date of project activity
>>
28/02/2012 – date of the EPC Term Sheet signature.

C.1.2. Expected operational lifetime of project activity
>>
20 years[21].

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[21] Vestas brochure V 112-3.0MW, page 18, available online from http://v112.vestas.com/Vestas_V_112_web.pdf , last accessed on 30 March 2102.

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>

Fixed crediting period.

C.2.2. Start date of crediting period

>>

03/10/2014 (expected commissioning date) or the date of registration, whichever occurs later.

C.2.3. Length of crediting period

10 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>

The Environmental Impact Assessment[22] was conducted in accordance with the host country regulations for this project activity. This study was conducted by *Savannah Environmental Pty Ltd* in November 2010 and it was approved by the South African Department of Environmental Affairs on 02 February 2012. Below is the conclusion presented in the EIA of the project activity:

"*The findings of the specialist studies undertaken within this 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 wind energy facility and associated infrastructure from proceeding on the identified site, provided that the recommended mitigation, monitoring and management measures are implemented, and given due consideration of the recommendations regarding the re-location of 3 turbines highlighted in this report during the process of finalising the wind energy facility layout.*
- *Based on the findings of the Social Impact Assessment, none of the landowners who stand to be directly affected by the proposed wind energy facility are opposed to the development. In order to enhance the local employment and business opportunities the mitigation measures listed in the report should be implemented. The mitigation measures and recommendations listed in the report to address the potential negative impacts during the construction phase, specifically the presence of construction workers, should also be implemented.*
- *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 significance levels of the majority of identified negative impacts can generally be reduced by implementing the recommended mitigation measures."

As a result of the EIA, no transboundary impact was found. All impacts will occur inside South Africa borders.

D.2. Environmental impact assessment

>>

[22] Environmental impact assessment process – final environmental impact assessment report: Proposed Rheboksfontein wind energy facility and associated infrastructure on site near Darling, November 2010, prepared by Savannah Environmental (Pty) Ltd, Page 190.

As previously stated, the Environmental Impact Assessment (EIA) was submitted to the local authorities who have accepted the EIA and have granted authorisation to proceed with the project. This authorisation is dated of 02/02/2012, NEAS reference DEAT/EIA/5958/2009 and DEA Reference 12/12/20/1582.

Consequently no environmental impacts are considered significant by the host party. The project participants agree and share the same opinion.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

The public involvement process was initiated at the start of the EIA process, and has continued through the EIA process[23] for this project. The aim of the public participation process was primarily to ensure that:

- Information containing all relevant facts in respect of the proposed project was made available to potential stakeholders;
- Invitation to provide comments on the proposed project;
- Registration of all comments received, consideration and incorporation in the EIA process.

To reach the above described objectives, the project developers conducted a public meeting on 30 September 2010 at the Yzerfontein Community Hall.

In addition, the project owners conducted a CDM specific public consultation, inviting stakeholders by fax and email to provide comments. This consultation started in 15 March 2012 and was concluded in 20 April 2012.

E.2. Summary of comments received

>>

No comments on the CDM specific public consultation were received. However during the EIA phase, comments were received and addressed as part of the EIA process. A compilation is presented in the table below.

Table 9. Stakeholders comments and PP response

Question / Comment	Response
Bennet Joubert: There is not only one heritage site that would be disturbed by the development. There are many sites across the entire footprint.	The specialists need to confirm which areas they investigated. All gaps identified need to be addressed.
Bennet Joubert: Have you done a study of the farm Doornfontein? The yellow highlighted areas on the map.	A small portion of Doornfontein is part of the proposed site. We only undertook studies of a small portion of Doornfontein.
Bennet Joubert: There are wetlands on Doornfontein and according to legislation, development within wetlands is not allowed.	If this area is occupied by wetlands and Renosterveld, the Department of Environmental Affairs will not allow us to develop this area.
Bennet Joubert: The particular part of the farm Doornfontein that is proposed is a natural area of Renosterveld and it is going to be completely destroyed.	Comment noted. This will be verified with the vegetation specialist.

[23] Environmental impact assessment process – final environmental impact assessment report: Proposed Rheboksfontein wind energy facility and associated infrastructure on site near Darling, November 2010, prepared by Savannah Environmental (Pty) Ltd, Page 56 and annex F.

Bennet Joubert: I would like to have a visual simulation of turbines from my homestead on the farm Doornfontein. This was not done by your visual impact specialist and it does not occur in your visual impact assessment report.	The visual simulations were compiled to inform the visual impact assessment and not to provide views from all identified sensitive receptors. Impacts on sensitive receptors are assessed in the EIA Report.
Bennet Joubert: Have you taken photos from Darling's side for the visual impacts? The 80 meter high turbines on the hills are going to have a major visual impact on the town.	Various photographs were taken and the ones presented here tonight are part of an overall set of visual simulations. In terms of the visual impact assessment, the impact on Darling will be limited due to the local topography. Tommie Potgieter: Photos are just taken to simulate the visual impact. We did not necessarily take photographs from every angle.
Bennet Joubert: The first turbine is less than 1km from my house and I am not happy with the placement of the wind turbines next to my farm Doornfontein.	The recommendation from the noise specialist is that turbines are located at least 1km from noise sensitive receptors. This will be considered in the final design of the facility.
Joc Wagner and Bennet Joubert: That area was identified as a highly sensitive area. Why is it even on a proposal to develop this area?	This sensitivity was identified in the EIA process and the area has been highlighted as an area where infrastructure should not be located.
Martin Halvorsen: The botanical sensitive areas should be avoided and where gaps exist in the draft environmental impact assessment report it should be addressed as indicated by Bennet Joubert.	If the specialists have identified these areas as botanically sensitive, we will stay out of it and go around these areas. This is not the final footprint and layout for the wind turbines on Rheboksfontein.
Bennet Joubert: How will you deal with stormwater drainage on my farm?	We have a process with Mr. Basson that we will protect all contours. The stormwater drainage issue will be adequately addressed as part of the environmental management plan for construction and operation.
Martin Halvorsen: Bennet Joubert has a low lying farm and he is a receptor of stormwater. Mr. Basson will received financial gain out of this project. How will you reward Mr. Joubert and accommodate his needs as a farmer and landowner relating to the access of stormwater onto his and other adjacent properties. The issue of stormwater is not addressed within your environmental impact assessment and environmental management plan for this site.	These are important points raised and we need to investigate this and clarify any gaps in this regard. Jo-Anne Thomas: The need for the development of a stormwater management plan is included in the EMP for the project.
Bennet Joubert: There's a lot of sand and mud on this site. What will happen if a mudslide occurs?	The Department of Agriculture has requirements for soil protection. This requirement is also part of the environmental management plan.
Brian Bosman: Will there be vibrations travelling down the turbines into the ground? Will this affect homesteads in the area?	No vibrations will be generated and propagated through the ground to homesteads. The wind turbines are fitted with dampers to avoid any propagation of vibrations from the turbine to ground.
Keith Harrison: All environmental impact assessment reports will go to Birdlife S.A. and Endangered Wildlife Trust committee which have been set up as a working group	Comment noted.

and will be reviewed before a final environmental authorisation will be issued.	
Keith Harrison: It's illegal for running stormwater to go straight into a neighbour's farm. The environmental management plan needs to clearly spell out how stormwater will be handled and the footprint and layout of the site needs to accommodate for stormwater run-off and dissipation.	The need for a stormwater management plan is included in the draft EMP for the project.
Nicola Tullie: It hasn't been proven that wind energy is an efficient green energy. It's a huge amount of effort to install wind turbines in terms of environmental impact when wind farms are not really as effective as expected.	Nuclear energy is expensive. Gas is expensive. Coal is running and oil is running out. Wind energy is a natural energy source that is available and can be harvested effectively by independent power producers and Eskom. Joc Wagner: In Germany, a big topic is the prolonging of nuclear power. Their goal is to have 50% renewable energy thus wind energy is definitely being looked at as part of the future answer to their needs.
Joc Wagner: There is a lot of resistance to windfarms in the country primarily due to the visual impacts.	Comment noted.
Steyn Marais: I am in support of wind energy. However, my concern is the location and placement of these facilities in sensitive areas. Suitable places need to be found where the wind resource is ideal and where it does not affect the visual character and biodiversity of an area such as the R27 and Darling Hills and surrounding conservation areas.	The Western Cape Department of Environmental Affairs are currently undertaking a strategic environmental assessment for the entire Western Cape where they looking at these issues but there also needs to be a wind resource to make a project viable.
Martin Halvorsen: All the birds and snakes in the proposed area will be affected as well. Please include in to your environmental impact assessment the Critical Biodiversity of the Swartland research which was completed a few years ago.	These issues have been included in the specialist studies undertaken.
Bennet Joubert: There are 7 springs on my farm and approximately 70 in the surrounding area. How will these be affected by the vibrations and blasting during construction?	The question and concern about vibrations and blasting relating to how it would affect localised freshwater springs need to be clarified as requested by Mr. Joubert.
Bennet Joubert: Is this wind energy facility proposed out of the need for energy or to make money?	We need wind energy to support the country's needs for growth. The proposal's objective is also to gain profits. It's a business venture.
Keith Harrison: Cumulative Impact Assessments need to be done for facilities of this nature. To do this, you need to monitor one year to 18 months before construction, during construction and five years after construction.	The cumulative impact has to be done at national level. We will not bypass legislation in developing proposals.

Keith Harrison: Eskom is requiring 400 MW of wind by 2013. There is 6000 MW of applications for wind turbines in the pipeline. How is this planned to be accommodated?	Firstly, the 400 MW is not indicated by Eskom, but rather NERSA. There's reference to 1025 MW of Renewable Energy in the first Integrated Resource Plan 2010 published in January 2010. The new IRP is expected in November 2010 and this value is expected to be revised. The implementation of all 6000 MW is very optimistic.
Joc Wagner: In the long-term, there are going to be a lot of wind turbines. What about solar power plants in South Africa?	Some independent power producers (IPPs) are currently working on a number of solar projects in the country, specifically in the Northern Cape where excellent solar resources exist. In some areas IPPs are looking at hybrid technology, i.e. combinations of solar and wind.

E.3. Report on consideration of comments received

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All the comments made by the stakeholders were answered. There were no serious negative comments, consequently the project participants decided to proceed with the project activity development. Also, the authorities noted the comments and approved the EIA.

SECTION F. Approval and authorization

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The letter of approval fro, the host country is not yet available.

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Appendix 1: Contact information of project participants

Organization name	Micawber 895 (Pty) Ltd
Street/P.O. Box	6-10 Woodlands Drive
Building	Lincolnwood Office Park Block E, First floor
City	Woodmead, Sandton
State/Region	
Postcode	
Country	South Africa
Telephone	
Fax	
E-mail	
Website	www.Gdfsuez.com
Contact person	
Title	
Salutation	
Last name	Mungroo
Middle name	
First name	Sanjith
Department	
Mobile	
Direct fax	+27 11 209 9229
Direct tel.	+27 11 209 9225
Personal e-mail	Sanjith.mungroo@gdfsuezmeaa.com

Organization name	Moyeng Energy (Pty) Ltd
Street/P.O. Box	6-10 Woodlands Drive
Building	Lincolnwood Office Park Block E, First floor
City	Woodmead, Sandton
State/Region	
Postcode	
Country	South Africa
Telephone	
Fax	
E-mail	
Website	www.Gdfsuez.com
Contact person	
Title	
Salutation	
Last name	Mungroo
Middle name	
First name	Sanjith
Department	
Mobile	
Direct fax	+27 11 209 9229
Direct tel.	+27 11 209 9225
Personal e-mail	Sanjith.mungroo@gdfsuezmeaa.com

Appendix 2: Affirmation regarding public funding

No public funding from annex I countries will be used.

Appendix 3: Applicability of selected methodology

No further background information deemed necessary by the project participants.

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

BASELINE INFORMATION

Table 10.Operating margin emission factor determination

				Electricity generation MWh [1]			**Fuel consumption (ton) [1]**								
Plant Name	**Installed capacity (MW)**	**Commissioning date**	**Fuel type**	**2008-2009**	**2009-2010**	**2010-2011**	**2008-2009**	**2009-2010**	**2010-2011**	$EF_{EL,m,2008-2009}$	$EF_{EL,m,2009-2010}$	$EF_{EL,m,2010-2011}$	$EG_{2008}*EF_{EL,m,2008-2009}$	$EG_{2009}*EF_{EL,m,2009-2010}$	$EG_{2010}*EF_{EL,m,2010-2011}$
Arnot	1980	21/09/1971	Coal	11987281	13227864	12194878	6395805	6794134	6525670	0.912076	0.883529	0.931516	10933308.86	11687201.37	11359723.19
Duvha	3450	18/01/1980	Coal	21769489	22581228	20267508	11393553	11744606	10639393	0.894679	0.894679	0.913817	19476709.18	20202953.8	18520789.35
Hendrina	1895	12/05/1970	Coal	12296687	12143292	11938206	7122918	6905917	7139198	0.990208	0.978276	1.041005	12176272.18	11879489.36	12427737.4
Kendal	3840	01/10/1988	Coal	23841401	23307031	25648258	15356595	13866514	15174501	1.101082	1.023427	1.029910	26251331.32	23853038.72	26415391.98
Kriel	2850	06/05/1976	Coal	18156686	15906816	18204910	9420764	8504715	9527185	0.886964	0.919714	0.911001	16104325.02	14629725.7	16584685.47
Lethabo	3558	22/12/1985	Coal	23580232	25522698	25500366	16715323	18170227	17774699	1.211778	1.224645	1.213385	28574008.9	31256242.78	30941751.65
Matimba	3690	04/12/1987	Coal	26256068	27964141	28163040	13991453	14637481	14596842	0.910939	0.900412	0.902240	23917689.33	25179248.44	25409817.63
Majuba	3843	01/04/1996	Coal	22676924	22340081	24632585	12554406	12261833	13020512	0.946386	0.944163	0.920154	21461129.34	21092682.51	22665781.78
Matla	3450	29/09/1979	Coal	21863400	21954536	21504422	12689387	12438391	12155421	0.992155	0.974577	0.983977	21691872.61	21396395.81	21159852.99
Tutuka	3510	01/06/1985	Coal	21504122	19847894	19067501	11231583	10602839	10191709	0.892844	0.918934	0.930456	19199829.56	18238897.62	17741472.23
Koeberg	1800	21/07/1984	Nuclear							0.000000	0.000000	0.000000	0	0	0
Acacia	171	13/05/1976	Gas*			992			381	0.000000	0.000000	1.154352	0	0	1145.117315
Port Rex	171	30/09/1976	Gas*			5507			242	0.000000	0.000000	0.131757	0	0	725.58813

															73
Ankerlig	1338	29/03/2007	Gas*			"6303.225									
Gourikwa	746	30/03/2007	Gas*	"				0.000000	0.000000	0.000000	0	0	0		
Colley Wobbles	42	01/01/1985	Hydro							0.000000	0.000000	0.000000	0	0	0
First Falls	6	01/02/1979	Hydro							0.000000	0.000000	0.000000	0	0	0
Gariep	360	08/09/1971	Hydro							0.000000	0.000000	0.000000	0	0	0
Ncora	2	01/03/1983	Hydro							0.000000	0.000000	0.000000	0	0	0
Second Falls	11	01/04/1979	Hydro							0.000000	0.000000	0.000000	0	0	0
Van der Kloof	240	01/01/1977	Hydro							0.000000	0.000000	0.000000	0	0	0
Drakensberg	1000	17/06/1981	Pump storage							0.000000	0.000000	0.000000	0	0	0
Palmiet	400	18/04/1988	Pump storage							0.000000	0.000000	0.000000	0	0	0
Camden	1600	21/12/1966	Coal							0.000000	0.000000	0.000000	0	0	0
Grootvlei	1200	30/06/1969	Coal	6509079	7472070	7490836	3876211	4732163	4629763	1.017992	1.089420	1.075898	6626188.894	8140219.471	8059375.686
Komati	1000	06/11/1961	Coal	1249556	2656230	3546952	674538	1637371	2132979	0.922799	1.060371	1.046825	1153088.984	2816589.22	3713036.519
IPPs [2]			Renewable		1016023	2060141		664497	1271010	0.000000	1.125035	1.073976	0	1143061.094	2212542.433
Imports [2]						1833000				0.000000	0.000000	0.000000	0		
Grid generation w/o LC/MR w/ Imports				**223,879,925**	**229,693,904**	**235,672,102**				$EF_{grid,OM,simple,y}$ =			0.9271	0.9208	0.9217

Table 11. Build Margin calculation

Plant Name	Installed capacity (MW)	Commissioning date	Fuel type	Electricity generation MWh [1] 2010	$\eta_{m,v}$ [5]	$EF_{EL,m,2010}$	$\Sigma EG_m \times EF_{EL}$
Bethlehem Hydroelectric project (CDM) [6]	7	11/11/2009	Hydro	34 031	-	0	0
PetroSA Biogas to Energy Project (CDM) [7]	4.248	01/10/2007	LFG	23 000		0	0
Majuba	3843	01/04/1996	Coal	24 632 585	37.00%	0.870811	21450321.32
Kendal	3840	01/10/1988	Coal	25 648 258	37.00%	0.870811	22334780.34

Table 12. CM emission factor

Ex-ante emission factor for the South African interconnected system		
Baseline	EF_{OM} [tCO_2/MWh]	Generation [GWh]
2008-2009	0.9271	223 880
2009-2010	0.9209	229 694
2010-2011	0.9217	235 672
	$EF_{OM\ simple,\ 2008\text{-}2010}$ 0.9232	$EF_{grid,BM,2010}$ 0.8698
	Weights_wind and solar projects w_{OM} = 0.75 w_{BM} = 0.25	Weights_all other projects w_{OM} = 0.50 w_{BM} = 0.50
	$EF_{2008\text{-}2010}$ [tCO_2/MWh] **0.9098**	**$EF_{2008\text{-}2010}$ [tCO2/MWh]** **0.8965**

Appendix 5: Further background information on monitoring plan

1. Not applicable. All information is available in the previous relevant sections.

Appendix 6: Summary of post registration changes

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03	EB 25, Annex 15 26 July 2006	
02	EB 14, Annex 06b 14 June 2004	
01	EB 05, Paragraph 12 03 August 2002	Initial adoption.

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