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

CONTENTS

SECTION A. General description of project activity

A.1. Title of the project activity:

Springbok Grid Connected 55.5 MW Wind Farm, South Africa

Version number: 1.0

Date: 22 August 2011

A.2. Description of the project activity:

The aim of the project is to supply wind-generated electricity to the grid of the Republic of South Africa.

The energy system of the Republic of South Africa (RSA) is managed by the state-owned company Eskom which is in charge of generation, transmission and distribution of power to end-users. The company's total net maximum capacity as of 31 March 2010 is 40 870 MW, most of which is coal-fired (34 658 MW).

The project envisages the construction and operation of a wind farm with installed capacity of 55.5 MW[1]. The wind farm will be comprised of 37 wind turbines, each with a power capacity of 1.5 MW, and the associated infrastructure. Produced electricity will be supplied to the Eskom electricity network via the Nama Substation.

The proposed project is located outside of the town of Springbok in the Northern Cape Province of the RSA. Construction and installation works under the project are expected to be started in June 2012 (the expected starting date of the project). The wind farm is expected to be commissioned by the 1st of June 2013. The required investments into the project amount to around USD 125 million.

The baseline scenario assumes that electricity delivered to the grid by the wind farm would have otherwise been generated by the operation of grid-connected Eskom's power plants and by the addition of new generation sources.

Greenhouse gas (GHG) emissions from electricity generation for the wind farm amount to zero. The reduction of GHG emissions as a result of the project implementation will be achieved due to reduction of CO_2 emissions from combustion of fossil fuel at the existing grid-connected power plants and plants which would likely be built in the absence of the project activity.

The project activity satisfies all sustainable development criteria identified by the DNA of the RSA. Implementation of the project:

1. Promotes the development of wind farms in the RSA which in turn will lead to the creation of new job opportunities both during the construction and operation phases and to the growth in tax revenues. Sales of carbon credits generated by the project will result in increased foreign direct investment. In the long term it is considered to set up tower and blade manufacturing companies in the RSA;

[1] The project owner plans to increase the wind farm capacity up to 400 MW in future in case of successful implementation of the proposed project. Such increase will be considered in another PDD as a phase 2 of the Springbok Wind Farm Project, herewith Springbok Grid Connected 55.5 MW Wind Farm, South Africa is appointed as a phase 1.

2. Ensures the creation of 137 new job opportunities (120 jobs during the construction phase and 17 jobs during the operation phase);
3. Leads to mitigation of the negative environmental impact. Combustion of fossil fuels (mostly coal) at Eskom's power plants and hereby emissions of the harmful substances into the atmosphere, such as flue ash, oxides of sulphur and nitrogen will be reduced due to the project implementation;
4. Makes a contribution to achievement of the goal to generate 10 000 GWh of electricity from renewable energy by 2013 and the objective to reduce RSA's GHG emissions below the current emissions baseline of around 34% by 2020.

A.3. Project participants:

Name of Party involved (host) indicates a Host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of South Africa (Host Party)	• Longyuan Mulilo (Pty) Ltd	No
One of the Parties to Annex B of the Kyoto Protocol	• To be determined upon approval of the project by the DNA of RSA	No

Longyuan Mulilo (Pty) Ltd

The project is being developed by Longyuan Mulilo (Pty) Ltd, a private company established in 2008 to develop renewable energy projects in the RSA.

Longyuan Mulilo (Pty) Ltd will establish the SPV called Longyuan Mulilo Springbok which will construct and operate the wind farm.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

The Republic of South Africa

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

Northern Cape Province

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

The town of Springbok

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

Springbok is the main town of the Nama Khoi Local Municipality located in the Northern Cape Province of the RSA (Fig. A.4-1).

The project site is located on Farm Erf 946 Concordia, Re/635, 9/133, 1/132 and Re/132 (Transmission Line) outside of the town of Springbok (Fig. A.4-2).

Geographical latitude: 29°36' S. Geographical longitude: 17°54' E. Time zone: UTC+2.

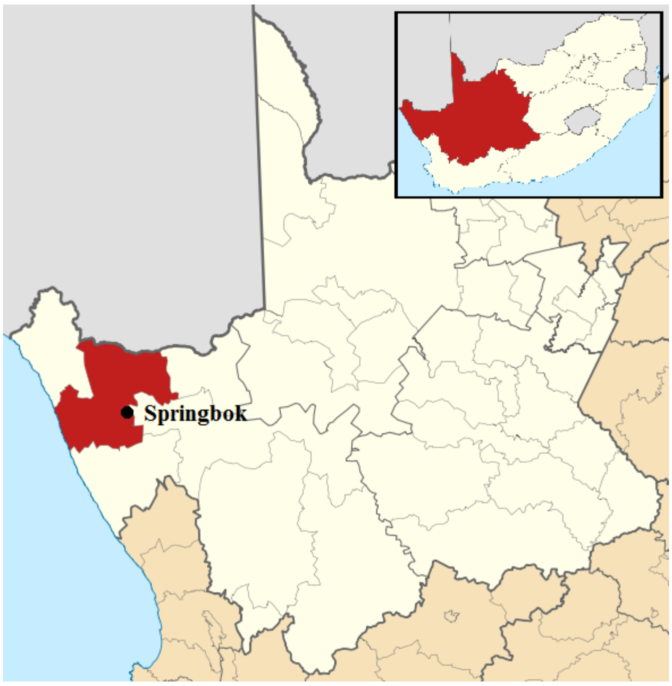

Fig. A.4-1: Location of Springbok in the territory of the Republic of South Africa

Fig. A.4-2: Google Earth map pinpointing the location of the project activity

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

Sectoral Scope 1: Energy industries (renewable/non renewable sources)

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

General characteristic of RSA's grid before the project implementation

The energy system of the RSA is managed by the state-owned company Eskom which is in charge of generation, transmission and distribution of power to end-users. The company's total net maximum capacity as of 31 March 2010 is 40 870 MW, most of which is coal-fired (34 658 MW).

The basic scheme of the Eskom electricity network (the national grid of the RSA) is presented in Annex 3-1.

Data on Eskom's grid-connected power plants as of 31 March 2010 is presented in Annex 3-2.

The project activity characteristic

The project envisages the construction and operation of a wind farm with the installed capacity of 55.5 MW. The wind farm will comprise - 37 wind turbines of UP77/1500 and UP82/1500 types manufactured by a Chinese company United Power with the power capacity of 1.5 MW each as well as the following associated infrastructure:

- Underground electrical distribution cabling between the turbines;
- An on-site substation with an associated transformer;
- New overhead power lines to connect to the Eskom electricity network;
- Small office and/or workshop for maintenance purposes.

The main technical parameters of wind turbines of UP77/1500 and UP82/1500 types are presented in Table A.4-1.

Table A.4-1: The main technical parameters of the employed wind turbines

Parameter	Unit	Value	
		UP77/1500	UP82/1500
Rated power	kW	1,500	
Rotor diameter	m	77.36	82.76
Cut-in wind speed	m/s	3	
Rated wind speed	m/s	11.1	10.8
Cut-out wind speed	m/s	25 (Mean value in 10 minutes) 35 (Mean value in 3 seconds)	
Re-cut in wind speed	m/s	20	
Design life	years	20	

A wind turbine captures the kinetic energy of the wind to drive a generator located within the wind turbine where this energy is subsequently converted into electricity. The amount of energy the turbine can harness is dependent on the wind velocity and the length of the rotor blades. Wind turbines start generating power at wind speeds of between 10÷15 km/hour (3÷4 m/s). Speeds between 45÷60 km/hour

(12÷16 m/s) are required for full power operation. In a situation where wind speeds are excessive, the turbine automatically shuts down to prevent damage.

The wind turbines will generate electricity at a voltage of 22 kV which will be stepped up with a transformer to 66 kV and then delivered to the Nama Substation situated 5 kilometres from the project site in order to supply electricity to RSA's grid (Fig. A.4-3).

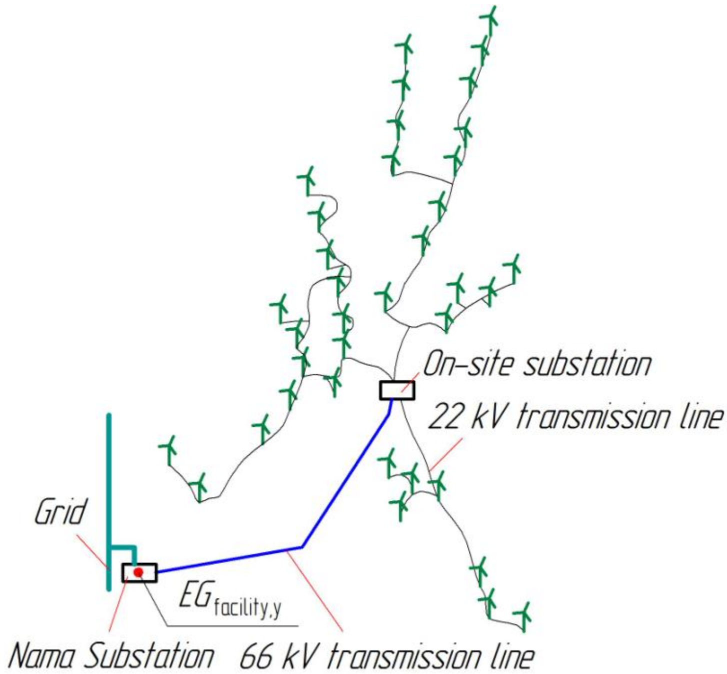

Fig. A.4-3: Basic diagram of the wind farm transmission network

The project implementation schedule is presented in Table A.4-1.

Table A.4-1: The schedule of the project implementation

Number	Action	Date
1	Completion of Environmental Impact Assessment	December 2010
2	Completion of Feasibility Study	March 2011
3	Start of construction and installation works	June 2012
4	Completion of construction and installation works	May 2012
5	Commissioning of the wind farm	1 June 2013

The load factor of the wind farm is expected to be 0.268[2]. The estimated amount of electricity annually supplied by the wind farm to the Eskom electricity network is equal to 130 296.24 MWh[3].

Quantity of net electricity generation supplied by the wind farm to the grid will be determined on the basis of electricity meters located in the Nama substation. The metering instruments will be installed in

[2] According to the feasibility study report, March 2011

[3] 130 296.24 MWh = 55.5 MW * 0.268 * 8760 h

accordance with the requirements of Grid and the Distribution Metering Codes at the points of supply which define the commercial boundary between Eskom and the wind farm owner.

The baseline scenario characteristic

The baseline scenario assumes that electricity delivered to the grid by the wind farm would have otherwise been generated by the operation of grid-connected Eskom's power plants and by the addition of new generation sources.

The combined margin CO_2 emission factor of RSA's grid calculated using the "Tool to calculate the emission factor for an electricity system" is equal to 0.988 tCO_2/MWh.

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

The 10-years crediting period was selected for the project.

Years	Annual estimation of emission reductions in tonnes of CO_2 e
2013 (from the 1st of June to 31st of December)	75 094
2014	128 733
2015	128 733
2016	128 733
2017	128 733
2018	128 733
2019	128 733
2020	128 733
2021	128 733
2022	128 733
2023 (from the 1st of January to the 31st of May)	53 639
Total estimated reductions (tonnes of CO_2 e)	1 287 330
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	128 733

A.4.5. Public funding of the project activity:

No public funding will be applied to the project.

SECTION B. Application of a baseline and monitoring methodology

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

Approved consolidated baseline and monitoring methodology ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (Version 12.1.0)[4] is applicable to the project activity.

The methodology ACM0002 is applicable to grid-connected renewable power generation project activities that install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity.

"Tool to calculate the emission factor for an electricity system" (Version 02.2.0)[5] is used to calculate the combined margin CO_2 emission factor of RSA's grid.

"Tool for the demonstration and assessment of additionality" (Version 05.2.1)[6] is used to demonstrate and assess the additionality of the proposed project activity.

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

The ACM0002 methodology (Version 12.1.0) is applicable to grid-connected renewable power generation project activities that:

(a) Install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant);

(b) Involve a capacity addition;

(c) Involve a retrofit of (an) existing plant(s); or

(d) Involve a replacement of (an) existing plant(s).

The proposed project activity envisages the construction and operation of the wind farm at the site where no renewable power plant has been previously operated and therefore the project activity falls under item (a).

The project activity meets all necessary applicability conditions of the ACM0002 methodology to apply (see Table B.2-1).

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[4] http://cdm.unfccc.int/methodologies/DB/C505BVV9P8VSNNV3LTK1BP3OR24Y5L

[5] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.2.0.pdf

[6] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.1.pdf

Table B.2-1: Applicability conditions check

Applicability condition	Applicability	Comment
The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit.	Applicable	The project activity is the installation of a wind farm.
In the case of capacity additions, retrofits or replacements (except for wind, solar, wave or tidal power capacity addition projects which use Option 2 on page 10 to calculate the parameter $EG_{PJ,y}$): the existing plant started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.	Not applicable	The project activity is the installation of a greenfield plant, so it does not need to satisfy this applicability condition.
In case of hydro power plants, one of the following conditions must apply: • The project activity is implemented in an existing reservoir, with no change in the volume of reservoir; or • The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m^2; or • The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m^2.	Not applicable	The project activity is not the installation of a hydro power plant, so it does not need to satisfy this applicability condition.

Applicability condition	Applicability	Comment
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.	Not applicable	The project activity does not involve switching from fossil fuels to renewable energy sources. The project activity envisages the installation of a greenfield plant at the site where no fossil fuels have been previously used. According to the ACM0002, the project activity must not satisfy this applicability condition.
Biomass fired power plants.	Not applicable	The project activity is not the installation of a biomass fired power plant. According to the ACM0002, the project activity must not satisfy this applicability condition.
Hydro power plants that result in new reservoirs or in the increase in existing reservoirs where the power density of the power plant is less than 4 W/m^2.	Not applicable	The project activity is not the installation of a hydro power plant. According to the ACM0002, the project activity must not satisfy this applicability condition.

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

The spatial extent of the project boundary includes the proposed wind farm and all power plants physically connected to the grid of the Republic of South Africa (Fig. B.3-1).

The greenhouse gases and emission sources included in or excluded from the project boundary are shown in Table B.3-1.

Table B.3-1: Emissions sources included in or excluded from the project boundary

Source		Gas	Included?	Justification / Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project Activity	GHG emissions from electricity generation in the proposed wind farm	CO_2	No	GHG emissions for a wind power generation project are equal to zero
		CH_4	No	GHG emissions for a wind power generation project are equal to zero
		N_2O	No	GHG emissions for a wind power generation project are equal to zero

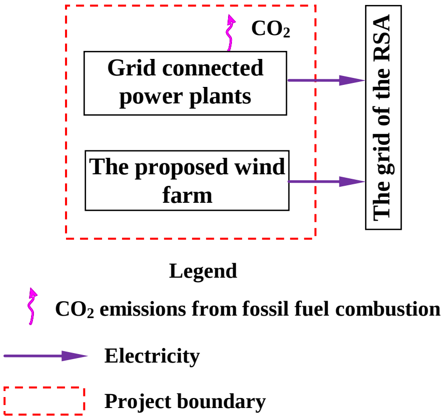

Fig. B.3-1: Project boundary

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

According to the ACM0002 (Version 12.1.0), 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 the "Tool to calculate the emission factor for an electricity system".

The project activity is the installation of a new grid-connected wind farm that connects with and delivers electricity to the grid of the RSA. The baseline scenario of the proposed project is:

- Electricity delivered to the grid by the wind farm would have otherwise been generated by the operation of grid-connected Eskom's power plants and by the addition of new generation sources that is reflected in the CM calculations presented in Section B.6.

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 additionality of the project activity is demonstrated and assessed using the latest version of the "Tool for the demonstration and assessment of additionality" (Version 05.2.1). This tool provides for the following step-wise approach:

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

Step 2: Investment analysis (optional)

Step 3: Barrier analysis (optional)

Step 4: Common practice analysis

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

Realistic and credible alternatives to the proposed project activity shall be provided through the following Sub-steps:

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

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

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

The alternatives available to the project participants or similar project developers that provide outputs or services comparable with the proposed project activity are to include:

(a) The proposed project activity undertaken without being registered as a CDM project activity;

(b) Other realistic and credible alternative scenario(s) to the proposed CDM project activity scenario that deliver outputs services (e.g., cement) or services (e.g. electricity, heat) with comparable quality, properties and application areas, taking into account, where relevant, examples of scenarios identified in the underlying methodology;

(c) If applicable, continuation of the current situation (no project activity or other alternatives undertaken).

Let us further consider these alternatives in the project context.

Alternative 1: The proposed project activity undertaken without being registered as a CDM project activity

This alternative envisages the construction and operation of a grid connected wind farm with the installed capacity of 55.5 MW. Produced electricity is supplied to the Eskom electricity network.

The investment expenditure for a wind power project is very high and return on equity is very low. In addition to that, there are no large wind farms in South Africa so far, only small-scale installations.

Based on these observations the proposed project without being registered as a CDM project activity is not a credible alternative. However, to substantiate this conclusion the alternative is included in the investment analysis below.

Alternative 2: The construction and operation of a grid connected thermal or nuclear power plant

This alternative is not a comparable alternative to a wind power project as the capacity factors of both thermal and nuclear power plants as well as their roles in power system dispatch are different from the wind farm performance.

Unlike fossil fuel generating plants, the capacity factor of the wind farm is limited by the inherent properties of wind. The capacity factor of a thermal power plant is based mostly on fuel cost and plant efficiency. Moreover fossil fuel fired power plant can easily adjust power output depending on a request of a transmission system operator which in turn a wind farm cannot do. Nuclear plants are usually run at full output and achieve a 90% load factor.

No new thermal or nuclear power plant can thus be regarded as a comparable and credible alternative to the proposed project activity. *Alternative 2 is excluded from further consideration.*

Alternative 3: The construction and operation of a grid connected power plants using other sources of renewable energy

This alternative like Alternative 2 is not a comparable alternative to a wind power project as renewable energy power plants cannot guarantee the same service with comparable quality as the proposed project activity.

Hydroelectric and solar power plants can only generate power in the presence of the sufficient amount of renewable resources. A capacity factor of a solar park is limited by the intensity of the solar radiation and a capacity factor of a hydroelectric power plant is dependent on the head and flow rate of inlet water. It means that the solar park as well as the hydroelectric power plant would not be able to provide an output comparable with the proposed project activity.

Construction of a geothermal power plant in order to provide the same service as the proposed project is ruled out due to the lack of geothermal resources in the RSA.

Production of the electricity, generated by the wind farm, in the absence of the proposed project by a biomass-fired power plant is also highly unlikely. Biomass power generation is not a common way to produce electricity in the RSA. It may only be found at pulp and paper mills which have sufficient amount of waste biomass. That electricity is mainly used to meet auxiliary power consumption of the mills.

Thus, Alternative 3 is excluded from further consideration.

Alternative 4: Continuation of the current situation

Electricity delivered to the grid by the wind farm would have otherwise been generated by the operation of grid-connected Eskom’s power plants and by the addition of new generation sources.

This alternative is a business as usual scenario corresponded to the baseline scenario identified in Section B.4.

Outcome of Sub-step 1a: Alternative 1 and Alternative 4 are carried to Sub-step 1b.

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

Both alternatives are in compliance with all applicable mandatory legal and regulatory requirements.

Outcome of Sub-step 1b: Both alternatives are in compliance with mandatory legislation and regulations.

Then the project developer has to proceed to Step 2 (Investment analysis) or Step 3 (Barrier analysis). The project developer proceeds to Step 2 (Investment analysis).

<u>Step 2: Investment analysis</u>

It has to be determined whether the proposed project activity is not:

(a) The most economically or financially attractive; or

(b) Economically or financially feasible without the revenue from the sale of certified emission reductions (CERs).

The project developer demonstrates that the proposed project activity is not economically or financially feasible without the revenue from the sale of CERs using the following Sub-steps:

Sub-step 2a: Determine appropriate analysis method

Sub-step 2b: Apply simple cost analysis (Option I), investment comparison analysis (Option II) or benchmark analysis (Option III)

Sub-step 2c: Calculation and comparison of financial indicators (only applicable to Options II and III)

Sub-step 2d: Sensitivity analysis (only applicable to Option II and III)

Sub-step 2a: Determine appropriate analysis method

It has to be determined whether to apply simple cost analysis (Option I), investment comparison analysis (Option II) or benchmark analysis (Option III).

The proposed project activity generates financial and economic benefits other than CER revenues, so the simple cost analysis (Option I) is not applicable. Following the paragraph 19 of the "Guidelines on the assessment of investment analysis" (Version 05)[7] "*if the alternative to the project activity is the supply of electricity from a grid, this is not to be considered an investment and a benchmark approach is considered appropriate*" the benchmark analysis (Option III) is chosen.

Sub-step 2b: Apply benchmark analysis (Option III)

For the benchmark analysis, the project Internal Rate of Return (project IRR) before tax is used to determine the project financial viability.

Project IRR is calculated based on parameters that are standard in the market as the proposed project could be developed by an entity other than the project participant.

According to the paragraph 13 of the "Guidelines on the assessment of investment analysis" (Version 05) "*in the cases of projects which could be developed by an entity other than the project participant the benchmark should be based on parameters that are standard in the market*".

The lowest rate of interest at which money may be borrowed commercially in the RSA is a prime rate provided by South African Reserve Bank. At present the prime rate in the RSA is 9.0%[8]. This rate can be considered as a conservative benchmark for project IRR post tax. As the project developed calculates project IRR before tax, the benchmark should be adjusted properly: 9.0% *1/(1 - 0.28) = 12.5%.[9]

Thus, 12.5% benchmark for project IRR before tax is assumed for wind power projects in the RSA.

Sub-step 2c: Calculation and comparison of financial indicators

According to the paragraph 7 of Step 2 of the "Tool for the demonstration and assessment of additionality" (Version 05.2.1) the project developer while calculating the suitable financial indicator has to "*include all relevant costs (including, for example, the investment cost, the operations and maintenance costs), and revenues (excluding CER revenues, but possibly including inter alia subsidies/fiscal incentives[10], ODA, etc*".

[7] http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf

[8] www.reservebank.co.za

[9] Income tax in the RSA is 28%, www.sars.gov.za/home.asp?pid=289#Incometa

[10] "*See EB guidance on the consideration of national/local/sectoral policies and measures for the baseline setting*"

At the twenty-second meeting the Executive Board (EB) accepted "Clarifications on the consideration of national and/or sectoral policies and circumstances in baseline scenarios" (Version 02)[11] where EB separates out following two types of national and/or sectoral policies that are to be taken into account when establishing baseline scenarios (paragraph 6):

(a) National and/or sectoral policies or regulations that give comparative advantages to more emissions-intensive technologies or fuels over less emissions-intensive technologies or fuels (so called type E+);

(b) National and/or sectoral policies or regulations that give comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies (e.g. public subsidies to promote the diffusion of renewable energy or to finance energy efficiency programs) (so called type E-).

According to the paragraph 7 of this clarifications "*national and/or sectoral policies or regulations under paragraph 6 (b) that have been implemented since the adoption by the COP of the CDM M&P (decision 17/CP.7, 11 November 2001) need not be taken into account in developing a baseline scenario (i.e. the baseline scenario could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place)*".

In November 2003 South African Department of Minerals and Energy released White Paper on Renewable Energy (White Paper)[12] where it sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in the RSA.

White Paper, page i,*"It is in this context that the Ministry is committed to this policy document which is intended to give much needed thrust to renewable energy; a policy that envisages a range of measures to bring about integration of renewable energies into the mainstream energy economy. To achieve this aim Government is setting as its target 10 000 GWh (0.8 Mtoe) renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro".*

In March 2009 the Energy Regulator of South Africa (NERSA)[13] approved the Renewable Energy Feed - In Tariff (REFIT) to meet the government target of 10 000 GWh by 2013. REFIT for wind farms was 1.25 ZAR/kWh. This value is being reconsidered at the moment.

According to the "Clarifications on the consideration of national and/or sectoral policies and circumstances in baseline scenarios" (Version 02) the policy pursued by NERSA falls under E- policy and need not be taken into account (see paragraph 7 (b) for more details).

Thus, an additional income received due to REFIT compared with an income which will be received in the absence of REFIT needs to be excluded from the calculation of revenues. To calculate project IRR a value of hypothetical feed-in tariff (FIT) which would exist in the absence of REFIT has to be used.

Table B.5-1 shows the input data used to calculate project IRR.

Detailed information on the investment analysis of the project is given in Annex 3-6.

[11] http://cdm.unfccc.int/EB/022/eb22_repan3.pdf

[12] http://unfccc.int/files/meetings/seminar/application/pdf/sem_sup1_south_africa.pdf

[13] http://www.nersa.org.za/

Table B.5-1: Input data to calculate project IRR

Parameter	Unit	Value	Data source
Capacity of the wind farm	MW	55.5	Report "Draft Environmental Impact Report for a proposed wind farm in Springbok", November 2010, page 13, section 2.1
Load factor of the wind farm	ratio	0.268	Feasibility study report, March 2011, page ..., paragraph ...
The operating life of the wind farm	years	20	Wind turbines manufacturer
Electricity tariff*	ZAR/kWh	0.6585	Media statement "NERSA's decision on Eskom's required revenue application – multi-year price determination 2010/11 to 2012/13 (MYPD 2)" 24 February 2010, page 2, paragraph 1[14]
Total investments cost	USD/kW	2 255	Renewable Energy Feed-In Tariff Guidelines (March 2009), page 8, Table 3[15]
Fixed O&M costs	USD/kW/a	24	
Variable O&M costs	USD/kWh	0	
ZAR exchange rate	ZAR/USD	7.03	South African Reserve Bank[16]

*So far there is no FIT for Independent Power Producers in the RSA except REFIT and FIT for projects applying for Medium Term Power Purchase Programme, the programme to support implementation of co-generation projects. Therefore Eskom's standard average electricity price is used as hypothetical FIT which would exist in the absence of REFIT. That is quite conservative as this price reflects transmission costs and transmission losses. Basically hypothetical FIT should be less than Eskom's electricity price.

Project IRR before tax is 5.956%, which is below 12.5% benchmark.

Outcome of Sub-step 2c: The proposed project activity is not economically or financially feasible without the revenue from the sale of CERs.

Sub-step 2d: Sensitivity analysis

A sensitivity analysis is included to show that the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. The investment analysis provides a valid argument in favour of additionality as this sensitivity analysis consistently supports (for a realistic range of assumptions) the conclusion that the project activity is unlikely to be economically or financially attractive.

According to the paragraph 20 of the "Guidelines on the assessment of investment analysis" (Version 05) only variables that constitute more than 20% of either total project costs or total project revenues should

14 www.eskom.co.za/content/MediaStatementMYPD2~1.pdf

15 www.remtproject.org/FileDownload.aspx?FileID=46

16 Average values for the last 5 months of 2010 (August – December), www.resbank.co.za

be included in the sensitivity analysis. In addition the sensitivity analysis should at least cover the range of +10% and -10%. A more robust sensitivity analysis with a range of +20% and -20% was applied.

The following variables were included in the sensitivity analysis:

- Investment cost;
- Operations and maintenance costs;
- Income from electricity sale (which is affected by electricity tariff and quantity of net electricity generation supplied by the wind farm to the grid).

The results of the sensitivity analysis are shown in Table B.5-2.

Table B.5-2: Sensitivity analysis of project IRR

Variable	Variation						
	-20%	-10%	-5%	0%	+5%	+10%	+20%
Investment cost	8.878%	7.290%	6.596%	5.956%	5.364%	4.814%	3.817%
Operations and maintenance costs	6.256%	6.107%	6.032%	5.956%	5.881%	5.805%	5.653%
Income from electricity sale	3.025%	4.537%	5.257%	5.956%	6.638%	7.303%	8.592%

It can be observed that in any of the cases the project IRR is less than the benchmark.

Even with a decrease of 20% in investment cost the project IRR remains significantly lower than the benchmark.

Outcome of Sub-step 2d: The proposed CDM project activity is unlikely to be financially/economically attractive.

Step 3: Barrier analysis

The Barrier analysis is not applied.

Step 4: Common practice analysis

As the proposed project is not first-of-its-kind, the above additionality test shall be complemented with an analysis of the extent to which the proposed project type has already diffused in the relevant sector and region using the following Sub-steps:

Sub-step 4a: Analyze other activities similar to the proposed project activity

Sub-step 4b: Discuss any similar Options that are occurring

Sub-step 4a: Analyze other activities similar to the proposed project activity

According to the paragraph 1 of Step 4 of the "Tool for the demonstration and assessment of additionality" (Version 05.2.1) "*projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc*".

The list of power plants servicing RSA's grid is presented in Annex 3-2. Only one pilot wind farm situated at Klipheuwel in the Western Cape is currently being operated in the RSA. Klipheuwel Wind Farm consists of only three wind turbines with the total power capacity of 3.16 MW. Whereas, the Springbok Wind Farm consists of 37 wind turbines with total power capacity of 55.5 MW.

Thus, the Klipheuwel Wind Farm cannot be considered as a similar project to the Springbok Wind Farm as it has different scale.

Outcome of Sub-step 4a: There are no activities similar to the proposed project activity in the RSA.

Sub-step 4b: Discuss any similar Options that are occurring

As shown in Sub-step 4a there are no activities similar to the proposed project activity in the RSA. This step is not applicable.

Outcome of the additionality test: As similar activities cannot be observed, the proposed project activity undertaken without being registered as a CDM project activity is not a baseline scenario, the proposed project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Project emissions

Since the project activity uses wind energy to generate electricity the project emissions are equal to zero:

$$PE_y = 0 \quad \text{(B.6-1)}$$

Where:

PE_y = Project emissions in year *y* (tCO_2e/yr)

Baseline emissions

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The ACM0002 methodology (Version 12.1.0) assumes that electricity delivered to the grid by the wind farm would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources. The baseline emissions are calculated as follows:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y} \quad \text{(B.6-2)}$$

Where:

BE_y = Baseline emissions in year *y* (tCO_2/yr)

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year *y* (tCO_2/MWh)

Calculation of $EG_{PJ,y}$

Since the project activity is the installation of a new grid-connected renewable power plant at a site where no renewable power plant was operated prior to the implementation of the project activity, $EG_{PJ,y}$ is calculated as follows:

$$EG_{PJ,y} = EG_{\text{facility,y}} \quad \text{(B.6-3)}$$

Where:

$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)
$EG_{\text{facility,y}}$	=	Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh/yr)

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

Combined margin CO_2 emission factor for grid connected power generation in year *y* ($EF_{grid,CM,y}$) is calculated using the "Tool to calculate the emission factor for an electricity system" (Version 02.1.0). According to this tool the following six steps shall be applied:

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.

Step 1: Identify the relevant electricity systems

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 and that can be dispatched without significant transmission constraints.

Electricity generated by the proposed project activity will be supplied to the national grid of the RSA which is defined as a project electricity system by default.

The national grid of the RSA is managed by the state-owned company Eskom which is the only company in the South Africa in charge of generation, transmission and distribution of power to end-users.

The basic scheme of the Eskom electricity network (the national grid of the RSA) is presented in Annex 3-1.

Data on Eskom's grid-connected power plants as of 31 March 2010 is presented in Annex 3-2.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

The project participant may choose between the following two options to calculate the operating margin and build margin emission factors:

Option I: Only grid power plants are included in the calculation; or

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

Option I was chosen to calculate the operating margin and build margin emission factors.

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.

Option (a) (Simple OM method) can 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. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation.

The most recent data on the electricity supplied to the national grid of the RSA is presented in Table B.6-1. Share of electricity supplied from the low-cost/must-run sources in total grid generation on average of the five most recent years constitute 7.03%. Thus, Option (a) (Simple OM method) has been chosen to calculate the operating margin emission factor.

Table B.6-1: Electricity supplied to the national grid of the RSA, GWh[17]

Type of power plant	Years*					Average	Share
	04.2005 – 03.2006	04.2006 – 03.2007	04.2007 – 03.2008	04.2008 – 03.2009	04.2009 – 03.2010		
Coal-fired	206 606	215 211	222 908	211 941	215 940	214 521	92.84%
Hydro-electric	1 141	2 443	751	1 082	1 274	1 338	**0.58%**
Pumped storage	2 867	2 947	2 979	2 772	2 742	2 861	**1.24%**
Gas turbine	78	62	1 153	143	49	297	0.13%
Nuclear	11 293	11 780	11 317	13 004	12 806	12 040	**5.21%**
Wind energy	3	2	1	2	1	2	**0.00%**
Total net generation	221 988	232 445	239 109	228 944	232 812	231 060	100.00%

*A reporting year for Eskom starts on the 1st of April and finishes on the 31st of March.

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

- *Ex ante option*: 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 grid power plants, use a 3-year generation-weighted average;

[17] Eskom Annual Report 2010, page 1, http://www.eskom.co.za/annreport10/downloads/eskom_ar2010.pdf

- *Ex post option*: The emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

Ex ante option was chosen to calculate the OM emission factor.

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_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:

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.

The *Option A* is used as data on the net electricity generation and a CO_2 emission factor of each Eskom's power plant is available. The OM emission factor is calculated as follows:

$$EF_{grid,OM} = EF_{grid,OMsimple} \quad \text{(B.6-4)}$$

Where:

$EF_{grid,OM}$	=	Operating margin CO_2 emission factor calculated ex ante (tCO_2/MWh)
$EF_{grid,OMsimple}$	=	Simple operating margin CO_2 emission factor calculated ex ante (tCO_2/MWh)

The simple operating margin CO_2 emission factor is calculated as follows:

$$EF_{grid,OMsimple} = \frac{\sum_{m,y} EG_{m,y} \cdot EF_{EL,m,y}}{\sum_{m,y} EG_{m,y}} \quad \text{(B.6-5)}$$

Where:

$EF_{grid,OMsimple}$	=	Simple operating margin CO_2 emission factor calculated ex ante (tCO_2/MWh)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh). Data is presented in Annex 3-3
$EF_{EL,m,y}$	=	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. The list of power plants included into the operating margin is presented in Annex 3-3
y	=	The relevant year as per the data vintage chosen in Step 3

Data for the three most recent reporting years on operation of Eskom's power plants included into the operating margin is presented in Annex 3-3.

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

As data on fuel consumption and electricity generation for each coal-fired power unit *m* is available, the emission factor ($EF_{EL,m,y}$) for these units is determined as follows (*Option A1*):

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_{m,y}} \quad \text{(B.6-6)}$$

Where:

$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$FC_{i,m,y}$	=	Amount of fossil fuel type *i* consumed by power unit *m* in year *y* (mass or volume unit). Data is presented in Annex 3-3
$NCV_{i,y}$	=	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit). Constant value was adopted (see Section B.6.2 for details)
$EF_{CO2,i,y}$	=	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ). Constant value was adopted (see Section B.6.2 for details)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh). Data is presented in Annex 3-3
m	=	All power units serving the grid in year *y* except low-cost/must-run power units. The list of power plants included into the operating margin is presented in Annex 3-3
i	=	All fossil fuel types combusted in power unit *m* in year *y*
y	=	The relevant year as per the data vintage chosen in Step 3

As only data on electricity generation for gas turbine power plants is available, *Option A2* is used to determine $EF_{EL,m,y}$ for these plants:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \cdot 3.6}{\eta_{m,y}} \quad \text{(B.6-7)}$$

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). Constant value was adopted (see Section B.6.2 for details)
$\eta_{m,y}$	=	Average net energy conversion efficiency of power unit *m* in year *y* (ratio). Constant value was adopted (see Section B.6.2 for details)
m	=	All power units serving the grid in year *y* except low-cost/must-run power units. Option A2 is only used for gas turbine power plants (see Annex 3-3)
i	=	All fossil fuel types combusted in power unit *m* in year *y*
y	=	The relevant year as per the data vintage chosen in Step 3

The calculation of the operating margin emission factor is presented in Annex 3-5.

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. This option does not require monitoring the emission factor during the crediting period; or

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.

Option 1 was chosen.

The build margin calculation algorithm is presented in Fig. B.6-1. For simplification three levels of analysis were identified for the calculation of the BM:

Level A: Inclusion of power units which started to supply electricity to the grid less than 10 years ago, excluding power units registered as CDM project activities;

Level B: Inclusion of power units which started to supply electricity to the grid less than 10 years ago and power units registered as CDM project activities; and

Level C: Inclusion of power units which started to supply electricity to the grid more than 10 years ago and power units registered as CDM project activities.

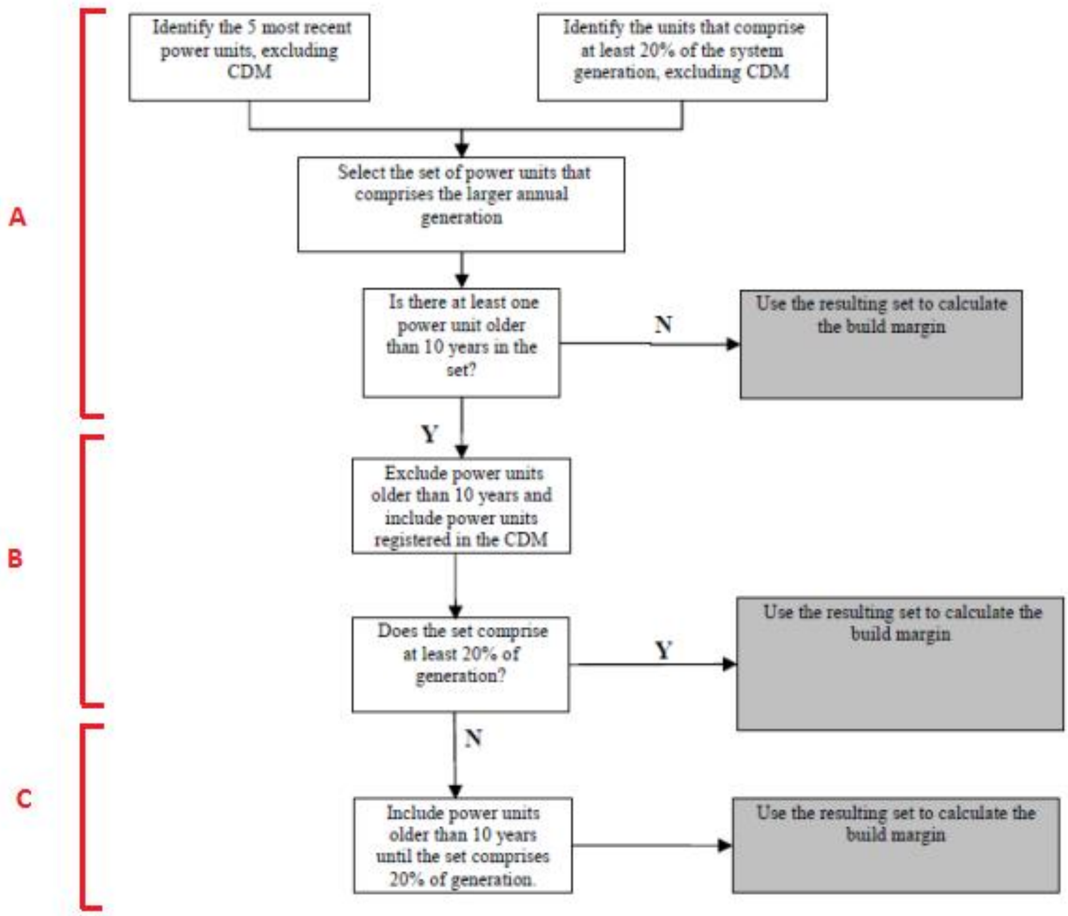

Fig. B.6-1: Build margin calculation algorithm

The following procedures were applied to determine the sample group of power units *n* used to calculate the build margin:

(a) Identify the set of five power units, excluding power units registered as 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 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 ($AEG_{SET\text{-}\geq 20\%}$, 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. Ignore steps (d), (e) and (f);

The sets of power units $SET_{5\text{-}units}$ and $SET_{\geq 20\%}$ were identified (see Annex 3-4). The set of power units $SET_{\geq 20\%}$ that comprises the larger annual electricity generation was chosen as SET_{sample}. As SET_{sample} includes power units which started to supply electricity to the grid more than 10 years ago, the conditions for *Level A* have therefore not been satisfied and the project developer move to step (d).

(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 activity, 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 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);

The annual electricity generation of $SET_{sample\text{-}CDM}$ is comprises less than 20% of the annual electricity generation of the national grid of the RSA (see Annex 3-4). The conditions for *Level B* have not been satisfied. Therefore continue to step (e) and (f).

(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 *n* used to calculate the build margin is the resulting set ($SET_{sample\text{-}CDM\text{-}>10yrs}$).

The power units in $SET_{sample\text{-}CDM\text{ }\text{-}>10yrs}$ was used to calculate the build margin. The list of power plants included into the build margin is presented in Annex 3-4.

The build margin emission factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *n* included into the build margin during the most recent year *y* (2010 reporting year) for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_n EG_{n,y} \cdot EF_{EL,n,y}}{\sum_n EG_{n,y}} \quad \text{(B.6-8)}$$

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year y (2010 reporting year) (tCO_2/MWh)
$EG_{n,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit *n* in year *y* (MWh). Data is presented in Annex 3-4
$EF_{EL,n,y}$	=	CO_2 emission factor of power unit *n* in year *y* (tCO_2/MWh)
n	=	Power units included in the build margin. The list of power plants included into the build margin is presented in Annex 3-4
y	=	Most recent historical year for which power generation data is available. The 2010 reporting year was selected

The CO_2 emission factor of power unit *n* in year *y* ($EF_{EL,n,y}$) is calculated using Formulas (B.6-6) and (B.6-7).

According to the "Tool to calculate the emission factor for an electricity system" (Version 02.2.0) if the power units included in the build margin *n* correspond to the sample group $SET_{sample\text{-}CDM\text{->}10yrs,}$ then, as a conservative approach, only *Option A2* from *Step 4* can be used to calculate $EF_{EL,n,y}$ and the default values provided in Annex 1 of the Tool shall be used to determine the parameter $\eta_{m,y}$. Therefore Formula (B.6-7) was used to calculate $EF_{EL,n,y}$ for Majuba and Kendal power plants.

The calculation of the build margin CO_2 emission factor is presented in Annex 3-5.

<u>Step 6: Calculate the combined margin (CM) emissions factor</u>

The combined margin emission factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,CM} = EF_{grid,OM} \cdot w_{OM} + EF_{grid,BM,y} \cdot w_{BM} \quad \text{(B.6-9)}$$

Where:

$EF_{grid,CM,y}$	=	Combined margin CO_2 emission factor for grid connected power generation in year *y* (tCO_2/MWh)
$EF_{grid,CM}$	=	Combined margin CO_2 emission factor for grid connected power generation calculated ex ante (tCO_2/MWh)
$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in the most recent year *y* (2010 reporting year) (tCO_2/MWh)
$EF_{grid,OM}$	=	Operating margin CO_2 emission factor (tCO_2/MWh)
w_{OM}	=	Weighting of operating margin emission factor
w_{BM}	=	Weighting of build margin emission factor

According to the “Tool to calculate the emission factor for an electricity system” (Version 02.2.0) the following default values should be used for wind power generation project activities: w_{OM} = 0.75 and w_{BM} = 0.25.

The calculation of the combined margin CO_2 emission factor is presented in Annex 3-5.

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:

$$ER_y = BE_y - PE_y \qquad \text{(B.6-10)}$$

Where:

ER_y = Emission reductions in year *y* (tCO_2e/yr)

BE_y = Baseline emissions in year *y* (tCO_2/yr)

PE_y = Project emissions in year *y* (tCO_2e/yr)

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

Data / Parameter:	$EG_{m,y}$
Data unit:	MWh
Description:	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y*
Source of data used:	Eskom’s statistic data
Value applied:	See Annex 3-3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official statistics, publicly available and reliable data source
Any comment:	The data for the three most recent reporting years is provided.

Data / Parameter:	$FC_{i,m,y}$
Data unit:	mass or volume unit
Description:	Amount of fossil fuel type *i* consumed by power unit *m* in year *y*
Source of data used:	Eskom’s statistic data
Value applied:	See Annex 3-3
Justification of the choice of data or	Official statistics, publicly available and reliable data source

description of measurement methods and procedures actually applied :	
Any comment:	The data for the three most recent reporting years is provided.

Data / Parameter:	$NCV_{coal,y}$
Data unit:	GJ/t
Description:	Net calorific value of Other Bituminous Coal
Source of data used:	2006 IPCC Guidelines for National GHG Inventories, Volume 2: Energy, Chapter 1, Table 1.2
Value applied:	19.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	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.
Any comment:	This value was appointed as a constant.

Data / Parameter:	$EF_{CO2,coal,y}$
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of Other Bituminous Coal
Source of data used:	2006 IPCC Guidelines for National GHG Inventories, Volume 2: Energy, Chapter 1, Table 1.4
Value applied:	0.0895
Justification of the choice of data or description of measurement methods and procedures actually applied :	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.
Any comment:	This value was appointed as a constant.

Data / Parameter:	$EF_{CO2,NG,y}$
Data unit:	tCO2/GJ
Description:	CO2 emission factor of Natural Gas
Source of data used:	2006 IPCC Guidelines for National GHG Inventories, Volume 2: Energy, Chapter 1, Table 1.4
Value applied:	0.0543
Justification of the choice of data or description of measurement methods and procedures	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.

actually applied :	
Any comment:	This value was appointed as a constant.

Data / Parameter:	η_{OCGT}
Data unit:	ratio
Description:	Average net energy conversion efficiency of open cycle gas turbine power plant
Source of data used:	Tool to calculate the emission factor for an electricity system, Annex 1
Value applied:	0.395
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value is used
Any comment:	This value was appointed as a constant.

Data / Parameter:	$\eta_{m,y}$
Data unit:	ratio
Description:	Average net energy conversion efficiency of coal-fired power plant that has operated for more than 10 years
Source of data used:	Tool to calculate the emission factor for an electricity system, Annex 1
Value applied:	0.37
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value is used
Any comment:	This value was appointed as a constant to Majuba and Kendal power plants for the calculation of build margin CO_2 emission factor (refer to Annex 3-5).

Data / Parameter:	$EG_{n,y}$
Data unit:	MWh
Description:	Net quantity of electricity generated and delivered to the grid by power unit *n* in year *y*
Source of data used:	Eskom’s statistic data
Value applied:	See Annex 3-4
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official statistics, publicly available and reliable data source
Any comment:	The data for 2010 reporting year is provided.

Data / Parameter:	$FC_{i,n,y}$
Data unit:	mass or volume unit
Description:	Amount of fossil fuel type *i* consumed by power unit *n* in year *y*
Source of data used:	Eskom's statistic data
Value applied:	See Annex 3-4
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official statistics, publicly available and reliable data source
Any comment:	The data for 2010 reporting year is provided.

Data / Parameter:	$EF_{grid,CM}$
Data unit:	tCO_2e/MWh
Description:	Combined margin CO_2 emission factor for grid connected power generation calculated ex ante
Source of data used:	Calculated (see Annex 3)
Value applied:	0.988
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated ex ante based on the "Tool to calculate the emission factor for an electricity system" (version 02.2.0)
Any comment:	This value was appointed as a constant for the whole crediting period.

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

According to Formulas (B.6-1), (B.6-2), (B.6-3), (B.6-9) and (B.6-10) annual emission reductions can be calculated as follow:

$$ER_y = EG_{\text{facility,y}} \cdot EF_{grid,CM} \quad \text{(B.6-11)}$$

Where:

ER_y	=	Emission reductions in year *y* (tCO_2e/yr)
$EG_{\text{facility,y}}$	=	Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh/yr)
$EF_{grid,CM,y}$	=	Combined margin CO_2 emission factor for grid connected power generation calculated ex ante (tCO_2/MWh)

The calculation of the combined margin CO_2 emission factor is presented in Annex 3-5. A constant emission factor of $EF_{grid,CM}$ = 0.988 tCO_2/MWh was adopted for the whole crediting period.

The estimated amount of electricity annually supplied by the wind farm to the Eskom electricity network during the 10-year crediting period is presented in Table B.6-2.

Summary of the ex-ante estimation of emission reductions is presented in Section B.6.4 below.

Table B.6-2: Quantity of net electricity generation annually supplied by the wind farm to the grid ($EG_{facility,y}$) during the 10-year crediting period, MWh

Year	$EG_{facility,y}$
From the 1st of June 2013 to the 31st of December 2013	76 006.14
2014	130 296.24
2015	130 296.24
2016	130 296.24
2017	130 296.24
2018	130 296.24
2019	130 296.24
2020	130 296.24
2021	130 296.24
2022	130 296.24
From the 1st of January 2023 to the 31st of May 2023	54 290.10

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

Year	Estimation of project activity emissions (tonnes of CO_2 e)	Estimation of baseline emissions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of overall emission reductions (tonnes of CO_2 e)
1 June 2013 - December 2013	0	75 094	0	75 094
2014	0	128 733	0	128 733
2015	0	128 733	0	128 733
2016	0	128 733	0	128 733
2017	0	128 733	0	128 733
2018	0	128 733	0	128 733
2019	0	128 733	0	128 733
2020	0	128 733	0	128 733
2021	0	128 733	0	128 733
2022	0	128 733	0	128 733
1 January 2023 - 31 May 2023	0	53 639	0	53 639
Total (tonnes of CO_2 e)	0	1 287 330	0	1 287 330

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$EG_{facility,y}$
Data unit:	MWh/yr
Description:	Quantity of net electricity generation supplied by the wind farm to the grid in year *y*
Source of data to be used:	On-site measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	See table below
Description of measurement methods and procedures to be applied:	Measurement by means of electricity meters installed at the points of supply which define the commercial boundary between Eskom and the wind farm owner. Data on electricity supply shall be regularly transferred to the Chief Engineer's computer and archived.
QA/QC procedures to be applied:	Electricity meters are regularly calibrated; readings are cross-checked with records for sold electricity.
Any comment:	See Section B.7.2 for details.

Year	Value
From the 1st of June 2013 to the 31st of December 2013	76 006.14
2014	130 296.24
2015	130 296.24
2016	130 296.24
2017	130 296.24
2018	130 296.24
2019	130 296.24
2020	130 296.24
2021	130 296.24
2022	130 296.24
From the 1st of January 2023 to the 31st of May 2023	54 290.10

B.7.2. Description of the monitoring plan:

The monitoring plan is devised as per approved consolidated baseline and monitoring methodology ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (Version 12.1.0). The following procedures shall be applied:

1. Monitoring period

The 10-year crediting period was chosen for the project. The monitoring period starts since the wind farm is commissioned or the proposed project is registered by CDM Executive Board (whichever is later). At the end of each reporting year, monitored data shall be aggregated to a monitoring report.

2. Data monitored and sources

Quantity of net electricity generation supplied by the wind farm to the grid shall be determined on the basis of electricity meters located in the Nama substation. The metering instruments shall be installed in accordance with the requirements of Grid and the Distribution Metering Codes at the points of supply which define the commercial boundary between Eskom and the wind farm owner. Readings of the electricity meters shall be cross-checked with records for sold electricity. Data on electricity supply shall be regularly transferred to the Chief Engineer’s computer and archived.

The sources of data for calculation of GHG emission reductions in the course of monitoring shall be the internal reports of the wind farm.

The emission reductions shall be calculated using the Formula (B.6-11).

3. The monitoring team

The power plant staff shall undergo necessary training related to operation and maintenance of the wind farm and all of the equipment installed. The training shall take place at the manufacturer's facility and on site at the power plant.

The maintenance personnel of the wind farm are responsible for daily control over the monitoring plan implementation.

The Chief Engineer of the wind farm is responsible for timely calibration of all instrumentation in accordance with the manufacturer’s requirements.

The management of Longyuan Mulilo (Pty) Ltd is fully responsible for the project implementation and overall control. The management of Individual Special Purpose Vehicle (SPV) which will be specially established to run the wind farm is fully responsible for collection of all data required for calculation of GHG emission reductions.

The GHG emission reductions shall be calculated by specialists of Blue World Carbon Asset Management (Pty) Ltd on the basis of data received from SPV.

In case of any doubts as to the accuracy of the input data, the specialists of Longyuan Mulilo (Pty) Ltd shall check and correct the data. The preliminary version of the monitoring report shall be submitted to the specialists of Longyuan Mulilo (Pty) Ltd and SPV for review. In case any mistakes are found in the calculations of GHG emission reductions, the specialists of Blue World Carbon Asset Management (Pty) Ltd shall correct these calculations accordingly.

Regularly, at least once a year, specialists of Blue World Carbon Asset Management (Pty) Ltd shall carry out “test verification” with a view to checking out the observance of the monitoring plan at SPV.

4. Data storage

All data collected as part of monitoring should be archived electronically and kept at least for 2 years after the end of the crediting period.

5. Instrumentation calibration

The instrumentation calibration and check-out shall be carried out by contracted specialized organizations licensed for this type of activity according to the requirement of a manufacturing company and to the schedule developed by SPV.

6. Emergency situations

If any instrument that is used in the monitoring process fails, SPV shall remedy the situation as soon as possible and if necessary shall replace the instrument. In case of breakdown of any of the wind turbines electricity generation will go down, and amount of electricity supplied by the wind farm to the grid will be reduced. All accidents that may occur at the wind farm shall be recorded by SPV. Information on major accidents shall be included in the monitoring report.

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: 22/08/2011

Baseline was developed by Blue World Carbon Asset Management (Pty) (Blue World Carbon Asset Management (Pty) is not the project participant listed in Annex 1 of the PDD).

Contact persons: Ilya Goryashin (i.goryashin@ccgs.ru), Aleksandra Kapustina (a.kapustina@ccgs.ru)

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:

According to the "Glossary of CDM terms" (Version 05)[18] the starting date of a CDM project activity is the earliest date at which either the implementation or construction or real action of a project activity begins.

No implementation or construction or real action of the proposed project activity has begun so far. The expected starting date of the proposed project activity is the 1st of June 2012 (start of construction).

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

20 years/240 months

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

C.2.1. Renewable crediting period:

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

Not applicable

C.2.1.2. Length of the first crediting period:

Not applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/06/2013 or the date of registration of the CDM project activity, whichever is later

C.2.2.2. Length:

10 years/120 months

[18] http://cdm.unfccc.int/Reference/Guidclarif/glos_CDM.pdf

SECTION D. Environmental impacts

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

The Environmental Impact Assessment (EIA) of the proposed project was carried out in accordance with the South African legislation by DJ Environmental Consultants. Draft Environmental Impact Report (EIR) was published for public review and comment for a period of 40 days in November 2010. EIR was submitted to the Department of Environmental Affairs for a decision in December 2010 and finally approved on the 29th of July 2011.

The proposed project activity has no significant impact on the environment, as the wind power is one of the cleanest sources of renewable energy, with no associated emissions and waste products. Possible negative impacts are discussed in the ensuing paragraphs.

Impact on biodiversity and ecosystems

Reptiles may be forced out of their underground shelters during the construction phase. Birds and bats may be impacted through collision with the blades of the wind turbines as well as collision with the associated power line during the operational phase.

Noise impact

The noise from construction machines has some impact on the surrounding area during the construction phase, which will only have a localized effect and is not expected to increase the ambient noise levels in nearest towns, except for the south-eastern part of Okiep which is situated within 1 km of the wind farm site. This impact, however, will only last during the erection of the nearby turbines.

During the operation phase the cumulative contribution of the wind turbines and the transformer substation on the noise environment at the communities around the site will be within acceptable levels. The only exception is the south-eastern part of the Okiep area, where the noise impact will be higher.

Impact on natural resources

The impact on the natural resources is the loss of arable land due to the construction of the turbines and associated infrastructure. However, most of the current cultivation or grazing practices will still be possible between the structures.

Impact on the atmosphere

The main impact is related to formation of dust during the construction period from land excavation and transportation vehicles. It should be mentioned that combustion of fossil fuels (mostly coal) at the Eskom power stations and hereby emissions of the harmful substances into the atmosphere, such as flue ash, oxides of sulphur and nitrogen will be reduced due to the project implementation.

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:

Environmental impacts of the proposed project activity are not considered significant.

SECTION E. Stakeholders' comments

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

The project owner appointed DJ Environmental Consultants to undertake the Scoping and Environmental Impact Assessment and associated Public Participation Process (PPP) in terms of the NEMA EIA Regulations and CDM requirement based on the Kyoto protocol.

The activities undertaken to canvass public opinion regarding the proposed project activity are summarised in Table E.1-1.

An advertisement announcing the Environmental Impact Assessment Process and inviting Interested and Affected Parties (I&APs) to register on the project database was placed in Die Plattelander and Die Volksblad on 27 November 2009.

All I&APs who registered were sent a copy of the Background Information Document.

Two notices were placed on site (Afrikaans and English) advertising the proposed development and inviting I&APs to register on the project database.

The Scoping Report was placed for public review and comment at the Springbok Public Library and O'Nabapeep Farm. E-mails (preferred means of communication) were also sent to all registered I&APs informing them of the release of the Scoping Report for public review and comment.

The Environmental Impact Report was released in the public domain for review and comment in November 2010. Announcement on the release of the report for review and comment were placed in the local newspaper. Copies of the Environmental Impact Assessment (EIA) Report were placed at the Springbok Public Library and at O'Nabapeep Farm. The EIA Report was available for public review and comment for 40 days from 2 November 2010 until 13 December 2010.

In addition letters were also sent out to all registered I&AP, notifying them on the availability of the EIA Report for review and comment.

I&APs were afforded an opportunity to raise their issues and concerns regarding the proposed development during the consultation process. All comment and response was compiled.

Table E.1-1: Summary of activities undertaken and proposed during public consultation

Activity	Date
Phase 1: Project initiation	
Submission of Application to Department of Environmental Affairs (DEA)	Application submitted to DEA on: 28 October 2009
DEA Acknowledgement of Application	24 November 2009
Identification of I&APs	October 2009
Advertisement of the process	The application was advertised in Die Plattelander and Die Volksblad on 27 November 2009
Placement of posters on site	Posters indicating the proposed project were placed on the site on 02 October 2009

Activity	Date
Phase 2: Initial public consultation process	
Circulation of Background Information Document to I&APs	From 9 February 2010
End of comment period on BID and registration for I&AP	10 March 2010
Draft Scoping Report was made available for comment on 1 June 2010 and circulated to registered I&APs. The DSR was made available in the Springbok Public Library and on O'Nababeep farm, from 1 June to 12 July 2010	1 June to 12 July 2010
End of official comment period on Draft Scoping Report	12 July 2010
Final Scoping Report submitted to DEA comment	14 July 2010
Phase 4: EIA	
DEA reviewed Scoping Report and Plan of Study for EIA and issued a letter of acceptance and to proceed with the EIA phase	25 August 2010
Appointment of Specialists to undertake studies according to the approved terms of reference	October 2009
EIA Report drafted and released in public domain for review and comment	2 November 2010
Collation of comments and submission of EIA Report and draft EMP to DEA	December 2010

E.2. Summary of the comments received:

The following comments were received:

- The proposed site for Wind Power Generation as per the Scoping Report does not have any agricultural value and for many years has not been - utilized for any agricultural purposes
- The area is mostly covered by Galenia Africana (Kraalbos), an unpalatable plant and harmful to domestic animals
- Irrigation on this dry and arid area is excluded due to the unavailability of water
- The site is ideally situated as it is near a Eskom Sub-supplier which will ease integration with the national power grid
- The Department of Agriculture, Land Reform and Rural Development is supporting clean power generation

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

No negative comments were raised by the stakeholders. In fact the stakeholders appreciated the initiative of Longyuan Mulilo (Pty) Ltd towards clean power generation and strengthening of local grid.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Annex 3

BASELINE INFORMATION

Annex 3-1. The national grid of the RSA (Eskom electricity network)[19]

[19] http://www.eskom.co.za/content/2008EskomPoster.jpg

Annex 3-2. Data on Eskom's grid-connected power plants (at the 31st of March 2010)[20,21]

Name of power plant	Location	Type of power plant (PP)	Type of fuel	Date of commissioning/ (Re-commissioning)*	Total net maximum capacity, MW
Arnot	Middelburg, Mpumalanga	Thermal PP	Coal	1971.09.21	2 232
Camden[22]	Ermelo, Mpumalanga	Thermal PP	Coal	(2005.03.31)	1 440
Duvha	Witbank, Mpumalanga	Thermal PP	Coal	1980.01.18	3 450
Grootvlei[23]	Balfour, Mpumalanga	Thermal PP	Coal	(2008.03.31)	760
Hendrina	Mpumalanga	Thermal PP	Coal	1970.05.12	1 865
Kendal	Witbank, Mpumalanga	Thermal PP	Coal	1988.10.01	3 840
Komati[24]	Middelburg, Mpumalanga	Thermal PP	Coal	(2009.01.05)	170
Kriel	Bethal, Mpumalanga	Thermal PP	Coal	1976.05.06	2 850
Lethabo	Viljoensdrift, Free State	Thermal PP	Coal	1985.12.22	3 558
Majuba	Volksrust, Mpumalanga	Thermal PP	Coal	1996.04.01	3 843
Matimba	Lephalale, Limpopo	Thermal PP	Coal	1987.12.04	3 690
Matla	Bethal, Mpumalanga	Thermal PP	Coal	1979.09.29	3 450

[20]Eskom Annual Report 2010, page 298, http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf

[21]Data Requirements for Calculating the Carbon Emission Factor (CEF) for the South African Grid, General Information, http://www.eskom.co.za/content/calculationTable.htm

[22] Re-commissioned power plant, Eskom Annual Report 2009, page 63 http://www.financialresults.co.za/eskom_ar2009/ar_2009/downloads.htm

[23] Re-commissioned power plant, Eskom Annual Report 2010, page 126, http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf

[24] Re-commissioned power plant, Eskom Annual Report 2010, page 127, http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf

Name of power plant	Location	Type of power plant (PP)	Type of fuel	Date of commissioning/ (Re-commissioning)*	Total net maximum capacity, MW
Tutuka	Standerton, Mpumalanga	Thermal PP	Coal	1985.06.01	3 510
Acacia	Cape Town, Western Cape	Gas turbine PP	Kerosene	1976.05.13	171
Port Rex	East London, Eastern Cape	Gas turbine PP	Kerosene	1976.09.30	171
Ankerlig	Atlantis, Western Cape	Gas turbine PP	Natural gas	2007.03.29	1 327
Gourikwa	Mossel Bay, Western Cape	Gas turbine PP	Natural gas	2007.03.30	740
Colley Wobbles	Mbashe River, Eastern Cape	Hydro PP	-	1900.01.01	0
Ncora	Ncora River, Eastern Cape	Hydro PP	-	1900.03.01	0
First Falls	Umtata River, Eastern Cape	Hydro PP	-	1900.02.01	0
Gariep	Norvalspont, Free State	Hydro PP	-	1971.09.08	360
Second Falls	Umtata River, Eastern Cape	Hydro PP	-	1900.04.01	0
Vanderkloof	Petrusville, Northern Cape	Hydro PP	-	1977.01.01	240
Drakensberg	Bergville Kwazulu-Natal	Hydroelectric Pumped Storage PP	-	1981.06.17	1 000
Palmiet	Grabouw, Western Cape	Hydroelectric Pumped Storage PP	-	1988.04.18	400
Koeberg	Cape Town, Western Cape	Nuclear PP	-	1984.07.21	1 800
Klipheuwel	Klipheuwel, Western Cape	Wind farm	-	**	3

* Re-commissioned units are: Camden, Grootvlei and Komati.

**No data available

Annex 3-3. Data on operation of Eskom's grid-connected power plants included into the operating margin for the 3 most recent reporting years

The list of power plants included into the operating margin[25]

Name of power plant	Type of power plant (PP)	Type of fuel	Total net maximum capacity, MW
Arnot	Thermal PP	Coal	2 232
Camden	Thermal PP	Coal	1 440
Duvha	Thermal PP	Coal	3 450
Grootvlei	Thermal PP	Coal	760
Hendrina	Thermal PP	Coal	1 865
Kendal	Thermal PP	Coal	3 840
Komati	Thermal PP	Coal	170
Kriel	Thermal PP	Coal	2 850
Lethabo	Thermal PP	Coal	3 558
Majuba	Thermal PP	Coal	3 843
Matimba	Thermal PP	Coal	3 690
Matla	Thermal PP	Coal	3 450
Tutuka	Thermal PP	Coal	3 510
Ankerlig	Gas turbine PP	Natural gas	1 327
Gourikwa	Gas turbine PP	Natural gas	740

[25]Kerosene-fired gas turbine power plants were excluded from the operating margin since they were not operated for the 3 most recent reporting years.

Net quantity of electricity generated and delivered to the grid by the power plants included into the operating margin ($EG_{m,y}$)[26]

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				
			Total net electricity generation:			651 882 496

*A reporting year for Eskom starts on the 1st of April and finishes on the 31st of March

**Data was taken from Table B.6-1.

[26]Data Requirements for Calculating the Carbon Emission Factor (CEF) for the South African Grid, General Information, http://www.eskom.co.za/content/calculationTable.htm

Amount of fossil fuel consumed by the power plants included into the operating margin ($FC_{i,m,y}$)[27]

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	tonnes	6 210 700	6 395 805	6 794 134	19 400 639
Camden	Coal	tonnes	3 218 873	3 876 211	4 732 163	11 827 247
Duvha	Coal	tonnes	12 425 531	11 393 553	11 744 606	35 563 690
Grootvlei	Coal	tonnes	130 748	674 538	1 637 371	2 442 657
Hendrina	Coal	tonnes	7 794 220	7 122 918	6 905 917	21 823 055
Kendal	Coal	tonnes	15 986 131	15 356 595	13 866 514	45 209 240
Komati	Coal	tonnes	0	0	664 497	664 497
Kriel	Coal	tonnes	9 059 934	9 420 764	8 504 715	26 985 413
Lethabo	Coal	tonnes	18 314 572	16 715 323	18 170 227	53 200 122
Majuba	Coal	tonnes	12 853 342	12 554 406	12 261 833	37 669 581
Matimba	Coal	tonnes	14 862 323	13 991 453	14 637 481	43 491 257
Matla	Coal	tonnes	13 795 309	12 689 387	12 438 391	38 923 087
Tutuka	Coal	tonnes	10 627 575	11 231 583	10 602 839	32 461 997
Ankerlig	Natural gas	thousand m^3	N/A**	N/A	N/A	N/A
Gourikwa	Natural gas	thousand m^3	N/A	N/A	N/A	N/A
					Total coal consumption:	369 662 482

*A reporting year for Eskom starts on the 1st of April and finishes on the 31st of March

**No data available

[27]Data Requirements for Calculating the Carbon Emission Factor (CEF) for the South African Grid, General Information, http://www.eskom.co.za/content/calculationTable.htm

Annex 3-4. Determination of power units included into the build margin[28]

Determination of the set of power units SET_{sample}

			Name of power plant	Type of power plant (PP)	Type of fuel	Date of commissioning	Net electricity generation ($EG_{n,y}$), MWh	Weight fraction in total net electricity generation*	Accumulated weight fraction
SET_{sample}	$SET_{\geq 20\%}$	$SET_{5\text{-units}}$	Komati	Thermal PP	Coal	2009.01.05	1 016 023	0.0044	0.0044
			Grootvlei	Thermal PP	Coal	2008.03.31	2 656 230	0.0114	0.0158
			Gourikwa	Gas turbine PP	Natural gas	2007.03.30	49 000	0.0002	0.0160
			Ankerlig	Gas turbine PP	Natural gas	2007.03.29			
			Camden	Thermal PP	Coal	2005.03.31	7 472 070	0.0321	**0.0481**
			Majuba	Thermal PP	Coal	1996.04.01	22 340 081	0.0960	0.1440
			Kendal	Thermal PP	Coal	1988.10.01	23 307 031	0.1001	**0.2441**

*Total net electricity generation in 2010 reporting year is 232 812 GWh (see Table B.6-1).

$AEG_{SET\text{-}5\text{-}units}$ = 11 193 323 MWh,

$AEG_{SET\text{-}\geq 20\%}$ = 56 840 435 MWh.

[28] Based on data presented in Annexes 3-2 and 3-3

The sets of power units $SET_{sample\text{-}CDM}$

	Name of power plant	Type of power plant (PP)	Type of fuel	Date of commissioning	Net electricity generation ($EG_{n,y}$), MWh	Weight fraction in total net electricity generation*	Accumulated weight fraction
$SET_{sample\text{-}CDM}$	Bethlehem Hydro	Small Scale Hydro	Renewable	2009.07.18	34 031	0.0001	0.0001
	Komati	Thermal PP	Coal	2009.01.05	1 016 023	0.0044	0.0045
	Grootvlei	Thermal PP	Coal	2008.03.31	2 656 230	0.0114	0.0159
	Gourikwa	Gas turbine PP	Natural gas	2007.03.30	49 000	0.0002	0.0161
	Ankerlig	Gas turbine PP	Natural gas	2007.03.29			
	Camden	Thermal PP	Coal	2005.03.31	7 472 070	0.0321	0.0482

*Total net electricity generation in 2010 reporting year including power units registered as CDM project activities is 232 846 GWh (see Annex 3-5)

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

Data on operation of Eskom's grid-connected power plants and power plants registered as CDM project activities included into the build margin during 2010 reporting year

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[29]	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	**0.2443**

*Total net electricity generation in 2010 reporting year including power units registered as CDM project activities is 232 846 GWh (see Annex 3-5)

**No data available

[29] http://cdm.unfccc.int/Projects/DB/SGS-UKL1245061289.99, CDM PDD, page 12

Annex 3-5. The calculation of the combined margin emission factor

Total net electricity generation in 2010 reporting year including power units registered as CDM project activities, MWh

Net electricity generation	Value
Total Eskom	232 812 000
Bethlehem Hydro	34 031
Total	**232 846 031**

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

Name of power plant	Years		
	04.2007 - 03.2008	04.2008 - 03.2009	04.2009 - 03.2010
Arnot	0.929	0.950	0.915
Camden	1.109	1.061	1.128
Duvha	0.937	0.932	0.926
Grootvlei	0.982	0.961	1.098
Hendrina	1.009	1.032	1.013
Kendal	1.074	1.147	1.060
Komati	-	-	1.165
Kriel	0.908	0.924	0.952
Lethabo	1.269	1.263	1.268
Majuba	0.967	0.986	0.978
Matimba	0.912	0.949	0.932
Matla	1.001	1.034	1.009
Tutuka	0.902	0.930	0.951
Ankerlig Gourikwa	0.495	0.495	0.495

CO_2 emissions of power units *m* in year *y* ($EG_{m,y} \cdot EF_{EL,m,y}$), tCO_2

Name of power plant	Years			Total 04.2007 - 03.2010
	04.2007 - 03.2008	04.2008 - 03.2009	04.2009 - 03.2010	
Arnot	11 061 567	11 391 248	12 100 692	34 553 508
Camden	5 732 974	6 903 726	8 428 219	21 064 918
Duvha	22 130 492	20 292 488	20 917 731	63 340 710
Grootvlei	232 868	1 201 386	2 916 240	4 350 494
Hendrina	13 881 896	12 686 273	12 299 783	38 867 952
Kendal	28 472 099	27 350 864	24 696 955	80 519 917
Komati	0	0	1 183 502	1 183 502
Kriel	16 136 195	16 778 852	15 147 323	48 062 370
Lethabo	32 619 168	29 770 826	32 362 083	94 752 077
Majuba	22 892 445	22 360 025	21 838 938	67 091 407
Matimba	26 470 540	24 919 477	26 070 086	77 460 103
Matla	24 570 135	22 600 433	22 153 396	69 323 964
Tutuka	18 928 242	20 004 011	18 884 186	57 816 440
Ankerlig Gourikwa	570 604	70 769	24 249	665 622
			Total emissions:	659 052 985

Calculation of simple operating margin CO_2 emission factor ($EF_{grid,OMsimple}$)

Parameter	Unit	Value
Total net electricity generation of power units *m* for the 3 most recent reporting years	MWh	651 882 496
Total CO_2 emissions of power units *m* for the 3 most recent reporting years	tCO_2	659 052 985
Simple operating margin CO_2 emission factor	**tCO_2/MWh**	**1.011**

Calculation of build margin CO_2 emission factor ($EF_{grid,BM,y}$)

Name of power plant	Net electricity generation ($EG_{n,y}$), MWh	CO_2 emission factor ($EF_{EL,n,y}$), tCO_2/MWh	CO_2 emissions ($EG_{n,y} \cdot EF_{EL,n,y}$), tCO_2	Build margin CO_2 emission factor ($EF_{grid,BM,y}$), tCO_2/MWh
Bethlehem Hydro	34 031	0	0	-
Grootvlei	2 656 230	1.098	2 916 240	-
Komati	1 016 023	1.165	1 183 502	-
Gourikwa	49 000	0.495	24 249	-
Ankerlig				
Camden	7 472 070	1.128	8 428 219	-
Majuba	22 340 081	0.871*	19 453 984	-
Kendal	23 307 031	0.871*	20 296 015	-
Total:	**56 874 466**	**-**	**52 302 209**	**0.920**

* Recalculated emission factor for power plants which started to supply electricity to the grid more than 10 years ago

Calculation of combined margin CO_2 emission factor ($EF_{grid,CM}$)

Parameter	Unit	Value
Operating margin CO_2 emission factor	tCO_2/MWh	1.011
Weighting of operating margin emission factor	-	0.75
Build margin CO_2 emission factor	tCO_2/MWh	0.920
Weighting of build margin emission factor	-	0.25
Combined margin CO_2 emission factor	**tCO_2/MWh**	**0.988**

Annex 3-6. Calculation of project IRR before tax for the proposed project activity

Calculation of the net cash flow

Parameter	Unit	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Investment cost	thous.USD	-73 005,63	-52 146,88																				
Annual electricity supply to Eskom	MWh		76 006,1	130 296,2	130 296,2	130 296,2	130 296,2	130 296,2	130 296,2	130 296,2	130 296,2	130 296,2	130 296,2	130 296,2	130 296,2	130 296,2	130 296,2	130 296,2	130 296,2	130 296,2	130 296,2	130 296,2	54 290,1
Income from elecricity sale	thous.USD		7 119,49	12 204,85	12 204,85	12 204,85	12 204,85	12 204,85	12 204,85	12 204,85	12 204,85	12 204,85	12 204,85	12 204,85	12 204,85	12 204,85	12 204,85	12 204,85	12 204,85	12 204,85	12 204,85	12 204,85	5 085,35
Cost of electricity generation	thous.USD		-777,0	-1 332,0	-1 332,0	-1 332,0	-1 332,0	-1 332,0	-1 332,0	-1 332,0	-1 332,0	-1 332,0	-1 332,0	-1 332,0	-1 332,0	-1 332,0	-1 332,0	-1 332,0	-1 332,0	-1 332,0	-1 332,0	-1 332,0	-555,0
Total income from the project implementation	thous.USD		6 342,5	10 872,8	10 872,8	10 872,8	10 872,8	10 872,8	10 872,8	10 872,8	10 872,8	10 872,8	10 872,8	10 872,8	10 872,8	10 872,8	10 872,8	10 872,8	10 872,8	10 872,8	10 872,8	10 872,8	4 530,4
Net cash flow	thous.USD	-73 005,63	-45 804,38	10 872,85	10 872,85	10 872,85	10 872,85	10 872,85	10 872,85	10 872,85	10 872,85	10 872,85	10 872,85	10 872,85	10 872,85	10 872,85	10 872,85	10 872,85	10 872,85	10 872,85	10 872,85	10 872,85	4 530,35

Pre-tax Project IRR

Parameter	Unit	Value
Pre-tax Project IRR	**%**	**5,956%**

<u>Annex 4</u>

MONITORING INFORMATION

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