



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

CONTENTS

- A. General description of project activity.
- B. Application of a baseline and monitoring methodology
- C. Duration of the project activity / crediting period
- D. Environmental impacts
- E. Stakeholders' comments

Annexes

- Annex 1: Contact information on participants in the project activity
- Annex 2: Information regarding public funding
- Annex 3: Baseline information
- Annex 4: Monitoring plan

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

Amakhala Emoyeni Grid Connected 138.6 MW Wind Farm, Phase 1, South Africa

Version number: 1.1

Date: 21 December 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 138.6 MW¹ or less. The wind farm will be comprised of 66 wind turbines and the associated infrastructure. Produced electricity will be supplied to the Eskom electricity network.

The proposed project is located south of the towns of Cookhouse and Bedford in the Eastern Cape Province of the RSA. Construction and installation works under the project are expected to be started in December 2012 (the expected starting date of the project activity). The first phase of the entire wind farm is expected to be commissioned by June 2015. The required investments into the proposed project amount to around USD 315.7 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 CO₂ 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;

¹The entire project envisages the construction and operation of a wind farm with a total installed capacity of up to 750MW. The project will be developed in separate phases, the first phase will have a capacity of 140 MW or less with each consecutive phase occurring at an estimate of anything between 1 to 2 year intervals after the first successful signing of a power purchase agreement. Phase 1 will be constructed within the boundaries of the given 750 MW farm location.



2. Ensures the creation of approximately 200 full-time jobs during the construction phase (for Phase 1 of the project). The operations period would employ up to approximately 30 full-time employees (for Phase 1 of the project);
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 2013² and the objective to reduce RSA's GHG emissions below the current emissions baseline of around 34% by 2020³.

A.3. <u>Project participants:</u>
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Name of Party involved (host) indicates a Host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of South Africa (Host Party)	<ul style="list-style-type: none"> • Amakhala Emoyeni RE Project 1 (Pty) Ltd 	No
One of the Parties to Annex B of the Kyoto Protocol	<ul style="list-style-type: none"> • To be determined upon the registration of the project by the CDM EB 	No

Amakhala Emoyeni RE Project 1 (Pty) Ltd

The project is being developed by Windlab Developments South Africa (Proprietary) Limited, a private company developed and established in 2003 for the following activities:

1. Overseeing and managing existing renewable energy projects to financial close;
2. Identifying future renewable energy projects and properties on which those projects may be developed;
3. Managing each project entity until the entity is managed by its own project team.

Windlab Developments South Africa (Proprietary) Limited set up an SPV called Amakhala Emoyeni RE Project 1 (Pty) Ltd to develop the project and then run the wind farm after construction.

²http://www.energy.gov.za/files/renewables_frame.html

³<http://www.unep.org/climatepledges/Default.aspx?pid=68>

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.:

Eastern Cape Province

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

The town of Bedford

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

Bedford is a small town situated approximately 180 km north from Port Elizabeth in the Blue Crane Route Local Municipality in the Eastern Cape Province of the Republic of South Africa (Figure A.4-1).

Phase 1 of the project is located on the following farms/portions (Figure A.4-2): Portion 0 of Farm 206, Portion 5 of Farm 149 (Great Knoffel Fonteyn), Portion 0 of Farm 242, Portion 0 or Farm 205 (Kop Leegte), Portion 1 of Farm 222, Portion 0 of Farm 222, Portion 0 of Farm 168 (Stompstaart Fontein), Portion 0 of Farm 259, Portion 1 (RE) of Farm 187 (Klein Knoffel Fonteyn).

The approximate centre of the Phase 1 development area is geographical latitude: 32°50'27.29"S, geographical longitude: 26°0'37.11"E. Time zone: UTC+2.



Figure A.4-1: Location of Bedford in the territory of the Republic of South

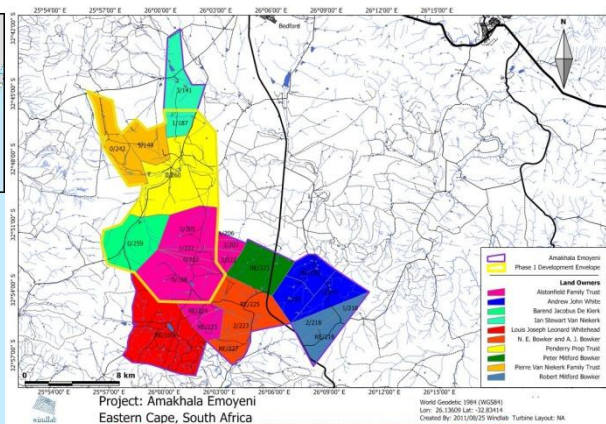


Figure A.4-2: Pinpointing the location of the entire project activity and Phase 1.

**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 138.6 MW or less. The wind farm will be comprised of 66 wind turbines and the following associated infrastructure:

- Underground electrical distribution cabling between the turbines (at that, a geological feature or a stream may require the cable to go above ground for a short distance);
- 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.

Produced electricity will be supplied to the Eskom electricity network.

Preferred suppliers have been selected and engineering, procurement and construction tenders have been received. It is anticipated that the turbine supplier and model will be selected for final negotiation of contracts by the end of December 2011 at the latest.

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.

Current analyses, done by Windlab Developments South Africa (Proprietary) Limited, of the latest project layouts (for Phase 1) indicate a load factor of 30.5%.⁴ The assumed amount of electricity annually supplied by the wind farm to the Eskom electricity network is equal to 374 052 MWh⁵.

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

⁴This value is conservative since it is higher than the load factor of 0.27 given by Renewable Energy Feed-In Tariff Guidelines for wind farm projects.

⁵374 052 MWh = 140 MW * 0.305 * 8760 h

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

Number	Action	Date
1	Completion of Environmental Impact Assessment	November 2010
2	Start of construction and installation works	December 2012
3	Completion of construction and installation works	May 2015
4	Commissioning of the wind farm	June 2015

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

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 CO₂ emission factor of RSA's grid calculated using the "Tool to calculate the emission factor for an electricity system" is equal to 0.988 tCO₂/MWh.

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

The 7-year crediting period was selected for the project.

Years	Annual estimation of emission reductions in tonnes of CO ₂ e
2015 (From 1 July to 31 December)	184 782
2016	369 563
2017	369 563
2018	369 563
2019	369 563
2020	369 563
2021	369 563
2022 (From 1 January to 30 June)	184 781
Total estimated reductions (tonnes of CO ₂ e)	2 586 941
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO ₂ e)	369 563

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 12.2.0)⁶ 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)⁷ is used to calculate the combined margin CO₂ emission factor of RSA’s grid.

“Tool for the demonstration and assessment of additionality” (Version 06.0.0)⁸ 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 12.2.0) 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).

⁶ <http://cdm.unfccc.int/methodologies/DB/C505BVV9P8VSNNV3LTK1BP3OR24Y5L>

⁷ <http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.2.0.pdf>

⁸ <http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v6.0.0.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 11 to calculate the parameter $EG_{PI,y}$): 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.
<p>In case of hydro power plants, one of the following conditions must apply:</p> <ul style="list-style-type: none"> • The project activity is implemented in an existing single or multiple reservoirs, with no change in the volume of any of reservoirs; or • The project activity is implemented in an existing single or multiple reservoirs, where the volume of any of reservoirs is increased and the power density of each reservoir, as per the definitions given in the Project Emissions section, is greater than 4 W/m²; or • The project activity results in new single or multiple reservoirs and the power density of each reservoir, as per the definitions given in the Project Emissions section, is greater than 4 W/m². 	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
<p>In case of hydro power plants using multiple reservoirs where the power density of any of the reservoirs is lower than 4 W/m^2 all the following conditions must apply:</p> <ul style="list-style-type: none"> • The power density calculated for the entire project activity using equation 5 is greater than 4 W/m^2; • Multiple reservoirs and hydro power plants located at the same river and where are designed together to function as an integrated project that collectively constitute the generation capacity of the combined power plant; • Water flow between multiple reservoirs is not used by any other hydropower unit which is not a part of the project activity; • Total installed capacity of the power units, which are driven using water from the reservoirs with power density lower than 4 W/m^2, is lower than 15MW; <p>Total installed capacity of the power units, which are driven using water from reservoirs with power density lower than 4 W/m^2, is less than 10% of the total installed capacity of the project activity from multiple reservoirs.</p>	Not applicable	The project activity is not the installation of a hydro power plant, so it does not need to satisfy this applicability condition.
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.



Applicability condition	Applicability	Comment
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 (Figure 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

<u>Source</u>		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 ₂ O	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 ₂ O	No	GHG emissions for a wind power generation project are equal to zero

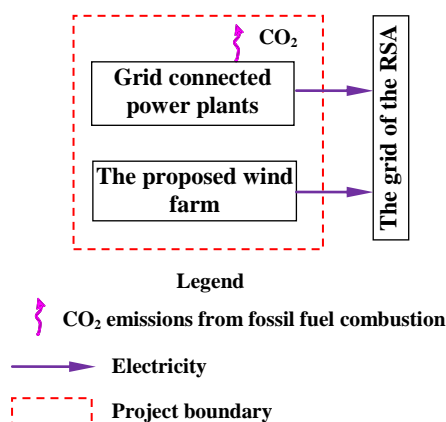


Figure B.3-1: Project boundary

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

According to the ACM0002 (Version 12.2.0), 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 06.0.0). 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).

According to ACM0002 (Version 12.2.0), 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 “Tool for the demonstration and assessment of additionality” also states:

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

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 140 MW or less. 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 project participant does not undertake an investment but an investment to provide comparable outputs or services is undertaken by a third party (or parties).



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 2 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).

Step 2: Investment analysis

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)⁹ "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.

⁹http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf



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%¹⁰. 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: $9.0\% * 1/(1-0.28) = 12.5\%$.¹¹

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 06.0.0) 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 incentives¹², ODA, etc”*.

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)¹³ 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)¹⁴ 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*

¹⁰ www.reservebank.co.za

¹¹ Income tax in the RSA is 28%, www.sars.gov.za/home.asp?pid=289#Incometa

¹² “See EB guidance on the consideration of national/local/sectoral policies and measures for the baseline setting ”

¹³ http://cdm.unfccc.int/EB/022/eb22_repan3.pdf

¹⁴ http://unfccc.int/files/meetings/seminar/application/pdf/sem_sup1_south_africa.pdf



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)¹⁵ 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. In March 2011 an updated REFIT of 0.938 ZAR/kWh was published¹⁶, which is much higher than the predicted electricity price of 0.6585 ZAR/kWh established by NERSA for 2013. The REFIT values still expected to change due to the current national “Independent Power Producer Procurement Program (IPPPP)” which is a bidding scheme developed by the Department of Energy¹⁷. This scheme allows for a REFIT of 1.15 ZAR/kWh or lower. The REFIT will only be allowed to increase according to the Cost Price Index (CPI).

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.

¹⁵ <http://www.nersa.org.za>

¹⁶ Refer to page 25.

<http://www.nersa.org.za/Admin/Document/Editor/file/Electricity/Consultation/Documents/Review%20of%20Renewable%20Energy%20Feed-In%20Tariffs%20Consultation%20Paper.pdf>

¹⁷ <http://www.ipp-renewables.co.za/>

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

Parameter	Unit	Value	Data source
Capacity of the wind farm	MW	140.0	As specified by the project developer, Windlab Developments South Africa (Pty) Ltd.
Load factor of the wind farm	ratio	0.305	See Section A.4.3
The period of assessment	years	20	“Guidelines on the assessment of investment analysis”
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 ¹⁸
Total investments cost	USD/kW	2 255	Renewable Energy Feed-In Tariff Guidelines (March 2009), page 8, Table 3 ¹⁹
Fixed O&M costs	USD/kW/a	24	
Variable O&M costs	USD/kWh	0	
ZAR exchange rate	ZAR/USD	7.23	South African Reserve Bank ²⁰

*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 6.646%, 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 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.

¹⁸ www.eskom.co.za/content/MediaStatementMYPD2~1.pdf

¹⁹ www.remtproject.org/FileDownload.aspx?FileID=46

²⁰ Average values for the last 6 months of 2011 (9th May – 8th November), www.resbank.co.za



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	9.356%	7.890%	7.244%	6.646%	6.091%	5.572%	4.630%
Operations and maintenance costs	6.913%	6.780%	6.713%	6.646%	6.579%	6.512%	6.377%
Income from electricity sale	3.895%	5.320%	5.994%	6.646%	7.280%	7.895%	9.081%

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

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

According to “Tool for the demonstration and assessment of additionality (version 06.0.0)”, “*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 activities similar to the proposed project activity were selected according to the following three criteria:

1. **Region:** The proposed project will be a newly-built 140 MW wind farm in the Eastern Cape Province in South Africa, and the electricity generated from the proposed project will be supplied to South African National Grid. Therefore, the selected geographical area for the similar project is South Africa.
2. **Time frame:** The White Paper²¹ on Renewable Energy recognises that the medium and long-term potential of renewable energy is significant. This Paper sets out Government’s vision, policy

²¹ www.energy.gov.za/files/policies/whitepaper_renewables_2003.pdf



principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa. It also informs the public and the international community of the Government's vision, and how the Government intends to achieve these objectives; and informs Government agencies and organs of their roles in achieving the objectives. This Paper was published in November 2003 and therefore the common practice analysis starts from November 2003.

3. **Scale:** A comparable size to the project activity is defined as an installed capacity which is greater than 15MW.

Therefore, activities similar to the proposed project should be wind farms in South Africa with an installed capacity greater than 15 MW and a starting date of operation later than November 2003.

According to the "Tool for the demonstration and assessment of additionality (version 06.0.0)", 'other CDM project activities (registered project activities and project activities which have been published on the UNFCCC website for global stakeholder consultation as part of the validation process) are not to be included in this analysis'. Therefore, the wind power projects which are registered and applying for CDM are not included in the common practice analysis.

The list of power plants servicing RSA's grid is presented in Annex 3-2. As can be seen, there are currently no wind farms in South Africa.

Therefore, no similar activities are identified with the above criteria.

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

No project activities similar to the proposed project are identified in South Africa. The fact demonstrates that the proposed project does not belong to common practice and fulfils the requirement of additionality.

In conclusion, the proposed project activity passed all criteria of "Tool for the demonstration and assessment of additionality (Version 06.0.0)" and the proposed project 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 (tCO₂e/yr)

Baseline emissions

Baseline emissions include only CO₂ emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The ACM0002 methodology (Version 12.2.0) 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 (tCO₂/yr)
- $EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)
- $EF_{grid,CM,y}$ = Combined margin CO₂ emission factor for grid connected power generation in year y (tCO₂/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:

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

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)
- $EG_{facility,y}$ = 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 CO₂ 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 02.2.0). 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, GWh²²

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.

²²Eskom Annual Report 2010, page 1,
http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf



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;
- *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 CO₂ emissions per unit net electricity generation (tCO₂/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 CO₂ 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 CO₂ emission factor of each Eskom's power plant is available. The OM emission factor is calculated as follows:

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

Where:

$EF_{grid,OM}$ = Operating margin CO₂ emission factor calculated ex ante (tCO₂/MWh)

$EF_{grid,OMsimple}$ = Simple operating margin CO₂ emission factor calculated ex ante (tCO₂/MWh)

The simple operating margin CO₂ emission factor is calculated as follows:

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

Where:

$EF_{grid,OMsimple}$ = Simple operating margin CO₂ emission factor calculated ex ante (tCO₂/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

$EF_{EL,m,y}$ = CO₂ emission factor of power unit m in year y (tCO₂/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:

- $EF_{EL,m,y}$ = CO₂ emission factor of power unit m in year y (tCO₂/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)
- $EF_{CO2,i,y}$ = CO₂ emission factor of fossil fuel type i in year y (tCO₂/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:

- $EF_{EL,m,y}$ = CO₂ emission factor of power unit m in year y (tCO₂/MWh)
- $EF_{CO2,m,i,y}$ = Average CO₂ emission factor of fuel type i used in power unit m in year y (tCO₂/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 Figure 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.

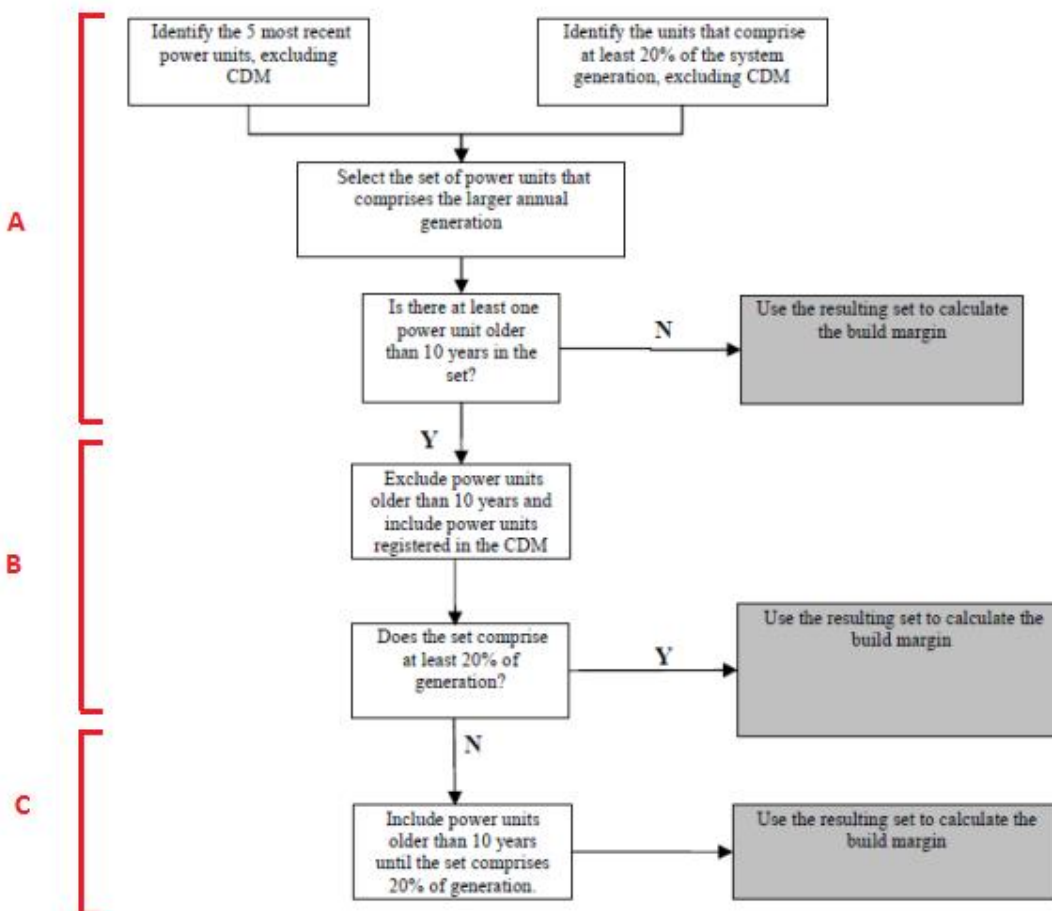


Figure B.6-1: Build margin calculation algorithm

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 ($SET_{5-units}$) and determine their annual electricity generation ($AEG_{SET_{5-units}}$, 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 ($AEG_{SET_{\geq 20\%}}$, in MWh);
- (c) From $SET_{5-units}$ 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 $SET_{5-units}$ 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 it is possible. Determine for the resulting set ($SET_{sample-CDM}$) the annual electricity generation ($AEG_{SET_{sample-CDM}}$, 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. $AEG_{SET_{sample-CDM}} \geq 0.2 \times AEG_{total}$), then use the sample group $SET_{sample-CDM}$ to calculate the build margin. Ignore steps (e) and (f);

The annual electricity generation of $SET_{sample-CDM}$ 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 $SET_{sample-CDM}$ 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 ($SET_{sample-CDM->10yrs}$).

The power units in $SET_{sample-CDM->10yrs}$ 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 (tCO₂/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 CO₂ emission factor in year y (2010 reporting year) (tCO₂/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
- $EF_{EL,n,y}$ = CO₂ emission factor of power unit n in year y (tCO₂/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 CO₂ 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 $SET_{sample-CDM->10yrs}$, 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 CO₂ emission factor is presented in Annex 3-5.

Step 6: Calculate the combined margin (CM) emissions factor

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 CO₂ emission factor for grid connected power generation in year y (tCO₂/MWh)
- $EF_{grid,CM}$ = Combined margin CO₂ emission factor for grid connected power generation calculated ex ante (tCO₂/MWh)
- $EF_{grid,BM,y}$ = Build margin CO₂ emission factor in the most recent year y (2010 reporting year) (tCO₂/MWh)
- $EF_{grid,OM}$ = Operating margin CO₂ emission factor (tCO₂/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 CO₂emission 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:

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

Where:

- ER_y = Emission reductions in year y (tCO₂e/yr)
 BE_y = Baseline emissions in year y (tCO₂/yr)
 PE_y = Project emissions in year y (tCO₂e/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. The default NCV that is available on the Eskom website is 0.02509 TJ/t fuel. ²³ The 2006 IPCC Guidelines reference the NCV of the different types of coal. The Eskom default value corresponds to the NCV of 'other bituminous coal'. Therefore the IPCC value for 'other bituminous coal' was applied to calculate the grid emission factor.
Any comment:	This value was appointed as a constant.

Data / Parameter:	$EF_{CO_2,coal,y}$
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. The default emission factor that is available on the Eskom website is 25.8 tC/TJ. ²⁴ The 2006 IPCC Guidelines reference the carbon content of the different types of coal. The Eskom default value corresponds to the carbon content of 'other bituminous coal'. Therefore the IPCC value for 'other bituminous coal' was applied to calculate the grid emission factor.
Any comment:	This value was appointed as a constant.

Data / Parameter:	$EF_{CO_2,NG,y}$
Data unit:	tCO ₂ /GJ
Description:	CO ₂ emission factor of Natural Gas
Source of data used:	2006 IPCC Guidelines for National GHG Inventories, Volume 2: Energy,

²³ <http://www.eskom.co.za/c/article/236/cdm-calculations/>

²⁴ <http://www.eskom.co.za/c/article/236/cdm-calculations/>



	Chapter 1, Table 1.4
Value applied:	0.0543
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:	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	Official statistics, publicly available and reliable data source



description of measurement methods and procedures actually applied :	
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 ₂ e/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.

Data / Parameter:	LF_{wf}
Data unit:	Ratio
Description:	Load factor of the wind farm
Source of data used:	Windlab Developments South Africa (Proprietary) Limited
Value applied:	0.305
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value is conservative since it is higher than the load factor of 0.27 given by Renewable Energy Feed-In Tariff Guidelines for wind farm projects
Any comment:	This value is used for estimating the amount of electricity that will be generated by the wind farm. This value will not be monitored. Instead the actual amount



	of electricity that is produced (MWh) will be monitored by electricity meters.
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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:

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

Where:

- ER_y = Emission reductions in year y (tCO₂e/yr)
- $EG_{\text{facility},y}$ = Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh/yr)
- $EF_{\text{grid},CM,y}$ = Combined margin CO₂ emission factor for grid connected power generation calculated ex ante (tCO₂/MWh)

The calculation of the combined margin CO₂ emission factor is presented in Annex 3-5. A constant emission factor of $EF_{\text{grid},CM} = 0.988$ tCO₂/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 7-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 ($EG_{\text{facility},y}$) during the 7-year crediting period, MWh

Year	$EG_{\text{facility},y}$
2015 (From 1 July to 31 December)	187 026
2016	374 052
2017	374 052
2018	374 052
2019	374 052
2020	374 052
2021	374 052
2022 (From 1 January to 30 June)	187 026

**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)
2015 (From 1 July to 31 December)	0	184 782	0	184 782
2016	0	369 563	0	369 563
2017	0	369 563	0	369 563
2018	0	369 563	0	369 563
2019	0	369 563	0	369 563
2020	0	369 563	0	369 563
2021	0	369 563	0	369 563
2022 (From 1 January to 30 June)	0	184 781	0	184 781
Total (tonnes of CO ₂ e)	0	2 586 941	0	2 586 941

B.7. Application of the monitoring methodology and description of the monitoring plan:**B.7.1 Data and parameters monitored:**

Data / Parameter:	$EG_{\text{facility},y}$																		
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	<table border="1"> <thead> <tr> <th>Year</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>2015 (From 1 July to 31 December)</td> <td>187 026</td> </tr> <tr> <td>2016</td> <td>374 052</td> </tr> <tr> <td>2017</td> <td>374 052</td> </tr> <tr> <td>2018</td> <td>374 052</td> </tr> <tr> <td>2019</td> <td>374 052</td> </tr> <tr> <td>2020</td> <td>374 052</td> </tr> <tr> <td>2021</td> <td>374 052</td> </tr> <tr> <td>2022 (From 1 January to 30 June)</td> <td>187 026</td> </tr> </tbody> </table>	Year	Value	2015 (From 1 July to 31 December)	187 026	2016	374 052	2017	374 052	2018	374 052	2019	374 052	2020	374 052	2021	374 052	2022 (From 1 January to 30 June)	187 026
Year	Value																		
2015 (From 1 July to 31 December)	187 026																		
2016	374 052																		
2017	374 052																		
2018	374 052																		
2019	374 052																		
2020	374 052																		
2021	374 052																		
2022 (From 1 January to 30 June)	187 026																		
Description of measurement methods	Measurement by means of electricity meters installed at the points of supply which define the commercial boundary between Eskom and the wind farm																		



and procedures to be applied:	owner. The generated electricity shall be continuously measured and recorded. Data on electricity supply shall be digitally archived at least on a monthly basis.
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.

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 12.2.0). The following procedures shall be applied:

1. Monitoring period

A 7-year crediting period with the option of renewal 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 at the point of supply to the Eskom electricity network. The generated electricity shall be continuously measured and recorded. 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 digitally archived at least on a monthly basis.

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 Windlab Developments South Africa (Proprietary) Limited is fully responsible for the project implementation and overall control. The management of Individual Special Purpose Vehicle (SPV) called Amakhala Emoyeni RE Project 1 (Pty) Ltd. 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 Amakhala Emoyeni RE Project 1 (Pty) Ltd.



In case of any doubts as to the accuracy of the input data, the specialists of Amakhala Emoyeni RE Project 1 (Pty) Ltd. shall check and correct the data. The preliminary version of the monitoring report shall be submitted to the specialists of Amakhala Emoyeni RE Project 1 (Pty) Ltd. 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 Amakhala Emoyeni RE Project 1 (Pty) Ltd.

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 Amakhala Emoyeni RE Project 1 (Pty) Ltd.

6. Emergency situations

If any instrument that is used in the monitoring process fails, Amakhala Emoyeni RE Project 1 (Pty) Ltd. 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 Amakhala Emoyeni RE Project 1 (Pty) Ltd. 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: 21/12/2011

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), Jeroen van Lier (jeroenvlier@gmail.com).

**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)²⁵ 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 December 2012 (start of construction).

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

25 years²⁶

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:**

01/07/2015 or the date of registration of the CDM project activity, whichever is later

C.2.1.2. Length of the first crediting period:

7 years

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

Not applicable

C.2.2.2. Length:

Not applicable

²⁵ http://cdm.unfccc.int/Reference/Guidclarif/glos_CDM.pdf

²⁶ The expected operation lifetime of the project activity was taken from the “Tool to determine the remaining lifetime of equipment” (Version 01), reported as Annex 15 to the EB 50, page 4.

<http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-10-v1.pdf>

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

The Environmental Impact Assessment (EIA)²⁷ of the proposed wind farm was carried out in accordance with the South African legislation by Savannah Environmental (Pty) Ltd. The Final EIA Report was submitted to the Department of Environmental Affairs for a decision in November 2010. Environmental authorisation was obtained by means of a Record of Decision (ROD) that was issued by the department on 2 September 2011.

The possible negative impacts with and without mitigation are discussed in Table D.1-1. The EIA report concluded that no fatal environmental flaws are created by the proposed development. The wind power is one of the cleanest sources of renewable energy, with no associated emissions and waste products.

Table D.1-1: Summary of Impacts and Mitigation Schemes

Impact	Negative Impact Before Mitigation	Negative Impact After Mitigation
Impact on ecology	<p>Moderate local and regional impact.</p> <p>1) Impacts potentially on natural vegetation and watercourses/wetlands due to underground cables between turbines. 2) Disturbances due to construction could lead to the spread of alien plants</p>	<p>Moderate - low local and regional impact.</p> <p>1) Impacts can be contained to some degree within construction area, as well as re-positioning some turbines and infrastructure away from sensitive areas. 2) This may be effectively controlled with suggested measures.</p>
Impact on avifauna	<p>High significance</p> <p>May have impact on rare, red-listed and/or endemic species through construction of facility, lose foraging habitat from construction footprint, displacement from area from operating turbines or collision with turbine blades. The most important negative impacts are likely to be on the Cape Vulture, Denham's Bustard and Blue Crane.</p>	<p>Moderate significance</p> <p>Careful and responsible development and management of the facility, with sensitivity to potential negative impacts and preparedness to adjust operating procedures.</p>

²⁷Final EIA Report: Proposed Amakhala Emoyeni Wind Energy Facility and Associated infrastructure, Eastern Cape Province, November 2010



Impact	Negative Impact Before Mitigation	Negative Impact After Mitigation
Impact on geology and soils	<p style="text-align: center;">Moderate</p> <p>Impacts occur due to removal of topsoil for construction, degradation of soil and parent rock from constructions, increased erosion on slopes due to removal of vegetation.</p>	<p style="text-align: center;">Low</p> <p>Due to the nature that the project activity is scattered and that there will be a limited extent of proposed earthworks, impact will be reduced. The proposed layouts for the turbines have been designed to avoid areas of unfavorable topography and this bodes well for erosion.</p>
Impact on heritage sensitivity	<p style="text-align: center;">Moderate</p> <p>No fatal flaws have been identified. Change of character and public memory.</p>	<p style="text-align: center;">Moderate – Low</p> <p>Mark buffer zones around sensitive sites and undertake periodic inspection of listed sites during construction and operation.</p>
Impact on paleontology	<p style="text-align: center;">Moderate</p> <p>It is difficult to determine where all fossils are as they are only observable from geological outcrops. Excavation due to construction may destroy these fossil records in the ground.</p>	<p style="text-align: center;">Low</p> <p>Outcrops with observed fossils have been identified and mapped. Construction around these buffer zones is therefore possible. In the case of fossils being identified within the ground during excavation and construction, operations are to cease and reported to the geological society for the removal of these fossils.</p>
Visual impact	<p style="text-align: center;">Very high within the 5 km core area. Very high within the 10 km area.</p> <p>The facility is visible in a large area which is generally seen as having a special landscape and tourism value.</p>	<p style="text-align: center;">Very high within the 5 km core area. High within the 10 km area.</p> <p>Since it is impossible to hide the wind turbines, the only other alternative is to promote the area as an attraction or landmark.</p>
Noise Impact	<p style="text-align: center;">Low for surrounding areas. Moderate within the proposed energy facility footprint.</p> <p>The wind turbines emit sound power levels at a level that does impact areas at some distance away.</p>	<p style="text-align: center;">Low within the proposed energy facility footprint.</p> <p>When potential sensitive receptors are nearby, care must be taken to ensure that operations at the facility to not unduly cause annoyance or otherwise interfere with the quality of life of the receptors. Wind turbines are positioned in a 1 000 m radius away from any potentially sensitive receptors.</p>



Impact	Negative Impact Before Mitigation	Negative Impact After Mitigation
Impact on social environment as a result of construction	- The negative impacts are associated with the presence of construction workers, increased risk of stock theft and poaching, impact of heavy vehicles, and loss of agricultural land	Moderate to low Windlab will employ no less than 80% of their low-skilled workers from the local area. They will also create a monitoring forum to prevent poaching and theft. Many mitigation strategies are suggested for each impact.
Impact on natural resources	There is no sign of any arable agriculture on the land, therefore the impact on the natural resources show very little effect on the loss of arable agricultural land due to the low rainfall.	The soils are suited for extensive grazing at best which 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 identified no fatal flaws.

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

The project owner appointed Savannah Environmental (Pty) Ltd to undertake the Scoping and Environmental Impact Assessment. As part of these environmental studies, the public involvement process was undertaken by Sustainable Futures ZA in terms of the NEMA EIA Regulations and CDM requirements based on the Kyoto protocol.

The public involvement process was initiated at the start of the EIA process and has continued throughout the Scoping and EIA Phases. The aim of the public participation process is primarily to ensure that:

- Information containing all relevant facts in respect of the proposed project was made available to potential stakeholders and Interested and Affected Parties (I&APs)
- Participation by potential I&APs was facilitated in such a manner that all potential stakeholders and I&APs were provided with a reasonable opportunity to comment on the proposed project
- Comment received from stakeholders and I&APs was recorded, considered, and incorporated into the EIA process

Through on-going consultation with key stakeholders and I&APs, issues raised through the Scoping Phase for inclusion within the EIA study were confirmed. All relevant stakeholder and I&AP information have been recorded within a database of affected parties. While I&APs were encouraged to register their interest in the project from the onset of the process, the identification and registration of I&APs has been on-going for the duration of the EIA process and the project database has been updated on an on-going basis²⁸.

The following Organs of State which may have jurisdiction over certain aspects of the CPA were also consulted:

- Department of Economic Development and Environmental Affairs
- Department of Energy
- Department of Water Affairs
- South African Heritage Resources Agency
- Conservation Authorities
- Department of Transport and Public Works and various District Roads Departments
- South African National Road Agency
- Department of Land Affairs
- Civil Aviation Authority
- Cacadu District Municipality
- Blue Crane route Local Municipality

²⁸The list of stakeholders is presented in Appendix C of the final EIA report for Amakhala Emoyeni Wind Energy Facility



In order to accommodate the varying needs of stakeholders and I&APs, as well as ensure the relevant interactions between stakeholders and the EIA specialist team, the following opportunities have been provided for I&APs issues to be recorded and verified through the EIA phase, including:

- Focus group meetings (pre-arranged and stakeholders invited to attend)
- One-on-one consultation meetings and telephonic consultation sessions (consultation with various parties, for example with directly affected landowners and local municipalities, by the project participation consultant as well as specialist consultants)
- Written, faxed or e-mail correspondence
- Public meeting and stakeholder meetings (during the review period of the draft EIA Report)
- Site meetings for key stakeholders and authorities

A summary of the activities to inform stakeholders and I&APs is provided in Table E.1-1.

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

Activity	Date
Scoping phase	
Public review period for Draft Scoping Report (DSR)	21 May – 21 June 2010
Advertisement of EIA process in local newspapers: <ul style="list-style-type: none"> • The Herald • Somerset Budget & Pearston Advocate 	
Site notices: <ul style="list-style-type: none"> • R350 regional road • R63 – R350 Bedford – Grahamstown crossing • Farms: Leeufontein and Brakke Fonteyn 	
The DSR was made available at: <ul style="list-style-type: none"> • Bedford Library • Cookhouse Library • www.savanahSA.com • Cookhouse Farmers Association 	
EIA Phase	
Public feedback meeting before release of draft EIA report.	7 October 2010
Public review period for Draft EIA Report (DSR)	18 October – 16 November 2010
The DSR was made available at: <ul style="list-style-type: none"> • Bedford Library • Cookhouse Library • www.savanahSA.com 	
Submission of EIA to the Department of Environmental Affairs	25 November 2010
Environmental authorisation for the project was obtained from the Department of Environmental Affairs by means of a Record of Decision (ROD).	2 September 2011

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

Issues and comments raised by I&APs over the duration of the EIA process have been synthesized into Comments and Response Reports (Appendix E of the Final EIA report). All stakeholders' comments and concerns were taken into account and considered in the EIA and environmental management plan.

Due to the large scale of the Amakhala Emoyeni wind energy facility numerous comments were received from various stakeholders. Comments were mostly precautionary and included the typical environmental concerns associated with the birds and bats, as well as visual and sound impacts which are generally associated with wind farms.

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

Most of the comments were raised by the stakeholders were precautionary, and no serious negative comments were raised. Responses to comments are included in the Comments and Response Reports (Appendix E of the Final EIA report).

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

Organization:	Amakhala Emoyeni RE Project 1 (Pty) Ltd
Street/P.O.Box:	Green Building, 9B Bell Crescent Close
Building:	Westlake Business Park
City:	Cape Town
State/Region:	
Postcode/ZIP:	7945
Country:	Republic of South Africa
Telephone:	+27 (0)21 701 1292
FAX:	0800 981 222 (within SA only)
E-Mail:	
URL:	www.windlab.com
Represented by:	
Title:	Director
Salutation:	
Last name:	Degenaar
Middle name:	-
First name:	Katherine
Department:	
Mobile:	+27 (0)73 819 4870
Direct FAX:	
Direct tel:	
Personal e-mail:	katherine.degenaar@windlab.com



Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Annex 3

BASELINE INFORMATION

Annex 3-1. The national grid of the RSA (Eskom electricity network)²⁹



²⁹ <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)^{30,31}**

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	2232
Camden ³²	Ermelo, Mpumalanga	Thermal PP	Coal	(2005.03.31)	1440
Duvha	Witbank, Mpumalanga	Thermal PP	Coal	1980.01.18	3450
Grootvlei ³³	Balfour, Mpumalanga	Thermal PP	Coal	(2008.03.31)	760
Hendrina	Mpumalanga	Thermal PP	Coal	1970.05.12	1865
Kendal	Witbank, Mpumalanga	Thermal PP	Coal	1988.10.01	3840
Komati ³⁴	Middelburg, Mpumalanga	Thermal PP	Coal	(2009.01.05)	170
Kriel	Bethal, Mpumalanga	Thermal PP	Coal	1976.05.06	2850
Lethabo	Viljoensdrift, Free State	Thermal PP	Coal	1985.12.22	3558
Majuba	Volksrust, Mpumalanga	Thermal PP	Coal	1996.04.01	3843
Matimba	Lephalale, Limpopo	Thermal PP	Coal	1987.12.04	3690
Matla	Bethal, Mpumalanga	Thermal PP	Coal	1979.09.29	3450

³⁰Eskom Annual Report 2010, page 298,

http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf

³¹Data Requirements for Calculating the Carbon Emission Factor (CEF) for the South African Grid, General Information, <http://www.eskom.co.za/content/calculationTable.htm>

³² Re-commissioned power plant, Eskom Annual Report 2009, page 63

http://www.financialresults.co.za/eskom_ar2009/ar_2009/downloads.htm

³³ Re-commissioned power plant, Eskom Annual Report 2010, page 126,

http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf

³⁴ 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	3510
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	1327
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	1000
Palmiet	Grabouw, Western Cape	Hydroelectric Pumped Storage PP	-	1988.04.18	400
Koeberg	Cape Town, Western Cape	Nuclear PP	-	1984.07.21	1800
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 margin³⁵**

Name of power plant	Type of power plant (PP)	Type of fuel	Total net maximum capacity, MW
Arnot	Thermal PP	Coal	2232
Camden	Thermal PP	Coal	1440
Duvha	Thermal PP	Coal	3450
Grootvlei	Thermal PP	Coal	760
Hendrina	Thermal PP	Coal	1865
Kendal	Thermal PP	Coal	3840
Komati	Thermal PP	Coal	170
Kriel	Thermal PP	Coal	2850
Lethabo	Thermal PP	Coal	3558
Majuba	Thermal PP	Coal	3843
Matimba	Thermal PP	Coal	3690
Matla	Thermal PP	Coal	3450
Tutuka	Thermal PP	Coal	3510
Ankerlig	Gas turbine PP	Natural gas	1327
Gourikwa	Gas turbine PP	Natural gas	740

³⁵Kerosene-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 ($EG_{m,y}$)³⁶

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.

³⁶Data 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 ($FC_{i,m,y}$)³⁷**

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

³⁷Data 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 margin³⁸Determination 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}	$SET_{\geq 20\%}$	$SET_{5-units}$	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).

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

$$AEG_{SET-\geq 20\%} = 568\,404\,35 \text{ MWh.}$$

³⁸Based on data presented in Annexes 3-2 and 3-3

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

	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
$SET_{sample-CDM}$	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)

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



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 ³⁹	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

³⁹<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

CO₂ emission factors of power units m in year y ($EF_{EL,m,y}$), tCO₂/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	0.495	0.495	0.495
Gourikwa			

CO₂ emissions of power units m in year y ($EG_{m,y} \cdot EF_{EL,m,y}$), tCO₂

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	570 604	70 769	24 249	665 622
Gourikwa				
Total emissions:				659 052 985

Calculation of simple operating margin CO₂ 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 CO₂ emission factor	tCO₂/MWh	1.011



Calculation of build margin CO₂ 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 CO₂ 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 CO₂ emission factor	tCO₂/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	2034	2035	
Investment cost	thous.USD	-10,523.33	-126,280.00	-126,280.00	-52,616.67																					
Annual electricity supply to Eskom	MWh				187,026.0	374,052.0	374,052.0	374,052.0	374,052.0	374,052.0	374,052.0	374,052.0	374,052.0	374,052.0	374,052.0	374,052.0	374,052.0	374,052.0	374,052.0	374,052.0	374,052.0	374,052.0	374,052.0	374,052.0	187,026.0	
Income from electricity sale	thous.USD				17,045.02	34,090.04	34,090.04	34,090.04	34,090.04	34,090.04	34,090.04	34,090.04	34,090.04	34,090.04	34,090.04	34,090.04	34,090.04	34,090.04	34,090.04	34,090.04	34,090.04	34,090.04	34,090.04	34,090.04	17,045.02	
Cost of electricity generation	thous.USD				-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	-3,360.0	
Total income from the project implementation	thous.USD				13,685.0	30,730.0	30,730.0	30,730.0	30,730.0	30,730.0	30,730.0	30,730.0	30,730.0	30,730.0	30,730.0	30,730.0	30,730.0	30,730.0	30,730.0	30,730.0	30,730.0	30,730.0	30,730.0	30,730.0	30,730.0	13,685.0
Net cash flow	thous.USD	-10,523.33	-126,280.00	-126,280.00	-38,931.65	30,730.04	30,730.04	30,730.04	30,730.04	30,730.04	30,730.04	30,730.04	30,730.04	30,730.04	30,730.04	30,730.04	30,730.04	30,730.04	30,730.04	30,730.04	30,730.04	30,730.04	30,730.04	30,730.04	30,730.04	13,685.02

Pre-tax Project IRR:

Parameter	Unit	Value
Pre-tax Project IRR	%	6.646%



Annex 4

MONITORING INFORMATION
