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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

Prieska Grid Connected 20 MW Solar Park, South Africa

Version number: 2.0

Date: 09 December 2011

A.2. Description of the project activity:

The aim of the project is to supply solar-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 34 658 MW is coal-fired[1].

The project envisages the construction and operation of a solar park with an installed capacity of 20 MW or less. The solar park will be equipped with several arrays of photovoltaic (PV) panels. It is expected that Trina PV solar panels[2] supplied by Gestamp Solar[3] will be used for this project[4]. Produced electricity will be supplied to the Eskom electricity network.

The proposed project is located on Vogelstruisbult Farm which is approximately 52 km from the town of Prieska in the Northern Cape Province of the RSA. The proposed site is adjacent to the abandoned mining town of Copperton. The anticipated starting date for construction and installation works under this project is the 1st of October 2012. The solar park will be constructed in two 10 MW phases and the Commercial Operation Date (COD) is the 1st of October 2013. The required investment into the project amounts to 80 million USD[5] (or 554.4 million ZAR)[6].

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

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

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

[2] The expected manufacturer of PV solar panels: http://www.trinasolar.com/eu/

[3] The expected supplier of PV solar panels : http://www.gestampsolar.com/

[4] In the event that the manufacturer or supplier of PV solar panels (or both) are changed during this project, different suppliers or manufactures of PV solar panels may also be used for this project.

[5] Solar Photovoltaic Project Report, Prieska, April 2011

[6] Average exchange rate over last 5 months, (January – May 2011), 6.93 (ZAR/USD), http://www.x-rates.com/d/ZAR/USD/hist2011.html

The project activity satisfies all sustainable development criteria identified by the DNA of the RSA. The main benefits of the implementation of the present project are:

1. Promotion and development of photovoltaic solar parks in the RSA which in turn will lead to the creation of new job opportunities both during the construction and operation phases and to growth in tax revenues. Sales of carbon credits generated by the project will result in increased foreign direct investment;
2. Creation of 120 jobs during the construction phase and 25 jobs during the operation phase;
3. 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; and
4. Contribution to achievement of the goal to generate 10 000 GWh of electricity from renewable energy by 2013 and the objective to reduce RSA's GHG emissions by approximately 34% below the current emissions baseline by 2020.

A.3. Project participants:

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

Mulilo Renewable Energy Solar PV Prieska (Pty) Ltd

The project is being developed by Mulilo Renewable Energy Solar PV Prieska (Pty) Ltd, a private company established to develop solar energy projects in the RSA.

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 (RSA)

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

Northern Cape Province

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

The town of Prieska

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

The proposed project site is located near the town of Prieska on the Vogelstruisbult Farm (or Farm 104/1) adjacent to the abandoned mining town of Copperton. This site falls under the jurisdiction of the Pixley Ka Seme District Municipality situated in the Northern Cape Provence of the RSA (Fig. A.4-1). The proposed site covers approximately 34 ha. The GPS coordinates for the proposed project site are: 29° 58' S and 22° 19' E (Fig. A.4-2). This site falls in the time zone UTC+2.

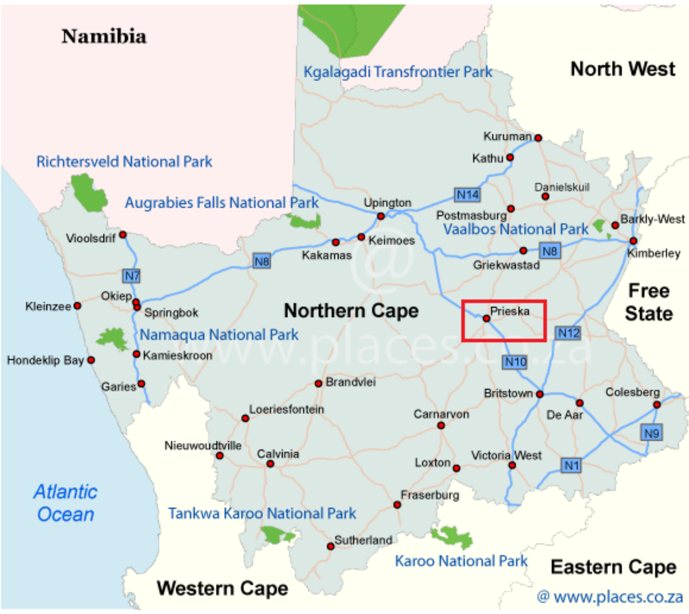

Fig. A.4-1: Location of Prieska in the Republic of South Africa

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

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

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

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

General characteristic of RSA's grid before the project implementation

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

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

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

The project activity characteristic

The project activity envisages the construction and operation of a solar park with an installed capacity of 20 MW or less. The solar park will be equipped with several arrays of photovoltaic (PV) panels. It is expected that Trina PV solar panels supplied by Gestamp Solar will be used for this project. The produced electricity will be supplied to the Eskom electricity network.

The term photovoltaic describes a solid-state electronic cell that produces direct current electrical energy from the radiant energy of the sun. "Photo" refers to light and "voltaic" to voltage. Solar cells are made of semi-conducting material, most commonly silicon, coated with special additives. When light strikes the cell, electrons are knocked loose from the silicon atoms and flows in a built-in circuit, producing electricity. If a load is connected under these conditions, an electrical current will result, which is capable of doing work. The current produced is proportional to the amount of light absorbed by the device. In a solar cell the photovoltaic effect is manifested as the generation of voltage at its terminals while being struck by the sun's rays. A solar panel is a packaged interconnected assembly of photovoltaic cells. A thin silicon cell, four inches across, can produce approximately one watt of direct current electrical power in full sun.

The amount of electricity which is produced by the PV panel is dependent on the irradiation intensity at the site. A test facility was set up at the proposed site to verify the annual amount of energy that can be produced. The load factor established by the project developer for this solar park is 0.22[7]. At maximum capacity the 20 MW solar park will produce 38 544 MWh/year[8]. Construction of the solar park will be done in two phases of 10 MW each.

[7] The load factor was established by the test facility that has been operated since 20 April 2010

[8] A load factor of 22% applies, therefore: 20 MW x 22% x 24h x 365day/year = 38 544 MWh/year

Fig. A.4-3: An illustration of a PV solar panel

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

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

Number	Action	Date
1	Completion of Environmental Impact Report (EIR)	November 2010
2	Completion of Feasibility Study	June 2011
3	Start of construction and installation works	1 October 2012
4	Start of commissioning	1 August 2013
5	Commercial Operation Date (COD)	1 October 2013

Quantity of net electricity generation supplied by the solar park to the grid will be determined on the basis of electricity meters located at the point of supply to the Eskom electricity network. The metering instruments will be installed in accordance with the requirements of Grid and the Distribution Metering Codes at the point of supply which defines the commercial boundary between Eskom and the owner of the solar park.

The baseline scenario characteristic

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

The combined margin CO_2 emission factor of RSA's grid was calculated using the "Tool to calculate the emission factor for an electricity system" (Version 02.2.0) and is equal to 0.988 tCO_2/MWh.

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

A 7-year crediting period with possibility of renewal was selected for the project.

Years	Annual estimation of emission reductions in tonnes of CO_2 e
2013 (From 1 October to 31 December)	9 520
2014	38 081
2015	38 081
2016	38 081
2017	38 081
2018	38 081
2019	38 081
2020 (From 1 January to 30 September)	28 561
Total estimated reductions (tonnes of CO_2 e)	**266 567**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**38 081**

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)[9] 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)[10] is used to calculate the combined margin CO_2 emission factor of RSA's grid.

"Tool for the demonstration and assessment of additionality" (Version 06.0.0)[11] 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 solar park 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).

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

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

[11] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v6.0.0.pdf/history_view

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 the solar park.
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 $EG_{PJ,y}$): the existing plant started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.	Not applicable	The project activity is the installation of a greenfield plant, so it does not need to satisfy this applicability condition.
In case of hydro power plants, one of the following conditions must apply: • The project activity is implemented in an existing 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/m^2; 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/m^2.	Not applicable	The project activity is not the installation of a hydro power plant, so it does not need to satisfy this applicability condition.

Applicability condition	Applicability	Comment
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: • 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; • 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.	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.
A hydro power plant2 that results in the creation of a new single reservoir or in the increase in an existing single reservoir where the power density of the 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 solar park and all power plants physically connected to the grid of the Republic of South Africa (Fig. B.3-1).

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

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

Source		Gas	Included?	Justification / Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project Activity	CO_2 emissions from the combustion of fossil fuels for electricity generation in solar thermal power plants	CO_2	No	GHG emissions for the present solar power generation project are equal to zero and no fossil fuels combustion will occur as part of the operation of the solar park.
		CH_4	No	
		N_2O	No	

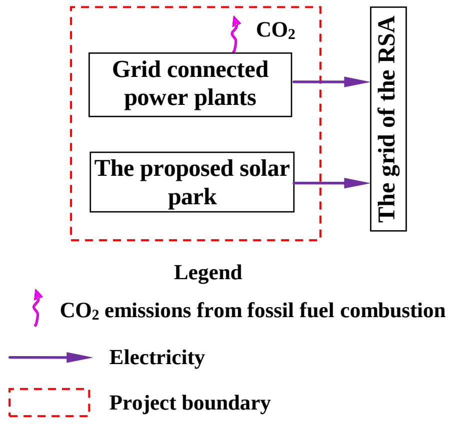

Fig. B.3-1: Project boundary

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

According to the ACM0002 (Version 12.2.0), 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 solar park 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 solar park 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):

According to the "Tool for the demonstration and assessment of additionality" the following step-wise approach should be employed:

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 the ACM0002 the baselines for eligible projects are:

1. *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".

ACM0002 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 solar park with an installed capacity of 20 MW or less. Produced electricity is supplied to the Eskom electricity network. The investment expenditure for a solar park project is very high and return on equity is very low. To date, there are no large solar parks in South Africa, only micro and small installations.

Based on these observations the proposed project is not a credible alternative without being registered as a CDM project activity. 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 solar park 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 corresponds to the baseline scenario identified in Section B.4.

Outcome of Sub-step 1a: Alternatives 1 and 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).

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

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

(a) The most economically or financially attractive; or

(b) Economically or financially feasible without the revenue from the sale of Certified Emission Reductions (CERs).

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

Sub-step 2a: Determine appropriate analysis method

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

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

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

Sub-step 2a: Determine appropriate analysis method

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

The proposed project activity generates financial and economic benefits other than CER revenues, so the simple cost analysis (Option I) is not applicable. Following the paragraph 19 of the "Guidelines on the assessment of investment analysis" (Version 05)[12] "*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.

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[12] http://cdm.unfccc.int/Reference/Guidclarif/meth/index_guid.html

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%[13]. This rate can be considered as a conservative benchmark for post-tax project IRR. Since the project IRR is calculated before tax, the benchmark should be adjusted accordingly: 9.0%*1/(1-0.28) = 12.5%.[14]

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

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

According to paragraph 7 of Step 2 of the "Tool for the demonstration and assessment of additionality" (Version 06.0.0) the project developer should while calculating a suitable financial indicator "*include all relevant costs (including, for example, the investment cost, the operations and maintenance costs), and revenues (excluding CER revenues, but possibly including inter alia subsidies/fiscal incentives*[15]*, 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)[16] 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)[17] where it sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in the RSA.

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[13] www.reservebank.co.za
[14] Income tax in the RSA is 28%, www.sars.gov.za/home.asp?pid=289#Incometa
[15] "*See EB guidance on the consideration of national/local/sectoral policies and measures for the baseline setting*"
[16] http://cdm.unfccc.int/EB/022/eb22_repan3.pdf
[17] http://unfccc.int/files/meetings/seminar/application/pdf/sem_sup1_south_africa.pdf

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

In March 2009 the Energy Regulator of South Africa (NERSA)[18] approved the Renewable Energy Feed - In Tariff (REFIT) to meet the government target of 10,000 GWh by 2013. REFIT for Photovoltaic solar parks was 3.94 ZAR/kWh. In March 2011 an updated REFIT of 2.311 ZAR/kWh was published[19], 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 Energy[20]. This scheme allows for a REFIT of 2.85 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 that will be received due to REFIT (compared with an income which would have been received in the absence of REFIT) should be excluded from the calculation of revenues. Instead, a hypothetical feed-in tariff (FIT) which would exist in the absence of such REFIT should be used to calculate the project IRR.

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.

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

[19] 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

[20] http://www.ipp-renewables.co.za/

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

Parameter	Unit	Value	Data source
Capacity of the solar park	MW	20	Environmental Impact Report for proposed solar farm in Prieska, October 2011
Load factor of the solar park	ratio	0.22	See Section A.4.3
The operating life of the solar park	years	20	NERSA Consultation Paper, Review of Renewable Energy Feed - In Tariffs March 2011, page 13.[21] (The term for a PPA is 20 years)
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[22]
Total investment cost	ZAR/kW	27 701	Solar Photovoltaic Project Report, Prieska, April 2011
Fixed O&M costs	ZAR/kWh	0.2366	NERSA Consultation Paper, Review of Renewable Energy Feed - In Tariffs March 2011, page 30, Table A7
Variable O&M costs	ZAR/kWh	0	
ZAR exchange rate	ZAR/USD	6.93	www.x-rates.com[23]

*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 have existed in the absence of REFIT. This is a conservative assumption since the price reflects transmission costs and losses, and therefore the hypothetical FIT should actually be less than Eskom's electricity price.

Project IRR before tax is -4.61%, 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.

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

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

23 Average over 5 most recent months (January – May 2011)

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. The sensitivity analysis should at least cover the range of +10% and -10%. A more robust sensitivity analysis with a range of +20% and -20% was applied.

The following variables were included in the sensitivity analysis:

- Income from electricity sale (which is affected by electricity tariff and quantity of net electricity generation supplied by the solar park to the grid).
- Investment cost; and
- Operations and Maintenance (O&M) costs.

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%
Electricity Price	-7.42%	-5.92%	-5.25%	-4.61%	-4.01%	-3.44%	-2.27%
Investment Cost	-2.78%	-3.76%	-4.20%	-4.61%	-5.00%	-5.36%	-5.80%
O&M Cost	-3.76%	-4.18%	-4.39%	-4.61%	-4.84%	-5.07%	-5.33%

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

Even with a decrease of 20% of the 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.

<u>Step 3: Barrier analysis</u>

The Barrier analysis is not applied.

Step 4: Common practice analysis

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

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

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

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

According to paragraph 44 of the "Tool for the demonstration and assessment of additionality" "*projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc*".

The list of power plants servicing RSA's grid is presented in Annex 3-2. No solar parks are producing electricity for supply to RSA's grid. At this stage solar parks are limited personal and micro installations due to the high investment cost.

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

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

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

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

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Project emissions

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

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

Where:

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

Baseline emissions

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The ACM0002 methodology (Version 12.2.0) assumes that electricity delivered to the grid by the solar park 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:

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

Where:

BE_y	=	Baseline emissions in year *y* (tCO_2/yr)
$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)
$EF_{grid,CM,y}$	=	Combined margin CO_2 emission factor for grid connected power generation in year *y* (tCO_2/MWh)

Calculation of $EG_{PJ,y}$

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

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

Where:

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

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

Combined margin CO_2 emission factor for grid connected power generation in year *y* ($EF_{grid,CM,y}$) is calculated using the "Tool to calculate the emission factor for an electricity system" (Version 02.2.0). 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.

<u>Step 1: Identify the relevant electricity systems</u>

A project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints.

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

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

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

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

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

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

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

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

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

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

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

(a) Simple OM; or

(b) Simple adjusted OM; or

(c) Dispatch data analysis OM; or

(d) Average OM.

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

Low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid. They typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation.

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

Table B.6-1: Electricity supplied to the national grid of the RSA, GWh[24]

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

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

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

- *Ex ante option*: The emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, use a 3-year generation-weighted average;
- *Ex post option*: The emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

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

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

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

The simple OM may be calculated:

Option A: Based on the net electricity generation and a CO_2 emission factor of each power unit; or

Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

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

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

Where:

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

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

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

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

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

Where:

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

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

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

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

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

Where:

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

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

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

Where:

$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$EF_{CO2,m,i,y}$	=	Average CO_2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/GJ). Constant value was adopted (see Section B.6.2 for details)
$\eta_{m,y}$	=	Average net energy conversion efficiency of power unit *m* in year *y* (ratio). Constant value was adopted (see Section B.6.2 for details)
m	=	All power units serving the grid in year *y* except low-cost/must-run power units. Option A2 is only used for gas turbine power plants (see Annex 3-3)
i	=	All fossil fuel types combusted in power unit *m* in year *y*
y	=	The relevant year as per the data vintage chosen in Step 3

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

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

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

> *Option 1:* For the first crediting period, calculate the build margin emission factor ex ante based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation. This option does not require monitoring the emission factor during the crediting period; or

> *Option 2:* For the first crediting period, the build margin emission factor shall be updated annually, ex post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available.

Option 1 was chosen.

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

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

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

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

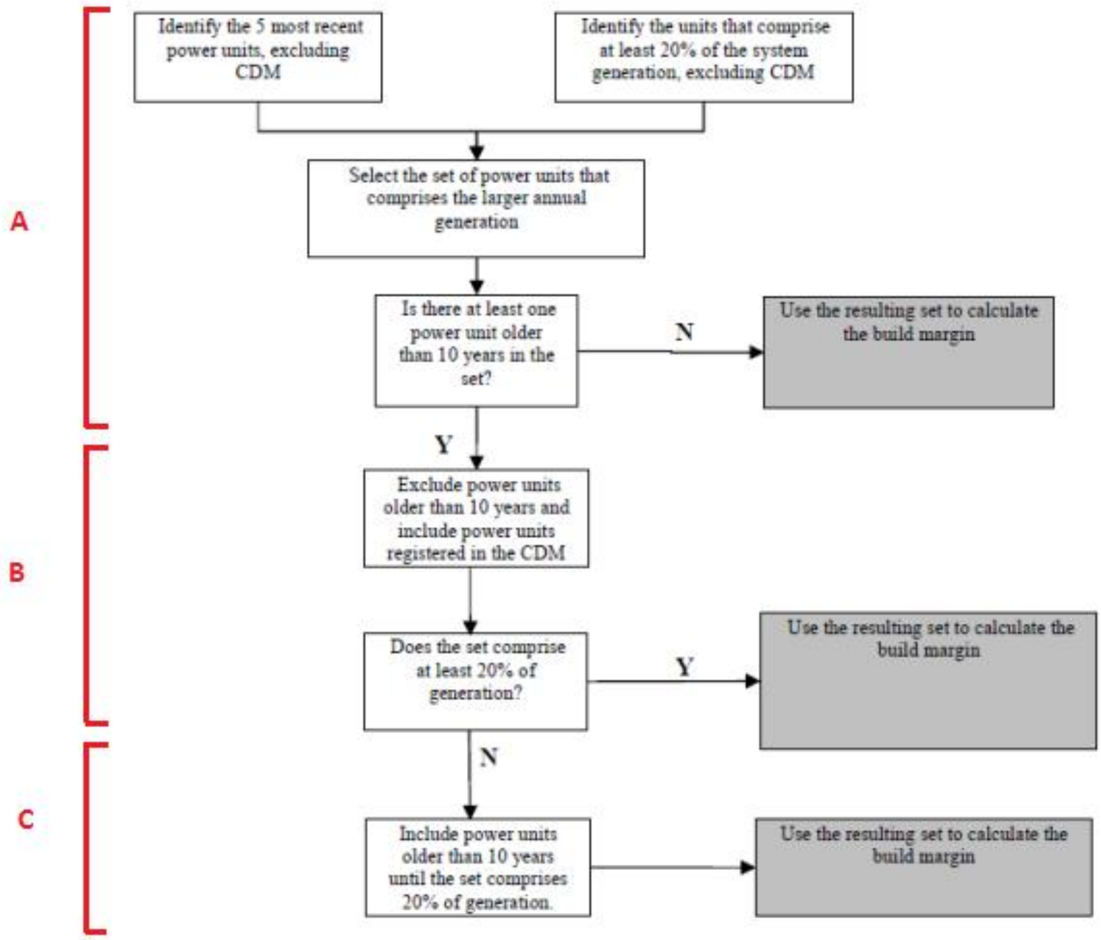

Fig. B.6-1: Build margin calculation algorithm

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

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

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

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

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

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

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

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

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

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

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

The power units in $\text{SET}_{\text{sample-CDM ->10yrs}}$ 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 (tCO_2/MWh) of all power units *n* included into the build margin during the most recent year *y* (2010 reporting year) for which power generation data is available, calculated as follows:

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

Where:

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

y	=	Most recent historical year for which power generation data is available. The 2010 reporting year was selected

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

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

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

Step 6: Calculate the combined margin 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 CO_2 emission factor for grid connected power generation in year *y* (tCO_2/MWh)
$EF_{grid,CM}$	=	Combined margin CO_2 emission factor for grid connected power generation calculated ex ante (tCO_2/MWh)
$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in the most recent year *y* (2010 reporting year) (tCO_2/MWh)
$EF_{grid,OM}$	=	Operating margin CO_2 emission factor (tCO_2/MWh)
w_{OM}	=	Weighting of operating margin emission factor
w_{BM}	=	Weighting of build margin emission factor

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

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

Leakage

No leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing and transport). These emissions sources are neglected.

Emission reductions

Emission reductions are calculated as follows:

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

Where:

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

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

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

Data / Parameter:	$FC_{i,m,y}$
Data unit:	mass or volume unit
Description:	Amount of fossil fuel type *i* consumed by power unit *m* in year *y*
Source of data used:	Eskom's statistic data
Value applied:	See Annex 3-3
Justification of the choice of data or 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:	$NCV_{coal,y}$
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	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.

measurement methods and procedures actually applied :	The default NCV that is available on the Eskom website is 0.02509 TJ/t fuel.[25] 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:	$EF_{CO2,coal,y}$
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of Other Bituminous Coal
Source of data used:	2006 IPCC Guidelines for National GHG Inventories, volume 2: Energy, Chapter 1, Table 1.4
Value applied:	0.0895
Justification of the choice of data or description of measurement methods and procedures actually applied :	For the sake of a conservative approach the IPCC default value at the lower limit of the uncertainty at a 95% confidence interval is used. The default emission factor that is available on the Eskom website is 25.8 tC/TJ.[26] 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:	$EF_{CO2,NG,y}$
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, 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

[25] http://www.eskom.co.za/c/article/236/cdm-calculations/

[26] http://www.eskom.co.za/c/article/236/cdm-calculations/

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 for calculation of the Build Margin.
Source of data used:	Tool to calculate the emission factor for an electricity system, Annex 1
Value applied:	0.37
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value is used
Any comment:	This value was appointed as a constant to Majuba and Kendal power plants for the calculation of build margin CO_2 emission factor (refer to Annex 3-5).

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

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

measurement methods and procedures actually applied :	
Any comment:	The data for 2010 reporting year is provided.

Data / Parameter:	$EF_{grid,CM}$
Data unit:	tCO_2/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:	$LF_{facility}$
Data unit:	Ratio
Description:	Load factor for the solar park
Source of data used:	Preferred supplier of the solar panels (Gestamp Solar)
Value applied:	0.22
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated by Gestamp Solar based on measurements done at a PV test facility.[27]
Any comment:	This value is used for estimating the amount of electricity that will be generated by the solar park. This value will not be monitored. Instead the actual amount of electricity that is produced (MWh) will be monitored by electricity meters.

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

Combining equations (B.6-1), (B.6-2), (B.6-3), (B.6-9) and (B.6-10) the annual emission reductions can be calculated as follows:

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

Where:

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

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

[27] Prieska PV Report April 2011

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation calculated ex ante (tCO_2/MWh)

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

The estimated amount of electricity annually supplied by the solar park to the Eskom electricity network during the first 7-year crediting period is presented in Table B.6-2.

The 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 solar park to the grid ($EG_{facility,y}$) during the first 7-year crediting period, MWh

Year	$EG_{facility,y}$ (MWh)
2013 (From 1 October to 31 December)	9 636
2014	38 544
2015	38 544
2016	38 544
2017	38 544
2018	38 544
2019	38 544
2020 (From 1 January to 30 September)	28 908

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)
2013 (From 1 October to 31 December)	0	9 520	0	9 520
2014	0	38 081	0	38 081
2015	0	38 081	0	38 081
2016	0	38 081	0	38 081
2017	0	38 081	0	38 081
2018	0	38 081	0	38 081
2019	0	38 081	0	38 081
2020 (From 1 January to 30 September)	0	28 561	0	28 561
Total (tonnes of CO_2 e)	0	**266 567**	0	**266 567**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$EG_{facility,y}$
Data unit:	MWh/yr
Description:	Quantity of net electricity generation supplied by the solar park to the grid in year *y*
Source of data to be used:	On-site measurement with electricity meters
Value of data applied for the purpose of calculating expected emission reductions in section B.5	(see table below)
Description of measurement methods and procedures to be applied:	Measurement by means of electricity meters installed at the point of supply which defines the commercial boundary between Eskom and the solar park owner. The generated electricity will be continuously measured and recorded. Data on electricity supply will 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.

Year	**Value (MWh)**
2013 (From 1 October to 31 December)	9 636
2014	38 554
2015	38 554
2016	38 554
2017	38 554
2018	38 554
2019	38 554
2020 (From 1 January to 30 September)	28 908

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 from the date of commissioning of the solar park or the date of registration of the proposed project 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 solar park 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 will be continuously measured. The metering instruments shall be installed in accordance with the requirements of Grid and the Distribution Metering Codes at the point of supply which defines the commercial boundary between Eskom and the solar park owner. Readings of the electricity meters shall be cross-checked with records for sold electricity. Data on electricity supply will 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 solar park.

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

3. The monitoring team

The power plant staff shall undergo the necessary training related to operation and maintenance of the solar park and all of the installed equipment. The training shall take place at the manufacturer's facility and on site at the power plant. The maintenance personnel of the solar park are responsible for daily control over the monitoring plan implementation.

The Chief Engineer of the solar park is responsible for timely calibration of all instrumentation in accordance with the manufacturer's requirements. The management of Mulilo Renewable Energy Solar PV Prieska (Pty) Ltd is fully responsible for the project implementation and overall control as well as collection of all data required for calculation of GHG emission reductions.

Specialists of Blue World Carbon Asset Management (Pty) Ltd will calculate GHG emission reductions with data that will be provided by Mulilo Renewable Energy Solar PV Prieska (Pty) Ltd.

In case of any doubts as to the accuracy of the data, the specialists of Mulilo Renewable Energy Solar PV Prieska (Pty) Ltd shall check and correct the data. The preliminary version of the monitoring report shall be submitted to the specialists of Mulilo Renewable Energy Solar PV Prieska (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.

Specialists of Blue World Carbon Asset Management (Pty) Ltd shall regularly (at least annually) carry out "test verifications" with a view to ensure that the monitoring plan at Mulilo Renewable Energy Solar PV Prieska (Pty) Ltd is applied correctly.

4. Data storage

All data collected as part of monitoring plan should be archived electronically and be 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 organisations that are licenced for this type of activity, according to the requirements of the manufacturing company and to the schedule developed by Mulilo Renewable Energy Solar PV Prieska (Pty) Ltd.

6. Emergency situations

If any instrument that is used in the monitoring process fails, Mulilo Renewable Energy Solar PV Prieska (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 solar panels the electricity generation will go down, and amount of electricity supplied to the grid by the solar park will be reduced. All accidents that may occur at the solar park shall be recorded by Mulilo Renewable Energy Solar PV Prieska (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: 01/06/2011

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), Tom Hugo (tom.hugo@blueworldcarbon.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)[28] 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 October 2012 (start of construction).

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

30 years[29]

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:

01/10/2013

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

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

[29] K. Branker (*et al.*) "A review of solar photovoltaic levelized cost of electricity" *Renewable and sustainable energy reviews*, 15 (2011) 4470-4482.

SECTION D. Environmental impacts

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

The Environmental Impact Assessment (EIA) of the proposed project was carried out in accordance with the South African legislation by DJ Environmental Consultants (DJEC). The draft Environmental Impact Report (EIR) was published for public review and comment over a period of 40 days from October 2010. Hereafter the EIR was submitted to the Department of Environmental Affairs (DEA) in November 2010 for a decision. On 6 April 2011 the Record of Decision (ROD) was obtained and Environmental Authorisation was granted for the Prieska Solar Park.

Summary of EIR

Based on the findings of all the credible specialists who undertook their respective specialist studies (based on the approved terms of references), it is concluded that the overall impact of this development is low. This development has been reviewed by using the triple bottom line approach, which clearly shows that this is a sustainable development with a balance between the biodiversity, social and economic elements. Global dependence on fossil fuels and the impacts of climate change is of global concern. South Africa's energy is largely fossil fuel dependent. The government therefore aims to meet targets which have been set to incorporate more renewable energy into the energy mix and reduce carbon dioxide emission. The proposed solar farm is a step in this direction as this form of energy is considered to be a clean fuel which has not only local but also global benefits. The benefits of this proposed development with respect to biodiversity, social and economic elements outweigh the negative impacts. All measures and recommendations proposed by the various specialists are considered achievable and should be included as conditions of approval.

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

Botanical

The activities for the Prieska solar park are not located on vegetation types which are regarded as "threatened on a national basis" and the vegetation is widespread within the Nama Karoo. Overall botanical sensitivity is rated as *medium*. Since the scoping phase the layout has been amended to avoid sensitive species including three protected plant species.

The botanical study finds that the development would have *no significant* impacts as impacts identified during the scoping phase have been avoided and the vegetation on site is not threatened on a national basis.

Avifauna

The avifaunal assessment reports that the development would have *no significant* or long term impacts. Long term impacts monitoring, however, has been recommended.

Archaeology

The key findings of the Archaeological Impact Assessment were that relatively large numbers of Later Stone Age tools were recorded over the proposed development site. However, the vast majority of tools were found outside the proposed 34ha development site, which is already quite severely degraded, consisting of demolished mine works, tailings and old farm infrastructure.

Indications from the Archaeological Impact Assessment are that in terms of archaeological heritage, the proposed project is viable, and impacts are expected to be *limited* as no fatal flaws have been identified.

Palaeontology

The palaeontological impact assessment study outlines the fossil heritage recorded within each of the three rock units occurring within the study area in order of decreasing geological age as follows:

• Fossils in the Jacobsmyn Pan Group

• Fossils in the Dwyka Group

• Fossils in the Kalahari Group

The study indicated palaeontological sensitivity to be *low – zero* for the proposed site. There are therefore no significant impacts to be expected as a result of the proposed development.

Heritage

Part of the brief of the heritage study was to identity heritage resources and buildings older than 60 years affected by the proposal or within the immediate environs and affected visually by the proposal. The study revealed that there were old and dilapidated buildings which form part of the disused mining area, but these buildings were not older than 60 years. No buildings older than 60 years were found either on the site or in the general vicinity of the site. The heritage study also found that there are no channelled views due to the opens of the landscape and little vertical relief. Vertical elements on this site are local comprising the mine shaft which is visible from many points some disused pylons to the north of the site and to a lesser extent low tree canopy in the town. In terms of the cultural landscape, which is defined by the World Heritage Committee as “the combined work of nature and man”, the proposed site was found that the affected landscape is not part of a designed landscape or one which exhibits characteristic of organic human settlement and growth nor is it an associative landscape or one associated with valued religious and cultural associations. The morphology of the landscape may be described as typical central Karoo landscape that comprises flat open extensive vistas of sky. It is generally flat sandy land of grassland and scrub.

No heritage related constraints therefore exist on the site and the area comprises no cultural landscapes of significance.

Visual

The key findings of the visual impact assessment study were that the overall visual impression of the locality is one of an open flat rural landscape, offering long expansive views. The visual characteristic of the area is that of a completely uncluttered landscape; even the clutter of the mine and of the town is set in a landscape of such a scale that they do not form a visual focus. Generally photovoltaic installations make a strong visual statement. They are not high, below 2.5m and it is the scale of their footprint that is so large. Although they are generally expected to be visible for most receptors living and working locally up to 2 km, and to a lesser degree, up to a 5km distance, the proposed Prieska site is remote and has few receptors living and working locally. In addition, some adjacent areas are already despoiled through mining. The visual envelope indicates that receptors are largely confined to those to the north. The locality is ideally suited to this form of development. It was also found that the view shed for the development site is defined by:

- Copperton town, Airfield, and the ground to the north and north east.
- Munitions testing site
- Mine
- R357 and other local roads

The Visual impact of the proposed development has been assessed as *moderate* and with time may reduce to *moderate-low* as mitigation matures.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

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

SECTION E. Stakeholders' comments

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

The project owner appointed DJ Environmental Consultants (DJEC) to undertake the Scoping and Environmental Impact Assessment (EIA) as well as the Public Participation Process (PPP) in terms of the NEMA EIA Regulations, CDM requirement based on the Kyoto protocol, for the proposed project activity. The activities undertaken to canvass public opinion regarding the proposed project activity are summarised in Table E.1-1.

An advertisement announcing the EIA Process and inviting Interested and Affected Parties (I&APs) to register on the project database was placed in "Die Plattelander" on 27 November 2009. All registered I&APs[30] were sent a copy of the Background Information Document (BID).

Because the farms are very far apart and are on private property with no public access, site notices were placed at the boundary of each farm along the main roads that lead to the farm entrances. Notices were also placed on the project site. Notices advertised the proposed development and invited I&APs to register on the project database.

The Draft Scoping Report was available from 9 July 2010 to 17 August 2010 at the Elizabeth Vermeulen and Alpha Public Libraries and at the DJEC offices. Notice of the availability was also sent to all registered I&APs informing them of the release of the Draft Scoping Report for public review and comment. Hardcopies of the Draft Scoping Report was also sent to the flowing departments:

- National Department of Environmental Affairs
- Department of Environment, Nature and Conservation – Northern Cape
- Department of Agriculture, Land Reform and Rural Development – Northern Cape
- Pixley Ka Seme District Municipality
- Siyathemba Local Municipality

The draft Environmental Impact Report (EIR) was available from 9 July 2010 to 17 August 2010 at the Elizabeth Vermeulen and Alpha Public Libraries and at the DJEC offices. In addition letters were also sent out to all registered I&AP, notifying them on the availability of the EIR for review and comment. I&APs were afforded an opportunity to raise their issues and concerns regarding the proposed development during the consultation process. All comments and responses were compiled and added to the EIR, which was subsequently sent to the following departments:

- Department of Environment, Nature and Conservation – Northern Cape
- Department of Agriculture, Land Reform and Rural Development – Northern Cape
- Pixley Ka Seme District Municipality
- Siyathemba Local Municipality

[30] Final Environmental Impact Report, November 2010, Annexure 6A

A draft Environmental Management Programme (EMP) was also complied and submitted along with the Draft EIR. An EMP is a document created to provide a framework for dealing with the pollution and other environmental risks associated with their site and activities.

Finally the EIR along with an Issues Trail Report and the draft EMP was submitted to DEA for a decision. The Record of Decision (ROD) for environmental authorisation was obtained from DEA on 6 April 2011.

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

Activity	Date
Phase 1: Project initiation	
Submission of Application to Department of Environmental Affairs (DEA)	Application submitted to DEA on: 28 October 2009
DEA Acknowledgement of Application	20 November 2009
Identification of (Interested and Affected Parties) I&APs	November 2009
Advertisement of the process	The application was advertised in "Die Plattelander" on 27 November 2009.
Placement of posters on site	Posters indicating the proposed project were placed on the site on 24 November 2009.
Letters to surrounding land owners	Letters to adjoining land owners of the proposed development site were sent on 9 February 2010
Phase 2: Initial public consultation process	
Circulation of Background Information Document (BID) to I&APs	16 March 2010
End of comment period on BID and registration for I&AP	18 April 2010
Phase 3: Scoping	
Registered I&APs made aware of the availability of the Draft Scoping Report (DSR). The DSR was made available in the Elizabeth Vermeulen and Alpha Public Libraries.	9 July 2010
End of official comment period on DSR	17 August 2010
Final Scoping Report (FSR) was submitted to DEA for approval	19 August 2010
Phase 4: EIA	
DEA approval of FSR and (Plan of Study) PoS for EIA	23 September 2010
Appointment of specialists to undertake studies	November 2009
Registered I&APs were made aware of the availability of the Draft EIR and Draft Environmental Management Plan (EMP).	15 October 2010
End of official comment period on Draft EIR and	25 November 2010

Activity	Date
Draft EMP	
Collation of comments from I&APs	30 August 2010 and on-going until report is finalised
Submission of final EIR and draft EMP to DEA for authorization	November 2010
Record of Decision (ROD) from DEA for environmental authorisation	6 April 2011

E.2. Summary of the comments received:

The following comments were received:

- Route alternatives to the site that reduce the footprint area are preferred and no rare or threatened plant species were identified in the area.
- The identification and assessment of impacts are detailed in the EIR dated November 2010 and sufficient assessment of the key identified issues and impacts have been completed.
- The procedure followed for the impact assessment is adequate for the decision-making process.
- The proposed mitigation of impacts identified and assessed adequately curtails the identified impacts.
- All legal and procedural requirements have been met.
- The information in the EIR dated November 2010 is accurate and credible.
- EMP measures for the pre-construction, construction and rehabilitation phases of the development were proposed and included in the EIR and will be implemented to manage the identified environmental impacts during the construction process.

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

No negative comments were raised by the stakeholders. All stakeholders' comments and concerns were taken into account and considered in the EIR and environmental management plan.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Mulilo Renewable Energy Solar PV Prieska (Pty) Ltd
Street/P.O.Box:	Tower Road
Building:	Execujet Business Centre
City:	Cape Town
State/Region:	Western Cape
Postcode/ZIP:	7525
Country:	Republic of South Africa
Telephone:	+27 (0) 21 934 5268
FAX:	+27 (0) 21 935 0505
E-Mail:	info@mulilo.com
URL:	www.mulilorenewableenergy.com
Represented by:	
Title:	Director
Salutation:	Mr.
Last name:	Coetsee
Middle name:	-
First name:	Johannes
Department:	
Mobile:	
Direct FAX:	+27 (0) 21 935 0505
Direct tel:	+27 (0) 21 934 5278
Personal e-mail:	johannes@mulilo.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Annex 3

BASELINE INFORMATION

Annex 3-1. The national grid of the RSA (Eskom electricity network)[31]

31 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)[32,33]

Name of power plant	Location	Type of power plant (PP)	Type of fuel	Date of commissioning/ (Re-commissioning)*	Total net maximum capacity, MW
Arnot	Middelburg, Mpumalanga	Thermal PP	Coal	1971.09.21	2 232
Camden[34]	Ermelo, Mpumalanga	Thermal PP	Coal	(2005.03.31)	1 440
Duvha	Witbank, Mpumalanga	Thermal PP	Coal	1980.01.18	3 450
Grootvlei[35]	Balfour, Mpumalanga	Thermal PP	Coal	(2008.03.31)	760
Hendrina	Mpumalanga	Thermal PP	Coal	1970.05.12	1 865
Kendal	Witbank, Mpumalanga	Thermal PP	Coal	1988.10.01	3 840
Komati[36]	Middelburg, Mpumalanga	Thermal PP	Coal	(2009.01.05)	170
Kriel	Bethal, Mpumalanga	Thermal PP	Coal	1976.05.06	2 850
Lethabo	Viljoensdrift, Free State	Thermal PP	Coal	1985.12.22	3 558
Majuba	Volksrust, Mpumalanga	Thermal PP	Coal	1996.04.01	3 843
Matimba	Lephalale, Limpopo	Thermal PP	Coal	1987.12.04	3 690

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

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

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

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

[36] 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
Matla	Bethal, Mpumalanga	Thermal PP	Coal	1979.09.29	3 450
Tutuka	Standerton, Mpumalanga	Thermal PP	Coal	1985.06.01	3 510
Acacia	Cape Town, Western Cape	Gas turbine PP	Kerosene	1976.05.13	171
Port Rex	East London, Eastern Cape	Gas turbine PP	Kerosene	1976.09.30	171
Ankerlig	Atlantis, Western Cape	Gas turbine PP	Natural gas	2007.03.29	1 327
Gourikwa	Mossel Bay, Western Cape	Gas turbine PP	Natural gas	2007.03.30	740
Colley Wobbles	Mbashe River, Eastern Cape	Hydro PP	-	1900.01.01	0
Ncora	Ncora River, Eastern Cape	Hydro PP	-	1900.03.01	0
First Falls	Umtata River, Eastern Cape	Hydro PP	-	1900.02.01	0
Gariep	Norvalspont, Free State	Hydro PP	-	1971.09.08	360
Second Falls	Umtata River, Eastern Cape	Hydro PP	-	1900.04.01	0
Vanderkloof	Petrusville, Northern Cape	Hydro PP	-	1977.01.01	240
Drakensberg	Bergville Kwazulu-Natal	Hydroelectric Pumped Storage PP	-	1981.06.17	1 000
Palmiet	Grabouw, Western Cape	Hydroelectric Pumped Storage PP	-	1988.04.18	400
Koeberg	Cape Town, Western Cape	Nuclear PP	-	1984.07.21	1 800
Klipheuwel	Klipheuwel, Western Cape	Wind farm	-	**	3

* Re-commissioned units are: Camden, Grootvlei and Komati.**No data available

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

The list of power plants included into the operating margin[37]

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

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

Net quantity of electricity generated and delivered to the grid by the power plants included into the operating margin ($EG_{m,y}$)[38]

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.

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

Amount of fossil fuel consumed by the power plants included into the operating margin ($FC_{i,m,y}$)[39]

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

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

Annex 3-4. Determination of power units included into the build margin[40]

Determination of the set of power units SET_{sample}

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

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

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

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

[40]Based 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)

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

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

Name of power plant	Type of power plant (PP)	Type of fuel	Date of commissioning	Fuel consumption ($FC_{i,n,y}$), tonnes	Net electricity generation ($EG_{n,y}$), MWh	Weight fraction in total net electricity generation*	Accumulated weight fraction
Bethlehem Hydro[41]	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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Calculation of the net cash flow in ZAR

	Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Investment cost	mZAR	-554.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Income from elecricity sale	mZAR		25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4
Cost of electricity generation	mZAR		-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1
Total income from the project implementation	mZAR		16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3
Net cash flow	mZAR	-554.0	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3

Pre-tax Project IRR

Parameter	Unit	Value
Pre-tax Project IRR	**%**	**-4.61%**

Calculation of the net cash flow in USD

	Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Investment cost	mUSD	-80.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Income from elecricity sale	mUSD	0.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Cost of electricity generation	mUSD	0.0	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3
Total income from the project implementation	mUSD	0.0	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Net cash flow	mUSD	-80.0	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3

Pre-tax Project IRR

Parameter	Unit	Value
Pre-tax Project IRR	**%**	**-4.61%**

Annex 4

MONITORING INFORMATION

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