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

CONTENTS

SECTION A. General description of project activity

A.1. Title of the project activity:

Kathu Grid Connected 100 MW Solar Park, South Africa

Version number: 1.0

Date: 08 November 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 development envisages the construction and operation of a solar park with an installed capacity of up to and including 100 MW. The solar park will be equipped with a cluster of photovoltaic (PV) panel arrays, and the associated infrastructure. Produced electricity will be supplied to the Eskom electricity network.

The proposed project is located 16 km North-West of the town of Kathu situated in the Northern Cape Province of the RSA.

The anticipated starting date for construction and installation works under this project is the 1st of July 2012. It is planned that the project will be developed in two phases: phase 1 – 75 MW, phase 2 – 25 MW, which will be implemented concurrently, with commissioning planned in March 2014. The required investment into the project amounts to 250 million Euro (or 2 436 million ZAR)[2].

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.

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 80-110 jobs during the construction phase and 10 jobs during the operation phase;

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

[2] Average exchange rate over last 8 months, (January – August 2011), 9.74 (ZAR/EURO), http://www.x-rates.com/d/ZAR/EUR/hist2011.html

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[3] and the objective to reduce RSA's GHG emissions by approximately 34% below the current emissions baseline by 2020.[4]

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)	• Renewable Energy Investments of South Africa (Pty) Ltd (REISA)	No
One of the Parties to Annex B of the Kyoto Protocol	• To be determined upon the registration of the project by the CDM EB	No

Renewable Energy Investments of South Africa (Pty) Ltd (REISA)

The project is being developed by REISA, a private company established for the following activities:

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

REISA will transfer the project into two Special Purpose Vehicles (SPVs) which will be specially established to run the solar parks.

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[3] http://www.energy.gov.za/files/renewables_frame.html

[4] http://www.unep.org/climatepledges/Default.aspx?pid=68

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

The Republic of South Africa (RSA)

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

Northern Cape Province

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

The town of Kathu

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

Kathu, 'the town under the trees', came into being because of Iscor's iron ore mining activity in the Kalahari and connected to it by road, rail and air through nearby Kimberley, the modern, model town is strategically situated. Some of the world's longest ore trains travel through harsh territory to offload their precious cargo at Saldanha Bay.

The location of Kathu with respect to the RSA can be seen in Figure A.4-1.

Geographical latitude: 27º35' S. Geographical longitude: 25º40' E. Time zone: GMT +02:00.

The Project activity is proposed on Portion 4 of the Farm Wincanton 472, which lies approximately 16 km north-west of the town of Kathu and 2 km east of the small township of Dibeng, as can be seen in Figure A.4-2.

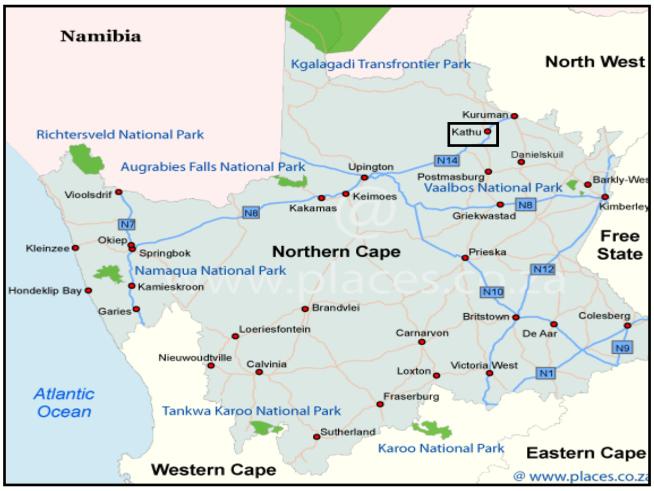

Figure A.4-1: Location of Kathu in the Republic of South Africa

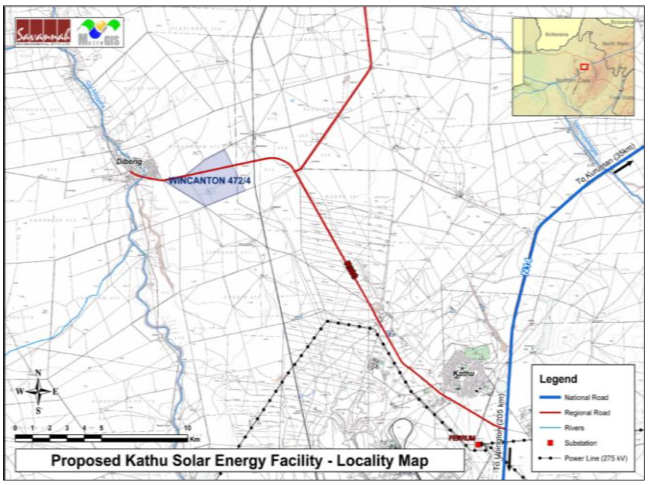

Figure A.4-2: Kathu Solar Energy Facility – Locality Map illustrating the location of the proposed development site

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 development envisages the construction and operation of a solar park with an installed generating capacity of up to and including 100 MW. The solar park will be equipped with a cluster of photovoltaic (PV) panel arrays, which may possibly be installed on a tracker system. 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[5]. The 100 MW solar park will produce 192 720 MWh/year[6].

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[5] The load factor was established by REISA's test facility. This value is conservative since it is higher than the load factor of 0.18 given by Renewable Energy Feed-In Tariff Guidelines for solar park projects.

[6] A load factor of 22% applies, therefore: 100 MW x 22% x 24h x 365day/year = 192 720 MWh/year

Figure A.4-1: An illustration of a PV solar panel

The project implementation schedule is presented in Table A.4-1. Construction of the solar park will be done in two phases of 75 MW and 25 MW each, running concurrently.

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

Number	Action	Date
1	Completion of Environmental Impact Assessment (EIA)	January 2011
2	Start of construction and installation works	July 2012
3	Start of operation	March 2014

Quantity of net electricity generation supplied by the solar park to the grid will be determined on the basis of electricity meters. The metering instruments will be installed in accordance with the requirements of the Grid and the Distribution Metering Codes at the points of supply which define 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)[7] and is equal to 0.988 tCO_2/MWh.

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

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

The 7-year crediting period with the option of renewal was selected for the project as can be seen in Table A.4-2.

Table A.4-2: Estimated amount of emission reductions over the 7 year crediting period

Years	Annual estimation of emission reductions in tonnes of CO2 e
2014 (from 01/03 to 31/12)	158 673
2015	190 407
2016	190 407
2017	190 407
2018	190 407
2019	190 407
2020	190 407
2021 (from 01/01 to 28/02)	31 734
Total estimated reductions (tonnes of CO_2 e)	**1 332 849**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**190 407**

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)[8] 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)[9] is used to calculate the combined margin CO_2 emission factor of the Republic of South Africa's grid.

"Tool for the demonstration and assessment of additionality" (Version 06.0.0)[10] 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).

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[8] http://cdm.unfccc.int/UserManagement/FileStorage/LTUGMDQZP69E472IOYK8XR0CBHFV1J

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

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

Table B.2-1: Applicability conditions check

Applicability condition	Applicability	Comment
The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit;	Applicable	The project activity is the installation of 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 10 to calculate the parameter EGPJ,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; therefore 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; therefore 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 does not need to 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 does not need to satisfy this applicability condition.
Hydro power plants that result in new reservoirs or in the increase in existing reservoirs where the power density of the power plant is less than 4 W/m^2.	Not applicable	The project activity is not the installation of a hydro power plant. According to the ACM0002, the project activity does not need to 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 (Figure B.3-1).

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

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

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	

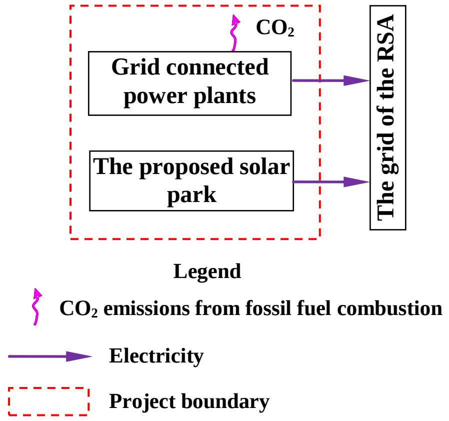

Figure B.3-1: Project boundary

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

According to the ACM0002 (Version 12.2.0), if the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the following:

- Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system".

The project activity is the installation of a new grid-connected 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):

The additionality of the project activity is demonstrated and assessed using the latest version of the "Tool for the demonstration and assessment of additionality" (Version 06.0.0). This tool provides for the following step-wise approach:

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

Step 2: Investment analysis (optional)

Step 3: Barrier analysis (optional)

Step 4: Common practice analysis

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

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

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

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

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

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

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

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

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

According to ACM0002 (Version 12.2.0), if the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the following:

- Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system".

The "Tool for the demonstration and assessment of additionality" also states:

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

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

This alternative envisages the construction and operation of a grid connected solar park with an installed capacity of 100 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: Alternative 1 and Alternative 2 are carried to Sub-step 1b.

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

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

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

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

Step 2: Investment analysis

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

(a) The most economically or financially attractive; or

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

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

Sub-step 2a: Determine appropriate analysis method

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

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

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

Sub-step 2a: Determine appropriate analysis method

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

The proposed project activity generates financial and economic benefits other than CER revenues, so the simple cost analysis (Option I) is not applicable. Following point 19 of the "Guidelines on the assessment of investment analysis" (Version 05)[11] "*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: Option III. Apply benchmark analysis

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

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

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

According to point 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%[12]. 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%.[13]

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 Sub-step 2c 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[14], ODA, etc where applicable)*".

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)[15] where the EB separated out the 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)[16] where it sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in the RSA.

White Paper, page i, *"It is in this context that the Ministry is committed to this policy document which is intended to give much needed thrust to renewable energy; a policy that envisages a range of measures to bring about integration of renewable energies into the mainstream energy economy. To achieve this aim*

[12] www.reservebank.co.za

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

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

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

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

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)[17] 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[18], 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[19]. 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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17 http://www.nersa.org.za/

18 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

19 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	100	Environmental Impact Report for proposed solar farm in Kathu, January 2011
Load factor of the solar park	ratio	0.22	See Section A.4.3
The period of assessment	years	20	Refer to point 3 in the “Guidelines on the assessment of investment analysis” (Version 05)
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, Table 1[20]
Total investment cost	ZAR/kW	24 362	Kathu Project Developer
Fixed O&M costs	ZAR/kWh	0.2366	NERSA Consultation Paper, Review of Renewable Energy Feed - In Tariffs March 2011, [21] page 30, Table A7
Variable O&M costs	ZAR/kWh	0	
ZAR exchange rate	ZAR/Euro	9.74	www.x-rates.com[22]

*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 -3.47%, which is below 12.5% benchmark.

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

Sub-step 2d: Sensitivity analysis

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

According to the paragraph 20 of the “Guidelines on the assessment of investment analysis” (Version 05) only variables that constitute more than 20% of either total project costs or total project revenues should be included in the sensitivity analysis. 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.

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[20] www.eskom.co.za/content/MediaStatementMYPD2~1.pdf

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

[22] Average over 8 most recent months (January – August 2011)

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 Cost	-6.32%	-4.80%	-4.11%	-3.47%	-2.86%	-2.28%	-1.19%
Investment Cost	-1.61%	-2.61%	-3.05%	-3.47%	-3.86%	-4.22%	-4.89%
O&M Cost	-2.60%	-3.03%	-3.25%	-3.47%	-3.70%	-3.93%	-4.41%

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.

Step 3: Barrier analysis

According to "Tool for the demonstration and assessment of additionality (version 06.0.0)", this PDD skips the barrier analysis and argues the additionality.

Step 4: Common practice analysis

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

According to "Tool for the demonstration and assessment of additionality (version 06.0.0)", "*Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc.*"

The activities similar to the proposed project activity were selected according to the following three criteria:

1. **Region:** The proposed project will be a newly-built 100 MW photovoltaic power plant in the Northern Cape Province in South Africa, and the electricity generated from the proposed project will be supplied to South African National Grid. Therefore, the selected geographical area for the similar project is South Africa.
2. **Time frame:** The White Paper[23] on Renewable Energy recognises that the medium and long-term potential of renewable energy is significant. This Paper sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in

[23] www.energy.gov.za/files/policies/whitepaper_renewables_2003.pdf

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

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

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

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

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

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

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

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

In conclusion, the proposed project activity passed all criteria of "Tool for the demonstration and assessment of additionality (Version 06.0.0)" and the proposed project is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Project emissions

Since the project activity uses 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:

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

Where:

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

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

Calculation of $EG_{PJ,y}$

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

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

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

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

Combined margin CO_2 emission factor for grid connected power generation in year *y* ($EF_{grid,CM,y}$) is calculated using the "Tool to calculate the emission factor for an electricity system" (Version 02.2.0). According to this tool the following six steps shall be applied:

Step 1: Identify the relevant electricity systems;

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

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

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

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

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

Step 1: Identify the relevant electricity systems

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

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

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

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

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

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

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.

<u>Step 3: Select a method to determine the operating margin (OM)</u>

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:

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

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:

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

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 Figure 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.

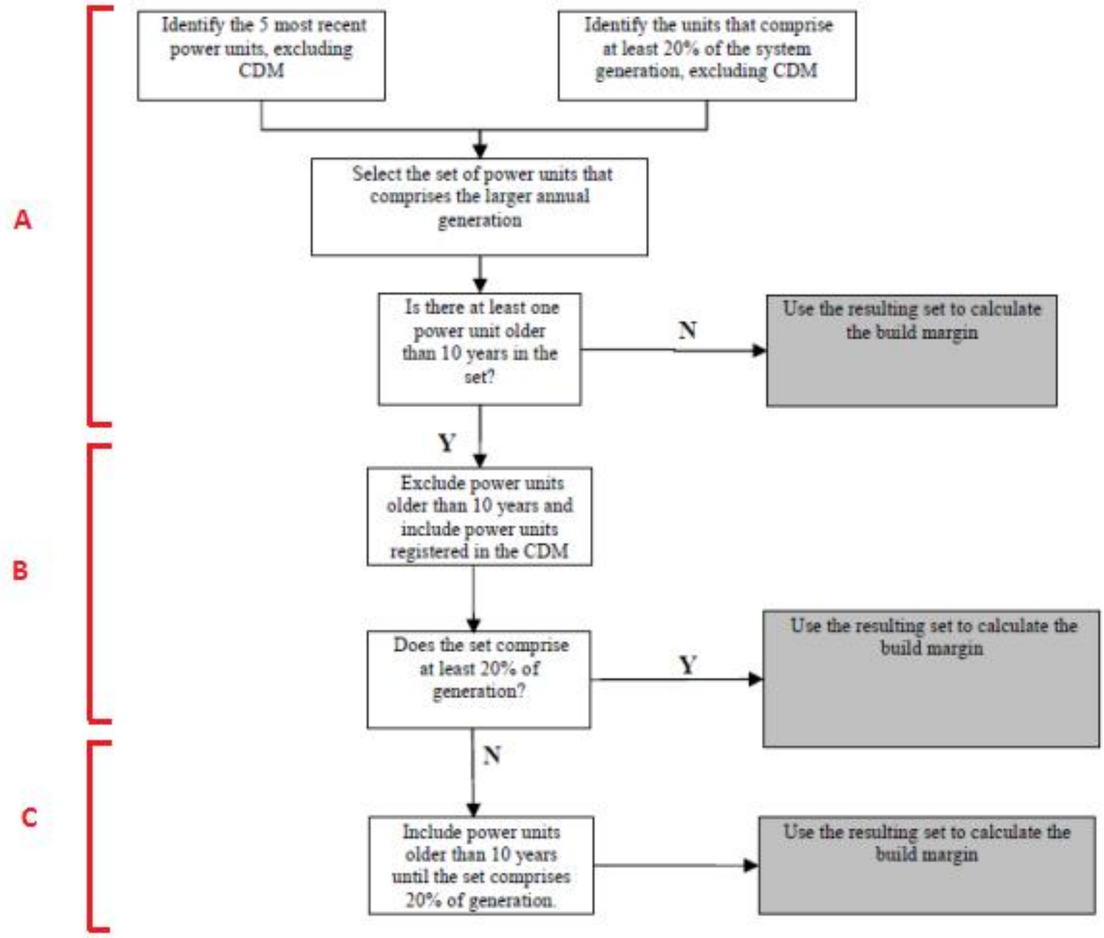

Figure B.6-1: Build margin calculation algorithm

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

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-}units}$) 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 $SET_{sample\text{-}CDM\ \text{->}10yrs}$ was used to calculate the build margin. The list of power plants included into the build margin is presented in Annex 3-4.

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

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

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 measurement methods and procedures actually applied :	For the sake of a conservative approach the IPCC default value at the lower limit of the uncertainty at a 95% confidence interval is used. The default NCV that is available on the Eskom website is 0.02509 TJ/t fuel.[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	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.

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

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

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

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

Data / Parameter:	$\eta_{m,y}$
Data unit:	ratio
Description:	Average net energy conversion efficiency of coal fired power plant that has operated for more than 10 years 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 measurement methods and procedures actually applied :	Official statistics, publicly available and reliable data source
Any comment:	The data for 2010 reporting year is provided.

Data / Parameter:	$EF_{grid,CM}$
Data unit:	tCO_2/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_{sp}
Data unit:	Ratio
Description:	Load factor of the solar park
Source of data used:	REISA
Value applied:	0.22
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value is conservative since it is higher than the load factor of 0.18[27] given by Renewable Energy Feed-In Tariff Guidelines for PV panels.
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.

[27] Table A7 of page 30 in the March 2011 Review of Renewable Energy Feed - In Tariffs

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:

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

Where:

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

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

The estimated amount of electricity annually supplied by the solar park to the Eskom electricity network during the 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 ($EG_{\text{facility,y}}$) during the 7-year crediting period, MWh

Year	$EG_{\text{facility,y}}$ (MWh/a)
2014 (from 01/03 to 31/12)	160 600
2015	192 720
2016	192 720
2017	192 720
2018	192 720
2019	192 720
2020	192 720
2021 (from 01/01 to 28/02)	32 120

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)
From 01/03/2014 to 31/12/2014	0	158 673	0	158 673
2015	0	190 407	0	190 407
2016	0	190 407	0	190 407
2017	0	190 407	0	190 407
2018	0	190 407	0	190 407
2019	0	190 407	0	190 407
2020	0	190 407	0	190 407
From 01/01/2021 to 28/02/2021	0	31 734	0	31 734
Total (tonnes of CO_2 e)	**0**	**1 332 849**	**0**	**1 332 849**

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

<table>
<tr><td rowspan="9">Value of data applied for the purpose of calculating expected emission reductions in section B.5</td><td>Year</td><td>EG_{facility,y}
(MWh/a)</td></tr>
<tr><td>2014 (from 01/03 to 31/12)</td><td>160 600</td></tr>
<tr><td>2015</td><td>192 720</td></tr>
<tr><td>2016</td><td>192 720</td></tr>
<tr><td>2017</td><td>192 720</td></tr>
<tr><td>2018</td><td>192 720</td></tr>
<tr><td>2019</td><td>192 720</td></tr>
<tr><td>2020</td><td>192 720</td></tr>
<tr><td>2021 (from 01/01 to 28/02)</td><td>32 120</td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td colspan="2">Measurement by means of electricity meters installed at the points of supply which defines the commercial boundary between Eskom and the solar park owner. The generated electricity shall be continuously measured and recorded. Data on electricity supply shall be digitally archived at least on a monthly basis.</td></tr>
<tr><td>QA/QC procedures to be applied:</td><td colspan="2">Electricity meters are regularly calibrated; readings are cross-checked with records for sold electricity.</td></tr>
<tr><td>Any comment:</td><td colspan="2">See Section B.7.2 for details.</td></tr>
</table>

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

The 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 shall be continuously measured and recorded. The metering instruments shall be installed in accordance with the requirements of Grid and the Distribution Metering Codes at the point of supply which define 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 shall be digitally archived at least on a monthly basis.

The sources of data for calculation of GHG emission reductions in the course of monitoring shall be the internal reports of the 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 Renewable Energy Investments of South Africa (Pty) Ltd (REISA) 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 REISA.

In case of any doubts as to the accuracy of the data, the specialists of REISA shall check and correct the data. The preliminary version of the monitoring report shall be submitted to the specialists of REISA 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 of REISA 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 licensed for this type of activity, according to the requirements of the manufacturing company and to the schedule developed by REISA.

6. Emergency situations

If any instrument that is used in the monitoring process fails, REISA 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 REISA. 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: 08/11/2011

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),
Louie Eggers (louie.eggers@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 July 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:

01/03/2014 or the date of registration of the CDM project activity, whichever is later

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not Applicable

C.2.2.2. Length:

Not Applicable

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

[29] K. Branker, M.J.M. Pathak, J.M. Pearce, “A review of solar photovoltaic levelized cost of electricity”, *Renewable and Sustainable Energy Reviews*, Vol. 15, 2011, pg. 4472; & Kathu Final EIA, pg 20.

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 Savannah Environmental (Pty) Ltd. The draft EIA report provided stakeholders with an opportunity to verify that the issues they have raised through the EIA process have been captured and adequately considered. A 30 day review period from 22 November 2010 was given, which also provided a further opportunity for additional key issues for consideration to be raised. Following this period, the final EIA was submitted to the Department of Environmental Affairs (DEA) in January 2011 for a decision. A Record of Decision (ROD) was received 30 September 2011.

Summary of EIA

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.

No environmental fatal flaws were identified with the establishment of the proposed Kathu Solar Energy Facility, as the solar power is one of the cleanest sources of renewable energy, with no associated emissions and waste products. However a number of issues requiring mitigation have been highlighted and are discussed below.

Ecology

Solar energy facilities typically require large areas of land surface for placement of infrastructure. Once operational, the facility would pose fewer threats as there would be little to no use for fuel and there would be limited vertical infrastructure that could potentially pose a hazard for flying animals.

The overall impacts of the proposed project on ecology have been assessed as being of *low* or *medium* significance. One major vegetation type occurs in the study area, namely Kathu Bushveld, which is classified as Least Threatened. The site does not occur within any Centre of Floristic Endemism and the vegetation on site has relatively low conservation value despite being in a mostly natural state. Factors that may lead to parts of the study area having high ecological sensitivity are the presence of a saline pan and the potential presence of a small number of plant and animal species of conservation concern. These species, however, either in a low conservation status category or there is a low likelihood of them occurring on site. The proposed project is therefore considered acceptable in terms of potential impacts on flora, fauna, and pans and it is recommended that it should be permitted to go ahead.

Geology, soils and erosion potential

The most important direct impact is soil degradation including erosion from the area of construction activity. The most important indirect impact is the increased potential for dust pollution near the site because of wind erosion of exposed and loosened soil.

In terms of geology, soil, and erosion potential, the potential significance was rated as having a predominately *low* to *medium* significance. The soil erosion potential for the site is considered *low* due to the high permeability, low slope and low annual precipitation. The surrounding area has been severely degraded by the mining activities of the Sishen Mine (amongst other operations) and the cumulative impact on the natural soil profile and geology is considered high. This proposed development will have a relatively minor contribution to cumulative impact on the area.

Heritage

Low density heritage traces were found in the development footprint areas. From an archaeological perspective the observed heritage resources either fall well outside of the proposed development footprint or are of low significance. Immediate reporting to relevant heritage authorities of any heritage feature discovered during any phase of development or operation of the facility will be required. Therefore in terms of heritage resources, the potential significance was rated as having a predominately *low* significance.

Visual Impacts

The natural and undeveloped views surrounding the site will be impacted upon, for the entire operational lifespan (approximately 30 years) of the facility. However, the cumulative visual impact of multiple industrial initiatives in the area, both existing and proposed, should be noted, as it threatens to alter the visual character of the region as a whole. Of specific relevance are the existing Sishen mine, the existing railway line and power line infrastructure, the proposed Kalahari CSP project, and this project.

In terms of visual impacts, the potential significance was rate as having a predominately *low* to *moderate* significance. The potential visual affect on users of arterial and secondary roads and on residents of towns and homesteads in close proximity of the solar energy facility will be of *high* significance. The on-site infrastructure (i.e. the access roads, substation, and workshop) will have a *moderate* visual impact.

Within the region, the anticipated visual impact on users of the national, arterial, and secondary roads, as well as residents of built up areas and homesteads will be moderate. The solar energy facility will have a *low* visual impact on tourist access routes (i.e. the N14 national road).

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 Savannah Environmental (Pty) Ltd (SE) to undertake the Scoping and Environmental Impact Assessment (EIA), as well as the Public Participation Process (PPP) in terms of the NEMA EIA Regulations[30] and the CDM requirement based on the Kyoto protocol for the proposed project activity.

The scoping phase which concluded in October 2010 (with the acceptance of the final scoping report), provided interested and affected parties (I&AP) with the opportunity to receive information regarding the proposed project, to participate in the process and raise issues or concerns.

The draft scoping report was made available for public review and comment at the Kathu and Dibeng Public Libraries, the District and Local Municipalities, and on the Savannah Environmental website (www.savannahSA.com) for I&AP review and comment. All the comments, concerns, and suggestions received during the scoping phase and the review period were included within the final scoping report. The final scoping report and plan of study for EIA were submitted to the National Department Affairs (DEA) in September, following a 30-day public review period (and consideration of stakeholder comments received). The Final Scoping Report was accepted by the DEA, as the competent authority, in October 2010. In terms of this acceptance, an EIA was required to be undertaken for the proposed project.

One of the key tasks of the EIA is to undertake a fully inclusive public participation process to ensure that all I&AP are afforded the opportunity to participate, and that their issues and concerns are recorded.[31] An advertisement for a notice of the EIA public participation process was placed in the Kathu Gazette on the 20th November 2010.

The Final EIA Report was only submitted following the 30-day public review period 22 November 2010-10 January 2011[32].

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

- Focus group meetings (stakeholders invited to attend)
- Public Meeting (advertised in the local press)
- Written, faxed or e-mail correspondence

In addition, during the EIA phase, a public meeting was held in order to provide feedback of the finding of the EIA studies undertaken. Stakeholders were invited to attend the public meeting held on the 29th November 2010 in the VIP Lounge at the Sishen Golf Club in Kathu.

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[30] Note that the EIA process is being conducted in accordance with EIA regulations that were current at the time of application for authorisation (i.e. the EIA regulations of April 2006)

[31] In accordance with Regulation 56 & 59 of Government Notice No R385 of 2006

[32] Extended from 22 December 2010 to 10 January 2011 following consideration of the National Department of Environmental Affairs Protocol for the festive season

E.2. Summary of the comments received:

Comments were received mainly on 3 different aspects and are given below.

Technical aspects of the project:

- Site selection motivation
- How will the power be generated?
- Power line options and routes
- Distance between panels
- Height of panels
- Will the panels require cleaning
- Project related costs
- Duration of the EIA process and of the construction phase
- Rezoning

Social Impacts:

- Procurement
- Safety and Security
- Visual Impacts
- Heritage related impacts

Biophysical Impacts:

- Water Usage
- Vegetation-related impacts
- Fire and lightning issues
- Impacts on avifauna

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

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Represented by:	
Title:	Director
Salutation:	Mr.
Last name:	Brambilla
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Annex 3

BASELINE INFORMATION

Annex 3-1. The national grid of the RSA (Eskom electricity network)[33]

[33] 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)[34,35]

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[36]	Ermelo, Mpumalanga	Thermal PP	Coal	(2005.03.31)	1 440
Duvha	Witbank, Mpumalanga	Thermal PP	Coal	1980.01.18	3 450
Grootvlei[37]	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[38]	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

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

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

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

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

[38] 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[39]

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

[39]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 ($EG_{m,y}$)[40]

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.

[40]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 ($FC_{i,m,y}$)[41]

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

[41] 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[42]

Determination of the set of power units SET_{sample}

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

*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.

[42]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[43]	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

[43] 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 Ankerlig	49 000	0.495	24 249	
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	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Investment cost	mZAR	-730.9	-1 461.7	-243.6	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 electricity sale	mZAR		0.0	105.8	126.9	126.9	126.9	126.9	126.9	126.9	126.9	126.9	126.9	126.9	126.9	126.9	126.9	126.9	126.9	126.9	126.9	126.9	126.9	21.2
Cost of electricity generation	mZAR		0.0	-38.0	-45.6	-45.6	-45.6	-45.6	-45.6	-45.6	-45.6	-45.6	-45.6	-45.6	-45.6	-45.6	-45.6	-45.6	-45.6	-45.6	-45.6	-45.6	-45.6	-7.6
Total income from the project implementation	mZAR		0.0	67.8	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	13.6
Net cash flow	mZAR	-730.9	-1 461.7	-175.9	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	81.3	13.6

Pre-tax Project IRR

Parameter	Unit	Value
Pre-tax Project IRR	**%**	**-3.47%**

Calculation of the net cash flow in Euro

	Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Investment cost	mEURO	-75.0	-150.0	-25.0	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 electricity sale	mEURO	0.0	0.0	10.9	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	2.2
Cost of electricity generation	mEURO	0.0	0.0	-3.9	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7	-4.7	-0.8
Total income from the project implementation	mEURO	0.0	0.0	7.0	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	1.4
Net cash flow	mEURO	-75.0	-150.0	-18.0	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	1.4

Pre-tax Project IRR

Parameter	Unit	Value
Pre-tax Project IRR	**%**	**-3.47%**

Annex 4

MONITORING INFORMATION

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