**CLEAN DEVELOPMENT MECHANISM**
**PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)**
**Version 03 - in effect as of: 22 December 2006**

## CONTENTS

**Revision history of this document**

| Version Number | Date | Description and reason of revision |
|---|---|---|
| 01 | 21 January 2003 | Initial adoption |
| 02 | 8 July 2005 | •The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.<br>•As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>. |
| 03 | 22 December 2006 | •The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM. |

## SECTION A. General description of small-scale project activity

### A.1. Title of the small-scale project activity:

De Aar Grid Connected 10 MW Solar Park, South Africa

Version number: 1.0

Date: 12 December 2011

### A.2. Description of the small-scale project activity:

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

The energy system of the Republic of South Africa (RSA) is managed by the state-owned company Eskom which is in charge of generation, transmission and distribution of power to end-users. The company's total net maximum capacity as of 31 March 2010 is 40 870 MW, most of which 34 658 MW is coal-fired[1].

The project envisages the construction and operation of a solar park with an installed capacity of 10 MW or less. The solar park will be equipped with several arrays of photovoltaic (PV) panels. It is expected that Trina PV solar panels[2] supplied by Gestamp Solar[3] will be used for this project[4]. The produced electricity will be supplied to the Eskom electricity network.

The proposed project activity will be constructed on the Farm 145/2 located approximately 2.5 km north-west from the centre of the town of De Aar (the North West site). De Aar is located in the Northern Cape Province of the RSA. The anticipated starting date for construction and installation works under this project is the 1st of October 2012. The solar park will be constructed and commissioned over one year and the Commercial Operation Date (COD) is the 1st of October 2013. The required investment into the project amounts to 40 million USD[5] (or 287 million ZAR)[6].

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

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

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

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

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

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

[5] Solar Photovoltaic Project Report, De Aar, August 2011

[6] Average exchange rate over last 6 months (up to 31 October 2011) is 7.18 (ZAR/USD), http://www.x-rates.com/d/ZAR/USD/hist2011.html

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

1. Promotion and development of PV solar parks in the RSA which in turn will lead to the creation of new job opportunities both during the construction and operation phases and to growth in tax revenues. Sales of carbon credits generated by the project will result in increased foreign direct investment;
2. Creation of 120 jobs during the construction phase and 25 jobs during the operation phase;
3. Mitigations of the negative environmental impact. Combustion of fossil fuels (mostly coal) at Eskom 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[7] and the objective to reduce RSA's GHG emissions by 34% below the current emissions baseline by 2020[8].

## A.3. Project participants:

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

**Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd**

The project is being developed by Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd, which is an Special Purpose Vehicle (SPV) established to develop and operate the proposed solar park.

## A.4. Technical description of the small-scale project activity:

### A.4.1. Location of the small-scale project activity:

#### A.4.1.1. Host Party(ies):

The Republic of South Africa (RSA)

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

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

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

Northern Cape Province

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

The town of De Aar

| A.4.1.4. | Details of physical location, including information allowing the unique identification of this small-scale project activity: |
|---|---|

Fig. A.4-1 shows the location of the project in the RSA. The project activity will be constructed on the Farm 145/2 located approximately 2.5 km north-west from the centre of De Aar (Fig. A.4-2). This location falls under the jurisdiction of Emthanjeni Local Municipality. The GPS coordinates for the site are: 30° 37' and 23° 59'. The time zone is UTC +2.

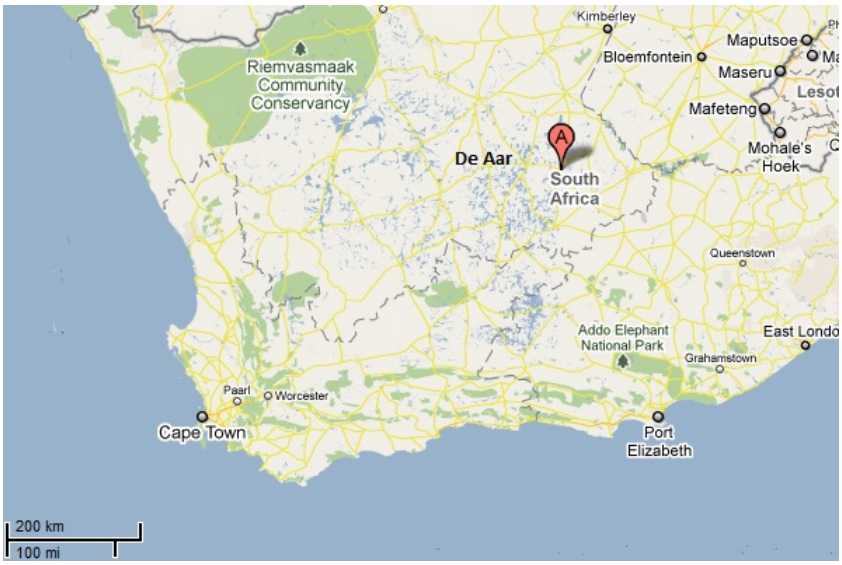


**Fig. A.4-1: The location of De Aar in the Republic of South Africa**


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

**A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:**

The present project falls under Type I: Renewable energy projects and Category D: Grid connected renewable electricity generation.[9]

Since the project activity envisages the production of electricity, which will be supplied to the national grid of the RSA, from solar energy and has an installed capacity of less than 15 MW it meets the eligibility criteria for small-scale CDM project activities set out in Annex II of Decision 4/CMP.1[10] and therefore 'Simplified modalities and procedures for small-scale clean development mechanism project activities' may be applied.

**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 grid-connected power plants as of 31 March 2010 is presented in Annex 3-2.

**The project activity characteristics**

The proposed project activity will employ the photovoltaic (PV) technology.

In the term photovoltaic (PV) "Photo" refers to light and "voltaic" to voltage. A PV cell is a solid-state electronic cell that produces direct current electrical energy from the radiant energy of the sun. PV 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 flow in a built-in circuit and produces electricity. If a load is connected under these conditions, an electrical current will result. The current

[9] http://cdm.unfccc.int/methodologies/DB/RSCTZ8SKT4F7N1CFDXCSA7BDQ7FU1X

[10] http://cdm.unfccc.int/Reference/COPMOP/08a01.pdf#page=6

produced is proportional to the amount of light absorbed by the device. In a solar cell the PV 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 PV cells. A thin silicon cell, four inches across, can produce approximately one watt of Direct Current (DC) electrical power in full sun. Some examples of PV solar panels are shown in Fig. A.4-3.

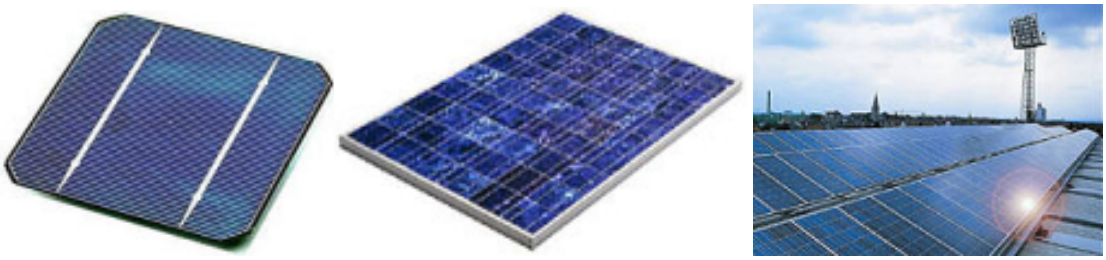

**Fig. A.4-3: Solar cell, solar panel and solar array**

The project envisages the construction and operation of a solar park with an installed capacity of 10 MW or less. The solar park will be equipped with several arrays of PV panels. It is expected that Trina PV solar panels supplied by Gestamp Solar will be used for this project. The produced electricity will be supplied to the Eskom electricity network.

The amount of electricity that is produced is dependent on the irradiation intensity at the site. Irradiation intensity is dependent on factors like hours of daylight, cloud cover, etc. Data received from the De Aar weather station predicted an average irradiation intensity of 5 786 Wh/m$^2$/day[11]. At maximum capacity the 10 MW Solar park will produce 19 272 MWh/year[12].

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

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

| Number | Action | Date |
|---|---|---|
| 1 | Completion of Environmental Impact Assessment | December 2010 |
| 2 | Completion of Feasibility Study | June 2011 |
| 3 | Start of construction and installation works | 1 October 2012 |
| 4 | Commissioning | 1 September 2013 |
| 5 | Commercial Operation Date (COD) | 1 October 2013 |

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

[11] Project Report, De Aar PV facility, September 2010

[12] Gestamp Solar, Estimation of annual electricity, (September 2011):
10 MW x 0.22 x 8 760 h/year = 19 272 MWh/year

**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 Eskom grid-connected 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 02.2.1), reported as Annex 19 to the EB 63[13] and is equal to 0.988 $tCO_2/MWh$.

### A.4.3. 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.

| Years | Estimation of annual emission reductions in tonnes of $CO_2$ e |
|---|---|
| 2013 (From 1 October to 31 December) | 4 760 |
| 2014 | 19 041 |
| 2015 | 19 041 |
| 2016 | 19 041 |
| 2017 | 19 041 |
| 2018 | 19 041 |
| 2019 | 19 041 |
| 2020(From 1 January to 30 September) | 14 281 |
| **Total estimated reductions** (tonnes of $CO_2$ e) | **133 287** |
| **Total number of crediting years** | **7** |
| **Annual average of the estimated reductions over the crediting period** (t $CO_2$ e) | **19 041** |

### A.4.4. Public funding of the small-scale project activity:

No public funding will be applied to the project.

### A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large-scale project activity

As indicated in the "Guidelines on assessment of debundling for SSC project activities" (Version 03)[14], *'Debundling is defined as the fragmentation of a large project activity into smaller parts. A small-scale project activity that is part of a large project activity is not eligible to use the simplified modalities and*

[13] http://cdm.unfccc.int/methodologies/PAmethodologies/tools

[14] http://cdm.unfccc.int/Reference/Guidclarif/ssc/index_guid.html

*procedures for small-scale CDM project activities… A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:*

a. *With the same project participants;*
b. *In the same project category and technology/measure; and*
c. *Registered within the previous 2 years; and*
d. *Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.'*

Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd does not have any other PV solar projects within 1 km of the proposed project site. This proves that the proposed project is not a debundled component of a large project activity.

## SECTION B. Application of a baseline and monitoring methodology

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

The approved simplified baseline and monitoring methodology AMS-I.D. "Grid connected renewable electricity generation" (Version 17)[15] is applicable to the proposed project activity.

The methodology AMS-I.D. is applicable to grid-connected renewable power generation project activities with capacities smaller than 15 MW.

This methodology refers to the use of the "Tool to calculate the emission factor for an electricity system" (Version 02.2.1)[16] to calculate the combined margin $CO_2$ emission factor of RSA's grid.

### B.2. Justification of the choice of the project category:

The present project falls under Type I: Renewable energy projects and Category D: Grid connected renewable electricity generation (see Section A.4.2 for details).

The applicability criteria for activities under methodology AMS-I.D. are defined and addressed as follows:

| # | Applicability criterion | Applicability | Response |
|---|---|---|---|
| 1 | This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass<br>a) Supplying electricity to a national or regional grid; or<br>b) Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling. | Applicable | The proposed project activity comprises renewable electricity generation, by means of a solar park, which will supply electricity to the national electricity grid of the RSA. |
| 2 | Illustration of respective situations under which each of the methodology (i.e. AMS-I.D, AMS-I.F and AMS-I.A) applies is included in Table 2[17]. | Applicable | The proposed project falls under methodology AMS-I.D. since the project supplies electricity to a national grid. |
| 3 | This methodology is applicable to project activities that: (a) install a new power plant at a site where there was no renewable energy power plant | Applicable | The proposed project activity is a "greenfield plant" because it involves the |

[15] http://cdm.unfccc.int/methodologies/DB/RSCTZ8SKT4F7N1CFDXCSA7BDQ7FU1X

[16] http://cdm.unfccc.int/methodologies/PAmethodologies/tools

[17] AMS-I.D. (version 17), page 15

| # | Applicability criterion | Applicability | Response |
|---|---|---|---|
| | operating 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). | | installation of a new solar park at a site where no renewable electricity generation occurred prior to this project activity. |
| 4 | Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology:<br>• The project activity is implemented in an existing reservoir with no change in the volume of reservoir; or<br>• The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 $W/m^2$; or<br>• The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 $W/m^2$. | Not applicable | The project activity is not the installation of a hydro power plant, so it does not need to satisfy this applicability condition. |
| 5 | If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW. | Not applicable | The project activity does not have non-renewable components, so it does not need to satisfy this applicability condition. |
| 6 | Combined heat and power (co-generation) systems are not eligible under this category. | Not applicable | The proposed project activity does not involve co-generation. According to the AMS-I.D., the project activity must not satisfy this applicability condition. |
| 7 | In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be | Not applicable | The project activity does not involve the addition of renewable energy generation units to an existing facility, so it does not need to satisfy |

| # | Applicability criterion | Applicability | Response |
|---|---|---|---|
| | physically distinct from the existing units. | | this applicability condition. |
| 8 | In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the modified or retrofitted or replacement unit shall not exceed the limit of 15 MW. | Not applicable | The project activity does not involve retrofit or replacement of an existing facility, so it does not need to satisfy this applicability condition. |

**The proposed CDM project activity satisfies all the relevant applicability criteria of AMS-I.D.**

## B.3. Description of the project boundary:

As defined in the methodology AMS-I.D.: '*The spatial extent of the project boundary includes the project power plant and all power plants physically connected to the electricity system that the CDM project power plant is connected to*'.

The proposed project activity emits zero GHGs and only the displacement of $CO_2$ is considered in the baseline of this project (Table B.3.1 and Fig. 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 fuel combustion will occur as part of the operation of the solar park. |
| | | $CH_4$ | No | |
| | | $N_2O$ | No | |

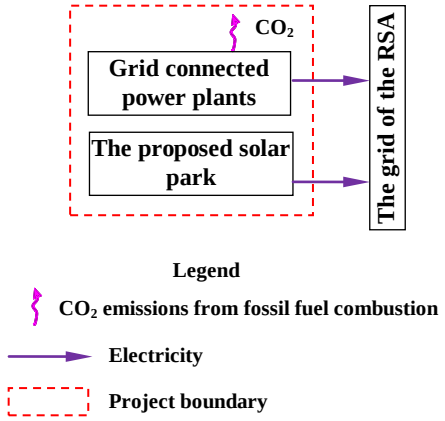


**Fig. B.3-1: Project boundary**

## B.4. Description of baseline and its development:

According to the AMS-I.D. the baseline scenario is the following:

- *The baseline scenario is that the 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 into the grid.*

The project activity is the installation of a solar park with an installed capacity of 10 MW or less that connects with and delivers electricity to the grid of the RSA. The baseline scenario of the proposed project, as reflected in the CM calculations presented in Section B.6, is:

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

## 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 small-scale CDM project activity:

The additionality is demonstrated according to Attachment A of Appendix B of the "Simplified modalities and procedures for small-scale CDM project activities" (Version 08), reported as Annex 24 to EB 63[18].

According to Attachment A of appendix B '*the positive list of grid-connected renewable electricity generation technologies that are automatically defined as additional, without further documentation of barriers, consists of the following grid-connected renewable electricity generation technologies of installed capacity up to 15 MW:*

*(a) Solar technologies (photovoltaic and solar thermal electricity generation);*

*(b) Off-shore wind technologies;*

*(c) Marine technologies (wave, tidal).'*

[18] http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid05.pdf

Since the proposed project is a grid-connected PV solar park with an installed capacity of 10 MW or less the project is automatically defined as additional.

***Outcome of the additionality test: the proposed project activity is additional.***

## B.6. Emission reductions:

### B.6.1. Explanation of methodological choices:

**Project emissions**

Since the project activity uses solar energy to generate electricity the project emissions are equal to zero[19]:

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

Where:

$PE_y$ = Project emissions in year *y* (t $CO_2$/y)

**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 AMS-I.D. methodology 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 into the grid. The baseline emissions are calculated as follows:

$$BE_y = EG_{BL,y} * EF_{CO_2,grid,y} \quad \text{(B.6-2)}$$

Where:

$BE_y$ = Baseline emissions in year *y* (t $CO_2$)

$EG_{BL,y}$ = Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y* (MWh)

$EF_{CO_2,grid,y}$ = $CO_2$ emission factor of the grid in year *y* (t $CO_2$/MWh)

According to the AMS-I.D.: *'The emission factor can be calculated in a transparent and conservative manner as follows:*

*a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the Emission Factor for an electricity system"; or*

[19] There will be no onsite combustion of fossil fuels during the operation of the solar plant

*b) The weighted average emissions (in t $CO_2$/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.'*

Option *a)* will be applied for the present project. The procedures prescribed in the "Tool to calculate the emission factor for an electricity system" will be applied to calculate a combined margin $CO_2$ emission factor for the grid in year y ($EF_{grid,CM,y}$).

$$EF_{CO_2,grid,y} = EF_{grid,CM,y} \quad \text{(B.6-3)}$$

Where:

$EF_{CO_2,grid,y}$ = $CO_2$ emission factor of the grid in year *y* (t $CO_2$/MWh)

$EF_{grid,CM,y}$ = Combined margin $CO_2$ emission factor for the project electricity system in year *y* (t$CO_2$/MWh)

**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". 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***

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 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 grid-connected power plants as of 31 March 2010 is presented in Annex 3-2.

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

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

*Option I: Only grid power plants are included in the calculation.*

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

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

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

*'The calculation of the operating margin emission factor ( $EF_{grid,OM,y}$ ) is based on one of the following methods, which are described under Step 4:*

*(a) Simple OM; or*

*(b) Simple adjusted OM; or*

*(c) Dispatch data analysis OM; or*

*(d) Average OM.*

*The simple OM method (Option a) can only be used if low-cost/must-run resources[20] 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.'*

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[21]**

| 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.

[20] *'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.'*

[21] Eskom Annual Report 2010, page 1, http://financialresults.co.za/2010/eskom_ar2010/index.htm

*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 by one of the following two options:

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

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

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

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

Where:

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

$EF_{grid,OMsimple,y}$ = Simple operating margin $CO_2$ emission factor in year y ($tCO_2/MWh$)

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

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

Where:

$EF_{grid,OMsimple,y}$ = Simple operating margin $CO_2$ emission factor in year y ($tCO_2/MWh$)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh). 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 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*):

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

Where:

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

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

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

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 Fig. B.6-1. For simplification three levels were identified for the calculation of the BM.

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

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

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

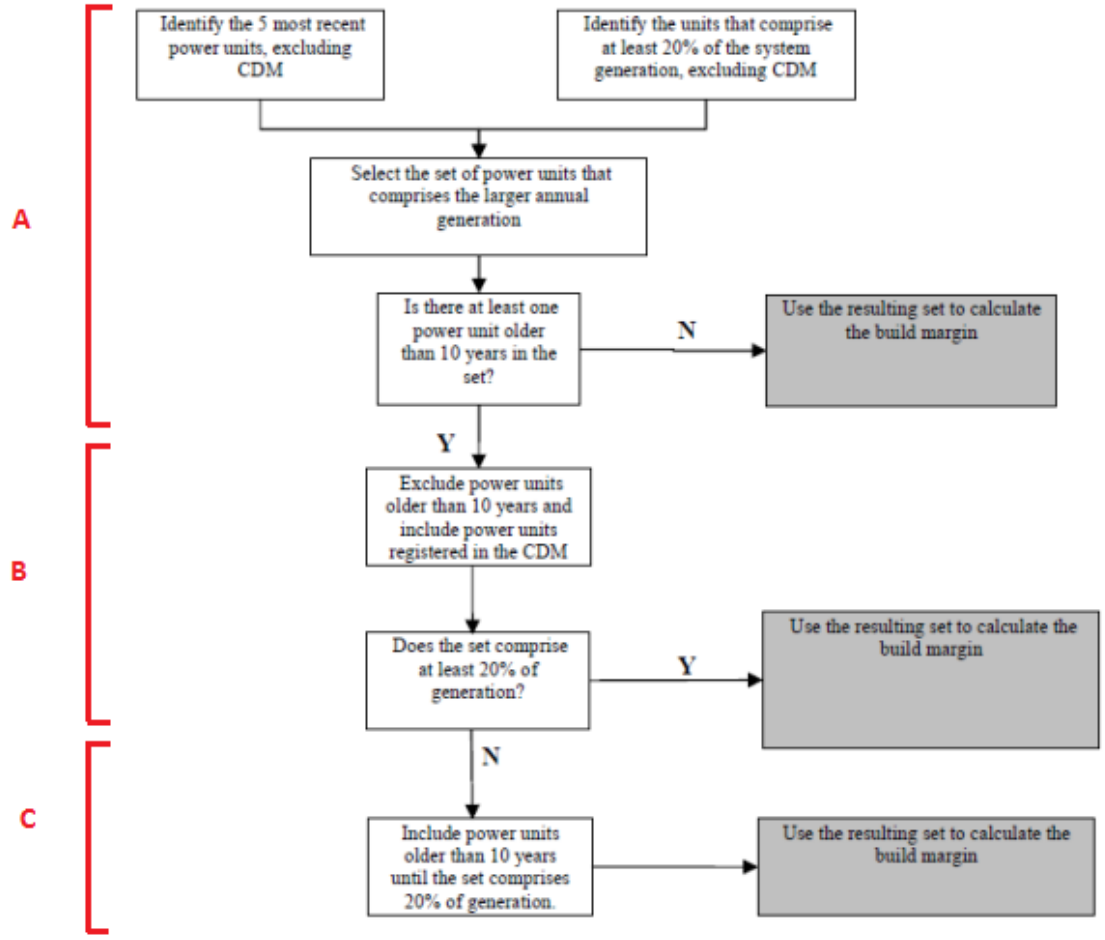


Fig. B.6-1: Build margin calculation algorithm

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

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

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

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

Identify the date when the power units in $SET_{sample}$ started to supply electricity to the grid. If none of the power units in $SET_{sample}$ started to supply electricity to the grid more than 10 years ago, then use $SET_{sample}$ to calculate the build margin. In this case 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 activities, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent 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 electricity 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 electricity 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" 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:

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

Where:

$EF_{grid,CM,y}$ = Combined margin $CO_2$ emission factor for the project electricity system 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) ($tCO_2/MWh$)

$EF_{grid,OM,y}$ = 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" 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**

The methodology AMS-I.D. states that: "*If the energy generating equipment is transferred from another activity leakage is to be considered*".

In the proposed project activity, no energy generating equipment is transferred from another activity and there is no existing equipment that could be transferred to another activity. Hence leakage is not considered.

**Emission reductions**

Emission reductions are calculated as follows:

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

Where:

$ER_y$ = Emission reductions in year *y* (t $CO_2$/y)

$BE_y$ = Baseline emissions in year *y* (t $CO_2$/y)

$PE_y$ = Project emissions in year *y* (t $CO_2$/y)

$LE_y$ = Leakage emission in year y ( t $CO_2$/y)

**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.<br>The default NCV that is available on the Eskom website is 0.02509 TJ/t fuel.[22] The 2006 IPCC Guidelines references 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.<br>The default emission factor that is available on the Eskom website is 25.8 tC/TJ.[23] The 2006 IPCC Guidelines references 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. |

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

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

| Data / Parameter: | $EF_{CO2,NG,y}$ |
|---|---|
| Data unit: | $tCO_2/GJ$ |
| Description: | $CO_2$ emission factor of Natural Gas |
| Source of data used: | 2006 IPCC Guidelines for National GHG Inventories, volume 2: Energy, chapter 1, Table 1.4 |
| Value applied: | 0.0543 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | For the sake of a conservative approach the IPCC default value at the lower limit of the uncertainty at a 95% confidence interval is used. |
| Any comment: | This value was appointed as a constant. |

| Data / Parameter: | $\eta_{OCGT}$ |
|---|---|
| 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" |
| Any comment: | This value was appointed as a constant for the whole crediting period. |

| Data / Parameter: | $LF_{facility}$ |
|---|---|
| Data unit: | Ratio |
| Description: | Load factor for the solar park |
| Source of data used: | Preferred supplier of the solar panels (Gestamp Solar) |
| Value applied: | 0.22 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Calculated by Gestamp Solar based on measurements done at a PV test facility.[24] |
| Any comment: | This value is used for estimating the amount of electricity that will be generated by the solar park. This value will not be monitored. Instead the actual amount of electricity that is produced (MWh) will be monitored by electricity meters. |

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

Combining equation (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:

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

Where:

$ER_y$ = Emission reductions in year $y$ (t $CO_2$/y)

$EG_{BL,y}$ = Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year $y$ (MWh)

$EF_{grid,CM}$ = 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 is adopted for the 7 year crediting period.

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

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

[24] Project Report, De Aar PV facility, September 2010

**Table B.6-2: Quantity of net electricity generation annually supplied by the solar park to the grid ( $EG_{BL,y}$ ) during the first 7-year crediting period, MWh**

| Year | $EG_{BL,y}$ (MWh) |
|---|---|
| 2013 (From 1 October to 31 December) | 4 818 |
| 2014 | 19 272 |
| 2015 | 19 272 |
| 2016 | 19 272 |
| 2017 | 19 272 |
| 2018 | 19 272 |
| 2019 | 19 272 |
| 2020 (From 1 January to 30 September) | 14 454 |
| **Total over 7 years** | **134 904** |

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

| Year | Estimation of project activity emissions ($tCO_2$ e) | Estimation of baseline emissions ($tCO_2$ e) | Estimation of leakage ($tCO_2$ e) | Estimation of overall emission reductions ($tCO_2$ e) |
|---|---|---|---|---|
| 2013 (From 1 October to 31 December) | 0 | 4 760 | 0 | 4 760 |
| 2014 | 0 | 19 041 | 0 | 19 041 |
| 2015 | 0 | 19 041 | 0 | 19 041 |
| 2016 | 0 | 19 041 | 0 | 19 041 |
| 2017 | 0 | 19 041 | 0 | 19 041 |
| 2018 | 0 | 19 041 | 0 | 19 041 |
| 2019 | 0 | 19 041 | 0 | 19 041 |
| 2020 (From 1 January to 30 September) | 0 | 14 281 | 0 | 14 281 |
| **Total** (tonnes of $CO_2$ e) | 0 | **133 287** | 0 | **133 287** |

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

### B.7.1 Data and parameters monitored:

| **Data / Parameter:** | $EG_{BL,y}$ |
|---|---|
| Unit: | MWh/y |
| Description: | Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity |
| Source of data : | On-site measurement with electricity meters |
| Value of data | Estimated quantity of electricity that will be produced: |

| **Year** | **Quantity of electricity (MWh)** |
|---|---|
| 2013 (From 1 October to 31 December) | 4 818 |
| 2014 | 19 272 |
| 2015 | 19 272 |
| 2016 | 19 272 |
| 2017 | 19 272 |
| 2018 | 19 272 |
| 2019 | 19 272 |
| 2020 (From 1 January to 30 September) | 14 454 |

| | |
|---|---|
| Brief description of measurement methods and procedures to be applied: | Measurement by means of electricity meters installed at the point of supply which defines the commercial boundary between Eskom and the solar park owner. The generated electricity will be continuously measured and recorded. Data on electricity supply will be digitally archived at least on a monthly basis. |
| QA/QC procedures to be applied (if any): | Electricity meters will be regularly calibrated; readings will be cross-checked with records for sold electricity. |
| Any comment: | See Section B.7.2 for details. |

### B.7.2 Description of the monitoring plan:

The monitoring plan is devised as per AMS-I.D. The following procedures shall be applied:

1. Monitoring period

A 7-year crediting period with the option of renewal was chosen for the project. The monitoring period starts from the date of commissioning of the solar park or the date of registration of the proposed project by CDM Executive Board (whichever is later). At the end of each reporting year, monitored data shall be aggregated to a monitoring report.

2. Data monitored and sources

Quantity of net electricity generation supplied by the solar park to the grid shall be determined on the basis of electricity meters located at the point of supply to the Eskom electricity network. The generated electricity will be continuously measured. The metering instruments shall be installed in accordance with the requirements of Grid and the Distribution Metering Codes at the point of supply which defines the commercial boundary between Eskom and the solar park owner. Readings of the electricity meters shall be cross-checked with records for sold electricity. Data on electricity supply will be digitally archived at least on a monthly basis.

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

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

3. The monitoring team

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

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

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

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

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

4. Data storage

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

5. Instrumentation calibration

The instrumentation calibration and check-out shall be carried out by contracted specialized organisations that are licenced for this type of activity according to the requirements of the manufacturing company and to the schedule developed by Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd.

6. Emergency situations

If any instrument that is used in the monitoring process fails, Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd shall remedy the situation as soon as possible and if necessary shall replace the instrument. In case of breakdown of any of the solar panels the electricity generation will go down, and amount of electricity supplied to the grid by the solar park will be reduced. All accidents that may occur at the solar park shall be recorded by Mulilo Renewable Energy Solar PV De Aar (Pty) Ltd. Information on major accidents shall be included in the monitoring report.

**B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):**

Date of completion: 28/11/2011

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

Contact persons: Ilya Goryashin (i.goryashin@ccgs.ru), Tom Hugo (tom.hugo@blueworldcarbon.com)

## SECTION C. Duration of the project activity / crediting period

### C.1. Duration of the project activity:

#### C.1.1. Starting date of the project activity:

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

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

30 years[25]

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

#### C.2.1. Renewable crediting period:

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

01/10/2013

##### C.2.1.2. Length of the first crediting period:

7 years

#### C.2.2. Fixed crediting period:

##### C.2.2.1. Starting date:

Not applicable

##### C.2.2.2. Length:

Not applicable

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

## SECTION D. Environmental impacts

**D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:**

The Environmental Impact Assessment (EIA) of the proposed project was carried out in accordance with the South African legislation by DJ Environmental Consultants (DJEC). The draft Environmental Impact Report (EIR) was published for public review and comment over a period of 40 days from 22 October 2010. Hereafter the EIR was submitted to the Department of Environmental Affairs (DEA) in December 2010 for a decision.

A summary of the specialist findings are briefly discussed below.

***Botanical***
The vegetation type located on the proposed site is not regarded as threatened on a national basis, and is very widespread within the Nama Karoo. It was concluded that the site does not present significant or important constraints to the proposed development with regard to botanical sensitivity.

***Avifauna***
The avifaunal study indicated that the development area does not support any important bird populations, and the proposed PV facility is likely to have no significant, long-term impact on the local avifauna.

***Archaeology***
In terms of archaeological heritage, the proposed activity is viable. While impacts on the proposed site are expected to be negative, these can be effectively mitigated.

***Palaeontology***
The palaeontological study indicated that the comparatively small footprint of the proposed facility and the shallow excavations envisaged warrant no further palaeontological mitigation.

***Heritage***
The Heritage Impact Assessment indicated that the site has low heritage significance.

***Visual***
The visual impact of the proposed development has been assessed as moderate-high and with time will reduce to moderate. The proposed site is preferred above all alternatives with the regard to visual impact. By choosing the proposed site above alternative sites identified in the EIR, the visual impact has been mitigated as far as possible.

***Cumulative impacts***
The cumulative impacts will fall mainly in the spheres of land use change and visual impact.

**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:**

Based on the findings of all the credible specialists who undertook their respective specialist studies, it was concluded that there are no negative impacts that cannot be adequately mitigated. All mitigatory measures and recommendations are outlined in the EIR. These measures are considered achievable and should be included as conditions of approval.

## SECTION E. Stakeholders' comments

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

The project owner appointed DJ Environmental Consultants (DJEC) to undertake the Scoping and Environmental Impact Assessment as well as the Public Participation Process (PPP)[26] in terms of the NEMA EIA Regulations, CDM requirement based on the Kyoto protocol, for the proposed project activity. The activities undertaken to canvass public opinion regarding the proposed project activity are summarised in Table E.1-1.

An advertisement announcing the Environmental Impact Assessment Process and inviting Interested and Affected Parties (I&APs) to register on the project database was placed in the "Echo" and "Die Volksblad" newspapers on 9 October 2009. The Background Information Document (BID) was circulated on the 10th of December 2009 to all persons and organisations registered as I&APs and to surrounding landowners informing them of the proposed development.

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

Notification letters were sent to all land owners who had signed agreements with respect to the proposed development and also to the owners and occupants of land immediately abutting and within 100m of the proposed De Aar PV project site. Written notices were also sent to all registered I&APs informing them of the availability of the DSR

The Draft Scoping Report was available from 8 June 2010 to 19 July 2010 at the Elizabeth Vermeulen and Alpha Public Libraries and at the DJEC offices. Notice of the availability was also sent to all registered I&APs informing them of the release of the Draft Scoping Report for public review and comment. Hardcopies of the Draft Scoping Report was also sent to the flowing departments:

- National Department of Environmental Affairs (DEA)
- Department of Environment, Nature and Conservation – Northern Cape,
- Department of Agriculture, Land Reform and Rural Development - Northern Cape,
- Emthanjeni Local Municipality

The Draft EIR was available from 22 October 2010 to 01 December 2010 at the De Aar public library and the DJEC offices. In addition letters were also sent out to all registered I&AP, notifying them on the availability of the EIA Report for review and comment. I&APs were afforded and an opportunity to raise their issues and concerns regarding the proposed development during the consultation process. All comment and response was compiled. The EIR was also sent to the flowing departments:

- Northern Cape Department of Tourism, Environment & Conservation
- Northern Cape Department of Agriculture
- Emthanjeni Local Municipality

[26] Chapter 6 of the final EIR

- Land Reform and Rural Development

A draft Environmental Management Programme (EMP) was also complied and submitted along with the Draft EIA report. Finally the EIR along with an Issues Trail Report and the draft EMP was submitted to DEA for a decision. The Record of Decision (ROD) for environmental authorisation was obtained from DEA on 29 August 2011.

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

| Activity | Date |
|---|---|
| **Phase 1: Project initiation** | |
| Submission of Application to Department of Environmental Affairs (DEA) | 28 August 2009 |
| DEA Acknowledgement of Application | 31 August 2009 |
| Identification of (Interested and Affected Parties) I&APs | October 2009 and on-going |
| Advertisement of the process | Advertisements were placed in the Echo and the Volksblad newspapers on 9 October 2009 |
| Placement of posters on site | Posters indicating the proposed project were placed on the site on 5 October 2009. |
| **Phase 2: Initial public consultation process** | |
| Circulation of Background Information Document (BID) to I&APs | From 10 December 2009 |
| End of comment period on BID and registration for I&AP | 17 January 2010. |
| **Phase 3: Scoping** | |
| Registered I&APs was made aware of the availability of the Draft Scoping Report (DSR). The DSR was made available in the De Aar Public Library and DJEC offices. | 8 June 2010 |
| End of official comment period on DSR | 19 July 2010 |
| Final Scoping Report (FSR) was submitted to DEA for approval | 23 September 2010 |

| Activity | Date |
|---|---|
| **Phase 4: EIA** | |
| Appointment of specialists to undertake studies | October 2009 |
| Registered I&APs were made aware of the availability of the Draft EIR and Draft Environmental Management Plan (EMP). | 22 October 2010 |
| End of official comment period on Draft EIR and Draft EMP | 01 December 2010 |
| Collation of comments from I&APs | 30 August 2010 and on-going until report is finalised |
| Submission of final EIR and draft EMP to DEA for authorization | 02 December 2010 |
| Record of Decision (ROD) from DEA for environmental authorisation | 29 August 2011 |

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

Comments were received from Transnet Freight Rail mostly regarding infrastructure at overlapping territories.

- It was mentioned that care should be taken with regard to cables that are underground and overhead at the site where the proposed access road will be constructed.
- All impacts on rail operations during construction phase, including dust generation and dispersal as well as its impacts in visibility in the area, particularly in relation to train operations in the vicinity of the proposed site
- Storm water management measures to prevent possible flooding of the railway line in the vicinity of the site
- Measures to prevent trespassing, illegal crossing of railway line and to protect Transnet Freight Rail property from being stolen or vandalized by the projects workers during construction phase.
- Should there be any need for establishment of new level crossings or services to cross below or over the railway lines, the proponent must consult Transnet Freight Rail Depot Engineer, Infrastructure Kimberley for permission.

For all comments received from Transnet Freight Rail the project developers responded by ensuring them that these issues will be taken into account during the detailed design phase of the project. Should alternative routes be required, these will be presented in a revised plan and resubmitted to Transnet for comment.

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

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

**Annex 1**

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

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

## Annex 2

## INFORMATION REGARDING PUBLIC FUNDING

## Annex 3

## BASELINE INFORMATION

### Annex 3-1. The national grid of the RSA (Eskom electricity network)[27]


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

**Annex 3-2. Data on Eskom grid-connected power plants (at the 31st of March 2010)[28,29]**

| 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[30] | Ermelo, Mpumalanga | Thermal PP | Coal | (2005.03.31) | 1 440 |
| Duvha | Witbank, Mpumalanga | Thermal PP | Coal | 1980.01.18 | 3 450 |
| Grootvlei[31] | 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[32] | 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 |

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

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

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

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

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

| 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 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[33]**

| 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 |

[33]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 ( $EG_{m,y}$ )[34]**

| 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.

[34]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 ( $FC_{i,m,y}$ )[35]**

| 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

[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

## Annex 3-4. Determination of power units included into the build margin[36]

**Determination of the set of power units $SET_{sample}$**

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

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

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

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

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

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

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

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

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

**Data on operation of Eskom 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[37] | 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

[37] 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 | 0.495 | 0.495 | 0.495 |
| Gourikwa | | | |

**$CO_2$ 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 | 570 604 | 70 769 | 24 249 | 665 622 |
| Gourikwa | | | | |
| | | | Total emissions: | 659 052 985 |

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

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

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

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

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

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

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

## Annex 4

## MONITORING INFORMATION

- - - - -