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

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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. • 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:

>>
Installation of energy efficient ventilation fans at South Deep and Beatrix Gold Mines in South Africa
Version: 01
Date: 26/04/2012

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

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GFI Mining South Africa (Pty) Ltd (hence forth referred to as 'Gold Fields') is one of the largest producers of gold in the world. Gold Fields' operations are located as far afield as Australia, Ghana, and Peru, with the Group's primary operation in the Witwatersrand Basin in South Africa.

The Golf Fields' South Deep and Beatrix mining operations are located in the northern and southern regions of the Witwatersrand Basin respectively, and exploit the gold-bearing reefs west of Johannesburg.

Purpose of the project activity

The purpose of this project is to reduce greenhouse gas emissions through the implementation of an energy efficient project at the South Deep and Beatrix gold mines.

These mines currently use a number of steel axial ventilation fans in their operations to move air to specific points underground. These fans are highly inefficient due to their aerodynamic design. This project will involve the replacement of these steel axial fans with more energy efficient axial fans. These more energy efficient fans will be made of either steel or composite fibre. Composite fibre fans are manufactured from various materials ranging from white cast irons to glass fibre. Depending on the environment, the combinations of the materials used may be varied to suit the environment in which the fan will operate. The new fans will deliver the same air flow rate and pressure as the existing fans. Some additional advantages of the new fans include its light weight and improved strength, as well the fan's increased 'jet throw' – the distance from the physical fan to the end point of air movement.

Up to 240 fans will be replaced in the South Deep and Beatrix underground mining operations. The actual amount of fans to be installed in this project activity will be confirmed during project commissioning however, the annual energy savings as a result of this project will be less than 60 GWh_e (in accordance with the applied small-scale methodology). The project will be rolled out over several months, due to work space and time limits placed on underground mining operations.

Reduction in greenhouse gas emissions

The installation of energy efficient ventilation fans at KDC East will see a reduction in electricity consumption from South Africa's national grid, which will result in a reduction of greenhouse gas emissions.

Contribution to sustainable development

The project makes a positive contribution to sustainable development. The South African Designated National Authority (DNA) evaluates sustainability in three categories: economic, environmental, and social. The contribution of the project towards sustainable development is discussed below in terms of these three categories:

Environmental

This project supports the emission mitigation actions of South Africa. According to a letter sent to the United Nations Framework Convention on Climate Change (UNFCCC) on 29/01/2010, South Africa committed to “taking nationally appropriate mitigation actions to enable a 34% deviation below the ‘Business as Usual’ emissions growth trajectory by 2020 and a 42% deviation below the ‘Business as Usual’ emissions growth trajectory by 2025”.

The project will reduce electricity consumption from the national grid. This grid is predominantly coal-fired (coal accounts for more than 92% of the fuel used in South Africa’s electricity generation[1]) and therefore, heavily carbon-intensive. The reduction in electricity consumption from the grid will result in a reduction of greenhouse gas emissions, as well as all of the negative impacts of coal mining. These impacts include: the utilisation of scarce water resources, SO_2 emissions and the impacts associated with the disposal of coal ash.

Economic

South Africa’s national electricity provider, Eskom, carried out planned electricity supply interruptions at the beginning of 2008. These interruptions were caused by the demand for electricity exceeding the supply of electricity. During the interruptions, grid electricity was not accessible. Promoting an energy efficiency project at these gold mines will reduce the pressure on energy infrastructure, thereby making important contributions to the country’s economic sustainability.

Social

This project will improve the working conditions at the South Deep and Beatrix gold mines. The new ventilation fans will remove dust particles, dilute contaminants and move air to specific points underground, thereby improving the health and safety of mine workers. Personnel will also acquire additional skills as they will be trained on how to properly install and maintain the new fans.

A.3. Project participants:

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Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Party considered as project participant (Yes/No)
South Africa (Host)	Nedbank Limited (Private Entity)	No
	GFI Mining South Africa (Pty) Ltd (Private Entity)	No

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[1] Department of Water and Environmental Affairs. (2010). *National Climate Change Response Draft Green Paper, pg 13, para..3.* Retrieved from South Africa Government Online: http://www.environment.gov.za. Date accessed 16/02/2011.

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):

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Republic of South Africa

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

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Gauteng Province

A.4.1.3. City/Town/Community etc:

>>

Carletonville and Welkom

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

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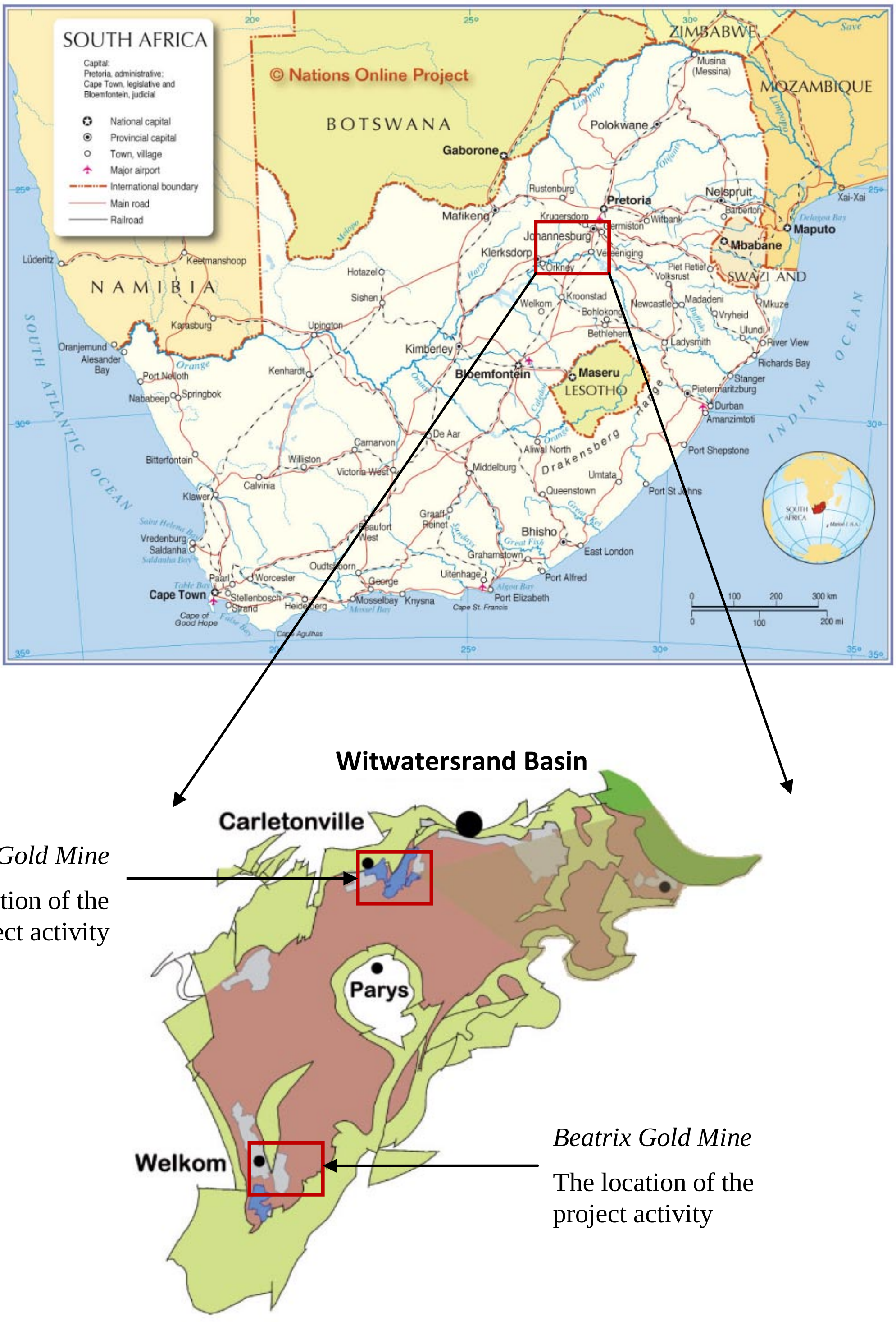
This project activity will be located at two underground mining operations in the Witwatersrand Basin.

South Deep gold mine is located in the northern region of the Witwatersrand basin. The GPS coordinates of the entrance to the South Deep mining operation are 26°25'S 27°41'E

Beatrix is the southernmost mine in the Witwatersrand basin. The GPS coordinates of the entrance to the Beatrix mining operation are 28°15’S 26°47E.

The locations of the project activity are shown in Figure 1 below.



South Deep Gold Mine

The location of the project activity

Beatrix Gold Mine

The location of the project activity

Figure 1: Locations of the project activity

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

>>
The applied baseline and monitoring methodology for this project activity is AMS-II.C ‘Demand-side energy efficiency activities for specific technologies’, version 13, sectoral scope 03.

The purpose of this project activity is to improve underground mine ventilation and reduce energy consumption at the South Deep and Beatrix gold mines. This will be achieved through the replacement of conventional steel axial fans with more energy-efficient composite fibre or steel axial fans. To be conservative, the average saving per fan is estimated at 13.5 kW (this saving was determined through laboratory tests – refer to Annex 3 for more information).

Though the new fan has the same electrical motor as the existing fan, the new fan has a different nose cone, tail cone, impeller, and stator to optimise the air flow through the fan. The barrel of the fan is also changed for a higher tolerance. Each new fan may be made of steel or composite fibre[2] and is built to comply with South Africa’s Department of Mineral Standards. The fans are developed using computer modeling and experimental testing. This method allowed the fan developer to optimise aerodynamic efficiencies, thereby maximizing energy savings. The pictures below (Figure 2) depict the air flows from the computer modeling tests.

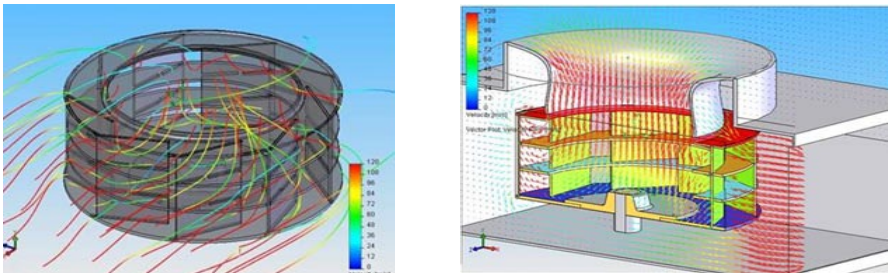


Figure 2: Pictures of the air flows generated from computer modelling tests

Though the composite fibre/steel fan technology is new, the technology is environmentally safe and sound as each fan is tested and compliance certified prior to installation. The new fans have also won a Technology Top 100 award – an award that is sponsored and accredited by Eskom, South Africa’s national electricity provider.

The fans have been tested underground at Gold Fields for two months with a positive outcome. The fans have also been tested in a laboratory to show that they can deliver the same air flow rate and pressure as the existing fans. This is shown in Figure 3 below.

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[2] Composite fibre is manufactured from various materials ranging from white cast irons to glass fibres.

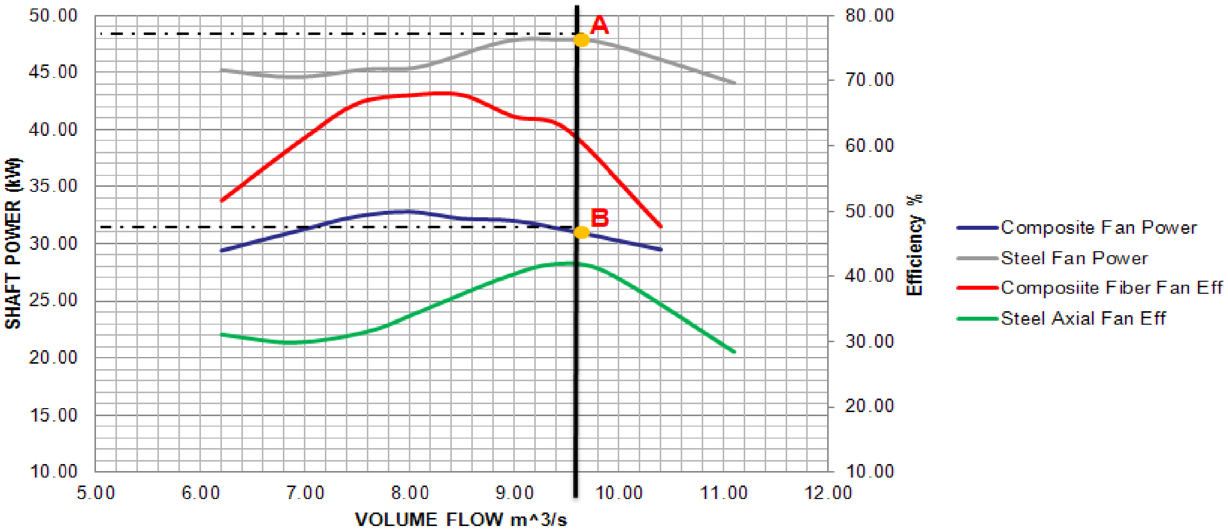

Figure 3: Laboratory test results of the existing and new axial fans

The pictures below (Figures 4 and 5) show the existing steel axial fan and the new axial fan. The newly installed fans will be painted red (the existing fans are blue) and will have a unique serial number to allow for easy identification underground.

Figure 5:
Existing steel axial ventilation fan

Figure 4:
New axial ventilation fan

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

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Years	**Annual estimation of emission reductions in tonnes of CO_2e**
1 January 2013 – 31 December 2013	30,795
1 January 2014 – 31 December 2014	30,795
1 January 2015 – 31 December 2015	30,795
1 January 2016 – 31 December 2016	30,795
1 January 2017 – 31 December 2017	30,795
1 January 2018 – 31 December 2018	30,795
1 January 2019 – 31 December 2019	30,795
1 January 2020 – 31 December 2020	30,795
1 January 2021 – 31 December 2021	30,795
1 January 2022 – 31 December 2022	30,795
Total estimated reductions (tonnes of CO_2 e)	307,950
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	30,795

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

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Official Development Assistance (ODA) has not, and will not, be used in the development and implementation of this project.

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

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According to version 03 of the ‘Guidelines on assessment of debundling for SSC 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;*
(c) *Registered within the previous two years;*
(d) *Whose boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.*

The size of this project falls under the limits of a small-scale project activity. Nedbank Limited/ Gold Fields have not registered a similar project in the same project category, technology, or measure within a 1 km radius of the project boundary within the previous two years. Therefore, as per Appendix C of the

‘Simplified modalities and procedures for small-scale CDM project activities[3]’, this project activity is not a debundled component of a large-scale 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:

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The approved baseline and monitoring methodology is:
AMS-II.C ‘Demand-side energy efficiency activities for specific technologies’ (Version 13)

The following methodological tool is used:
‘Tool to calculate the emission factor for an electricity system’ (Version 02.2.1)

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

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The project complies with the applicability criteria set out in AMS-II.C (Version 13). This is justified in the table below.

Item	AMS II.C.	Project activity
1.	*This methodology comprises activities that encourage the adoption of energy-efficient equipment/appliance (e.g., lamps, ballasts, refrigerators, motors, fans, air conditioners, pumping systems) at many sites. These technologies may replace existing equipment or be installed at new sites. In the case of new facilities, the determination of baseline scenario shall be as per the procedures described in the general guidance to SSC methodologies under the section ‘Type II and III Greenfield projects (new facilities)’. The aggregate energy savings by a single project may not exceed the equivalent of 60 GWh per year for electrical end use energy efficiency technologies.* *For fossil fuel end use energy efficient technologies, the limit is 180 GWh thermal per year in fuel input.*	**Applicable** This project involves the replacement of up to 240 ventilation fans. Energy-efficient composite fibre/steel axial fans will replace conventional steel axial fans in South Deep and Beatrix’s underground mining operations. This replacement will see annual energy savings of up to 28.4 GWh_e, which is well within the limits of the small-scale methodology.
2.	*For each replaced appliance/equipment/system the rated capacity or output or level of service (e.g., light output, water output, room temperature and comfort, the rated output capacity of air-conditioners etc.) is not significantly smaller (maximum - 10%) than the baseline or significantly larger (maximum + 50%) than the baseline.*	**Applicable** The new composite fibre/steel axial fans will deliver at least the same quantity of air and pressure as the existing steel axial fans, and not more than 50% above the baseline equipment. This has been proven during laboratory tests, as shown in the graph in section A.4.3.

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[3] http://unfccc.int/resource/docs/2005/cmp1/eng/08a01.pdf#page=43

Item	AMS II.C.	Project activity
3.	*If the energy efficient equipment contains refrigerants, then the refrigerant used in the project case shall be CFC free. Project emissions from the baseline refrigerant and/or project refrigerants shall be considered in accordance with the guidance of the Board (EB 34, paragraph 17). This methodology credits emission reductions only due to the reduction in electricity consumption from use of more efficient equipment/appliances.*	**Not relevant to this project** This is not applicable as ventilation fans do not contain refrigerants.

B.3. Description of the project boundary:

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According to AMS-II.C (version 13), the project boundary is the physical, geographical location of each piece of equipment installed. The project boundary therefore encompasses each ventilation fan that is installed in the Beatrix and South Deep mine shafts.

B.4. Description of baseline and its development:

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According to AMS-II.C (version 13), if the energy displaced in the project activity is electricity (as it is in this project activity), the emissions baseline is determined using one of two options. Option 1 is applied to this project activity, and the baseline is determined using the product of the baseline energy consumption of the existing fans and the emission factor for the electricity displaced.

The emission factor for the electricity displaced is calculated using version 02.2.1 of the ‘Tool to calculate the emission factor for an electricity system’. The calculations for the grid emission factor are found in Annex 3.

Table 1 below presents all data used to determine the baseline emissions.

Table 1: All data used to determine baseline emissions

Parameter	Description	Value	Data source
$\rho_{fans,baseline}$	Power of each baseline ventilation fan (MW)	0.045	Capacity of existing fans.
n_{fans}	Number of fans replaced, for which the project energy efficient equipment is operating during the year y	240	Project plan.
o_{fans}	Average annual operating hours of the ventilation fans (hours)	8,760	Mine shafts require the ventilation fans to operate continuously.
l_y	Average annual technical grid losses for the grid (transmission and distribution) during the year *y*	0.067	Eskom (South Africa’s national electricity provider) annual report.
$EF_{CO2,elec,y}$	Emission factor in year *y* calculated in accordance with the provisions in AMS-I.D (tCO_2/MWh)	1.0213	Calculated from version 02.2.1 of the ‘Tool to calculate the emission factor for an electricity system’ (calculations in Annex 3).

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:

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According to paragraph 28 of the ‘Simplified modalities and procedures for small-scale CDM project activities’, a simplified baseline and monitoring methodology may be used for a small-scale CDM project activity if the project participants are able to demonstrate that the project activity would otherwise not be implemented due to the existence of one or more of the barriers. The attachment A to Appendix B corresponds to the list of barriers that project participants shall use in order to demonstrate that a small-scale project activity would not have occurred otherwise (i.e. is additional).This will be demonstrated below.

This project will demonstrate additionality based on a lack of prevailing practice – more specifically, the project participant shall show that this project is a first-of-its-kind. Other barriers will also be provided in this section to further corroborate the additionality of the project.

First-of-its-kind project:

According to the version 01.0 of the ‘Guidelines on additionality of first-of-its-kind projects’, paragraph 5, ‘a proposed project activity is the first-of-its-kind in the applicable geographical area if:

a) *The project is the first in the applicable geographical area that applies a technology that is different from any other technologies able to deliver the same output and that have started commercial operation in the applicable geographical area before the start date of the project; and*

b) *Project participant selected a crediting period for the project activity that is “a maximum of 10 years with no option of renewal”’.*

To respond to point (a):
There is no energy efficient ventilation fan project that is currently (April 2012) in commercial operation at any mine shaft in South Africa. This project activity is a first-of-its-kind.

To respond to point (b)
A fixed 10 year crediting period has been selected for this project activity (see section C.2.2) and therefore the condition of point (b) has been met.

Since the project activity has been identified as a first of-its-kind (as both conditions (a) and (b) have been met), the project is additional in accordance with version 01 of the ‘Guidelines on additionality of first-of-its-kind projects’

Other barriers

Although the above first-of-its-kind barrier is sufficient to prove additionality alone, there are other barriers facing this project activity which are significant enough that, in the absence of the CDM, would prevent the implementation of the project activity. These other barriers include:

- The time spent in the shaft replacing the ventilation fans. There is limited space underground and the installation of the ventilation fans will decrease the mine’s productivity.
- Since the fans need to be switched off during fan replacement, there is a risk of hazardous gases and carbon monoxide accumulating in the mine.

- If several fans are replaced at a time, the shaft is closed and the mine workers are moved to the surface which further decreases the mine's productivity.

National policies and circumstances relevant to the baseline

The baseline in this project is electricity consumption from the national grid to meet South Deep and Beatrix's energy requirement. In South Africa, there are national policies and circumstances relevant to this baseline. Consuming electricity from the grid is business as usual for mines in South Africa, and there are no policies that regulate the amount of electricity that is allotted for each consumer. Without the proposed CDM revenue, these mines would continue to meet its shaft air flow requirement with conventional energy inefficient fans.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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The emission reductions of this project are calculated in accordance with the provisions under AMS-II.C (version 13).

Baseline emissions

The baseline emissions of the project are calculated by the product of the baseline energy consumption of the ventilation fans and the emission factor for the electricity displaced. This is in accordance with equation (1) of the applied methodology:

$$BE_y = E_{BL,y} \times EF_{CO2,elec} + Q_{ref,BL} \times GWP_{ref,BL} \qquad \text{(Equation 1)}$$

Where,

BE_y	Baseline emissions in year *y* (tCO_2e)
$E_{BL,y}$	Energy consumption in the baseline in year *y* (MWh)
$EF_{CO2,elec}$	Emission factor of the grid calculated in accordance with the provisions in AMS-I.D (tCO_2/MWh)
$Q_{ref,BL}$	Average annual quantity of refrigerant used in the baseline to replace the refrigerant that has leaked (tonnes/year)
$GWP_{ref,BL}$	Global Warming Potential of the baseline refrigerant (tCO_2e/t refrigerant)

No refrigerant is used in the baseline so equation 1 simplifies to:

$$BE_y = E_{BL,y} \times EF_{CO2,elec,y} \qquad \text{(Equation 1.1)}$$

The emission factor of the grid is calculated using version 02.2.1 of the 'Tool to calculate the emission factor for an electricity system'. These calculations are provided in Annex 3. The methodological choices made regarding this tool are as follows:

- In terms of data vintages, the ex ante option were chosen to calculate the simple OM. In this option a 3 year generation-weighted average are used for the grid power plants. Using this option also means that the emission factor is determined only once at the validation stage, thus no monitoring and recalculation is required during the crediting period.

- The simple operating margin emission factor ($EF_{grid,OMsimple,y}$) is chosen for the calculation method, seeing as low-cost/must-run resources constitute less than 50% of total grid generation in average of the five most resent years.
- For calculating of the combined margin emission factor: w_{OM} = 0.5 and w_{BM} = 0.5 (as specified by the applied tool – it is an 'other'-type project).

The energy consumption in the baseline is calculated using equation (2) of the applied methodology:

$$E_{BL,y} = \sum_{fans}\left(n_{fans} \times \rho_{fans,baseline} \times o_{fans}\right) / \left(1 - l_y\right) \qquad \text{(Equation 2)}$$

Where,

n_{fans}	Number of fans replaced, for which the project energy efficient equipment is operating during the year *y*
$\rho_{fans,baseline}$	Power of the baseline ventilation fans (MW)
o_{fans}	Average annual operating hours of the ventilation fans (hours)
l_y	Average annual technical grid losses for the grid (transmission and distribution) during the year *y*

Project emissions

The project emissions are calculated in using equation (5) of the applied methodology:

$$PE_y = E_{PJ,y} \times EF_{CO2,elec} \qquad \text{(Equation 5)}$$

Where,

PE_y	Project emissions in year *y* (tCO_2e)
$E_{PJ,y}$	Energy consumption in project activity in year *y* (MWh/year)
EF_{grid}	Emission factor of the grid calculated in accordance with the provisions in AMS-I.D (tCO_2/MWh)

The energy consumption in the project is calculated using equation (5.1):

$$E_{PJ,y} = \sum_{fans}\left(n_{fans} \times \rho_{fans,project} \times o_{fans}\right) / \left(1 - l_y\right) \qquad \text{(Equation 5.1)}$$

Where,

$\rho_{fans,project}$	Power of the project ventilation fans (MW)

There are no refrigerants used in the project activity and therefore equation (6) of the applied methodology is not applicable.

Leakage

No leakage is associated with this project as the existing ventilation fans are scrapped. The existing fans will be stored on site until all of fans have been replaced. The fans will then be collected from South Deep and Beatrix by an independent company, who will destroy the fans at their own site. The independent company will document this process, and the records of this will be kept for CDM verification. The independent company will also issue Gold Fields with invoices for the scrapping process. These invoices will also be kept to be used as a cross check.

Emission reductions

The emission reductions of the project activity are calculated using equation (7) below:

$$ER_y = (BE_y - PE_y) - LE_y \qquad \text{(Equation 7)}$$

Where,

ER_y	Emission reductions in year *y* (tCO_2e)
BE_y	Baseline emissions in year *y* (tCO_2e)
PE_y	Project emissions in year *y* (tCO_2e)
LE_y	Leakage in year *y* (tCO_2e)

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

Data / Parameter:	$EF_{CO2,elec,y}$
Data unit:	tCO_2e/MWh
Description:	Emission factor of the grid
Source of data used:	Calculated
Value applied:	1.0213
Justification of the choice of data or description of measurement methods and procedures actually applied :	The emission factor of the grid is calculated in accordance with the ‘Tool to calculate the emission factor for an electricity system’ (version 02.2.1). These calculations are provided in Annex 3.
Any comment:	As per the applied tool, this value can be calculated ex-ante.

Data / Parameter:	$\rho_{fans,baseline}$
Data unit:	MW
Description:	Power of the baseline ventilation fans
Source of data used:	Controlled performance tests on the existing fans using standardised ducts and test procedures.
Value applied:	0.0450
Justification of the choice of data or description of measurement methods and procedures actually applied :	A random sample of the existing fans will be tested to estimate the conservative energy savings for all of the fans used in this project activity. This is in accordance with paragraph (15) of AMS-II.C which states: ‘If the devices have variable current (ampere) characteristics, monitoring shall consist of metering the “energy use” of an appropriate sample of devices installed’. Controlled performance testing determines fan performance in isolation of any specific installation and provides a direct fan-to-fan comparison for any fan. A characteristic performance curve can then be determined for each fan which can then be applied to investigate suitability for various installations in terms of flow rate, pressure and power consumption.
Any comment:	-

Data / Parameter:	$\rho_{fans,project}$
Data unit:	MW
Description:	Power of the project ventilation fans
Source of data used:	Controlled performance tests on the new fans using standardised ducts and test procedures.
Value applied:	0.0315
Justification of the choice of data or description of measurement methods and procedures actually applied :	A random sample of the new fans will be tested to estimate the conservative energy savings for all of the fans used in this project activity. This is in accordance with paragraph (15) of AMS-II.C which states: ‘If the devices have variable current (ampere) characteristics, monitoring shall consist of metering the “energy use” of an appropriate sample of devices installed’. Controlled performance testing determines fan performance in isolation of any specific installation and provides a direct fan-to-fan comparison for any fan. A characteristic performance curve can then be determined for each fan which can then be applied to investigate suitability for various installations in terms of flow rate, pressure and power consumption.
Any comment:	-

B.6.3 Ex-ante calculation of emission reductions:

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The emission reductions of the project activity are calculated using equation (7) in section B.6.1 of this document.

$$ER_y = (BE_y - PE_y) - LE_y \qquad \text{(Equation 7)}$$

The values of the parameters used to calculate the emission reductions are shown in the table below.

Parameter	Units	Applied value
n_{fans}	-	240
o_{fans}	hours	8,760
l_y	-	0.067
$\rho_{fans,baseline}$	MW	0.0450
$\rho_{fans,project}$	MW	0.0315
$EF_{CO2,elec}$	tCO_2e/MWh	1.0213

The emission reductions for each year in the crediting period are 30,795 tCO_2e.

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

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Year	**Estimation of project activity emissions (tCO_2e)**	**Estimation of baseline emissions (tCO_2e)**	**Estimation of leakage (tCO_2e)**	**Estimation of overall emission reductions (tCO_2e)**
2013	71,854	102,649	0	30,795
2014	71,854	102,649	0	30,795
2015	71,854	102,649	0	30,795

2016	71,854	102,649	0	30,795
2017	71,854	102,649	0	30,795
2018	71,854	102,649	0	30,795
2019	71,854	102,649	0	30,795
2020	71,854	102,649	0	30,795
2021	71,854	102,649	0	30,795
2022	71,854	102,649	0	30,795
Total (tonnes of CO_2e)	718,540	1,026,490	0	307,950

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

B.7.1 Data and parameters monitored:

Parameter:	n_{fans}
Unit:	-
Description:	Number of fans replaced, for which the project energy efficient equipment is operating during the year y
Source of data:	Supplier invoices
Value of data:	240
Brief description of measurement methods and procedures to be applied:	The number of fans installed will be determined from supplier invoices.
QA/QC procedures to be applied (if any):	No QA/QC procedures need to be applied.
Any comment:	-

Parameter:	o_{fans}
Unit:	hours/year
Description:	Average annual operating hours of the baseline ventilation fans
Source of data:	As required for mine operation.
Value of data:	8,760
Brief description of measurement methods and procedures to be applied:	Mine records will be examined annually to check for any production downtimes. These downtimes will be factored into the emission reduction calculations during verification.
QA/QC procedures to be applied (if any):	It is assumed that the ventilation fans operate continuously but this shall be checked during the verification of the project.
Any comment:	-

Parameter:	l_y
Unit:	-
Description:	Average annual technical grid losses for the grid (transmission and distribution)

	during the year y
Source of data:	Eskom annual report
Value of data:	0.067
Brief description of measurement methods and procedures to be applied:	Not applicable.
QA/QC procedures to be applied (if any):	Not applicable.
Any comment:	Eskom measures the losses on their system every year and publishes them in the annual report.

Parameter:	*Scrapping existing fans*
Unit:	-
Description:	Records of the scrapping of existing fans to ensure there is no leakage.
Source of data:	Independent verification of scrapping process.
Value of data:	Not applicable.
Brief description of measurement methods and procedures to be applied:	The existing fans will be stored on site until all of fans have been replaced. The fans will then be collected from South Deep and Beatrix by an independent company, who will destroy the fans at their own site.
QA/QC procedures to be applied (if any):	The independent company will document this process, and the records of this will be kept for CDM verification. The independent company will also issue Gold Fields with invoices for the scrapping process. These invoices will also be kept to be used as a cross check.
Any comment:	-

Parameter:	*Annual check of a sample of the installed fans to ensure still operationa*
Unit:	-
Description:	Annual check of a sample of the installed fans to ensure that they are still operational.
Source of data:	Physical confirmation
Value of data:	Not applicable.
Brief description of measurement methods and procedures to be applied:	The project participant shall follow version 01 of the ‘General guidelines for sampling and surveys for small-scale CDM project activities’ to determine the fan sampling method. A random sampling method shall be applied.
QA/QC procedures to be applied (if any):	Not applicable.
Any comment:	-

B.7.2 Description of the monitoring plan:

>>

The monitoring plan will ensure that the project emission reductions are accurately monitored, recorded and reported. The monitoring plan is established in accordance with the provisions in AMS-II.C version 13.

All new ventilation fans will be certified and laboratory tested[4] before they are installed underground. The installed fans will also meet with Gold Fields' mine safety standards. Since ventilation fans have variable current characteristics, a random sample of the new fans will tested for their energy consumption. This will define the 'project scenario'. A random sample of the existing fans will also be tested for their energy consumption. This will define the 'baseline scenario'. The means of random sampling is in accordance with the applied methodology. After project implementation, a sample of the fans will be checked annually underground to ensure that the new fans are still in operation.

The existing fans steel axial fans will scrapped to ensure that there is no leakage as a result of the project activity. The existing fans will be stored on site until all of fans have been replaced. The fans will then be collected from South Deep and Beatrix by an independent company, who will destroy the fans at their own site. The independent company will document this process, and the records of this will be kept for CDM verification. The independent company will also issue Gold Fields with invoices for the scrapping process. These invoices will also be kept to be used as a cross check.

All records and data associated with the monitoring of this project will be kept for a minimum of two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

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

>>
Date of completion of application: 26/04/2012

Contact information for the entity responsible for the application of the baseline and monitoring information:
Promethium Carbon (Pty) Ltd
Coral House
20 Peter Place
Bryanston 2021
Johannesburg
Telephone: +27 11 706 8185

This entity is not a project participant.

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, *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.*

This project has not yet started. According to the project plan, the new ventilation fans will be ordered on 01/06/2012. This estimated date will represent the starting date of the project.

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[4] The fans are tested in accordance with BS 848 – the British Standard for testing fans.

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

>>
The operational lifetime of the ventilation fans exceeds the ten year CDM crediting period.

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

C.2.1. Renewable crediting period

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

>>
Not applicable. This section has been intentionally left blank. A fixed crediting period is selected for this project activity.

C.2.1.2. Length of the first crediting period:

>>
Not applicable. This section has been intentionally left blank. A fixed crediting period is selected for this project activity.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
A fixed crediting period is selected for this project activity. The starting date of the crediting period is 01/01/2013, or the date that the project is registered under CDM, whichever occurs later.

C.2.2.2. Length:

>>
10 years 0 months.

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 project does not involve any activity that is listed in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) and, as such, does not require an environmental impact assessment or a basic assessment.

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:

>>
The project activity mainly has a positive impact on the environment. It will reduce the electricity consumption from the South African national grid. The reduction in electricity consumption from the national grid will result in a reduction of coal-based electricity and all the negative impacts associated

with coal mining such as: the impact of the actual (coal) mining process, the utilisation of scarce water resources, SO_2 emissions and the impacts associated with the disposal of coal ash. Hence the project will reduce GHG emissions.

SECTION E. Stakeholders' comments

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

>>

Advertisements were placed in the Carletonville Herald (13/04/2012) and were distributed to all employees in the South African region (12/04/2012). Posters were also placed at the mine shafts where the new ventilation fans will be installed (17/04/2012).

The adverts and posters provided some background information about the proposed project, and also explained that it aimed to be registered as a carbon credit project which would offset some of the costs of the project.

E.2. Summary of the comments received:

>>

No comments were received.

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

>>

Communication and awareness campaigns regarding the project remain ongoing.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Nedbank Limited
Street/P.O.Box:	135 Rivonia Road
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City:	Sandown
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FAX:	+27 11 295 2268
E-Mail:	carbon@nedbankcapital.co.za
URL:	www.nedbankcapital.co.za
Represented by:	Head: African Treasuries, Carbon and Financial Products Unit
Title:	Mr
Salutation:	
Last Name:	Whitfield
Middle Name:	
First Name:	Kevin
Department:	African Treasuries, Carbon and Financial Products
Mobile:	+27 82 901 5846
Direct FAX:	+27 11 295 2268
Direct tel:	+27 11 294 2268
Personal E-Mail:	kevinwh@nedbankcapital.co.za

Organization:	GFI Mining South Africa (Pty) Ltd
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State/Region:	Gauteng
Postfix/ZIP:	2196
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FAX:	+27 562 9839
E-Mail:	
URL:	www.goldfields.co.za
Represented by:	Jan du Plessis
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Salutation:	
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Official Development Assistance (ODA) has not, and will not, be used in the development and implementation of this project.

Annex 3

BASELINE INFORMATION

Tests to determine the average energy saving per fan

Each fan will have different pressure requirements and volumetric flow rate delivery objectives. Each fan installed in the mine will have different and varying operating conditions. It is because of these varying conditions that a baseline (and the subsequent energy saving) needs to be developed that takes into account all of these differences.

This can be achieved in one of the following two methods:

1. Test each existing fan in its installed position to determine the actual operating/performance point. This would entail in situ measurement. The new axial fan would then be installed, replacing the 'old' fan, and then the in situ measurements would be repeated. This would then allow direct comparison of the performance in terms of flow rates, pressure and power (kW) consumed for that installation.

2. Complete controlled performance tests on the existing and new fans using standardised ducts and test procedures. This testing determines fan performance in isolation of any specific installation and provides a direct fan-to-fan comparison for any fan.

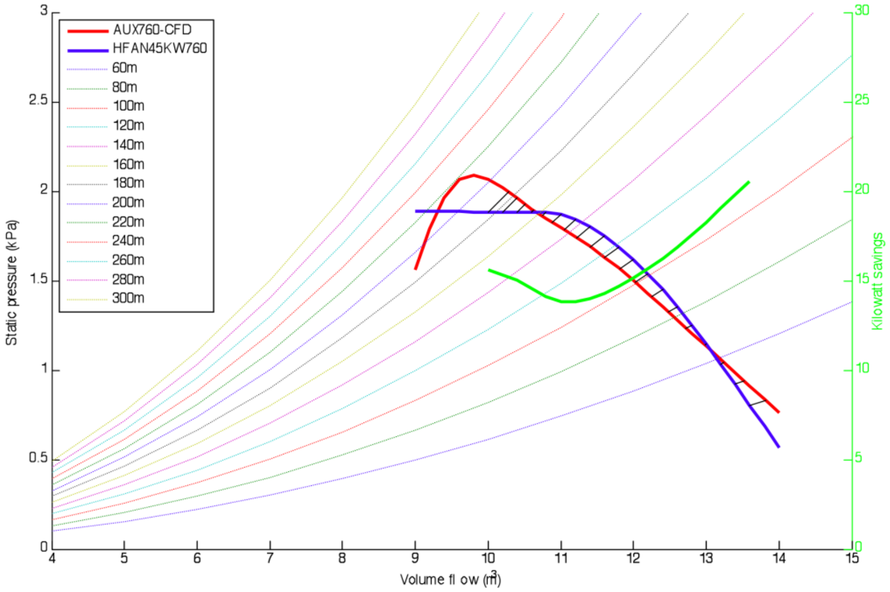
The primary disadvantages of the first method lie in:

- The complexity of doing the testing underground, and
- The limited scope of the results, e.g. the results from one installation cannot readily be applied to another unless all of the installation effects in both cases are accurately accounted for.

From the second method, a characteristic performance curve can be determined for each fan which can then be applied to investigate suitability for various installations in terms of flow rate, pressure and power consumption:

- By comparing the power consumption of two different fans at the same flow rate and pressure (operating point), the potential power saving can be determined for a particular application.
- By calculating and comparing the power consumption at various flow rates across all flow rates to the right of the fan stall point (i.e. at all possible operating points for the fan), a representative power saving 'figure of merit' can be determined which is independent of installed conditions.

The figure below depicts an example of the ‘figure of merit’ calculation based on a two fan comparison as described above.



Depending on the actual operating point/installation, power savings of between 8kW and 20kW will be realised by installing the new axial flow fan. However, the lower mean saving of 13.5 kW (as measured in numerous tests) will be conservatively used for planning.

Grid emission factor calculations

This section presents the calculations for the South African grid emission factor.

Step 1: Identify the Relevant Electricity Systems

This tool will serve project activities that prospect to displace grid electricity in South Africa.
The 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 displaced without significant transmission constraints.

Similarly, a connected electricity system, e.g. national or international, is defined as an electricity system that is connected by transmission lines to the project electricity system. Power plants within the connected electricity system can be dispatched without significant transmission constraints, but transmission to the project electricity system has significant transmission constraints.

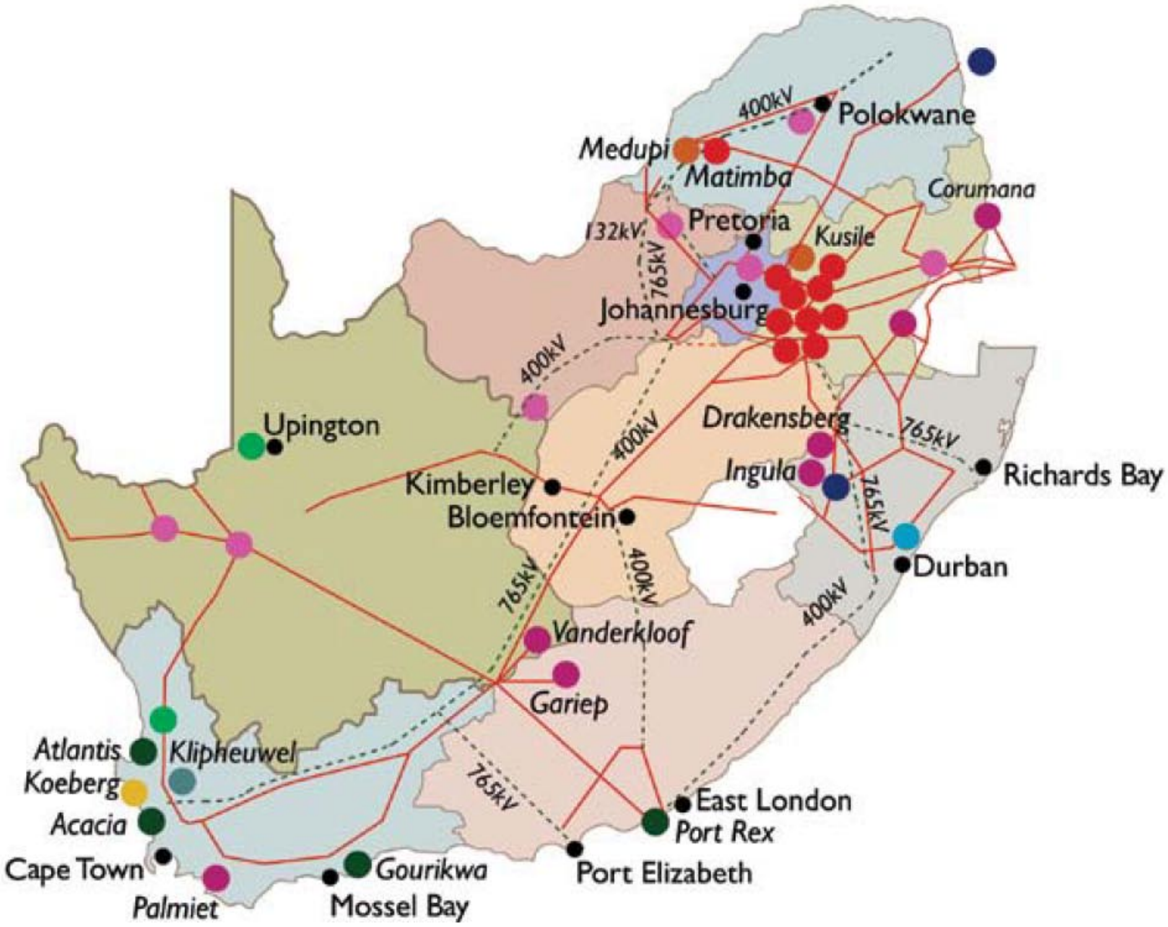
The DNA of South Africa has not published a delineation of the project electricity system and connected electricity systems. Also, the application of the criteria with regards to determining significant transmission constraints does not result in a clear grid boundary due to a lack of sufficient data. For these reasons the following was chosen for the reference system of this project:

- The project electricity system entails all the Eskom power plants in the South African electricity grid.
- Due to a lack of data available in the public domain (in order to evaluate significant transmission constraints), all other power stations (non-Eskom) and countries with power grids connected to South Africa, are treated as connected electricity systems, and emission factors for imports from these systems are conservatively assumed to be 0 tCO_2/MWh.

All electricity generated by the Eskom power stations is taken into consideration when calculating the grid emission factor; exports are not subtracted.

All the data for the Eskom power stations are obtained from the Eskom website, where they have a specific webpage dedicated to CDM grid emission factor related data (Eskom Holdings SOC Limited , 2011). This data includes commissioning dates, electricity generated, and fuel consumed.

Data for the imported electricity are obtained from the Eskom annual report, where "*Total purchased for the Eskom system (GWh)*" is shown in the "*Statistical overview*" table on pg. 324 of the report (Eskom Holdings SOC Limited, 2011).



Step 2: Chose Whether to Include Off-Grid Power Plants in the Project Electricity System

This step is optional according to the tool. The grid emission factor is calculated from only grid power plants (Option I). Off-grid power plants are not included in the calculations.

Step 3: Select a Method to Determine the Operating Margin (OM)

The OM is calculated using the simple OM method (Option a). The simple OM method can be used provided that the low-cost/must-run resources constitute less than 50% of the total grid generation in average of the five most recent years.

The average percentage of low-cost/must-run resources amount to 0.00% of the total grid generation for this project electricity system. Therefore, Option (a) is applicable.

In terms of data vintages, the *ex ante* option were chosen to calculate the simple OM. In this option a 3 year generation-weighted average are used for the grid power plants. Using this option also means that the emission factor is determined only once at the validation stage, thus no monitoring and recalculation is required during the crediting period.

The data used in OM calculations are for the 3 year period of 1 April 2008 – 31 March 2011 (Eskom financial year runs from 1 April – 31 March). This is the latest available data.

Step 4: Calculate the Operating Margin Emission Factor According to the Selected Method

The simple OM emission factor ($EF_{grid,OMsimple,y}$) 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. Hence, the hydro and nuclear power plants are excluded from the calculation of the OM.

Option A is used for calculating the simple OM. The calculations in this option are based on the total net electricity generation and a CO_2 emission factor of each power plant.

Option A: Calculation based on average efficiency and electricity generation of each plant

Under this option, the simple OM emission factor is calculated based on the net electricity generation of each power plant and an emission factor of each power plant, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

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 the year y (MWh)
$EF_{EL,m,y}$	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
y	The relevant year as per data vintage chosen in Step 3

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

The emission factor for each power plant (*m)* was determined as follows (Option A1):

$$EF_{grid,OMsimple,y} = \frac{\sum_{i} \left(FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y} \right)}{EG_{y}}$$

Where:

$EF_{grid,\ OMsimple,y}$	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$FC_{i,y}$	Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i,y}$	Net calorific value (energy content) fossil fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ)
EG_y	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year y (MWh)
i	All fossil fuel types combusted in power sources in the project electricity system in year y

y The relevant year as per data vintage chosen in Step 3.

Electricity imports are treated as one power plant, as per the tool guidance.

The constants used in calculations appear in the table below.

Constants used in calculations

Constants		
$NCV_{other\ bituminous\ coal}$	19.9	GJ/T
$NCV_{other\ kerosene}$	42.9	GJ/T
$EF_{CO2other\ bituminous\ coal}$	0.0895	tCO_2/GJ
$EF_{CO2,other\ kerosene}$	0.0708	tCO_2/GJ

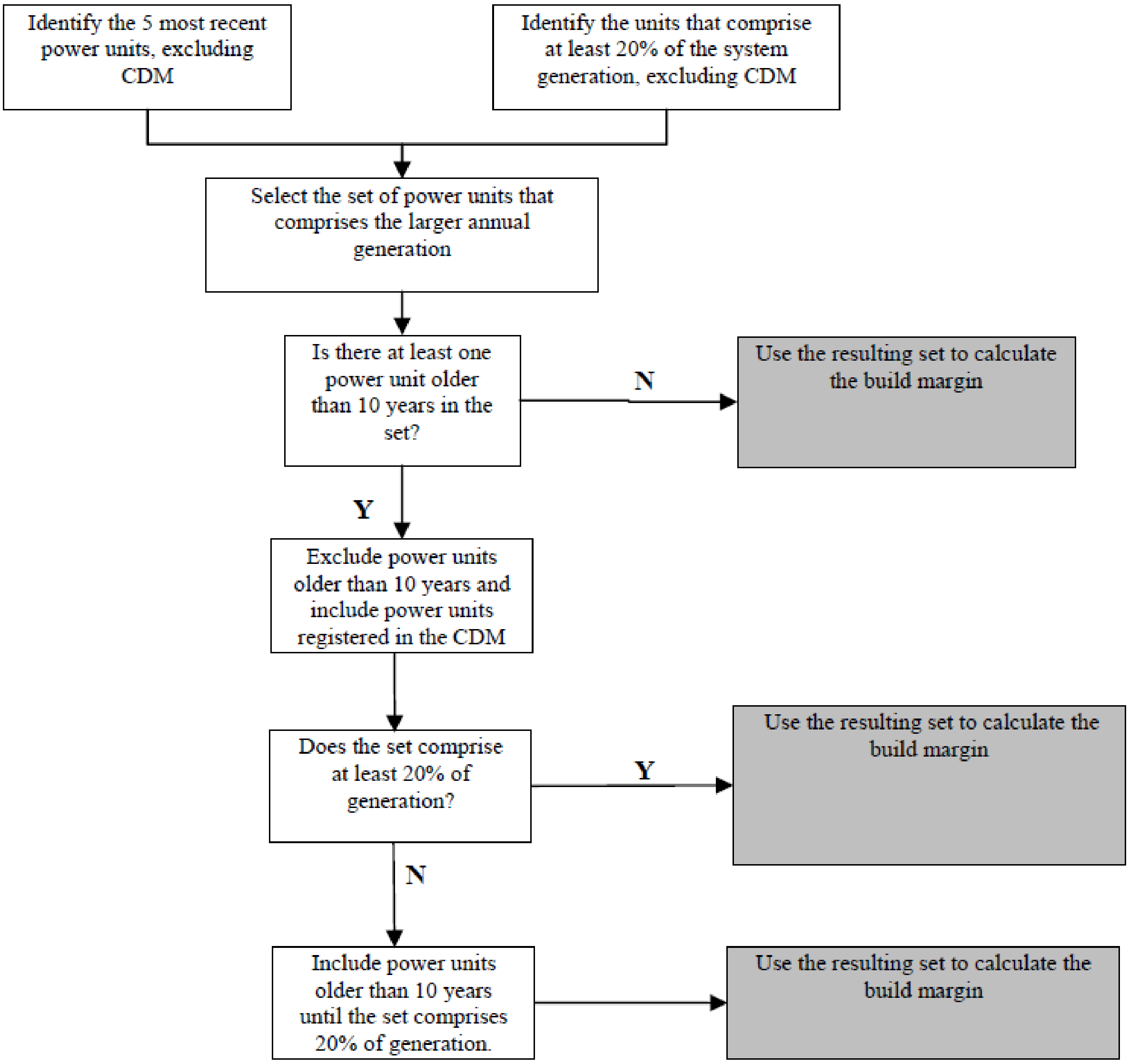
The OM is calculated as **1.0182** tCO_2e/ MWh.

Step 5: Calculate the Build Margin (BM) Emission Factor

In terms of vintage of data, one Option 1 was selected: 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.

The sample group of power units (*m)* used to calculate the build margin were determined as per the procedure delineated in the tool, consistent with the data vintages selected.

The following diagram summarizes the procedure of identifying the sample group:



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

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:

$EF_{grid,BM,y}$	Build 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)
$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2/GJ)

m	Power units included in the build margin
y	Most recent historical year for which power generation data is available.

The CO_2 emission factor of each power unit m ($EL_{EL,m,y}$) should be determined as per the guidance in Step 4 (a) for the simple OM, using Option A1 using for *y* the most recent historical year for which power generation data is available, and using for *m* the power units included in the build margin.

If for a power unit *m* data on fuel consumption and electricity generation is available the emission factor ($EF_{EL,m,y}$) should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{\sum_m EG_{m,y}}$$

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)
$NCV_{i,y}$	Net calorific value (energy content) fossil fuel type *i* in year y (GJ/mass or volume)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* in year y (tCO_2/GJ)
$EG_{m,y}$	Net electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
m	All power plants/units serving the grid in year y except low-cost/must-run power plants/units
i	All fossil fuel types combusted in power plant/unit m in year y
y	The relevant year as per data vintage chosen in Step 3.

The BM is calculated as **1.0245** tCO_2e/ MWh.

Step 6: Calculate the Combined Margin (CM) Emission Factor

The combined margin factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

Where:

$EF_{grid,BM,y}$	Build Margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	Weighting of operating margin emissions factor (%)
w_{BM}	Weighting of build margin emissions factor (%)

The emission factors for the operating margin, the build margin, and the final combined margin appear in the table below.

CM emission factor

$EF_{grid,OM,y}$	1.0182
$EF_{grid,BM,y}$	1.0245
w_{OM}	0.5
w_{BM}	0.5
$EF_{grid,CM,y}$	**1.0213**

Annex 4

MONITORING INFORMATION

This section is intentionally left blank.

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