CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

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SECTION A. General description of project activity

A.1 Title of the project activity:

Emfuleni Power Project – PDD version 28, 27 January 2006

A.2. Description of the project activity:

Mittal Steel is the African continent's dominant steel producer, with a steelmaking capacity in excess of 7 million tonnes pa. It operates a large steel production plant at Vanderbijlpark that produces 3,5 million tons of liquid steel a year, which constitutes 84 % of South Africa's flat steel requirements. The facility is ISO 9002 certified, enjoys ISO 14001 accreditation and consists of inter alia the following:

> Six coke oven batteries; One sinter plant (two strands); Two blast furnaces; Direct reduction plant (four kilns); Three electric arc furnaces; Three basic oxygen furnaces; Three continuous casters; 3,650 mm plate mill; 2,050 mm hot strip mill (seven strand)

In the production process significant quantities of furnace off-gases are produced in the form of Blast Furnace Gas, Coke Oven Gas and Basic Oxygen Furnace Gas. Some of the Coke Oven and Blast Furnace gases are presently captured by Mittal Steel and used in some of their process plants including a current 23,5 MW power plant. The excess Coke Oven and Blast Furnace as well as all of the Basic Oxygen Furnace Gas (which is currently not used for energy production) are flared to atmosphere.

The **Purpose of the Project Activity** is to collate these gases, stop wasteful flaring and rather utilize the gases to generate 115 MegaWatts of electricity for the South African electricity grid. The present 23,5 MW power plant would be decommissioned.

The project developer is **Eco Emfuleni (Pty) Ltd,** a Special Project Vehicle of EcoElectrica (Pty) Ltd. The company will operate as an Independent Power Producer on the Mittal Steel site in terms of an agreement between EcoElectrica and Mittal Steel.

The history of the project is that the idea to use the significant amounts of off-gases (available after the present 23,5 MW power plant had been supplied) for electricity production was mooted about five years ago and Mittal Steel at the time initiated a study to determine the viability of such a power plant. Due to inter alia the relatively low cost of electricity and a constraining regulatory electricity policy in South Africa the project was considered not to be feasible.

In December 2003 however, EcoElectrica assisted by its EPC contractor Bateman Africa approached Mittal Steel to revive interest in this venture. EcoElectrica applied for and was granted a conditional license for this project by the National Electricity Regulator (NER).

The developer applied for an Independent Power Producer (IPP) license from the National Energy Regulator and a conditional license has been granted.

In the view of the developer the Project Activity assists South Africa in achieving **sustainable development**, primarily in the following respects:

- It will lower the GHG emissions from the South African electricity grid;
- It will create significant employment opportunities (jobs);
- It will create new electricity for a South African grid that needs additional power to grow the economy;
- It will create an Independent Power Producer and so diversify the grid's energy supply in accordance with the country's White Paper on Energy (1998);
- It will lead to the transfer of cutting edge, modern technology to South Africa

The South African DNA has already issued a Letter of No Objection after assessing the project against its sustainable development criteria and is expected to grant Host Country Approval.

A.3. Project participants:

Name of Party Involved	Public/Private entities Project participants (*)	Kindly indicate if the Party wishes to be considered as project participant
Republic of South Africa	Eco Emfuleni (Pty) Ltd* - developer – private entity	No

Eco Emfuleni will function as the power plant owner, project sponsor and the developer of the project and will be assisted by Bateman Africa as its EPC contractor (Engineering, Procurement and Construction). It is expected that Eco Emfuleni will be authorised by the South African Designated National Authority.

Eco Emfuleni is a project participant.

The South African Government is a Party through the South African Designated National Authority but it does not wish to be considered a project participant.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

The host country is the Republic of South Africa

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

Gauteng Province

A.4.1.3. City/Town/Community etc:

Vanderbijlpark

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

The proposed power plant is to be located within the Mittal Steel Vanderbijlpark industrial site. Vanderbijpark is situated approximately 75km south of Johannesburg, South Africa. The Mittal Steel site is about 2500 hectares in size and the proposed site will cover about 2 hectares of this site. The proposed site for the plant is currently used for industrial activities.

An exact description of the project site co-ordinates may not be given due to Mittal Steel Security Policy.

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

Energy industries – Sectoral scope 01.

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

The technology to be employed can be distinguished as belonging to one of two categories, namely **gas collection/storage/supply technology** on the one hand and **energy generation technology** on the other. Technology in the first category would ensure consistent delivery of the gas feedstock in optimal quantities while technology in the second category would use the gas to generate electrical energy.

Gas collection/storage/supply technology

Regarding **gas collection** much of the technology needed is in existence already and can merely be supplemented. So for instance, a *waste furnace gas collection system* is needed to deliver all the waste gases to the boiler where they will be used for energy generation. At present there are existing, sufficient and safe ring mains at the Mittal Steel site that transport the Coke Oven and Blast Furnace gases to the proposed on-site location for the Eco Emfuleni boiler. Regarding the collection of Basic Oxygen Furnace gas there are no existing facilities that can adequately deal with this and a new main duct of approximately 2 km in length would be installed to transport the Basic Oxygen Furnace gas to the proposed boiler station. This duct would have the same safety profile as the existing ring mains but will be new.

Gas storage is needed because the proposed boiler will require a relatively constant supply of energy in order to function efficiently – however the rate at which flammable gases are generated is not constant and varies considerably over time (particularly in the instance of Basic Oxygen Furnace gas). Maximising the availability and effective use of flammable gases (conversely, minimising flaring) thus requires gas storage. The intention is to direct excess gas to storage during periods when the gas supply exceeds boiler requirements and to burn stored gas during periods when the gas supply is less than boiler requirements. There is an existing low pressure gas storage facility at Mittal Steel. This gas storage tank would be replaced and would store a maximum of 50 000 Nm^3 of Basic Oxygen Furnace gas at a pressure of 3,3 kPa (gauge).

Gas supply will be necessary because in times of emergency the on-site generated gas supply may be insufficient to meet boiler requirements. EcoElectrica will meet this demand with Natural Gas supplied by Sasol. There is an existing 50 bar Natural Gas line from Sasol's Sasolburg plant to Mittal Steel and the Natural Gas for the proposed boiler, when required, would be drawn from the existing line.

Energy generation technology

Regarding energy generation technology a single, specially designed 131 MW boiler constructed by Babcock Hitachi Europe will be used to burn the three streams of off-gas (and/or the stream of natural gas in an emergency). The boiler will produce net exportable power at 115 MW maximum capacity. More particularly it will produce approximately 360t/hr of steam at 140 bar pressure and 540ºC. The steam will be used to drive a 131 MW steam turbine/generator combination.

Babcock Hitachi have previously been involved in twenty-two projects similar to the present Project Activity. The latest were a 260MWe plant in Germany and three 73MWe plants in Brazil.

The steam turbine generator is existing technology and is offered by various original equipment manufacturers including but not limited to GE in the USA, Siemens of Germany and Hitachi of Japan.

The electricity generated will be sold to and fed into the South African electricity grid.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

There are at present no legislative measures or sectoral policies that compel industries like steel producers in South Africa to turn off-gases into electricity. Mittal Steel would thus be at liberty to continue flaring the off-gases produced at its plant at Vanderbijlpark and the present Project Activity is additional to what legislation and national policy requires.

Furthermore, the Project Activity faces significant barriers and also is not financially attractive in the absence of carbon finance. The project is thus additional.

The installation of the Emfuleni Power Plant will result in the production of electricity to be fed into the coal-dominated South African electricity grid. As a consequence, grid electricity of an equal quantity as the energy produced at Mittal Steel by EcoElectrica will be displaced by the Project Activity.

This in turn will lead to an emissions reduction through less electricity (and thus less emissions) being produced by the grid. At an assumed load factor of 90% it is estimated that the Project Activity will generate 608 242 tonnes of CO_2e in emissions reductions pa and thus that the total emissions reductions over the chosen crediting period of ten years will be approximately 6 082 420 tonnes of CO_2e.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

Years	**Estimated emissions reduction in tonnes of CO_2e**
2009	608 242
2010	608 242
2011	608 242
2012	608 242
2013	608 242
2014	608 242
2015	608 242
2016	608 242
2017	608 242
2018	608 242
Total	6 082 420
Crediting years	10
Average per year	608 242

A.4.5. Public funding of the project activity:

The project will not receive any public funding from a Party in Annex 1.

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

"**ACM0004** Consolidated methodology for waste gas and/or heat for power generation".

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

ACM0004 is applicable in the following circumstances:

> "*This methodology applies to project activities that generate electricity from waste heat or the combustion of waste gases in industrial facilities.*
>
> *The methodology applies to electricity generation project activities:*
>
> - *that displace electricity generation with fossil fuels in the electricity grid or displace captive electricity generation from fossil fuels, electricity:*
> - *where no fuel switch is done in the process where the waste heat or the waste gas is produced after the implementation of the project activity*
>
> *The methodology covers both new and existing facilities"*

In the present instance the Project Activity comprises the generation of electricity from the combustion of waste gas in an existing industrial facility and ACM0004 is thus directly applicable.

ACM0004 further explicitly envisions the use of additional fuel sources in the Project Activity, which additional source may be fossil fuel based:

> *"For the purpose of determining GHG emissions of the* ***project activity****, project participants shall include:*
>
> - *CO_2 emissions from combustion from auxiliary fossil fuels"*

In the present instance the Project Activity will include the combustion of additional natural gas during emergencies.

The Project Activity thus falls squarely within the ambit of **ACM0004.**

B.2. Description of how the methodology is applied in the context of the project activity:

This section consists of the following subsections:

- Step-wise determination of most economically attractive viable alternative (baseline) as per ACM 0004
- Calculation of Baseline Emissions Factor as per ACM 0004 and ACM 0002
- Calculation of Project Emissions Factor for auxiliary fuel as per ACM 0004
- Summary of important variables calculated

Step-wise determination of most economically attractive viable alternative as per ACM 0004

Determining what viable alternatives exist

ACM 0004 prescribes that the **baseline scenario** should be the economically most attractive alternative that does not face prohibitive barriers. It further identifies some examples of alternatives to the Project Activity.

At the proposed project site, there is not a viable possibility of generating power from hydro or wind sources. The option to generate electricity from coal or diesel is likewise not viable as these resources are not available at the project site and it would unduly impose upon the activities of Mittal Steel to transport the necessary feedstock over the premises of Mittal Steel or store it on the Mittal Steel premises. Moreover, this would entail a much larger operation and a much larger workforce and render the operations and maintenance beyond the developer's capacity.

The option of using the waste gas in a cogenerative combined cycle plant exists at least notionally and has been implemented at a steel mill at Trieste, Italy in similar circumstances as the present. In such a plant the gas is used to fire a turbine coupled to an electrical generator. Flue gases from the gas engine are then used generate steam in a heat exchanger.

Why the option to use a cogenerative combined cycle plant is being discounted

Due to inter alia the following technical reasons this option was not considered feasible:

- The technology is not considered as internationally proven yet to the extent that it can ensure its reliability over time;
- No Original Equipment Manufacturer has a reference plant utilizing this type of fuel in a combined cycle arrangement;
- The fuel gases at the project site contain solids that can damage turbine blades, with consequent increased maintenance and lower reliability;
- Gas supply is at a pressure too low for this option and compression would thus be needed, lowering efficiency;
- The lack of a clear proven track record and safety record makes this technology contrary to the aims of the CDM.

More detail appears from page 36 of the Environmental Impact Report, attached hereto.

Comparative analysis of remaining options

The following alternative options are thus available:

(a) A continuation of the status quo – in other words no project activity;
(b) The proposed project activity not undertaken as a CDM project activity;
(c) Power generation on-site using natural gas

In the present instance the baseline is determined by calculating the NPV for each viable alternative option and determining which is economically the most attractive (detail and assumptions appear in section B3 below).

As explained in detail in section B3 below, the project is the recipient of a subsidy scheme which in the opinion of the project developer falls squarely within the ambit of the decision Executive Board 16 annex 3(1)(b) and (3), which means that the subsidy may not be considered in developing the baseline. The figures below thus exclude the subsidy and refer to the hypothetical situation without the policy being in place.

	Status quo continued	Project Activity without CDM	Project Activity but using natural gas not waste gas
Project NPV	0	- ZAR 169 million	- ZAR 663 million

Conclusion

It thus appears that if the steps indicated by ACM0004 are followed, the most financially attractive alternative and thus the baseline would be not to invest at all – thus a continuation of the status quo where 23,5 MW is generated from off-gases while the remaining gases are flared and Mittal Steel imports the bulk of its electricity from the grid. The baseline scenario thus includes both captive and imported power and the emissions factor needs to be calculated according to Option 3 of ACM 0004.

CALCULATION OF BASELINE EMISSIONS FACTOR AS PER ACM 0004

Methodology ACM 0004 gives clear instructions on how the baseline emissions factor needs to be calculated if the baseline includes both captive and imported power generation. In such a case the emissions factor for the baseline is the weighted average of the emissions factor for grid power and captive power. In this section the captive power emissions factor will be calculated, the baseline grid emissions factor will be calculated and the weighted average of the latter two will be calculated to establish the baseline emissions factor.

Calculation of the captive power emissions factor

Because both Blast Furnace Gas and Coke Oven Gas are used in the baseline for captive power generation it becomes necessary to find their respective calorific values and the emission factors for each.

Blast Furnace Gas emission factor

1 mole	=	22.4	Litres			
		44.64285714	Moles per m3			
		44.00	Atomic mass of CO_2	75	MJ	kmol
				3.348214	MJ	M3
Gas:		**Blast furnace gas**				
Cv	=	3.348214286				
Oxid	=	99.50%				

Gas	Composition [%]	Atomic Mass [g/mole]	Moles of Carbon per mole	Moles of Gas	Moles of Carbon	Moles of CO_2
C02	18	44	1	8.035714	8.035714	8.03571429
O2	1	32	0	0.446429	0	0
H2	3.5	2	0	1.5625	0	0
CO	24.5	28	1	10.9375	10.9375	10.8828125
N2	53	28	0	23.66071	0	0
Total	100			44.64286	18.97321	18.9185268

Emission factor (volume)	**0.83241 5**	Kg/m3
Emission factor (energy)	**248.614 7**	Tonnes/TJ

Coke Oven Gas emission factor

1 mole	=	22.4	Litres
		44.64285714	Moles per m3
		44.00	Atomic mass of CO_2
Gas:		**Coke oven gas**	
Cv	=	18	
Oxid	=	99.50%	

Gas	Composition [%]	Atomic Mass [g/mole]	Moles of Carbon per mole	Moles of Gas	Moles of Carbon	Moles of CO_2
C02	2.7	44	1	1.205357	1.205357	1.20535714
O2	1.3	32	0	0.580357	0	0
CH4	22.7	16	1	10.13393	10.13393	10.0832589
C2H4	3.3	28	2	1.473214	2.946429	2.93169643
H2	52.9	2	0	23.61607	0	0
CO	8.5	28	1	3.794643	3.794643	3.77566964
N2	8.6	28	0	3.839286	0	0
Total	100			44.64286	18.08036	17.9959821

Emission factor (volume)	0.791823	kg/m3
Emission factor (energy)	43.99018	Tonnes/TJ

Calculating boiler efficiency

The project proponent has chosen Option a. As appears from the data in section 1-2 of Annexure 3, the highest value of available data regarding the three options in (a) is the nameplate efficiency for the captive boiler, which for the combination of Blast Furnace gas and Coke Oven gas in the relative proportions used over the last three years is 83,93%.

Using this value yields the following calculation of the captive power emissions factor:

CAPTIVE POWER EMISSIONS FACTOR	2002	2003	2004	Three year average
Generation captive GWh/annum	179	177	163	173
Fuel use in nm^3/hour				
Blast furnace gas EF	139250	139250	139250	139250
Coke oven gas EF	10676	10676	10676	10676
Basic Oxygen furnace EF	0	0	0	0
Fuel emission factor [tC/TJ]	51.51580679	51.515807	51.5158068	51.51581
Emission factor [kg/MWh]	809.53411	809.53411	809.53411	**809.5**
Emission factor [kg/kWh]	0.81	0.81	0.81	**0.8095**

<u>Calculation of the grid emissions factor</u>

In terms of ACM0004, the grid emissions factor has to be calculated in terms of ACM0002. This entails finding the operating margin and the build margin and then establishing the combined margin. These calculations are done with reference to the data in annexure 3 below.

Calculation of the Operating Margin

In terms of ACM 0002 the default method for calculating the operating margin is option (c), the "data dispatch method." This has not been used due to the lack of data and the prohibitive cost of processing such data, should it become available. Option (b) is also not possible due to the fact that the draw load duration curve is not available.

In order to know whether to choose (a) or (d), it is necessary to analyse the power plants supplying power to the grid to ascertain which are "low cost, must run" power plants. In this respect the South African grid is exceptional in that it contains negligible renewable energy. Most electricity is provided by coal fired power stations and the only supplementary source of note is one nuclear power station making up about 4% of the installed capacity. ACM 0002 states that the definition of "low cost, must run" power stations is as follows:

> "*Low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e. excluded from the set of plants*."

It thus becomes necessary to establish whether any coal plants are used as "must run" plants. As is evident from the generation data in annex 3 hereto, in South Africa over 90% of the grid power is generated by Eskom using predominantly coal fired power stations and so most base load power is provided by coal fired plants. There is also very little spare capacity in the system.

In the absence of a quantative measure/benchmark by which it can be established when coal is "*obviously used as must run*" it was decided to proceed on two premises and then to choose the most conservative value. The first premise is that no Eskom coal plants are ‘low cost, must run” [1]. This leads to a situation where less than 50% of the electricity in the grid for the last five years is generated by ‘must run” plants and thus a calculation of the simple operating margin in terms of option (a) above. The second premise is that any coal fired Eskom plant with an average load factor higher than the load factor for all the coal fired Eskom plants as a group over the last three years is a ‘must run” plant. This leads to the situation where the ‘must run” plants constitute more than 50% of the power generated by the grid in the last five years for which data is available and leads to a calculation of the average operating margin in terms of option ‘d” above [2].

Option “a” – calculating the simple operating margin

This calculation is based on the assumption that no coal fired power stations in South Africa are ‘low -cost must run” and on the categorisation of plants into groups ‘j” and ‘k” as per the table in section 2-2-1 in Annexure 3 hereto. Fuel consumption data for each power station is not available and has been estimated using generation data obtained from the NER and efficiency data from Eskom. *Calculations are thus based on the energy content of the fuel rather than the mass/volume of the fuel used.*

$$EF_{om,y} = \frac{\sum_{i,j} F_{i,j,y} \, COEF_{i,j}}{\sum_{j} Gen_{j,y}}$$

Variable	Description	Value used	Source
Fi, j, y	Amount of fuel consumed by power sources (in energy units) excluding low cost must run plants	Range of values calculated in annexure 3	Generation figures NER; Eskom
J	Power sources delivering electricity to the grid, excluding low cost ‘must run” sources	See tables in annexure 3 below	As per calculations in annexure 3 section2-2
COEF i, j, y	CO_2 emissions factor per unit of energy of the fuel ‘i”.	94.6 t CO_2/ Tjoule	Estimated from generation figures using IPCC default values p 1-13 Revised 1996 IPCC guidelines for National Greenhouse Gas Inventories
GEN j, y	The electricity delivered to the grid by source j	See annexure 3 below	As per calculations in annexure 3 section2-2

[1] As appears from the data in annexure 3 section 1-2, the two coal fired Sasol captive power plants are regarded as ‘must run” due to the fact that they serve an industrial application needing the power they generate

[2] As appears from the two tables in annexure 3, if coal plants can be regarded as ‘must run” in South Africa, the precise definition of which coal plants are regarded as ‘must run” makes little difference as by most definitions the ‘must run” coal plants will constitute more than 50% of the electricity generated and thus lead to a calculation of the average operating margin (option ‘d”) including all the plants in the system

Operating margin	A	2001	2002	2003	Three year average
Imports		2337	2458	2605	2466.7
Emission factor [kg/MWh]		937.2	940.0	937.7	**938.3**
Emission factor [kg/kWh]		0.94	0.94	0.94	**0.9383**

Option (d) – calculation of the average operating margin

This calculation is based on the assumption that the coal fired power stations in South Africa with a higher load factor than the average for coal fired stations are 'low -cost must run" and on the categorisation of plants into groups 'j" and 'k" as per the table in section 2 -2-2 in Annexure 3 hereto. The same formula is used as above with the necessary changes to take account of the differences in the set 'j".

Variable	Description	Value used	Source
Fi, j, y	Amount of fuel consumed by power sources (in energy units) excluding low cost must run plants	Range of values calculated in annexure 3	Generation figures NER; Eskom
J	All power sources delivering electricity to the grid,	See tables in annexure 3 below	As per calculations in annexure 3 section2-2
COEF i, j, y	CO_2 emissions factor per unit of energy of the fuel 'i".	94.6 CO_2t/ Tjoule	Estimated from generation figures using IPCC default values p 1-13 Revised 1996 IPCC guidelines for National Greenhouse Gas Inventories
GEN j, y	The electricity delivered to the grid by source j	See annexure 3 below	As per calculations in annexure 3 section2-2

Operating margin	D				
		2001	2002	2003	Three year average
Imports		2337	2458	2605	2466.7
Emission factor [kg/MWh]		863.1	858.8	862.7	**861.6**
Emission factor [kg/kWh]		0.86	0.86	0.86	**0.8616**

Determining the operating margin in a conservative manner

As stated above, two calculations were done because of the uncertainty of whether coal plants in South Africa should be regarded as low cost "must run" plants. It is submitted that choosing the lower value of the average operating margin (0,8616 kg/kWh as opposed to 0,9383 kg/kWh) is conservative. It is thus submitted that the operating margin is 0,8616 kg/kWh.

Calculation of the Build Margin

The project proponent chooses option 1. It then becomes necessary to determine which of the two possibilities under option 1 renders the larger annual generation in order to determine the sample group 'M'. As is evident from the data and calculations in annexure 2 section 2 -3, the five power plants built most recently are Majuba, Kendall, Lethabo, Tutuka and Matimba while the power stations most recently built making up 20% of the grid in terms of MWh output over three years are Majuba, Kendall and Lethabo. The larger output comes from the first group and thus the sample group 'M' consists of the stations Majuba, Kendall, Lethabo, Tutuka and Matimba.

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

Variable	Description	Value used	Source
Fi, m, y	Amount of fuel consumed by power sources (in energy units) excluding low cost must run plants	Range of values calculated in annexure 3	Generation figures NER; Eskom
M	Majuba, Kendall, Lethabo, Tutuka and Matimba	Range of values as per annexure 3	NER data
COEFi, m,	CO_2 emissions factor per unit of energy of the	94.6 t CO_2/	Estimated from

y	fuel 'i'.	Tjoule	generation figures using IPCC default values p 1-13 Revised 1996 IPCC guidelines for national Greenhouse Gas Inventories
GEN m, y	The electricity delivered to the grid by source j	As per annexure 3 below	As per calculations in annexure 3 section2-2

Build margin	**2001**	**2002**	**2003**	**Three year average**
Emission factor [kg/MWh]				
Majuba	933.0	933.0	933.0	933.0
Kendal	964.8	964.8	964.8	964.8
Lethabo	901.0	901.0	901.0	901.0
Tutuka	896.2	896.2	896.2	896.2
Matimba	956.6	956.6	956.6	956.6
Generation [GWh]				
Majuba	5616.1	4600.976	10015.56	6744.2
Kendal	24326.1	26006.905	27820.202	26051.1
Lethabo	21907.0	22019.627	23505.543	22477.4
Tutuka	8398.8	11185.646	14195.963	11260.1
Matimba	23822.7	25145.393	26510.802	25159.6
Emission factor for M [kg/MWh]	936.9	936.4	935.3	**936.2**
Emission factor for M [kg/kWh]	0.937	0.936	0.935	**0.9362**

The baseline grid emissions factor

This is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

= (0,5*0,8616) + (0,5*0,9362)

= 0,898 kg/kWh

Calculation of the combined margin

If the baseline scenario selection determines that both captive and grid power would be used, then the emissions factor for the baseline is the weighted average of the emissions factor for grid power and captive power. The data appears in section 2-4 of annexure 3.

Combined Emission Factor D	**2002**	**2003**	**2004**	**Three year average**
Captive emission factor	809.5	809.5		809.5
Captive electricity share of supply	7.1%	6.7%		6.9%
Grid emission factor	897.6	899.0		898.3
Grid electricity share of supply	92.9%	93.3%		93.1%
Combined emission factor [kg/MWh]	891.4	893.0		**892.2**
Combined emission factor [kg/kWh]	0.891	0.893		**0.892**

CALCULATION OF PROJECT EMISSIONS FACTOR FOR AUXILIARY FUEL AS PER ACM 0004

$$PE_y = \sum_i Q_i \times NCV_i \times Ef_i \times 44/12 \times OXID_i$$

Natural Gas emissions factor

1 mole	=	22.4	litres
		44.64285714	Moles per m3
		44.00	Atomic mass of CO_2
Cv	=	36.588	
Oxid	=	99.50%	

Gas	Composition [%]	Atomic Mass [g/mole]	Moles of Carbon per mole	Moles of Gas	Moles of Carbon	Moles of CO_2
C02	1	44	1	0.446429	0.446429	0.44642857
C2H4	3	28	2	1.339286	2.678571	2.66517857
C2H6	7	30	2	3.125	6.25	6.21875
CH4	84.5	16	1	37.72321	37.72321	37.5345982
N2	4.5	28	0	2.008929	0	0
Total				44.64286	47.09821	46.8649554

Emission factor (volume)	**2.062058**	kg/m3
Emission factor (energy)	**56.35886**	Tonnes/TJ

The values needed for the calculation of the Project Emissions appear from Annexure 3 hereto, more specifically section 3 of that annexure.

Variable	**Description**	**Value**	**Source**
PEy	Project emissions in year y (t CO_2)		
Qi	Mass or volume unit of fuel *i* consumed (m^3 pa)	24 637 500 m^3/annum	Bateman
NCVi	Net calorific value per mass or volume unit of fuel *i* (TJ/t or m3)	36,588	Bateman
EFi	Carbon emissions factor per unit of energy of the fuel *i* (tC/TJ)	56.35886	Sasol and calculated by Thomas Alfstad
Oxidi	Oxidation factor of the fuel *i* (%)	99,5	IPCC Guidelines for National Greenhouse Gas Inventories, Table 1-6

SUMMARY

A summary of the important variables calculated above appears in the table below.

TABLE SUMMARISING CALCULATED EMISSION FACTORS	
Captive power emissions factor	0,8095 kg/kWh
Operating margin	0,8616 kg/kWh
Build margin	0,9362 kg/kWh
Grid emissions factor	0,8983 kg/kWh
Combined margin	0,892 kg/kWh
Project emissions factor	2,0658 kg/m^3

APPROPRIATE VALUES FOR CALCULATIONS

It is submitted that, due to the fact that the captive power is being decommissioned in the Project Activity, the emissions generated by the grid to replace the captive power should be subtracted from the total as a leakage and that the grid emissions factor should be used to correctly determine electricity displacement and not the combined emissions factor. This implies that the calculation of the captive power emissions factor was unnecessary but the latter was included for the sake of transparency.

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

As prescribed by ACM0004, additionality is illustrated using the *Tool for the Demonstration and Assessment of Additionality.* By way of introduction however, some background follows on the Eskom Demand Side Management ('DSM") fund and the National Energy Regulator Energy Efficiency and Demand Side Management Regulatory Policy. This is done in the context of Executive Board 16 annex 3.

Executive Board 16 Annex 3

In terms of this decision and more particularly paragraph 1(b) and (3) thereof, if there is a national and/or sectoral policy that gives positive comparative advantages to less emissions-intensive technologies over more emissions intensive technologies (for example public subsidies to promote renewable energy or to finance energy efficiency programs) then, if the policy has been implemented after 11 November 2001 it may not be taken into account in developing the baseline scenario (i.e. the baseline scenario should refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place).

Eskom and DSM

> 'Eskom Holdings is a South African utility that generates, transports and distributes electricity. It supplies approximately 95% of the country' s electricity and 60% of the total electricity consumed on the African continent. Compared with other international utilities, Eskom is the eleventh in terms of generating capacity and ninth in terms of sales. **The ownership of Eskom vests in the South African Government**"
>
> Source: http://www.eskom.co.za/live/content.php?Item_ID=790).

The National Energy Regulator

> 'The National Energy Regulator (NER) is the regulatory authority established in terms of the National Energy Regulator Act, 2004 (Act No. 40 of 2004) with the mandate to undertake the functions of the Gas Regulator as set out in the Gas Act of 2001, the Petroleum Pipelines Regulatory Authority as set out in the Petroleum Pipelines Act of 2003 and the National Electricity Regulator as set out in the Electricity Act of 1987 as amended……
>
> **…….** NERSA's[3] mandate is further derived from written government policies as well as Regulations issued by the Minister of Minerals and Energy. NERSA is expected to proactively take necessary regulatory actions in anticipation of and in response to the changing circumstances in the energy industry."
>
> Source: http://www.ner.org.za/nersa_profile.htm#4

[3] The industry in South Africa generally refers to the National Energy Regulator as the 'NER" while the institution sometimes refers to itself as 'NERSA". The former abbreviation is preferred in this document.

The DSM Fund

In accordance with the NER Energy Efficiency and Demand Side Management Regulatory Policy as approved by the NER on 25 May 2004, the DSM fund provides subsidies to projects that effect energy efficiency, load shedding, load shifting etcetera. The quantum of the subsidy varies according to the type of intervention.

The DSM fund and Executive Board 16 Annex 3

As appears from the paragraphs above the DSM fund is thus clearly established by a national policy of a public utility belonging to the South African Government and endorsed by the National Energy Regulator, the over-arching regulatory authority in South Africa. The DSM programme clearly started after 11 November 2001 and is aimed inter alia at financing energy efficiency programs.

The result of the above is that any DSM subsidy granted to a CDM project in South Africa amounts to a type 'E -"policy and has the effect that the subsidy has to be disregarded for purposes of the baseline, that is the baseline should refer to the hypothetical situation where the DSM fund is not in place.

In light of the fact that the Project Activity would have been in the submission of the developer, additional even in the absence of Executive Board 16 annex 3(1)(b) and (3), the calculations below are done also to illustrate same.

Step 0 Preliminary screening based on starting date of the Project Activity

Not applicable as the developer does not wish the crediting period to start before registration of the Project Activity.

Step 1 Identification of alternatives to the Project Activity consistent with current laws and Regulations

Sub-step 1(a) Define alternatives to the project activity

As explained in section B-2 above, the viable alternatives to the Project Activity are as follows:

(a) A continuation of the status quo – in other words no Project Activity;
(b) The proposed project activity not undertaken as a CDM project activity;
(c) Power generation on-site using natural gas, for purposes of additionality assessed as being not undertaken as a CDM activity

Sub-step 1(b) Compliance with applicable laws and regulations

All the alternatives above are compliant with applicable laws and regulations

Step 2 Investment analysis

Sub-step 2(a) Determine appropriate analysis method

The simple cost analysis is not applicable due to the fact that there will be a revenue stream in the form of electricity sales. A choice thus has to be made between investment comparison analysis and benchmark analysis. In the present instance investment comparison analysis is appropriate.

Sub-step 2(b) option 2 Apply investment comparison analysis

As a first step it is necessary to determine the appropriate financial indicator. In the present instance NPV is seen as the appropriate indicator for the following reasons:

The continuation of the status quo is the most viable financial alternative and NPV is an elegant method of illustrating the choice between this and the Project Activity.

The project has an unusually small equity contribution (reflecting mostly time and effort spent in developing the project) due to the fact that the project is receiving a Demand Side Management (DSM) subsidy from Eskom. This in effect is equity.

Any equity injected over and above the DSM funding pushes up generation cost as it displaces senior debt. The reason for this is that equity requires a return in excess of the cost of debt. This additional return would be recovered via a higher electricity price, but there is a cap on the price due to competing projects and a generally low electricity price in the country.

NPV is thus a more meaningful indicator than either Equity or Project IRR, especially as in terms of Executive Board 16 Annex 3 the DSM subsidy should be disregarded for purposes of the baseline. This point is elaborated further in the sensitivity analysis below.

Under certain scenarios, like trying to determine the IRR for a Project Activity fed entirely by natural gas, the IRR becomes so negative that it is unstable and meaningless.

Sub-step 2(c) Calculation and comparison of financial indicators

Alternative	**Project NPV**
Project Activity including DSM subsidy and CDM	ZAR 67 million
Project Activity without DSM subsidy with CDM	- ZAR 117 million
Project Activity without CDM but with DSM	ZAR 14 million
Project Activity without CDM or DSM	- ZAR 169 million
On-site natural gas without CDM	- ZAR 663 million
Continuation of status quo	ZAR 000 million

Assumptions:

- Discount rate: related to historical lending rates of long term senior debt facilities for senior debt facilities – a figure of 15% pa was used;
- Lending rate: Average interest rate on loans provided by The Development Bank of Southern Africa is 11.8% pa (source: www.dbsa.org - 2004 annual report). Lending margins on commercial limited recourse borrowing facilities are in the range of 2%-3% pa. (source: Fieldstone) The interest rate for the project will be approximately 10% pa inclusive of all costs;
- The long term inflation rate is 4.8% pa based on historical data (source: www.statssa.gov.za). A figure of 5% pa has been used for the project;
- Project duration: 15 years in accordance with the PPA, with a contract renewal clause to be negotiated.
- Revenue: single source of revenue is electricity sales at a rate not exceeding the all-in cost of new projects to Eskom (source: www.eskom.co.za - megaflex tariff). The final PPA price is under negotiation but is likely to be in the region of ZAR 0,20.
- Investment: all capital expenditure including the equipment required for gas capture, transportation and storage, generation equipment (boiler), infrastructure, sub-station connection;
- Costs: taken into account are associated operational expenses (mainly contractually determined long term operation and maintenance, labour and finance costs).
- Value of CER's calculated at USD 4,50, at an exchange rate of ZAR 6,50/USD and on the premise that the CER's will only have value until 2012 when the Kyoto Protocol's First Commitment Period expires.

Sub-step 2(d) Sensitivity analysis

A sensitivity analysis was conducted as appears below.

Scenario	**Project NPV (ZAR) including DSM subsidy**	**Project NPV excluding DSM subsidy**
Project Activity without CDM	ZAR 14 million	- ZAR 117 million
Decrease energy output by 10% pa - value without CDM	- ZAR 72 million	- ZAR 256 million
Increase in inflation from 5% pa to 7% pa with commensurate increase in discount rate – value without CDM	ZAR 62 million	- ZAR 99 million
Decrease in inflation from 5% pa to 3% pa with commensurate decrease in discount rate – value without CDM	- ZAR 44 million	- ZAR 255 million

It thus appears the project would be less attractive than the status quo even for a range of realistic assumptions. If the DSM subsidy is disregarded in accordance with Executive Board 16 annex 3, no scenario incorporating sensitivities yields a positive NPV.

Even if the DSM subsidy is not disregarded, the only scenario with changed sensitivities where the project has a positive NPV is if there is an increase in inflation. Such a scenario might have knock-on effects on currency value, borrowing costs, hardware costs etcetera that are difficult to predict and it would therefore not be viable for a project proponent to proceed with a non-viable project in the hope that inflation will rise without affecting any of the other key parameters.

In addition, a project without CDM would not be able to sustain the debt service cover ratios to make the project bankable. Even on the 7% pa inflation scenario the benefits only really manifest in the final years of the project and insufficient cash flow will still be an absolute bar to success in the early years without CDM.

Step 3 Barrier analysis

Sub-step 3(a) Identify barriers that would prevent the implementation of the Proposed Project Activity

- This will be the first operation of its kind in South Africa;
- It is well known that the electricity price in South Africa is amongst the lowest in the world. It is thus very difficult for any new market entrant to be competitive, be it using a fossil fuel based or renewable energy source;
- Over 90% of the electricity in South Africa is produced by Eskom, the national utility which represents an installed capacity of over 40 000 MW;
- There is only one independent power producer of note (Kelvin), a coal fired plant which was sold by the City of Johannesburg and has a capacity of approximately 480MW;
- Independent Power Producers face several challenges that for instance has seen the Darling National Demonstration Windfarm being in development for eight years now without financial close having been reached. This was due mainly to an environmental impact assessment for a 5,2 MW windfarm that took over six years to approve;
- IPP's face other challenges, particularly in obtaining licences, permits and approvals which is a bureaucratic and time-consuming process. Examples are concluding a wheeling agreement with Eskom and getting a generation licence from the National Energy Regulator, both activities that can take several months or more than a year.
- Exchange rate risk and/or the very high cost of hedging an exposure to the South African currency over the lifetime of a project has made it unattractive for foreign companies to invest in the South African Energy Sector;
- As against this, most hardware needed for energy projects has to be imported and paid for in hard currency;
- There is a lack of capacity to operate and maintain high technology energy assets and it is usually not viable to use the services of expatriate technicians.

For corroboratory evidence of the above, see the attached letter from Mr Hermann Oelsner, attached hereto. Mr Oelsner's expertise appears from the letter.

Sub-step 3(b) Show that the barriers would not prevent at least one of the alternatives

The continuation of the status quo as an alternative would not be prevented by the obstacles mentioned above – in fact the obstacles would tend to lead to a continuation of the status quo.

Step 4 Common practice analysis

Sub-step 4(a) Analyse other activities similar to the proposed Project Activity

To the knowledge of the project developer there is no Independent Power Producer in South Africa producing electricity for the grid from industrial waste gases.

Step 5 Impact of CDM registration

If the project is approved as a CDM project and CDM project registration takes place, the revenue that will accrue from the CER's will enable the project to overcome both the financial hurdles mentioned in step 2 above and other barriers described in step 3 above.

On a financial level the additional revenue stream from CDM will bring the project NPV to an attractive level at which the project developer is willing to invest. The improved NPV and better debt-service cover ratios will also facilitate securing debt finance for the project.

Regarding the obstacles mentioned in step 3 above, the additional income stream will again overcome the problem of the low electricity prices in South Africa, will compensate the project developer for the considerable time and effort already spent on getting licences and approvals for the project, will build capacity in the field, illustrate that industrial waste gases can be utilized commercially with the assistance of the CDM, will create a viable IPP and will make it possible to pay for the import of the boiler and associated technological hardware in hard currency.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

ACM0004 requires that the project boundary for purposes of the Project Activity includes CO_2 emissions from the combustion from auxiliary fossil fuels. In the present instance this comprises the use of natural gas from Sasol during emergencies.

For the purpose of determining **baseline emissions**, ACM 0004 requires that the following emission sources be included:

- CO_2 emissions from fossil fuel fired power plants connected to the electricity system;
- CO_2 emissions from fossil fuel fired captive power plants supplying the project site facility;

In the context of the Project Activity this includes:

- The CO_2emissions from the present 23,5 MW power plant;
- The CO_2 emissions from fossil fuel plants on the grid.

The **spatial extent** of the project boundary comprises the waste heat or gas sources, captive power generating equipment, any equipment used to provide auxiliary heat to the waste heat recovery process, and the power plants connected physically to the electricity grid that the proposed project activity will affect. The combined margin will be calculated as described in ACM0002, both in terms of the relevant grid definitions and the emissions factors.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

Baseline study completed in December 2005 by Johan van den Berg of CDM Africa Climate Solutions and Thomas Alfstad of the Energy Research Centre at the University of Cape Town. The former's details appear in annexure 1 while Thomas Alfstad's details are as follows: Tel 27 (21) 650 57 69; mobile 27 72 339 3934, email talfstad@ebe.uct.ac.za

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:

1 January 2009

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

While the initial Power Purchase Agreement is for 15 years only the technology to be installed is robust and should last much longer, for 30 years or longer. State of the hardware after 15 years permitting, the PPA will be extended and the likelihood is that the Project Activity will operational for well beyond the 10 years for which CER's will be claimed. The expected lifetime is thus 30 years while the Projec t Activity will cease after 10 years. For purposes of financial modelling however the conservative approach is taken and the project is modelled on a 15 year lifetime that coincides with the PPA lifetime.

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 left open on purpose

C.2.1.2. Length of the first crediting period:

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

1 January 2009

C.2.2.2. Length:

10 years 0 months

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

"ACM0004 Consolidated monitoring methodology for waste and/or heat for power generation."

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

In section B.2. above it was set out why the Project Activity falls squarely within the ambit of ACM0004. Given this conclusion the Project Activity needs to use the Monitoring Methodology prescribed by ACM 0004.

In terms of ACM 0004 the following needs to be monitored:

- Net electricity generation from the proposed project activity;
- Data needed to calculate the CO_2 emissions from fossil fuel consumption due to the project activity;
- Data needed to recalculate the operating margin emission factor, if needed, based on the choice of the method to determine the operating margin (OM), consistent with "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002);
- Data needed to recalculate the build margin emission factor, if needed, consistent with "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002);
- Data needed to calculate the emissions factor of captive power generation.

In the present instance the captive power generation component will fall away as it will be decommissioned in the lead up to commissioning of the Project Activity. All net electricity generated will be fed into the grid. Due to the fact that a fixed crediting period of ten years is chosen, data for the recalculation of the operating margin and build margin will not be relevant. Furthermore, due to the fact that the existing captive power will be decommissioned, monitoring data related to the captive power emissions factor is irrelevant.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number (Please use numbers to ease cross-referencing to D.3)	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data to be kept?	Comment
1. Q_i	*Quantitative*	*Volume of the auxiliary fuel used by project activity*	*tonnes*	*M*	*Contin-uously*	*100%*	*Electronic*	*Credit period plus 2 years*	*To be measured and used for estimation of project emissions.*
2.NCV_f	*Quantitative*	*Net Calorific Value of Fuel (if any)*	*TJ per t or m3*	*M*	*Monthly*	*Random*	*Electronic*	*Credit period plus 2 years*	*To be measured and used for estimation of project emissions.*
3.EF_i	*Quantitative*	*Carbon emissions factor*	*tC/TJ*	*National sources or IPCC*	*Monthly*	*Random*	*Electronic*	*Credit period plus 2*	*To be measured and used for*

		of fuel		*defaults*				*years*	*estimation of project emissions.*
4. EGGEN	*Quantitative*	*Total Electricity Generated*	*MWh/ yr*	*Online measurement*	*Continuo usly*	*100%*	*Electronic*	*Credit period plus 2 years*	*Monitoring location: meters at plant and DCS will measure the data. Manager Incharge would be responsible for regular calibration of the meter*
5. EGAUX	*Quantitative*	*Auxiliary Electricity including used by Eco Emfuleni Power Plant*	*MWh/ yr*	*Online measurement*	*Continuo usly*	*100%*	*Electronic*	*Credit period plus 2 years*	*Monitoring location: meters at plant and DCS will measure the data. Manager Incharge would be responsible for regular calibration of the meter*

6. EGy	*Quantitative*	*Net Electricity supplied to facility*				*0% This is not applicable as no electricity will be provided or sold inside the fence – everything exported to grid*			

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Formulae as contained in ACM 0004: Emissions from natural gas used for start-up/emergencies (in tonnes of CO_2e per annum) calculated by the formula:

$$PE_y = \sum_{i} Q_i \times NCV_i \times Ef_i \times 44/12 \times OXID_i$$

<u>Where</u>:

Pe_y	=	Project emissions in year y (tCO2)
Q_i	=	Mass or volume unit of fuel *i* consumed (t or m3)
NCV_i	=	Net calorific value per mass or volume unit of fuel *i* (TJ/t or m3)
Efi	=	Carbon emissions factor per unit of energy of the fuel *i* (tC/TJ)
$OXID_i$	=	Oxidation factor of the fuel *i* (%)

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :									
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long will data be kept?	Comment
7. EFy	*Emission factor*	*CO_2 emission factor of the grid*	*tCO2 /MWh*	*C*	*Yearly*	*100%*	*Electronic*	*Credit period plus 2 years*	*Calculated as a weighted sum of the OM and BM emission factors Given a 10 year crediting period was selected and the use of 3 year vintage data, it will be calculated and recorded just once at the beginning of the crediting period.*

8. $EF_{OM,y}$	Emission factor	CO_2 Operating Margin emission factor of the grid	tCO_2 /MWh	C	Yearly	100%	Electronic	Credit period plus 2 years	Calculated as indicated in the relevant OM baseline method. Given a 10 year crediting period was selected it will be calculated and recorded just once at the beginning of the crediting period.
9. $EF_{BM,y}$	Emission factor	CO_2 Build Margin emission factor of the grid	tCO_2 /MWh	C	Yearly	100%	Electronic	Credit period plus 2 years	Calculated as [• i Fi,y*COEFi) / [• mGENmy) over recently built power plants defined in the baseline methodology. Given a 10 year crediting period was selected it will be calculated and recorded just once at the beginning of the crediting period.

10. $F_{i,j,y}$	*Fuel quantity*	*Amount of each fossil fuel consumed by each power source / plant*	*t or* m^3*/yr*	*M*	*Yearly*	*100%*	*Electronic*	*Credit period plus 2 years*	*This data is presently not available and has been estimated using IPCC default values. Given a 10 year crediting period was selected it will be calculated and recorded just once at the beginning of the crediting period.*
11. $COEF_{i,k}$	*Emission factor coefficient*	CO_2 *emission coefficient of each fuel type and each power source / plant*	tCO_2 */ t or* m^3	*M*	*Yearly*	*100%*	*Electronic*	*Credit period plus 2 years*	*This data is presently not available and has been estimated using IPCC default values.*

12. $GEN_{j,y}$	*Electricity quantity*	*Electricity generation of each power source / plant*	*MWh/ yr*	*M*	*Yearly*	*100%*	*Electronic*	*Credit period plus 2 years*	*Obtained from the National Energy Regulator or "NER". Given a 10 year crediting period was selected it will be calculated and recorded just once at the beginning of the crediting period*

For Baseline emission factor: captive power, no monitoring would be done as the captive power component would be decommissioned once it is decided to go ahead with the Project Activity.

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Formulae as prescribed by ACM 0004, in order to calculate the baseline emissions factor (tonnes of CO_2e per annum):

$BE_{electricity} = E_y * EF_{electricity, y,}$

Where:

Egy = Net quantity of electricity supplied to the manufacturing facility by the project during the year *y* in MWh, and

Efy = CO2 baseline emission factor for the electricity displaced due to the project activity during the year *y* (tCO2/MWh).

Because the captive power existent in the baseline is being decommissioned in the Project Activity it is submitted that the baseline emissions factor should be calculated according to Option 2 of ACM 0004, which refers back to ACM 0002 and requires use of the following formulae discussed below. Because of the uncertainty of which plants in South Africa are 'low cost must run" plants, both the simple operating margin and the average operating margin where calculated using the following formulae:

$$EF_{om,y} = \frac{\sum_{i,j} F_{i,j,y} \, COEF_{i,j}}{\sum_{j} Gen_{j,y}}$$

where:

Fi ,j, y	=	the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*,
j	=	the power sources delivering electricity to the grid, not including low-operating cost and must run power plants, and including imports to the grid,
COEFi,j y	=	the CO2 emission coefficient of fuel *i* (tCO2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y*, and
GENj,y	=	the electricity (MWh) delivered to the grid by source *j*.

The CO2 emission coefficient *COEFi* is obtained as:

$COEF_i = NCV_i \cdot EF_{CO2,i} \cdot OXID_i$

where:

NCVi	=	the net calorific value (energy content) per mass or volume unit of a fuel *i*;
OXIDi	=	the oxidation factor of the fuel (see page 1.29 in the 1996 Revised IPCC Guidelines for default values);
EFCO2,I	=	the CO2 emission factor per unit of energy of the fuel *i*.

The *average operating margin* was calculated on the assumption that coal fired plants with an annual load factor higher than the national average for coal plants are 'low cost, must run" plants.

The *build margin* was calculated using the formula:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} COEF_{i,m}}{\sum_{m} Gen_{m,y}}$$

where:

$F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method above for plants *m*.

The *baseline emissions factor* was calculated using the formula:

$EF_y = W_{OM} * EF_{OM,y} + W_{BM} * EF_{BM,y}$

where the weights W_{OM} and W_{BM}, by default, are 50%

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

Not applicable – left open on purpose

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
Not applicable left open on purpose								

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Not applicable left open on purpose

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long will the data be kept?	Comment
1. Three year average captive energy generation	*Electricity historically produced by captive power generation*	*Historical data provided by Mittal Steel*	*MWh/pa*	*Measured historically*	*Once off*	*N.a*	*N.a*	*Credit period plus 2 years*	*Because the captive power generation is being decommissioned it is necessary to treat it as a leakage. The three year average annual generation will be used to determine the annual number of MWH now bought in from the grid by Mittal due to decommissioning rather than generated as captive power as in the baseline*
2. EFy	*Emission factor*	*CO_2 emission factor of the grid*	*tCO2 /MWh*	*C*	*Yearly*	*100%*	*Electronic*	*Credit period plus 2 years*	*Calculated as a weighted sum of the OM and BM emission factors*
3. $EF_{OM,y}$	*Emission factor*	*CO2 Operating Margin emission*	*tCO_2 /MWh*	*C*	*Yearly*	*100%*	*Electronic*	*Credit period plus 2 years*	*Calculated as indicated in the relevant OM baseline method*

		factor of the grid							
4. $EF_{BM,y}$	*Emission factor*	*CO_2 Build Margin emission factor of the grid*	*tCO_2 /MWh*	*C*	*Yearly*	*100%*	*Electronic*	*Credit period plus 2 years*	*Calculated as [•i Fi,y*COEFi) / [•mGENm,y) over recently built power plants defined in the baseline methodology*
5. $F_{i,j,y}$	*Fuel quantity*	*Amount of each fossil fuel consumed by each power source / plant*	*t or m^3/yr*	*M*	*Yearly*	*100%*	*Electronic*	*Credit period plus 2 years*	*This data is presently not available and has been estimated using IPCC default values.*
6. $COEF_{i,k}$	*Emission factor coefficie nt*	*CO_2 emission coefficient of each fuel type and each power source / plant*	*tCO_2 / t or m^3*	*M*	*Yearly*	*100%*	*Electronic*	*Credit period plus 2 years*	*This data is presently not available and has been estimated using IPCC default values.*
7. $GEN_{j,y}$	*Electricit y quantity*	*Electricity generation of each power source / plant*	*MWh/ yr*	*M*	*Yearly*	*100%*	*Electronic*	*Credit period plus 2 years*	*Will be obtained from the National Energy Regulator or "NER"*

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

The leakage will be equal to 173 MWh (the average annual captive power generation for the last three years) multiplied by the grid emissions factor

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

$$ER_y = BE_y - PE_y - L_y$$

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Are QA/QC procedures planned for these data?	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1,2	*Low*	*Yes*	*This data will be required for the calculation of project emissions*
4-6	*Low*	*Yes*	*This data will be used for the calculation of project electricity generation.*
7-9	*Low*	*No*	*This data is calculated, so does not need QA/QC procedures*
10-12	*Low*	*No*	*This data is presently not available and being estimated. If it becomes available it will be required for the calculation of baseline emissions (from grid electricity) and will be obtained through published and official sources*

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

Eco Emfuleni is a Special Purpose Vehicle (‘SPV) or project company. It is being specifically set up for the Emfuleni Power Project and will only come into full operation once financial close is reached, which again depends on a successful registration of the CDM project. Because operations have not as yet commenced, the operational and management structure is not in existence as yet but has already been planned.

Eco Emfuleni is the Project Developer and owner and takes final responsibility for all aspects of the project, including monitoring. The person tasked with this responsibility will be Mr Jan de Beer, Operations Manager Eco Emfuleni. The operations and maintenance of the plant will be outsourced to Siemens, a large multi-national company with the necessary experience and expertise to execute the task successfully. Siemens will also be responsible for archiving data. Siemens will report meter readings to Mr De Beer who will be responsible for archiving. Records will be kept until two years after the Project Activity has ended.

Electricity meters will be supplied by the South African utility Eskom and will be calibrated in accordance with the manufacturer’s specifications. Eskom is the purchaser of the electricity produced by the Emfuleni Power Project and it is thus in Eskom’s direct interest to ensure that meters are accurate and if any variance exists, that they provide conservative readings. This is an inherent quality control in the project.

The developer is presently investigating the possibility of fitting another electricity meter that will belong to Eco Emfuleni and will act as a back-up to the Eskom meters. Should this happen and a discrepancy be found to exist in any specific year between the two sets of readings, a conservative approach will be taken and the lower reading of the two used for CER purposes.

Regarding leakage, the methodology ACM0004 does not in the normal course require that leakage be considered. In the present instance the leakage that is considered occurs because an existing 23,5 MW captive power plant would be decommissioned to make way for a new 115 MW plant. As all net power generated by the new plant will be exported to the grid, the leakage that occurs is thus simply the emissions occurring from the grid to replace the captive power plant. For this reason no operational and management structure is needed to monitor leakage.

D.5 Name of person/entity determining the monitoring methodology:

Compiled by Johan van den Berg of CDM Africa Climate Solutions with the assistance of Boikanyo Mazibuko of Bateman Africa. The details of both persons appear in annexure 1 hereto.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

Maximum annual use of natural gas estimated at 24 637 500 m^3 pa multiplied by natural gas emissions factor of 2,062058 kg/m^3 = 50 804 tonnes pa

E.2. Estimated leakage:

173 000 kWh pa (3 year average)* grid emissions factor of 0,8983 = 155 406 tonnes pa

E.3. The sum of E.1 and E.2 representing the project activity emissions:

50 804 + 155 406 = 206 210 tonnes pa

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

814 452 tonnes pa

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

814 452 – 206 210 = 608 242 tonnes pa

E.6. Table providing values obtained when applying formulae above:

Sr No	Operating years	Baseline emissions (tonnes CO_2)	Project Activity emissions (tonnes CO_2)	Leakage (tonnes CO_2)	Annual reductions in tonnes of CO_2e
1	2009	814 452	50 804	155 406	608 242
2	2010	814 452	50 804	155 406	608 242
3	2011	814 452	50 804	155 406	608 242
4	2012	814 452	50 804	155 406	608 242
5	2013	814 452	50 804	155 406	608 242
6	2014	814 452	50 804	155 406	608 242
7	2015	814 452	50 804	155 406	608 242
8	2016	814 452	50 804	155 406	608 242
9	2017	814 452	50 804	155 406	608 242
10	2018	814 452	50 804	155 406	608 242
Total		8 144 520	508 040	1 554 060	6 082 420

SECTION F. Environmental impacts

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

The Environment Conservation Act 73 of 1989 together with the regulations thereto require that the developers of certain listed activities (of which the Project Activity is one) acquire written permission to proceed from the Minister or Competent Authority before doing so. If an activity is listed, this means that the Proponent must either do a full Environmental Impact Assessment (‘EIA”) or apply for an exemption from doing so in terms of section 28A of the Act.

In the latter case it is usually still required of the Proponent to assess the environmental impacts and address any issues emanating from the investigation.

EcoElectrica appointed an independent environmental consultant called Environmental Planning and Design to undertake a study of environmental impacts and facilitate meetings with the communities in the area of the proposed Project Activity. In the light of the predominantly positive impacts of the project it was decided to request an exemption from the Gauteng Department of Agriculture and Environmental Affairs. A comprehensive Environmental Impact Report was compiled in support of the application for an exemption from certain sections of the Environment Conservation Act 73 of 1989.

In this report Environmental Planning and Design identified both positive and some negative expected impacts. The expected positive impacts are (Environmental Impact Report p 67):

- Less emissions of greenhouse gas, SO2, particulate matter and NOx by the power stations supplying the grid.
- Less water consumption by the power stations supplying the grid.
- Flaring reduction;
- Increase of electricity to the grid and the creation of an Independent Power Producer.

The expected negative impacts identified are (Environmental Impact Report p 68):

- Water use
- Waste disposal
- Potential risk inherent in the collection, storage and use of flammable gases

In the application for an exemption from certain sections of the Environment Conservation Act the case was made that the expected negative impacts are easily addressed within the context of a major industrial installation like Mittal Steel. The authorities agreed and in due course granted the application for an exemption and issued a written authorisation to proceed.

F.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 environmental impacts are not considered significant but the Environmental Impact Report will nevertheless be available for perusal.

SECTION G. Stakeholders' comments

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

Environmental Planning and Design (in association with COEX Environmental Planners), managed the stakeholder participation process. The process included the following activities:

- A copy of the draft Environmental Impact Report (EIR) was placed in the Vanderbijlpark Public Library for reference by stakeholders;
- Advertisements were placed in both local and national newspapers;
- Letters of notification were posted to all known stakeholders (approximately 390 people);
- Focus group meeting were held with the Boipatong and Bophelong communities;
- A public open day was held in Vanderbijlpark.

G.2. Summary of the comments received:

The process of stakeholder participation and receiving comments was noted and documented.

Emfuleni Local Municipality and Earthlife Africa had no comments.

The two community meetings generated some comments (but mostly questions and answers) while some comments were received at the open day.

The Boipatong Community asked questions relating environmental, social and also economic matters. On the social front, several questions were asked about social upliftment of the community, job creation and skills development. A particular example was a question on whether EcoElectrica will source labour from the local community. On the environmental front, the community wanted to know how much impact the project would have on the environment. On the economic front, again questions were asked about employment opportunities and also about whether any shares in the project would be allocated to the community. Regarding comments, a member of the Boipatong Community stated that the commitment of EcoElectrica was doubted as only skilled labour would benefit from the project. Some remarks were also made pertaining to the relationship between the community and the project host, Mittal Steel.

The Bophelong community meeting generated only a few questions and answers mostly of a factual nature. There was a question on whether EcoElectrica had investigated the safety aspects of the project. There was also a comment that the community requests continuous feedback.

The open day generated some comments. There was a remark by Mr Abram Gumbi that more stakeholders should be involved through the mass media, another by Mr Albert Sekere that the community was looking for job creation and finally a comment by Mr Lucas Mokwane applauding EcoElectrica for its communication with the community.

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

All factual questions asked were answered as comprehensively and accurately as possible.

Regarding remarks pertaining to the relationship between the community and Mittal Steel, it was pointed out that EcoElectrica is a separate legal entity that can neither speak for Mittal Steel nor influence its decision making. However, an undertaking was given to forward such comments to Mittal Steel.

Regarding job creation and social upliftment it was explained that the project would create about 200 jobs during the construction phase and 32 permanent positions (the latter may however include the 22 people presently employed by Mittal Steel at the to-be-decommissioned power plant of 23,5 MW). EcoElectrica undertook to source labour from the local community to the extent possible.

Regarding the question of whether any shares in the project will be allocated to the community, EcoElectrica undertook to reserve a to-be-finalised proportion of shares in the project company for the community to assist in social upliftment.

Regarding the remark that only skilled labour would benefit, two responses were given by EcoElectrica. The first was to point out that there would be employment opportunities for unskilled labour in the construction phase. Secondly EcoElectrica undertook to provide training to suitable members of the community to equip them with the skills to perform the skilled labour that the permanent positions will mostly require.

Regarding the request for continuous feedback the undertaking was given by EcoElectrica. Finally, regarding the comment that more stakeholders should be involved, EcoElectrica were of the view that this issue had been adequately addressed in that the newspapers had been used and that about 390 stakeholders had been identified. The Gauteng Department of Agriculture and Environmental Affairs, in recently granting an approval to proceed, implicitly agreed with this view.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Eco Emfuleni (Pty) Ltd
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Not applicable left open on purpose

Annex 3

BASELINE INFORMATION

This section consists of the following subsections:

1. CALCULATION OF CAPTIVE EMISSIONS FACTOR

- 1-1: The properties of the off-gases at Mittal Steel
- 1-2: Data on captive power boiler efficiency

2. CALCULATION OF THE GRID EMISSION FACTOR

- 2-1: Grid data
  - 2-1-1: Generation data from NER 1999 – 2003 (15 pages)
  - 2-1-2: Efficiency data and calculated fuel use 2001-2003
- 2-2: Operating margin
  - 2.2.1: Data for calculation of simple operating margin
  - 2.2.2: Data for calculation of average operating margin
- 2-3: Build margin – Data for calculation of the sample group M
- 2-4: Data for calculation of the combined margin

3. DATA FOR THE CALCULATION OF PROJECT EMISSIONS FROM AUXILIARY FUEL

1. CALCULATION OF CAPTIVE EMISSIONS FACTOR

1-1. THE PROPERTIES OF THE OFF-GASES AT MITTAL STEEL

	Blast Furnace gas	**Coke Oven Gas**	**Basic Oxygen Gas**
Carbon dioxide (CO_2)	18%	2,7%	17,8%
Oxygen (O_2)	1,0 %	1,3%	0,2%
Methane (CH_4)	0,0%	22,7%	0,0%
Other organic gases (excluding methane)	0,0%	3,3%	0,0%
Carbon monoxide (CO)	24,5%	8,5%	54,0%
Hydrogen (H_2)	3,5%	52,9%	0,0%
Nitrogen (N_2)	53,0%	8,6%	28%
Total	100%	100%	100%
Net calorific value MJ/m^3	**3,3**	**16,3**	**5,1**
Estimated average flow m^3/hr	220 000	5 000	51 000
Estimated maximum flow	250 000	7 500	55 000
Available energy (GJ/hr)	730	80	260
Present use for boiler energy generation in baseline (nm^3/hr)	**139 250**	**10 676**	**0**

Source: Environmental Impact Report, p 42 and 43

1.2. DATA ON CAPTIVE POWER BOILER EFFICIENCY

Option a

Measured efficiency prior to project implementation

These figures are not available

Measured efficiency during monitoring

The efficiency of the entire process was monitored by Mittal Steel (Mr Jaco Perold) and found to be 18%. The boiler efficiency from this data was calculated by Mr Thomas Alfstad at 78% by using the ratio of the energy content of the steam produced to the energy content of the fuel burnt.

Manufacturer nameplate data for efficiency of the existing boilers

On 100 % Blast Furnace gas: 83.9 % based on the Lower Calorific Value
On 100 % Coke Oven gas: 84.3 % based on the Lower Calorific Value

Thus on the weighted average of the feedstock composition the efficiency is thus (83,9*139 250/149 926) + (84.3*10 676/149 926) = 77,93 + 6 = **83,93%**.

Source: Mr Louis Goldberg:
Engineer: Air, Steam and Power Generation Infrastructure Engineering
Mittal Steel South Africa Limited - Vanderbijlpark Steel
Tel +27 16 889 4097
Cell + 27 83 304 0436
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2. CALCULATION OF GRID EMISSIONS FACTOR

2-1. GRID DATA

2-1-1 GENERATION DATA 1999 - 2003[4]: **1999**

Station	**Licensed capacity**	**Maximum power produced**	**Gross energy sent out**	**Own use - generation process**	**Nett energy sent out**	**Own use - private consumption & SCO**	**Load factor on maximum power**
	MW	MW	MWh	MWh	MWh		%
Grand Total	43143	34472	190143973	3756594	186387379	5372269	50.3
ESKOM Generation							
Total	39870	32704	181997405	3436874	178560531	97946	63.5
Coal fired stations	35627	28682	165665434		165665434		65.9
Arnot	1980	1659	8500200		8500200		58.5
Camden	1520	in storage					
Duvha	3450	3473	22247626		22247626		73.1
Grootvlei	1130	in storage					
Hendrina	1900	1680	10163249		10163249		69.1
Kendal	3840	3963	24466457		24466457		70.5
Komati	906	in storage					
Kriel	2850	2876	16535025		16535025		65.6
Lethabo	3558	3568	20490972		20490972		65.6
Majuba	3843	1413	2437198		2437198		19.7
Matimba	3690	3685	23368644		23368644		72.4
Matla	3450	3485	23907681		23907681		78.3
Tutuka	3510	2880	13548382		13548382		53.7
Gas turbine stations	342	45	1118	737	381	34422	0.3
Acacia	171	23	131	16	115	17378	0.1
PortRex	171	22	987	721	266	17044	0.5
Hydro power stations	661	636	903856		903856		16.2
Gariep	360	340	287619		287619		9.7
Vanderkloof	240	246	438624		438624		20.4
Colleywobbles(Mbashe)	42	42	152043		152043		41.3
First Falls	6	6	12709		12709		24.2
Second Falls	11						
Ncora	2	2	12861		12861		69.9
Nuclear stations	1840	1816	12837323		12837323		80.7
Koeberg	1840	1816	12837323		12837323		80.7

[4] Information and statistics needed to calculate the grid emissions factor were acquired from the National Energy Regulator at www.ner.org.za and from electronic documentation provided by Mr Ezekiel Motsosi (ezekiel.motsosi@ner.org.za). The latest available generation data is for the year 2003.

1999 (continued)

Pumped-storage stations	1400	1542	2592816	3434610	-841794	47602	19.2
Drakensberg	1000	1116	1772314	2353727	-581413	29262	18.1
Palmiet	400	426	820502	1080883	-260381	18340	22
Station	**Licensed capacity**	**Maximum power produced**	**Gross energy sent out**	**Own use - generation process**	**Nett energy sent out**	**Own use - private consumptio n**	**Load factor on maximu m power**
	MW	MW	MWh	MWh	MWh		%
Municipal Generation							
Total	2436	1013	2565260	307989	2256271	0	28.9
Coal fired stations	1932	646	2311062		2310062		40.9
Athlone	180	90	65753		65753		8.3
Kroonstad	30	not in operation					
Swartkops	240	not in operation					
Bloemfontein	102	30	21266		20266		8.1
Orlando	300	not in operation					
Rooiwal	300	120	533000		533000		50.7
Pretoria West	180	56	37028		37028		7.6
Kelvin' A'	180	90	396837		396837	40177	50.3
Kelvin' B'	420	260	1257178		1257178	111676	55.2
Gas turbine stations	320	188	4685	621	4064		0.3
Roggebaai	40	36	40	107	-67		0
Athlone	40	29	618		618		0.2
Port Elizabeth	40	21	-21		-21		0
Johannesburg	176	102	4048	514	3534		0.5
Pretoria West	24	not in operation					
Hydro power stations	4	3	9690	0	9690		36.9
Lydenburg	2	2	6000		6000		34.2
Ceres	1	0	90		90		5.1
Piet Retief	1	1	3600		3600		68.5
Pumped-storage stations	180	176	239823	307368	-67545		15.5
Steenbras	180	176	239823	307368	-67545		15.5

1999 (continued)

Private Generation	Licensed capacity	Maximum power produced	Gross energy sent out	Own use - generation process	Nett energy sent out	Own use - private consumption	Load factor on maximum power
Total	837	831	5391023		5391023	5274323	74.1
Bagasse / coal fired stations	106	60	196572		196572	181510	37.4
Tongaat-Hulett Amatikulu	12	11	41864		41864	43775	45.5
Tongaat Hulett – Darnall	13	7	24156		24156	27388	39.4
Tongaat Hulett – Felixton	32	24	87735		87735	85623	41.7
Tongaat Hulett - Maidstone Mill	29	18	42817		42817	24724	27.2
Transvaal Suiker Ltd	20						
Coal fired stations	728	769	5180017		5180017	5091772	76.9
Sasol Synthetic Fuels	600	629	4978617		4978617	4978617	90.4
Sasol Chemical Industry	128	140	201400		201400	113155	16.5
Hydro power stations	3	2	14434		14434	1041	
Friedenheim	3	2	14434		14434	1041	73.7

2000

N Station	Licensed capacity	Maximum power produced	Gross energy sent out	Own use in generation process	Nett energy sent out	Own use - private consumption & SCO	Load factor on maximum power
	MW	MW	MWh	MWh	MWh		%
Grand Total	43140	35323	198191336	3744456	194445880	6001858	52.4
ESKOM Generation							
Total	39870	33461	189505436	3436467	186068969	75002	64.7
Coal fired stations	35627	29277	172362464		172362464		67.2
Arnot	1980	1858	9135768		9135768		56.1
Camden	1520	in storage					
Duvha	3450	3483	23530675		23530675		77.1
Grootvlei	1130	in storage					
Hendrina	1900	1884	12530513		12530513		75.9
Kendal	3840	4063	25279546		25279546		71
Komati	906	in storage					
Kriel	2850	2402	16392855		16392855		77.9
Lethabo	3558	3592	22319026		22319026		70.9
Majuba	3843	2465	4278340		4278340		19.8
Matimba	3690	3772	23721203		23721203		71.8
Matla	3450	3518	25085200		25085200		81.4
Tutuka	3510	2240	10089338		10089338		51.4
Gas turbine stations	342	172	1435	1857	-422	27400	0.1
Acacia	171	7	36	907	-871	11600	0.1
PortRex	171	165	1399	950	449	15800	0.1
Hydro power stations	661	660	1538879		1538879		26.6
Gariep	360	365	631329		631329		19.7
Vanderkloof	240	245	711416		711416		33.1
Colleywobbles(Mbashe)	42	42	133242		133242		36.2
First Falls	6	6	18654		18654		35.5
Second Falls	11		35107		35107		
Ncora	2	2	9131		9131		49.6
Nuclear stations	1840	1810	13009842		13009842		82.1
Koeberg	1840	1810	13009842		13009842		82.1

2000 - Continued

Pumped-storage stations	1400	1542	2592816	3434610	-841794	47602	19.2
Drakensberg	1000	1116	1772314	2353727	-581413	29262	18.1
Palmiet	400	426	820502	1080883	-260381	18340	22
Station	**Licensed capacity**	**Maximum power produced**	**Gross energy sent out**	**Own use - generation process**	**Nett energy sent out**	**Own use - private consumption**	**Load factor on maximum power**
	MW	MW	MWh	MWh	MWh		%
Municipal Generation							
Total	2436	1013	2565260	307989	2256271	0	28.9
Coal fired stations	1932	646	2311062		2310062		40.9
Athlone	180	90	65753		65753		8.3
Kroonstad	30	not in operation					
Swartkops	240	not in operation					
Bloemfontein	102	30	21266		20266		8.1
Orlando	300	not in operation					
Rooiwal	300	120	533000		533000		50.7
Pretoria West	180	56	37028		37028		7.6
Kelvin' A'	180	90	396837		396837	40177	50.3
Kelvin' B'	420	260	1257178		1257178	111676	55.2
Gas turbine stations	320	188	4685	621	4064		0.3
Roggebaai	40	36	40	107	-67		0
Athlone	40	29	618		618		0.2
Port Elizabeth	40	21	-21		-21		0
Johannesburg	176	102	4048	514	3534		0.5
Pretoria West	24	not in operation					
Hydro power stations	4	3	9690	0	9690		36.9
Lydenburg	2	2	6000		6000		34.2
Ceres	1	0	90		90		5.1
Piet Retief	1	1	3600		3600		68.5
Pumped-storage stations	180	176	239823	307368	-67545		15.5
Steenbras	180	176	239823	307368	-67545		15.5

2000 (Continued)

Private Generation	Licensed capacity	Maximum power produced	Gross energy sent out	Own use - generation process	Nett energy sent out	Own use - private consumption	Load factor on maximum power
Total	834	849	6120640		6120640	5926856	82.4
Bagasse / coal fired stations	106	80	307498		307498	225097	43.9
Tongaat-Hulett Amatikulu	12	10	46772		46772	46604	52.3
Tongaat Hulett – Darnall	13	7	29433		29433		48
Tongaat Hulett – Felixton	32	24	89310		89310	82110	42.5
Tongaat Hulett – Maidstone Mill	29	20	64346		64346	33113	37.7
Transvaal Suiker Ltd	20	19	77637		77637	63270	46.6
Coal fired stations	728	769	5813142		5813142	5701759	86.4
Sasol Synthetic Fuels	600	629	5107703		5107703	5107703	92.8
Sasol Chemical Industry	128	140	705439		705439	594056	57.7
Hydro power stations	3	2	14288		14288		
Friedenheim	3	2	14288		14288		73

2001

Station	Licensed capacity	Maximum power produced	Gross energy sent out	Own use in generation process	Nett energy sent out	Own use - private consum ption & SCO	Load factor on maximum power
	MW	MW	MWh	MWh	MWh		%
Grand Total	43018	38004	219198686	4019679	215179 007	381856	58.2
ESKOM Generation							
Total	39810	35922	210218785	3670755	206548 030	79136	66.8
Coal fired stations	35607	31952	194046490		194046 490		69.3
Arnot	1980	2076	14135237		141352 37		77.7
Camden	1520	in storage					
Duvha	3450	2943	21384335		213843 35		82.9
Grootvlei	1130	in storage					
Hendrina	1895	2015	12329325		123293 25		69.8
Kendal	3840	3998	27820202		278202 02		79.4
Komati	891	in storage					
Kriel	2850	2854	18347304		183473 04		73.4
Lethabo	3558	3615	23505543		235055 43		74.2
Majuba	3843	3763	10015560		100155 60		30.4
Matimba	3690	3724	26510802		265108 02		81.3
Matla	3450	3502	25802219		258022 19		84.1
Tutuka	3510	3462	14195963		141959 63		46.8
Gas turbine stations	342	69	341		341	27400	0.1
Acacia	171	54	299		299	11600	0.1
PortRex	171	15	42		42	15800	0.0
Hydro power stations	661	561	777041		777041		15.8
Gariep	360	336	383991		383991		13.0
Vanderkloof	240	225	393050		393050		19.9
Colleywobbles(Mbash e)	42				0		
First Falls	6				0		
Second Falls	11				0		
Ncora	2				0		
Nuclear stations	1800	1809	12662591		126625 91		79.9
Koeberg	1800	1809	12662591		126625 91		79.9

2001 (continued)

Pumped-storage stations	1400	1516	1587501	2356796	-769295	51736	12.0
Drakensberg	1000	1073	1038583	1633724	-595141	25235	11.0
Palmiet	400	443	548918	723072	-174154	26501	14.1
Station	**Licensed capacity**	**Maximum power produced**	**Gross energy sent out**	**Own use - generation process**	**Nett energy sent out**	**Own use - private consump tion**	**Load factor on maximum power**
	MW	MW	MWh	MWh	MWh		%
Municipal Generation							
Total	1836	632	865608	308077	557531		15.6
Coal fired stations	1332	249	609676	0	609676		28.0
Athlone	180	74	79273	0	79273		12.2
Kroonstad	30	not in operation		0	0		
Swartkops	240	not in operation		0	0		
Bloemfontein	102	103	21437	0	21437		2.4
Orlando	300	not in operation		0	0		
Rooiwal	300	55	433983	0	433983		90.1
Pretoria West	180	17	74983	0	74983		50.4
Gas turbine stations	320	204	6419	709	5710		0.4
Roggebaai	40	43	1707	118	1589		0.5
Athlone	40	38	685	77	609		0.2
Port Elizabeth	40	21	-21		-21		0.0
Johannesburg	176	102	4048	514	3534		0.5
Pretoria West	24	not in operation		0	0		
Hydro power stations	4	3	9690	0	9690		36.9
Lydenburg	2	2	6000	0	6000		34.2
Ceres	1	0	90	0	90		5.1
Piet Retief	1	1	3600	0	3600		68.5
Pumped-storage stations	180	176	239823	307368	-67545		15.5
Steenbras	180	176	239823	307368	-67545		15.5

2001 (Continued)

Private Generation	Licensed capacity	Maximum power produced	Gross energy sent out	Own use - generation process	Nett energy sent out	Own use - private consumption	Load factor on maximum power
Total	1436	1159	7761241	0	7761241	6074129	76.4
Bagasse / coal fired stations	105	79	306878	0	306878	220517	44.3
Tongaat-Hulett Amatikulu	12	10	46772		46772	46604	52.3
Tongaat Hulett – Darnall	13	7	29433		29433		48.0
Tongaat Hulett – Felixton	32	24	80085		80085	79840	38.1
Tongaat Hulett - Maidstone Mill	29	19	75415		75415	32205	45.3
Transvaal Suiker Ltd	20	19	75173		75173	61868	46.4
Coal fired stations	1328	1078	7440075	0	7440075	5853612	78.8
Kelvin ' A'	180	88	424791		424791	40177	55.1
Kelvin ' B'	420	222	1202142		1202142	111676	61.8
Sasol Synth Fuels	600	629	5107703	0	5107703	5107703	92.8
Sasol Chem Ind	128	140	705439		705439	594056	57.7
Hydro power stations	3	2	14288	0	14288	0	
Friedenheim	3	2	14288		14288		73.0

2002

Station	Licensed capacity	Maximum power produced	Gross energy sent out	Own use in generation process	Nett energy sent out	Own use - private consumption & SCO	Load factor on maximum power
	MW	MW	MWh	MWh	MWh		%
Grand Total	43034	40444	206523137	2830416	203692722	5611009	54.8
ESKOM Generation							
Total	39810	38231	197805557	2480978	195324579	79136	59.1
Coal fired stations	35607	33959	181749299		181749299		61.1
Arnot	1980	2100	11974764		11974764		65.1
Camden	1520	In storage					
Duvha	3450	3600	23320444		23320444		73.9
Grootvlei	1130	In storage					
Hendrina	1895	2000	12752987		12752987		72.8
Kendal	3840	4116	26006905		26006905		72.1
Komati	891	In storage					
Kriel	2850	3000	19165265		19165265		72.9
Lethabo	3558	3798	22019627		22019627		66.2
Majuba	3843	4110	4600976		4600976		12.8
Matimba	3690	3990	25145393		25145393		71.9
Matla	3450	3600	25577292		25577292		81.1
Tutuka	3510	3645	11185646		11185646		35.0
Gas turbine stations	342	69	225	1857	-1632	27400	0.0
Acacia	171	54	197	907	-710	11600	0.0
PortRex	171	15	28	950	-922	15800	0.0
Hydro power stations	661	609	2356753		2356753		44.2
Gariep	360	365	1164640		1164640		36.4
Vanderkloof	240	244	1192113		1192113		55.8
Colleywobbles(Mbashe)	42						
First Falls	6						
Second Falls	11						
Ncora	2						
Nuclear stations	1800	1930	11961744		11961744		70.8
Koeberg	1800	1930	11961744		11961744		70.8

2002 (CONTINUED)

Pumped-storage stations	1400	1664	1737536	2479121	-741585	51736	11.9
Drakensberg	1000	1178	1136740	1718519	-581779	25235	11.0
Palmiet	400	486	600796	760602	-159806	26501	14.1
Station	**Licensed capacity**	**Maximum power produced**	**Gross energy sent out**	**Own use - generation process**	**Nett energy sent out**	**Own use - private consum ption**	**Load factor on maxim um power**
	MW	MW	MWh	MWh	MWh		%
Municipal Generation							
Total	1837	917	1492743	349087	1143657		18.6
Coal fired stations	1323	535	1201006		1201006		25.6
Athlone	180	121	76596		76596		7.3
Kroonstad	30	not in operation					
Swartkops	240	not in operation					
Bloemfontein	103	62	8233		8233		1.5
Orlando	300	not in operation					
Rooiwal	300	216	949078		949078		50.2
Pretoria West	170	136	167099		167099		14.0
Gas turbine stations	330	206	7702	514	7189		0.4
Roggebaai	50	66	2787		2787		0.5
Athlone	40	38	867		867		0.3
Port Elizabeth	40	not in operation					
Johannesburg	176	102	4048	514	3535		0.5
Pretoria West	24	not in operation					
Hydro power stations	4	3	10632		10632		40.5
Lydenburg	2	2	6000		6000		34.2
Ceres	1	0	1082		1082		61.7
Piet Retief	1	1	3550		3550		50.7
Pumped-storage stations	180	174	273403	348573	-75170		18.0
Steenbras	180	174	273403	348573	-75170		18.0

2002 (CONTINUED)

Private Generation	Licensed capacity	Maximum power produced	Gross energy sent out	Own use - generation process	Nett energy sent out	Own use - private consumption	Load factor on maximum power
Total	1387	1296	7224837	351	7224486	5611009	63.6
Bagasse / coal fired stations	105	79	259317	0	259317	221291	37.5
Tongaat-Hulett Amatikulu	12	9	26781		26781	26781	34.0
Tongaat Hulett – Darnall	12	7	21704		21704	21704	35.4
Tongaat Hulett – Felixton	32	24	66510		66510	66510	31.6
Tongaat Hulett - Maidstone Mill	29	20	67397		67397	42299	38.5
Transvaal Suiker Ltd	20	19	76925		76925	63997	46.2
Coal fired stations	1279	1215	6950506	0	6950506	5389718	65.3
Kelvin	540	470	1721353		1721353	160565	41.8
Sasol Synth Fuels	600	628	4421074		4421074	4421074	80.4
Sasol Chem Ind	139	117	808079		808079	808079	78.8
Hydro power stations	3	2	15014	351	14663	0	
Friedenheim	3	2	15014	351	14663		85.7

2003

Station	Licensed capacity	Maximum power produced	Gross energy sent out	Own use in generation process	Nett energy sent out	Own use - private consumption & SCO	Load factor on maximum power
	MW	MW	MWh	MWh	MWh		%
Grand Total	43018	38004	219198686	4019679	215179007	381856	58.2
ESKOM Generation							
Total	39810	35922	210218785	3670755	206548030	79136	66.8
Coal fired stations	35607	31952	194046490		194046490		69.3
Arnot	1980	2076	14135237		14135237		77.7
Camden	1520	in storage					
Duvha	3450	2943	21384335		21384335		82.9
Grootvlei	1130	in storage					
Hendrina	1895	2015	12329325		12329325		69.8
Kendal	3840	3998	27820202		27820202		79.4
Komati	891	in storage					
Kriel	2850	2854	18347304		18347304		73.4
Lethabo	3558	3615	23505543		23505543		74.2
Majuba	3843	3763	10015560		10015560		30.4
Matimba	3690	3724	26510802		26510802		81.3
Matla	3450	3502	25802219		25802219		84.1
Tutuka	3510	3462	14195963		14195963		46.8
Gas turbine stations	342	69	341		341	27400	0.1
Acacia	171	54	299		299	11600	0.1
PortRex	171	15	42		42	15800	0.0
Hydro power stations	661	561	777041		777041		15.8
Gariep	360	336	383991		383991		13.0
Vanderkloof	240	225	393050		393050		19.9
Colleywobbles(Mbashe)	42				0		
First Falls	6				0		
Second Falls	11				0		
Ncora	2				0		
Nuclear stations	1800	1809	12662591		12662591		79.9
Koeberg	1800	1809	12662591		12662591		79.9

2003 (Continued)

Pumped-storage stations	1400	1531	2732322	3670755	-938433	51736	20.4
Drakensberg	1000	1084	1787554	2544556	-757002	25235	18.8
Palmiet	400	447	944768	1126199	-181431	26501	24.1
Station	**Licensed capacity**	**Maximum power produced**	**Gross energy sent out**	**Own use - generation process**	**Nett energy sent out**	**Own use - private consumption**	**Load factor on maximum power**
	MW	MW	MWh	MWh	MWh		%
Municipal Generation							
Total	1821	794	1326122	348573	977549		19.1
Coal fired stations	1323	513	1038433		1038433		23.1
Athlone	180	121	76596		76596		7.2
Kroonstad	30	not in operation					
Swartkops	240	not in operation					
Bloemfontein	103	80	19444		19444		2.8
Orlando	300	not in operation					
Rooiwal	300	182	826217		826217		51.8
Pretoria West	170	130	116176		116176		10.2
Gas turbine stations	314	104	3654		3654		0.4
Roggebaai	50	66	2787		2787		0.5
Athlone	40	38	867		867		0.3
Port Elizabeth	40	not in operation					
Johannesburg	160	not in operation			0		
Pretoria West	24	not in operation					
Hydro power stations	4	3	10632		10632		40.5
Lydenburg	2	2	6000		6000		34.2
Ceres	1	0	1082		1082		61.8
Piet Retief	1	1	3550		3550		40.5
Pumped-storage stations	180	174	273403	348573	-75170		17.9
Steenbras	180	174	273403	348573	-75170		17.9

2003 (continued)

Private Generation	Licensed capacity	Maximum power produced	Gross energy sent out	Own use - generation process	Nett energy sent out	Own use - private consumption	Load factor on maximum power
Total	1387	1288	7653779	351	7653428	381856	67.8
Bagasse / coal fired stations	105	79	259317		259317	221291	37.5
Tongaat-Hulett Amatikulu	12	9	26781		26781	26781	34.0
Tongaat Hulett – Darnall	12	7	21704		21704	21704	35.4
Tongaat Hulett – Felixton	32	24	66510		66510	66510	31.6
Tongaat Hulett - Maidstone Mill	29	20	67397		67397	42299	38.5
Transvaal Suiker Ltd	20	19	76925		76925	63997	46.2
Coal fired stations	1279	1207	7379448		7379448	160565	69.8
Kelvin	540	470	1721353		1721353	160565	41.8
Sasol Synthetic Fuels	600	620	4738677		4738677		87.2
Sasol Chemical Industry	139	117	919418		919418		89.7
Hydro power stations	3	2	15014	351	14663		
Friedenheim	3	2	15014	351	14663		85.7

2-1-2 Efficiency data and calculated fuel use 2001-2003[5]

FUEL USE AND EFFICIENCY	2001		2002		2003	
Station	**Fuel use**	**Efficiency**	**Fuel use**	**Efficiency**	**Fuel use**	**Efficiency**
	TJ	**%**	**TJ**	**%**	**TJ**	**%**
Grand Total						
ESKOM Generation						
Total						
Coal fired stations						
Arnot	115180109	35.60%	121093119	35.60%	142940599	35.60%
Camden	0	33.40%	0	33.40%	0	33.40%
Duvha	216538583	37.60%	223280847	37.60%	204743633	37.60%
Grootvlei	0	32.90%	0	32.90%	0	32.90%
Hendrina	131162400	34.20%	134241968	34.20%	129782368	34.20%
Kendal	248085107	35.30%	265226227	35.30%	283718774	35.30%
Komati	0	30.00%	0	30.00%	0	30.00%
Kriel	189548741	36.90%	186978195	36.90%	178998088	36.90%
Lethabo	208638476	37.80%	209710733	37.80%	223862314	37.80%
Majuba	55391533	36.50%	45379489	36.50%	98783605	36.50%
Matimba	240904193	35.60%	254279255	35.60%	268086762	35.60%
Matla	241818903	37.60%	244888966	37.60%	247042522	37.60%
Tutuka	79567456	38.00%	105969278	38.00%	134488071	38.00%
Gas turbine stations						
Acacia	2364	30%	2364	30%	3588	30%
PortRex	336	30%	336	30%	504	30%
Hydro power stations						
Gariep	3666251	100%	4192704	100%	1382368	100%
Vanderkloof	3752734	100%	4291607	100%	1414980	100%
Colleywobbles(Mbashe)	479670	100%	0	100%	0	100%
First Falls	0	100%	0	100%	0	100%
Second Falls	0	100%	0	100%	0	100%
Ncora	0	100%	0	100%	0	100%
Nuclear stations						
Koeberg	120584509	32%	134569620	32%	142454149	32%
Pumped-storage stations						
Drakensberg	4732783	79%	5180081	79%	8145816	79%
Palmiet	2501398	79%	2737805	79%	4305272	79%
Station						
Municipal Generation						
Total						
Coal fired stations						
Athlone	815376	35%	787845	35%	787845	35%
Kroonstad	0	35%	0	35%	0	35%
Swartkops	0	35%	0	35%	0	35%
Bloemfontein	220495	35%	84682	35%	199995	35%

[5] The fuel use was calculated from efficiency using the NER data above and IPCC default values. Efficiencies for Eskom plants are displayed on the Eskom website at www.eskom.co.za and were compiled by Thomas Alfstad. Efficiencies for non-Eskom plants are not available and were estimated by Thomas Alfstad. An estimate of 35% thermal efficiency has been used for coal fired private and municipal generators for which data on thermal efficiency was not available. For gas turbine generators a value of 30% was used. These values are most likely higher than actual efficiencies achieved at these plants, thus leading to a conservative estimate of emissions.

Orlando	0	35%	0	35%	0	35%
Rooiwal	4463825	35%	9761945	35%	8498232	35%
Pretoria West	771254	35%	1718733	35%	1194953	35%
Gas turbine stations	66024	35%	79221	35%	37584	35%
Roggebaai	17558	35%	28664	35%	28666	35%
Athlone	7048	35%	8915	35%	8918	35%
Port Elizabeth	-219	35%	0	35%	0	35%
Johannesburg	41637	35%	41637	35%	0	35%
Pretoria West	0	35%	0	35%	0	35%
Hydro power stations						
Lydenburg	21600	100%	21600	100%	21600	100%
Ceres	323	100%	3894	100%	3895	100%
Piet Retief	12960	100%	12780	100%	12780	100%
Pumped-storage stations						
Steenbras	1092864	79%	1245887	79%	1245887	79%
Private Generation						
Total						
Bagasse / coal fired stations						
Tongaat-Hulett Amatikulu	481083	35%	275462	35%	275462	35%
Tongaat Hulett – Darnall	302739	35%	223241	35%	223241	35%
Tongaat Hulett – Felixton	823731	35%	684103	35%	684103	35%
Tongaat Hulett - Maidstone Mill	775694	35%	693226	35%	693226	35%
Transvaal Suiker Ltd	773208	35%	791229	35%	791229	35%
Coal fired stations	76526486	35%	71490919	35%	75902894	35%
Kelvin	16734168	35%	17705345	35%	17705345	35%
Sasol Synth Fuels	52536374	35%	45473904	35%	48740678	35%
Sasol Chem Ind	7255944	35%	8311670	35%	9456871	35%
Hydro power stations		35%		35%		35%
Friedenheim	51437	100%	54050	100%	54050	100%

2-2. OPERATING MARGIN

2-2-1. Data for calculation of simple operating margin

MUST RUN ("J")						OTHER POWER PLANTS ("K")
	1999 MWh*	**2000 MWh***	**2001 MWh***	**2002 MWh***	**2003 MWh***	
Koeberg	12837	13009	10 718	11 961	12 662	Camden
Vanderkloof,	438	711	1 042	1 192	393	Grootvlei
Gariep	287	631	1018	1 164	383	Komati
Friedenheim	14	14	14	14	14	Majuba
Tongaat Hulett-Maidstone Mill	42	64	75	67	67	Tutuka
Transvaal Suiker	0	77	75	69	76	Arnot
Colleywobbles	15	13	13	0	0	Duhva
Tongaat Hulett - Felixton	87	89	80	66	66	Hendrina
Tongaat-Hulett Amatikulu	41	46	42	26	26	Kendal
Tongaat Hulett - Darnall	24	29	29	21	21	Kriel
Ceres	0	0	0	1	1	Lethabo
Piet Retief	3	4	3	3	3	Mathimba
Lydenburg	6	6	0	3	3	Matla
Sasol Chem Industrial	201	705	705	808	919	Acacia
Sasol Synth Fuels	4 978	5 107	5 107	4 421	4 738	Port Rex
Totals	18 973	20 505	18 921	19 816	19372	Drakensberg
						Palmiet
						Athlone
						Bloemfontein
						Rooiwal
						Pretoria West
						Roggebaai
						Athlone gas
						Johannesburg
						Steenbras
						Kelvin
Total grid generation net sent out	186 387	194 445	195 683	203 692	215 179	
Must run percentage	**10,18%**	**10,54%**	**9,67%**	**9,42%**	**9%**	

- Rounded off to the lowest MWh

2-2-2 Data for calculation of average operating margin

MUST RUN ('J')						OTHER POWER PLANTS FEEDING THE GRID ('K')
	1999 MWh*	**2000 MWh***	**2001 MWh***	**2002 MWh***	**2003 MWh***	
Koeberg	12837	13009	10 718	11 961	12 662	Camden
Vanderkloof,	438	711	1 042	1 192	393	Grootvlei
Gariep	287	631	1018	1 164	383	Komati
Friedenheim	14	14	14	14	14	Majuba
Tongaat Hulett-Maidstone Mill	42	64	75	67	67	Tutuka
Transvaal Suiker	0	77	75	69	76	Acacia
Colleywobbles	15	13	13	0	0	Port Rex
Tongaat Hulett - Felixton	87	89	80	66	66	Drakensberg
Tongaat-Hulett Amatikulu	41	46	42	26	26	Palmiet
Tongaat Hulett - Darnall	24	29	29	21	21	Athlone
Ceres	0	0	0	1	1	Bloemfontein
Piet Retief	3	4	3	3	3	Rooiwal
Lydenburg	6	6	0	3	3	Pretoria West
Arnot	8 500	9 135	11 390	11 974	14 135	Roggebaai
Duvha	22 247	23 530	22 616	23 320	21 384	Athlone gas
Hendrina	10 163	12 530	12 460	12 752	12 329	Johannesburg
Kendal	24 466	25 279	24 326	26 006	27 820	Steenbras
Kriel	16 535	16 392	19 428	19 165	18 347	Kelvin
Lethabo	20 490	22 319	21 907	22 019	23 505	Kelvin
Mathimba	23 368	23 721	23 822	25 145	26 510	Roggebaai
Matla	23 907	25 085	25 256	25 577	25 820	Athlone gas
Sasol Chem Industrial	201	705	705	808	919	Johannesburg
Sasol Synth Fuels	4978	5107	5107	4421	4738	Steenbras
						Kelvin
Total	**168 649**	**178 496**	**180 126**	**185 774**	**189 222**	
Total grid generation net sent out	186 387	194 445	195 683	203 692	215 179	
Must run percentage	**90,48%**	**91,80%**	**92,05%**	**91,20%**	**87,94%**	

* Rounded off to the lowest MWh

2-3. BUILD MARGIN – DATA FOR THE CALCULATION OF THE SAMPLE GROUP 'M"

List of power plants, technology, year of commissioning and capacity

Plant name	Tech-nology	Fuel type	MW	Year online	State/ Private
Majuba	Steam	Coal	3843	1996	Private
Kendal	Steam	Coal	3840	1993	Private
Lethabo	Steam	Coal	3558	1990	Private
Tutuka	Steam	Coal	3510	1990	Private
Matimba	Steam	Coal	3690	1988	Private
Duvha	Steam	Coal	3450	1984	Private
Matla	Steam	Coal	3450	1983	Private
Kriel	Steam	Coal	2850	1979	Private
Hendrina	Steam	Coal	1895	1976	Private
Acacia	Steam	Kerosene	171	1976	Private
Port Rex	Steam	Kerosene	171	1976	Private
Arnot	Steam	Coal	1980	1975	Private
Athlone	Steam	Coal	180	N/a	State
Bloemfon-tein	Steam	Coal	103	N/a	State
Orlando	Steam	Coal	300	N/a	State
Pretoria West	Steam	Coal	170	N/a	State
Rooiwal	Steam	Coal	300	N/a	State
Athlone	Steam	Kerosene	180	N/a	State
Johannes-burg	Steam	Kerosene	176	N/a	State
Roggebaai	Steam	Kerosene	50	N/a	State
Kelvin	Steam	Coal	540	N/a	State
Sasol syn Fuels	Steam	Coal	600	N/a	Private
Sasol Chem Ind	Steam	Coal	139	N/a	Private

2-4. DATA FOR CALCULATION OF COMBINED MARGIN

For the past 3 years the relative use of captive power and imported electricity at Mittal Steel has been as follows:

Year	Captive generation GWH	Grid imports GWh
2002	179	2 337
2003	177	2 458
2004	163	2 605

Source: Environmental Impact Report p 17 and 18 and originally Mittal Steel

3. DATA FOR CALCULATION OF EMISSIONS FROM AUXILIARY FUEL

The natural gas that will be used as auxiliary fuel consists of the following (mol %):

CO_2 – 1
$C2H_4$ – 3
$C2H_6$ – 7
CH_4 – 84.5
N_2 – 4.5

The low calorific value is 36.588 MJ/m^3.

Source: Bateman

Annex 4

MONITORING PLAN

See section 'D" hereof.

Annex 5

ELECTRONIC COPY OF EXPERT REPORT ON BARRIERS TO IPP'S IN SOUTH AFRICA
(hard copy signed)

DARLIPP

DARLING INDEPENDENT POWER PRODUCER (PTY) LTD
A MEMBER OF THE OELSNER GROUP OF COMPANIES

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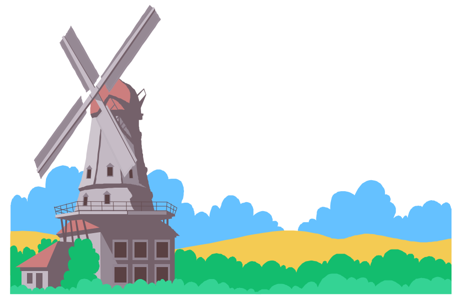

2005.12.13

To whom it may concern
c/o Johan van den Berg
CDM Africa Climate Solutions (Pty) Ltd

By telefax

Dear Sirs,

OBSTACLES TO THE DEVELOPMENT OF IPP ENERGY PROJECTS IN SOUTH AFRICA

I have been requested to share my experience on the obstacles that stand in the way of Independent Power Producers in South Africa.

1. By way of introduction, I am the Managing Director and a founder shareholder of the Darling Independent Power Producer (Pty) Ltd ('DARLIPP'), the developer of the Darling National Demonstration Windfarm.
2. My professional qualification is as graduated Dipl.Ing. (Mechanical) at OHM FACHHOCHSCHULE NUERNBERG.
3. Since 1996 I have been working in research, development and implementation of renewable energy projects. In this period I have attended and addressed each year a minimum of two international and several national conferences on renewable energy and wind energy in particular.
4. Through serving on committees and taking part in workshops I generally kept myself abreast of new developments.
5. Focal areas of activity past and ongoing are:

- Development and piloting of financial schemes including targeted subsidy and incentives schemes
- Renewable energy for productive end-use
- Skills development for jobs in the field of installation, maintenance and output optimisation of energy systems including WIND, WAVE and SOLAR systems.
- Evaluations of renewable energy pilot projects

6. The above involved close liaison and co-operation with institutional and private sector stakeholders as listed below:
    - DME (Department of Mining and Energy)
    - DEA&T (Department of Environmental Affairs and Tourism)
    - Darling Independent Power Producer (DARLIPP)
    - DBSA (Development Bank of Southern Africa)
    - NER (National Electricity Regulator)
    - ESKOM
    - SAWEA (South African Wind Energy Association)
    - WWEA (World Wind Energy Association)
    - AFRIWEA (African Wind Energy Association)
    - GEF
    - DANIDA (Danish International Donor Agency)
    - CEF (Central Energy Fund)
    - IDC (Industrial Development Corp.)
    - CTCC (Cape Town City Council)

7. At present I am actively involved in the following non-commercial organisations and committees:
    - THE SOUTH AFRICAN WIND ENERGY ASSOCIATION – Founder Member
    - THE WORLD WIND ENERGY ASSOCIATION – Vice President and Founder Member
    - THE AFRICAN WIND ENERGY ASSOCIATION – President and Founder Member
    - NATIONAL INTEGRATED RESOURCE PLAN ADVISORY AND REVIEW COMMITTEE - Committee Member representing Renewable Energy

8. The above has put me in a good position to assess obstacles to the development of Independent Power Producers, while my particular experience in developing the Darling National Demonstration Windfarm has been invaluable in this regard.

FACTUAL POSITION REGARDING IPP'S IN SOUTH AFRICA

9. Generically speaking there are several factors that make it extremely hard to successfully develop an IPP in South Africa. Amongst these are:

- The electricity price in South Africa is amongst the lowest in the world, making it very difficult for IPP's to compete with Eskom, the national utility.
- Eskom in fact produces over 90% of the electricity in South Africa and owns an installed capacity of around 42 000 MW;
- Most IPP's have an inherent disadvantage merely due to the lack of critical mass vis-à-vis Eskom, which again makes it more difficult to attract investment. My understanding is that Eskom has a credit rating in the same bracket as South Africa, due to the fact that the South African Government is its shareholder.
- Some foreign companies in the energy field are larger but exchange rate risk and/or the very high cost of hedging an exposure to the South African currency over the lifetime of a project have seemingly (so far) made it unattractive for them to invest in the South African Energy Sector.
- I am only aware of one independent power producer producing energy solely for the grid. This is Kelvin, a coal fired plant which was sold by the City of Johannesburg and has a capacity of approximately 480MW;
- IPP's face other challenges, particularly in obtaining licenses, permits and approvals, which is a bureaucratic and time-consuming process. An example is obtaining a wheeling agreement with Eskom, which took almost three years.
- A large portion of the hardware for projects has to be imported and paid for in hard currency;

10. These difficulties are practically illustrated by my experience in developing the Darling National Demonstration Windfarm.

DEVELOPING THE DARLING NATIONAL DEMONSTRATION WIND FARM

11. DARLIPP started in 1996 to develop the concept of a Windfarm in the vicinity of Darling in the Western Cape. This wind farm was envisioned as an IPP.
12. At the time wind power was a foreign concept in South Africa and nobody had any idea of what would be required to bring such a project to fruition, nor were there any criteria for the placement or erection of wind farms.

13. Due to the obvious value for the country that such a project would have in terms of breaking down barriers to entry for wind energy in particular, the National Government in the person of the Minister of Minerals and Energy on 12 June 2000 declared the project a National Demonstration Project in a bid to develop strategies for wind energy generation in South Africa.
14. DANIDA (formerly Danced) the donor agency of the Danish Government, agreed to donate R 19 million to the project. This was agreed on inter-governmental level and this grant was and remains essential in making the project financially viable.
15. The Cape Town Unicity has agreed to purchase the power produced by the Windfarm for the next twenty years at a rate approximately double the Eskom megaflex tariff.
16. The Global Environment Fund (GEF) has agreed pending final approval to provide the Unicity with a production subsidy of R 30 million in order to subsidise the difference between the "green power" forthcoming from Darling National Demonstration Windfarm and the price of fossil fuel-derived power provided by Eskom.
17. In November 2002 the national cabinet mandated the Minister of Minerals and Energy to issue a Directive on the Central Energy Fund CEF (done 26 November 2003) to invest up to R19.38 million, including contingencies, in the Darling National Demonstration Wind farm on certain conditions. This investment would be subordinated – again an essential ingredient in order to make the project feasible.
18. The importance of the DNDWF (but also the formidable barriers to its success) was underlined in President Mbeki's "State of the Nation" address at the opening of Parliament in February 2001 when he inter alia said:

> ***"With regard to the energy sector, among other things, our decision will entail the restructuring the electricity supply and distribution industries to introduce greater levels of competition. Independent Power Producers will be allowed into our energy system and localized energy grids for rural areas will be developed".***

19. An extract from the speech appears on the official website of the South African Government at http://www.gov.za/index.html.
20. During November 2003 the 2nd World Wind Energy Conference was held in the new Cape Town International Convention Centre. The DNDWF was constantly pointed out as the South Africa flagship on wind energy, inter alia by Minister of Minerals and Energy in a public address to the conference.

21. As appears more fully below under the discussion of urgency, the Darling National Demonstration Windfarm is of great importance to the country.
22. All of the above is relayed in order to underline the fact that despite full governmental backing, the Darling National Demonstration Windfarm has in eight years not yet come to financial close. The more pertinent reasons for this are discussed below.

ENVIRONMENTAL APPROVALS

23. The merits of disputes relating to environmental approvals for the 5,2 MW, four turbine windfarm will not be discussed as they are not relevant. What is indeed relevant is the time consumed by the process and the costs incurred.
24. DARLIPP as long ago as 1998 employed the Environmental Evaluation Unit at the University of Cape Town ('EEU") to be its Consultant regarding the environmental impact assessment. The costs were paid by the Danish government and no expense was spared.
25. In September 1998 EEU submitted EIA Scoping Report to Western Cape Department of Environmental and Cultural Affairs and Sport (DECAS). The Scoping Report was approved by DECAS, subject to 3 conditions: That an EIA be undertaken, that specialist studies recommended in the Scoping Report be undertaken and that the public participation process be continued throughout the EIA process.
26. On 23 June 2002 the Minister of Minerals and Energy declared the Darling Windfarm a National Demonstration project.
27. In July 2001**,** EEU was contracted by Danced to undertake Environmental Impact Assessment (EIA).
28. In January 2002**,** EEU submitted the EIA Report to DECAS.
29. On 8 July 2002**,** DECAS issued a Record of Decision: DECAS Chief Director Environmental granted authorization subject to certain conditions.
30. In August 2002 three appeals were received.
31. In February 2003 the DME received by fax (10 February 2003) non-dated letter from the Acting Minister stating that he had decided to set aside the environmental approval and that a new application had to be lodged.
32. At first the officials in the Department of Minerals and Energy hoped that the matter might be resolved on inter-departmental level and much time was spent in attempting to do this.

33. When no resolution of the impasse was forthcoming, DARLIPP took legal advice and was advised inter alia that, due to the fact that the project impacts on South Africa's International Obligations, in law the EIA falls to be decided by Central Government, not Provincial Government.
34. After further unsuccessful efforts to resolve the matter amicably and the passing of about eleven extremely frustrating months, DARLIPP under case number 515/04 instituted action in the Supreme Court in the Cape of Good Hope Provincial Division to force the Provincial Authorities to refer the project to National Government.
35. The matter was settled before going to court and it was agreed inter alia that the Provincial Authorities would refer the matter to National Government. This was done on 9 February 2004.
36. By August 2004 no decision was forthcoming and there was imminent danger that the donor funding from the Danish Government would lapse.
37. Darlipp instituted court action again, this time asking the court inter alia to compel National Government to make a decision on the matter in the near future.
38. The case was postponed for hearing in early 2005 and eventually settled after a positive Record of Decision was received in the first quarter of 2005, some seven years after the EIA process started.

POWER PURCHASE AGREEMENT

39. Despite the fact that it has been under negotiation for perhaps three years and despite the subsidy made available by GEF as mentioned above, the PPA has not yet been signed by the Cape Town Unicity. Financial close depends on it.

LOAN FUNDING

40. In the Minister's directive declaring the project as a National Demonstration Windfarm, it was envisioned that the Industrial Development Corporation would provide loan funding. The IDC however declined due to the insufficient returns of the project.
41. It took until November 2005 before the Development Bank of Southern Africa agreed to step into the breach.

SUPPLY OF WIND TURBINES

42. So much time has elapsed that the original supplier of turbines has been taken over by another company that now refuses to recognize any obligation to sell turbines to the project and says that all its turbines are sold until the end of 2007.
43. At this late juncture this is forcing DARLIPP to find another equipment supplier able to supply on short notice in a very active market.

EXPENSE

44. In all the years of developing the wind farm at Darling, DARLIPP has generated no income out of the project.
45. Indeed, eight years of sunken costs have had to be borne.

SUMMARY

46. There are substantial generic obstacles facing prospective Independent Power Producers in South Africa, as appears from the general background information provided at the start of this document.
47. When an unfortunate series of events arises, this can be most detrimental and lead to the obstacles being exacerbated to excessive levels, as appears from the succinct account of my experience in developing the Darling National Demonstration Windfarm.

Further details are available at 022 492 3095.

Yours sincerely
DARLING IPP (PTY) LTD.

Hermann Oelsner
Chairman