



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

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**SECTION A. General description of project activity****A.1. Title of the project activity:**

Waste energy to electricity at ArcelorMittal's Vanderbijlpark Steel, South Africa

Version number: 1.0

Date: 21 October 2011

A.2. Description of the project activity:

The proposed project activity is implemented by ArcelorMittal South Africa Limited (AMSA) at Vanderbijlpark Works (VDBP Works).

VDBP Works is one of the world's largest inland steel mills and the largest supplier of flat steel products in sub-Saharan Africa. The Vanderbijlpark Works' products are manufactured in an integrated process. Raw materials such as iron ore, coke and dolomite are charged to the two Blast Furnaces (BFs C and D) where they are converted to liquid iron. The liquid iron as well as the direct reduction iron from the four Direct Reduction Kilns (DR Kilns 1-4) is refined in basic oxygen furnaces and electric arc furnaces to produce liquid steel. The liquid steel is cast into slabs, which are hot rolled into heavy plate in a plate mill, or into coils in a strip mill. Coke for the iron making process is produced in seven Coke Oven Batteries.

During the iron making process the following waste gases are generated: Coke Oven Gas (COG) from the COBs and Blast Furnace Gas (BFG) from BFs C and D. Some of these gases are used within the plant with the rest flared.

The existing DR Kilns 1-4 have their own Waste Heat Recovery System (WHRS) that utilizes waste heat from the hot flue gas released during the direct reduction process in order to generate low-pressure steam (16 bar) for the Works. The excess low-pressure steam is vented to the atmosphere when steam production exceeds the 16 bar steam demand.

Steam for the Works is also generated at the existing Boiler House using COG and BFG. Generated medium-pressure steam (31 bar) is mainly used to meet 31 bar steam demand. When 16 bar steam demand exceeds low-pressure steam production, an additional amount of medium-pressure steam is produced by burning more COG and BFG. This steam is throttled in the four Desuperheaters from the pressure of 31 bar to the pressure of 16 bar and is used together with steam from the existing WHRS to meet 16 bar steam demand of the Works.

In 2004 AMSA started considering the opportunity to increase the direct reduction iron production capacity of VDBP Works by 350 000 t/a (from 700 000 t/a to 1 050 000 t/a) by installing two new Direct Reduction Kilns (DR Kilns 5 and 6). The construction of the new kilns started on the 29th of March 2007. DR Kiln 6 was put into operation on 10th of April 2009, DR Kiln 5 – on 8th June 2009.

In 2005 the company began pondering the possibility of utilizing waste heat of flue gas from those new kilns as well as waste energy of other Waste Energy Carrying Medium (WECM) streams available in order to generate electricity for the Works.

The proposed project activity envisages the construction and operation of a new Waste Energy Recovery System (WERS) which consists of the WHRS of the new DR Kilns 5 and 6 as well as the Power Plant



with an installed power capacity of 40 MW that utilizes waste energy from the following WECM streams for electricity generation only:

- Flue gas from the new DR Kilns 5 and 6;
- Excess low-pressure steam from the existing WHRS of the DR Kilns 1-4;
- Excess BFG from the existing BFs C and D; and
- Excess COG from the existing COBs.

The electricity generated by the new WERS is used for internal purposes of VDBP Works, reducing the demand for electricity supplied by Eskom.

The proposed project was approved by AMSA's Board on the 14th of March 2007. The construction of the new WERS began on the 29th of March 2007. The project was put into operation on 26th July 2009. At the point of decision making the required investment for the proposed project amounted to 246.61 million ZAR (or 36.43 million USD)¹ excluding VAT.

The baseline scenario assumes that in the absence of the project activity:

- Waste heat of the flue gas from the new DR Kilns 5 and 6 would be released into the atmosphere;
- Excess low-pressure steam from the existing WHRS of the DR Kilns 1-4 would be vented into the atmosphere;
- Excess BFG from the existing BFs C and D would be flared;
- Excess COG from the existing COBs would be flared; and
- Electricity generated by the new WERS would otherwise be supplied from the national grid of the RSA.

The reduction of Greenhouse Gas (GHG) emissions as a result of the project implementation are achieved due to reduction of CO₂ emissions from combustion of fossil fuel at the existing grid-connected power plants and plants which would likely be built in the absence of the project activity.

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

1. Promotion and development of Waste Energy Recovery (WER) projects in the RSA which in turn will lead to the creation of new job opportunities both during the construction and operation phases and to growth in tax revenues. Sales of carbon credits generated by the project will result in increased foreign direct investment;
2. Creation of 600 000 man-hours during the construction phase and 50 jobs during the operation phase;
3. Mitigation of the negative environmental impact. Combustion of fossil fuels (mostly coal) at Eskom's power plants and hereby emissions of the harmful substances into the atmosphere, such as flue ash, oxides of sulphur and nitrogen were reduced due to the project implementation.

¹ Average ZAR/USD exchange rate in 2006 is 6.77 (ZAR/USD),
<http://www.x-rates.com/d/ZAR/USD/hist2006.html>

**A.3. Project participants:**

Name of Party involved (host) indicates a Host Party	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of South Africa (Host Party)	<ul style="list-style-type: none"> ArcelorMittal South Africa Limited 	No
One of the Parties to Annex B of the Kyoto Protocol	<ul style="list-style-type: none"> To be determined upon approval of the project by the DNA of the RSA 	No

ArcelorMittal South Africa Limited (AMSA)

AMSA was founded in 1928. The company is the largest steel producer on the African continent, with a production capacity of 7.8 million tonnes of liquid steel per annum. AMSA's headquarters is in the town of Vanderbijlpark in the RSA, Gauteng Province.

ArcelorMittal is the leader in the supply of steel to all major global markets, including automotive, construction, household appliances and packaging, with leading R&D and technology, as well as sizeable captive supplies of raw materials and outstanding distribution networks.

A.4. Technical description of the project activity:**A.4.1. Location of the project activity:****A.4.1.1. Host Party(ies):**

The Republic of South Africa (RSA)

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

Gauteng Province

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

The town of Vanderbijlpark

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

The town of Vanderbijlpark is located within Emfuleni Local Municipality, which forms part of the greater Sedibeng District Municipality, in the Gauteng Province of the RSA (Fig. A.4-1).

The proposed project site is located in the territory of VDBP Works north of the town of Vanderbijlpark, approximately 20 km from Sasolburg and immediately east of the Golden Highway (R553). The property

is located off Delfos Boulevard, on the remaining extent of Portion 1 of the farm Vanderbijlpark 550 IQ, in the NW7 industrial area (Fig. A.4-2).

The GPS coordinates for the project site are: 26° 39' S and 27° 48' E. This site falls in the time zone UTC+2.



Fig. A.4-1: Location of the town of Vanderbijlpark in the territory of the RSA

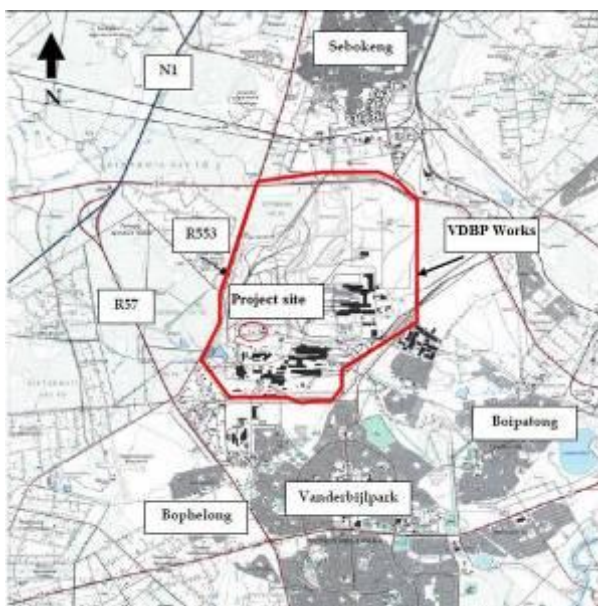


Fig. A.4-2: Location of the VDBP Works

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

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

Sectoral Scope 4: Manufacturing industries

**A.4.3. Technology to be employed by the project activity:****Overview of VDBP Works before the project implementation**

VDBP Works is one of the world's largest inland steel mills and the largest supplier of flat steel products in sub-Saharan Africa. The Vanderbijlpark Works' products are manufactured in an integrated process. Raw materials such as iron ore, coke and dolomite are charged to the two Blast Furnaces (BFs C and D) where they are converted to liquid iron. The liquid iron as well as the direct reduction iron from the four Direct Reduction Kilns (DR Kilns 1-4) is refined in basic oxygen furnaces and electric arc furnaces to produce liquid steel. The liquid steel is cast into slabs, which are hot rolled into heavy plate in a plate mill, or into coils in a strip mill. Coke for the iron making process is produced in seven Coke Oven Batteries².

During the iron making process the following waste gases are generated: COG from the COBs and BFG from BFs C and D. Some of these gases are used within the plant with the rest flared. The list of the COG and BFG consumers as well as gas balances over a period of 2004-2006 is presented in Annex 3-6.

The existing DR Kilns 1-4 have their own WHRS that utilizes waste heat from the hot flue gas released during the direct reduction process in four Waste Heat Recovery Boilers (WHRBs) in order to generate low-pressure steam (16 bar) for the Works. The excess low-pressure steam is vented to the atmosphere when steam production exceeds the 16 bar steam demand. Quantity of the excess low-pressure steam vented to the atmosphere over a period of 2004-2006 is presented in Annex 3-6.

Steam for the Works is also generated at the existing Boiler House (BH) using COG and BFG in 6 medium-pressure steam boilers. Generated medium-pressure steam (31 bar) is mainly used to meet 31 bar steam demand. When 16 bar steam demand exceeds low-pressure steam production, an additional amount of medium-pressure steam is produced by burning more COG and BFG. This steam is throttled in the four Desuperheaters from the pressure of 31 bar to the pressure of 16 bar and is used together with steam from the existing WHRS to meet 16 bar steam demand of the Works.

Fig. A.4-3 shows the basic steam supply scheme of the VDBP Works as well as the principal components of the situation before the project implementation.

In 2004 AMSA started considering the opportunity to increase the direct reduction iron production capacity of VDBP Works by 350 000 t/a (from 700 000 t/a to 1 050 000 t/a) by installing two new Direct Reduction Kilns (DR Kilns 5 and 6). The construction of the new kilns started on the 29th of March 2007. DR Kiln 6 was put into operation on 10th of April 2009, DR Kiln 5 – on 8th June 2009. The general view of DR Kilns 5 and 6 is presented on Fig. A.4-4.

AMSA buys power from Eskom to meet the electricity demand of the Works as well as generating some electricity using medium-pressure steam.

² Actual COB numbers are 1, 3, 4, 6, 7, 8, 9

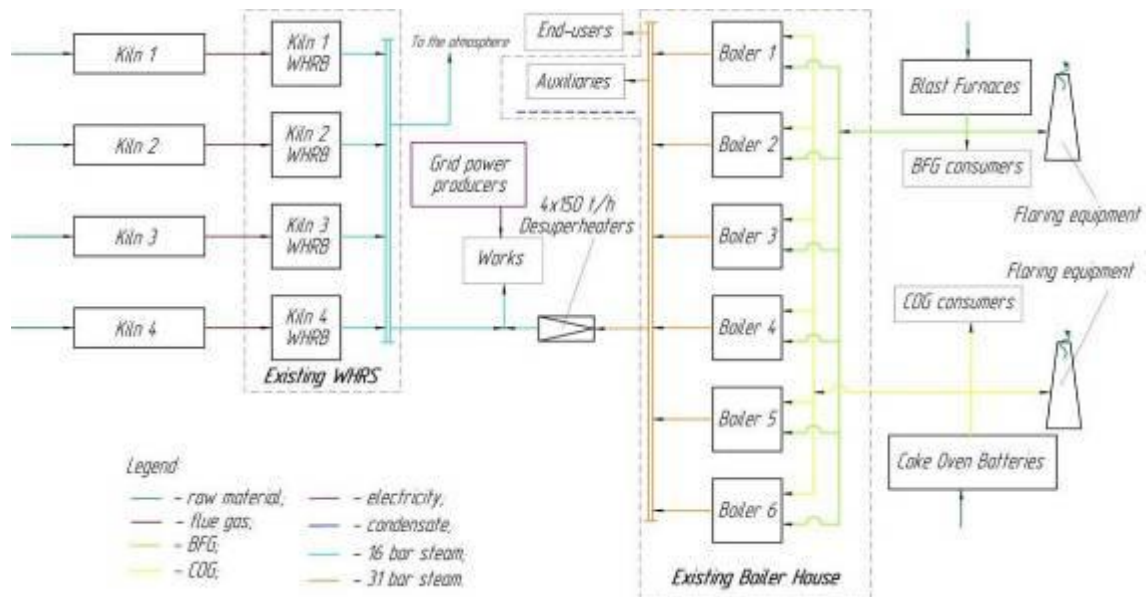


Fig. A.4-3: The principal components of the situation before the project implementation



Fig. A.4-4: The general view of the DR Kilns 5 and 6

The project activity characteristic

In 2005 AMSA began pondering the possibility of utilizing waste heat of hot flue gas from the new DR Kilns 5 and 6 as well as waste energy of other WECM streams available in order to generate electricity for the Works.

The proposed project activity envisages the construction and operation of a new WERS which consist of the WHRS of the new DR Kilns 5 and 6 and Power Plant with an installed power capacity of 40 MW³ which utilize waste energy from the following WECM streams for electricity generation only:

³ Turbogenerator Electrical Data

- Flue gas from the new DR Kilns 5 and 6;
- Excess low-pressure steam from the existing WHRS of the DR Kilns 1-4;
- Excess BFG from the existing BFs C and D; and
- Excess COG from the existing COBs.

The basic scheme of catching waste heat from the flue gas from the new DR Kilns 5 and 6 is presented on Fig. A.4.5.

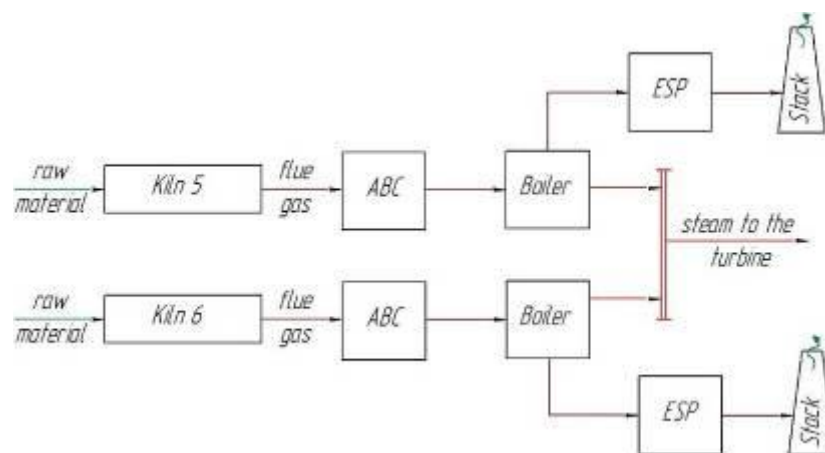


Fig. A.4.5: The basic scheme of catching of waste heat of the flue gas from the new DR Kilns 5 and 6

The flue gas from DR Kilns 5 and 6 is fed into the After Burning Chambers (ABCs). The function of the ABC is to burn off remaining combustible gasses, such as carbon monoxide and methane, and some carbon particles, at that chemical energy of the CO/CH₄ containing in the flue gas is particularly wasted during this process. After the ABC the flue gas passes through the waste heat recovery boilers to generate high-pressure steam (66 bar) which then is transferred to the steam turbine (Fig. A.4-6). Electrostatic Precipitator (ESP) removes dust before the stack.



Fig. A.4-6: The general view of the steam turbine and alternator

Fig. A.4-7 shows the basic steam supply scheme as well as the principal components of the situation after the project implementation.

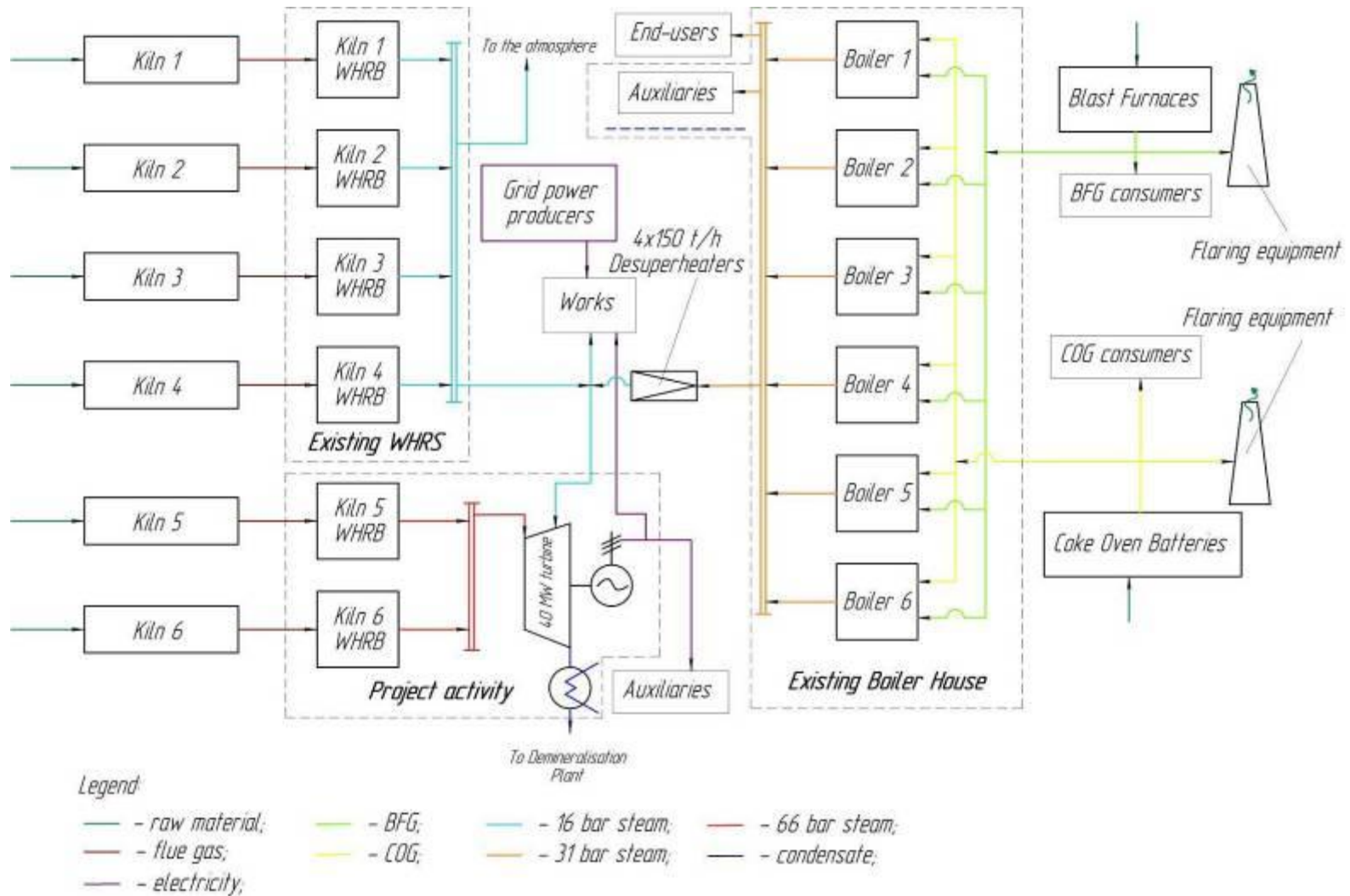


Fig. A.4-7: The principal components of the situation after the project implementation



The steam turbine is also fed with excess low-pressure steam from the existing WHRS of the DR Kilns 1-4 as well as steam generated at the existing boiler house by burning excess COG and BFG and throttled via four Desuperheaters.

The amount of electricity which is produced by the new WERS is dependent on the availability of WECM streams. It was expected that annual average net electricity generation capacity of the proposed power plant amounts to 32.8 MW⁴, and annual net electricity generation amounts to 262 098 MWh⁵.

The electricity generated by the new WERS is used for internal purposes of VDBP Works, reducing the demand for electricity supplied by Eskom.

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

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

Number	Action	Date
1	Approval by AMSA's Board	14 March 2007
2	Start of construction and installation works	29 March 2007
3	Completion of commissioning and start of operation	26 July 2009

At the point of decision making the required investment for the proposed project amounted to 246.61 million ZAR. The CAPEX breakdown excluding VAT is presented in Table A.4-2.

Table A.4-2: WERS breakdown of costs, million ZAR⁶

Equipment	Value
Waste heat recovery equipment:	
WHRBs 5 and 6	85.00
ESP	26.61
ABC	40.00
Power plant	95.00
Total:	246.61

The quantity of electricity supplied to VDBP Works by the power plant during the year y is determined on the basis of electricity meters. Supplementary electricity consumption is calculated.

The COG and BFG consumers are presented in Annex 3-6. The COG and BFG consumption is measured by flow meters.

The baseline scenario characteristic

The baseline scenario assumes that in the absence of the project activity:

⁴Memo for Directors of Mittal Steel South Africa Limited "New Direct Reduction Kilns 5 & 6 Approval Of Funds", section 3.4 "Economic Evaluation", page 3; 2006-11-30

⁵Memo for Directors of Mittal Steel South Africa Limited "New Direct Reduction Kilns 5 & 6 Approval Of Funds", section 2 "Strategic intent of the project", page 2; 2006-11-30

⁶ AMSA's internal reports



- Waste heat of the flue gas from the new DR Kilns 5 and 6 would be released into the atmosphere;
- Excess low-pressure steam from the existing WHRS of the DR Kilns 1-4 would be vented into the atmosphere;
- Excess BFG from the existing BFs C and D would be flared;
- Excess COG from the existing COBs would be flared; and
- Electricity generated by the new WERS would otherwise be supplied from the national grid of the RSA.

The combined margin CO₂ emission factor of RSA's grid was calculated using the "Tool to calculate the emission factor for an electricity system" (Version 02.2.0) and is equal to 0.965 tCO₂/MWh.

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

The 10-years crediting period was selected for the project.

Years	Annual estimation of emission reductions in tonnes of CO₂ e
2012 (from the 1 st of July to the 31 st of December) ⁷	126 462
2013	252 925
2014	252 925
2015	252 925
2016	252 925
2017	252 925
2018	252 925
2019	252 925
2020	252 925
2021	252 925
2022 (from the 1 st of January to the 30 th of June)	126 463
Total estimated reductions (tonnes of CO₂ e)	2 529 250
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO₂ e)	252 925

A.4.5. Public funding of the project activity:

No public funding was applied to the project.

⁷ The proposed project is expected to be registered by CDM EB on the 1st of July 2012.

**SECTION B. Application of a baseline and monitoring methodology****B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:**

Approved consolidated baseline and monitoring methodology ACM0012 “Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects” (Version 04.0.0)⁸ is applicable to the project activity.

The methodology ACM0012 is applicable to project activities implemented in an existing or Greenfield facility converting waste energy carried in identified waste energy carrying medium streams into useful energy.

“Tool to calculate the emission factor for an electricity system” (Version 02.2.0)⁹ is used to calculate the combined margin CO₂ emission factor of RSA’s grid.

“Tool for the demonstration and assessment of additionality” (Version 05.2.1)¹⁰ is used to demonstrate and assess the additionality of the proposed project activity.

“Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (Version 01)¹¹ is used to calculate the project emissions due to supplementary electricity consumption.

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

The methodology ACM0012 (Version 04.0.0) is applicable to project activities implemented in an existing or Greenfield facility converting waste energy carried in identified Waste Energy Carrying Medium (WECM) streams into useful energy. The WECM stream may be an energy source for:

- (1) Generation of electricity;
- (2) Cogeneration;
- (3) Direct use as process heat source;
- (4) Generation of heat in element process;
- (5) Generation of mechanical energy; or
- (6) Supply of heat of reaction with or without process heating.

In the absence of the project activity, the WECM streams:

- (a) Would not be recovered and therefore would be flared, released to atmosphere, or remain unutilized in the absence of the project activity at the existing or Greenfield project facility; or
- (b) Would be partially recovered, and the unrecovered portion of WECM stream would be flared, vented or remained unutilized at the existing or Greenfield project facility.

⁸ <http://cdm.unfccc.int/methodologies/DB/L731WMCXLT0WE6ALG5AYAGLTJP7KW7>

⁹ <http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-07-v2.2.0.pdf>

¹⁰ <http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-01-v5.2.1.pdf>

¹¹ <http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-05-v1.pdf>



Project activities improving the WECM recovery may:

- (i) Capture and utilise a larger quantity of WECM stream as compared to the historical situation in existing facility, or capture and utilise a larger quantity of WECM stream as compared to a “reference waste energy generating facility”; and/or
- (ii) Apply more energy efficient equipment to replace/modify/expand waste energy recovery equipment, or implement a more energy efficient equipment than the “reference waste energy generating facility”.

The proposed project activity envisages the construction and operation of the Waste Energy Recovery System (WERS) that utilize waste energy of the following WECM streams for the generation of electricity only:

- Flue gas from the new Direct Reduction Kilns 5 and 6 (DR Kilns 5 and 6);
- Excess low-pressure steam from the existing WHRS of the Direct Reduction Kilns 1-4 (DR Kilns 1-4);
- Excess Blast Furnace Gas (BFG) from the existing Blast Furnaces (BFs C and D); and
- Excess Coke Oven Gas (COG) from the existing Coke Oven Batteries (COBs).

Therefore the project activity falls under item (1).

In the absence of the project activity:

- Waste heat of the flue gas from the new DR Kilns 5 and 6 would be released into the atmosphere;
- Excess low-pressure steam from the existing WHRS of the DR Kilns 1-4 would be vented into the atmosphere;
- Excess BFG from the existing BFs C and D would be flared; and
- Excess COG from the existing COBs would be flared.

Thus, the proposed project falls under item (a).

Since the project activity was partially implemented at the Greenfield facility (new DR Kilns 5 and 6), the quantity of waste heat of the flue gas from the DR Kilns 5 and 6 captured and utilised in the proposed WERS has to be compared with the quantity of waste heat captured and utilised in a “reference waste energy generating facility” (see item (i)).

The project activity meets all necessary applicability conditions of methodology ACM0012 to apply (see Table B.2-1).



Table B.2-1: Applicability conditions check

Applicability condition	Applicability	Comment
For project activities which recover waste pressure, the methodology is applicable where waste pressure is used to generate electricity only and the electricity generated from waste pressure is measurable;	Not applicable	The project activity does not recover waste pressure, so it does not need to satisfy this applicability condition.
Regulations do not require the project facility to recover and/or utilize the waste energy prior to the implementation of the project activity.	Applicable	As of today existing regulations in the RSA do not require in any way the project facilities to recover and/or utilize the waste energy ¹² .
The methodology is applicable to both Greenfield and existing waste energy generation facilities. If the production capacity of the project facility is expanded as a result of the project activity, the added production capacity must be treated as a Greenfield facility.	Applicable	The project activity was implemented at both Greenfield and existing waste energy generation facilities. The proposed project envisages the utilization of waste energy of the following WECM streams: <ul style="list-style-type: none"> • Flue gas from the new DR Kilns 5 and 6; • Excess low-pressure steam from the existing WHRS of the DR Kilns 1-4; • Excess BFG from the existing BFs C and D; and • Excess COG from the existing COBs.
Waste energy that is released under abnormal operation (for example, emergencies, shut down) of the project facility shall not be included in the emission reduction calculations.	Applicable	Waste energy that is released under abnormal operation of the steel plant will not be accounted for. This will be specially provided for in the Monitoring Plan.

¹² National Environment Management: Air Quality Act 39 of 2004;
[http://www.environment.gov.za/PolLeg/Legislation/2006Jan10/NEM_Air_Quality_Management_Act_\(Act39_of_2004\).pdf](http://www.environment.gov.za/PolLeg/Legislation/2006Jan10/NEM_Air_Quality_Management_Act_(Act39_of_2004).pdf)



Applicability condition	Applicability	Comment
If multiple waste gas streams are available in the project facility and can be used interchangeably for various applications as part of the energy sources in the facility, the recovery of any waste gas stream, which would be totally or partially recovered in the absence of the project activity, shall not be reduced due to the implementation of CDM project activity.	Applicable	The recovery of COG and BFG for other applications will not be reduced due to the project implementation. This will be specially provided for in the Monitoring Plan.
The methodology is not applicable to the cases where a WECM stream is partially recovered in the absence of the CDM project activity to supply the heat of reaction, and the recovery of this WECM stream is increased under the project activity to replace fossil fuels used for the purpose of supplying heat of reaction.	Not applicable	WECM streams would not be partially recovered in the absence of the project activity to supply the heat of reaction. According to ACM0012, the project activity must not satisfy this applicability condition.
This methodology is also not applicable to project activities where the waste gas/heat recovery project is implemented in a single-cycle power plant (e.g. gas turbine or diesel generator) to generate power. However, the projects recovering waste energy from single cycle and/or combined cycle power plants for the purpose of generation of heat only can apply this methodology.	Not applicable	The proposed project was not implemented in a single-cycle power plant. According to ACM0012, the project activity must not satisfy this applicability condition.

B.3. Description of the sources and gases included in the project boundary:

According to ACM0012, the geographical extent project boundary shall include the relevant WECM streams, equipment and energy distribution system in the following facilities:

- (1) The Project Facility; and
- (2) The Recipient Facility.

The spatial extent of the grid is as defined in the “Tool to calculate the emission factor for an electricity system”.

Fig. B.3-1 shows the principal components and the boundary of the project.

The spatial extent of RSA’s grid is presented in Annex 3-1.

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



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

<u>Source</u>		Gas	Included?	Justification / Explanation
Baseline	Electricity generation, grid source	CO ₂	Yes	Main emission source
		CH ₄	No	Excluded for simplification. This is conservative
		N ₂ O	No	Excluded for simplification. This is conservative
	Fossil fuel consumption in element process for thermal energy	CO ₂	No	This does not take place in the baseline scenario.
		CH ₄	No	
		N ₂ O	No	
	Fossil fuel consumption in cogeneration plant	CO ₂	No	This does not take place in the baseline scenario.
		CH ₄	No	
		N ₂ O	No	
	Generation of steam used in the flaring process, if any	CO ₂	No	This does not take place in the baseline scenario.
		CH ₄	No	
		N ₂ O	No	
Project Activity	Fossil fuel consumption for supply of process heat and/or reaction heat	CO ₂	No	No fossil fuel combustion for supply of process heat and/or reaction heat occurs as a result of the project implementation.
		CH ₄	No	
		N ₂ O	No	
	Supplemental fossil fuel consumption at the project plant	CO ₂	No	No supplemental fossil fuel consumption at the project plant occurs.
		CH ₄	No	
		N ₂ O	No	
	Supplemental electricity consumption	CO ₂	Yes	Main emission source
		CH ₄	No	Excluded for simplification. This is conservative
		N ₂ O	No	Excluded for simplification. This is conservative
	Electricity import to replace captive electricity, which was generated using waste energy in absence of project activity	CO ₂	No	Only if captive electricity in the baseline is replaced by import electricity
		CH ₄	No	
		N ₂ O	No	
Energy consumption for gas cleaning	CO ₂	No	Only if waste gas cleaning is required and leads to emissions related to the energy requirement of the cleaning	
	CH ₄	No		
	N ₂ O	No		

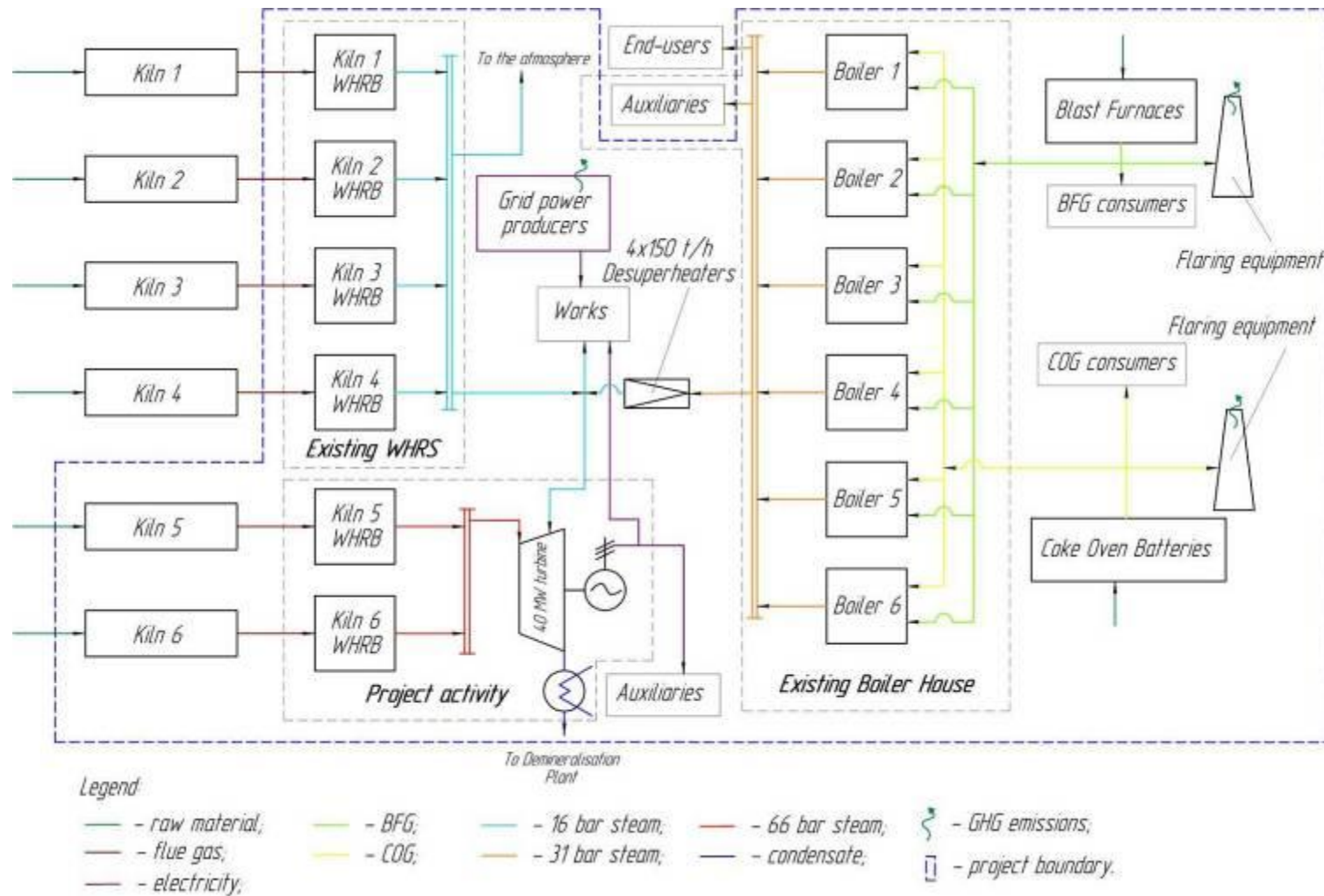


Fig. B.3-1: The project boundary

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

ACM0012 prescribes that the baseline scenario is identified as the most plausible baseline scenario among all realistic and credible alternatives.

Realistic and credible alternatives should be determined for:

- Waste energy use in the absence of the project activity;
- Power generation in the absence of the project activity;
- Heat generation in the absence of the project activity; and
- Mechanical energy generation in the absence of the project activity.

For the proposed project the realistic and credible alternatives should be determined for:

- Waste energy use in the absence of the project activity; and
- Power generation in the absence of the project activity.

Step 1: Define the most plausible baseline scenario for the generation of electricity using the following baseline options and combinations

The baseline candidates were considered for the following facilities:

- For the Waste Energy Generation Facilities (WEGFs) where the waste energy is generated; and
- For the recipient facility where the energy is consumed.

For the use of waste energy the realistic and credible alternatives may include:

- W1: WECM is directly vented to the atmosphere without incineration;
- W2: WECM is released to the atmosphere (for example after incineration) or waste heat is released (or vented) to the atmosphere or waste pressure energy is not utilized;
- W3: Waste energy is sold as an energy source;
- W4: Waste energy is used for meeting energy demand at the recipient facility;
- W5: A portion of the quantity or energy of WECM is recovered for generation of heat and/or electricity and/or mechanical energy, while the rest of the waste energy produced at the project facility is flared/released to atmosphere/unutilized; and
- W6: All the waste energy produced at the facility is captured and used for export electricity generation or steam.

For power generation the realistic and credible alternatives may include:

- P1: Proposed project activity not undertaken as a CDM project activity;
- P2: On-site or off-site existing fossil fuel fired cogeneration plant;
- P3: On-site or off-site Greenfield fossil fuel fired cogeneration plant;
- P4: On-site or off-site existing renewable energy based cogeneration plant;



- P5: On-site or off-site Greenfield renewable energy based cogeneration plant;
- P6: On-site or off-site existing fossil fuel based identified captive power plant;
- P7: On-site or off-site existing identified renewable energy or other waste energy based captive power plant;
- P8: On-site or off-site Greenfield fossil fuel based captive plant;
- P9: On-site or off-site Greenfield renewable energy or other waste energy based captive plant;
- P10: Sourced from grid-connected power plants;
- P11: Existing captive electricity generation using waste energy (if the project activity is captive generation using waste energy, this scenario represents captive generation with lower efficiency or lower recovery than the project activity); and
- P12: Existing cogeneration using waste energy, but at a lower efficiency or lower recovery.

Let us further consider these alternatives in the project context.

The baseline candidates for the WEGF 1 (the new DR Kilns 5 and 6)

WECM 1 is the flue gas from the new DR Kilns 5 and 6.

Alternative W1.1: WECM 1 is directly vented to the atmosphere without incineration

This alternative is identical to the *Alternative W1.2*, therefore see justification for *Alternative W1.2*.

Alternative W1.2: WECM 1 is released to the atmosphere

This alternative is in compliance with RSA's legislation and much less expensive compared with the project activity. *Alternative W1.2 is quite realistic and can be considered as the most likely baseline scenario for WEGF 1.*

International experts in the field of direct reduction rotary kilns were invited to submit designs for the *Alternative W1.2*. The following options were proposed:

Alternative W1.2.1: Kiln – ABC – Venturi – Stack;

Alternative W1.2.2: Kiln – ABC – Quench – ESP – Stack;

Alternative W1.2.3: Modified Kiln – Venturi – Stack; and

Alternative W1.2.4: Modified Kiln – Quench – ESP – Stack.

Alternative W1.2.1: Kiln – ABC – Venturi – Stack

Fig. B.4-1 shows the principal components of the *Alternative W1.2.1* as well as the gas flows.

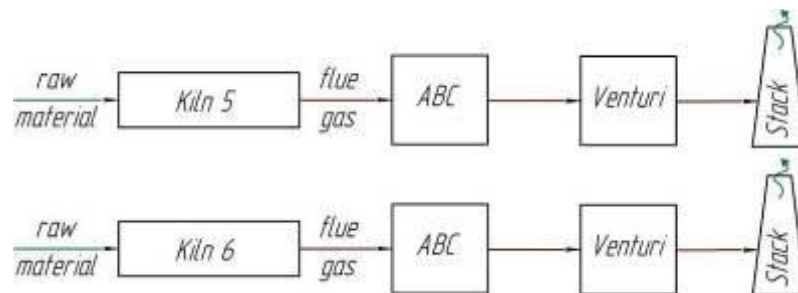


Fig. B.4-1: The principal components of the Alternative W1.2.1

The flue gas from the DR Kilns 5 and 6 is fed into the After Burning Chambers (ABCs). The function of the ABC is to burn combustible gasses, such as carbon monoxide and methane, and some carbon particles. After the ABC the flue gas is transferred to the Venturi which is designed to remove remaining heat load, as well as dusts and some gaseous pollutants. The flue gas leaving the Venturi has temperature of about 80 °C.

This option envisages generation of neither steam nor electricity.

Alternative W1.2.2: Kiln – ABC – Quench – ESP – Stack

Fig. B.4-2 shows the principal components of the *Alternative W1.2.2* as well as the gas flows.

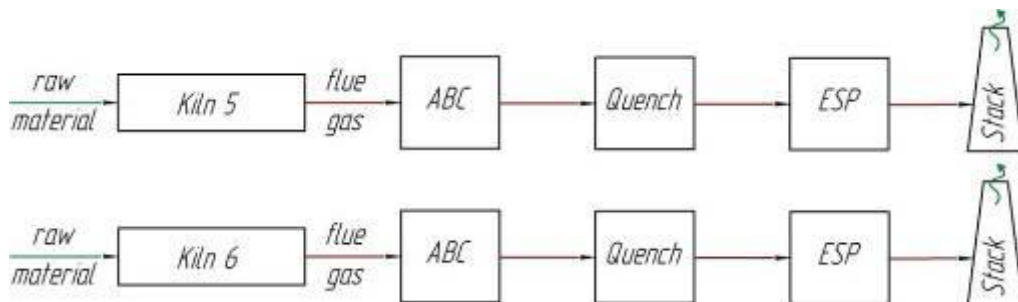


Fig. B.4-2: The principal components of the Alternative W1.2.2

The flue gas from the DR Kilns 5 and 6 is fed into the ABCs. The function of the ABC is to burn combustible gasses, such as carbon monoxide and methane, and some carbon particles. After the ABC the flue gas is transferred to the Quench which is designed to remove remaining heat load prior to the Electrostatic Precipitator (ESP). The flue gas leaving the Quench has temperature of about 230 °C. The ESP removes dust which is captured as dry material.

This option envisages generation of neither steam nor electricity.

Alternative W1.2.3: Modified Kiln – Venturi – Stack

Fig. B.4-3 shows the principal components of the *Alternative W1.2.3* as well as the gas flows.

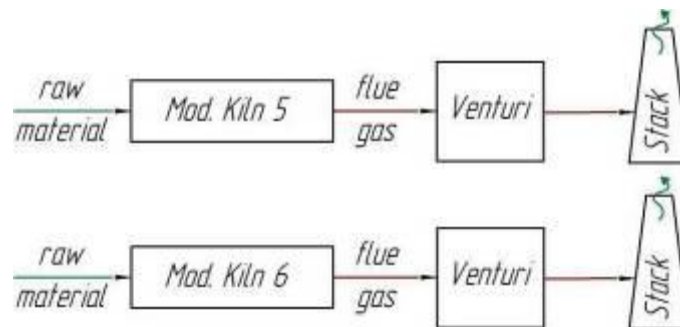


Fig. B.4-3: The principal components of the Alternative W1.2.3

This scheme envisages using of modified kilns that does not require the installation of ABCs. After the modified kiln the flue gas is transferred to the Venturi which is designed to remove remaining heat load, as well as dusts and some gaseous pollutants. The flue gas leaving the Venturi has temperature of about 75 °C.

This option provides the lower coal consumption and envisages generation of neither steam nor electricity.

Alternative W1.2.4: Modified Kiln – Quench – ESP – Stack

Fig. B.4-4 shows the principal components of the *Alternative W1.2.4* as well as the gas flows.

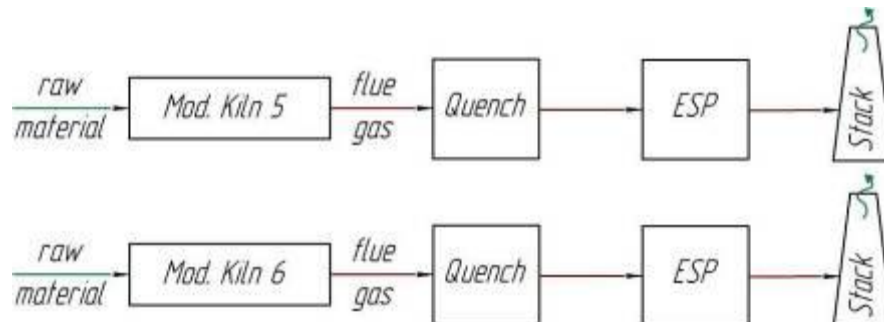


Fig. B.4-4: The principal components of the Alternative W1.2.4

This scheme envisages using of modified kilns that does not require the installation of ABCs. After the modified kiln the flue gas is transferred to the Quench which is designed to remove remaining heat load prior to the ESP. The flue gas leaving the Quench has temperature of about 230 °C. ESP removes dust which is captured as dry material.

This option provides the lower coal consumption and envisages generation of neither steam nor electricity.

Alternative W1.3: Waste energy is sold as an energy source

It is not possible to sell the flue gas from the DR Kilns 5 and 6 as an energy source since it has very low calorific value. Also there is no industrial facility in the vicinity of the project site which may use waste heat of the flue gas. *Thus, Alternative W1.3 is excluded from further consideration.*



Alternative W1.4: Waste energy is used for meeting energy demand at the recipient facility

This alternative is not a credible option for meeting heat demand since there is no thermal energy requirement within the recipient facility. A lot of excess low-pressure steam had been vented to the atmosphere before the project implementation.

As of using waste energy for meeting electricity demand the following two options are considered:

Alternative W1.4.1: Waste energy of the WECM 1 is used together with waste energy of other WECMs considered for meeting electricity demand at the recipient facility (proposed project activity not undertaken as a CDM project activity); and

Alternative W1.4.2: Only waste energy of the WECM 1 is used for meeting electricity demand at the recipient facility. Other WECMs considered are released or vented to the atmosphere.

Alternative W1.4.1: Waste energy of the WECM 1 is used together with waste energy of other WECMs considered for meeting electricity demand at the recipient facility (proposed project activity not undertaken as a CDM project activity)

This alternative is in compliance with all applicable legal and regulatory requirements therefore can be considered as a credible baseline candidate. *Alternative W1.4.1 is carried to the Step 2.*

Alternative W1.4.2: Only waste energy of the WECM 1 is used for meeting electricity demand at the recipient facility. Other WECMs considered are released or vented to the atmosphere

This alternative is identical to the *Alternatives W1.5.1, W1.5.2 and W1.5.3*, therefore see justification for those alternatives.

Alternative W1.5: A portion of the quantity or energy of WECM 1 is recovered for generation of heat and/or electricity and/or mechanical energy, while the rest of the waste energy produced at the project facility is flared/released to atmosphere/unutilized

The option of using of a portion of waste heat of the flue gas for generation of heat energy is not a realistic scenario due to the reason that the recipient facility had the overflow of heat energy from the existing WHRS. A lot of excess low-pressure steam had been vented to the atmosphere before the project implementation.

Generation of mechanical energy from waste heat of the flue gas is not a feasible option.

Considering the fact that there is no flue gas to electricity projects in the region due to their low financial viability (see Investment analysis below), the *Alternative W1.5* is not deemed to be a plausible baseline scenario for WEGF 1. However, according to ACM0012 *Alternative W1.5* cannot be excluded from further consideration at this step, since the new DR Kilns 5 and 6 are determined as Greenfield facility.

International experts in the field of direct reduction rotary kilns were invited to submit designs for the *Alternative W1.5*. The following options were proposed:

Alternative W1.5.1: Power generation under normal kiln operation;

Alternative W1.5.2: Power generation using CO/CH₄ heat;

Alternative W1.5.3: Power generation under the lower coal consumption; and

Alternative W1.5.4: Power generation using CO/CH₄ heat and under the lower coal consumption.

Alternative W1.5.1: Power generation under normal kiln operation

Fig. B.4-5 shows the principal components of the *Alternative W1.5.1* as well as the gas flows.

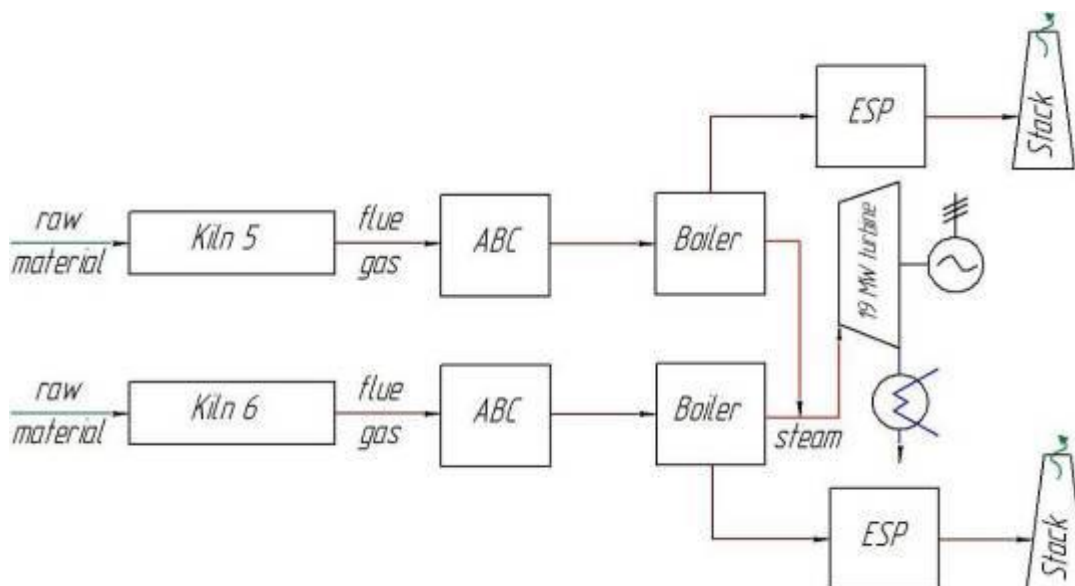


Fig. B.4-5: The principal components of the Alternative W1.5.1

The flue gas from the DR Kilns 5 and 6 is fed into the ABCs. The function of the ABC is to burn combustible gasses, such as carbon monoxide and methane, and some carbon particles, at that chemical energy of the CO/CH₄ containing in the flue gas is particularly wasted during this process. After the ABC the flue gas is transferred into the steam boilers to generate high-pressure steam which then is transferred to the steam turbine with net power capacity of 19 MW. The steam boilers have the same design as in the proposed project.

Alternative W1.5.2: Power generation using CO/CH₄ heat

Fig. B.4-6 shows the principal components of the *Alternative W1.5.2* as well as the gas flows.

The flue gas from the DR Kilns 5 and 6 is fed into the steam boilers to generate high-pressure steam which then is transferred to the steam turbine with net power capacity of 28 MW. The steam boilers have special design in order to use the chemical energy of the CO/CH₄ containing in the flue gas to generate steam¹³.

¹³ Using of the ABC in the proposed project does not allow doing it.

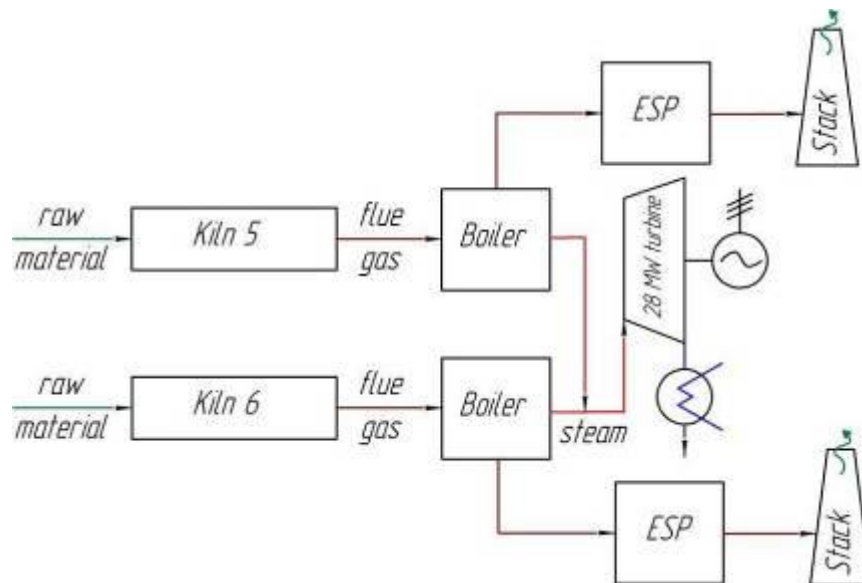


Fig. B.4-6: The principal components of the Alternative W1.5.2

Alternative W1.5.3: Power generation under the lower coal consumption

Fig. B.4-7 shows the principal components of the *Alternative W1.5.3* as well as the gas flows.

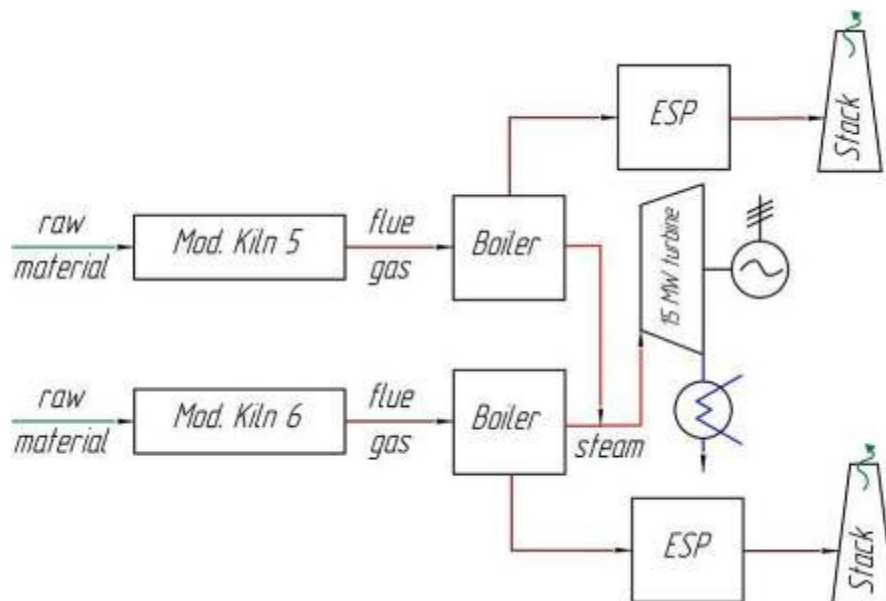


Fig. B.4-7: The principal components of the Alternative W1.5.3

This scheme envisages using of modified kilns. After the modified kilns the flue gas is fed into the steam boilers to generate high-pressure steam which then is transferred to the steam turbine with net power capacity of 15 MW.

Using of the modified kilns provide the lower coal consumption compared with the original kilns and therefore lower quantity of waste energy are available for power generation. Chemical energy of the CO/CH₄ containing in the flue gas is used for warming of the raw material.

Alternative W1.5.4: Power generation using CO/CH₄ heat and under the lower coal consumption

Fig. B.4-8 shows the principal components of the *Alternative W1.5.4* as well as the gas flows.

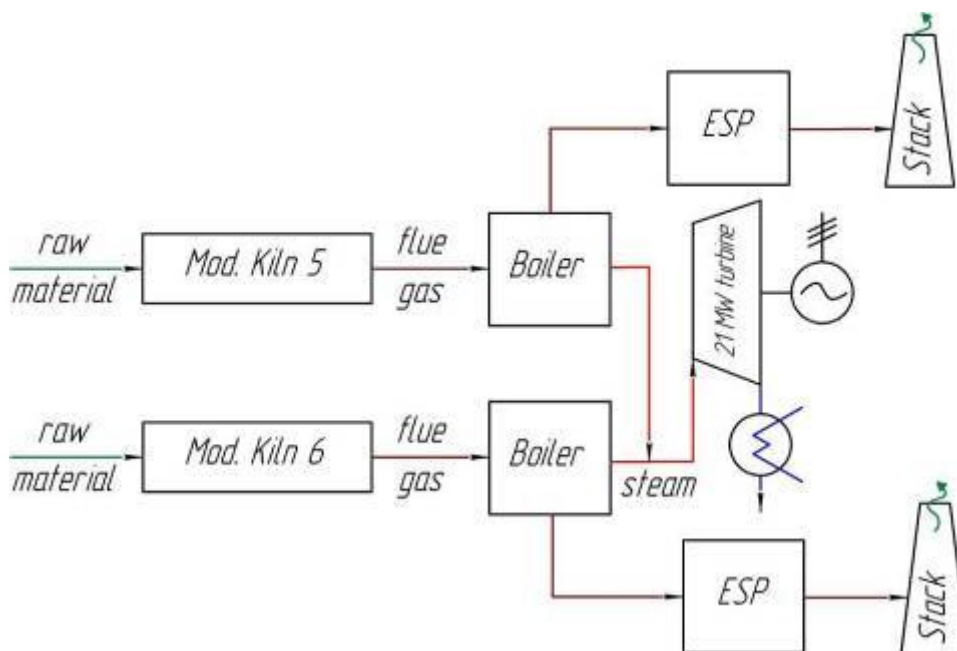


Fig. B.4-8: The principal components of the Alternative W1.5.4

This scheme envisages using of modified kilns. After the modified kilns the flue gas is fed into the steam boilers to generate high-pressure steam which then is transferred to the steam turbine with net power capacity of 21 MW. The steam boilers have special design in order to use the chemical energy of the CO/CH₄ containing in the flue gas to generate steam.

Using of the modified kilns provide the lower coal consumption compared with the original kilns and therefore lower quantity of waste energy are available for power generation.

Alternative W1.6: All the waste energy produced at the facility is captured and used for export electricity generation or steam

This alternative is not a possible scenario since AMSA is imported substantial amount of electricity from the RSA's grid, which means that the company would rather satisfy its own electricity demand than export power.

There is no industrial facility in the vicinity of the project site which has steam requirement. A lot of excess low-pressure steam had being vented to the atmosphere before the project implementation.

Alternative W1.6 is excluded from further consideration.

**The baseline candidates for the WEGF 2 (the existing WHRS of the DR Kilns 1-4)**

WECM 2 is the excess low-pressure steam from the existing WHRS of the DR Kilns 1-4.

Alternative W2.1: WECM 2 is directly vented to the atmosphere without incineration

This alternative is identical to *Alternative W2.2*, therefore see justification for *Alternative W2.2*.

Alternative W2.2: WECM 2 is vented to the atmosphere

This alternative is in compliance with RSA's legislation and envisages the continuation of the situation which had existed before the project implementation. *Alternative W2.2 is quite realistic and can be considered as the most likely baseline scenario for WEGF 2.*

Alternative W2.3: Waste energy is sold as an energy source

It is not possible to sell the excess steam from the DR Kilns 1-4 as an energy source since the steam flow rate is very unstable. Also there is no industrial facility in the vicinity of the project site which has steam requirement. *Thus, Alternative W2.3 is excluded from further consideration.*

Alternative W2.4: Waste energy is used for meeting energy demand at the recipient facility

This alternative is not a credible option for meeting heat demand since there is no thermal energy requirement within the recipient facility. A lot of excess low-pressure steam had been vented to the atmosphere before the project implementation.

As of using waste energy for meeting electricity demand the following two options are considered:

Alternative W2.4.1: Waste energy of the WECM 2 is used together with waste energy of other WECMs considered for meeting electricity demand at the recipient facility (proposed project activity not undertaken as a CDM project activity); and

Alternative W2.4.2: Only waste energy of the WECM 2 is used for meeting electricity demand at the recipient facility. Other WECMs considered are released or vented to the atmosphere.

Alternative W2.4.1: Waste energy of the WECM 2 is used together with waste energy of other WECMs considered for meeting electricity demand at the recipient facility (proposed project activity not undertaken as a CDM project activity)

This alternative is in compliance with all applicable legal and regulatory requirements therefore can be considered as a credible baseline candidate. *Alternative W2.4.1 is carried to the Step 2.*

Alternative W2.4.2: Only waste energy of the WECM 2 is used for meeting electricity demand at the recipient facility. Other WECMs considered are released or vented to the atmosphere

Generation of electricity from the excess steam is not a reasonable option since the steam flow rate is very unstable. *Thus, Alternative W2.4.2 is excluded from further consideration.*

Alternative W2.5: A portion of the quantity or energy of WECM 2 is recovered for generation of heat and/or electricity and/or mechanical energy, while the rest of the waste energy produced at the project facility is flared/released to atmosphere/unutilized

Generation of heat energy from the excess steam is not a credible option.

Generation of mechanical energy from the excess steam is not a feasible option.



Generation of electricity from the excess steam is not a reasonable option since the steam flow rate is very unstable.

Alternative W2.5 is excluded from further consideration.

Alternative W2.6: All the waste energy produced at the facility is captured and used for export electricity generation or steam

This alternative is not a possible scenario since AMSA is imported substantial amount of electricity from the RSA's grid, which means that the company would rather satisfy its own electricity demand than export power.

There is no industrial facility in the vicinity of the project site which has steam requirement. A lot of excess low-pressure steam had being vented to the atmosphere before the project implementation.

Alternative W2.6 is excluded from further consideration.

The baseline candidates for the WEGF 3 (the existing blast furnaces)

WECM 3 is excess BFG from the existing blast furnaces.

Alternative W3.1: WECM 3 is directly vented to the atmosphere without incineration

This alternative is not a credible scenario due to environmental reasons. *Alternative W3.1 is excluded from further consideration.*

Alternative W3.2: WECM 3 is released to the atmosphere after incineration

This alternative is in compliance with RSA's legislation and envisages the continuation of the situation which had existed before the project implementation. *Alternative W3.2 is quite realistic and can be considered as the most likely baseline scenario for WEGF 3.*

Alternative W3.3: Waste energy is sold as an energy source

There is no industrial facility in the vicinity of the project site which may use excess BFG as an energy source. Moreover the BFG flow rate is unstable. A lot of BFG had being flared before the project implementation. *Thus, Alternative W3.3 is excluded from further consideration.*

Alternative W3.4: Waste energy is used for meeting energy demand at the recipient facility

This alternative is not a credible option for meeting heat demand since there is no thermal energy requirement within the recipient facility. A lot of excess low-pressure steam had being vented to the atmosphere before the project implementation.

As of using waste energy for meeting electricity demand the following two options are considered:

Alternative W3.4.1: Waste energy of the WECM 3 is used together with waste energy of other WECMs considered for meeting electricity demand at the recipient facility (proposed project activity not undertaken as a CDM project activity); and

Alternative W3.4.2: Only waste energy of the WECM 3 is used for meeting electricity demand at the recipient facility. Other WECMs considered are released or vented to the atmosphere.

Alternative W3.4.1: Waste energy of the WECM 3 is used together with waste energy of other WECMs considered for meeting electricity demand at the recipient facility (proposed project activity not undertaken as a CDM project activity)



This alternative is in compliance with all applicable legal and regulatory requirements therefore can be considered as a credible baseline candidate. *Alternative W3.4.1 is carried to the Step 2.*

Alternative W3.4.2: Only waste energy of the WECM 3 is used for meeting electricity demand at the recipient facility. Other WECMs considered are released or vented to the atmosphere

Generation of electricity from the excess BFG is not a reasonable option due to the low net caloric value as well as unstable flow rate of BFG.

In addition, it should be noted that power generation is not the core business of AMSA. The investments into modernization and expansion of the company's own production capacities can yield much more profit for the company taking into account low Eskom electricity price.

Thus, Alternative W3.4.2 is excluded from further consideration.

Alternative W3.5: A portion of the quantity or energy of WECM 3 is recovered for generation of heat and/or electricity and/or mechanical energy, while the rest of the waste energy produced at the project facility is flared/released to atmosphere/unutilized

The option of using of a portion of excess BFG for generation of heat energy is not a realistic scenario due to the reason that the recipient facility had the overflow of heat energy from the existing WHRS. A lot of excess low-pressure steam had being vented to the atmosphere before the project implementation.

Generation of mechanical energy from excess BFG is not a feasible option.

Generation of electricity from the excess BFG is not a reasonable option due to the low net caloric value as well as unstable flow rate of BFG.

In addition, it should be noted that power generation is not the core business of AMSA. The investments into modernization and expansion of the company's own production capacities can yield much more profit for the company taking into account low Eskom electricity price.

Thus, Alternative W3.5 is excluded from further consideration.

Alternative W3.6: All the waste energy produced at the facility is captured and used for export electricity generation or steam

This alternative is not a possible scenario since AMSA is imported substantial amount of electricity from the RSA's grid, which means that the company would rather satisfy its own electricity demand than export power.

There is no industrial facility in the vicinity of the project site which has steam requirement. A lot of excess low-pressure steam had being vented to the atmosphere before the project implementation.

Alternative W3.6 is excluded from further consideration.

The baseline candidates for the WEGF 4 (the existing coke oven batteries)

WECM 4 is excess COG from the existing coke oven batteries.

Alternative W4.1: WECM 4 is directly vented to the atmosphere without incineration

This alternative is not a credible scenario due to environmental reasons. *Alternative W4.1 is excluded from further consideration.*

Alternative W4.2: WECM 4 is released to the atmosphere after incineration



This alternative is in compliance with RSA's legislation and envisages the continuation of the situation which had existed before the project implementation. *Alternative W4.2 is quite realistic and can be considered as the most likely baseline scenario for WEGF 4.*

Alternative W4.3: Waste energy is sold as an energy source

There is no industrial facility in the vicinity of the project site which may use excess COG as an energy source. Moreover the COG flow rate is unstable. A lot of COG had being flared before the project implementation. *Thus, Alternative W4.3 is excluded from further consideration.*

Alternative W4.4: Waste energy is used for meeting energy demand at the recipient facility

This alternative is not a credible option for meeting heat demand since there is no thermal energy requirement within the recipient facility. A lot of excess low-pressure steam had being vented to the atmosphere before the project implementation.

As of using waste energy for meeting electricity demand the following two options are considered:

Alternative W4.4.1: Waste energy of the WECM 4 is used together with waste energy of other WECMs considered for meeting electricity demand at the recipient facility (proposed project activity not undertaken as a CDM project activity); and

Alternative W4.4.2: Only waste energy of the WECM 4 is used for meeting electricity demand at the recipient facility. Other WECMs considered are released or vented to the atmosphere.

Alternative W4.4.1: Waste energy of the WECM 4 is used together with waste energy of other WECMs considered for meeting electricity demand at the recipient facility (proposed project activity not undertaken as a CDM project activity)

This alternative is in compliance with all applicable legal and regulatory requirements therefore can be considered as a credible baseline candidate. *Alternative W4.4.1 is carried to the Step 2.*

Alternative W4.4.2: Only waste energy of the WECM 4 is used for meeting electricity demand at the recipient facility. Other WECMs considered are released or vented to the atmosphere

Generation of electricity from the excess COG is not a reasonable option due to the unstable flow rate of COG.

In addition, it should be noted that power generation is not the core business of AMSA. The investments into modernization and expansion of the company's own production capacities can yield much more profit for the company taking into account low Eskom electricity price.

Thus, Alternative W4.4.2 is excluded from further consideration.

Alternative W4.5: A portion of the quantity or energy of WECM 4 is recovered for generation of heat and/or electricity and/or mechanical energy, while the rest of the waste energy produced at the project facility is flared/released to atmosphere/unutilized

The option of using of a portion of excess COG for generation of heat energy is not a realistic scenario due to the reason that the recipient facility had the overflow of heat energy from the existing WHRS. A lot of excess low-pressure steam had being vented to the atmosphere before the project implementation.

Generation of mechanical energy from excess COG is not a feasible option.



Generation of electricity from the excess COG is not a reasonable option due to the low net caloric value as well as unstable flow rate of COG.

In addition, it should be noted that power generation is not the core business of AMSA. The investments into modernization and expansion of the company's own production capacities can yield much more profit for the company taking into account low Eskom electricity price.

Thus, *Alternative W4.5 is excluded from further consideration.*

Alternative W4.6: All the waste energy produced at the facility is captured and used for export electricity generation or steam

This alternative is not a possible scenario since AMSA is imported substantial amount of electricity from the RSA's grid, which means that the company would rather satisfy its own electricity demand than export power.

There is no industrial facility in the vicinity of the project site which has steam requirement. A lot of excess low-pressure steam had being vented to the atmosphere before the project implementation.

Alternative W4.6 is excluded from further consideration.

The baseline candidates for the recipient facility (the VDBP works)

Alternative P1: Proposed project activity not undertaken as a CDM project activity

This alternative is in compliance with all applicable legal and regulatory requirements. Therefore, this scenario is at first sight a credible baseline candidate. *Alternative P1 is carried to the Step 2.*

Alternative P2: On-site or off-site existing fossil fuel fired cogeneration plant

The *Alternative P2* is not credible since there is existing fossil fuel fired cogeneration plant neither at VDBP site nor at its vicinity.

Alternative P2 is excluded from further consideration.

Alternative P3: On-site or off-site Greenfield fossil fuel fired cogeneration plant

It should be noted that the proposed project generates electricity only and does not have a heat supply component.

The *Alternative P3* is not credible since there is no heat requirement at the recipient facility. A lot of excess low-pressure steam had being vented before the project implementation.

Alternative P3 is excluded from further consideration.

Alternative P4: On-site or off-site existing renewable energy based cogeneration plant

The *Alternative P4* is not credible since there is existing renewable energy based cogeneration plant neither at VDBP site nor at its vicinity.

Alternative P4 is excluded from further consideration.

Alternative P5: On-site or off-site Greenfield renewable energy based cogeneration plant

It should be noted that the proposed project generates electricity only and does not have a heat supply component.



The *Alternative P5* is not credible since there is no heat requirement at the recipient facility. A lot of excess low-pressure steam had being vented before the project implementation.

Alternative P5 is excluded from further consideration.

Alternative P6: On-site or off-site existing fossil fuel based identified captive power plant

The *Alternative P6* is not credible since there is existing fossil fuel based captive power plant neither at VDBP site nor at its vicinity.

Alternative P6 is excluded from further consideration.

Alternative P7: On-site or off-site existing identified renewable energy or other waste energy based captive power plant

There is existing renewable energy based captive power plant neither at VDBP site nor at its vicinity. The existing waste gas based captive power plant is not deemed to be a plausible baseline scenario for power generation since it already operates at full capacity generating as much electricity as possible. Thereat a lot of electricity is supplied from RSA's grid at the moment. *Thus, Alternative P7 is excluded from further consideration.*

Alternative P8: On-site or off-site Greenfield fossil fuel based captive plant

This alternative is not credible since AMSA is not interested in construction of fossil fuel based captive plant. Power generation is not the core business of AMSA. The investments into modernization and expansion of the company's own production capacities can yield much more profit for the company. It also highly unlikely that other companies would be interested in construction of a fossil fuel based power plant off-site in order to sell electricity to AMSA taking into account low Eskom electricity price.

Alternative P8 is excluded from further consideration.

Alternative P9: On-site or off-site Greenfield renewable energy or other waste energy based captive plant

Neither renewable energy nor other waste energy resources are enough at VDBP site as well as at its vicinity that can provide the same quantity of electricity generated as the proposed project activity. Moreover renewable energy power plants are more expensive compared with fossil fuel based captive plants.

In addition, this alternative is not a comparable alternative to the proposed project since a renewable energy based or other waste energy based captive power plant cannot guarantee the same service with comparable quality as the proposed project activity.

Alternative P9 is excluded from further consideration.

Alternative P10: Sourced from grid-connected power plants

This alternative envisages the continuation of the prevailing practice at the VDBP Works. Therefore, *Alternative P10 is quite realistic and can be considered as the most likely baseline scenario for the recipient facility.*

Alternative P11: Existing captive electricity generation using waste energy (if the project activity is captive generation using waste energy, this scenario represents captive generation with lower efficiency or lower recovery than the project activity)



It is not rational to construct waste energy recovery system with lower efficiency. The technology used is well-proven internationally and efficiency levels are quite similar across the board. *Alternative P11 is not considered as a realistic baseline scenario.*

Alternative P12: Existing cogeneration using waste energy, but at a lower efficiency or lower recovery

The *Alternative P12* is not credible since there is no existing cogeneration plant at the project site, and construction of the new one does not make sense as there is no heat requirement there.

Alternative P12 is excluded from further consideration.

Outcome of Step 1

The following baseline candidates for the WEGF 1 (the new DR Kilns 5 and 6) are carried into Step 2:

Alternative W1.2.1: Kiln – ABC – Venturi – Stack;

Alternative W1.2.2: Kiln – ABC – Quench – ESP – Stack;

Alternative W1.2.3: Modified Kiln – Venturi – Stack;

Alternative W1.2.4: Modified Kiln – Quench – ESP – Stack;

Alternative W1.4.1: Waste energy of the WECM 1 is used together with waste energy of other WECMs considered for meeting electricity demand at the recipient facility (proposed project activity not undertaken as a CDM project activity);

Alternative W1.5.1: Power generation under normal kiln operation;

Alternative W1.5.2: Power generation using CO/CH₄ heat;

Alternative W1.5.3: Power generation under the lower coal consumption; and

Alternative W1.5.4: Power generation using CO/CH₄ heat and under the lower coal consumption.

The following baseline candidates for the WEGF 2 (the existing WHRS of the DR Kilns 1-4) are carried into Step 2:

Alternative W2.2: WECM 2 is vented to the atmosphere; and

Alternative W2.4.1: Waste energy of the WECM 2 is used together with waste energy of other WECMs considered for meeting electricity demand at the recipient facility (proposed project activity not undertaken as a CDM project activity).

The following baseline candidates for the WEGF 3 (the existing blast furnaces) are carried into Step 2:

Alternative W3.2: WECM 3 is released to the atmosphere after incineration; and

Alternative W3.4.1: Waste energy of the WECM 3 is used together with waste energy of other WECMs considered for meeting electricity demand at the recipient facility (proposed project activity not undertaken as a CDM project activity).

The following baseline candidates for the WEGF 4 (the existing coke oven batteries) are carried into Step 2:

Alternative W4.2: WECM 4 is released to the atmosphere after incineration; and



Alternative W4.4.1: Waste energy of the WECM 4 is used together with waste energy of other WECMs considered for meeting electricity demand at the recipient facility (proposed project activity not undertaken as a CDM project activity).

The following baseline candidates for the recipient facility (the VDBP works) are carried into Step 2:

Alternative P1: Proposed project activity not undertaken as a CDM project activity; and

Alternative P10: Sourced from grid-connected power plants.

Combinations of baseline candidates under different scenarios are presented in Table B.4-1.

Table B.4-1: Combinations of baseline candidates under different scenarios

Scenario	Combination of baseline candidates					Description
	WEGF 1	WEGF 2	WEGF 3	WEGF 4	Recipient facility	
1	W1.4.1	W2.4.1	W3.4.1	W4.4.1	P1	The proposed project activity not undertaken as a CDM project activity.
2	W1.2.1	W2.2	W3.2	W4.2	P10	All waste energy of the WECM streams remains unutilized (WECM streams are released or vented to the atmosphere). No power generation takes place.
3	W1.2.2					
4	W1.2.3					
5	W1.2.4					
6	W1.5.1	W2.2	W3.2	W4.2	P10	All waste energy of the excess WECM streams (low-pressure steam, BFG and COG) remains unutilized (WECM streams are released or vented to the atmosphere). Waste energy of the flue gas is used for power generation.
7	W1.5.2					
8	W1.5.3					
9	W1.5.4					

Step 2: Investment analysis

The Investment analysis is carried out using the latest version of the “Tool for the demonstration and assessment of additionality” (Version 05.2.1).

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

- The most economically or financially attractive; or
- Economically or financially feasible without the revenue from the sale of Certified Emission Reductions (CERs).

The project developer demonstrates that the proposed project activity is not the most economically or financially attractive using the following Sub-steps:

Sub-step 2a: Determine appropriate analysis method

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

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

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

**Sub-step 2a: Determine appropriate analysis method**

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

The investment comparison analysis (Option II) is chosen.

Sub-step 2b: Apply investment comparison analysis

Net Present Value (NPV) is used as the most suitable financial indicator.

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

Table B.4-2 shows the input data used to calculate NPV for scenarios identified in Step 1.

According to the appendix “Default values for the expected return on equity” to the “Guidelines on the assessment of investment analysis” (Version 05)¹⁴ the default value for the expected return on equity calculated after tax for manufacturing industries in RSA is 11.9%.

Since the proposed project was financed from the internal resources of AMSA only, the discount rate of 11.9% was chosen to calculate NPV, which is very conservative.

The maximum period of 20 years was chosen for the analysis.

According to the guide “Taxation in South Africa 2007/2008”¹⁵, page 92, the nominal income tax rate for the companies and close corporations between the 1st of April 2005 and 31st of March 2008 was 29%.

Eskom’s electricity tariff for VDBP Works in 2004-2006 was 0.153 ZAR/kWh excluding VAT.¹⁶

Table B.4-3 shows the summary of NPV calculation for scenarios identified in Step 1. Detailed information on NPV calculation is given in Annex 3-7.

¹⁴ http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf

¹⁵ <http://www.sars.gov.za/home.asp?pid=4150&tid=65&s=pubs&show=1283>

¹⁶ AMSA’s internal reports

Table B.4-2: Input data used to calculate NPV of the scenarios identified in Step 1¹⁷

#	Parameter	Unit	Value								
			1**	2	3	4	5	6	7	8	9
1	CAPEX (excluding VAT) incl.:	Million ZAR	246.61	120.00	99.59	106.00	98.40	191.61	231.42	205.88	234.69
2	Power plant*	Million ZAR	95.00	-	-	-	-	125.00	208.00	143.00	175.00
3	Waste heat recovery equipment:	Million ZAR	-	-	-	-	-	-	-	-	-
4	Boiler	Million ZAR	85.00	-	-	-	-	-	-	-	-
5	ABC	Million ZAR	40.00	40.00	40.00	-	-	40.00	-	-	-
6	ESP***	Million ZAR	26.61		34.59	-	31.40	26.61	23.42	22.88	19.69
7	Venturi	Million ZAR	-	80.00		66.00		-	-	-	-
8	Quench	Million ZAR	-	-	25.00	-	27.00	-	-	-	-
9	Modification of kilns	Million ZAR	-	-	-	40.00	40.00	-	-	40.00	40.00
10	Operating costs****	Million ZAR/a	22.50	11.80	1.40	11.90	5.40	22.50	32.75	20.30	27.25
11	Annual average net electricity generation capacity	MW	32.8	0	0	0	0	19	28	15	21
12	Annual average net electricity generation ¹⁸	MWh	262 098	0	0	0	0	166 440	245 280	131 400	183 960

*For Scenarios 6-9 the value includes the cost of WHRB

**See Section A.4

*** ESP Costs for Scenarios 3 and 5-9, were adjusted from initial values in accordance with ESP cost in Scenario 1

****Operation costs for Scenario 1 was assumed to be equal to operation costs for Scenario 6, which is conservative

¹⁷ EIA Discussion Presentation 3, R. Paxton & Assoc Ltd, 5th May 2005

¹⁸ #12 = #11 * 8 760, except Scenario 1; see Section A.4.3

Table B.4-3: Summary of NPV calculation, million ZAR

Situation	Value
1	-125.80
2	-169.89
3	-96.21
4	-157.95
5	-116.49
6	-154.90
7	-180.70
8	-184.49
9	-204.33

Outcome of Sub-step 2c: The proposed project activity (Scenario 1) is not the most economically or financially attractive. NPV of the Scenario 3 is highest among the other scenarios, so Scenario 3 can be considered as the most appropriate baseline scenario.

Sub-step 2d: Sensitivity analysis

A sensitivity analysis is included to show that the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. The investment analysis provides a valid argument in favour of chosen baseline scenario as this sensitivity analysis consistently supports (for a realistic range of assumptions) the conclusion that NPV of the Scenario 3 is highest among the other scenarios.

According to the paragraph 20 of the “Guidelines on the assessment of investment analysis” (Version 05) only variables that constitute more than 20% of either total project costs or total project revenues should be included in the sensitivity analysis. In addition the sensitivity analysis should at least cover the range of +10% and -10%.

A range of +10% and -10% was applied.

The following variables were included in the sensitivity analysis:

- Investment cost;
- Operations and maintenance costs; and
- Income from electricity savings (which is affected by electricity tariff and quantity of net electricity generation supplied by the project activity).

The results of the sensitivity analysis of NPV for scenarios identified in Step 1 are shown in Tables B.4-4, B.4-5 and B.4-6.

Table B.4-4: Sensitivity analysis of NPV to variation of the investment cost

Variation	Scenario								
	1	2	3	4	5	6	7	8	9
+10	-147.77	-180.59	-105.08	-167.40	-125.26	-171.97	-201.32	-202.83	-225.24
+5	-136.79	-175.24	-100.65	-162.68	-120.88	-163.44	-191.01	-193.66	-214.79
0	-125.80	-169.89	-96.21	-157.95	-116.49	-154.90	-180.70	-184.49	-204.33
-5	-114.81	-164.55	-91.77	-153.23	-112.11	-146.37	-170.39	-175.32	-193.88
-10	-103.83	-159.20	-87.34	-148.51	-107.73	-137.83	-160.08	-166.15	-183.42

Table B.4-5: Sensitivity analysis of NPV to variation of the operations and maintenance costs

Variation	Scenario								
	1	2	3	4	5	6	7	8	9
+10	-137.81	-176.19	-96.96	-164.30	-119.38	-166.91	-198.17	-195.32	-218.87
+5	-131.80	-173.04	-96.58	-161.13	-117.93	-160.91	-189.44	-189.91	-211.60
0	-125.80	-169.89	-96.21	-157.95	-116.49	-154.90	-180.70	-184.49	-204.33
-5	-119.80	-166.75	-95.84	-154.78	-115.05	-148.90	-171.96	-179.07	-197.06
-10	-113.79	-163.60	-95.46	-151.60	-113.61	-142.89	-163.22	-173.66	-189.79

Table B.4-6: Sensitivity analysis of NPV to variation of the income from electricity savings

Variation	Scenario								
	1	2	3	4	5	6	7	8	9
+10	-104.40	-169.89	-96.21	-157.95	-116.49	-141.31	-160.67	-173.76	-189.31
+5	-115.10	-169.89	-96.21	-157.95	-116.49	-148.11	-170.68	-179.13	-196.82
0	-125.80	-169.89	-96.21	-157.95	-116.49	-154.90	-180.70	-184.49	-204.33
-5	-136.50	-169.89	-96.21	-157.95	-116.49	-161.70	-190.71	-189.85	-211.84
-10	-147.20	-169.89	-96.21	-157.95	-116.49	-168.49	-200.72	-195.22	-219.35

Outcome of Sub-step 2d: According to the sensitivity analysis results, the outcome of the above sub-step 2c is robust: the NPV of the Scenario 3 is highest among those.

Outcome of Section B.4: Scenario 3 is the most appropriate baseline scenario.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

The additionality of the project activity is demonstrated and assessed using the latest version of the “Tool for the demonstration and assessment of additionality” (Version 05.2.1). This tool provides for the following step-wise approach:

- Step 1: Identification of alternatives to the project activity consistent with current laws and regulations
- Step 2: Investment analysis (optional)
- Step 3: Barrier analysis (optional)
- Step 4: Common practice analysis



Since the starting date of the project activity is before the date of validation, the project participants should demonstrate that the CDM was seriously considered in the decision to implement the project activity.

Implementation timeline of the proposed CDM project activity

Table B.5-1 demonstrates that AMSA was aware of CDM prior to the project starting date as well as has been taken actions to achieve CDM registration.

Table B.5-1: Implementation timeline of the proposed CDM project activity

Date	Action
November 2004	Releasing of the first Background Information Document
January 2005	Environmental Resources Management Southern Africa (Pty) Ltd (ERM) were appointed by AMSA to undertake an Environmental Impact Assessment (EIA) (including a public participation process), for the construction and operation of two new rotary kilns.
7 December 2006	Record of Decision (RoD) was obtained and Environmental Authorization was granted for the project.
13 September 2006	The contract signed with CDM Africa Climate Solutions (Pty) Ltd to develop the project as a CDM project
21 December 2006	The Project Identification Note (PIN) prepared and submitted to the DNA for approval
02 January 2007	The Project approved by the DNA
14 March 2007 (the starting date)	The project approval by AMSA Board
03 September 2008	The draft PDD compiled by CDM Africa Climate Solutions (Pty) Ltd

Hence, AMSA was aware of CDM prior to the project starting date and undertook real actions to secure CDM registration.

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

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

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

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

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

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



- (a) The proposed project activity undertaken without being registered as a CDM project activity;
- (b) Other realistic and credible alternative scenario(s) to the proposed CDM project activity scenario that deliver outputs services (e.g., cement) or services (e.g. electricity, heat) with comparable quality, properties and application areas, taking into account, where relevant, examples of scenarios identified in the underlying methodology;
- (c) If applicable, continuation of the current situation (no project activity or other alternatives undertaken).

The alternatives to the project are analyzed in Section B.4 above.

Outcome of Sub-step 1a:

The following baseline candidates for the WEGF 1 (the new DR Kilns 5 and 6) are carried into Step 2:

- Alternative W1.2.5:* Kiln – ABC – Venturi – Stack;
- Alternative W1.2.6:* Kiln – ABC – Quench – ESP – Stack;
- Alternative W1.2.7:* Modified Kiln – Venturi – Stack;
- Alternative W1.2.8:* Modified Kiln – Quench – ESP – Stack;
- Alternative W1.4.1:* Waste energy of the WECM 1 is used together with waste energy of other WECMs considered for meeting electricity demand at the recipient facility (proposed project activity not undertaken as a CDM project activity);
- Alternative W1.5.5:* Power generation under normal kiln operation;
- Alternative W1.5.6:* Power generation using CO/CH₄ heat;
- Alternative W1.5.7:* Power generation under the lower coal consumption; and
- Alternative W1.5.8:* Power generation using CO/CH₄ heat and under the lower coal consumption.

The following baseline candidates for the WEGF 2 (the existing WHRS of the DR Kilns 1-4) are carried into investment analysis:

- Alternative W2.2:* WECM 2 is vented to the atmosphere; and
- Alternative W2.4.1:* Waste energy of the WECM 2 is used together with waste energy of other WECMs considered for meeting electricity demand at the recipient facility (proposed project activity not undertaken as a CDM project activity).

The following baseline candidates for the WEGF 3 (the existing blast furnaces) are carried into investment analysis:

- Alternative W3.2:* WECM 3 is released to the atmosphere after incineration; and
- Alternative W3.4.1:* Waste energy of the WECM 3 is used together with waste energy of other WECMs considered for meeting electricity demand at the recipient facility (proposed project activity not undertaken as a CDM project activity).

The following baseline candidates for the WEGF 4 (the existing coke oven batteries) are carried into investment analysis:

- Alternative W4.2:* WECM 4 is released to the atmosphere after incineration; and

Alternative W4.4.1: Waste energy of the WECM 4 is used together with waste energy of other WECMs considered for meeting electricity demand at the recipient facility (proposed project activity not undertaken as a CDM project activity).

The following baseline candidates for the recipient facility (the VDBP works) are carried into investment analysis:

Alternative P1: Proposed project activity not undertaken as a CDM project activity; and

Alternative P10: Sourced from grid-connected power plants.

Combinations of baseline candidates under different situations are presented in Table B.5-1.

Table B.5-1: Combinations of baseline candidates under different scenarios

Scenario	Combination of baseline candidates					Description
	WEGF 1	WEGF 2	WEGF 3	WEGF 4	Recipient facility	
1	W1.4.1	W2.4.1	W3.4.1	W4.4.1	P1	The proposed project activity not undertaken as a CDM project activity.
2	W1.2.1	W2.2	W3.2	W4.2	P10	All waste energy of the WECM streams remains unutilized (WECM streams are released or vented to the atmosphere). No power generation takes place.
3	W1.2.2					
4	W1.2.3					
5	W1.2.4					
6	W1.5.1	W2.2	W3.2	W4.2	P10	All waste energy of the excess WECM streams (low-pressure steam, BFG and COG) remains unutilized (WECM streams are released or vented to the atmosphere). Waste energy of the flue gas is used for power generation.
7	W1.5.2					
8	W1.5.3					
9	W1.5.4					

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

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

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

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

Step 2: Investment analysis

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

- (c) The most economically or financially attractive; or
- (d) Economically or financially feasible without the revenue from the sale of certified emission reductions (CERs).

The project developer demonstrates that the proposed project activity is not the most economically or financially attractive via the investment comparison analysis. NPV is used as the most suitable financial indicator. The investment analysis is shown in Section B.4 above.



Outcome of Step 2: The proposed CDM project activity is not the most economically or financially attractive. NPV of the Scenario 3 is highest among the other scenarios.

Step 3: Barrier analysis

The Barrier analysis is not applied.

Step 4: Common practice analysis

The project developer demonstrates that the proposed project is the first-of-its-kind and thus is not a common practice based on the “Guidelines on additionality of first-of-its-kind project activity” (Version 01.0)¹⁹.

According to these guidelines a proposed project activity is the first-of-its-kind in the applicable geographical area if:

- The project is the first in the applicable geographical area that applies a technology that is different from any other technologies able to deliver the same output and that have started commercial operation in the applicable geographical area before the start date of the project
- Project participants selected a crediting period for the project activity that is “a maximum of 10 years with no option of renewal”.

AMSA is South Africa’s biggest steel producer. Other industry players include Scaw Metals Group, Columbus Stainless Steel, Evraz Highveld Steel and Vanadium Limited, Duferco Steel Processing (Pty) Ltd, Lenreco and some other²⁰. At the point of decision making in the RSA waste heat from DR Kilns were never used for power generation and waste gases were flared to the atmosphere for safety reasons.

The project participant selected a crediting period for the project activity that is a maximum of 10 years with no option of renewal.

Therefore, the proposed project activity is the first-of-its-kind and thus additional.

Outcome of the Step 4 and additionality test: A proposed project activity is the first-of-its-kind and thus additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Baseline emissions

The baseline emissions for the year y shall be determined as follows:

¹⁹ http://cdm.unfccc.int/filestorage/B/K/9/BK94VYNMGE72PCD8JFQ6UT3SWHZAXI/eb63_repan11.pdf?t=UUR8bHRkNjVvfDDC6_rjB2ANZfj6TRGXulhQ

²⁰ <http://www.southafrica.info/business/economy/sectors/manufacturing.htm>



$$BE_y = BE_{En,y} + BE_{flst,y} \quad (B.6-1)$$

Where:

- BE_y = The total baseline emissions during the year y (tCO₂)
- $BE_{En,y}$ = The baseline emissions from energy generated by the project activity during the year y (tCO₂)
- $BE_{flst,y}$ = Baseline emissions from fossil fuel combustion either directly for flaring of waste gas or for steam generation that would have been used for flaring the waste gas in the absence of the project activity (tCO₂)

Since combustion of fossil fuel both for flaring of waste gas and for steam generation that would have been used for flaring the waste gas does not take place in the baseline, $BE_{flst,y}$ is equal to zero.

The baseline emissions from energy generated by the project activity during the year y are calculated as follows:

$$BE_{En,y} = BE_{Elec,y} + BE_{Ther,y} \quad (B.6-2)$$

Where:

- $BE_{En,y}$ = The baseline emissions from energy generated by the project activity during the year y (tCO₂)
- $BE_{Elec,y}$ = Baseline emissions from electricity during the year y (tCO₂)
- $BE_{Ther,y}$ = Baseline emissions from thermal energy (due to heat generation by elemental processes) during the year y (tCO₂)

Baseline scenario represents the situation where the waste energy of WECM streams used in the project is released or vented to the atmosphere, the electricity is obtained from the grid. Since under the project the WECM streams are used for electricity generation only, $BE_{Ther,y}$ is equal to zero.

Thus, the total baseline emissions during the year y are calculated as follows:

$$BE_y = BE_{Elec,y} \quad (B.6-3)$$

Where:

- BE_y = The total baseline emissions during the year y (tCO₂)
- $BE_{Elec,y}$ = Baseline emissions from electricity during the year y (tCO₂)

Baseline emissions from electricity during the year y present the baseline emissions due to displacement of electricity during the year y which are calculated as follows:

$$BE_{Elec,y} = f_{cap} \times f_{wcm} \times \sum_j \sum_i (EG_{i,j,y} \times EF_{Elec,i,j,y}) \quad (B.6-4)$$

Where:

- $BE_{Elec,y}$ = Baseline emissions due to displacement of electricity during the year y (tCO₂)
- $EG_{i,j,y}$ = The quantity of electricity supplied to the recipient j by generator, which in the absence of the project activity would have been sourced from source i (the grid or an identified source) during the year y (MWh)
- $EF_{Elec,i,j,y}$ = The CO₂ emission factor for the electricity source i , displaced due to the project activity, during the year y (tCO₂/MWh)



- f_{wcm} = Fraction of total electricity generated by the project activity using waste energy
- f_{cap} = Factor that determines the energy that would have been produced in project year y using waste energy generated at a historical level, expressed as a fraction of the total energy produced using waste source in year y

According to ACM0012, since the project activity was partially implemented at the Greenfield facility (new DR Kilns 5 and 6), the quantity of waste heat of the flue gas from the DR Kilns 5 and 6 captured and utilised in the proposed WHRS has to be compared with the quantity of waste heat captured and utilised in a “reference waste energy generating facility” and the following adjustment to Formula (B.6-4) should be done:

$$EG_{i,j,y} = F_{j,y} \times EG_{PJ,y} \times f_{practice} \quad (B.6-5)$$

Where:

- $EG_{i,j,y}$ = The quantity of electricity supplied to the recipient j by generator, which in the absence of the project activity would have been sourced from source i (the grid or an identified source) during the year y (MWh)
- $EG_{PJ,y}$ = The total quantity of electricity generated from the identified WECM streams during the year y (MWh)
- $f_{practice}$ = The factor determined by the practice of “reference waste energy generating facility”, to be calculated using the guidelines given in Annex 1 to ACM0012
- $F_{j,y}$ = Fraction of total electricity generated by the project activity that is supplied to recipient j in year y

For Greenfield facilities f_{cap} is 1.

All electricity generated by the proposed project will be supplied to the identified recipient facility (the VDBP works), therefore $F_{j,y}$ is equal to 1.

Since the project activity envisages electricity generation based on several steam streams (see Fig. B.6-1), Formula (B.6-4) in the project context has the following view:

$$BE_{Elec,y} = (f_{cap} \times f_{wcm,16} \times EG_{PJ,16,y} + f_{practice} \times f_{wcm,66} \times EG_{PJ,66,y}) \times EF_{Elec,grid,RF,y} \quad (B.6-6)$$

Where:

- $BE_{Elec,y}$ = Baseline emissions due to displacement of electricity during the year y (tCO₂)
- $EG_{PJ,16,y}$ = The quantity of electricity generated from the WECMs 2-4 during the year y (MWh)
- $EG_{PJ,66,y}$ = The quantity of electricity generated from the WECM 1 during the year y (MWh)
- $EF_{Elec,grid,RF,y}$ = The CO₂ emission factor for the grid electricity, displaced due to the project activity, during the year y (tCO₂/MWh)
- $f_{wcm,16}$ = Fraction of total electricity generated by the project activity using waste energy of WECMs 2-4
- $f_{wcm,66}$ = Fraction of total electricity generated by the project activity using waste energy of WECM 1
- f_{cap} = Factor that determines the energy that would have been produced in project year y using waste energy generated at a historical level, expressed as a fraction of the total energy produced using waste source in year y

$f_{practice}$ = The factor determined by the practice of “reference waste energy generating facility”, to be calculated using the guidelines given in Annex 1 to ACM0012

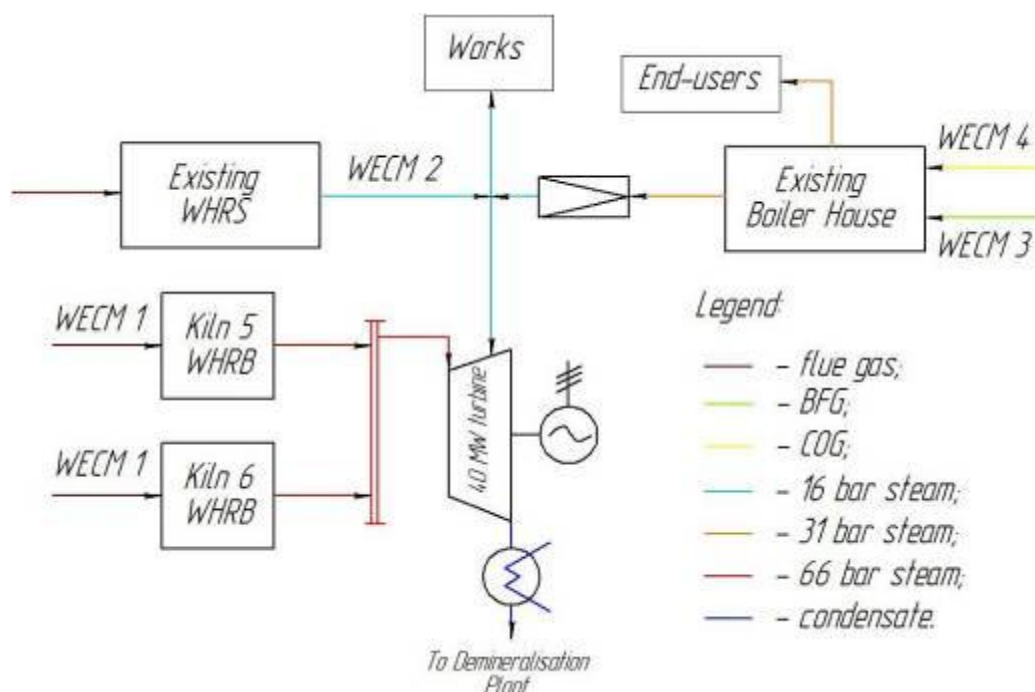


Fig. B.6-1: Waste energy recovering scheme

It should be noted that:

$$EG_{grid,RF,y} = EG_{PJ,16,y} + EG_{PJ,66,y} \tag{B.6-7}$$

Where:

- $EG_{grid,RF,y}$ = The quantity of electricity supplied to the recipient facility by generator, which in the absence of the project activity would have been sourced from the grid during the year y (MWh)
- $EG_{PJ,16,y}$ = The quantity of electricity generated from the WECMs 2-4 during the year y (MWh)
- $EG_{PJ,66,y}$ = The quantity of electricity generated from the WECM 1 during the year y (MWh)

Determination of $f_{practice}$

This factor is determined based on Annex 1 to ACM0012, which gives the following two options:

- Option 1:* Assessment of other existing facilities; and
- Option 2:* Assessment of alternative design of the project facility.

For the use of *Option 1*, it is necessary that at least five facilities are analysed to arrive at “reference facility” practice. Since there are no five facilities for the analysis, *Option 2* is used.



International experts in the field of direct reduction rotary kilns were invited to submit designs including the usage of WECM 1 that is recovered under project. Detailed description of the alternatives proposed is given in Section B.4. The following options are considered:

- Design 1:* Kiln – ABC – Venturi – Stack (see *Alternative W1.2.1* above);
- Design 2:* Kiln – ABC – Quench – ESP – Stack (see *Alternative W1.2.2* above);
- Design 3:* Modified Kiln – Venturi – Stack (see *Alternative W1.2.3* above);
- Design 4:* Modified Kiln – Quench – ESP – Stack (see *Alternative W1.2.4* above);
- Design 5:* Power generation under normal kiln operation (see *Alternative W1.5.1* above);
- Design 6:* Power generation using CO/CH₄ heat (see *Alternative W1.5.2* above);
- Design 7:* Power generation under the lower coal consumption (see *Alternative W1.5.3* above); and
- Design 8:* Power generation using CO/CH₄ heat and under the lower coal consumption (see *Alternative W1.5.4* above).

The Investment analysis carried out in Section B.4 shows that *Design 2* would have been the baseline scenario for the waste energy generated in the Greenfield facility. Thus, the “reference waste energy generating facility” would have wasted the energy of flue gas. $f_{practice}$ is equal to 1.

Determination of $EF_{Elec,grid,RF,y}$

Displaced electricity for the recipient facility is supplied from RSA’s grid. The CO₂ emission factor for the grid electricity, displaced due to the project activity, during the year y is determined using the “Tool to calculate the emission factor for an electricity system” (Version 02.2.0) as a combined margin CO₂ emission factor for grid connected power generation in year y :

$$EF_{Elec,grid,RF,y} = EF_{grid,CM,y} \quad (B.6-8)$$

Where:

- $EF_{Elec,grid,RF,y}$ = The CO₂ emission factor for the grid electricity, displaced due to the project activity, during the year y (tCO₂/MWh)
- $EF_{grid,CM,y}$ = Combined margin CO₂ emission factor for grid connected power generation in year y (tCO₂/MWh)

Combined margin CO₂ emission factor for grid connected power generation in year y ($EF_{grid,CM,y}$) is calculated using the following six steps:

- Step 1: Identify the relevant electricity systems;
- Step 2: Choose whether to include off-grid power plants in the project electricity system (optional);
- Step 3: Select a method to determine the operating margin (OM);
- Step 4: Calculate the operating margin emission factor according to the selected method;
- Step 5: Calculate the build margin (BM) emission factor; and
- Step 6: Calculate the combined margin (CM) emissions factor.



Step 1: Identify the relevant electricity systems

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

Electricity generated by the proposed project activity will displace the power production in the national grid of the RSA which is defined as a project electricity system by default.

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

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

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

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

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

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

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

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

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

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

- (a) Simple OM; or
- (b) Simple adjusted OM; or
- (c) Dispatch data analysis OM; or
- (d) Average OM.

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

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

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

**Table B.6-1: Electricity supplied to the national grid of the RSA, GWh²¹**

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

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

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

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

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

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

The simple OM emission factor is calculated as the generation-weighted average CO₂ emissions per unit net electricity generation (tCO₂/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

The simple OM may be calculated:

Option A: Based on the net electricity generation and a CO₂ emission factor of each power unit;
or

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

The *Option A* is used as data on the net electricity generation and a CO₂ emission factor of each Eskom's power plant is available. The OM emission factor is calculated as follows:

$$EF_{grid,OM} = EF_{grid,OMsimple} \quad (B.6-9)$$

Where:

$EF_{grid,OM}$ = Operating margin CO₂ emission factor calculated ex ante (tCO₂/MWh)

$EF_{grid,OMsimple}$ = Simple operating margin CO₂ emission factor calculated ex ante (tCO₂/MWh)

The simple operating margin CO₂ emission factor is calculated as follows:

²¹Eskom Annual Report 2010, page 1, http://www.eskom.co.za/annreport10/downloads/eskom_ar2010.pdf

$$EF_{grid,OMsimple} = \frac{\sum_{m,y} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m,y} EG_{m,y}} \quad (B.6-10)$$

Where:

- $EF_{grid,OMsimple}$ = Simple operating margin CO₂ emission factor calculated ex ante (tCO₂/MWh)
- $EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh). Data is presented in Annex 3-3
- $EF_{EL,m,y}$ = CO₂ emission factor of power unit m in year y (tCO₂/MWh)
- m = All power units serving the grid in year y except low-cost/must-run power units. The list of power plants included into the operating margin is presented in Annex 3-3
- y = The relevant year as per the data vintage chosen in Step 3

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

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

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

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}} \quad (B.6-11)$$

Where:

- $EF_{EL,m,y}$ = CO₂ emission factor of power unit m in year y (tCO₂/MWh)
- $FC_{i,m,y}$ = Amount of fossil fuel type i consumed by power unit m in year y (mass or volume unit). Data is presented in Annex 3-3
- $NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type i in year y (GJ/mass or volume unit). Constant value was adopted (see Section B.6.2 for details)
- $EF_{CO2,i,y}$ = CO₂ emission factor of fossil fuel type i in year y (tCO₂/GJ). Constant value was adopted (see Section B.6.2 for details)
- $EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh). Data is presented in Annex 3-3
- m = All power units serving the grid in year y except low-cost/must-run power units. The list of power plants included into the operating margin is presented in Annex 3-3
- i = All fossil fuel types combusted in power unit m in year y
- y = The relevant year as per the data vintage chosen in Step 3

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

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}} \quad (B.6-12)$$



Where:

$EF_{EL,m,y}$	=	CO ₂ emission factor of power unit m in year y (tCO ₂ /MWh)
$EF_{CO_2,m,i,y}$	=	Average CO ₂ emission factor of fuel type i used in power unit m in year y (tCO ₂ /GJ). Constant value was adopted (see Section B.6.2 for details)
$\eta_{m,y}$	=	Average net energy conversion efficiency of power unit m in year y (ratio). Constant value was adopted (see Section B.6.2 for details)
m	=	All power units serving the grid in year y except low-cost/must-run power units. Option A2 is only used for gas turbine power plants (see Annex 3-3)
i	=	All fossil fuel types combusted in power unit m in year y
y	=	The relevant year as per the data vintage chosen in Step 3

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

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

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

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

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

Option 1 was chosen.

The build margin calculation algorithm is presented in Fig. B.6-2. For simplification three levels of analysis were identified for the calculation of the BM:

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

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

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

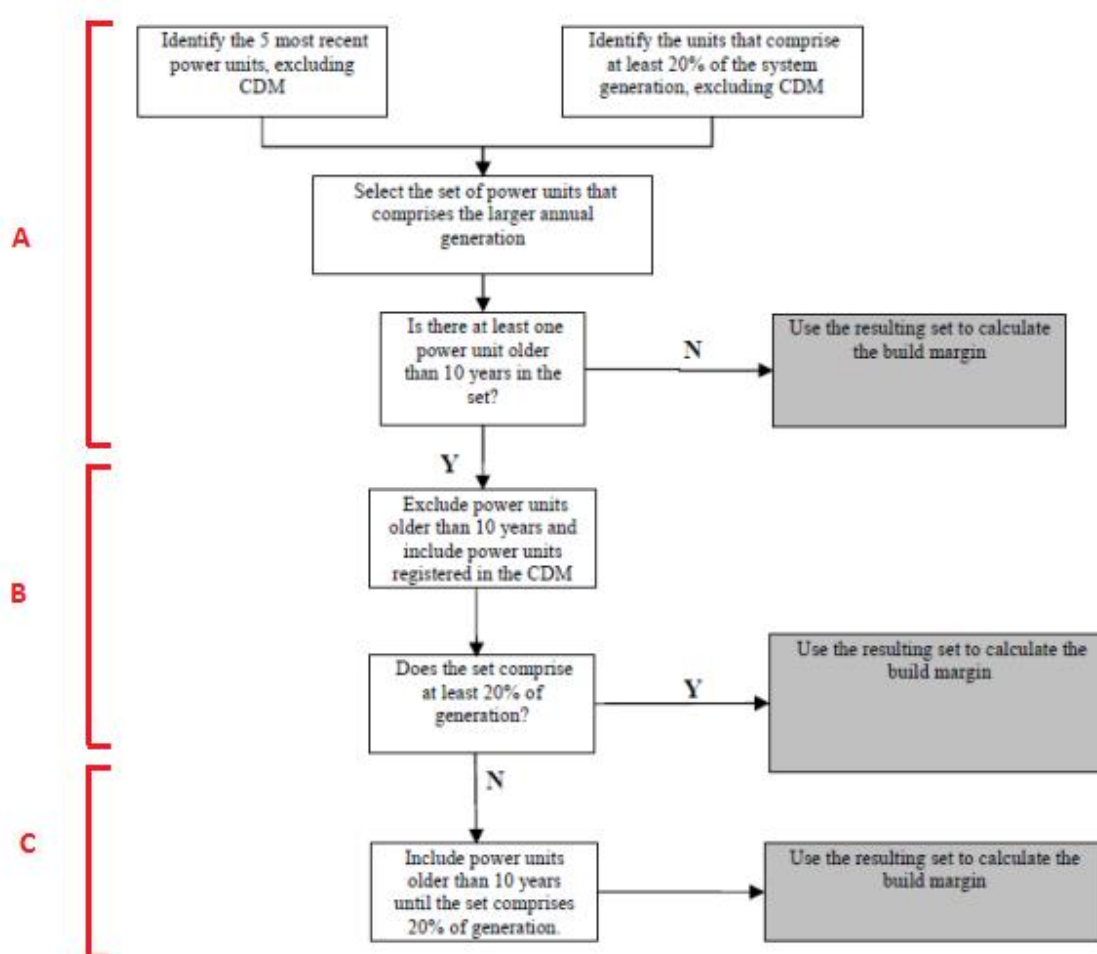


Fig. B.6-2: Build margin calculation algorithm

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

- (a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5-units}$) and determine their annual electricity generation ($AEG_{SET-5-units}$, in MWh);
- (b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total} , in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET \geq 20\%}$, in MWh);
- (c) From $SET_{5-units}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});



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

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

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

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

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

- (e) Include in the sample group $SET_{sample-CDM}$ the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation);
- (f) The sample group of power units n used to calculate the build margin is the resulting set ($SET_{sample-CDM->10yrs}$).

The power units in $SET_{sample-CDM->10yrs}$ was used to calculate the build margin. The list of power plants included into the build margin is presented in Annex 3-4.

The build margin emission factor is the generation-weighted average emission factor (tCO₂/MWh) of all power units n included into the build margin during the most recent year y (2010 reporting year) for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_n EG_{n,y} \times EF_{EL,n,y}}{\sum_n EG_{n,y}} \quad (B.6-13)$$

Where:

- $EF_{grid,BM,y}$ = Build margin CO₂ emission factor in year y (2010 reporting year) (tCO₂/MWh)
- $EG_{n,y}$ = Net quantity of electricity generated and delivered to the grid by power unit n in year y (MWh). Data is presented in Annex 3-4
- $EF_{EL,n,y}$ = CO₂ emission factor of power unit n in year y (tCO₂/MWh)
- n = Power units included in the build margin. The list of power plants included into the build margin is presented in Annex 3-4

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

The CO₂ emission factor of power unit n in year y ($EF_{EL,n,y}$) is calculated using Formulas (B.6-11) and (B.6-12).

According to the “Tool to calculate the emission factor for an electricity system” (Version 02.2.0) if the power units included in the build margin n correspond to the sample group $SET_{sample-CDM->10yrs}$, then, as a conservative approach, only *Option A2* from *Step 4* can be used to calculate $EF_{EL,n,y}$ and the default values provided in Annex 1 of the Tool shall be used to determine the parameter $\eta_{m,y}$. Therefore Formula (B.6-12) was used to calculate $EF_{EL,n,y}$ for Majuba and Kendal power plants.

The calculation of the build margin CO₂ emission factor is presented in Annex 3-5.

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

The combined margin emission factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,CM} = EF_{grid,OM} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad (B.6-14)$$

Where:

$EF_{grid,CM,y}$	=	Combined margin CO ₂ emission factor for grid connected power generation in year y (tCO ₂ /MWh)
$EF_{grid,CM}$	=	Combined margin CO ₂ emission factor for grid connected power generation calculated ex ante (tCO ₂ /MWh)
$EF_{grid,BM,y}$	=	Build margin CO ₂ emission factor in the most recent year y (2010 reporting year) (tCO ₂ /MWh)
$EF_{grid,OM}$	=	Operating margin CO ₂ emission factor (tCO ₂ /MWh)
w_{OM}	=	Weighting of operating margin emission factor
w_{BM}	=	Weighting of build margin emission factor

According to the “Tool to calculate the emission factor for an electricity system” (Version 02.2.0) the following default values should be used for the proposed project activities: $w_{OM} = 0.5$ and $w_{BM} = 0.5$.

The calculation of the combined margin CO₂ emission factor is presented in Annex 3-5.

Determination of $f_{wcm,16}$ and $f_{wcm,66}$

These fractions are equal to 1 since the electricity generation is purely from use of waste energy.

Determination of f_{cap}

For the existing facilities ACM0012 requires the baseline emissions to be capped irrespective of planned/unplanned or actual increase in output of plant, change in operational parameters and practices, change in fuel type and quantity resulting in an increase in generation of waste energy. The cap can be estimated using the three methods following this hierarchy:

- (i) Method 1 can be used to estimate the capping factor if required data is available;
- (ii) If the project activities implemented in a Greenfield facility, or in existing facilities where the required data is unavailable Method-2 shall be used;



- (iii) If the project proponents demonstrate technical infeasibility in direct monitoring of waste heat / pressure of waste energy carrying medium (WECM), then Method-3 is used.

Since it may neither be possible to measure the waste energy of WECMs used for electricity generation (Method-1 requirement), nor the specific amounts of WECM per unit of product (Method-2 requirement), Method 3 is used.

Since the energy is particularly recovered from WECMs and converted into final output energy through the existing Boiler House (Fig. B.6-1 above), f_{cap} should be the ratio of maximum energy that could be recovered (MER) by the waste heat recovery equipment implemented under the CDM project activity and the actual energy recovered under the project activity (using direct measurement) (*Case 1 in ACM0012*).

The following equation should be used to determine f_{cap} :

$$f_{cap} = \frac{Q_{OE,BL}}{Q_{OE,y}} \quad (\text{B.6-15})$$

Where:

- $Q_{OE,BL}$ = Maximum intermediate energy of 16 bar steam before the 40 MW turbine that could be recovered from the WECM streams, which would have been released in the absence of CDM project activity (TJ)
- $Q_{OE,y}$ = Quantity of actual intermediate energy generated during year y (TJ)

Project emissions

Project Emissions include emissions due to (1) combustion of auxiliary fuel to supplement waste gas/heat and (2) electricity emissions due to consumption of electricity for cleaning of gas before being used for generation of energy or other supplementary electricity consumption:

$$PE_y = PE_{AF,y} + PE_{EL,y} \quad (\text{B.6-16})$$

Where:

- PE_y = Project emissions due to the project activity (tCO₂)
- $PE_{AF,y}$ = Project activity emissions from on-site consumption of fossil fuels by the unit process if they are used as supplementary fuels due to non-availability of waste energy to the project activity or due to any other reason (tCO₂)
- $PE_{EL,y}$ = Project activity emissions from on-site consumption of electricity for gas cleaning equipment or from supplementary electricity consumption (tCO₂)

Since the calculation of the project emissions for the auxiliary fossil fuels is not required, $PE_{AF,y} = 0$.

$PE_{EL,y}$ is equal to the emissions from supplementary electricity consumption. This parameter is calculated by using “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (Version 01).

Project emissions from consumption of additional electricity by the project are determined as follows:

$$PE_{EL,y} = EC_{PJ,y} \times EF_{CO2,EL,y} \quad (\text{B.6-17})$$



Where:

- $PE_{EL,y}$ = Project emissions from supplementary electricity consumption (tCO₂)
- $EC_{PJ,y}$ = Additional electricity consumed in year y as a result of the implementation of the project activity (MWh)
- $EF_{CO_2,EL,y}$ = CO₂ emission factor for electricity generation in year y (tCO₂/MWh)

CO₂ emission factor for electricity generation in year y is determined as a combined margin CO₂ emission factor for grid connected power generation calculated ex ante ($EF_{grid,CM}$).

Leakage

No leakage is applicable under this methodology.

Emission reductions

Emission reductions due to the project activity during the year y are calculated as follows:

$$ER_y = BE_y - PE_y \quad (B.6-18)$$

Where:

- ER_y = Total emissions reductions during the year y (tCO₂)
- PE_y = Project emissions due to the project activity (tCO₂)
- BE_y = The total baseline emissions during the year y (tCO₂)

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

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

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



choice of data or description of measurement methods and procedures actually applied :	
Any comment:	The data for the three most recent reporting years is provided.

Data / Parameter:	$NCV_{coal,y}$
Data unit:	GJ/t
Description:	Net calorific value of Other Bituminous Coal
Source of data used:	2006 IPCC Guidelines for National GHG Inventories, volume 2: Energy, chapter 1, table 1.2
Value applied:	19.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	For the sake of a conservative approach the IPCC default value at the lower limit of the uncertainty at a 95% confidence interval is used.
Any comment:	This value was appointed as a constant.

Data / Parameter:	$EF_{CO_2,coal,y}$
Data unit:	tCO ₂ /GJ
Description:	CO ₂ emission factor of Other Bituminous Coal
Source of data used:	2006 IPCC Guidelines for National GHG Inventories, volume 2: Energy, chapter 1, table 1.4
Value applied:	0.0895
Justification of the choice of data or description of measurement methods and procedures actually applied :	For the sake of a conservative approach the IPCC default value at the lower limit of the uncertainty at a 95% confidence interval is used.
Any comment:	This value was appointed as a constant.

Data / Parameter:	$EF_{CO_2,NG,y}$
Data unit:	tCO ₂ /GJ
Description:	CO ₂ emission factor of Natural Gas
Source of data used:	2006 IPCC Guidelines for National GHG Inventories, volume 2: Energy, chapter 1, table 1.4
Value applied:	0.0543
Justification of the choice of data or description of measurement methods	For the sake of a conservative approach the IPCC default value at the lower limit of the uncertainty at a 95% confidence interval is used.



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

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

Data / Parameter:	$\eta_{m,y}$
Data unit:	ratio
Description:	Average net energy conversion efficiency of coal-fired power plant that has operated for more than 10 years
Source of data used:	Tool to calculate the emission factor for an electricity system, Annex 1
Value applied:	0.37
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value is used
Any comment:	This value was appointed as a constant.

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



Data / Parameter:	$FC_{i,n,y}$
Data unit:	mass or volume unit
Description:	Amount of fossil fuel type i consumed by power unit n in year y
Source of data used:	Eskom's statistic data
Value applied:	See Annex 3-4
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official statistics, publicly available and reliable data source
Any comment:	The data for 2010 reporting year is provided.

Data / Parameter:	$EF_{grid,CM}$
Data unit:	tCO ₂ /MWh
Description:	Combined margin CO ₂ emission factor for grid connected power generation calculated ex ante
Source of data used:	Calculated (see Annex 3)
Value applied:	0.965
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated ex ante based on the "Tool to calculate the emission factor for an electricity system" (Version 02.2.0)
Any comment:	This value was appointed as a constant for the whole crediting period.

Data / Parameter:	$Q_{OE,BL}$
Data unit:	TG
Description:	Maximum intermediate energy of 16 bar steam before the 40 MW turbine that could be recovered from the WECM streams, which would have been released in the absence of CDM project activity
Source of data used:	Calculated
Value applied:	4 730
Justification of the choice of data or description of measurement methods and procedures actually applied :	$(1\ 966\ 652 + 3\ 208\ 959) * 0.9 * 0.99 + 48\ 203 * 2.462 = 4\ 730\ 145\ \text{GJ}$ Where 1 966 652 is energy of the COG which would have been released (GJ) 3 208 959 is energy of the BFG which would have been released (GJ) 0.9 is reference efficiency of gas fired boilers 0.99 is reference efficiency of steam lines 48 203 is mass of 16 bar steam which would have been vented (t) 2.462 is specific energy of 16 bar steam (t/GJ) calculated as a difference between low pressure steam enthalpy (2.898 t/GJ) and boiler house feed water enthalpy (0.436 t/GJ)



Any comment:	This value was appointed as a constant for the whole crediting period.
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B.6.3. Ex-ante calculation of emission reductions:

According to the all data above, the baseline emissions for the year y shall be determined as follows:

$$ER_y = \left(\frac{Q_{OE,BL}}{Q_{OE,y}} \times EG_{PJ,16,y} + EG_{PJ,66,y} - EC_{PJ,y} \right) \times EF_{grid,CM} \quad (B.6-19)$$

Where:

- ER_y = Total emissions reductions during the year y (tCO₂)
- $Q_{OE,BL}$ = Maximum intermediate energy of 16 bar steam before the 40 MW turbine that could be recovered from the WECM streams, which would have been released in the absence of CDM project activity (TJ)
- $Q_{OE,y}$ = Quantity of actual intermediate energy generated during year y (TJ)
- $EG_{PJ,16,y}$ = The quantity of electricity generated from the WECMs 2-4 during the year y (MWh)
- $EG_{PJ,66,y}$ = The quantity of electricity generated from the WECM 1 during the year y (MWh)
- $EC_{PJ,y}$ = Additional electricity consumed in year y as a result of the implementation of the project activity (MWh)
- $EF_{grid,CM}$ = Combined margin CO₂ emission factor for grid connected power generation calculated ex ante (tCO₂/MWh)

It should be noted that:

$$EG_{grid,RF,y} = EG_{PJ,16,y} + EG_{PJ,66,y} \quad (B.6-20)$$

Where:

- $EG_{grid,RF,y}$ = The quantity of electricity supplied to the recipient facility by generator, which in the absence of the project activity would have been sourced from the grid during the year y (MWh)
- $EG_{PJ,16,y}$ = The quantity of electricity generated from the WECMs 2-4 during the year y (MWh)
- $EG_{PJ,66,y}$ = The quantity of electricity generated from the WECM 1 during the year y (MWh)

The calculation of the combined margin CO₂ emission factor is presented in Annex 3-5. A constant emission factor of 0.965 tCO₂/MWh was adopted for the whole crediting period.

Ration between ($Q_{OE,BL}$) and ($Q_{OE,y}$) is assumed to be equal to 1 for ex-ante calculation.

Expected annual net electricity generation ($EG_{grid,RF,y} - EC_{PJ,y}$) amounts to 262 098 MWh.

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

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

Year	Estimation of project activity emissions (tonnes of CO ₂ e)	Estimation of baseline emissions (tonnes of CO ₂ e)	Estimation of leakage (tonnes of CO ₂ e)	Estimation of overall emission reductions (tonnes of CO ₂ e)
2012 (from the 1 st of July to the 31 st of December)	0	126 462	0	126 462
2013	0	252 925	0	252 925
2014	0	252 925	0	252 925
2015	0	252 925	0	252 925
2016	0	252 925	0	252 925
2017	0	252 925	0	252 925
2018	0	252 925	0	252 925
2019	0	252 925	0	252 925
2020	0	252 925	0	252 925
2021	0	252 925	0	252 925
2022 (from the 1 st of January to the 30 th of June)	0	126 463	0	126 463
Total (tonnes of CO ₂ e)	0	2 529 250	0	2 529 250

B.7. Application of the monitoring methodology and description of the monitoring plan:**B.7.1 Data and parameters monitored:**

Data / Parameter:	$EG_{grid,RF,y}$
Data unit:	MWh
Description:	The quantity of electricity supplied to the recipient facility by generator, which in the absence of the project activity would have been sourced from the grid during the year y
Source of data to be used:	On-site measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable



Description of measurement methods and procedures to be applied:	Measurement by means of electricity meters installed. Data will be digitally archived on a regular basis.
QA/QC procedures to be applied:	The electricity meters will undergo maintenance/calibration to the industry standards.
Any comment:	Since the project facility is integrated into the recipient facility, supplied electricity will be measured once.

Data / Parameter:	$EC_{PJ,y}$
Data unit:	MWh
Description:	Additional electricity consumed in year y as a result of the implementation of the project activity
Source of data to be used:	On-site measurement and technical data of electricity consumers
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable
Description of measurement methods and procedures to be applied:	Calculated based on electricity capacity of the electricity consumers and hours of their operation. Data will be digitally archived on a regular basis.
QA/QC procedures to be applied:	Employed method is conservative.
Any comment:	Since the project facility is integrated into the recipient facility, it is not possible to measure the supplementary electricity consumption.

Data / Parameter:	$Q_{OE,y}$
Data unit:	TJ
Description:	Quantity of actual intermediate energy generated during year y
Source of data to be used:	On-site measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable
Description of measurement methods and procedures to be applied:	See Section B.7.2
QA/QC procedures to be applied:	The meters will undergo maintenance/calibration to the industry standards.



Any comment:	-
--------------	---

B.7.2. Description of the monitoring plan:

The monitoring plan is devised as per approved consolidated baseline and monitoring methodology ACM0012 “Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects” (Version 04.0.0). The following procedures shall be applied:

1. Monitoring period

The 10-year crediting period was chosen for the project. The monitoring period starts since the proposed project is registered by CDM Executive Board. At the end of each reporting year, monitored data shall be aggregated to a monitoring report.

2. Data monitored and sources

The quantity of electricity supplied to the recipient facility by generator, which in the absence of the project activity would have been sourced from the grid during the year y , shall be determined on the basis of electricity meters.

Additional electricity consumed in year y as a result of the implementation of the project activity shall be calculated on the basis of electricity capacity of the electricity consumers and hours of their operation.

Quantity of actual intermediate energy generated during year y shall be calculated using the following formula:

$$Q_{OE,y} = Q_{16,y} \times (H_{16,y} - H_{ref,y}) \quad (B.7-1)$$

Where:

- $Q_{OE,y}$ = Quantity of actual intermediate energy generated during year y (TJ)
- $Q_{16,y}$ = Total quantity of 16 bar steam sent to the 40MW steam turbine during year y , (tonne)
- $H_{16,y}$ = Average specific enthalpy of 16 bar steam sent to the 40MW steam turbine during year y , (TG/tonne)
- $H_{ref,y}$ = Reference specific enthalpy during year y , (TG/tonne)

Total quantity of 16 bar steam sent to the 40MW steam turbine during year y shall be determined on the basis of flow meters installed in the inlet pipeline of the turbine.²²

Average specific enthalpy of 16 bar steam sent to the 40MW steam turbine during year y shall be determined on the basis of temperature and pressure of low-pressure steam in the inlet pipeline of the turbine.

Reference specific enthalpy during year y shall be determined on the basis of temperature of the feed water before boilers of the Boiler House.

All data shall be digitally archived on a regular basis.

The sources of data for calculation of GHG emission reductions in the course of monitoring shall be the VDBP Works' internal reports.

²² See Fig. B.6-1 above



The emission reductions shall be calculated using the Formulas (B.6-19) and (B.6-20).

If $Q_{OE,y} > Q_{OE,BL}$, the project developer will have to calculate $EG_{PJ,16,y}$ and $EG_{PJ,66,y}$ based on energy balance.

To prove that the recovery of COG and BFG for other applications was not reduced due to the project implementation, the amount of COG and BFG consumed during year y shall be measured and compared with historical date (see Annex 3.6). If COG or BFG consumption were reduced, the project developer shall give an explanation why those have happened and that the reduction was not related to the project implementation.

3. The monitoring team

The power plant staff shall undergo necessary training related to operation and maintenance of all equipment installed.

The maintenance personnel of the power plant are responsible for daily control over the monitoring plan implementation.

The Chief Engineer of VDBP Works is responsible for timely calibration of all instrumentation in accordance with the manufacturer's requirements.

The management of AMSA is fully responsible for the project implementation and overall control as well as for collection of all data required for calculation of GHG emission reductions.

The GHG emission reductions shall be calculated by specialists of Blue World Carbon Asset Management (Pty) Ltd on the basis of data received from AMSA. Pattern table with data provided by AMSA is given in Annex 4.

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

Regularly, at least once a year, specialists of Blue World Carbon Asset Management (Pty) Ltd shall carry out "test verification" with a view to checking out the observance of the monitoring plan at VDBP Works.

4. Data storage

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

5. Instrumentation calibration

The instrumentation calibration and check-out shall be carried out by contracted specialized organizations licensed for this type of activity according to the requirement of a manufacturing company and to the schedule developed by AMSA.

6. Emergency situations

If any instrument that is used in the monitoring process fails, AMSA shall remedy the situation as soon as possible and if necessary shall replace the instrument. In case of breakdown of the turbines electricity generation will go down, and amount of electricity supplied by the project will be reduced. All accidents



that may occur at the power plant shall be recorded by AMSA. Information on major accidents shall be included in the monitoring report.

Waste energy that was released under abnormal operation of the steel plant shall not be accounted for.

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

Date of completion: 15/08/2011

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

Contact persons: Ilya Goryashin (i.goryashin@ccgs.ru), Aleksandra Kapustina (a.kapustina@ccgs.ru).

**SECTION C. Duration of the project activity / crediting period****C.1. Duration of the project activity:****C.1.1. Starting date of the project activity:**

According to the “Glossary of CDM terms” (Version 05)²³ the starting date of a CDM project activity is the earliest date at which either the implementation or construction or real action of a project activity begins.

The starting date of the proposed project activity is the 14th of March 2007 (project approval by AMSA Board).

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

25 years/300 months

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

C.2.1.2. Length of the first crediting period:

Not applicable

C.2.2. Fixed crediting period:**C.2.2.1. Starting date:**

01/01/2012 or the date of registration of the CDM project activity, whichever is later

C.2.2.2. Length:

10 years/120 months

²³ http://cdm.unfccc.int/Reference/Guidclarif/glos_CDM.pdf

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

The Environmental Resources Management Southern Africa (Pty) Ltd (ERM) was appointed by AMSA in January 2005 to undertake the Environmental Impact Assessment (EIA) (including a public participation process) for the proposed project.

The main aim of the EIA process was to determine the impacts on the receiving environment and human health associated with the expansion of the DR Plant. The production at the DR plant was proposed to increase from 700 000 tons per annum (tpa) to 1.05 million tpa, i.e. by 50%.

Based on the findings of all the credible specialists who undertook their respective specialist studies (based on the approved terms of references), it is concluded that the overall impact of that development is low.

The project implementation leads to mitigation of the negative environmental impact. Combustion of fossil fuels (mostly coal) at Eskom's power plants and hereby emissions of the harmful substances into the atmosphere, such as flue ash, oxides of sulphur and nitrogen were reduced due to the project implementation.

On 7 December 2006 the Record of Decision (RoD) was obtained and Environmental Authorisation was granted for the project.

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

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

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

The project owner appointed the Environmental Resources Management Southern Africa (Pty) Ltd (ERM) to undertake the Scoping and Environmental Impact Assessment (EIA) as well as the Public Participation Process (PPP) in terms of the National Environmental Management Act and the Environment Conservation Act for the proposed project activity. The activities undertaken to canvass public opinion regarding the proposed project activity are summarised in Table E.1-1.

Public consultation includes advertising the proposed activity in the local (and possibly regional) media, distributing project-related information to Interested and Affected Parties (I&APs), holding public events such as Open Days and Focus Group Meetings/Workshops, providing mechanisms for comment and providing regular feedback and updates on the process. The objective of the public participation process is to allow I&APs the opportunity to comment on the proposed activity and to raise issues and concerns.

An advertisement announcing the Scoping Phase and inviting I&APs to register on the project database was placed in "Die Beeld" and "The Star" on 9 February 2005, "Vaal Vision" and "Vaal Weekly" on 11 February 2005. Letter, faxes and e-mails were also sent to the persons/organisations that were pre-identified by the consultants and the applicant. Some personal invitations were sent to I&APs inviting them to the public open day. The personal invitation was accompanied by brief information that provided more information on what the proposed project entails and on the EIA process.

The open day during the scoping phase was held on 24 February 2005 at the Emfuleni Conference and Sport Centre.

Two focus group meetings were held during the scoping exercise:

- Boipatong Environmental Working Group meeting - 7 March 2005 (some 9 attendees signed the attendance register);
- Bophelong Community Meeting – 10 March 2005 (8 attendees signed the attendance register).

During the focus group meeting the EIA consultants delivered a presentation introducing the project team and explaining the process to be followed.

The Draft Scoping Report was made available for public comment from 19 April 2005 until 18 May 2005. Significant issues/comments raised were incorporated into a Revised Draft Scoping Report which was once again made available for comment from 1 July 2005 to 1 August 2005. No further issues or comments were raised and the report was finalised and submitted to the regulatory authority, the Gauteng Department of Agriculture, Conservation and Environment (GDACE) for approval in August 2005.

The Draft Scoping Report and the Revised Draft Scoping Report were made available at the following public places:

- Vanderbijlpark public library;
- Driehoek public library;
- Sebokeng public library;
- Bophelong public library;
- Boipatong public library;



- Evaton public library;
- The Mittal Steel Vanderbijlpark Steel library.

An advertisement announcing the EIA Process and inviting I&APs to register on the project database was placed in “Die Beeld”, “Vaal Vision”, “Vaal Weekly”, “Vaal Weekblad” and “Vanderbijlpark Ster”. The letter, faxes and e-mails were also sent to I&APs inviting them to the Environmental Impact Report (EIR) feedback public open day on 19 April 2006. All registered I&APs were sent a copy of the Background Information Document (BID). The public open day was at the Emfuleni Conference and Sport Centre on 19th April 2006.

The Draft Environmental Impact Report (EIR) was available from 20 March 2006 to 2 May 2006. The report was made available at the following public places:

- Vanderbijlpark public library;
- Driehoek public library;
- Sebokeng public library;
- Bophelong public library;
- Boipatong public library;
- Evaton public library;
- The Mittal Steel Vanderbijlpark Steel library.

The Final EIR was submitted after summarising all comments for the Draft EIR

The Record of Decision (ROD) for environmental authorisation was obtained from DEA on 7 December 2006.

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

Activity	Date
Phase 1: Project initiation	
Submission of an Application for Authorisation by MSVS	November 2004
Scope clarification meeting and liaison with project team	January 2005
Site Assessment	January 2005
Phase 2: Initial public consultation process	
Information gathering and review	January – February 2005
Initial identification of legislative and permitting requirements	January 2005
Initial stakeholder consultation (identification of issues and concerns)	February 2005
Identification and description of potential alternatives	February – August 2005
Phase 3: Scoping	
Submission of a Plan of Study for Scoping to	April 2005



Activity	Date
GDACE	
Compilation of a Draft Scoping Report	April to July 2005
Submission of a Final Scoping Report to GDACE	August 2005
Submission of a Plan of Study for EIA to GDACE	November 2005
Phase 4: EIA	
Compilation of a Draft EIR	December 2005 – March 2006
Compilation of a Final EIR	May 2006
Record of Decision (ROD) from DEA for environmental authorisation	7 December 2006

An additional consultation to make specific mention that the project developer will apply for carbon credits was done in October 2011.

Written invitations were posted via registered mail to more than 255 stakeholders who consist of different spheres of government, local Non-governmental organisations (NGO's), public members and other industries and neighbours. An advertisement announcing the consultation and inviting I&APs to register on the project database was placed in a National Newspaper, "The Sowetan", on the 11th of October 2011 and comments were invited till the 19th of October 2011. The posters were placed in AMSA's Vanderbijlpark plant's canteen and the entrance to the plant. An additional poster was placed at a local shopping centre.

A total of 19 people attended the event. 11 people were AMSA employees and 8 were I&APs. Stakeholder comments were invited in writing at stakeholder workshops. Comments were documented and compiled.

E.2. Summary of the comments received:

The list of comments received during the EIA process is provided in Annex A to the Final Environmental Impact Report – Public Participation Process Report. About 265 comments were received during the two open days. All comments are divided into groups according to the type of questions, such as:

- Organisation of the open days and general questions;
- Socio – economic issues;
- Health impacts;
- Environmental impact issues;
- Visual impact issues.

Organisation of the open days and general questions

A lot of comments were about organisation of the open days, participations consider that the transport should be provided and open days should be held in the centre of the communities and not at the Emfuleni Conference and Sport Centre. Some people asked about translating the Background Information Document (BID) on S.Sotho and Zulu languages and the explanation of the project should be in mother tongue. The Environmental workshop should be held to familiarize the community with environmental issues. The participation offered to select a number of the members and employ them to rebuild things which are in bad conditions.



Socio – economic issues

The most important question was about employment opportunities – participations looking forward to new job opportunities. Participants consider that community members should be employed for the development of the project. Community members believe that AMSA must build a community hospital to treat people affected by pollution. In addition, participants consider that AMSA should invest in building of houses, infrastructure, storm water drainage system and road construction.

The project does not interfere with societies interests.

Health impacts

Participations worried about health impacts, such as damage to the eyes from the small steel particles. Community members wanted to know what other problems and diseases are caused by project. Old and rusted pipes pose a serious health hazard to the community and employees. Pipes are monitored and inspected.

Environmental impact issues

Participations worried about environmental situation, they asked a lot of questions about environmental impact from the project. Public was informed of the impact of the process on the environment and what possible steps are available to minimize or negate the impacts. Community members interested how AMSA is managing air and water pollution.

Based on the inputs received during the PPP conducted so far, the following conclusions can be made:

- Communication with I&APs, especially the communities surrounding the site, should continue to ensure informed decision-making and a transparent process throughout.
- The aim of this PPP process was to identify issues and concerns in order to feed it into the technical and planning processes with a view to developing measures for successful mitigation / avoidance of negative impacts.

The additional comments were received during the consultation on 12th of October 2011.

The principle comments received telephonically and via the Public Participation process were as follows:

- Were any job opportunities regarding this project?
- What are the local economic benefits?
- How much emissions are produced by the existing kilns and how much emission is Kiln 5 and 6 producing?
- Has there been any research done on using alternative sources of energy besides coal?
- How does CDM affect the community?
- There was a query to understand the concept of CDM.
- Is the Kilns operating at 100%?

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

No negative comments were raised by the stakeholders. All stakeholders' comments and concerns were taken into account and considered in the EIR and CDM documentation.

**Annex 1****CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

Organization:	ArcelorMittal South Africa Limited
Street/P.O.Box:	Delfos Boulevard/P.O. Box 10202
Building:	
City:	Vanderbijlpark
State/Region:	
Postcode/ZIP:	1900
Country:	Republic of South Africa
Telephone:	
FAX:	
E-Mail:	
URL:	www.arcelormittal.com/southafrica/
Represented by:	
Title:	Manager
Salutation:	Mr.
Last name:	Churilov
Middle name:	
First name:	Alexander
Department:	
Mobile:	+33 (0) 6 10 45 47 17
Direct FAX:	+33 (0) 1 71 92 25 26
Direct tel:	
Personal e-mail:	alex.churilov@arcelormittal.com



Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Annex 3

BASELINE INFORMATION

Annex 3-1. The national grid of the RSA (Eskom electricity network)²⁴



²⁴ <http://www.eskom.co.za/content/2008EskomPoster.jpg>

**Annex 3-2. Data on Eskom's grid-connected power plants (at the 31st of March 2010)^{25,26}**

Name of power plant	Location	Type of power plant (PP)	Type of fuel	Date of commissioning/ (Re-commissioning)*	Total net maximum capacity, MW
Arnot	Middelburg, Mpumalanga	Thermal PP	Coal	1971.09.21	2 232
Camden ²⁷	Ermelo, Mpumalanga	Thermal PP	Coal	(2005.03.31)	1 440
Duvha	Witbank, Mpumalanga	Thermal PP	Coal	1980.01.18	3 450
Grootvlei ²⁸	Balfour, Mpumalanga	Thermal PP	Coal	(2008.03.31)	760
Hendrina	Mpumalanga	Thermal PP	Coal	1970.05.12	1 865
Kendal	Witbank, Mpumalanga	Thermal PP	Coal	1988.10.01	3 840
Komati ²⁹	Middelburg, Mpumalanga	Thermal PP	Coal	(2009.01.05)	170
Kriel	Bethal, Mpumalanga	Thermal PP	Coal	1976.05.06	2 850
Lethabo	Viljoensdrift, Free State	Thermal PP	Coal	1985.12.22	3 558
Majuba	Volksrust, Mpumalanga	Thermal PP	Coal	1996.04.01	3 843
Matimba	Lephalale, Limpopo	Thermal PP	Coal	1987.12.04	3 690
Matla	Bethal, Mpumalanga	Thermal PP	Coal	1979.09.29	3 450

²⁵Eskom Annual Report 2010, page 298,

http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf

²⁶Data Requirements for Calculating the Carbon Emission Factor (CEF) for the South African Grid, General Information, <http://www.eskom.co.za/content/calculationTable.htm>

²⁷ Re-commissioned power plant, Eskom Annual Report 2009, page 63
http://www.financialresults.co.za/eskom_ar2009/ar_2009/downloads.htm

²⁸ Re-commissioned power plant, Eskom Annual Report 2010, page 126,
http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf

²⁹ Re-commissioned power plant, Eskom Annual Report 2010, page 127,
http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf



Name of power plant	Location	Type of power plant (PP)	Type of fuel	Date of commissioning/ (Re-commissioning)*	Total net maximum capacity, MW
Tutuka	Standerton, Mpumalanga	Thermal PP	Coal	1985.06.01	3 510
Acacia	Cape Town, Western Cape	Gas turbine PP	Kerosene	1976.05.13	171
Port Rex	East London, Eastern Cape	Gas turbine PP	Kerosene	1976.09.30	171
Ankerlig	Atlantis, Western Cape	Gas turbine PP	Natural gas	2007.03.29	1 327
Gourikwa	Mossel Bay, Western Cape	Gas turbine PP	Natural gas	2007.03.30	740
Colley Wobbles	Mbashe River, Eastern Cape	Hydro PP	-	1900.01.01	0
Ncora	Ncora River, Eastern Cape	Hydro PP	-	1900.03.01	0
First Falls	Umtata River, Eastern Cape	Hydro PP	-	1900.02.01	0
Gariep	Norvalspont, Free State	Hydro PP	-	1971.09.08	360
Second Falls	Umtata River, Eastern Cape	Hydro PP	-	1900.04.01	0
Vanderkloof	Petrusville, Northern Cape	Hydro PP	-	1977.01.01	240
Drakensberg	Bergville Kwazulu-Natal	Hydroelectric Pumped Storage PP	-	1981.06.17	1 000
Palmiet	Grabouw, Western Cape	Hydroelectric Pumped Storage PP	-	1988.04.18	400
Koeberg	Cape Town, Western Cape	Nuclear PP	-	1984.07.21	1 800
Klipheuwel	Klipheuwel, Western Cape	Wind farm	-	**	3

* Re-commissioned units are: Camden, Grootvlei and Komati.

**No data available

**Annex 3-3. Data on operation of Eskom's grid-connected power plants included into the operating margin for the 3 most recent reporting years****The list of power plants included into the operating margin³⁰**

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

³⁰Kerosene-fired gas turbine power plants were excluded from the operating margin since they were not operated for the 3 most recent reporting years.



Net quantity of electricity generated and delivered to the grid by the power plants included into the operating margin ($EG_{m,y}$)³¹

Name of power plant	Type of fuel	Unit	Years*			Total 04.2007 - 03.2010
			04.2007 - 03.2008	04.2008 - 03.2009	04.2009 - 03.2010	
Arnot	Coal	MWh	11 905 060	11 987 281	13 227 864	37 120 205
Camden	Coal	MWh	5 171 057	6 509 079	7 472 070	19 152 206
Duvha	Coal	MWh	23 622 732	21 769 489	22 581 228	67 973 449
Grootvlei	Coal	MWh	237 138	1 249 556	2 656 230	4 142 924
Hendrina	Coal	MWh	13 756 351	12 296 687	12 143 292	38 196 330
Kendal	Coal	MWh	26 517 420	23 841 401	23 307 031	73 665 852
Komati	Coal	MWh	0	0	1 016 023	1 016 023
Kriel	Coal	MWh	17 762 398	18 156 686	15 906 816	51 825 900
Lethabo	Coal	MWh	25 701 723	23 580 232	25 522 698	74 804 653
Majuba	Coal	MWh	23 680 971	22 676 924	22 340 081	68 697 976
Matimba	Coal	MWh	29 021 742	26 256 068	27 964 141	83 241 951
Matla	Coal	MWh	24 549 833	21 863 400	21 954 536	68 367 769
Tutuka	Coal	MWh	20 980 242	21 504 122	19 847 894	62 332 258
Ankerlig**	Natural gas	MWh	1 153 000	143 000	49 000	1 345 000
Gourikwa**	Natural gas	MWh				
Total net electricity generation:						651 882 496

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

**Data was taken from Table B.6-1.

³¹Data Requirements for Calculating the Carbon Emission Factor (CEF) for the South African Grid, General Information, <http://www.eskom.co.za/content/calculationTable.htm>

**Amount of fossil fuel consumed by the power plants included into the operating margin ($FC_{i,m,y}$)³²**

Name of power plant	Type of fuel	Unit	Years*			Total 04.2007 - 03.2010
			04.2007 - 03.2008	04.2008 - 03.2009	04.2009 - 03.2010	
Arnot	Coal	tonnes	6 210 700	6 395 805	6 794 134	19 400 639
Camden	Coal	tonnes	3 218 873	3 876 211	4 732 163	11 827 247
Duvha	Coal	tonnes	12 425 531	11 393 553	11 744 606	35 563 690
Grootvlei	Coal	tonnes	130 748	674 538	1 637 371	2 442 657
Hendrina	Coal	tonnes	7 794 220	7 122 918	6 905 917	21 823 055
Kendal	Coal	tonnes	15 986 131	15 356 595	13 866 514	45 209 240
Komati	Coal	tonnes	0	0	664 497	664 497
Kriel	Coal	tonnes	9 059 934	9 420 764	8 504 715	26 985 413
Lethabo	Coal	tonnes	18 314 572	16 715 323	18 170 227	53 200 122
Majuba	Coal	tonnes	12 853 342	12 554 406	12 261 833	37 669 581
Matimba	Coal	tonnes	14 862 323	13 991 453	14 637 481	43 491 257
Matla	Coal	tonnes	13 795 309	12 689 387	12 438 391	38 923 087
Tutuka	Coal	tonnes	10 627 575	11 231 583	10 602 839	32 461 997
Ankerlig	Natural gas	thousand m ³	N/A**	N/A	N/A	N/A
Gourikwa	Natural gas	thousand m ³	N/A	N/A	N/A	N/A
Total coal consumption:						369 662 482

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

**No data available

³²Data Requirements for Calculating the Carbon Emission Factor (CEF) for the South African Grid, General Information, <http://www.eskom.co.za/content/calculationTable.htm>

Annex 3-4. Determination of power units included into the build margin³³Determination of the set of power units SET_{sample}

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

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

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

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

³³Based on data presented in Annexes 3-2 and 3-3

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

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

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

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



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

Name of power plant	Type of power plant (PP)	Type of fuel	Date of commissioning	Fuel consumption ($FC_{i,n,y}$), tonnes	Net electricity generation ($EG_{n,y}$), MWh	Weight fraction in total net electricity generation*	Accumulated weight fraction
Bethlehem Hydro ³⁴	Small Scale Hydro	Renewable	2009.07.18	0	34 031	0.0001	0.0001
Komati	Thermal PP	Coal	2009.01.05	664 497	1 016 023	0.0044	0.0045
Grootvlei	Thermal PP	Coal	2008.03.31	1 637 371	2 656 230	0.0114	0.0159
Gourikwa	Gas turbine PP	Natural gas	2007.03.30	N/A**	49 000	0.0002	0.0161
Ankerlig	Gas turbine PP	Natural gas	2007.03.29				
Camden	Thermal PP	Coal	2005.03.31	4 732 163	7 472 070	0.0321	0.0482
Majuba	Thermal PP	Coal	1996.04.01	12 261 833	22 340 081	0.0959	0.1442
Kendal	Thermal PP	Coal	1988.10.01	13 866 514	23 307 031	0.1001	0.2443

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

**No data available

³⁴ <http://cdm.unfccc.int/Projects/DB/SGS-UKL1245061289.99>, CDM PDD, page 12

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

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

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

CO₂ emission factors of power units *m* in year *y* ($EF_{EL,m,y}$), tCO₂/MWh

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

CO₂ emissions of power units m in year y ($EG_{m,y} \cdot EF_{EL,m,y}$), tCO₂

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

Calculation of simple operating margin CO₂ emission factor ($EF_{gridOMsimple}$)

Parameter	Unit	Value
Total net electricity generation of power units m for the 3 most recent reporting years	MWh	651 882 496
Total CO ₂ emissions of power units m for the 3 most recent reporting years	tCO ₂	659 052 985
Simple operating margin CO₂ emission factor	tCO₂/MWh	1.011



Calculation of build margin CO₂ emission factor ($EF_{gridBM,y}$)

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

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

Calculation of combined margin CO₂ emission factor ($EF_{grid,CM}$)

Parameter	Unit	Value
Operating margin CO ₂ emission factor	tCO ₂ /MWh	1.011
Weighting of operating margin emission factor	-	0.5
Build margin CO ₂ emission factor	tCO ₂ /MWh	0.920
Weighting of build margin emission factor	-	0.5
Combined margin CO₂ emission factor	tCO₂/MWh	0.965

**Annex 3-6. The data on WECM stream management before the project implementation****The historical data on generation, consumption and flaring of COG, GJ**

Parameter	Value			
	2004	2005	2006	On average
Quantity of gas generation	10 734 905	12 379 907	11 550 694	11 555 169
Quantity of gas consumption:				
In the boiler of the Boiler House	1 201 029	1 124 632	1 460 985	1 952 129
At the Coke Plant	2 771 802	2 837 411	2 793 895	2 782 849
At the Direct Reduction	125 267	63 981	165 228	118 159
At the SMS (BOF and LF)	335 068	252 860	173 103	253 677
At the Continuous Caster V1 & V2	87 863	93 670	52 867	78 133
At the ESM (Arc & Arc L)	323 811	324 727	379 797	342 778
At the Continuous Caster V3	90 077	125 790	127 769	114 545
At the Plate Mill & Treatment	730 291	930 525	824 886	828 567
At the Hot Rolling Mill	3 650 608	3 953 612	3 494 749	3 699 656
Total gas consumption	9 315 816	6 869 797	9 473 279	10 170 494
Gas flaring	1 627 242	2 268 166	2 004 548	1 966 652

The historical data on generation, consumption and flaring of BFG, GJ

Parameter	Value			
	2004	2005	2006	On average
Quantity of gas generation	14 392 108	15 331 763	15 830 709	15 184 860
Quantity of gas consumption:				
In the boiler of the Boiler House	3 270 771	3 503 647	3 845 609	2 850 095
At the Coke plant	3 027 020	3 139 671	2 960 491	3 042 394
At the PCI	80 700	80 393	40 755	67 283
At the Blast Furnaces	4 571 108	3 452 991	5 678 612	4 567 570
Total gas consumption	10 949 599	10 176 702	12 525 467	10 527 342
Gas flaring	3 160 238	3 260 637	3 206 003	3 208 959



Quantity of excess low-pressure steam from the existing WHRS of the DR Kilns 1-4 vented into the atmosphere, tonnes

Month	Value			
	2004	2005	2006	On average
January	N/A*	4 235	836	-
February	N/A*	5 697	2 826	-
March	3 006	5 152	8 467	-
April	6 938	4 858	11 126	-
May	4 046	11 147	3 536	-
June	1 793	3 974	449	-
July	2 219	7 816	8	-
August	35	9 276	44	-
September	5 143	5 710	227	-
October	1 874	5 226	3 948	-
November	12 815	3 233	497	-
December	4 725	1 913	1 812	-
Total:	42 594	68 240	33 776	48 203

*No data available

