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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

Samancor Chrome Middelburg Electricity from Waste Gas
Version 03
Date: 10 June 2012

Document version History

PDD version 01, submitted 12 December 2011	Version submitted for Global Stakeholder Process
PDD version 02, submitted 22 May 2012	Revised version during validation
PDD version 03, submitted 10 June 2012	Revised version during validation

A.2. Description of the project activity:

Definitions as provided in ACM0012 and how they apply to the project activity

Recipient facility. *The facility that receives useful energy generated using waste energy under the project activity from the waste energy generation facility. It may be the same as the waste energy generation facility (*Page 2/60, ACM0012*).*

- The recipient facility is Samancor Middelburg Ferrochrome, (MFC) which will receive electricity.

Waste Energy. *Energy contained in a residual stream from industrial processes in the form of heat, chemical energy or pressure, for which it can be demonstrated that it would have been wasted in the absence of the project activity. Examples of waste energy include the energy contained in gases flared or released into the atmosphere, the heat or pressure from a residual stream not recovered (i.e. wasted) (*Page 3/60, ACM0012*).*

- The waste energy is in the form of waste gas flared in the baseline scenario, which is also the current scenario.

Waste Energy Carrying Medium (WECM). *The medium carrying the waste energy in form of heat, chemical energy or pressure. Examples of WECM include gas, air or steam carrying waste energy (*Page 3/60, ACM0012*).*

- The WECM is waste gas produced in two closed furnaces at Samancor Middelburg Ferrochrome.

Waste energy generation facility ('the project facility'). *The facility where the waste energy, which is to be utilized by the CDM project activity, is available. The project activity can be implemented by the owner of the facility or by a third party (e.g. ESCO). If the waste energy is recovered by a third party in a separate facility, the 'project facility' will encompass both the waste energy generation facility and the waste energy recovery facility (*Page 3/60, ACM0012*).*

- The project activity is implemented by a third party, an independent power producer (IPP), Exxaro On-Site, in a separate power generation facility. Therefore, the 'project facility' includes (1)Samancor furnaces where the waste energy is produced and (2)the waste energy recovery plant and power generation plant owned and operated by Exxaro On-Site.

MFC is situated in Middelburg, Mpumalanga and was established in 1964 as a Low Carbon Ferrochrome production facility. Charge chrome was first produced on this site in 1974 by Middelburg Steel and Alloys (Pty) Ltd, which was acquired by Samancor in 1991.

The core business of MFC is the production of charge chrome from two submerged arc furnaces (M1 and M2, semi closed, 40 MW), and two direct-current plasma furnaces (M3 and M4, closed, 50 MW and 60MW respectively) A metal recovery plant is also operated on site to recover ferrochrome metalics from the existing slag dumps, as well as from the slag arising from the M1 and M2 operations. The facility also operates a pelletization plant for the preparation of some of the fine ores for use in M1 and M2 furnaces.

A low carbon ferrochrome production facility is also located on the premises. This facility operates three furnaces, being two 9MW and one 17 MW furnaces designated B, C and Open Arc. B and C furnaces are semi closed furnaces producing ferrosilicochrome (FeSiCr), and the open arc furnace is a slag melter, with no carbonaceous reduction reactions taking place in it. No CO rich off-gas is produced.

Only M3 and M4 have a combustible, CO-rich off-gas as by-product, which is treated in gas cleaning plants before being flared. The off-gas quality and quantity varies with production rate as well as with reductant types and feed ratios, and contains on average between 65% and 70% CO and 25% and 30% H_2.

Because of the combustible and potentially explosive nature of the off-gas and high temperatures involved in the smelting process, strict safety precautions is followed during operations, which include monitoring of oxygen levels in the gas as well as pressure and temperature fluctuations. When any of these parameters fall outside the control limits the furnace electrical input is immediately lowered or shut down, which reduces or stops the production of the off-gas[1].

No process gas form the Middelburg Chrome operation is currently used for any energy recovery applications or other plant use.

1. Purpose of the project activity

Middelburg Ferrochrome (MFC)

The proposed project activity is an initiative to recover waste energy in the form of flared waste gas from two existing ferrochrome closed furnaces at MFC. The envisaged project will use the waste gas in an estimated 20 gas engines with a guaranteed maximum continuous rating (MCR) of 1.698 MW[2] each. The project will generate an expected total of 34 MW of electricity if all engines are operating simultaneously at full load. The electricity will be used by MFC to replace electricity purchased from the national grid which is managed by the national utility, Eskom.

The implementation of the project will have no impact on the existing production operations at the smelter.

The crediting period selected is a fixed 10 years and the amount of emission reductions that will be generated during the crediting period is estimated at 210,138.7tons per annum.

No construction has taken place at the time of validation of the project.

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[1] Appendix 8 Technology Supplier information and specification document (GLPS), page 2

[2] Appendix 6 Jenbacher Specification Sheet_620_F57MFC, page 1

Expected start date of the project activity: 15 December 2012

Expected handover date after commissioning[3]: 31 January 2014

Expected date that the crediting period will start (end of commissioning period): 1 February 2014

2. Scenario existing prior to the implementation of the project activity and Baseline scenario

The scenario existing prior to the implementation of the project activity and the baseline scenario is the same.

2.1 Current scenario and baseline for electricity

MFC currently purchases all the electricity needed for its production activities directly from Eskom, the national power utility. The electricity is delivered via the South Africa power grid.

2.2 Current scenario and baseline for waste gas

At present, the waste gas produced from the furnaces M3 and M4 is cleaned and conditioned in the gas cleaning plants before it is flared in the clean gas stack to atmosphere. Each furnace has its own dedicated gas cleaning plant and two dedicated flares, a clean gas flare and a raw gas flare. (Figure 2)

When the gas cleaning plant is down for planned or unplanned maintenance, the gas is flared in the raw gas flare. No fossil fuel is used in the raw gas flare to support continuous flaring but there are pilot flames that use methane rich gas on each furnace's clean gas and raw gas flates to ensure the off-gas is ignited when the flare is put in use.

2.3 Currently the following conditions apply for the MFC site:

- No waste gas is currently recovered for the generation of electricity[4] at the site.
- No electricity generation equipment is installed on site that converts waste gas to electricity[5].
- No waste gas is used for any purposes at MFC. All the waste gas generated in the two closed furnaces (M3 and M4) is flared to atmosphere. This statement is supported by an independent Waste Gas Assessment Report (Appendix 22) and also the regulatory operating licenses of MFC (Appendix 3[6] and Appendix 4).

2.4 National grid information for South Africa

The national utility, Eskom, is a government-owned entity and generates more than 95 per cent of the South Africa's electricity[7]. Private generators produce approximately 3% of national electricity

[3] Appendix 11_Technical Feasibility Study Report for MFC, May 2012, Table 6, Project schedule, page 20 of 20

[4] Appendix 8 Technology Supplier Information and specification document (GLPS), page 2 and Appendix 11 Technical Feasibility Study Report for MFC, page 9 of 20

[5] Appendix 8 Technology Supplier Information and specification document (GLPS), page 2 and Appendix 11 Technical Feasibility Study Report for MFC, page 9 of 20

[6] The Atmospheric Pollution Prevention Act No 45 of 1965 requires that the waste gas be flared. The regulatory permit requires that MFC reports abnormal or emergency situations in which venting occurs. (Refer to Appendix 3 and Appendix 4).

[7] Appendix 33: Electricity Supply Industry of South Africa Report, page 6

requirements and municipalities produce less than 1%. Approximately 90% of electricity in South Africa is derived from coal-fired power stations[8].

2.5 MFC process

Chromite ore consists of iron oxide and chromium oxide. In the production of ferrochrome, chromite ore is reduced in the presence of reductants in submerged arc furnaces according to the following reactions:

$Cr_2O_3 + 3\,C \rightarrow 2Cr + 3CO(g)$

$FeO + C \rightarrow Fe + CO(g)$

The metallic iron and chromium formed leaves the furnace as ferrochrome.

These reactions are endothermic, and the energy needed for the endothermic reaction is supplied by the electricity. Commonly used sources of reductants include coal, char, coke and anthracite. Coke gives rise to the formation of almost pure carbon monoxide (CO), while volatile hydrocarbons introduced through the addition of coal and anthracite gives rise to the formation of hydrogen.

In an open top furnace the combustible carbon monoxide and hydrogen gasses are oxidized, and no energy can be recovered. In closed top furnaces the waste gas is not oxidized and can therefore be recovered and utilised. Gas leaving the furnace is treated in a wet scrubber and disintegrator (on M4) to cool the gas and remove particulates before it is flared.

MFC operates two closed top furnaces. By design, the off-gas from the current furnaces is 686,400 normal cubic meters per day at specific conditions[9].

2.6 Project scenario

2.6.1 Project scenario for the electricity

Electricity generated from the project activity will be replacing electricity imported by MFC from the national utility (Eskom) via the national grid. No backup electricity generation equipment will be installed as part of the project in the case that the proposed power plant experiences outages or abnormal conditions. Also, the engines are not designed to run on fuels other than the waste gas (refer to Appendix 50_Letter from Jenbacher regarding fuel type). Therefore, no fossil fuel will be used for backup purposes of any kind in the power plant to generate electricity.

Greenhouse gas emissions associated with the electricity generation in the national grid will be reduced as a result.

2.6.2 Project scenario for the waste gas

The waste gas currently flared at the site will be recovered, conditioned and diverted to internal combustion gas engines. Gas engines will generate electricity from the waste gas.

The primary new equipment components of the project activity include the following main equipment:

i. **Internal combustion Gas Engines**

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[8] Appendix 34: IEA Energy Statistics for South Africa, http://www.geni.org/globalenergy/library/energy-issues/south africa/index_chart.html

[9] Appendix 8 Technology Supplier information and specification document (GLPS)

The technology selected for the electricity generation is internal combustion gas engines supplied by GE Jenbacher – an Austrian-based subsidiary of General Electric.

ii. Fuel used in the gas Engines

The engines are designed only to use waste gas (CO rich gas) and no other gas (for example natural gas) can be used as a backup without rebuilding the engines and applying major modifications to them. Therefore, no fuel except waste gas will be utilised in the engines.

iii. **Gas Conditioning Equipment**

The gas cleaning equipment will include a booster fan, drop separator, mixing tank, heat exchanges and a filter.

iv. Flare

One new flare will be installed near the proposed power plant to absorb waste gas flow fluctuations.

A comprehensive list of all the new equipment is provided in Appendix 10.

3. Sustainable Development

The project will contribute to sustainable development in South Africa in the following ways:

Environment Benefits

The project will displace some coal-dominated power generation in South Africa with power generated from waste gas, thereby reducing the carbon footprint of South Africa.

Social Benefits at Middelburg

The proposed development also represents an investment in waste energy to power generation, which, given the challenges created by climate change, represents positive social benefit for society as a whole.

The key social issues associated with the construction phase include the creation of employment and the opportunity for skills development and training. The construction phase will employ approximately 100 people over the construction period. The proposed power plant will employ approximately 15 full time employees and, as such, will create potential employment opportunities in the province[10]. However, given that the industry is relatively new it may be necessary to initially import the required operational and maintenance skills from overseas. However, it will be possible to increase the number of local employment opportunities through the implementation of a skills development programme linked to the operational phase.

[10] Appendix 35 Report Number 408836, Draft Scoping Report for the proposed development of an Energy Recovery Plant at the Samancor Chrome Plant, Middelburg Ferrochrome, December 2011, page 36

Economic Benefits

Given the highly technical nature of the power plant, the opportunity for South African production and local content is likely to increase over time, however will be lower for the first number of waste energy to power projects. Local economies in the Middelburg area are likely to benefit where already established industries can be utilised by the project, such as civil engineering skills, construction skills and low skilled labour, however for the equipment manufacture industry, this is likely to be introduced and increased over time.

Technology Transfer

There will be a transfer of technology from a developed country to a developing country. The internal combustion engines that are used to generate the electricity will be sourced from GE Jenbacher in Austria (Annex-1 country) and will be imported to South Africa.

The proposed project activity will contribute to technology transfer to the host country South Africa, since it utilises Jenbacher technology. Jenbacher is an established Austrian company and the technology has been implemented in a number of developed countries.

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)
Host Party South Africa	Exxaro on-Site	No

Samancor Middelburg Ferrochrome (MFC)

MFC is situated in Middelburg, Mpumalanga and was established in 1964 as a Low Carbon Ferrochrome production facility. Charge chrome was first produced on this site in 1974 by Middelburg Steel and Alloys (Pty) Ltd, which was acquired by Samancor in 1991. The core business of MFC is the production of charge chrome from two open submerged arc furnaces SAFs, two closed DC arc furnaces and a metal recovery plant. The expected useful life of the facility is at least 25 years[11].

Exxaro On-Site (EOS)

Exxaro On-Site is a joint venture between Exxaro Resources Ltd and Prana Energy (Pty) Ltd with the purpose of developing and operating on-site power generation facilities. The JV company is called "Exxaro On-Site" and Exxaro controls the JV with 51% of the shareholding. Exxaro On-Site's business model is to primarily Build, Own and Operate the power generation facilities.

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[11] Appendix 12 Samancor Website downloaded on 19 December 2011: http://www.samancorcr.com/content.asp?subID=8

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

South Africa

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

The project is located in the Mpumalanga province.

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

The project is located near the town of Middelburg.

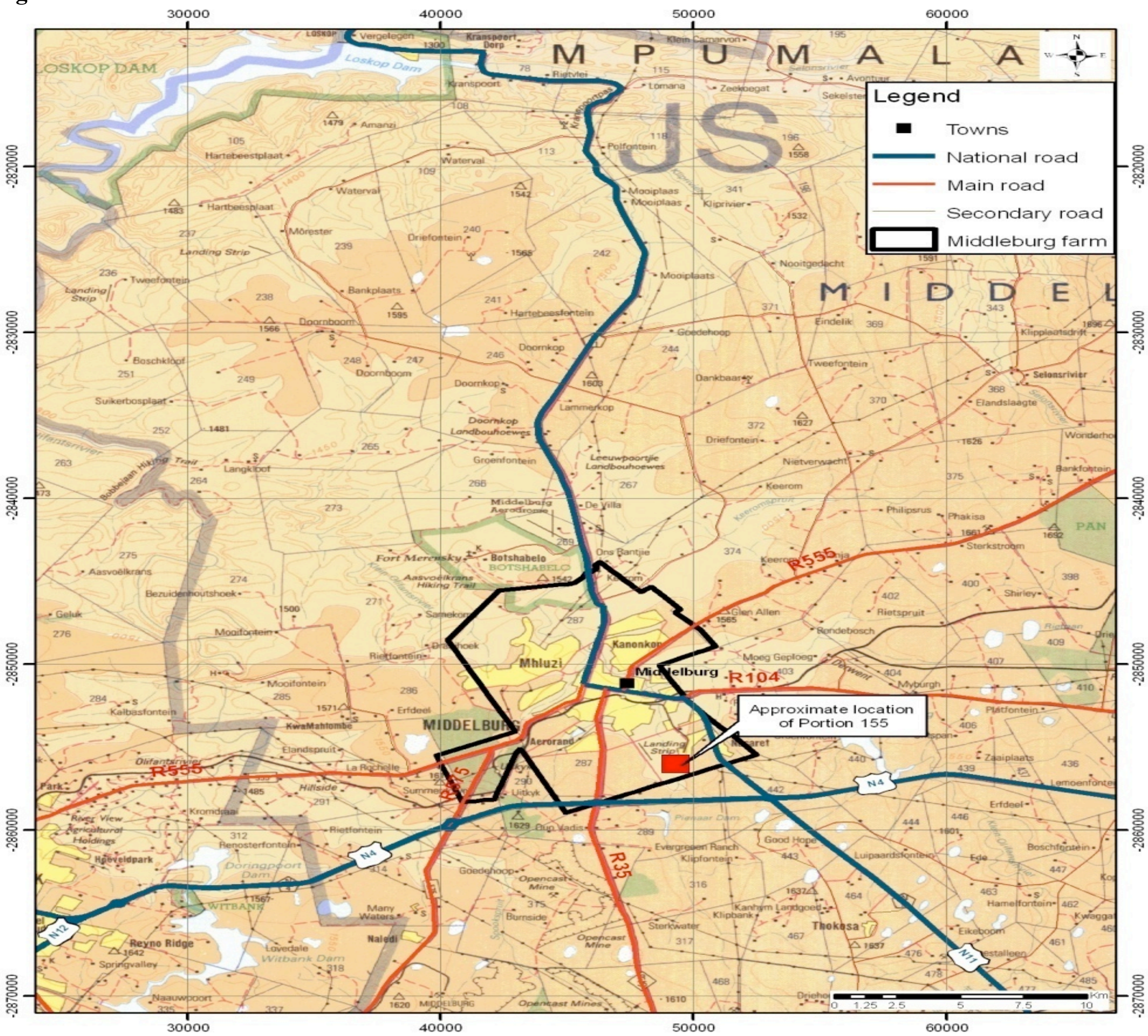
A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

The Middelburg Ferrochrome operation lies approximately 4.5 km southeast of the centre of Middelburg on the eastern bank of the Vaalbankspruit, and covers approximately 362 ha. The plant boundary traverses the farm Townlands Farm No 287, Portion 155. The nearest residential area is Nazareth which falls on the eastern boundary of the site and within 1 km of the closest Middelburg Ferrochrome installations. This area falls under the jurisdiction of the Steve Tshwete Local Municipality (see Figure 1).

GPS coordinates for the site:

25°48'16.26"S
29°29'40.38"E

Figure 1: Location of the MFC site



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

Sectoral scope 01: Energy industries (renewable-/non-renewable sources)
Sectoral scope 04: Manufacturing industries

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

A.4.3.1 Description of the environmentally safe and sound technology and knowledge that is transferred to South Africa.

There will be a transfer of technology from a developed country (Austria) to a developing country (South Africa). The internal combustion engines that are used to generate the electricity will be sourced from GE

Jenbacher in Austria (Annex-1 country) and will be imported to South Africa. The technology is mature technology that is applied extensively internationally, although not in the ferrochrome industry.

A.4.3.2 Purpose of the project activity

Exxaro on-Site (Pty) Ltd is to develop an electricity generation power plant with a maximum capacity of 34 MW utilizing furnace waste gas generated at MFC in two closed submerged arc direct current (DC) ferrochrome furnaces (M3 and M4).

The electricity generated by Exxaro On-Site will displace a maximum 34 MW, i.e. 20 engines x 1.698 MWe[12] each. The displaced electricity is electricity imported from the South African national grid.

In the case of this project activity, the existing scenario and the baseline scenario is the same.

A.4.3.3 The scenario existing prior to the start of the implementation of the project activity, with a list of the equipment and systems in operation

MFC (Refer to Appendix 36 for the design P&IDs for the furnaces)

The two closed furnaces M3 and M4 generate waste gas that is designed[13] to flare to atmosphere as part of the business-as-usual production process since 1996 for M3 and 12 March 2009 for M4[14]. This gas is rich in CO and H_2, which is to be utilised as a fuel source for the project activity.

Waste off-gas from the M3 furnace is flared after passing through a cleaning system (Howden venturi scrubber plant) prior to release to atmosphere. At no time is furnace gas vented to the atmosphere un-combusted.

Waste off-gas from the M4 furnace is flared after passing through a cleaning system (Theisen Disintegrator plant) prior to release to atmosphere. At no time is furnace gas vented to the atmosphere un-combusted.

The existing equipment that is relevant to the waste gas system includes the following:

1. Two closed direct current arc furnaces (M3 and M4) – where the waste gas is produced;
2. Gas cleaning equipment for each furnace – where the waste gas is cooled and cleaned before being flared to atmosphere;
3. Two flares for each furnace:
    a. One flare (main flare) is used in normal operations
    b. Raw gas flare (emergency flare) is used only when the gas cleaning plant is not in operation

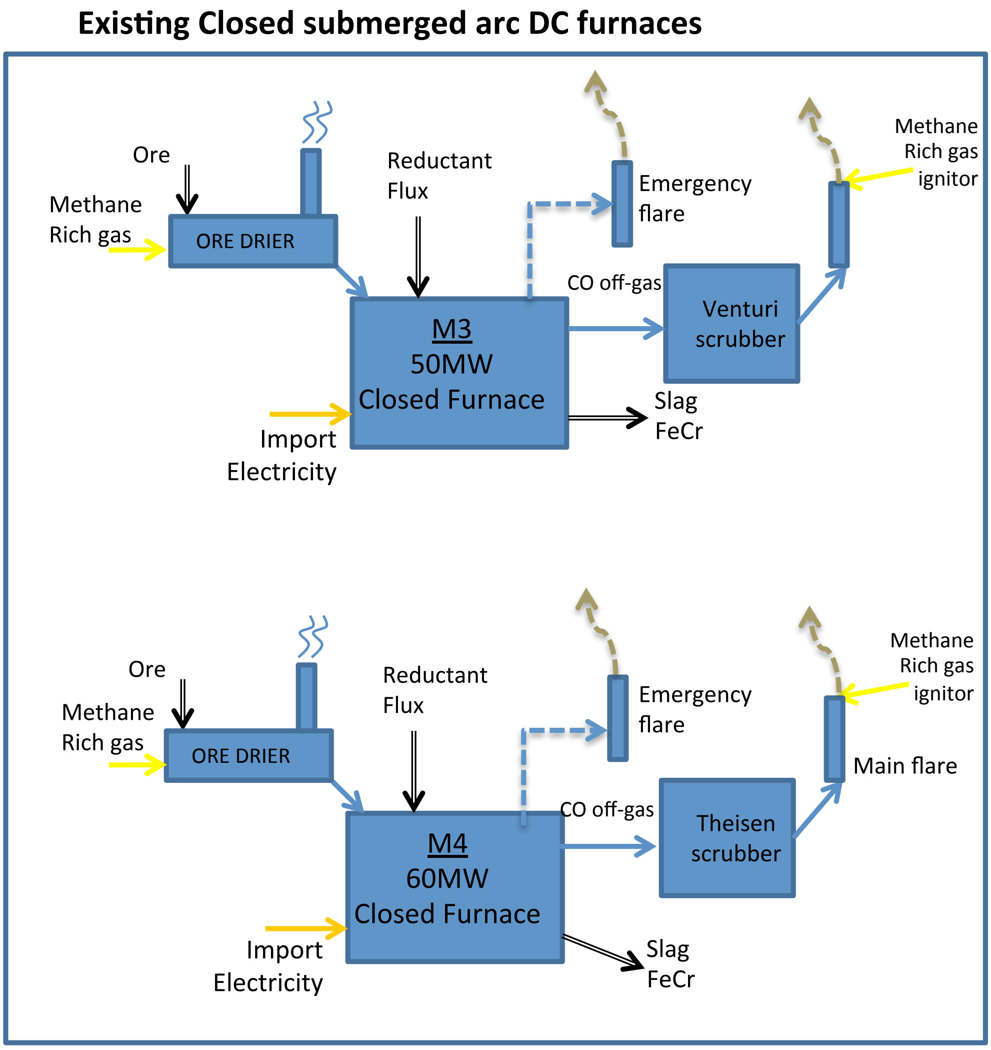
Figure 2 below provides a layout of the existing gas reticulation system at MFC.

[12] Appendix 6 Jenbacher Specification Sheet_620_F57MFC, page 1

[13] Appendix 36 for the design P&IDs for the furnaces

[14] Appendix 8 Technology Supplier information and specification document (GLPS)

Figure 2: Layout of the existing waste gas reticulation system for M3 and M4 furnaces at MFC



Information about the existing Furnaces M3 and M4

Table 1: Equipment information for the current scenario at MFC

		Parameter Description	
i.	Age and average lifetime of the furnaces and gas cleaning equipment	Report provided by furnace expert company GLPS to confirm that the lifetime of the furnaces M3 and M4 and the gas cleaning equipment is in excess of 20 years. [15]	
ii.	Existing and forecast installed capacities for the existing furnaces and gas cleaning plants that produce the waste gas	Furnace M3: Furnace design specifications[16] are provided by the technology supplier (GLPS)[17]. Capacity: 50 MW Production Output: 84,000 tons/year Electricity consumption: 4.5 MWh/ton Design Availability: 92% Design Utilisation: 94 % Gas Cleaning equipment: Howden Venturi Scrubber	Furnace M4: Furnace design specifications[18] are provided by the technology supplier (GLPS)[19]. Capacity: 60 MW Production Output: 101,000 tons/year Electricity consumption: 4.5 MWh/ton Design Availability: 92 % Design Utilisation: 94 % Gas Cleaning equipment: Theisen Disintegrator Plant
iii.	The monitoring equipment and their location in the system	Existing meters and analysers that are installed on the existing furnace and off-gas system: - Gas composition of the off-gas (CO and H_2) is measured with two analysers[20].	
iv.	The types and levels of services (normally in terms of mass or energy flows) provided by the systems and equipment that are being installed under the project activity and their relation, if any, to other manufacturing/production equipment and systems outside the	- The type of service delivered by the project activity is electricity. - The level of service is 224,596 MWh (refer to the financial model, Sheet: Inputs_Production, Cell F149). - Equipment required in the waste gas recovery plant will include: 20 General Electric Jenbachers internal combustion engines with closed circuit radiators and exhaust silencers, CO fans, a flare, flame arrestors, gas filters, gas coolers, instrumentation and control equipment, piping to route the off-gas to the engines, a control room, ablution facilities and offices - There is no relation between the type and level of service or the equipment installed with other manufacturing or production	

[15] Appendix 9 Lifetime of equipment – GLPS report

[16] Detailed Specifications for the furnaces are confidential and will be submitted to the validator only

[17] Appendix 8 Technology Supplier information and specification document (GLPS)

[18] Detailed Specifications for the furnaces are confidential and will be submitted to the validator only

[19] Appendix 8 Technology Supplier information and specification document (GLPS)

[20] Appendix 45 P&ID showing the analysers installed on the waste gas system

	Parameter Description
project boundary.	equipment outside the project boundary.
v. Explain how the same types and levels of services provided by the project activity would have been provided in the baseline scenario.	The electricity will be provided by Eskom via the national grid in the baseline scenario.

A.4.3.4 The scope of measures that are being implemented within the project activity, with a list of the equipment and systems that will be installed

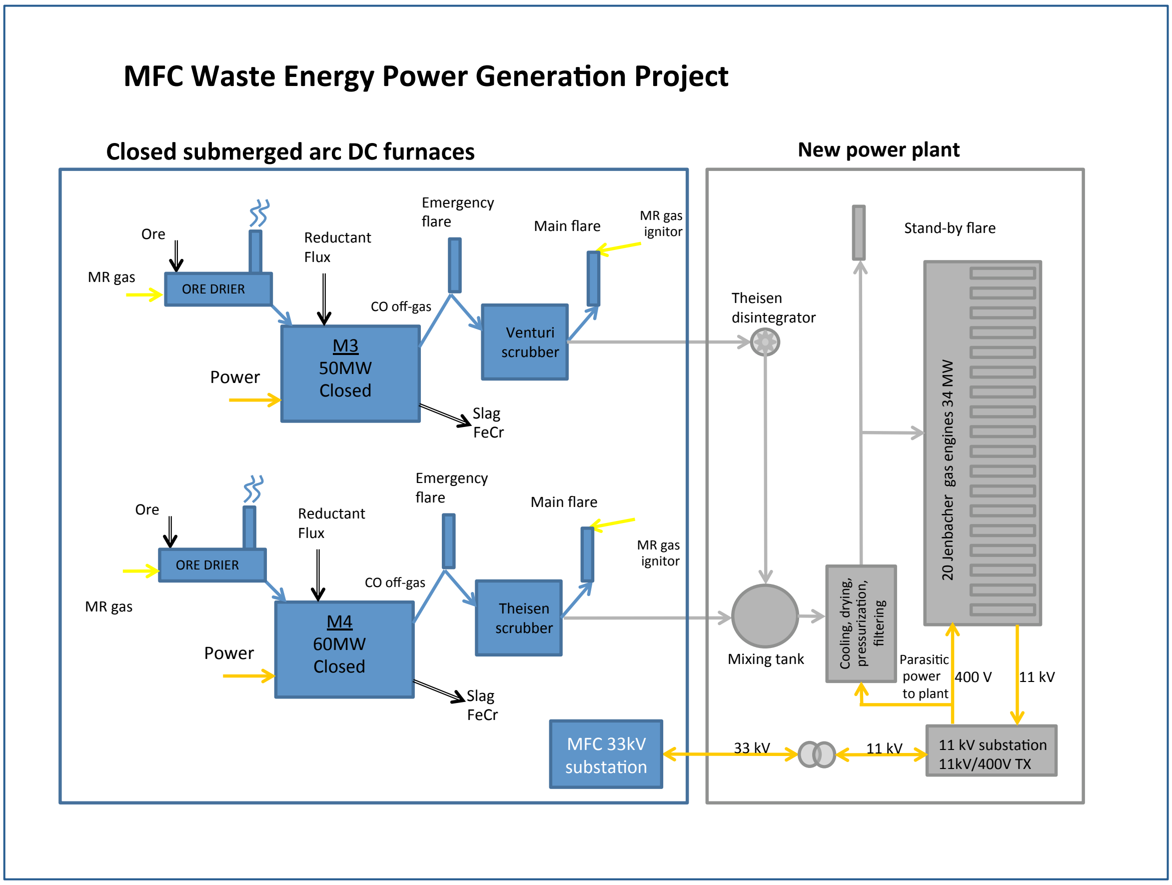


Figure 3: Proposed Power Generation Plant at MFC

Figure 3 provides a layout of the proposed power generation system at MFC.

Description of the proposed power generation plant at MFC

Waste gas from M3 and M4 furnaces will be directed into the proposed waste gas recovery plant to generate electricity. Equipment required in the waste gas recovery plant will include: internal combustion engines with closed circuit radiators and exhaust silencers, CO fans, a flare, flame arrestors, gas filters, gas coolers, instrumentation and control equipment, piping to route the off-gas to the engines, a control room, ablution facilities and offices. Refer to Appendix 10 for a comprehensive list of new equipment that will be implemented in the project activity.

The main equipment is the following:

1. Internal combustion engines

The electricity will be generated using 20 new GE Jenbacher internal combustion gas engines. The internal combustion gas engines are spark ignition engines operating on the same principles as normal petrol engines. The guaranteed electrical output for the gas engines is 1.698 MW. The project activity will use as much of the off-gas that is currently flared in the internal combustion gas engines as possible. Table 2 shows the design parameters for the preferred gas engines.

Information regarding the preferred technology (GE Jenbacher gas engines)

- **i.** Average lifetime of the equipment based on manufacturer's specifications is 120,000[21] hours.
- **ii.** Existing and forecast installed capacities, load factors and efficiencies.

Table 2: Design parameters for the gas engine preferred technology (refer to Appendix 6, Jenbacher specification sheet)

Manufacturer		GE Jenbacher
Engine type		J 620 GS-E53
Working principle		4-Stroke
Configuration		V 60°
No. of cylinders		20
Bore	mm	190
Stroke	mm	220
Piston displacement	lit	124,75
Fuel gas LHV	kWh/Nm³	2,9
Energy input	kW	4.589
Gas volume	Nm³/h	1582
Electrical output	kW el.	1.698
Spec. fuel consumption of engine	kWh/kWh	2,62
Electrical efficiency	%	37,0%

- **iii.** The monitoring equipment and their location in the system are described in Section 7.2.3.
- **iv.** The types and levels of service: Jenbachers will be implemented delivering an estimated 224,596

[21] Appendix 1 Letter from Gas Engine Supplier confirming the lifetime of the gas engines

MWh per year[22].

v. In the baseline scenario, the electricity would be delivered by the national grid.

2. Gas conditioning equipment

Figure 3 describes the layout of the proposed gas cleaning plant.

Please refer to Appendix 10 for a comprehensive list of equipment, including the equipment that will be installed for gas conditioning.

3. The estimated load factor for the power generation system

The load factor or capacity factor for the power generation system was calculated by independent engineering expert TWP by multiplying the gas availability (%), scheduled engine downtime (%) and utilization (average capacity in MW over design capacity in MW). The power system design load factor is described in Appendix 11, pages 7,8 and 10.

The determination of the parasitic load is demonstrated in Appendix 7.

A.4.3.5 The baseline scenario with an indicative list of the equipment and systems that would have been in place in the absence of the project activity.

In the case of this project activity, the existing scenario and the baseline scenario is the same, so the information for the baseline scenario is provided under A.4.3.3.

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

Year	Annual estimation of emission reductions in tonnes of CO_2e
1	210,138.7
2	210,138.7
3	210,138.7
4	210,138.7
5	210,138.7
6	210,138.7
7	210,138.7
8	210,138.7
9	210,138.7
10	210,138.7

[22] Gross energy, not accounting for parasitic load of the power plant. The net energy delivered is 212,691 MWh (Financial spreadsheet, Sheet "Inputs_Production', Cell F169)

Year	Annual estimation of emission reductions in tonnes of CO_2e
Total estimated reductions (tonnes of CO_2e)	2,101,387
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	210,138.7

A.4.5. Public funding of the project activity:

No public funding has been used in the development of this project and no public funding will be used in its implementation. Official Development Assistance (ODA) has not and will not be used in the development and implementation of this project.

SECTION B. Application of a baseline and monitoring methodology

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

1. Approved consolidated baseline and monitoring methodology ACM0012 "Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects", Version 4.0.0.

This methodology also refers to the latest approved versions of the following tools:

2. "Tool to calculate the emission factor for an electricity system", Version 02.2.1;
3. "Tool for the demonstration and assessment of additionality", Version 06;
4. "Tool to determine the remaining lifetime of equipment", Version 01;

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

The following table summarises the applicability criteria for projects using ACM0012. Applicability criteria from the various Tools that are applied in the PDD are also provided.

This project activity meets all of the criteria – this is justified in the table below.

The consolidated methodology is applicable to project activities implemented in an existing facility converting waste energy carried in identified WECM stream(s) into useful energy. In this project activity, the WECM is waste gas produced in existing ferrochrome furnaces.

Demonstration that the proposed project activity complies with the Applicability Criteria from ACM0012

Applicability Condition from ACM0012	**Comment on whether the Applicability Criteria applies to the project activity. If it applies, a discussion is provided to demonstrate how the project activity complies with the criteria.**	**Summary of Applicability of the project activity to the criteria**
The WECM stream may be an energy source for: • Generation of electricity; • Cogeneration; • Direct use as process heat source; • Generation of heat in element process; • Generation of mechanical energy; or • Supply of heat of reaction with or without process heating.	The waste gas will be utilised for the generation of electricity only. Reference material: Feasibility study confirms that the scope of the project activity is the generation of electricity only and this is again supported by the cost analysis of the project activity.	Project activity complies with the criteria.
In the absence of the project activity, the WECM stream: 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 unutilised at the existing or Greenfield project facility.	In the case of the proposed project activity, condition (a) applies, it is in the absence of the project activity, the waste gas would not be recovered and would be flared and remain unutilized. The waste gas is currently flared. Reference material: 1. Technical Design • The waste gas has to be flared and cannot be vented to atmosphere without combustion due to safety reasons. Carbon monoxide is a very poisonous gas, colourless, odourless and tasteless. CO creates an explosive gas mixture with air at a content of 12-75 %. Ignition takes	Project activity complies with the criteria.

Applicability Condition from ACM0012	Comment on whether the Applicability Criteria applies to the project activity. If it applies, a discussion is provided to demonstrate how the project activity complies with the criteria.	Summary of Applicability of the project activity to the criteria
	place even with a very small energy spark, < 1 mJ, like the static electricity felt by man (refer to Appendix 2[23], page 75, last paragraph). For these reasons, the high concentration CO gas has to flared and cannot be vented without combustion. • To comply with safety laws, the working environment in the industrial facility is equipped with a CO-alarm system to detect any possible CO leakages. Two different alarm limits are normally used, which give an alarm both locally and to the control rooms. In addition, personal portable meters are used by all employees, in which the normal alarm limit is 50 ppm. 2. The Atmospheric Pollution Prevention Act No 45 of 1965 requires that the waste gas be flared. The regulatory permit requires that MFC reports abnormal or emergency situations in which venting of un-combusted waste gas occurs. (Refer to Appendix 3 page 26[24] & Appendix 4 page 21[25]).	

[23] Appendix 2_ FORMATION, CHARACTERISTICS AND UTILISATION OF COGAS FORMED IN FERROCHROMIUM SMELTING, Proceedings: Tenth International Ferroalloys Congress; 1 ñ 4 February 2004, INFACON X: “*Transformation through Technology*” Cape Town, South Africa, ISBN: 0-9584663-5-1, P. Niemelä, H. Krogerus and P. Oikarinen

[24] Appendix 3_Air Pollution Prevention Act Licence Conditions 2010, page 26, Section 7.5

[25] Appendix 4_Air Quality Annual Report 2011_Middelburg, page 21 of 22 shows where MFC reported venting incidents to the Department of Environment as

Applicability Condition from ACM0012	Comment on whether the Applicability Criteria applies to the project activity. If it applies, a discussion is provided to demonstrate how the project activity complies with the criteria.	Summary of Applicability of the project activity to the criteria
	3. An independent expert assessment was conducted by furnace and gas cleaning equipment expert GLPS (Refer to Appendix 22) that confirms that the waste gas that will be used to generate electricity in the project activity is currently flared and that it is not used for any other purpose in the industrial facility[26]. The expert report contains (1)An assessment of audited financial statements to demonstrate that all the energy required for the process has been procured commercially and (2) P&IDs (Technical design drawings of the plant) confirms that the waste gas was designed for flaring. 4.The supplementary validator site visit will confirm that no waste gas recovery equipment is installed on the site and that the waste gas is flared. 5. A declaration by the Samancor Ltd Financial manager that the waste energy is not exported. (Refer to Appendix 55)	
Project activities improving the WECM recovery may: (i) capture and utilise a larger quantity of WECM stream as	(i) Currently, no waste gas is recovered (Refer to Appendix 8, page 2, 4th paragraph and Appendix 22_Waste Gas	Project activity complies with the criteria.

[26] Appendix 22 Waste Energy Assessment Expert Report

Applicability Condition from ACM0012	Comment on whether the Applicability Criteria applies to the project activity. If it applies, a discussion is provided to demonstrate how the project activity complies with the criteria.	Summary of Applicability of the project activity to the criteria
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".	Assessment Report). The proposed project activity will improve the waste gas recovery, i.e. the project activity captures and utilises a larger quantity of waste gas stream as compared to the historical situation in existing facility. Also refer to Appendix 45 (P&IDs) to confirm that the plant was designed to flare all waste gas produced in furnaces M3 & M4 (251P-0-0120, Howden Venture Scrubber Drawings) (ii)The project activity does not replace, modify or expand any waste energy recovery equipment and it does not implement more energy efficient equipment, therefore condition (ii) does not apply to the proposed project activity. No waste energy recovery equipment is installed in the plant. Refer to the supporting documentation: (Refer to independent study report in Appendix 22 and Appendix 45_P&IDs to confirm that the plant was designed all waste gas produced in furnaces M3 & M4 (251P-0-0120, Howden Venture Scrubber Drawings).	
The methodology is applicable under the following conditions: • 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;	This applicability condition does not apply to the project activity, as the project activity is not recovering waste pressure.	Not applicable to the project activity

Applicability Condition from ACM0012	**Comment on whether the Applicability Criteria applies to the project activity. If it applies, a discussion is provided to demonstrate how the project activity complies with the criteria.**	**Summary of Applicability of the project activity to the criteria**
• Regulations do not require the project facility to recover and/or utilize the waste energy prior to the implementation of the project activity;	There are no regulations in South Africa that require MFC to recover and/or utilize the waste gas prior to the implementation of the project activity. Please see National Environment Management: Air Quality Act 39 of 2004[27]. The Act does not require the plant to recover or utilize waste gas.	Project activity complies with the criteria.
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;	• The proposed project activity will be implemented at an existing industrial facility. • The production capacity of the furnaces M3 and M4 that produce ferrochrome is NOT expanded as a result of the project activity. – The scope of the project activity does not include any modification to the existing furnaces (refer to the Technical Feasibility Study in Appendix 11). The scope of the project is to utilise the waste gas produced in the furnaces after it has gone through the gas handling plant and therefore the project activity has no direct or indirect impact on the furnace operation or capacity. – The Environmental Impact Assessment confirms that the scope of the project activity is only to	Project activity complies with the criteria.

[27] Appendix 38: National Environment Management: Air Quality Act 39 of 2004; http://www.environment.gov.za/PolLeg/Legislation/2006Jan10/NEM_Air_Quality_Management_Act_(Act39_0f_2004).pdf

Applicability Condition from ACM0012	Comment on whether the Applicability Criteria applies to the project activity. If it applies, a discussion is provided to demonstrate how the project activity complies with the criteria.	Summary of Applicability of the project activity to the criteria
	utilise the waste gas from the furnaces in a new waste gas to electricity power plant. The scope does not include any modification to Furnaces M3 and M4. Refer to Appendix 35_EIA_Draft Scoping report Samancor Chrome Plant_MFC.pdf.	
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.	Abnormal and upset conditions at the power plant will be as a result of fluctuations in off gas quality (composition and temperature) or quantity (pressure). Fluctuations in these parameters always involve the de-loading or stopping of engines due to the automated engine protection systems that are part of the plant design and will thus result in a reduction or stoppage of electricity generation. Other protection systems that will also stop or de-load the engines are engine room temperature control, cooling water temperature control and the fire detection system. During abnormal conditions the waste gas is flared through the stack as is done in the current scenario. The waste gas will not be routed to the engines during these conditions as the engines will be de-loaded or stopped and therefore electricity will not be produced during abnormal conditions and emissions reductions will not be claimed.	Project activity complies with the criteria.
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	No waste energy from waste gas is currently recovered for any purpose/application on site. All energy needed for the MFC process is imported/purchased from external sources. The recovery of	Project activity complies with the criteria.

Applicability Condition from ACM0012	Comment on whether the Applicability Criteria applies to the project activity. If it applies, a discussion is provided to demonstrate how the project activity complies with the criteria.	Summary of Applicability of the project activity to the criteria
not be reduced due to the implementation of CDM project activity. For such situations, the guidance provided in Annex 3 shall be followed.	waste gas will therefore not reduce the recovery of any other waste gas stream produced in the MFC process. Please refer to the reference documentation in the second applicability criteria where it is demonstrated that no waste gas is recovered without the project activity.	
The methodology is **<u>not</u>** 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.	No waste gas is recovered for heat of reaction purposes. This condition does not apply to the project activity.	Not applicable to the project activity
This methodology is also **<u>not</u>** 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.	The project activity is implemented in a ferrochrome industrial facility, NOT in a single-cycle power plant.	Not applicable to the project activity
The emission reduction credits can be claimed up to the end of the lifetime of the waste energy generation equipment. The remaining lifetime of the equipment should be determined using the latest version of the “Tool to determine the remaining lifetime of equipment”.	The remaining lifetime of the chrome furnaces and the waste gas cleaning plant is determined by applying the “Tool to determine the remaining lifetime of equipment”, version 01. Option (b) as defined in the Tool is applied, i.e. the project participants obtained an expert evaluation for the lifetime of the existing waste gas production and cleaning	Project activity complies with the criteria.

Applicability Condition from ACM0012	Comment on whether the Applicability Criteria applies to the project activity. If it applies, a discussion is provided to demonstrate how the project activity complies with the criteria.	Summary of Applicability of the project activity to the criteria
	plants[28].	
The extent of use of waste energy from the waste energy generation facilities in the absence of the CDM project activity will be determined in accordance with the procedures provided in Annex 1 (for Greenfield project facilities) and in Annex 2 (for existing project facilities) to this methodology.	No waste gas is used on site in the absence of the project activity. A Waste Gas Assessment Report was compiled based on an independent expert study (Refer to Appendix 22). The study confirmed that no waste gas is used on the site in the absence of the project activity.	Project activity complies with the criteria.

[28] Appendix 9 Lifetime of equipment, GLPS report

Table 3: Applicability conditions defined by the Tools applied in the PDD

Applicability Condition from the Tools that are applied in the PDD	Discussion of how the criteria applies to the project activity and how the project activity complies with the requirement	Applicability
"Tool to calculate the emission factor for an electricity system", Version 02.2.1 - This tool may be applied to estimate the OM, BM and/or CM when calculating baseline emissions for a project activity that substitutes grid electricity, i.e. where a project activity supplies electricity to a grid or a project activity that results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects). (Refer to page 2 of the Tool under "Scope and applicability")	The project activity substitutes grid electricity.	Project activity complies with the criteria.
In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country. (Refer to page 2 of the Tool under "Scope and applicability")	The project electricity system is located in South Africa, which is not an Annex I country. Also, none of the neighbouring countries around South Africa are Annex I countries.	Project activity complies with the criteria.
Methodologies referring to this tool should clearly specify for which equipment the remaining lifetime should be determined. The remaining lifetime of relevant equipment shall be determined prior to the implementation of the project activity. Project participants using this tool shall document transparently in the CDM-PDD how the remaining lifetime of applicable equipment has been determined, including (references to) all documentation used. (Source: Page 1 of the Tool)	- This criteria applies to methodologies and not to PDDs. - The remaining lifetime of the existing furnaces and waste gas cleaning equipment have been confirmed by an independent expert GLPS, prior to implementation of the project activity. The evaluation report (Appendix 9) was received in May and the handover after commissioning of the project activity is expected to occur in January 2014 only. - The lifetime of the existing equipment that produce the	Does not apply to the project activity Project activity complies with the criteria. Project activity

Applicability Condition from the Tools that are applied in the PDD	Discussion of how the criteria applies to the project activity and how the project activity complies with the requirement	Applicability
	waste gas and clean the waste gas have determined by an independent expert. (Refer to Appendix 9) - Option (b) "Obtain an expert evaluation" has been applied.	complies with the criteria.
Under this tool, impacts on the lifetime of the equipment due to policies and regulations (e.g. environmental regulations) or changes in the services needed (e.g. increased energy demand) are not considered. Methodologies referring to this tool shall, where applicable, provide specific guidance on how regulations that warrant the replacement of the equipment before it has reached the end of its technical lifetime should be addressed. (Source: Page 1 of the Tool)	There are no regulations or policies in South Africa that impact the lifetime of ferrochrome furnaces. Also, any increase or decrease in the ferrochrome demand impacts on the production from the furnaces, but has no impact on the remaining lifetime of the furnaces. The lifetime of furnaces depends only on the quality of maintenance that is conducted.	Project activity complies with the criteria.

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

As per methodology ACM0012, the geographical extent of the project boundary shall include the relevant waste energy stream(s), equipment and energy distribution system in the following facilities:
(1) The project facility (Exxaro On-Site energy recovery plant);
(2) The recipient facility receiving the electricity (MFC).

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

As defined in ACM0012, the relevant equipment and energy distribution system covers:
• In the project facility where the electricity generation occurs (Exxaro On-Site), the waste gas streams from the gas cleaning plants for furnaces M3 & M4, waste gas condition plant and the power generation plant.
• In a recipient facility (MFC), the transformers or busbars where the electricity is fed into.
In particular, the following are included:

- The furnaces generating the furnace off-gas;
- The proposed electricity generation plant, which will generate electricity from the furnace off-gas;
- The facility using the electricity (MFC), which in this case is the same as the facility generating the furnace off-gas; and
- The national electricity grid, to the extent of determining the grid emission factor.

The project boundary is illustrated in Figure 4 below:

Figure 4: Project activity boundary

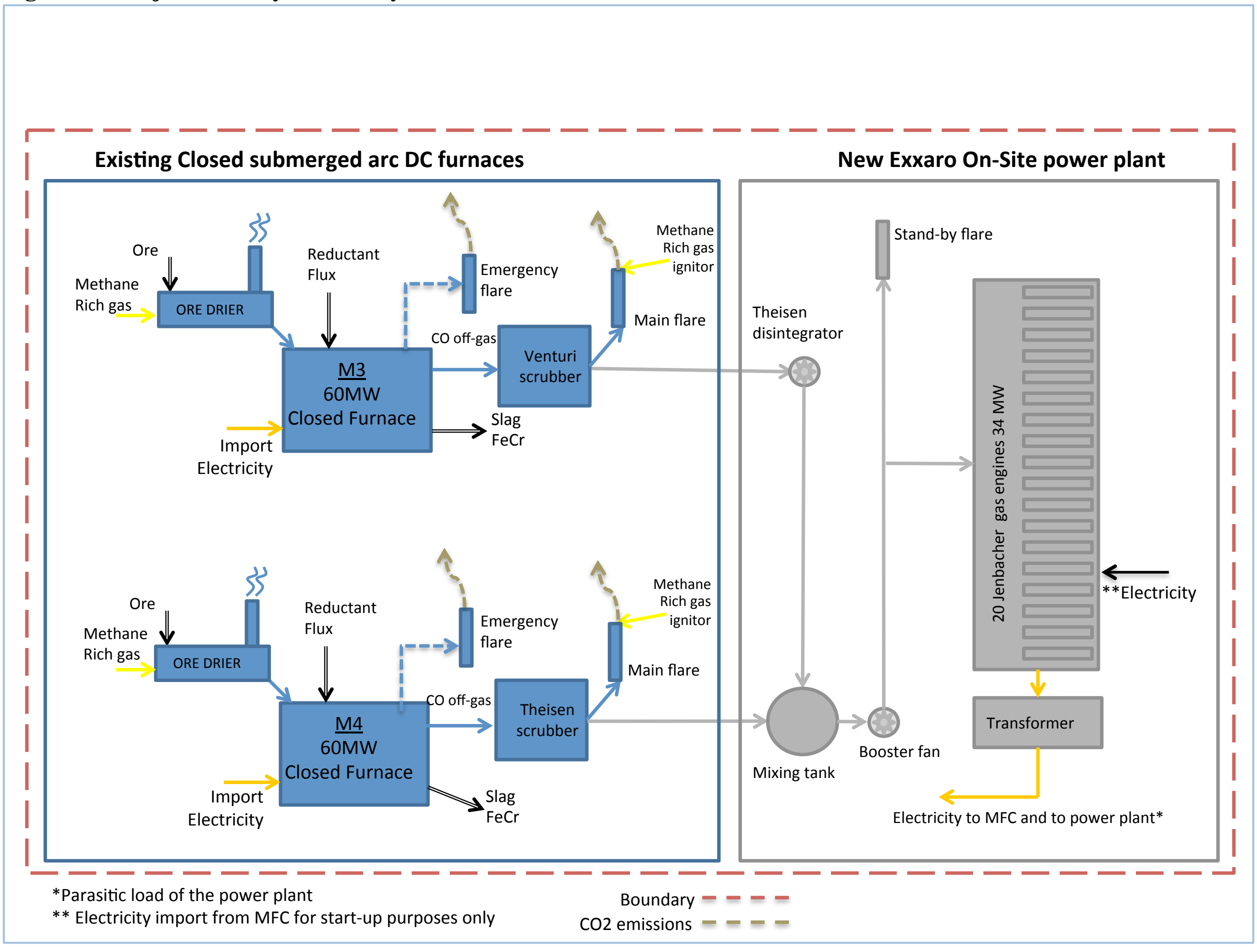


Table 4: Summary of gases and sources included in the project boundary and justification explanation where gases and sources are not included

	Source	Gas	Included?	Justification / Explanation
Baseline	Electricity generation, grid or captive source	CO_2	Included	Main emission source.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Fossil fuel consumption in element process for thermal energy	CO_2	Excluded	Not applicable. The project activity does not involve the generation of thermal energy from waste gas.
		CH_4	Excluded	Not applicable. The project activity does not involve the generation of thermal energy from waste gas.

	Source	Gas	Included?	Justification / Explanation
		N_2O	Excluded	Not applicable. The project activity does not involve the generation of thermal energy from waste gas.
	Fossil fuel consumption in cogeneration plant	CO_2	Excluded	Not applicable. The project activity does not involve cogeneration.
		CH_4	Excluded	Not applicable. The project activity does not involve cogeneration.
		N_2O	Excluded	Not applicable. The project activity does not involve cogeneration.
	Baseline emissions from generation of steam used in the flaring process, if any	CO_2	Excluded	Not applicable. Steam is not used in the flaring process.
		CH_4	Excluded	Not applicable. Steam is not used in the flaring process.
		N_2O	Excluded	Not applicable. Steam is not used in the flaring process.
Project Activity	Fossil fuel consumption for supply of process heat and/or reaction heat	CO_2	Excluded	Not applicable to the project activity.
		CH_4	Excluded	Not applicable to the project activity.
		N_2O	Excluded	Not applicable to the project activity.
	Supplemental fossil fuel consumption at the project plant	CO_2	Excluded	No supplemental fossil fuel is used at the project plant.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
	Supplemental electricity consumption	CO_2	Included	Main emission source. Supplemental electricity consumption from the national grid (provided through MFC) during start-up of the engines if all engines are down.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
	Electricity import to replace captive electricity, which was generated using waste energy in absence of project activity.	CO_2	Excluded	Not applicable. The baseline does not involve captive electricity and no electricity is generated from waste gas in the absence of the project activity.
		CH_4	Excluded	Not applicable. The baseline does not involve captive electricity and no electricity is generated from waste gas in the absence of the project activity.
		N_2O	Excluded	Not applicable. The baseline does not involve captive electricity and no electricity is generated from waste gas in the absence of the project activity.

	Source	Gas	Included?	Justification / Explanation
	Energy consumption for gas cleaning	CO_2	Included	The electricity consumption for gas cleaning will be provided by the proposed power plant and this electricity will be accounted for as part of the parasitic load of the power plant.
		CH_4	Excluded	Excluded for simplification
		N_2O	Excluded	Excluded for simplification

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

Identification of the baseline scenario

The baseline scenario is identified as the most plausible baseline scenario among all realistic and credible alternative(s). (page 6/60, ACM0012).

Realistic and credible alternatives are determined for:

- Waste gas use in the absence of the project activity;
- Power generation in the absence of the project activity for MFC;

There is only one recipient facility in the project activity, i.e. MFC. The information on the utilization of electricity in the absence of the CDM project activity is sourced from MFC and the information on the utilization of the waste gas in the absence of the CDM project activity will be sourced from the project facility, which is implemented by the project proponent, Exxaro On-Site, and from the recipient facility MFC.

Hence, the CDM project proponent (Exxaro On-Site) determines the baseline options, identifies the most appropriate baseline scenario, determines the baseline fuel and demonstrates and assesses additionality in consultation with the recipient facility (MFC) and the project facility (Exxaro On-Site).

Identification of the project facility: Exxaro On-Site will own and operate the project facility, i.e. the facility where the waste gas conditioning and power generation equipment will be implemented.

Identification of the recipient facility: MFC is the recipient facility because the electricity will be supplied to the MFC plant, thereby reducing their electricity consumption from the national grid managed by the national utility Eskom. No backup electricity generation equipment (such as diesel generators) are installed for the furnaces, therefore the project activity will only be substituting grid electricity.

The amount of electricity that will be delivered to MFC and displace electricity from the national grid by the project activity is 212,691 MWh, therefore the power alternatives identified will be based on 212,691

MWh. The annual energy equivalent amount of waste gas flared is calculated as 2,750,640[29] GJ, therefore the alternative uses of the waste gas will be based on 2,750,640 GJ waste gas.

The following baseline options are excluded as per the methodology instructions:

- Options that do not comply with legal and regulatory requirements; and
- Options that involve fuels used for the generation of power that are not produced or imported in South Africa.

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

The baseline candidates that are considered are:

- For the waste energy generation MFC where the waste energy is generated; and
- For the recipient facility MFC where the energy is consumed.

The project activity will be implemented on waste gas generated in an existing ferrochrome production facility therefore the following combinations are relevant combinations to be investigated as they represent possible baseline scenarios of an existing facility.

<u>For the use of waste energy the realistic and credible alternative(s) include:</u>

W1: Waste gas is directly vented to the atmosphere without incineration.

The waste gas cannot be vented directly to atmosphere for two reasons: (1) Safety reasons as the gas is poisonous and combustible; and (2) it is a regulatory requirement that the gas must be combusted before emitted to atmosphere due to safety reasons.
(1)The waste gas has to be flared and cannot be vented to atmosphere without combustion due to safety reasons. Carbon monoxide is a very poisonous gas, colourless, odourless and tasteless. CO creates an explosive gas mixture with air at a content of 12-75 %. Ignition takes place even with a very small energy spark, < 1 mJ, like the static electricity felt by man (refer to Appendix 2, page 75, last paragraph).

The working environment is equipped with an alarm system for possible CO leakages. Gas probes control the CO content in selected points. Two different alarm limits are normally used, which give an alarm both locally and to the control rooms. In addition, personal portable meters are used, in which the normal alarm limit is 50 ppm. In alarm cases the working safety instructions are to be complied with.

(2)The Atmospheric Pollution Prevention Act No 45 of 1965 requires that the waste gas be flared. The regulatory air quality permit/license requires that the gas cleaning equipment (including the flare) remain in operation for a minimum of 98% of the time that the furnace is in operation (Refer to Appendix 3[30], page 22). The licence requires that MFC reports abnormal or emergency situations in which venting

[29] Note that this is gas flared, so per definition this gas is available for electricity generation, although the total amount is not usable waste energy, because of the variable quality of the gas/intermittent supply etc. It is calculated by multiplying the average gas available (314 GJ/h from Appendix 11, page 7 of 20) by the hours in the year, so (314 x 365 x 24)

[30] Air Pollution Prevention Act Licence Conditions 2010

occurs. Venting is the release of waste gas to atmosphere un-combusted (Refer to Appendix 3, page 26 and 27) and occurs prior to the gas cleaning equipment.

W1 is therefore not a feasible alternative due to safety and regulatory requirements in South Africa.

W2: Waste gas is released to the atmosphere after incineration.

Flaring has been the historic practise since the commissioning of the furnaces (1996 for M3 and 2008 for M4). There are no regulations that prohibit that the gas be emitted to atmosphere after incineration.

W2 is feasible and has been the current practise.

W3: Waste energy is sold as an energy source.

MFC: Neighbouring industries are Columbus Steel (a stainless steel producer) and Thos Begbie (an alloy castings producer).

- The poisonous nature of the gas makes transfer over the distance between the sites hazardous.
- The low CV of the gas also limits its application possibilities to the extent that none have been identified with the neighbouring industries where high CV and pressure methane rich pipeline gas is already in use (see the two following bullets).
- A study has been done at Columbus Steel and the use of the waste gas was ruled out on practical grounds (Refer to Appendix 24).
- At the neighbouring Thos Begbie plant there is no existing process where the waste gas can be used (Refer to Appendix 19).

Thus, Alternative W3 is excluded from further consideration.

W4: Waste energy is used for meeting energy demand at MFC

MFC – Description of energy demand (heat and electricity)

Heat energy: Imported methane rich gas (from Sasol) is used for providing heat for pellet sintering and ore drying. Waste gas is not used for these purposes, because the temperature necessary for sintering and drying cannot be effectively maintained if waste gas is used, due to the low and fluctuating calorific value and pressure of the waste gas coming from furnaces M3 and M4. Methane rich gas with a high CV[31] and pressure pipeline gas is available on site and this is used for the sintering and ore drying processes. There is no other heat demand in the process (no preheaters are installed on the furnaces - Refer to GLPS report, page 2).

Electricity – The waste gas has to be recovered and cleaned and converted to electricity before it replaces some of the electricity demand of the site. This is the proposed project activity not undertaken as a CDM project activity and is described under P1.

W4 is therefore not a feasible alternative. P1 describes the waste gas recovery to electricity generation not as a CDM project. So the electricity component of W4 = P1.

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[31] Appendix 15 CV of methane rich gas, accessed 06/02/2012, http://www.sasol.com/sasol_internet/frontend/navigation.jsp?navid=5800002&rootid=600000&productId=4400001&pnav=products%20a-z&cnav=pipeline%20gas

W5: A portion of waste gas 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/ unutilised.

MFC: The option of using of a portion of waste gas for generation of heat energy is not a realistic scenario as described under W4.

The only mechanical energy requirements on the site are for drives for rotating equipment, i.e. fans, pumps, conveyors and feed screws. Electrical motors are used in all these applications because of ease of installations, small footprint, safe operation, ease and accuracy of control and reliability.

Replacing an electrical drive (motor) with a waste gas fuelled drive (gas engine or turbine) is not feasible at MFC for the following reasons:

a) Installation of a gas engine or turbine also requires the installation of:

- Gas supply pipelines and control stations
- Cooling water system
- Lubrication and combustion oil systems.
- Nitrogen supply system (safety and purging for maintenance)
- Ventilation systems
- Enclosure (for ventilation control)

The subsequent footprint (m^2/kW) and cost/unit output (ZAR/kW) is thus orders of magnitude larger than for an electric motor which only requires an electric cable connection.

b) The presence of the highly combustible gas at all the mechanical energy requirement locations on the site has been identified as a high and unacceptable safety risk, because of the high possibility of explosions in locations where employees work.

c) The mechanical drive applications require sophisticated and accurate control and reliability for steady plant operations. The variability of the gas quality (see Appendix 70_M3&4 gasplant analysis - trends) and gas availability will severely impact on steady plant operations.

W5 is therefore not a feasible alternative and is excluded from further consideration.

W6: All the waste energy produced at MFC is captured and used for export electricity generation or steam.

<u>Export of Electricity</u>

To export electricity to the national grid a Power Purchase Agreement has to be negotiated between the facility and Eskom. There is no regulatory or administrative process that can be followed to arrange a long term (10 to 15 year) PPA between Eskom and the ferrochrome facility (Refer to Appendix 48).

Therefore, producing and exporting electricity to the national grid is not a feasible option as long term PPAs cannot be secured.

Steam demand on MFC site

There is no steam demand at MFC.

Steam export

Steam can only be produced when the furnaces are in operation, because waste gas is only produced when the furnaces are in operation. Columbus, the only neighbouring industry that use steam, has conducted an investigation into the possible utilisation of steam generated by the waste gas and the option was rejected. (Please refer to Appendix 24 where Columbus confirms that they cannot make use of such an option).

Therefore, producing and exporting steam to the neighbouring facility is not a feasible option.

Table 5: Summary of alternative baseline scenarios for waste gas use and outcomes

	Description of the alternative	**Summary of the investigation**
W1:	Waste gas is directly vented to the atmosphere without incineration	Not permitted in South Africa
W2:	Waste gas is released to the atmosphere after incineration	Current permit allows for this situation. This is also the prevailing practise and the current scenario.
W3:	Waste energy is sold as an energy source	Not feasible
W4	Waste energy is used for meeting energy demand at the MFC;	Heat – not feasible to utilise the flared waste gas to meet the heat demand on the site. Electricity – The waste gas has to be recovered and cleaned and converted to electricity before it replaces some of the electricity demand of the site. This is the proposed project activity not undertaken as a CDM project activity. This is also the scenario discussed under P1.
W5:	A portion of the quantity or energy of waste gas is recovered for generation of heat, while the rest of the waste energy produced at the project facility is flared/released to atmosphere/ unutilised;	Not feasible
W6:	All the waste energy produced at the facility is captured and used for export electricity generation or steam.	Not feasible to produce and Export electricity to the national grid, because the cost of producing the electricity is higher than what it can be sold for to the national utility. Producing and export steam to the neighbouring facility is not a feasible

		option, because of the uncertain supply.

For power generation the realistic and credible alternative(s) include*:*

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.

P1 is carried to the Step 2.

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

There is no existing fossil fuel based cogeneration plant on-site or off-site at the MFC.

Therefore, P2 is not a realistic and credible alternative.

P3: On-site or off-site Greenfield fossil fuel fired cogeneration plant;
There is no demand for steam at the MFC site. Therefore a new cogeneration plant cannot replace the thermal demand at the MFC site. [Elaborate]

Therefore, P3 is not a realistic and credible alternative.

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

There is no existing renewable energy based cogeneration plant on-site or off-site at the MFC.

Therefore, P4 is not a realistic and credible alternative.

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

The realistic renewable energy sources that could be considered are biomass, solar and wind.

There is no steam demand at MFC and the neighbouring industries do not need additional steam supply. Therefore, constructing a cogeneration plant is not feasible as there is no demand for the steam.

Therefore, P5 is not a realistic and credible alternative.

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

There is no existing fossil fuel based captive power plant on-site or off-site at the Middelburg.

Therefore, P6 is not a realistic and credible alternative.

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

There is no existing renewable energy or other waste energy based captive power plant on-site or off-site at MFC.

Therefore, P7 is not a realistic and credible alternative.

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

The fossil fuel that is available is coal. This alternative is considered further in Step 2.

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

The potential renewable energy sources considered are biomass, hydro, wind and solar.
The production of electricity from biomass, wind, solar and hydro would be more expensive than purchasing it from Eskom[32] as is indicated when comparing the levelized cost of electricity production. Table 4 in Appendix 18, a report by the National Energy Regulator of South Africa (NERSA) shows the levelized cost for concentrated solar power trough without storage as R3.14/kWh, solid biomass as R1.18/kWh, wind as R1.25/kWh and small hydro as R0.96/kWh etc. Compared to these costs the megaflex tariff is R0.45/kWh[33].

Furthermore, in the case of biomass, sufficient amount of biomass to supply fuel to a biomass cogeneration plant is not available in the vicinity of MFC[34].

Therefore, P9 is not a realistic and credible alternative.

P10: Sourced from grid-connected power plants;

MFC is contracted and has the capacity to obtain all of its required electricity from South Africa's national electricity provider, Eskom. This alternative envisages the continuation of the prevailing practice at the site.

P10 is realistic and can be considered as the most likely baseline scenario for the recipient facility.

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);

There is no existing captive electricity generation using waste energy on the site.

Alternative P11 is not considered as a realistic baseline scenario.

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.

Alternative P12 is excluded from further consideration.

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32 Appendix 18 Table 4, page 10 of 24, National Energy Regulator of South Africa. (2009, October 30). *Decision in the matter regarding Renewable Energy Feed-In Tariffs Phase II by the National Energy Regulator of South Africa*.

33 As of April 2012, Appendix 59.

34 Appendix 17 Biomass Supply around Middelburg Report, Forestry Solutions, 29 March 2012

Table 6: Summary of alternative baseline scnearios for Power generation and description of the outcome

Scenario	Description of alternative scenario	Comments and reference to support documentation
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.*
P2:	On-site or off-site existing fossil fuel fired cogeneration plant;	Not feasible
P3:	On-site or off-site Greenfield fossil fuel fired cogeneration plant;	Not feasible
P4:	On-site or off-site existing renewable energy based cogeneration plant;	Not feasible
P5:	On-site or off-site Greenfield renewable energy based cogeneration plant;	Not feasible
P6:	On-site or off-site existing fossil fuel based existing identified captive power plant;	Not feasible
P7:	On-site or off-site existing identified renewable energy or other waste energy based captive power plant;	Not feasible
P8:	On-site or off-site Greenfield fossil fuel based captive plant;	Carried over for further investigation
P9:	On-site or off-site Greenfield renewable energy or other waste energy based captive plant;	Not feasible
P10:	Sourced from grid-connected power plants;	Current scenario and prevailing practise.
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);	Not feasible
P12:	Existing cogeneration using waste energy, but at a lower efficiency or lower recovery.	Not feasible

Combinations of baseline candidates under different scenarios are presented in Table 7: Combination of realistic baseline candidates

Table 7: Combination of realistic baseline candidates for the waste gas and electricity use

Scenario	Waste gas	Electricity – Recipient facility	Description
1	W2 – Waste gas is flared	P10 – Electricity is imported from the national grid	Current scenario and prevailing practise since the commissioning of the site.
2	W4 – Waste gas is recovered and used to generate electricity	P1 – Electricity is generated from the recovered and conditioned waste gas and used for captive purposes	The proposed project activity not undertaken as a CDM project activity.
3	W2 - Waste gas is flared	P8 – Electricity is produced by a greenfield fossil fuel power plant.	A greenfield fossil fuel plant is implemented to generate electricity whilst waste gas is flared.

Step 2: Step 2 (Investment Analysis) of the "Tool for the demonstration and assessment of additionality" shall be used to identify the most plausible baseline scenarios by eliminating non-feasible options.

Scenario 1, 2 and 3 described in Table 7 are the feasible alternatives that are investigated further to determine the most plausible baseline scenario.

An independent study (Appendix 58_ACE Coal fired power station assessment_Class 4_LCOE) was commissioned in order to establish the levelised cost of producing electricity at a greenfield coal fired power station. The study demonstrated that the levelised cost of generating electricity in a greenfield fossil fuel power plant (P8) at Middelburg is 107.82 Rc/kWh (May-12), which is higher compared to purchasing electricity from the national grid (the existing scenario) at megaflex tariff 0.45[35] Rc/kWh (May-12). The analysis proves that a greenfield fossil fuel power plant is not a plausible baseline scenario, with the result that P8 is eliminated as a plausible baseline scenario at the end of Step 2.

Summary:

The levelised cost of electricity production in a greenfield coal fired power plant is higher than purchasing electricity from the national grid. Therefore, P8 is eliminated as a plausible baseline scenario.

Step 3: If more than one credible and plausible alternative scenario remain, the alternative with the lowest baseline emissions shall be considered as the baseline scenario

This methodology is only applicable if the baseline scenario for the waste energy generator and the recipient facility, is one of the scenarios described in Table 8 below (copied directly from ACM0012, Version 04.0.0, Table 2). Heat and mechanical power is not relevant in this project activity and these have been excluded from the table.

[35] As of April 2012, Appendix 59.

Table 8: Combinations of baseline scenarios applicable under different project situations

Baseline Scenario	Combination of baseline scenarios		Description of project activity
	Waste energy	Power	
Project activity: Separate generation of electricity			
Baseline scenario-1 1. The total waste gas of WECM(s) recovered in the project is flared 2. The electricity is obtained from the grid.	W2	P10	Current scenario and prevailing practise since the commissioning of the furnaces (16 years for M3 that was commissioned in 1996 and 3+ years for M4 that was commissioned in 2008).
Baseline scenario-2 The project activity is undertaken but not as a CDM activity	W4	P1	The project activity is undertaken but not as a CDM activity.

Conclusion

The baseline scenario for the waste gas is continued flaring to atmosphere. The baseline scenario for electricity is the continued import of power from the national grid.

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

The additionality of the project activity shall be demonstrated and assessed using the latest version of the "Tool for the demonstration and assessment of additionality" agreed by the CDM Executive Board, available at the UNFCCC CDM website.[36] The latest version published at the time of compiling the PDD is Version 06.

The project participants will apply the investment analysis for demonstrating additionality.

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

Define realistic and credible alternatives to the project activity(s) through the following Sub-steps:

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

[36] Please refer to: <http://cdm.unfccc.int/goto/MPappmeth>.

From B.4, two realistic and credible alternatives remain:

Scenario 1:

- W2 – Waste gas is flared
- P10 – Electricity is imported from the national grid

AND

Scenario 2:

- W4 – Waste gas is recovered
- P1 – Electricity is generated for captive purposes

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

Both scenarios 1 and 2 meet all legal and regulatory requirements of the host country, South Africa.

Step 2: Investment analysis

Sub-step 2a: Determine appropriate analysis method

The analysis for the project activity will be analyzed through Option III of the additionality tool, i.e. benchmark analysis. This method is applicable because:

§ Option I: simple cost analysis, does not apply as the project generates economic returns through the sale of electricity to MFC. Other than CDM related income, the project produces economic benefit through the sale of electricity generated by the project activity.

§ Option II: Investment comparison analysis is not used, as there is no realistic alternative for the project (provision of power to the grid) involving investments. In other words, the investment comparison analysis is not applicable to the project because the alternative of the project is "Equivalent electricity service provided by the grid", which is not a single project.

§ Option III, benchmark analysis can be transparently demonstrated using financial/economic information for the proposed project activity and compare financial indicators against a relevant industry benchmark hurdle rate.

According to paragraph 19 of Annex 13, EB 62, the benchmark approach is suited to circumstances where the baseline does not require investment or is outside the direct control of the project developer, i.e. cases where the choice of the developer is to invest or not to invest. In the case of this project activity, the baseline is electricity supplied by the national grid and is outside of the control of the project developer.

Conclusion: Option III is applicable to the project activity as transparent data on the project activity and relevant industry benchmark is available. Hence, the benchmark analysis is applied and the Real Equity Internal Rate of Return (IRR) is used to assess the financial viability of the project activity.

Sub-step 2b. Option III. Apply benchmark Analysis

The benchmark analysis as described in the additionality tool prescribes that the project returns should be compared to a benchmark value that is based on "standard returns in the market, considering the specific risk of the project type, but not linked to the subjective profitability expectation or risk profile of a particular project developer". As previously explained, South Africa does not have an established independent power producer market. In the absence of an established independent power producer market in South Africa, the relevant benchmark would be based on the typical minimum required real rate of return for an equity providing investor in a project of this type in South Africa.

The benchmark in the present instance is derived from bankers' views which were obtained for inter alia a waste gas/heat to energy project without a long term PPA under-written by the government. The impact of this is that the absence of a government-backed PPA implies that the project may deliver what could become a stranded asset: If for reasons pertaining solely to the ferrochrome market the off-taker should get to be in financial distress, the ability of the plant to absorb the electricity and continue to pay the agreed price may be compromised.

In the present case bankers' views were received from: Rand Merchant Bank, a division of FirstRand Bank Limited and Cresco Project Finance (Pty) Ltd. (the documentation has been made available to the validators, Appendix 40.1 and Appendix 40.2).

As appears from the bankers' views received, Cresco put the IRR hurdle rate at 25 (nominal equity after tax) while Rand Merchant Bank put it at 25% (nominal equity IRR).

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

(1) Basic parameters for calculation of financial indicators

According to the relevant project documents, the parameters needed for calculation of the real Equity IRR of the project activity are given in the following table.

Table 9: Assumptions made for the financial analysis for the proposed project activity

Parameter	Unit	Value	Source of information to motivate the assumption
Installed design electrical capacity of the power plant	MW	34	1. EOS Decision to Proceed[37] 2. Prana Energy Design Basis Report for MFC, including the TWP Cost Estimate [38]
Hours operation	hours	120,000	1. EOS financial model (Spreadsheet, Inputs_General, Cell L17) 2. Gas Engine Lifetime (Appendix 1)
Net annual power generation	MWh	212,691	EOS Financial Model (Spreadsheet, Inputs_Production, Cell F169)

[37] Appendix 21 EOS Steercom Meeting Procedures, 7 February 2012

[38] Appendix 11 Technical Feasibility Study Report_TWP for MFC, page 3 of 20

Parameter	Unit	Value	Source of information to motivate the assumption
**Plant load factor	%	75.5	1. Financial Spreadsheet, Sheet: Inputs Production, Cell F25 2. Appendix 11, page 10 of 20
Project lifetime	Hours Years	120,000 17 Years 6 months[39]	1. EOS Decision to Proceed (Appendix 21) 2. EOS Financial Model (Financial Spreadsheet, Inputs_Production, Row AC65)
Total Capital Expenditure (CAPEX) plus Mobilisation Cost (Appendix 11 page 15 of 20 provides a description by TWP of how the CAPEX was put together)	South African Rand	537,415,151 plus 20,992,009	(Appendix 11, page 15, 16 and 17) Investment: all capital expenditure including generation equipment, infrastructure, sub-station connection, reciprocating gas engines and all ancillary equipment constituting a complete power station required for reliable long term power generation. Engineering, procurement and construction costs ("EPC") quoted price.
Annual Operation and Maintenance Cost estimate* (Appendix 11 page 17 of 20 and Table and Table 5 in the Report provides a description by TWP of how the OPEX was put together)	South African Rand	15,999,040 (Table 4, Appendix 11) plus R6,682,500 (Table 5, Appendix 11)	Cost Estimate done by Engineering Company TWP (Appendix 11, Table 4 and Table 5)
Income tax rate	%	28%	South Africa Revenue Services (SARS)[40]
Inflation rate	%	5.90%	Nedbank Currency Forecast (June 2011)
Residual Value	Euro	3 million for 20 engines	Jenbacher confirmation, Appendix 14
Debt:Equity	-	70:30	Appendix 57, termsheet

**Indexed by inflation over the life of the project.*

Notes:

[39] Based on the expected lifetime of the gas engines of 120,000 hours (Appendix 1) and the plant load factor described in Appendix 11

[40] Appendix 25 South Africa Revenue Services website (http://www.sars.gov.za/Tools/Documents/DocumentDownload.asp?FileID=44174)

**Plant Load Factor: For design purposes of the plant and for the purpose of estimating the electricity generation for the project, the annual plant load factor is determined by independent expert TWP (Appendix 11). Parameters used are the engine planned uptime (97% - Jenbacher Maintenance Schedule), engine unplanned uptime (Jenbacher specification), and furnace operating rate (Appendix 11, page 7 and 8). The furnace operating rate is determined from multiplying the furnace availability and furnace utilisation design rates. Please refer to Appendix 11 pages 7,8 and 10 for a description of the load factor.

Electricity Price: for the purpose of estimating the electricity price for the project, the average standard price as relevant to MFC is used, indexed by inflation over the life of the project. In February 2010, the NERSA approved Eskom's Multi-Year Price Determination 2 tariff application resulting in a percentage price increase on the average standard electricity tariff in South Africa of 25.8% from April 2011 and a further price increase of 16% was announced from April 2012. After 2012 the increase is set at the forecasted inflation rate.

(2) Comparison of equity IRR for the proposed project activity and the benchmark equity IRR

In accordance with the benchmark analysis, the proposed project is not considered as financially attractive if its financial indicators are lower than the benchmark requirements. The Internal Rate of Return (IRR) on the equity for the project activity serves as a benchmark to assess the financial attractiveness of the project activity.

Equity IRR is considered by the Project Participant to be the appropriate financial indicator for the project activity because:

(i) The Project Participant will decide whether or not to invest in the project and will assess the financial feasibility of the project on the basis of the internal rate of return to its equity investors (consistent with the equity IRR); and

(ii) Equity IRR assumes that you use debt for the project whereas a project IRR calculation assumes that no debt financing is used for the project; the project activity will be funded by both debt and equity.[41]

Table 10 below shows the nominal Equity IRR of the proposed project, without CDM-related income. Without CDM-related income, the nominal Equity IRR is lower than the benchmark and the proposed project is not financially acceptable.

Table 10: Financial analysis result

Scenario	Equity IRR (nominal)
Base Case without CER's	6.42%
Benchmark	25%

[41] Project IRR takes as its inflows the full amount(s) of money that is needed in the project. The outflows are the cash generated by the project. The project IRR is the internal rate of return of these cash flows. Therefore, the project IRR calculation assumes that no debt is used for the project.

The equity IRR assumes that you use debt for the project, as the inflows are the cash flows required minus any debt that was raised for the project. The outflows are cash flows from the project minus any interest and debt repayments.

Sensitivity Analysis

The purpose of the sensitivity analysis is to examine whether the conclusion regarding the financial viability of the proposed project is sound and tenable with those reasonable variations in the assumptions.

The investment analysis provides a valid argument in favour of additionality only if it consistently supports (for a realistic range of assumptions) the conclusion that the project activity is unlikely to be the most financially attractive or is unlikely to be financially attractive.

These sensitivities have been selected as they constitute more than 20% of either total project costs or total project revenues.

- Construction Cost Sensitivity: Sensitivity analysis was run on 100% of the construction cost.
- Electricity Price Sensitivity: The only revenue in the project is electricity revenue, which of course is more than 20% of project renevue.
- Jenbacher Maintenance Cost: This makes up about half of the operational expenditure of the project.

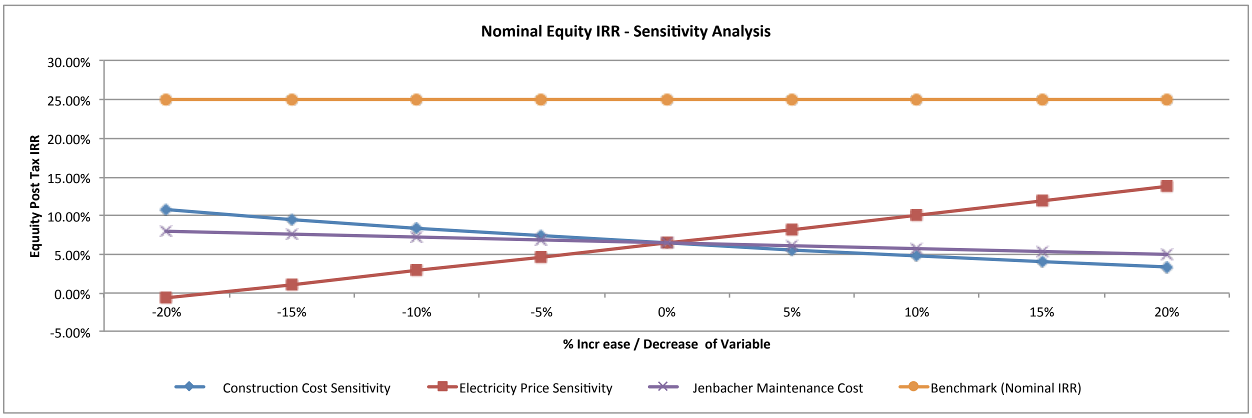
The parameters vary from -20% to +20% in the financial assessment and the selection is also in accordance with "Guidance on the Assessment of Investment Analysis" (version 03).

When the above financial indicators fluctuate within the range of –20% to +20%, the Equity IRR of the proposed project varies to different extent. The impact on the Equity IRR of fluctuations in the financial parameters (not considering CERs income) is shown in Table 11 and Figure 5.

Table 11: Sensitivity Analysis Results for the financial assessment

	-20%	-15%	-10%	-5%	0%	5%	10%	15%	20%
Construction Cost Sensitivity	10.88%	9.57%	8.41%	7.37%	6.42%	5.56%	4.77%	4.05%	3.37%
Electricity Price Sensitivity	-0.63%	1.11%	2.86%	4.64%	6.42%	8.22%	10.04%	11.88%	13.75%
Jenbacher Maintenance Cost	7.90%	7.52%	7.15%	6.79%	6.42%	6.06%	5.70%	5.35%	5.00%

Figure 5: Sensitivity Results for MFC



Threshold Analysis

Table 12: Threshold Analysis

Threshold Analysis to achieve 25% IRR (nominal)	
Construction Cost Sensitivity	-50.24%
Electricity Price Sensitivity	48.64%
Jenbacher Maintenance Cost	-212.44%

Project cost (Construction Cost)

The fluctuation of Capital Expenditure impacts on total project costs and hence on the Equity IRR of the proposed project. If the total project cost decreased by 20% the project IRR (after tax) will be 10.88% and is still below the benchmark. It is unlikely that the project cost will reduce with 20% or more due to a fact that the price index of capital goods has increased year-on-year over the last 10 years in South Africa (Appendix 20 shows that the index of capital goods has never decreases year on year for the last 10 years in South Africa). Therefore, it is unlikely that the project cost will decrease sufficiently, i.e. by 50% to reach the IRR benchmark of the project.

Electricity Price

Even if the electricity price increases with 20% compared to the base case, the IRR after tax for the project will reach 13.75%. With a 20% increase the electricity price is significantly higher than the expected Eskom megaflex price and MFC will continue to purchase electricity from the national utility as it is cheaper. It is not possible to sell the electricity to any other user in South Africa at prices higher than the national utility prices and therefore it is not possible to increase the price of electricity even by 20%. Therefore it is unrealistic to increase the sale price of the electricity by 48.64% to reach the benchmark as there is no market for electricity at this price.

Maintenance Costs

Fluctuations in Annual O&M Costs also have an impact on annual project costs (albeit a smaller impact than Capital Expenditure) and hence on the Equity IRR of the proposed project. Reducing maintenance costs by 20% still provides a return far below the benchmark.

The Annual O&M Costs are a function of the negotiated price quoted by the Jenbacher supplier to the Project Participant and the Annual O&M Costs are therefore extremely unlikely to decrease by 212.44%. It is not possible to reduce maintenance costs by the required amount for the project to reach the benchmark return.

It is evident that even if the sensitivity is carried out, the project returns still remain under the required levels.

Step 3: Barrier Analysis

There are significant barriers to the project in the context of additionality.

3.1 Technical Barrier

3.1.1 Nature of company, organization and its ownership

Exxaro On-Site (EOS) is a Joint Venture (JV) between Exxaro Resources (51%) and Prana Energy (49%). Exxaro Resources is a large diversified mining company. Prana Energy is a cleaner energy project developer. The JV was formed in 2007 with the specific purpose of developing, building, owning and operating on-site cleaner energy power plants.

3.1.2 Previous experience with similar projects (that is under consideration for CDM) in other locations

EOS is in the process of developing a number of energy recovery plants and none are yet in operation. EOS has one energy recovery project operating on Ilmenite furnace off-gas that is currently in detailed design with construction due to start in Q3 2012. EOS has not completed the development of any Ferrochrome furnace off-gas power generation projects but is currently developing two of projects, both under CDM.

Skilled and/or properly trained labour to operate and maintain the technology is not available in South Africa yet, which leads to an elevated risk of equipment disrepair and malfunctioning or other underperformance.

Risk of technological failure: the technology failure risk in the local circumstances is significantly greater compared to technology failure risk of power stations in the national grid. The power stations in the national grid have been in operation for decades and the most common technology (coal fired power stations), are well known and tested in South Africa. In the case of the national grid, the electricity generation system can continue even if one power station unit is down for maintenance or if one power unit experiences operational problems. In the case of the project activity, there are no backup measures if the technology fails or underperforms as a result of gas (fuel) quality variability.

The existence of a technological barrier for this technology is confirmed by showing evidence that the use of this technology in the ferrochrome sector is marginal, i.e. below 5% (CDM projects included). Refer to Appendix 26, the letter from the Ferrometal alloy industry Association.

The alternative of maintaining the current practice (flaring of waste gas and electricity import from the national grid) does not face any technical barriers. If no barriers existed, both the options of maintaining the current practice and the project activity would be feasible.

3.2 Barriers due to prevailing practice

Electricity tariffs in South Africa are relatively low by international standards.[42] Low electricity tariffs render the cost of waste energy recovery technologies relatively uncompetitive in comparison to conventional energy, thereby creating a significant barrier to entry for waste energy recovery projects. Electricity tariffs in many European countries, for example, are significantly higher than in South Africa, which ensures that the cost of electricity from waste energy generation is comparatively cost competitive with conventional energy making waste energy recovery commercially viable.[43] Therefore, due to the historically low cost of electricity in South Africa and lack of cost competitiveness of renewable energy and waste energy recovery with conventional power station technology, waste energy recovery has not been exploited on a large scale in South Africa.

The grid electricity traditionally used in the process at MFC has been so used for approximately 50 years (from 1961). MFC is currently connected to the national grid for the supply of up to 218.5MW[44] electrical power. The on-going import and use of the electricity presents the least risk technology option to MFC for the sustained production of ferrochrome. Considering the current practice and the pre-project scenario of MFC, import of electricity from the national grid would be the low risk alternative to the proposed project activity. The existence of a prevailing practice barrier is further confirmed by the fact that the use of this technology in the ferrochrome sector in Southern Africa is marginal, i.e. below 5% (CDM projects included). Refer to Appendix 26, the letter from the Ferrometal alloy industry Association.

The alternative of maintaining the current practice (flaring of waste gas and electricity import from the national grid) does not face any prevailing practice barriers. If no barriers existed, both the options of maintaining the current practice and the project activity would be feasible.

Sub-step 3 b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

The alternative of construction a greenfield power station based on fossil fuel is used to demonstrate that the identified barriers would not prevent this option.

Step 4: Common practice analysis

The Guidelines on Common Practice, (Version 01.0) are applied.

Table 13: Common Practice analysis

	Outcome of the Step applied to the project activity
Step 1: Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.	The design capacity for the power plant is 34 MW. Therefore the applicable output range is 17 to 51 MW.

[42] Appendix 28 Eskom Annual Report 2009 page XII

[43] Appendix 28 Eskom Annual Report 2009 page XII

[44] Appendix 27_CONFIDENTIAL_Electricity Supply Agreement with Eskom, Confidential information only available to validator.

	Outcome of the Step applied to the project activity
Step 2: In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Step 1, as the proposed project activity and have started commercial operation before the start date of the project. Note their number N_{all}. Registered CDM project activities shall not be included in this step.	**Applicable Geographical Area:** The common practice analysis is limited to South Africa and the neighbouring country Zimbabwe, because these are the only two countries in Southern Africa that produce ferrochrome (Refer to Appendix 42, page 2). As of 15 February 2012, there are fifteen ferrochrome smelters in South Africa and three in Zimbabwe. (Refer to http://www.pyrometallurgy.co.za/PyroSA/index.htm). Similar technologies that could be implemented on closed furnaces that produce a high CO content gas is a boiler and steam turbine combination that generates electricity and an integrated combined cycle gas turbine. However, There are no waste gas recovery technologies of any kind in operation at any of the closed furnace ferrochrome operations in South Africa or in Zimbabwe that generates electricity. (Refer to Appendix 26, letter from the FerroMetal Association) There is only one power plant using similar technology to produce electricity from waste gas at International FerroMetals (IFM) in operation in South Africa of this nature. The IFM project is developed under CDM project[45] as a first-of-its-kind. $N_{all} = 0$.
Step 3: Within plants identified in Step 2, identify those that apply technologies different that the technology applied in the proposed project activity. Note their number N_{diff}.	$N_{diff} = 0$, because N_{all} is 0
Step 4: Calculate factor $F=1-N_{diff}/N_{all}$ representing the share of plants using technology similar to the technology used in the proposed project activity in all plants that deliver the same output or capacity as the proposed project activity.	**F is 0**

[45] IFM Integrated Clean Energy Project, under validation at 19 December 2011

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

There is only one power plant using similar technology to produce electricity from waste gas at International FerroMetals (IFM) in operation in South Africa of this nature. The IFM project is developed under CDM project[46] as a first-of-its-kind.

On the basis of the analysis, it is clear that the extent, to which similar initiatives have diffused in South Africa, is zero.

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

Table 14: List of ferrochrome industries and waste gas recovery technology employed

Plant	Commissioned (year)	Is electricity generated from waste gas? If 'yes', is the project a CDM project?
Samancor Middelburg Ferrochrome (MFC)	[47]Established in 1964 as a Low Carbon Ferrochrome production facility. Charge chrome was first produced on this site in 1974. Reference: Samancor website.	No
Samancor Witbank (FMT)	[48]The plant was established in 1959.	No
Samancor Tubatse (open)	[49]TFC was initially built as a three-furnace operation in 1975. During the years 1989-1990 the plant was expanded to five furnaces with the sixth furnace being built in 1996.	No
Hernic	Hernic was established in 1995[50]. Reference www.hernic.co.za	No
Xstrata Wonderkop	Xstrata Wonderkop commenced production on 23 September 1996. In1998, an additional two furnaces were constructed and another two furnaces were commissioned in 2006[51].	No
Lion Ferrochrome Smelter	3rd Quarter 2006[52]	No
Xstrata Lydenburg	Lydenburg Works commenced production in	No

[46] IFM Integrated Clean Energy Project, under validation at 19 December 2011

[47] Appendix 44: http://www.samancorcr.com/content.asp?subID=8, 19 December 2011

[48] Appendix 44: http://www.samancorcr.com/content.asp?subID=8, 19 December 2011

[49] Appendix 44: http://www.samancorcr.com/content.asp?subID=8, 19 December 2011

[50] Appendix 44: http://www.hernic.co.za/index.php?page=overview, 19 December 2011

[51] Appendix 44: http://www.xstrataalloys.com/EN/Operations/Pages/Wonderkop.aspx, 19 December 2011

[52] Appendix 44: http://www.xstrataalloys.com/EN/Operations/Pages/LionFerrochromeSmelter.aspx, 19 December 2011

Plant	Commissioned (year)	Is electricity generated from waste gas? If 'yes', is the project a CDM project?
	1977[53].	
Xstrata Boshoek	The Boshoek smelter was constructed by Merafe Resources Limited (Merafe Resources) in 2001 and successfully commissioned in 2002[54].	No
IFM		Yes with CDM
Assmang Machadodorp	In 1971 Feralloys Limited a wholly-owned subsidiary of Assmang, expanded and erected a ferrochrome smelter at Machadodorp for the production and export of charge and low-carbon ferrochrome[55].	No
Tata Steel	August 2008[56]	No
ASA Metals	ASA Metals was established in 1997[57]	No

Sub-steps 4a and 4b are satisfied, i.e. similar activities are not observed, therefore the proposed project activity is additional.

Alleviation of barriers through CDM

Technology barrier

The CDM revenue will create a buffer that will enable the project to absorb additional downtime yet continue repaying its debt and honouring its operational obligations.

Skilled labour: The additional income from CDM will allow the project proponents to be bolder in appointing more and better skilled personnel to operate and maintain the plant, even if premiums have to be paid to acquire scarce skills from abroad.

Prevailing practice

Continuing the purchase and utilisation of fossil fuel derived, grid electricity requires no investment and carries no risk while the project activity does require very significant investment and also some risk. The only other project in the ferrochrome sector that has utilised waste gas to generate electricity has done so

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[53] Appendix 44: http://www.xstrataalloys.com/EN/Operations/Pages/LydenburgPlant.aspx, 19 December 2011

[54] Appendix 44: http://www.xstrataalloys.com/EN/Operations/Pages/BoshoekSmelter.aspx, 19 December 2011

[55] Appendix 44: http://www.assmang.co.za/o/chrome/machadodorp.asp, 19 December 2011

[56] Appendix 44: http://www.tata.com/company/Articles/inside.aspx?artid=PYkXhCLqLKQ=, 19 December 2011

[57] Appendix 44: http://www.asametals.co.za/history.html, 19 December 2011

with the assistance of CDM (IFM). In the present case the CDM income will create extra revenue that can be used to offset the risk posed by a pioneering intervention.

Notice of prior consideration

The project start date is 15 December 2012

Equipment has not been ordered and the construction of the project activity has not started at the time of validation.

The milestones in the project development are provided in the timeline below:

Table 15: Description of relevant dates to demonstrate prior consideration

Date	Activity
7 May 2010	EIA Invitation to Stakeholders inviting public comment[58]
14 September 2011	Notice of prior consideration submitted to the UNFCCC[59]
20 December 2011	PDD completed by CDM Africa Climate Solutions (Pty) Ltd
December 2011	Received proposal offer from TWP/Basil Read for the construction of the plant
29 December 2011	PDD published for Global Stakeholder Participation on UNFCCC website.
8 February 2012	PIN submitted to South African DNA
1 March 2012	Letter of no objection received from the South African DNA (Appendix 49)
19 March 2012	Notice of prior consideration submitted to the South African DNA

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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

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

Where:

BE_y = The total baseline emissions during the year y in tCO_2

$BE_{En,y}$ = The baseline emissions from energy generated by the project activity during the year y in tCO_2

$BE_{flst,y}$ = Baseline emissions from fossil fuel combustion

1. Baseline emissions from energy generated by the project activity ($BE_{En,y}$)

1.1. No recovery on the waste gas streams in the absence of CDM project activity

[58] Appendix 35 Draft Scoping report Samancor Chrome Plant_MFC, December 2011, Appendix E2

[59] Appendix 41 Letter of prior consideration submitted to the CDM EB

1.1.1. Baseline emissions for baseline Scenarios 1 and 2 (Refer to Table 8**)**

Baseline scenarios 1 and 2 represent the situation where the waste energy of waste gas streams used in the project is flared and the electricity is obtained from the grid.

Note: Only sub-sections (a) (Page 14/58 of ACM0012, "(a) Baseline emissions from electricity ($BE_{Elec,y}$) generation) as described in ACM0012 is applied in the project activity as sub-section (b) (Page 17/58 of ACM0012, "(b) Baseline emissions for generation of thermal energy ($BE_{ther,y}$) and steam-generated mechanical energy") in the methodology refers to "Baseline emissions for generation of thermal energy ($BE_{ther,y}$) and steam-generated mechanical energy" and these do not apply to the project activity.

$$BE_{En,y} = BE_{Elec,y} + BE_{Ther,y} \quad \textbf{(2)}$$

Where:

$BE_{Elec,y}$ = Baseline emissions from electricity during the year y in tCO_2

$BE_{Ther,y}$ = Baseline emissions from thermal energy (due to heat generation by elemental processes) during the year y (tCO_2) = 0

(a) Baseline emissions from electricity ($BE_{Elec,y}$) generation

Case 1: Waste energy is used to generate electricity

$$BE_{Elec,y} = f_{cap} * f_{wcm} * \sum_j \sum_i (EG_{i,j,y} * EF_{Elec,i,j,y}) \quad \textbf{(3)}$$

Where:

$BE_{elec,y}$ = Baseline emissions due to displacement of electricity during the year y (tCO_2)

$EG_{i,j,y}$ = 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) during the year y in MWh

$EF_{elec,i,j,y}$ = The CO_2 emission factor for the electricity source i (gr for the grid), displaced due to the project activity, during the year y (tCO_2/MWh). The "Tool to calculate the emission factor for an electricity system" is applied to determine the emission factor for the electricity supplied by the national grid. The information and data to calculate the grid emission factor is provided in Annex 3.

f_{wcm} = Fraction of total electricity generated by the project activity using waste energy. This fraction is 1 if the electricity generation is purely from use of 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. The ratio is 1 if the waste energy generated in project year y is the same or less than that generated at a historical level. The value is estimated using the equations in section 3.2.

j = Recipient j is MFC

i = National grid

The equation with the relevant subscripts becomes:

$$BE_{Elec,y} = f_{cap} * f_{wcm} * \sum_{MFC} \sum_{grid} (EG_{grid,MFC,y} * EF_{Elec,grid,MFC,y}) \quad (4)$$

2. Baseline emissions from flaring of waste gas ($BE_{flst,y}$)

A pilot flame fuelled by methane rich gas is used in the baseline scenario to ensure that proper combustion of the waste gas occurs. There is no plant specific historic data available to estimate the emissions from the use of the methane rich gas, therefore the emissions from this source shall be excluded from the baseline emissions (the conservative approach).

$$BE_{flst,y} = 0 \quad \textbf{(5)}$$

3. Estimation of various baseline factors

f_{WCM} = 1, since the electricity generation is purely from the use of waste gas.

3.1. Capping factors

ACM0012 requires the baseline emissions to be capped irrespective of planned or 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 described below, following this hierarchy:

(i) Method-1 can be used to estimate the capping factor if required data is available

The amount of information to apply Method-1 over a 3 year period is not available for MFC.

(ii) Also, it is not possible to determine the specific amount of waste gas produced historically per unit of production (Method-2 requirement), because of waste gas quality variability (refer to the information provided in the Box 1 below). According to ACM0012, in these cases, fcap is calculated based on indirect information about specific parameters allowing an estimate of the amount of waste energy available (Method-3). This is applied for MFC.

Case 1 in Method-3 as described in ACM0012 describes the project activity scenario for MFC: The energy is recovered from WECM (waste gas) and converted into final output energy (electricity) through a waste heat recovery equipment (Jenbacher engines). The useful energy (in this case waste gas) is produced by a chemical reaction (in this case a ferrochrome furnace). For such cases 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). The MER is determined by considering the number and the design capacity of the engines. The number of engines that will be implemented by the project activity (20) is selected based on the outcome of the technical feasibility study (Appendix 11).

Box 1: Waste gas variability

To demonstrate the variability (Appendix 70) and sensitivity of the waste gas quality the following should be noted (Appendix 2[1], page 72 and 73):

- The volume and composition of the waste gas depends on the feed materials and their pretreatment methods, on the construction of the smelting furnace and on the furnace controls.
- The gas production varies both in time and place. It is affected by e.g. different temperatures, furnace electrical values, material flows, segregation, position of electrodes and the time to tapping.
- The contents of H_2O and CO_2 increase when using lumpy ore because of carbonates and hydroxides.
- Feed materials affect the gas composition in many ways:
    - The volatile matter in the raw material decomposes into the gas. The moisture of the batch evaporates into the gas also, but in the cold batch the moisture and the hydroxides of the feed also react with the carbon and form hydrogen through water gas reaction, $H_2O + C = H_2 + CO$. CO_2 from carbonates can react with carbon through the Boudouard reaction, $CO_2 + C = 2CO$, which is a highly endothermic reaction.
    - The reduction behaviour of the decomposition reactions affects the coke utilisation and the amount and analysis of the gas.
- The pre-treatment methods of the feed materials also have an effect. The feed materials can be pre-dried, pre-heated or as in some solutions, pre-reduced. Every step decreases the amount of gas formed in smelting and affects the analysis by reducing gas components from evaporation, decomposition and reduction reactions. The concentrate can be pelletised and sintered at high temperatures.

The characteristics of sintered pellets due to Fe3+ combined with the preheating of the smelting charge has the effect that reduction starts in the smelting burden in the upper part of the burden by the CO-gas coming from the lower parts. The carbon dioxide in the off-gas increases, decreasing the carbon monoxide correspondingly.

f_{cap} is estimated by applying the following equation:

$$f_{cap} = \frac{Q_{OE,BL}}{Q_{OE,y}} \qquad (6)$$

Where:

$Q_{OE,BL}$ = Electricity that can be produced (GJ or TJ), to be determined on the basis of maximum energy that could be recovered from the waste gas, which would have flared in the absence of CDM project activity.

$Q_{OE,y}$ = Quantity of actual electricity generated during year y (GJ or TJ)

Determination of Q_{BL}

Electricity that can be produced (GJ or TJ), to be determined on the basis of maximum energy that could be recovered from the waste gas, which would have flared in the absence of CDM project activity.
The maximum energy that could be recovered from the waste gas is limited by the installed capacity of the power plant. The amount of electricity that can be produced (MWh) from the maximum amount of waste gas available over a year is determined by multiplying the engine planned uptime (97%) by engine availability (90%) by the plant capacity (1.698 MW x 20 engines) by furnace operating rate (86.48%) over a year.

Note that the design of the plant is such that there will always be an excess amount of waste gas that will be flaring. It is an operational requirement that some gas must always be flared because the gas pressure in the lines to the engines has to be controlled within a very narrow pressure range to ensure the engines function well. The only way in which this pressure can be controlled is by flaring excess gas via the main pressure control valve at the flare. So by design every GJ of waste gas produced cannot be used for power generation.

Q_{BL} = 0.97 x 0.90 x 33.96 x 0.8648 x 365 x 24 x 3.6
= 808,545.6 GJ

Project emissions

Project emissions include emissions due to consumption of electricity imported from the grid during start-up of the power plant and during times when none of the engines are in operation. During these times, electricity will be used by air conditioning equipment, lighting the control system and general office consumption. When the engines are in operation, this electricity will be supplied with the engines using waste gas as the energy source.

$$PE_y = PE_{AF,y} + PE_{EL,y} \quad \textbf{(7)}$$

Where:

PE_y	=	Project emissions due to the project activity (tCO_2)
$PE_{AF,y}$	=	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 (tCO_2)
$PE_{EL,y}$	=	Project activity emissions from on-site consumption of electricity for gas cleaning equipment or other supplementary electricity consumption (tCO_2) (as per Table 1: Summary of gases and sources included in the project boundary)

Note: No auxiliary fossil fuel will be used to supplement the waste energy in the project activity. Therefore, there are no project emissions due to auxiliary fossil fuel combusted to supplement waste energy in the project activity.

$PE_{AF,y} = 0.$ **(8)**

<u>Project emissions due to electricity consumption of gas cleaning equipment or other supplementary electricity consumption</u>

The electricity used to operate the gas conditioning and other equipment will be supplied from the gas engines using waste gas as energy source. Main electricity meters and check electricity meters will be installed on the 11kV feeders to MFC, which will have reverse metering capability to measure the amount of electricity used by the power plant during plant start up (when electricity from the grid will be used just to start up the plant). Only the net electricity generated to MFC will be used to determine the emission reductions for the project activity (Net electricity generated is equal to the total electricity generated minus the electricity imported from the grid for start up occasions). $P_{EL,y}$ is therefore not determined separately as the electricity imported from the national grid is already accounted for when determining the net electricity generated by the proposed project activity.

No backup equipment will be installed in the case that the power plant experiences outages or abnormal conditions. Also, no fossil fuel will be used for backup purposes of any kind in the power plant to generate electricity.

Therefore:

$PE_{EL,y} = 0.$ (9)

The gas engines will supply power to an 11kV board. There will be a feed from this board to a transformer, which will supply a 400V (or 525V) board. Electricity for all the motors for the new equipment will be fed from the 400V board. The electricity that is sent from the gas engine power plant to the MFC board is therefore the NETT electricity generated by the power plant and not the GROSS electricity. Refer to Figure 8.

The exception to the situation described in the paragraph above is during plant start-up. For this, the electricity feed will be reversed from MFC into the 11kV board and then to the 400V board. Electricity consumed from MFC (grid electricity) is therefore automatically deducted from the electricity generated by the meter to provide the net electricity generated by the power plant.

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:

$$ER_y = BE_y - PE_y \quad \textbf{(10)}$$

Where:

ER_y	=	Total emissions reductions during the year *y* in tons of CO_2
PE_y	=	Emissions from the project activity during the year *y* in tons of CO_2
BE_y	=	Baseline emissions for the project activity during the year *y* in tons of CO_2

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:	Calculated based on the national utility information for the South African national grid
Value applied:	Refer to Annex 3, Table 18: Calculation of the Operating Margin emission factor
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:	

Data / Parameter:	$F_{i,m,y}$
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:	Calculated based on the national utility information for the South African national grid
Value applied:	**Refer to Annex 3, Table 17: Power stations**
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:	$EF_{GRID,CM,y}$
Data unit:	tCO_2 / MWh
Description:	Emission factor of the national electrical grid for the year y
Source of data used:	Calculated based on the national utility information for the South African national grid and IPCC information where applicable.
Value applied:	0.9880
Justification of the choice of data or description of measurement methods and procedures actually applied :	The $EF_{grid,y}$ is calculated according to the 'Tool to calculate the emission factor for an electricity system'. The Simple OM method is used to calculate the Operating margin (using the ex-ante option); with the Build Margin also calculated ex-ante based on the most recent information.
Any comment:	None

Data / Parameter:	$EF_{CO2,i,y}$

Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories. 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.
Value applied:	Other Bituminous Coal: 2008/9 to 2011: 89.5 (t CO_2/TJ) Other Kerosene 2008/9 to 2011: 70.8tCO_2/TJ
Justification of the choice of data or description of measurement methods and procedures actually applied :	Some information is available about the various coal resources in South Africa, all of which is classified as bituminous. However, sufficient information is not available for each coal fired power station and therefore the IPCC default is applied. Refer to Appendix 30: 'Future_of_South_African_Coal', Section 2 "Overview of South African coal sector", page 2 where it is mentioned that: "South Africa's economically recoverable coal reserves are estimated at between 15 and 55 billion tonnes. 96% of reserves are bituminous coal; metallurgical coal accounts for approximately 2% and anthracite another 2%. Production is mainly steam coal of bituminous quality."
Any comment:	Value applied as a constant.

Data / Parameter:	$NCV_{i,y}$
Data unit:	GJ/mass or volume unit
Description:	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data used:	• For coal: Eskom published data, *Source: Appendix 66_Eskom Integrated Report 2011, page 324.* See GEF spreadsheet, Sheet Base_Data, Cells S12, T12 and U12. • For Other Kerosene: IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories. See GEF spreadsheet, Sheet 'DV', Cell D14
Value applied:	Coal (GJ/ton) Eskom: Coal (GJ/ton) 2008/9 – 19.1 2009/10 – 19.22 2010/11 – 19.5 Other Kerosene –42.4GJ/ton
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per "Tool to calculate the emission factor for an electricity system"

Any comment:	Information is used to calculate the combined margin emission factor

Data / Parameter:	$EF_{EL m,y}$
Data unit:	tCO_2/MWh
Description:	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
Source of data used:	Calculated from the information published by the national utility in South Africa.
Value applied:	Refer to GEF spreadsheet, sheet "OM", Annex 3, **Table 18: Calculation of the Operating Margin emission factor** **Table 18: Calculation of the Operating Margin emission factor**
Justification of the choice of data or description of measurement methods and procedures actually applied :	The three most recent years prior to the project implementation were used to calculate the factor. Refer to GEF spreadsheet, sheet "OM", Cells D(15:40), F(15:40), H(15:40) for all the values
Any comment:	As per the Tool to calculate the grid emission factor

Data / Parameter:	$Q_{OE,BL}$
Data unit:	GJ or TJ
Description:	Energy (electricity) that can be produced determined on the basis of engine design and maximum usable energy that could be recovered from the waste gas, which would have flared in the absence of CDM project activity.
Source of data used:	Genset supplier information and operational data from MFC
Value applied:	808,545.6 GJ
Justification of the choice of data or description of measurement methods and procedures actually applied :	The types and levels of service: Jenbachers will be implemented delivering an estimated 224,596 MWh per year (total electricity not accounting for parasitic load). This is calculated taking into account equipment availabilities (furnaces and gensets) and load factors. See financial model spreadsheet, Inputs_Production, Cell F149. The MWh is then multiplied by 3.6 to convert to GJ.
Any comment:	

Data / Parameter:	f_{wcm}
Data unit:	Unitless
Description:	Fraction of total electricity generated by the project activity using waste energy.

Source of data used:	PP
Value applied:	1
Justification of the choice of data or description of measurement methods and procedures actually applied :	This fraction is 1 because the electricity generation is purely from use of waste gas.
Any comment:	-

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

The baseline emissions (BE_y) were calculated using equation (1):

$BE_y = BE_{EN,y} + BE_{flst,y}$ where $BE_{flst,y} = 0$

The baseline emissions from the energy generated by the project activity $BE_{EN,y}$ were calculated using equation (2):

$BE_{EN,y} = BE_{Elec,y} + BE_{Ther,y}$ where $BE_{Ther,y} = 0$

$BE_{Elec,1\ to\ 10} = B_{EN,y} = BE_y = 210{,}138.7$ ton CO_2
f_{cap} was calculated using equation (6):

$$f_{cap} = \frac{Q_{OE,BL}}{Q_{OE,y}}$$

For demonstation purposes, it is assumed that the amount of electricity generated is equal to the amount that is theoretically possible to be produced, based on the maximum energy that could be recovered from the waste gas.

f_{cap} is therefore:

$$f_{cap} = \frac{808{,}545.6}{808{,}545.6}$$

$$f_{cap} = 1$$

The baseline emissions from electricity that is displaced by the project activity $BE_{Elec,y}$ were calculated using equation (4):

$$BE_{Elec,1\,to\,10} = f_{cap} * f_{wcm} * \sum_{MFC}\sum_{grid}(EG_{grid,MFC,y} * EF_{Elec,grid,MFC,y})$$

$BE_{Elec,1to10} = 1$ x 1 x $212{,}691$ x 0.9880

$BE_{Elec,1\,to\,10} = 210{,}138.7$ tCO_2 per year

$BE_{Elec,1\,to\,10} = B_{EN,y} = BE_y = 210{,}138.7$ tCO_2 per year

Project emissions were calculated using equation (8):

$PE_y = PE_{AF,y} + PE_{EL,y}$ where $PE_{AF,y} = 0$ as described previously and $PE_{EL,y}$ is zero because it is already accounted for in the net generation of electricity to MFC.

PE_y is therefore zero.

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)
1	0	210,138.7	0	210,138.7
2	0	210,138.7	0	210,138.7
3	0	210,138.7	0	210,138.7
4	0	210,138.7	0	210,138.7
5	0	210,138.7	0	210,138.7
6	0	210,138.7	0	210,138.7
7	0	210,138.7	0	210,138.7
8	0	210,138.7	0	210,138.7
9	0	210,138.7	0	210,138.7
10	0	210,138.7	0	210,138.7
Total (tonnes of CO_2 e)	0	2,101,387	0	2,101,387

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

Data / Parameter:	1.$EG_{i,j,y}$ ($EG_{grid,MFC,y}$)
Data unit:	MWh/y
Description:	Electricity generated by the project activity displacing electricity in the national grid. This is the nett electricity delivered to MFC. This electricity excludes the parasitic load and the electricity used from the grid during startup.
Source of data to be used:	Plant records produced by Exxaro On-Site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	212,691 (Calculated from design data for the purpose of estimating the CERs.) See Financial spreadsheet, Sheet: Input production, Cell F169
Description of measurement methods and procedures to be applied:	Location of electricity meters: See Figure 8: Electricity meter layout at the power plant. The two relevant electricity meters are indicated as Main meter 1 and Main meter 2. Continuous monitoring will be done and the data will be logged monthly.

	Two electricity import/export meters will be installed on the 11kV line after the Jenbachers on the feeder panel. These will measure the total bidirectional electricity flow between MFC and Exxaro On-Site and will record the nett electricity exported to MFC. The nett electricity meter reading is used in the calculation. The electricity that will run the gas conditioning and other equipment will be supplied from the Jenbachers and will be metered as the parasitic load. The Jenbachers will supply power to an 11kV board that is located in the 11kV substation. There will be a feed from this board to the 11kV/400 V transformer, which will supply a 400V (or 525V) board. All motors for the new equipment will be fed from the 400V board. The electricity that is sent to MFC board is therefore the NETT electricity produced and not the GROSS. The exception is starting the plant. For this, we will reverse feed from MFC, into the 11kV board and then to the 400V board. There will be a main and check bidirectional meter on each of the 11kV feeders to MFC which will have reverse metering to measure the amount of electricity used during start up.
QA/QC procedures to be applied:	• The electricity meters will be calibrated and maintained in accordance with manufacturer's specifications. • Records of calibrations and maintenance procedures will be kept by the project participant. • The electricity metered by Exxaro On-Site can be checked during verification by comparing the electricity figures that are metered by the recipient MFC.
Any comment:	The monitoring process and equipment for this procedure is standard. The above data will be kept for a minimum of two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data / Parameter:	**2. $Q_{OE,y}$**
Data unit:	TJ
Description:	Quantity of actual energy output generated during year y, i.e. the gross electricity generated by the Jenbacher engines from waste gas not taking into account the parasitic load of the power plant.
Source of data to be used:	Power plant process data
Value of data applied for the purpose of calculating expected emission reductions in section B.5	808,545.6
Description of measurement methods and procedures to be applied:	Continuous monitoring will be done and the data will be logged daily. Location of electricity meters: See Figure 8 The following meter readings are used: Main meter 1 and Main meter 2, showing total export electricity to the MFC substation plus the electricity metered by the

	parasitic load meter. The sum of these three readings provides the total electricity generated by the Jenbachers. The meter readings will be in MWh units and will be multiplied by 3.6 and divided by 1000 to convert to TJ.
QA/QC procedures to be applied:	• The electricity meters will be calibrated and maintained in accordance with manufacturer's specifications. • The electricity metered by EOS can be checked during verification by comparing the electricity figures from the MFC.
Any comment:	The above data will be kept for a minimum of two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data / Parameter:	3. $EC_{PJ,y}$
Data unit:	MWh
Description:	Additional electricity consumed in year *y* for project related equipment (gas conditioning equipment) during startup that is supplied by the national grid through MFC. Note that the electricity supply to the power plant is provided by the Jenbachers, i.e. the power plant parasitic load will be provided by the Jenbachers running on waste gas.
Source of data to be used:	Exxaro On-Site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Zero
Description of measurement methods and procedures to be applied:	Continuous monitoring will be done and the data will be logged daily. Location of electricity meters: See Figure 8 (MFC) for the layout of the electricity meters. The following meter readings are used: Main meter 1 and Main meter 2. These two electricity import/export meters will be installed on the 11kV line after the Jenbachers on the feeder panel. These will measure the total bidirectional electricity flow between MFC and Exxaro On-Site and will record the electricity imported from MFC during startup. The electricity that will run the gas conditioning and other equipment after startup will be supplied from the Jenbachers. The Jenbachers will supply power to an 11kV board. There will be a feed from this board to a transformer, which will supply a 400V (or 525V) board. All motors for the new equipment will be fed from the 400V board. During startup, we reverse feed from MFC, into the 11kV board and then to the 400V board. There will be main and check bidirectional meters on the 11kV feeders to MFC which will have reverse metering to measure the amount of electricity used during start up.
QA/QC procedures to be applied:	The electricity meters will be calibrated and maintained in accordance with manufacturer's specifications. The electricity meter reading will be checked against the individual electricity readings from each engine.
Any comment:	The above data will be kept for a minimum of two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data / Parameter:	**4. f_{cap}**
Data unit:	Unitless
Description:	Energy that would have been produced in project year y using waste heat generated in base year expressed as a fraction of total energy produced using waste heat in year y.
Source of data to be	Calculated by the project participant by applying Equation 6 in the PDD.

used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1
Description of measurement methods and procedures to be applied:	The relevant f_{cap} will be determined prior to each verification according to the calculation procedure described by ACM0012.
QA/QC procedures to be applied:	
Any comment:	The above data will be kept for a minimum of two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data / Parameter:	**5. Record of abnormal or emergency events in the project facility**
Data unit:	Number
Description:	Record of abnormal/emergency events that occurs in the project facility
Source of data to be used:	Exxaro On-Site plant records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The project facility process control system will have an archive capability where all process data, including alarms and operator actions (like setpoint changes), will be continuously stored for later retrieval into plant reports. Abnormal and emergency events and corrective actions will also be manually recorded in an operator's log.
Description of measurement methods and procedures to be applied:	Abnormal events can be cross checked with electricity generation. Alarm lists will be automatically generated for weekly and monthly analysis and incorporation into the Monthly Operations Report that will be compiled by the Plant Manager. The loss of power generation associated with the abnormal events will also be captured in the Monthly Operations Report.
QA/QC procedures to be applied:	Abnormal events can be cross checked with electricity generation, i.e. the DOE will be able to confirm that no electricity is generated during abnormal events by cross checking the times and duration of abnormal events with electricity generation data.
Any comment:	Abnormal and upset conditions at the power plant will be as a result of off gas quality (composition and temperature) or quantity (pressure). Fluctuations in these parameters always involve the de-loading or stopping of engines due to the automated engine protection systems that are part of the plant design and will thus result in a reduction or stoppage of electricity generation. Other protection systems that will also stop or de-load the engines are engine room temperature control, cooling water temperature control and the fire detection system. During abnormal conditions the waste gas is flared through the stack as is done in the current scenario. The waste gas will not be routed to the engines during these conditions as the engines will be de-loaded or stopped and therefore electricity will not be produced during abnormal conditions and emissions reductions will

	not be claimed.

B.7.2. Description of the monitoring plan:

7.2.1 Management structure for the facility during construction is provided in Figure 6.

The ultimate responsibility for the construction of the waste gas to electricity plant lies with Exxaro On-Site. Exxaro On-Site will have a project manager on site who will oversee the Exxaro On-Site team.

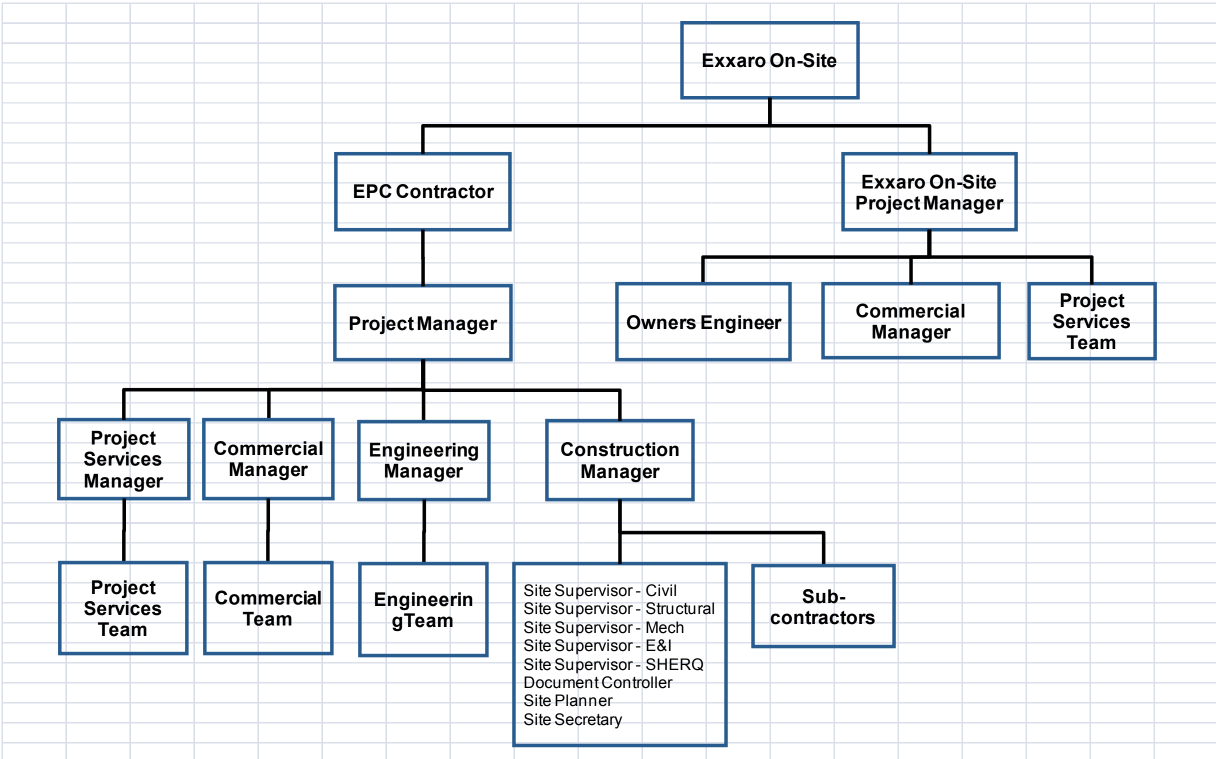

Figure 6: Management structure during construction of the proposed project actvity

7.2.2 Management structure for the facility during operation is provided in Figure 7 below. After commissioning of the waste gas to electricity plant, Exxaro On-Site is responsible for the operation and maintenance of the site.

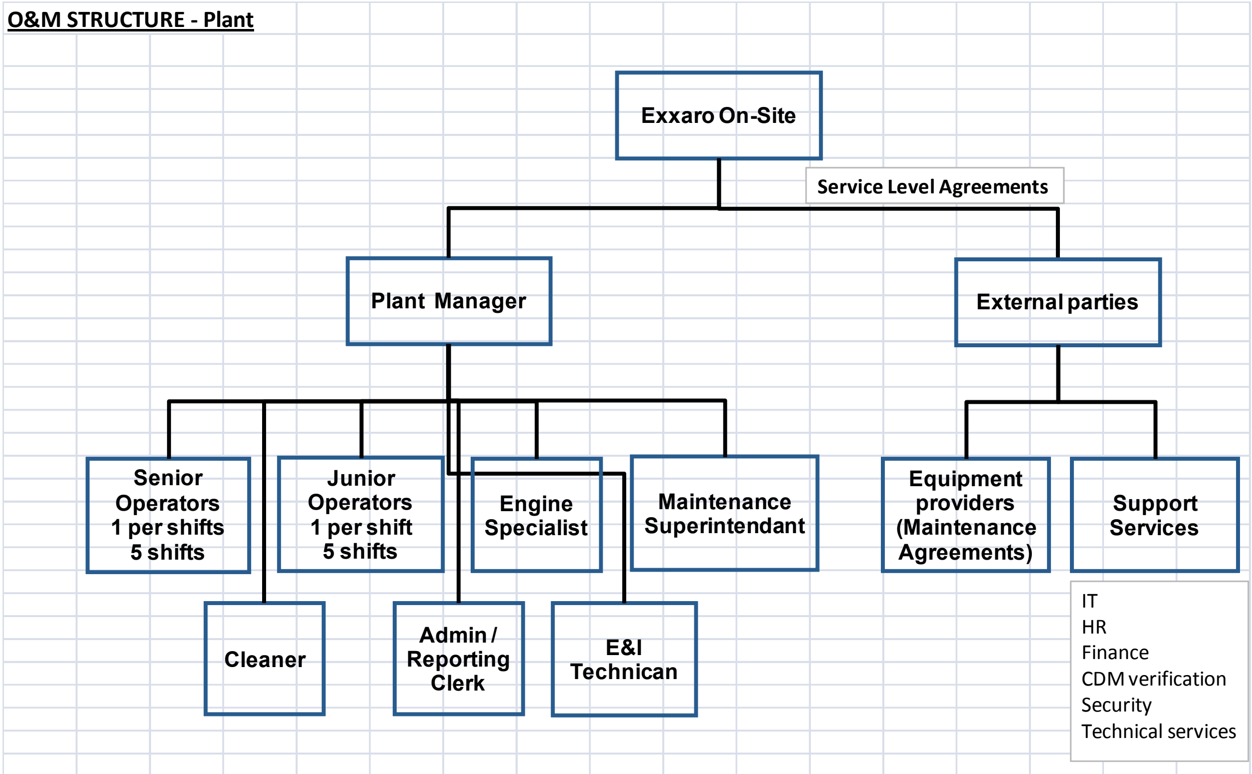

Figure 7: Management structure of the proposed project activity after commissioning

7.2.3 **Responsibility**

The responsibility for monitoring lies with Exxaro On-Site (EOS), who will operate the proposed project activity. EOS will be directly responsible for monitoring and reporting the relevant information. EOS will oversee the monitoring infrastructure installation in partnership with relevant parties (e.g. MFC, consultants and EPC contractor when necessary). EOS staff will be monitoring, reporting and compiling records of generated electricity, and all other parameters.

7.2.4 Monitoring Equipment

Electricity meters will measure the quantity of net electricity generated by the project activity and supplied to MFC. These meters are 4-quadrant billable class meters that are bi-directional – this means that they subtract any electricity used by the plant during start up, or when the plant is not producing electricity.

(i) Data to be monitored during the crediting period

The following data will be monitored by Exxaro On-Site:

- Quantity of electricity supplied to MFC (MWh);
- Electricity consumption (import) of additional plant equipment used in the project activity during start-up (MWh).
- Quantity of actual energy output generated during year y (GJ or TJ);
- F_{cap} will be determined for verification purposes;
- Abnormal conditions are monitored

(ii) Equipment

Electricity meters will measure the quantity of electricity supplied to MFC (Main meter 1, Main meter 2 Check meter 1 and Check meter 2) and the parasitic load used by the power plant (parasitic load meter) and new cleaning equipment. Also electricity meters will meter the electricity imported from MFC for cold start-up of the power plant (Main meter 1, Main meter 2 Check meter 1 and Check meter 2). The Main meter 1, Main meter 2 Check meter 1 and Check meter 2 are 4-quadrant billable class meters that are bi-directional – this means that they subtract any electricity used by the plant during start up, or when the plant is not producing electricity.

Four electricity meters will be installed on the feeds to the recipient plant – two main meters and two check meters. The metering setup is illustrated in the diagram below.

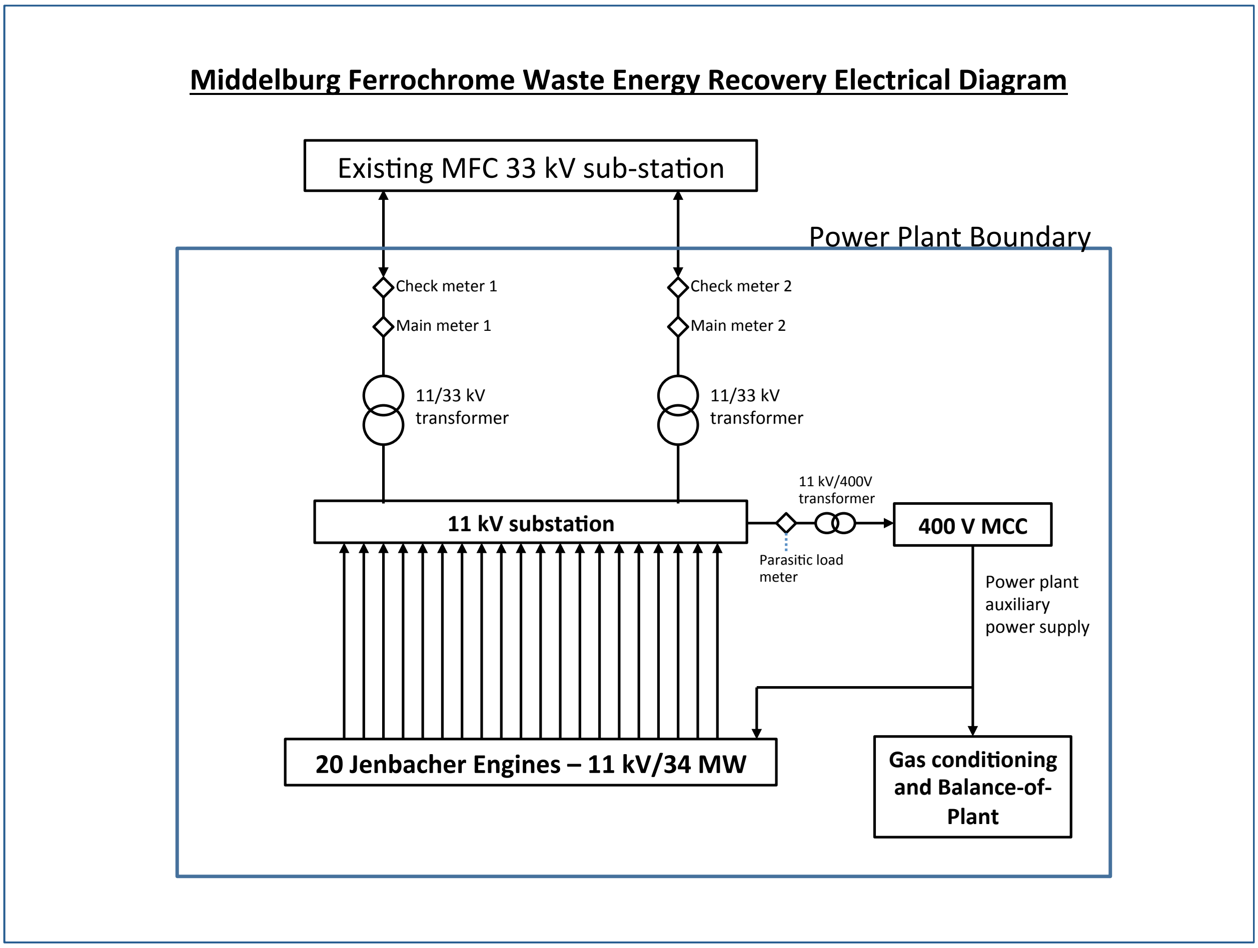

Figure 8: Electricity meter layout at the power plant

A CO meter, H2 meter and gas flow meters will be installed on the gas feeding system, but these are not part of the monitoring protocol as it is not required to monitor these parameters according to ACM0012, Method-3.

(iii) Capabilities of meters

The Facility Metering Installation and the System Metering Installation shall be capable of measuring and recording the following parameters for various time and frequency blocks:

- Energy Output and Reactive Energy Output;
- Instantaneous voltage, current and power factor;
- Frequency;
- Maximum demand in MW for each demand period and for the total period since the last reset;
- MWh/MVARh since last reading;
- Real time and time of day metering; and
- Number of resets.

The Metering Installation shall have the capability to download and transmit such real time data to a Supervisory Control and Data Acquisition ("SCADA") system, in a form and format suitable for SCADA.

(iv) Physical inspections and calibration

The maintenance superintendent will is responsible to do physical inspections and calibration of the measurement equipment, its transmitters and the control system on a frequent basis to ensure readings remain within the accuracy levels required. Physical inspections and calibration frequencies will be logged onto the shift inspection report sheets when performed and stored.

(v) Monitoring accuracy

The electricity meters will be fitted with a data transmitter, and the data will be fed into the plant control system on a daily basis. The main and check meters will be reconciled daily to check if their readings are within a pre-defined accuracy band. If there are discrepancies, then a notification will be sent to the control room to advise the operator to attend to a problem with the meters.

(vi) Data collection and storage

On a monthly basis, the power plant manager (or other designated employee) and a representative from MFC will read the two main electricity meters to determine the quantity of electricity produced by the plant. This will be done by adding the readings from the two main meters. The electricity readings will be logged electronically for the purposes of calculating emission reductions.

The information will be saved onto the power plant Supervisory Control and Data Acquisition (SCADA) system, as well as Exxaro On-site financial systems. Backups will be kept both on- and off-site, and all of the data will be available for CDM verification. All electronic and hard copy records of the metering devices, relevant documentation and the results of calibration will be collected in a central place by the project entity. Data record will be archived for a period of 2 years after the crediting period to which the records pertain.

(vii) Readings and inaccuracy

EOS shall be responsible for retrieving and analysing data from the Facility Metering Installation.

Should any of the meters fail to register or, upon testing, be found to have a level of inaccuracy falling outside the maximum tolerance level, then the meter shall be recalibrated and the Energy Output from (a) the electricity generation units or (b) the Project, shall be measured on the basis of the readings registered by MFC.

Should both the EOS and the MFC meters fail to register or, upon testing, be found to have a level of inaccuracy falling outside the maximum tolerance level, then each of the metering systems shall be recalibrated, and the Energy Output from (a) the electricity generation units.

(viii) Quality Assurance /Quality Control Procedures

The following quality assurance/quality control procedure will be applied in order to increase the reliability of the monitored data:

- The operators will be trained on CDM procedures.
- The operators will be trained on data recording procedures in the logbook (used for reporting any abnormal circumstances).
- The supervisor will check the recorded data and sign off on the logbook on a daily basis.
- The plant manager will ensure that an audit is carried out of the electricity distribution information at least once during the monitoring period. The audit may verify the data on electricity generation by crosschecking monthly electricity invoices to MFC or spot-checking the electricity reading of electricity meter/s.
- Physical inspections of monitoring equipment and calibration frequencies will be logged onto the shift inspection report sheets when performed and stored.
- **Audit**
  - Monthly net electricity supply and consumption data will be approved and signed off by the EOS Plant Manager before it is accepted and stored.
  - The Plant manager cross-checks meter readings from the EOS Metering Installation and sales receipts, and also compares the data with the meter reading from the MFC Metering Installation.
  - The Plant Manager also checks the validity of the calibration certificates of the electricity meters. If the data is correct and the meters calibrated, the data is approved, signed off and stored. If any errors are identified, such errors will be described and corrected, prior to approval, sign off and storage of the corrected data and error descriptions. This internal audit will also identify potential improvements to procedures to improve monitoring and reporting in future years.

7.2.5 Record Handling

Appendix 16 describes the record handling procedure.

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 of the application of the methodology to the project activity study:
20/12/2011
Contact Information:
Ciska Terblanche and Johan van den Berg
CDM Africa Climate Solutions (Pty) Ltd
407 Juliana
Princess Place
Parktown
South Africa
webmaster@cdmafrica.com
+27828985750

CDM Africa is not a project participant listed in Annex 1.

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:

15 December 2012

The starting date for the project activity is when the first deposit is paid or when an contract is signed with the equipment supplier to provide the equipment.

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

17 Years 6 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:

1 February 2014

Refer to Appendix 11, page 20 of 20, Table 6- Project schedule

C.2.2.2. Length:

10 Years 0 Months

SECTION D. Environmental impacts

The Environmental Impact Assessment is undertaken in terms of the National Environmental Management Act No 107 of 1998 (NEMA) as amended and the Environmental Impact Assessment Regulations, 2010 [As corrected by "Correction Notice 1" (GN No. R660 of 30 July 2010) and "Correction Notice 2" (GN No. R 1159 of December 2010) for the proposed project.

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

Impacts of the proposed project activity on the following areas were assessed in the EIA:
- Noise
- Water
- Construction Waste
- Atmospheric emissions from the power plant
- Domestic waste
- Staffing requirements
- Transportation
- Stormwater management
- Environmental management
- Health and Safety requirements
- Social responsibility

No transboundary impacts were identified in the environmental impact study.

Status of the EIA as of 4 May 2012: The EIA is in the finalisation of scoping report following public comment phase. Refer to Appendix 47, Figure 1 on page 7.

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:

None of the environmental impacts were considered significant.

SECTION E. Stakeholders' comments

The environmental impact assessment (EIA) for the proposed Exxaro On-Site Energy Facility has been undertaken in accordance with the EIA Regulations published in Government Notice 28753 of 21 April 2006, in terms of Section 24(5) of the National Environmental Management Act (NEMA; Act No 107 of 1998). No environmental fatal flaws were identified to be associated with the proposed Exxaro On-Site energy facility. A number of issues requiring mitigation have been highlighted. Environmental specifications for the management of potential impacts are detailed within the draft Environmental Management Plan (EMP) included within the Draft Scoping Report.

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

- An advertisement was placed in the Middelburg Observer on 7 May 2010 to inform stakeholders of the EIA and public participation process for the proposed power generation project[60].

- Distribution of public documents on 7 May 2010:
  - Newspaper advert in the Middelburg Observer;
  - Posted letters;
  - Posted background information documents (BIDs); and
  - Poster adverts in Middelburg – Middelburg Ferrochrome notice board, Gerald Lekoto library, Local Municipality notice board and Nazaret taxi rank.
- A public open day meeting was held on 2 June 2010 in Middelburg to inform stakeholders of the proposed project and to discuss any relevant issues. Stakeholders had the opportunity to highlight issues in an Issue sheet.
- Public notices to invite stakeholders to the open day were put up at several locations in Middelburg, for example the Public Library.
- September 2010 – The Issues Report is published by the SRK, addressing all the issues that were raised by stakeholders[61].

E.2. Summary of the comments received:

No relevant comments or questions were received relating to CDM or the CDM process. The comments and requests for information covered the creation of employment and air quality issues mostly[62]. The

[60] Appendix 35 Report Number 408836, Draft Scoping Report for the proposed development of an Energy Recovery Plant at the Samancor Chrome Plant, Middelburg Ferrochrome, December 2011, Appendix E2

[61] Appendix 35 Report Number 408836, Draft Scoping Report for the proposed development of an Energy Recovery Plant at the Samancor Chrome Plant, Middelburg Ferrochrome, December 2011, Appendix G

table below is a summary of the comments received. The table is taken from the EIA Scoping Report, Appendix G.

All comments received from I&APs have been subdivided into the following sections to address the key impacts described below:

Social investment

1. Benefits of the project on the community

Communication

1. The need for one on one discussions between the affected people and Samancor

Job opportunities

1. Local economic benefits
2. Employment opportunities for people directly affected by the project

Air Quality

1. The impact of the project on air quality and how this will be addressed

Noise

1. The impact of noise from the proposed operations and how this will be addressed

Water Quality

1. Concerns regarding the impact of the project on ground and surface water

Traffic and transportation

1. Impacts of the proposed project on traffic in the area

General

1. Responsibility for land use planning
2. Sustainable development

[62] Appendix 35 Report Number 408836, Draft Scoping Report for the proposed development of an Energy Recovery Plant at the Samancor Chrome Plant, Middelburg Ferrochrome, December 2011, Appendix G, page 2 - 4

Name and organisation	Date received	Issue raised	Response
Social investment			
Mr Meshack Mahamba **(Senior Manager of Town Planning: Steve Tshwete Local Municipality)**	Fax - 24 May 2010	Who is going to benefit from the generation of energy other than Samancor Chrome?	This project will benefit the MFC plant directly as MFC will require less electricity from the national grid. This in turn will allow more electricity for national consumption and therefore less power outages in the area.
Communication			
Mr Meshack Mahamba **(Senior Manager of Town Planning: Steve Tshwete Local Municipality)**	Fax - 24 May 2010	Would like to be contacted for one on one discussion	SRK has followed up where possible (via the contact details provided) with all parties that requested a one-on-one discussion through the response sheets. This communication was with regard to the EIA process only and issues raised have been added to this issues and response report. Please contact the environmental specialist at MFC on 0132494477 to arrange a meeting to discuss the project should you wish to speak to Samancor directly about broader issues.
Job opportunities			
Mr Timothy Mokwena **(Community Member)**	Fax - 1 June 2010	Interested in job opportunities	The company employs people from the local community as far as possible directly or indirectly via contractor companies. Should positions become available they will be advertised.
Mr Meshack Mahamba **(Senior Manager of Town Planning: Steve Tshwete Local Municipality)**	Fax - 24 May 2010	Are local people going to be given preference when job opportunities come up?	
Mr Meshack Mahamba **(Senior Manager of Town Planning: Steve Tshwete Local Municipality)**	Fax - 24 May 2010	How many jobs are going to be created and is the local community going to be given preference when people are employed?	Currently an estimated 100 temporary positions during construction and 15 permanent positions would be available after construction. The company employs people from the local community as far as possible directly or indirectly via contractor companies. Should positions become available they will be advertised.

Name and organisation	Date received	Issue raised	Response
Mr Meshack Mahamba **(Senior Manager of Town Planning: Steve Tshwete Local Municipality)**	Fax - 24 May 2010	What are the mitigation measures to be put in place to address impact on air pollution?	This project will actually require the use of offgas emissions for the generation of power and is therefore likely to decrease air emissions from the plant. An air quality specialist study will, however be undertaken as part of the environmental impact assessment to define the positive impacts anticipated as part of this development. The results thereof will be presented in the environmental impact assessment and fed back to all stakeholders.
Noise			
Mr Meshack Mahamba (Senior Manager of Town Planning: Steve Tshwete Local Municipality)	Fax - 24 May 2010	What are the mitigation measures to be put in place to address impact on noise?	Noise impacts are anticipated during all phases of the development. A noise impact assessment is being undertaken as part of the environmental impact assessment and further feedback on this will be provided following the completion of this study and the release of the Draft EIA Report.
Water quality			
Mr Ken Hattingh **(Middelburg Bird Club)**	Public meeting - 2 June 2010	The Bird Club has concerns with regard to water quality issues in the Vaalbankspruit and impacts on groundwater quality as well. Has the geological formation of the area being considered in the placement of the new infrastructure? The impervious shales promote the movement of contaminants towards the Spruit. Please keep us informed about the project.	Middelburg Ferrochrome has a water management system in place on the site, which includes stormwater management. No run-off from the Energy Recovery Plant location is expected to enter the Vaalbank Spruit. There is currently also a water monitoring programme in place on the site. This monitors ground and surface water quality upstream and downstream of the site.
Mr Meshack Mahamba **(Senior Manager of Town Planning: Steve Tshwete Local Municipality)**	Fax - 24 May 2010	What are the mitigation measures to be put in place to address impact on groundwater contamination?	The stormwater measures will, however, be discussed in more detail in the environmental impact assessment.
Traffic and transportation			
Mr Meshack Mahamba **(Senior Manager of Town Planning: Steve Tshwete Local Municipality)**	Fax - 24 May 2010	What are the mitigation measures to be put in place to address impact on traffic?	A traffic impact study is proposed as part of the environmental impact assessment and results of this study will be presented in the Draft EIA Report. It is not anticipated that significant traffic impacts will extend past the construction phase of the project given the limited additional employment opportunities associated with the energy recovery plant.
General			
Mr Meshack Mahamba **(Senior Manager of Town Planning: Steve Tshwete Local Municipality)**	Fax - 24 May 2010	The Municipality is responsible for land use planning in this instance	Comment noted.

Name and organisation	Date received	Issue raised	Response
Mr Meshack Mahamba **(Senior Manager of Town Planning: Steve Tshwete Local Municipality)**	Fax - 24 May 2010	Will the plant adhere to the principles of sustainable development?	This project will provide for positive development benefits such as job creation and skills development at the same time as reducing environmental impacts through reduced energy usage.
Mr Hannes van Zyl **(Assistant Manager: Areri Producer Services)**	Fax - 15 May 2010	The project is a great idea	Comment noted.

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

The independent consultant managing the EIA process, SRK, responded to all the comments received by stakeholders, as described in Section E.2.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Exxaro On-Site
Street/P.O.Box:	20 Peter Place
Building:	Coral House, 1st floor
City:	Bryanston
State/Region:	Gauteng
Postcode/ZIP:	
Country:	South Africa
Telephone:	+27(11)4639718
FAX:	+27(0)866471775
E-Mail:	
URL:	
Represented by:	
Title:	Director
Salutation:	Mr
Last name:	Posthumus
Middle name:	
First name:	Johan
Department:	
Mobile:	+27(0)824662452
Direct FAX:	+27(0)866471775
Direct tel:	+27(11)4639718
Personal e-mail:	johan@pranaenergy.co.za

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding involved.

Annex 3

BASELINE INFORMATION

Determination of the grid emission factor

The GHG emission calculation of the proposed project was based on the instruction of "Tool to calculate the emission factor for an electricity system". All the data employed in the calculation is based on the available data from South African Power Grid. The baseline emission factor (EF_y) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors:

The following steps are applied to calculate the emission factor for an electricity system:

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. Provide evidence that the simple operating margin is still the applicable selection.
STEP 4. Calculate the simple operating margin emission factor according to the selected method, ex-ante
STEP 5. Calculate the build margin (BM) emission factor, ex-ante.
STEP 6. Calculate the combined margin (CM) emissions factor.

Step 1: Identify the relevant electric power system

For determining the electricity emission factors, 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.

Project electricity system

The DNA of South Africa has, to date, not published a delineation of the project electricity system and connected electricity systems.

Spot markets: There exists no spot market in South Africa for electricity. The National Electricity Regulator (NER) regulates the prices at which electricity can be sold. There are no public information available regarding the operation of transmission lines and therefore it is not possible to define a grid boundary. Electricity generated by the proposed project activity will displace the power production in the national grid of South Africa which is defined as the project electricity system by default.

The project electricity system forms part of a connected electricity system whereby it is connected by transmission lines to the national grid of Botswana (Botswana Power Corporation), Mozambique, Namibia (NamPower), Zimbabwe (ZESA), Lesotho (Lesotho Electricity Company), Swaziland and Zambia (ZESCO).

Connected electricity system

The South African grid is connected by transmission lines to grids in neighboring countries Mozambique, Botswana, Namibia and Zimbabwe. South Africa exports some electricity to neighboring countries and import some as well. Therefore, this larger grid is defined as the **connected electricity systems**. The connected electricity systems are not partially or totally located in Annex 1 countries.

For the purpose of determining the operating margin emission factor, the CO_2 emission factor(s) for net electricity imports from a connected electricity system is 0 tCO_2/MWh, because information is not available for emission factors of any of the neighboring countries.

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

Off-grid power plants are not included in the calculations as information is not available at the time of including the CPA in the PoA.

Step 3: Provide evidence that the simple operating margin can be applied

The simple OM method can be used for as long as the low-cost/must-run resources constitute less than 50% of the total grid generation in the five most recent years.

Table 16: National utility electricity generation in South Africa

	2011	2010	2009	2008	2007
Coal-fired (GWh)	**220 219**	215 940	211 941	222 908	215 211
Hydro-electric (GWh)	**1 960**	1 274	1 082	751	2 443
Pumped storage (GWh)	**2 953**	2 742	2 772	2 979	2 947
Gas turbine (GWh)	**197**	49	143	1 153	62
Nuclear (GWh)	**12 099**	12 806	13 004	11 317	11 780
Wind energy (GWh)[6]	**2**	1	2	1	2
Total own production (GWh)	**237 430**	232 812	228 944	239 109	232 445

Source of information for the table: Appendix 60, Eskom Integrated Report 2011, page 13

Total GWh from coal from 2007 - 2011= 1,086,219
Total GWh production from 2007 – 2011 = 1,170,740

%Share of coal fired in power stations: 92.78%.
It is therefore confirmed that the low-cost/must-run resources constitute less than 50% of the total grid generation.

In terms of data vintages, the *ex ante* option are selected to calculate the simple OM.

In this option a 3 year generation-weighted average are used for the grid power plants.

Step 4: Calculate the simple operating margin emission factor

The simple OM emission factor ($EF_{grid,OMsimple,y}$) is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants.

Option A1 - Calculation based on average efficiency and electricity generation of each plant

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

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

Equation 1

Where:

Where:

$EF_{grid,OMsimple,y}$	=	Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m	=	All power units serving the grid in year *y* except low-cost / must-run power units
y	=	The relevant year as per the data vintage chosen in Step 3

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

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

Equation 2

Where:

$EF_{ELm,y}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$FC_{i,m,y}$	=	Amount of fossil fuel type i consumed by power unit m in year y (Mass or volume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ / mass or volume unit)
$EF_{CO2,i,y}$	=	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2 /GJ)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
i	=	All fossil fuel types combusted in power unit *m* in year *y*
m	=	The power plants/units delivering electricity to the grid, not including low-cost/must-run power plants/units, and including electricity imports to the grid
y	=	The relevant year as per the data vintage chosen in Step 3

Table 17: Power stations in the Operating Margin

No.	Name of Power Unit/country	Installed Capacity (MW) *Source: FuelConsumptionElectricityGen.xls puplished by Eskom, Appendix 61*	Net Electricity Generation (MWh) *Source: Appendix 61_FuelConsumptionElectricityGen.xls puplished by Eskom.* Website short cut access is: http://www.eskom.co.za/c/article/236/cdm-calculations/			Main Fuel Type/ Energey Source	Main Fuel Consumption (t (mass or volume unit)) *Source: Appendix 61_FuelConsumptionElectricityGen.xls puplished by Eskom* Website short cut access is: http://www.eskom.co.za/c/article/236/cdm-calculations/		
			2008-2009	2009-2010	2010-2011		2008-2009	2009-2010	2010-2011
Electricity import									
i-1	International imports *(Source: Eskom Integrated Report, 2011, page 13), Appendix 60*		12,189,000	13,754,000	13,613,000				
i-2	IPPs *(Source: Eskom Integrated Report, 2011, page 13), Appendix 60*		0	0	1,833,000				
Electricity generation in the project electricity system									
1	Arnot	1980	11,987,281	13,227,864	12,194,878	Other Bituminous Coal	6,395,805	6,794,134	6,525,670
2	Duvha	3450	21,769,489	22,581,228	20,267,508	Other Bituminous Coal	11,393,553	11,744,606	10,639,393
3	Hendrina	1895	12,296,687	12,143,292	11,938,206	Other Bituminous Coal	7,122,918	6,905,917	7,139,198
4	Kendal	3840	23,841,401	23,307,031	25,648,258	Other Bituminous Coal	15,356,595	13,866,514	15,174,501
5	Kriel	2850	18,156,686	15,906,816	18,204,910	Other Bituminous Coal	9,420,764	8,504,715	9,527,185
6	Lethabo	3558	23,580,232	25,522,698	25,500,366	Other Bituminous Coal	16,715,323	18,170,227	17,774,699
7	Matimba	3690	26,256,068	27,964,141	28,163,040	Other Bituminous Coal	13,991,453	14,637,481	14,596,842
8	Majuba	3843	22,676,924	22,340,081	24,632,585	Other Bituminous Coal	12,554,406	12,261,833	13,020,512
9	Matla	3450	21,863,400	21,954,536	21,504,422	Other Bituminous Coal	12,689,387	12,438,391	12,155,421
10	Tutuka	3510	21,504,122	19,847,894	19,067,501	Other Bituminous Coal	11,231,583	10,602,839	10,191,709
12	Ankerlig *(Source: For generation of electricity for all four gas turbine stations: Eskom Annual Integrated Report 2011, page 13, Appendix 60. For Kerosene (diesel) consumption: Eskom Holdings Limited Integrated Report 2011, page 152, Appendix 62)*	1327	143,000	49,000	190,501	Other Kerosene	24,776	13,803	53,901
13	Gourikwa (electricity production and kerosene consumption included in figures for Ankerlig)	740	0.0	0.0	0.0	Other Kerosene	0.0	0.0	0.0
14	Acacia	171	0.0	0.0	992	Other Kerosene	0.0	0.0	381
15	Port Rex	171	0.0	0.0	5,507	Other Kerosene	0.0	0.0	242
24	Camden *** Commissioning information source: Eskom Holdings Limited Integrated Report 2011, page 148	1600	6,509,079	7,472,070	7,490,836	Other Bituminous Coal	3,876,211	4,732,163	4,629,763
25	Grootvlei * Commissioing information source: Appendix 63_Eskom Annual Report 2010, page 126 http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf	1200	1,249,556	2,656,230	3,546,952	Other Bituminous Coal	674,538	1,637,371	2,132,979
26	Komati **Commissioing information source, Appendix 64_Eskom Annual Report 2010, page 127, http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf	1000	0	1,016,023	2,060,141	Other Bituminous Coal	0	664,497	1,271,010

Source: GEF Spreadsheet and Appendix 61_FuelConsumptionElectricityGen.xls published by Eskom. Website short cut access is: http://www.eskom.co.za/c/article/236/cdm-calculations/

Table 18: Calculation of the Operating Margin emission factor

Operating Margin Calculation Option	Simple OM

No.	Name of Power Unit	2008-2009		2009-2010		2010-2011	
		Net Electricity Generation	CO2 Emission Factor	Net Electricity Generation	CO2 Emission Factor	Net Electricity Generation	CO2 Emission Factor
		MWh	t-CO_2/MWh	MWh	t-CO_2/MWh	MWh	t-CO_2/MWh
Electricity import							
i-1	International imports	12,189,000		13,754,000		13,613,000	
i-2	IPPs	0.0		0.0		1,833,000.0	
Electricity generation in the project electricity system		-		-		-	
1	Arnot	11,987,281	0.9121	13,227,864	0.8835	12,194,878	0.9315
2	Duvha	21,769,489	0.8947	22,581,228	0.8947	20,267,508	0.9138
3	Hendrina	12,296,687	0.9902	12,143,292	0.9783	11,938,206	1.0410
4	Kendal	23,841,401	1.1011	23,307,031	1.0234	25,648,258	1.0299
5	Kriel	18,156,686	0.8870	15,906,816	0.9197	18,204,910	0.9110
6	Lethabo	23,580,232	1.2118	25,522,698	1.2246	25,500,366	1.2134
7	Matimba	26,256,068	0.9109	27,964,141	0.9004	28,163,040	0.9022
8	Majuba	22,676,924	0.9464	22,340,081	0.9442	24,632,585	0.9202
9	Matla	21,863,400	0.9922	21,954,536	0.9746	21,504,422	0.9840
10	Tutuka	21,504,122	0.8928	19,847,894	0.9189	19,067,501	0.9305
12	Ankerlig	143,000	0.5201	49,000	0.8456	190,501	0.8494
13	Gourikwa (electricity production and kerosene consumption included in figures for Ankerlig)	0	-	0	0.8456	0	0.8494
14	Acacia	0	-	0	0.8456	992	0.8494
15	Port Rex	0	-	0	0.8456	5,507	0.8494
24	Camden	6,509,079	1.0180	7,472,070	1.0894	7,490,836	1.0786
25	Grootvlei	1,249,556	0.9228	2,656,230	1.0604	3,546,952	1.3979
26	Komati	0	-	1,016,023	1.1250	2,060,141	2.1776
Annual Electricity Generation in Total		224,022,925		229,742,904		235,862,603	
Simple Operating Margin CO2 Emission Factor		EFgrid, OMsimple,y1	0.9269	EFgrid, OMsimple,y2	0.9208	EFgrid, OMsimple,y3	0.9293
Operating Margin Emission Factor(t-CO_2/MWh)							**0.9257**

Step 5 Calculate the build margin (BM) emission factor

(a) According to the information provided by the national utility, $SET_{5\text{-units}}$ consist of the following 5 units (based on the power stations most recently added to the national grid):

$SET_{5\text{-units}}$		
Plant Name	Fuel type	Commission year
Komati***	Coal	2009
Grootvlei**	Coal	2008
Gourikwa	Other Kerosene	2007
Ankerlig	Other Kerosene	2007
Camden*	Coal	2005

Source of information:
***Appendix 67_Re-commissioned power plant,** Eskom Holdings Limited Integrated Report 2011, page 148
****Appendix 63_Re-commissioned power plant,** Eskom Annual Report 2010, page 126, http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf
*****Appendix 64_Re-commissioned power plant,** Eskom Annual Report 2010, page 127, http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf

(a) 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 the annual electricity generation of the project electricity system, AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$).

(b) $SET_{\geq 20\%}$ consist of the following power stations indicated in the table below.

No.	Name of power unit	Year commissioned	Fuel Type Energey Source	Net Electricity Generation (MWh/y) of the latest year	CO2 Emission Factor ($t\text{-}CO_2/MWh$) of the latest year	CO2 Emissions ($t\text{-}CO_2$)
SET≥20%						
26	Komati Commissioing information source, Eskom Annual Report 2010, page 127, http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf	2009	Other Bituminous Coal	2,060,141	2.1776	4,486,265.9
25	Grootvlei * Commissioing information source: Eskom Annual Report 2010, page 126 http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf	2008	Other Bituminous Coal	3,546,952	1.3979	4,958,140.8
13	Gourikwa (electricity production and kerosene consumption included in figures for Ankerlig)	2007	Other Kerosene	0	0.2537	0.0
12	Ankerlig (Source: For generation of electricity for all four gas turbine stations: Eskom Annual Integrated Report 2011, page 13. For Kerosene (diesel) consumption: Eskom Holdings Limited Integrated Report 2011, page 152.)	2007	Other Kerosene	190,501	0.2537	48,330.9
24	Camden * Commissioning information source: Eskom Holdings Limited Integrated Report 2011, page 148, http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf	2005	Other Bituminous Coal	7,490,836	1.0786	8,079,616.7
8	Majuba	1996	Other Bituminous Coal	24,632,585	0.8872	21,854,396.1
4	Kendal	1988	Other Bituminous Coal	25,648,258	1.1470	29,417,684.9

(c) In the GEF spreadsheet, the set of power units will be selected from $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ that comprise the larger annual generation to calculate the build margin (SET_{sample}).

AEG $SET_{5\text{-units}}$ = 13,288,430 MWh (see grid emission spreadsheet, sheet BM-D)
AEG $SET_{>20\%}$ = 63,569,273 MWh (see grid emission spreadsheet, sheet BM-D)

SET_{sample} is equal to $SET_{\geq 20\%}$ because $SET_{\geq 20\%}$ comprises the larger annual generation.

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.

It is clear that Kendal and Majuba in SET_{sample} have started to supply electricity to the grid more than 10 years ago.

(d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. This excludes the following power plants from SET_{sample}.

- Kendal (1988)
- Majuba (1996)

The only CDM project activity that started supply electricity to the grid, is the Bethlehem Hydro plant.

No.	Name of power unit	Year commissioned	Fuel Type Energey Source	Net Electricity Generation (MWh/y) of the latest year	CO2 Emission Factor (t-CO_2/MWh) of the latest year	CO2 Emissions (t-CO_2)
SETsample-CDM						
26	Komati Commissioing information source, Eskom Annual Report 2010, page 127, http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf	2009	Other Bituminous Coal	2,060,141	2.1776	4,486,265.9
28	Bethlehem Hydro (Source: http://cdm.unfccc.int/Projects/DB/SGS-UKL1245061289.99, CDM PDD, page 12)	2009	Hydro	34,031	0.0000	0.0
25	Grootvlei * Commissioing information source: Eskom Annual Report 2010, page 126 http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf	2008	Other Bituminous Coal	3,546,952	1.3979	4,958,140.8
13	Gourikwa (electricity production and kerosene consumption included in figures for Ankerlig)	2007	Other Kerosene	0	0.2537	0.0
12	Ankerlig (Source: For generation of electricity for all four gas turbine stations: Eskom Annual Integrated Report 2011, page 13. For Kerosene (diesel) consumption: Eskom Holdings Limited Integrated Report 2011, page 152.)	2007	Other Kerosene	190,501	0.2537	48,330.9
24	Camden * Commissioing information source: Eskom Holdings Limited Integrated Report 2011, page 148, http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf	2005	Other Bituminous Coal	7,490,836	1.0786	8,079,616.7

$AEG_{SET\ sample\ CDM} < 0.2 \times AEG_{total}$. Therefore, continue to the next step below:

(e) The plants that have to be added to make up the set that comprises 20% of the grid are Majuba and Kendal.

The sample group of power units m used to calculate the build margin	SETsample-CDM->10yrs

No.	Name of power unit	Year commissioned	Fuel Type Energey Source	Net Electricity Generation (MWh/y) of the latest year	CO2 Emission Factor (t-CO_2/MWh) of the latest year	CO2 Emissions (t-CO_2)
26	Komati Commissioing information source, Eskom Annual Report 2010, page 127, http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf	2009	Other Bituminous Coal	2,060,141	2.1776	4,486,266
28	Bethlehem Hydro (Source: http://cdm.unfccc.int/Projects/DB/SGS-UKL1245061289.99, CDM PDD, page 12)	2009	Hydro	34,031	0.0000	0
25	Grootvlei * Commissioing information source: Eskom Annual Report 2010, page 126 http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf	2008	Other Bituminous Coal	3,546,952	1.3979	4,958,141
13	Gourikwa (electricity production and kerosene consumption included in figures for Ankerlig)	2007	Other Kerosene	0	0.2537	0
12	Ankerlig (Source: For generation of electricity for all four gas turbine stations: Eskom Annual Integrated Report 2011, page 13. For Kerosene (diesel) consumption: Eskom Holdings Limited Integrated Report 2011, page 152.)	2007	Other Kerosene	190,501	0.2537	48,331
24	Camden * Commissioing information source: Eskom Holdings Limited Integrated Report 2011, page 148, http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf	2005	Other Bituminous Coal	7,490,836	1.0786	8,079,617
8	Majuba	1996	Other Bituminous Coal	24,632,585	0.8872	21,854,396
4	Kendal	1988	Other Bituminous Coal	25,648,258	1.1470	29,417,685

Data Vintage – Option 1 is selected (ex-ante)

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.

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

Equation 3

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

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m = Power units included in the build margin
y = Most recent historical year for which power generation data is available

The emission factor for each power unit is calculated applying Option A1, if the electricity generation and fuel consumption information for the generating units are publicly available.

Determination of $EF_{EL,m,y}$ according to Option A1:

Equation 4

$$EF_{grid,BM,y} = \frac{\sum_{i} FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}}$$

The BM is calculated as 1.0503 tCO_2/MWh (refer to GEF spreadsheet, Sheet BM, Cell G:H42)

Step 6: Calculate the combined margin emissions factor

The calculation of the combined margin emission factor ($EF_{grid,CM,y}$) is determined by the Weighted average CM.

(a) Weighted average CM

The combined margin emissions factor is calculated as follows:

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

Equation 5

Where:

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

The methodology specifies default values of w_{OM} = 0.5 and w_{BM} = 0.5.

The combined margin is calculated as 0.9880 tCO_2/MWh (refer to GEF spreadsheet, Sheet CM, Cell I10)

Annex 4

MONITORING INFORMATION

Not applicable

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Table 17: Power stations