PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Hernic's Electricity Generation from Waste Gas Project
Version number of the PDD	03
Completion date of the PDD	20/09/2012
Project participant(s)	Hernic Ferrochrome (Pty) Ltd.
Host Party(ies)	South Africa
Sectoral scope and selected methodology(ies)	Sectoral scope 01: Energy industries (renewable-/non-renewable sources) Sectoral scope 04: Manufacturing industries Methodologies: 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;
Estimated amount of annual average GHG emission reductions	152,290

SECTION A. Description of project activity

A.1. Purpose and general description of 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* (Appendix 5: Page 2/60, ACM0012).

- The recipient facility is Hernic Ferrochrome 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)* (Appendix 5: 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* (Appendix 5: Page 3/60, ACM0012).

- The WECM is waste gas produced in four closed furnaces at Hernic.

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* (Appendix 5, Page 3/60, ACM0012).

- The project activity is implemented by the owner of the facility, Hernic who is also the project facility.

Hernic Ferrochrome (Pty) Ltd is the world's 4th largest integrated ferrochrome producer based in the North West Province, South Africa. It is located in a part of the western limb of the Bushveld Complex which is one of the world's largest chrome ore deposits. Ferrochrome is produced using four closed electric submerged arc furnaces. The closed furnaces are fed raw materials from various sources including chrome ore, coke, char, coal, quartzite and dolomite via the proportioning system for the production of ferrochrome.

In addition, chromite fines are pelletised and sintered through Outokumpu technology. A mixture is added to the chromite pellets and it is then heated in a steel belt sintering furnace. During this process the pellets are heated to form strong bonds between the chromite grains to yield and agglomerate the material. The sintered pellets are then sized and fed to the furnaces.

The first two furnaces (F1 and F2) were commissioned in May and June 1996 (Refer to Appendix 15(i)_Design Base F1&2, which is dated August 1996), Furnace 3 and Furnace 4 were commissioned in 1997 and 2006 respectively.

All four furnaces produce a combustible, CO-rich off-gas as by-product. This gas 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 70% and 80% CO and 5% and 15% H2.

Because of the combustible and potentially explosive nature of the off-gas and high temperatures involved in the smelting process, strict safety precautions are followed during operations which include monitoring of oxygen levels in the gas and pressure and temperature fluctuations. When any of these parameters fall outside the control limits the furnace electrical input is immediately lowered or switched off which reduce or stop the production of the off-gas.

No process gas from the Hernic plant is currently used for any energy generation applications (thermal or electrical), (Refer to Appendix 22_Waste gas assessment Report, Section 4.2). Under normal operational conditions 84,719 GJ/a waste gas is used for sintering and 374,427 GJ/a waste gas is used for raw material preheating. The study conducted by the independent energy and ferrochrome expert, confirms this (Refer to Appendix 22_Waste gas assessment Report, Section 4.3.2 and 4.3.3).

1. Purpose of the project activity

The proposed project activity is an initiative to recover waste gas from four existing closed ferrochrome furnaces at Hernic. The envisaged project will use the waste gas in 15 gas engines with a maximum capacity rating (MCR) of 1.698MW each (Appendix 6 Gas Engine Spec Sheet_JMS_620_F55, page 1, 13/02/2012). The installed capacity of the plant will be 25.47MW.

After the parasitic load is accounted for, the electricity that will be displaced from the grid is 170,729MWh per year.

The implementation of the project will have no impact on the existing production operations at the smelter. Construction of the project is expected to start at the earliest in January 2013.

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 168,953 tons per annum.

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.

Current scenario and baseline for electricity

Hernic 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.

Current scenario and baseline for waste gas

At present, the waste gas produced from the closed furnaces is cleaned and conditioned in the gas cleaning plant before it is flared to atmosphere. Each furnace has its own dedicated gas cleaning plant and two dedicated flares, a clean gas stack and a raw gas stack. (Refer Figure 3)

When the gas cleaning plant is down for planned or unplanned maintenance, the gas is flared in the raw gas stack. No fossil fuel is used in the raw gas stack to support continuous flaring. There is a continuous pilot flame on the clean gas stack (not the raw gas stack) to ensure the off-gas is ignited.

Currently the following conditions apply for the Hernic site:

- No waste gas is currently recovered for the generation of electricity at the site (Refer to Appendix 22_Waste gas assessment Report, Section 4.2).

- No electricity generation equipment is installed on site that converts waste gas to electricity (Refer to Appendix 22_Waste gas assessment Report, Section 4.2).
- By design, approximately 25% of the waste gas is diverted to two furnace feed pre-heaters (one each on furnaces F3 and F4), and sinter plant where it is used for heating purposes. After the pre-heaters, the flue gas (exhaust gas) is vented to atmosphere (Appendix 22_Waste gas assessment Report, Section 4.2.1).
- By design, the balance of the waste gas produced in the furnaces is flared to atmosphere (Appendix 22_Waste gas assessment Report, Section 4.2.1).

National grid information for South Africa

The national utility, Eskom, is a government-owned entity and generates approximately 95 per cent of the South Africa's electricity[1]. Private generators produce approximately 3% of national electricity requirements and municipalities produce less than 1%. Approximately 90% of electricity in South Africa is derived from coal-fired power stations[2].

Hernic

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 to drive them is supplied by the electricity to the furnace. 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 to cool the gas and remove particulates before it is flared.

b) Project scenario

Project scenario for the electricity

Electricity generated from the project activity will be replacing electricity imported by Hernic from the national utility (Eskom) via the national grid. Greenhouse gas emissions associated with the electricity generation in the national grid will be reduced as a result.

Project scenario for the waste gas

---

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

[2] Appendix 34: Electricity Generation Statistics in South Africa, http://www.geni.org/globalenergy/library/energy-issues/south africa/index_chart.html

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

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 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

The existing flare on furnace 4 will be used to absorb waste gas flow fluctuations.

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

v. **Backup equipment**

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_Jenbacher confirmation letter regarding fuel type). Therefore, no fossil fuel will be used for backup purposes of any kind in the power plant to generate electricity.

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 Brits

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 300 people over the construction period. The proposed power plant will employ approximately 8 to 10 full time employees and, as such, will create potential employment opportunities in the province[3]. However,

---

[3] Annex 16 DRAFT ENVIRONMENTAL IMPACT REPORT, Section 6.3.2

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.

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 Witbank 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 a well established Austrian company and the technology has been implemented in a number of developed countries.

A.2. Location of project activity

A.2.1. Host Party(ies)

South Africa

A.2.2. Region/State/Province etc.

The project is located in the Mpumalanga province.

A.2.3. City/Town/Community etc.

The project is located near the town of Brits.

A.2.4. Physical/Geographical location

Hernic Ferrochrome is a stand-alone plant situated right next to the ferrochrome mine. The surrounding area consists mainly of farmland and natural vegetation with the nearest settlement being 5km away (Brits).

Project activity location (specific location is the Furance 4 stack)
25°39'42.48"S
27°50'13.29"E

The figures below indicate the plant’s location.

Figure 1: Map of South Africa with the town of Brits and surroundings indicated with the red block

Figure 2: Hernic Plant

A.3. Technologies and/or measures

\>>

A.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.3.2 Purpose of the project activity

Hernic is to develop an electricity generation project with a maximum capacity of 25.47MWe utilizing furnace waste gas generated at Hernic in four closed submerged arc alternating current (AC) furnaces.

The electricity generated on site will displace 170,729 MWh electricity imported from the South African national grid, i.e. 25.47MW (i.e. 15 engines x 1.689 MWe) minus the parasitic load of the plant, taking into account the capacity factor of the system.

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

A.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

The four closed furnaces generate CO rich waste gas. By design, the waste gas from Furnaces 1 & 2 are designed to be flared to atmosphere as part of the business-as-usual production process since August 2009 for F1, August 2009 for F2. Furnace 3 & 4 is designed to flare the bulk of the waste gas since October 1999 for F3 and October 2005 for F4. By design, approximately 25% is designed for heating purposes in the raw material pre-heaters and sintering[4] and the remainder 75% of the waste gas produced is designed to be flared (Refer to Appendix 22_Waste gas assessment Report). This gas typically contains 70 to 80% CO and 5 to 15% H_2 by volume, which is to be utilised as a gas fuel source for the project activity.

Waste off-gas from the furnaces is flared after passing through a gas cleaning system for each furnace. At no time is furnace gas vented to the atmosphere unburnt.

The existing equipment that is relevant to the project activity includes the following:

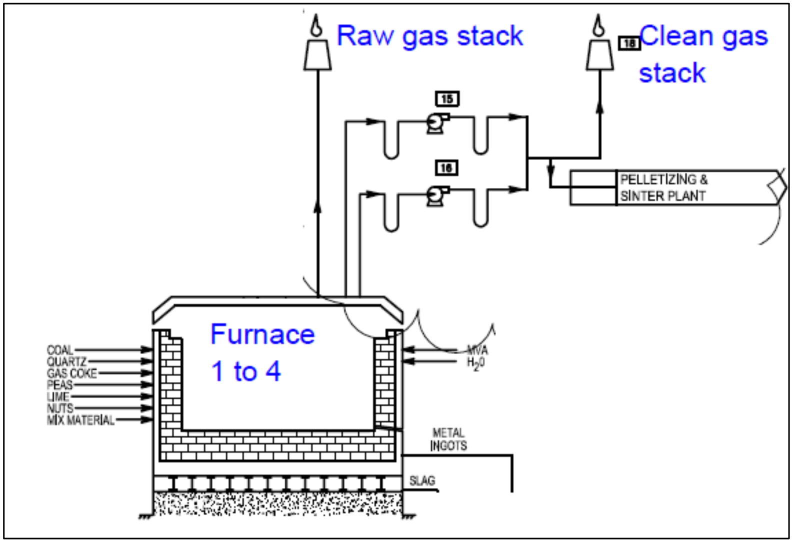
1. Four closed alternating current arc furnaces where the waste gas is produced
2. Gas cleaning equipment for each furnace – where the waste gas is cooled and cleaned before being flared and released to atmosphere
3. Two flares for each furnace
    a. One flare (main flare) is used during normal operations
    b. Raw gas stack (emergency stack) is used only when the gas cleaning plant is not in operation
4. Two preheaters (one on Furnace 3 and one on Furnace 4) to preheat the raw material feed into the furnaces 3 and 4.
5. Two sinter plants

The Figure 3 below provides a layout of the existing gas reticulation system.

---

[4] Appendix 45_P&IDs for the furnaces waste gas streams

Figure 3: Existing waste gas reticulation system for F1 to F4 at Hernic



Furnaces Design Information

Table 1: Equipment information for the current scenario at Hernic

	Furnace 1	**Furnace 2**	**Furnace 3**	**Furnace 4**
i. Age and average lifetime of the furnaces based on manufacturer's specifications -------------------------------- Manufacturer of furnaces	Confirmation letter provided by equipment supplier/independent expert to confirm that the lifetime of the furnace F1 is in excess of 20 years (Refer to Appendix 9_Lifetime of Equipment Report) Technology: Outokumpu	Confirmation letter provided by equipment supplier/independent expert to confirm that the lifetime of the furnace F2 is in excess of 20 years (Refer to Appendix 9_Lifetime of Equipment Report) Technology: Outokumpu	Confirmation letter provided by equipment supplier/independent expert to confirm that the lifetime of the furnace F3 is in excess of 20 years (Refer to Appendix 9_Lifetime of Equipment Report) Technology: Outokumpu	Confirmation letter provided by equipment supplier/independent expert to confirm that the lifetime of the furnace F4 is in excess of 20 years (Refer to Appendix 9_Lifetime of Equipment Report) Technology: Outokumpu
ii. Existing and forecast installed capacities for the existing four furnaces	Furnace design specifications, availabilities and load factors are confidential and will be supplied to the validator (Appendix 15_Design information for furnaces). Capacity: 37 MVA Nominal Plant Capacity: 65,000 tons/year	Furnace design specifications, availabilities and load factors are confidential and will be supplied to the validator Capacity: 37 MVA Nominal Plant Capacity: 65,000 tons/year	Furnace design specifications, availabilities and load factors are confidential and will be supplied to the validator Capacity: 54 MVA Nominal Plant Capacity: 110,000 tons/year	Furnace design specifications, availabilities and load factors are confidential and will be supplied to the validator Capacity: 78 MVA Nominal Plant Capacity: 163,912 tons/year
iii. The monitoring equipment and their location in the system.	Gas composition of the off-gas (CO and H_2) is measured with two analysers	Gas composition of the off-gas (CO and H_2) is measured with two analysers.	Gas composition of the off-gas (CO and H_2) is measured with two analysers.	Gas composition of the off-gas (CO and H_2) is measured with two analysers.
iv. The types and levels of services (normally in	- The type of service delivered by the project activity is electricity.			

	Furnace 1	Furnace 2	Furnace 3	Furnace 4
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 project boundary.	- The level of service is 170,729 MWh - Equipment required in the waste gas recovery plant will include: internal combustion engines General Electric Jenbachers gas engines (GEJs)) 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 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 170,729 MWh electricity will be provided by Eskom via the national grid in the baseline scenario.			

The ancillary equipment at Hernic which are relevant at present and in future is as follows:

Table 2: Design information for the sinter plants and preheaters

	Sinter Plant 1	**Sinter Plant 2**	**Furnace 3 Pre-heater**	**Furnace 4 Pre-heater**
Size	52tph Green Pellet Feed	52tph Green Pellet Feed	40tph Furnace Feed	64tph Furnace Feed
Technical description	Off-gas consumption for heating/combustion in the Sinter Plant. The Sinter Plant modifies the ore into a more useable form for the furnace. This is done by passing the 'green' (raw) ore pellets (fines) through a heating, firing (Sintering) and cooling zone and creating pellets (>13mm) that are easily reducable in the furnace.		Off-gas consumption for furnace feed pre-heating. Used to heat the furnace feed to 700degC to reduce overall furnace energy consumption by 20-30%.	
Manufacturer	Outokumpu	Outokumpu	Outokumpu	Outokumpu

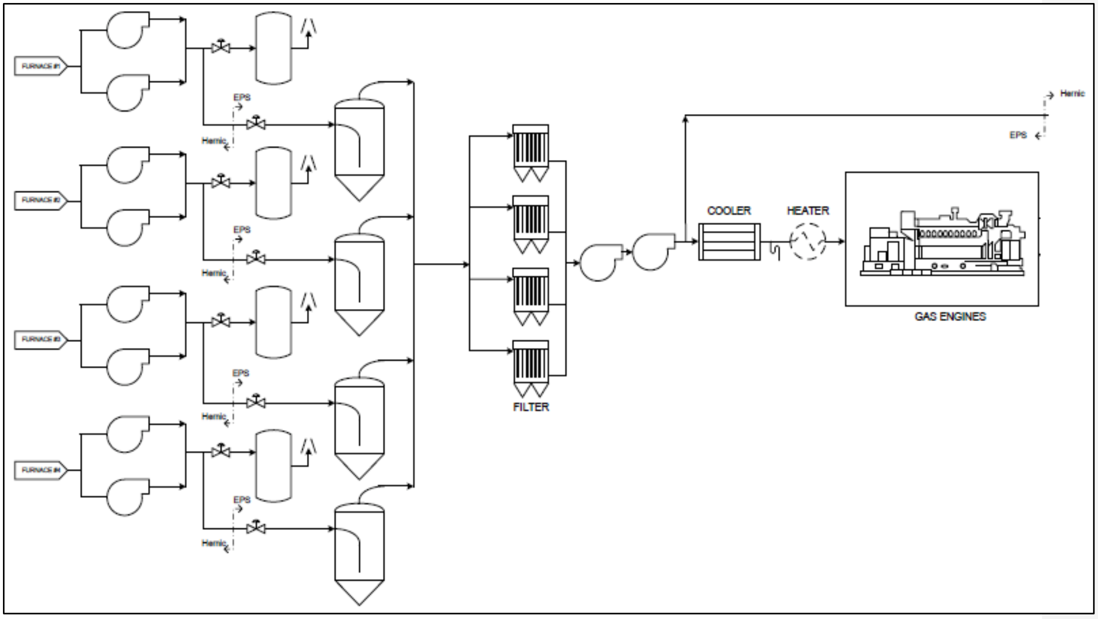
A.3.4 The scope of measures that are being implemented within the project activity, with a list of the equipment and systems that will be installed

The efficiencies and capacities of the furnaces will not be affected by the project activity nor will the expected lifetimes of the respective furnaces.

Figure 4 provides a layout of the proposed power generation system.

Ciska Terblanche 12/9/21 11:35 AM
Deleted: Figure 4

Figure 4: Proposed new waste gas power plant at Hernic



Description of the new power plant at Hernic

Waste gas from all four furnaces will be directed into the proposed new 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 15 new GEJ620 F55 Jenbacher internal combustion gas engines. The internal combustion gas engines are spark ignition engines operating on the same principles as normal petrol engines. The maximum rated capacity electrical output of the engines is 1.698 MW if the design quality gas is available. The project activity will use as much of the off-gas that is currently flared in the internal combustion gas engines as possible. Table 3 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[5] hours.
ii. Existing and forecast installed capacities, capacity factors, load factors and efficiencies (see Table 3).

Table 3: Design parameters for the preferred technology

Manufacturer	Units	GE Jenbacher
Engine type		JMS620GS 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	2.72
Energy input	kW	4639
Gas volume	Nm³/h	1702
Electrical output	kW el.	1698
Spec. fuel consumption of engine	kWh/kWh	2.73
Electrical efficiency	%	37

iii. The monitoring equipment and their location in the system is described in Section 7.

iv. After parasitic load has been accounted for 170,729MWh per year will be displaced from the national grid.

v. In the baseline scenario, the 170,729MWh would be delivered by the national grid.

2. Gas conditioning equipment

Refer to Appendix 10 for a comprehensive list of gas cleaning plant equipment.

3. The estimated capacity factor for the power generation system

The capacity factor for the power generation system is calculated taking account of technical power plant

---

[5] Appendix 81_Letter from Gas Engine Supplier confirming the lifetime of the gas engines

availability, furnace availability and a fuel quality load factor.

The capacity factor is used with the installed power plant capacity (MW) and the auxiliary/parasitic load to project the annual energy production. The annual projected energy is checked against gas energy constraints (i.e. estimated average off-gas energy available - GJ/hour) and adjusted as necessary.

The power system design capacity factor is described in Appendix 11, Section 9.1.1.

A.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.3.3.

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
South Africa (host)	Private entity Hernic Ferrochrome (Pty) Ltd.	No

A.5. Public funding of project activity

No public funding is involved in the development or the implementation of this project. All the capital and funds needed for the development and implementation of the project activity will be procured commercially.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

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:

“Tool to calculate the emission factor for an electricity system”, Version 02.2.1;

“Tool for the demonstration and assessment of additionality”, Version 06;

“Tool to determine the remaining lifetime of equipment”, Version 01;

Refer to http://cdm.unfccc.int/methodologies/PAmethodologies/approved for copies of the methodologies and Tools.

B.2. Applicability of methodology

Table 4 summarises the applicability criteria for projects using ACM0012 Version 4.0.0. 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 gas into useful energy.

Table 4: Demonstration that the proposed project activity complies with the Applicability Criteria from ACM0012

Applicability Condition from ACM0012, Version 4.0.0	Comments and Additional supporting documentation	Applicability
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, which is flared to atmosphere in the existing operation scenario will be utilised for the generation of electricity only. This is the scope of the project activity.	• The criteria is applicable to the project activity. • The 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 this project activity, condition (a) applies, it is in the absence of the project activity, the waste gas would not be recovered and is flared and remain unutilized. • The waste gas is currently flared. • An independent expert report (Appendix 22_Waste gas assessment report) 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. • 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. It is colourless, odourless and tasteless. Its physical characteristics are like nitrogen. CO is little lighter than air and is easily blended with it. Its solubility in water is little greater than that of air. CO creates an explosive gas mixture with air at	• The criteria is applicable to the project activity. • The project activity complies with the criteria.

Applicability Condition from ACM0012, Version 4.0.0	Comments and Additional supporting documentation	Applicability
	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 1[6], 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.	
Project activities improving the WECM recovery may: (i) capture and utilise a larger quantity of WECM stream as compared to the historical situation in existing facility, or capture and utilise a larger quantity of WECM stream as compared to a “reference waste energy generating facility”; and/or (ii) apply more energy efficient equipment to replace/modify/expand waste energy recovery equipment, or implement a more energy efficient equipment than the “reference waste energy generating facility”.	(i) Currently, no waste gas is recovered for the purpose of generating electricity. 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. (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.	• The criteria is applicable to the project activity. • The project activity complies with the criteria.

---

[6] 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

Applicability Condition from ACM0012, Version 4.0.0	Comments and Additional supporting documentation	Applicability
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 as the project activity is not recovering waste pressure.	Not applicable
• 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 Hernic to recover and/or utilize the waste gas prior to the implementation of the project activity. Please refer to Annex 21: National Environment Management: Air Quality Act 39 of 2004[7].	• The criteria is applicable to the project activity. • The 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 that produce ferrochrome is NOT expanded as a result of the project activity.	• The criteria is applicable to the project activity. • The project activity complies with the criteria.
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.	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 and pressure and temperature fluctuations. When any of these parameters fall outside the control limits the furnace electrical input is immediately lowered or removed which reduce or stop the production of the off-gas. Waste gas that is released under abnormal operation of the project facility is not included in	• The criteria is applicable to the project activity. • The project activity complies with the criteria.

---

[7] Annex 21: 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, Version 4.0.0	Comments and Additional supporting documentation	Applicability
	the emission reduction calculations as this gas will be diverted to the raw gas stack and will not be used for electricity generation.	
If multiple waste gas streams are available in the project facility and can be used interchangeably for various applications as part of the energy sources in the facility, the recovery of any waste gas stream, which would be totally or partially recovered in the absence of the project activity, shall not be reduced due to the implementation of CDM project activity. For such situations, the guidance provided in Annex 3 shall be followed.	There are four waste gas streams available for recovery in the Hernic process. By design, about 25% of this waste gas energy[8] is used for preheating of raw material and for sintering purposes. The guidance in Annex 3 of ACM0012 is applied to provide evidence that the recovery of the waste gas for heat purposes does not reduce as a result of the implementation of the project activity. This will be specially provided for in the Monitoring Plan.	• The criteria is applicable to the project activity. • The project activity complies with the criteria.
The methodology is **not** applicable to the cases where a WECM stream is partially recovered in the absence of the CDM project activity to supply the heat of reaction, and the recovery of this WECM stream is increased under the project activity to replace fossil fuels used for the purpose of supplying heat of reaction.	No waste gas is recovered for heat of reaction purposes. This condition does not apply to the project activity.	Not applicable
This methodology is also **not** applicable to project activities where the waste gas/heat recovery project is implemented in a single-cycle power plant (e.g. gas turbine or diesel generator) to generate power. However, the projects recovering waste energy from single cycle and/or combined cycle power plants for the purpose of generation of heat only can apply this methodology.	The project activity is implemented in a chrome industrial facility, NOT in a single-cycle power plant.	Not applicable
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 waste gas cleaning equipment is determined by applying the "Tool to determine the remaining lifetime of equipment", version 01. The project participants obtained an expert evaluation for the lifetime of	• The criteria is applicable to the project activity. • The project activity complies with the criteria.

---

[8] Annex 8 Design information from the Technology Supplier

Applicability Condition from ACM0012, Version 4.0.0	Comments and Additional supporting documentation	Applicability
	the furnaces (Refer to Appendix 7).	
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.	Annex 2 in ACM0012 is applied to determine the extent of use of waste gas from the furnace in the absence of the CDM project activity. - An independent energy company was commissioned to conduct an audit on the electricity bills and gas procured and compiled a report that confirms that the waste gas that will be utilised in the project activity is currently flared (Appendix 22_ Waste Gas Assessment Report). - The DOE will conduct an on-site assessment check during the validation site visit to confirm that no equipment for waste energy recovery and utilisation had been installed on the waste gas stream that is currently flared.	• The criteria is applicable to the project activity. • The project activity complies with the criteria.

Table 5: 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 supplies electricity to Hernic and displaces grid electricity that would be imported by Hernic in the absence of the project activity.	The criteria is applicable to the project activity.
In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I	The project electricity system is located in South Africa, which is not an Annex I country. Also, none of the neighbouring	The criteria is applicable to the 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**
country. (Refer to page 2 of the Tool under "Scope and applicability")	countries around South Africa are Annex I countries.	
"Tool to determine the remaining lifetime of equipment", Version 01 Methodologies referring to this tool should clearly specify for which equipment the remaining lifetime should be determined.	- This criteria applies to methodologies and not to PDDs.	-
The remaining lifetime of relevant equipment shall be determined prior to the implementation of the project activity.	- The remaining lifetime of the furnaces have been determined and confirmed by the furnace supplier between February and July 2012. Construction of the project is expected to start at the earliest in January 2013.	The criteria is applicable to the project activity. The project activity complies with the criteria.
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)	- The remaining lifetime of the furnaces has been determined by the furnace supplier, Outokumpto who designed and constructed all of the furnaces. The following reference documentation will be supplied to the validator: Furnace supplier letter to confirm the lifetime of the furnaces (Appendix 9 Lifetime of equipment Report_Furnaces and gas cleaning equipment).	The criteria is applicable to the project activity. The project activity 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.	The criteria is applicable to the project activity.

B.3. Project boundary

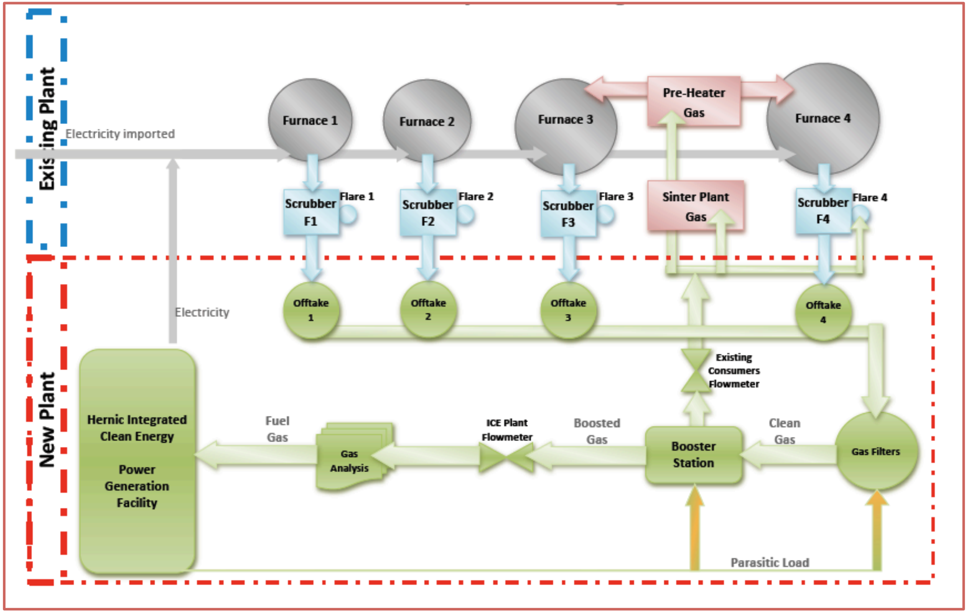
As per methodology ACM0012, the geographical extent of the project boundary shall include the relevant waste energy stream(s), equipment and energy distribution system in the following facilities:
(1) The project facility is Hernic;
(2) The recipient facility receiving the electricity Hernic.

As defined in ACM0012, the relevant equipment and energy distribution system covers:
In the project facility Hernic where the electricity generation occurs:

- The waste gas streams from the gas cleaning plants for the four furnaces, waste gas condition plant and the power generation plant.
- Transformers or busbars where the electricity is fed into.
- The four furnaces generating the furnace off-gas;
- The proposed electricity generation plant, which will generate electricity from the furnace off-gas;
- Other equipment using furnace off-gas and purchased (imported) propane gas for heating purposes, for the purpose of demonstrating that the same amount of furnace off-gas that was used by the equipment prior to the project activity will continue to be used by the equipment during the project activity;
- The facility using the electricity Hernic, 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 5 below:

Figure 5: Project boundary schematic



Source		GHGs	Included?	Justification/Explanation
Baseline scenario	Electricity generation, grid	CO_2	Included	Main emission source.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
		…	Excluded	Not applicable. The project activity does not involve the generation of thermal energy from waste gas.
	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.
		N_2O	Excluded	Not applicable. The project activity does not involve cogeneration.
	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.
	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.
Project scenario	Supplemental fossil fuel consumption at the project plant	CO_2	Excluded	No supplemental fossil fuel is used at the project plant.
		CH_4	Excluded	No supplemental fossil fuel is used at the project plant.
		N_2O	Excluded	No supplemental fossil fuel is used at the project plant.
	Supplemental electricity consumption	CO_2	Included	Supplemental electricity consumption from the national grid (provided through Hernic) during start-up of the engines if all engines are down.
		CH_4	Excluded	Excluded for simplification as per the methodology.
		N_2O	Excluded	Excluded for simplification as per the methodology.
	Electricity import to replace captive electricity, which was	CO_2	Excluded	Not applicable. The baseline does not involve captive electricity.
		CH_4	Excluded	Not applicable. The baseline does not involve captive electricity.
		N_2O	Excluded	Not applicable. The baseline does not involve captive electricity.

	generated using waste gas in absence of project activity			
	Energy consumption for gas cleaning	CO_2	Included	The electricity that will run the gas conditioning and other equipment will be supplied from the Jenbachers using waste gas. Please refer to the description of how the electricity monitoring is done in Section B.7.
		CH_4	Excluded	Not applicable
		N_2O	Excluded	Not applicable

B.4. Establishment and description of 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).

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 Hernic;

There is only one recipient facility in the project activity, i.e. Hernic. The information on the utilization of electricity in the absence of the CDM project activity is sourced from Hernic and the information on the utilization of the waste gas in the absence of the CDM project activity is sourced from Hernic.

Identification of the project facility: Hernic will own the project facility, i.e. the facility where the waste gas conditioning and power generation equipment will be implemented.

Identification of the recipient facility: Hernic is the recipient facility because the electricity will be supplied to the Hernic plant, thereby reducing their electricity consumption from the national grid managed by the national utility Eskom.

The amount of power generated by the project activity and supplied to Hernic is 170,729 MWh, therefore the power alternatives identified will be based on 170,729 MWh.

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 Hernic where the waste energy is generated; and

- For the recipient facility Hernic 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.

For the use of waste energy the realistic and credible alternative(s) include:

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 82, 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 83, pages 14). The licence requires that Hernic reports abnormal or emergency situations in which venting occurs. Venting is the release of waste gas to atmosphere un-combusted 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:

F1 – May 1996, F2 – June 1996, F3 – 1999 and F4 – 2005.

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.

The Hernic plant is the only industrial facility in a radius of 5 km. No neighbouring industries exist where the gas can possibly be used.

Thus, Alternative W3 is excluded from further consideration.

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

Energy demand at Hernic

Heat energy: The waste gas is used in the two (F3 and F4) furnace feed pre-heaters and two sinter plants by combustion in dedicated burners. There is no further demand for thermal energy on the site, only electricity is needed.

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.

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

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.

The portion of waste gas already used for heat generation satisfies all the heat demand on site for which this waste gas can be used. It is not suitable to replace the other heat requirements as described in 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 Hernic 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.

The mechanical drive applications require sophisticated and accurate control and reliability for steady plant operations. The variability of the gas quality and gas availability will severely impact on steady plant operations.

Therefore, generation of mechanical energy from waste gas is not a feasible option because it would require replacement of electrical motors with gas engines which is prohibitively expensive on such small scale.

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

Export of Electricity

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_Eskom and Long term PPAs).

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

Therefore, producing and exporting electricity to the national grid is not a feasible option.

There are no neighbouring facilities where steam can be exported. Therefore, producing and exporting steam to the neighbouring facility is not a feasible option.

Table 6: Summary of alternatives 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 plant;	Heat – not feasible to utilise the flared waste gas to meet the heat demand on the site.
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;	Done to maximum extent
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. No neighbouring facility to export steam to.

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 cogeneration plant on-site or off-site at the Hernic.

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 site and therefore it is not realistic to implement a cogeneration plant. Also, this alternative does not provide the same output as the proposed project activity. According to ACM0012 and the Tool for the demonstration and assessment of additionality, only alternatives, which provide the same output as the proposed project, need to be evaluated.

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 Hernic.

Therefore, P4 is not a realistic and credible alternative.

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

There is no demand for steam at the site and therefore it is not realistic to implement a cogeneration plant. Also, this alternative does not provide the same output as the proposed project activity. According to ACM0012 and the Tool for the demonstration and assessment of additionality, only alternatives, which provide the same output as the proposed project, need to be evaluated.

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 Hernic.

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 Hernic.

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.

Therefore, P8 is not a realistic scenario.

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 as is indicated when comparing the levelized cost of electricity production from the renewables. Table 4 in Appendix 18[9], 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 paid for electricity is R0.53.[10] /kWh.

Therefore, P9 is not a realistic and credible alternative.

P10: Sourced from grid-connected power plants;

Hernic 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 at all 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, and construction of the new one is not rational as there is no steam demand.

Alternative P12 is excluded from further consideration.

Table 7: Summary of alternatives for Power generation

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

---

[9] 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*.

[10] This is calculated using the price determined in Appendix 59 (Cell 51) for 2011 multiplied by the published 16% increase for 2012.

		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 8: Combination of realistic baseline candidates

Table 8: 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	P1 – Electricity is	The proposed project activity not undertaken as a CDM

	recovered and used to generate electricity	generated from the recovered and conditioned waste gas and used for captive purposes	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 and/or Step 3 of the latest approved version 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 8 are the feasible remaining alternatives.

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[11]. Based on the assumptions and approach set out above the levelised cost of a coal fired power plant is anticipated to be approximately 86.80 Rc/kWh. This is higher compared to purchasing electricity from the national grid (the existing scenario) at megaflex tariff 53.46[12] Rc/kWh. 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.

---

[11] In support of this it is noted, further, that ACE Energy has carried out various costing studies in the South African market where the analysis provides comparative levelised costs for smaller greenfield coal fired power plants of between 25 and 60 MW. The levelised cost estimates for these studies were based on a range of technical, operational and economic assumptions drawn from specific engineering and cost reports commissioned for the power plants in question. Understandably, the specific details of these reports remain the subject of confidentiality agreements and cannot be disclosed herein. The analysis did however indicate that the smaller power plants do not derive the benefits of economies of scale of larger power plant units.

In particular the overnight capital costs (i.e. excluding financing), which is a key determinant of the overall levelised costs, were typically 40% – 60% higher than the capital costs for the 750MW plant presented for the Hernic ICE Project. In addition, the plant thermal efficiencies associated with the smaller power plants, also a key driver of the overall levelised costs, were almost 5% lower than the thermal efficiency associated with the 750MW plant used. These key parameters together with the other operational and financing assumptions applied, deliver levelised costs associated with the smaller power plants that are between 25% and 80% higher than the corresponding levelised costs for the 750MW power plant presented for the Hernic ICE CDM Application.

The levelised costs for a 750MW power plant thus represent an absolute floor of the levelised costs that could be expected for smaller power plants (i.e. 25 to 60 MW). It is in our opinion highly improbable that a 25 MW or similar sized greenfields coal-fired power plant could be built so as to deliver a lower levelised costs than the 750MW plant as set out in the South African Integrated Resource Plan (IRP 2010) and used in the P8 analysis for Hernic.

[12] This is calculated using the price determined in Appendix 59 (Cell 51) for 2011 multiplied by the published 16% increase for 2012.

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 all the waste energy generator(s) and the recipient facility(ies) identified, is one of the scenarios described in Table 9 below (copied directly from ACM0012, Table 2).

Ciska Terblanche 12/9/21 11:35 AM
Deleted: Table 9

Heat and mechanical power is not relevant in this project activity and these have been excluded from the table.

Table 9: 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.
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. 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.[13]

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:

---

[13] 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 scenario 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 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.

§ 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 6, 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

Identify the financial/economic indicator, such as IRR, most suitable for the project type and decision context.

Hernic will not develop and own the project themselves but will house the project in a Special Project Vehicle ("SPV"). The exact ownership of the SPV is not known with certainty as yet – it may be owned by Hernic or by an Independent Power Producer ("IPP").

The exact split of debt and equity is not known as yet and so the default of 50/50 as per paragraph 18 of EB 62, Annex 5,

Hernic is not the only entity able to develop the project –it can also be developed by an IPP. For this reason, in accordance with EB 62 annex 5 and the Additionality Tool, the benchmark needs to relate to returns that are standard 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).

The hurdle rate is thus a 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 project IRR of the project activity are given in the following table.

Table 10: Assumptions made for the financial analysis

Parameter	Unit	Value	Source of information to motivate the assumption
Installed design electrical capacity of the power plant	MW	25.47MW (15 x 1.698) minus parasitic load = 23.18	Appendix 11_Technical Feasibility Study Report, Section 3.4.3 and Table 3.3.
Hours operation	hours	120,000	1. Financial model (Spreadsheet, Inputs_General, Cell L17) 2. Appendix 81_Letter from Jenbacher_lifetime of equipment.

Parameter	Unit	Value	Source of information to motivate the assumption
Net annual power generation	MWh	170,729	Hernic Financial Model (Spreadsheet, Inputs_Production, Cell G169)
**Plant capacity factor average over a year	%	84.11%	Financial spreadsheet, Sheet Inputs_Production, Cell G19
Project lifetime Based on the expected lifetime of the gas engines of 120,000 hours and the plant load factor described in Appendix 11.	Years	16.25	Financial Spreadsheet, Inputs_Production, Cell O19
Total Project Cost Capex plus development cost	South African Rand	R503,574 million	Refer to Financial Spreadsheet, Sheet 'Summary Capex' for a description of the capex.
Annual Operation and Maintenance Cost estimate*	South African Rand	Ranges between R33 million per annum and R145 million per annum	Refer to Financial Spreadsheet, Sheet 'Inputs Opex' for a description of the opex.
Income tax rate	%	28%	South Africa Revenue Services (SARS)[14]
Inflation rate	%	5.7%	Nedbank Currency Forecast (June 2011), Appendix 52

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

Notes:

Capacity factor: For design purposes of the plant and for the purpose of estimating the electricity generation for the project, the annual plant capacity factor is determined by independent expert AAP. Parameters used are the 96% - ICE availability (unplanned uptime), planned shut-downs (Jenbacher specification), and fuel availability. The fuel availability is determined as a result of gas availability and furnace shutdowns over winter peak periods (Appendix 11_Technical Feasibility Study Report, Section 9.1.1)..

Electricity Price: The benefit of the project to Hernic is based on avoided electricity costs from the grid. This is determined using actual, historical Hernic billing data and approved increases by the National Energy Regulator. Only the variable energy costs and the Environmental Levy are avoidable costs as the other network and subsidy related costs will still be payable. The variable cost component of the Eskom electricity supply is determined from historic Hernic billing data.

The amended, legislated NERSA price increase of 16% for 2012/13 has been applied to Hernic's actual electricity costs.

---

[14] Appendix 25.5_Corporate Tax Rate, South Africa Revenue Services website (http://www.sars.gov.za/Tools/Documents/DocumentDownload.asp?FileID=44174)

In the absence of any other compelling data increases beyond the MYPD3 period are assumed to be inflationary only.

The possibility that increases may be higher is catered for in the sensitivity analysis.

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

As argued below, the application of a pre-tax project IRR is deemed appropriate in this instance. This simplifies the analysis of the project investment decision and additionality considerations in that it removes aspects around financing structures and expenditures, tax losses associated with capital allowances etc.

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 project for the project activity serves as a benchmark to assess the financial attractiveness of the project activity.

Table 11 below shows the real pre-tax project IRR of the proposed project, without CDM-related income. Without CDM-related income, the project IRR is materially lower than the benchmark and the proposed project is not financially feasible.

Table 11: Financial analysis result

Scenario	Equity IRR (nominal)
Base Case without CER’s	4.46%
Benchmark	25%

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 reasonable variations in the key 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.

For the proposed project, the following financial parameters were identified as the variable factors for sensitivity analysis of financial attractiveness:

1) Construction Cost
2) Electricity Tariff
3) Energy (MWh) delivered by the power plant
4) Operations and Maintenance Costs (gas engines)

The parameters for the sensitivity analysis are selected as they constitute more than 20% of either total project costs or total project revenues or have significant impact on the financial feasibility indicator.

It is worth noting that the sensitivity to Electricity Tariff and Energy (MWh) delivered is identical as the financial impact of variations in these parameters is the same (i.e. the avoided cost savings is simply the product of these two and 20% variation in either will deliver the same outcome). The sensitivity analysis is thus combined for these two variables.

For the sensitivity analysis, the parameters are varied from -20% to +20% in the financial assessment and the selection is also in accordance with “Guidance on the Assessment of Investment Analysis” .

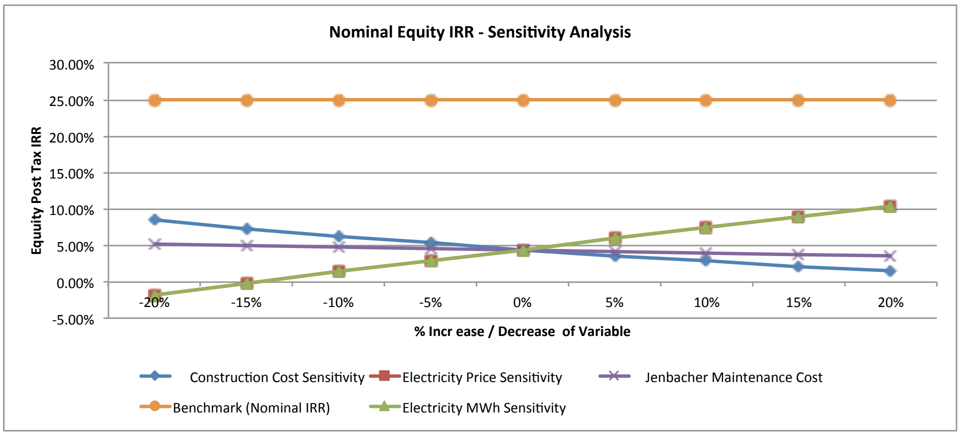
When the above five financial indicators fluctuate within the range of –20% to +20%, the project IRR of the proposed project varies to different degrees. The impact on the real pre-tax Project IRR of fluctuations in the four financial parameters (not considering CERs income) is shown in Table 12 and Figure 6 below.

Ciska Terblanche 12/9/21 11:35 AM
Deleted: Table 12

Table 12: Sensitivity Analysis Results for Hernic

	-20%	-15%	-10%	-5%	0%	5%	10%	15%	20%
Construction Cost	8.46%	7.32%	6.28%	5.33%	4.46%	3.65%	2.90%	2.21%	1.56%
Electricity Price Sensitivity	-1.77%	-0.08%	1.43%	2.95%	4.46%	5.95%	7.43%	8.90%	10.34%
Electricity MWh Sensitivity	-1.77%	-0.08%	1.43%	2.95%	4.46%	5.95%	7.43%	8.90%	10.34%
Jenbacher Maintenance	5.32%	5.10%	4.88%	4.67%	4.46%	4.24%	4.03%	3.82%	3.61%
Benchmark (Nominal IRR)	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%	25.00%

Figure 6: Results of Sensitivity Analysis for Hernic



Threshold Analysis

The following table summarizes the results of the threshold analysis.

Table 13: Results of the Threshold analysis to achieve the benchmark

Construction Cost Sensitivity	-58.83%
Electricity Price Sensitivity	73.97%
Electricity MWh Sensitivity	73.97%
Jenbacher Maintenance Cost	-467.65%

Discussion of Sensitivity Parameters and Threshold analysis to achieve the benchmark

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 8.46% 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_ Price index of capital goods in South Africa_history, 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 58% 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 a nominal return of 10.34%. With a 20% increase the electricity price is significantly higher than the expected Eskom megaflex price and Hernic will continue to purchase electricity from the national utility as it is cheaper option.

Maintenance Costs

Fluctuations in Annual Operation & Maintenance 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 operation and maintenance costs by 20% still provides a return (5.32%) 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. It is not possible to reduce maintenance costs by the required 467% for the project to reach the benchmark return.

From the sensitivity analysis, it is evident that even if the parameters vary by 20% in order to present a more financial feasible scenario, the project activity returns still remain under the financial benchmark.

Step 3: Barrier Analysis

3.1 Technical Barrier

3.1.1 Nature of company, organization and its ownership

Hernic has only one ferrochrome plant in South Africa. The company has no experience in electricity generation from waste gas. The prospective plant needs to integrate with the core production process of ferrochrome and not prejudice it in any manner. Even if the ownership of SPV owning the plant should vest in an Independent Power Producer, ferrochrome waste gas has only once in the country's history been utilised to produce electricity and this was very recently at IFM. It is thus highly likely that the owner and operator of the plant at Hernic will not have prior experience in the operation of such a plant.

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

Hernic has not developed power plants before.

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.[15] 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.[16] 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.

Hernic has easy access to grid electricity and has been importing grid electricity for the past 16 years. Hernic is currently connected to the national grid for the supply of all its electricity demand.[17] The on-going import and use of the electricity presents the least risk technology option to Hernic for the sustained production of ferrochrome. Considering the current practice and the pre-project scenario of Hernic, 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.

---

[15] Appendix 28 Eskom Annual Report 2009, page xii

[16] Appendix 28 Eskom Annual Report 2009, page xii

[17] Appendix 27 Electricity Supply Agreement with Eskom, Confidential information submitted to DOE.

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):

None of the barriers described above apply to the existing scenario where Hernic imports electricity from the national grid.

Step 4: Common practice analysis

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

Table 14: 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 25.47MW. Therefore the applicable output range is 12.7 to 38.2 MW, i.e. -50% and +50% of design capacity.
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_Pyrometallurgy in Southern Africa, 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. 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[18] as a first-of-its-kind. $N_{all} = 0$.
Step 3: Within plants identified in Step 2, identify those that apply	$N_{diff} = 0$, because N_{all} is 0

---

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

technologies different that the technology applied in the proposed project activity. Note their number N_{diff}.	
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**

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 (Refer to Appendix 26_Letter from FAPA) that generates electricity.

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[19] 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 small.

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

There are no other power plants using similar technology to produce electricity from waste energy produced in closed furnaces in the ferrochrome industry in South Africa or Zimbabwe.

"If Sub-steps 4a and 4b are satisfied, i.e.(i) similar activities cannot be observed or (ii) similar activities are observed, but essential distinctions between the project activity and similar activities can reasonably be explained, then the proposed project activity is additional)".

Notice of prior consideration

Construction of the project is expected to start at the earliest in January 2013. The project start date is 1 January 2013, the date on which the order for the equipment is likely to be placed.

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

Date	Activity
August 2011	Hernic Prefeasibility Study concluded

---

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

Date	Activity
18 November 2011	Environmental Impact Assessment initiated, stakeholder participation initiated
3 October 2011	Agreement signed with CDM Africa to develop the CDM component
22 March 2012	Letter of prior consideration submitted to the UNFCCC (Refer to Appendix 41 for a copy of the letter submitted)
22 March 2012	Letter of prior consideration submitted to the South African DNA (Refer to Appendix 36 for a copy of the letter submitted)
18 February 2012	PDD published for Global Stakeholder Participation on UNFCCC website

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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

$$BE_y = BE_{En,y} + BE_{flst,y} \tag{1}$$

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

1.1.1. Baseline emissions for baseline Scenarios 1 and 2

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)[20] as described in ACM0012 is applied in the project activity as sub-section (b)[21] 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.

---

[20] Page 14/58 of ACM0012, "(a) Baseline emissions from electricity ($BE_{Elec,y}$) generation"

[21] Page 17/58 of ACM001 Version 4, "(b) Baseline emissions for generation of thermal energy ($BE_{ther,y}$) and steam-generated mechanical energy"

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

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[22]: Waste energy is used to generate electricity

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

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"[23] 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.
j = Recipient j is Hernic
i = National grid

The equation with the relevant subscripts becomes:

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

---

[22] Case 2 as described in ACM0012: Waste energy is used to provide mechanical energy that would have been supplied by an electrical motor in the baseline. Case 2 does not apply to the project activity as mechanical energy is not replaced by the project activity.

[23] Page 16, paragraph 4 under heading: *Determination of $EF_{elec,i,j,y}$*

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

A pilot flame fuelled by propane gas is used in the baseline scenario to ensure that proper combustion of the waste gas occurs. 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 Hernic.

(ii) Required data is unavailable to apply Method-2.

(iii) In Hernic's case, it is not possible to measure the waste energy, nor the specific amount of waste gas produced per unit of product (Method-2 requirement). According to ACM0012, in such cases, the capping is based on indirect information about specific parameters allowing to estimate the amount of waste energy available.

Determination of f_{cap} applying Method-3

To demonstrate the variability and sensitivity of the waste gas parameters the following: (Appendix 70[24], page 72 and 73):

1) The volume and composition of the gas depends on the feed materials and their pretreatment methods, on the construction of the smelting furnace and on the furnace controls.
2) 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.
3) The contents of H_2O and CO_2 increase when using lumpy ore because of carbonates and hydroxides.
4) Feed materials affect the gas composition in many ways:
    a) 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

---

[24] Appendix 82_FORMATION, CHARACTERISTICS AND UTILISATION OF COGAS FORMED IN FERROCHROMIUM SMELTING

from carbonates can react with carbon through the Boudouard reaction, $CO_2 + C = 2CO$, which is a highly endothermic reaction.

b) The reduction behaviour of the decomposition reactions affects the coke utilisation and the amount and analysis of the gas.

5) 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.
6) 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.

Furthermore the following explanations are provided to give more insight into the variability of the quality of gas produced during the smelting process:

- If the reductant mix is changed from say 10% to 40% anthracite, the VOCs will "crack" in the freeboard (on the furnaces without pre-heaters i.e. F1 & F2, and when the pre-heaters are not running on F3 & F4), to produce higher H2 content in the offgas. With higher H2, the engines can produce more power.
- The exact same argument is applicable on those days following heavy rains. Without pre-heaters, the water cracks in the freeboard, producing more H_2.
- Further to the scenario under (1) above, because Anthracite in general is both less reactive than Coke and in most cases contain less fixed carbon, the relative proportion of reductant needs to be increased to achieve the same reduction potential in the hearth. This increase invariably leads to higher offgas volumes, in addition to the impact of (1) above. Only long term deliberate volume measurements will be able to quantify these effects.
- Over long-term operation, the furnace sealing degrades and progressively more air enters the freeboard. At progressively elevated air ingress volumes, this has progressively more significant impacts on the offgas volume, even if the conditions are still within acceptable limits for operation. The combustibles, CO and H2 may decrease to say 65% and 5% over time respectively, but the engines will still be able to produce say 1.698MW each on this gas mixture.

Case 1 as described in ACM0012 applies.
Case 1 in Method-3 as described in ACM0012 describes the project activity scenario for Hernic: The energy is recovered from WECM (waste gas) and converted into final output energy (electricity) through 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 (15) is selected based on the outcome of the technical feasibility study (Appendix 11_Technical Feasibility Study Report_July 2012).

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

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

Where:

$Q_{OE,BL}$ = Electricity that can be produced (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* (TJ)

Determination of $Q_{OE,BL}$

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 (96%) by engine availability (98.2%) by the plant capacity (1.698 MW x 15 engines) by the average furnace operating rate over a year (84.11%). The fuel availability is provided in the financial model, Sheet ‘Inputs_Production’, in the block starting with Cell G25. It is also described in Appendix 11_Technical Feasibility Report, Section 9.1.1. The fuel availability is predicted to be 92.36% for 9 months of the year and then 79.53% for three months of the 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.

As per example, the month of January is used:
$Q_{OE,BL}$ = 0.96 x 0.982 x 1.698 x 15 x 31 x 24 x 3.6 (Refer to CER Calculation spreadsheet, Baseline Emissions, Cell D36 to M37)

For January with 31 days, $Q_{OE,BL}$ = 59,398 GJ

The calculation is done for each month. For the year then, $Q_{OE,BL}$ = 675,410.4 GJ (Refer to the CER calculation spreadsheet cell D34 etc. and the financial spreadsheet “Inputs_Production” for the detail calculations, Cell G149 to Q149).

Ciska Terblanche 12/9/21 11:35 AM
Deleted: 675,410.4

References:

Engine planned uptime (96%) - Appendix 43_Calculated uptime based on Jenbacher scheduled maintenance specification, Page 1

Engine availability (98.2%) - Appendix 29_Jenbacher Maintenance Offer, Page 2 of 3

Plant capacity (1.698 MW x 15 engines) - Appendix 6_Jenbacher Specification Sheet.pdf, Page 1

Furnace operating rate 84.11% – See Appendix 11_Technical Feasibility Report.

3.6 = Conversion factor from MWh to GJ

Project emissions

Project Emissions include emissions due to 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 from the engines using waste gas.

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

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.

$$PE_{AF,y} = 0. \qquad \textbf{(8)}$$

Project emissions due to electricity consumption of gas cleaning equipment or other supplementary electricity consumption

Only the net electricity generated and delivered to the process plant 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 and the parasitic load of the power plant and related equipment). $P_{EL,y}$ 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.

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 Hernic and the power plant and will record the nett electricity exported to Hernic.

The electricity that will run the gas conditioning and other equipment will be supplied from the Jenbachers, generated from waste gas.

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. The electricity that is sent to Hernic's board is therefore the NETT electricity produced and not the GROSS.

The exception is starting the plant. For this, electricity will be imported from the grid, into the 11kV board and then to the 400V board. There will be main and check bidirectional meters on the 11kV feeders to Hernic which will have reverse metering to measure the amount of electricity used during start up.

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 electricity that will run the gas conditioning and other equipment will be supplied from the gas engines.

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:

$$ER_y = BE_y - PE_y \qquad \textbf{(9)}$$

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 fixed ex ante

Data / Parameter	$EG_{m,y}$
Unit	MWh
Description	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y*
Source of data	Calculated based on the national utility information for the South African national grid. Refer to Appendix 61B_GEFdata Final_vr1 published by Eskom Website short cut access is: http://www.eskom.co.za/c/article/236/cdm-calculations/
Value(s) applied	Refer to Appendix 4, Table 15: Power stations in the Operating Margin
Choice of data or Measurement methods and procedures	Official statistics, publicly available and reliable data source (national utility) as described in the "Tool to calculate the emission factor for an electricity system".
Purpose of data	Calculation of baseline emissions
Additional comment	The data is used to determine the operating margin ex ante

Data / Parameter	$FC_{i,m,y}$
Unit	mass or volume unit
Description	Amount of fossil fuel type *i* consumed by power unit *m* in year *y*
Source of data	Calculated based on the national utility information for the South African national grid. Refer to Appendix 61B_GEFdata Final_vr1 published by Eskom Website short cut access is: http://www.eskom.co.za/c/article/236/cdm-calculations/
Value(s) applied	Refer to Appendix 4, **Table 16: Calculation of the Operating Margin emission factor**
Choice of data or Measurement methods and procedures	Official statistics, publicly available and reliable data source (national utility) as described in the "Tool to calculate the emission factor for an electricity system".
Purpose of data	Calculation of baseline emissions
Additional comment	The data is used to determine the operating margin ex ante. The data for the three most recent reporting years is provided.

Data / Parameter	$EF_{CO2,i,y}$
Unit	tCO_2/GJ
Description	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data	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(s) applied	Bituminous Coal: 0.0895 tCO_2/GJ, for other bituminous at the lower limit. Other Kerosene 70.8 tCO_2/TJ Diesel: 72.6 tCO_2/TJ
Choice of data or Measurement methods and procedures	The IPCC values are used, because the emission factors for the power stations are not published by the national utility and is not publicly available. 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."
Purpose of data	Calculation of baseline emissions
Additional comment	The data is used to determine the operating margin ex ante. Value applied as a constant.

Data / Parameter	$NCV_{i,y}$
Unit	GJ/mass or volume unit
Description	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data	• For coal: Eskom published data, *Source:* Eskom Holdings Limited 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 • For Diesel: 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 D16
Value(s) applied	Coal (GJ/ton) Eskom: Coal (GJ/ton) 2008/09 – 19.1 2009/10 – 19.22 2010/11 – 19.45 Other Kerosene –42.4GJ/ton Diesel- 41.4GJ/ton
Choice of data or Measurement methods and procedures	As per “Tool to calculate the emission factor for an electricity system”, the published data from the national utility is applied and IPCC default figures are used for the data that is not publicly available.
Purpose of data	Calculation of baseline emissions
Additional comment	The data is used to determine the operating margin ex ante.

Data / Parameter	$Q_{OE,BL}$
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	Genset supplier information and operational data from FMT
Value(s) applied	675,410.4 GJ
Choice of data or Measurement methods and procedures	The types and levels of service: Jenbachers will be implemented delivering an estimated 187,614 MWh per year total electricity not accounting for parasitic load (refer to the financial spreadsheet, Inputs_production sheet, Cell G149 to Q149). This is calculated taking into account equipment availabilities (furnaces and gensets) and load factors. The MWh is then multiplied by 3.6 to convert to GJ.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	$\eta_{m,y}$
Unit	%
Description	Average net energy conversion efficiency of power unit *m* in year *y*
Source of data	Default values provided in the table in Annex 1 of the Tool to calculate the emission factor for an electricity system.
Value(s) applied	Open cycle diesel implemented after 2000: Efficiency is 39.5% Open cycle diesel implemented before 2000: Efficiency is 30% For the calculation for the Build margin: Sub-critical Power stations implemented before 2000: Efficiency is 37% Sub-critical Power stations implemented after 2000: Efficiency is 39%
Choice of data	As per “Tool to calculate the emission factor for an electricity system”. To determine the power station emission factor for the four single cycle

or Measurement methods and procedures	turbine power stations (Ankerlig, Gourikwa, Port Rex and Acacia), Option A2 is applied because the fuel consumption for these power stations are not available for all three years used to determine the operating margin. The default efficiencies provided in Annex 1 of the Tool is applied which is conservative.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter	f_{wcm}
Unit	Unitless
Description	Fraction of total electricity generated by the project activity using waste energy.
Source of data	PP
Value(s) applied	1
Choice of data or Measurement methods and procedures	This fraction is 1 because the electricity generation is purely from use of waste gas.
Purpose of data	Calculation of baseline emissions
Additional 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:

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

where $BE_{Ther,y} = 0$

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

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:

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

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

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

Where:

$EG_{grid,Hernic,y} = 170{,}729\ MWh$

and

$EG_{Elec,grid,Hernic,y} = \mathbf{0.8920}\ t\ CO2\ per\ MWh$

[Refer to Appendix 4 for the ex-ante determination of the grid emission factor]

$BE_{Elec,1\ to\ 10} = 1\ x\ 1\ x\ 170{,}729\ x\ \mathbf{0.8920}$

$BE_{Elec,1\ to\ 10} = 152{,}290\ \ ton\ CO2$ per year

$BE_{Elec,1\ to\ 10} = B_{EN,y} =\ BE_y = 152{,}290\ ton\ CO2$

Project emissions were calculated using equation (8):

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

$ER_y = BE_y - PE_y$

$ER_y\ = 152{,}290 - 0$

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
1	152,290	0	0	152,290
2	152,290	0	0	152,290
3	152,290	0	0	152,290
4	152,290	0	0	152,290
5	152,290	0	0	152,290
6	152,290	0	0	152,290
7	152,290	0	0	152,290
8	152,290	0	0	152,290

Ciska Terblanche 12/9/21 11:35 AM
170,729

Ciska Terblanche 12/9/21 11:35 AM
0.8920

Ciska Terblanche 12/9/21 11:35 AM
170,729

Ciska Terblanche 12/9/21 11:35 AM
0.8920

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
9	152,290	0	0	152,290
10	152,290	0	0	152,290
Total	1,522,900			1,522,900
Total number of crediting years	10			
Annual average over the crediting period	152,290	0	0	152,290

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	1.$EG_{i,j,y}$ ($EG_{grid,Hernic,y}$)
Unit	MWh/y
Description	Electricity generated and exported to Hernic
Source of data	Plant records from Hernic
Value(s) applied	170,729 (Calculated from design data for the purpose of estimating the CERs.)
Measurement methods and procedures	Continuous monitoring will be done and the data will be logged daily. Location of electricity meters: See **Figure 7**. 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 the power plant and Hernic and will record the nett electricity exported to Hernic. The electricity that will run the gas conditioning and other equipment 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. The electricity that is sent to Hernic's board is therefore the NETT electricity produced and not the GROSS. The exception is starting the plant. For this, feed is reversed from Hernic, into the 11kV board and then to the 400V board. There will be main and check bidirectional meters on the 11kV feeders to Hernic which will have reverse metering to measure the amount of electricity used during start up.
Monitoring frequency	Continuous monitoring will be done and the data will be logged monthly.
QA/QC procedures	• 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 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.
Purpose of data	Calculation of baseline emissions
Additional comment	

Data / Parameter	2. $Q_{OE,y}$
Unit	GJ
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	Hernic power plant process data
Value(s) applied	675,410.4
Measurement methods and procedures	Continuous monitoring will be done and the data will be logged daily.
Monitoring frequency	Continuous monitoring will be done and the data will be logged daily.
QA/QC procedures	- The electricity meters will be calibrated and maintained in accordance with manufacturer's specifications. - The electricity metered by Hernic can be checked during verification by comparing the electricity figures from the recipient power plant.
Purpose of data	Calculation of baseline emissions
Additional 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.

Ciska Terblanche 12/9/21 11:35 AM
Deleted: 675,410.4

Data / Parameter	3. $EC_{PJ,y}$
Unit	MWh
Description	Additional electricity consumed in year *y* for project related equipment (gas conditioning equipment) during start up that is supplied by the national grid through Hernic. 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	Exxaro On-Site
Value(s) applied	Zero
Measurement methods and procedures	Continuous monitoring will be done and the data will be logged daily. 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 Hernic and the power plant and will record the nett electricity exported to Hernic. The electricity that will run the gas conditioning and other equipment 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. The electricity that is sent to Hernic's board is therefore the NETT electricity produced and not the GROSS. The exception is starting the plant. For this, we will reverse feed from Hernic, into the 11kV board and then to the 400V board. There will be main and check bidirectional meters on the 11kV feeders to Hernic which will have reverse metering to measure the amount of electricity used during start up.
Monitoring frequency	Continuous monitoring will be done and the data will be logged daily.
QA/QC procedures	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.
Purpose of data	Calculation of project emissions
Additional 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}**
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	Calculated
Value(s) applied	1.0
Measurement methods and procedures	The relevant f_{cap} will be determined prior to each verification according to the calculation procedure described by ACM0012.
Monitoring frequency	Yearly
QA/QC procedures	
Purpose of data	Calculation of baseline emissions
Additional 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**
Unit	Hours
Description	The hours of abnormal operation of parts of project facility that can have an impact on waste energy generation and recovery
Source of data	Hernic process plant
Value(s) applied	Zero
Measurement methods and procedures	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. 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.
Monitoring frequency	Continuous monitoring of alarms. Manual recording into the operator’s log will take place when abnormal events occur on site.
QA/QC procedures	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.
Purpose of data	Calculation of baseline emissions

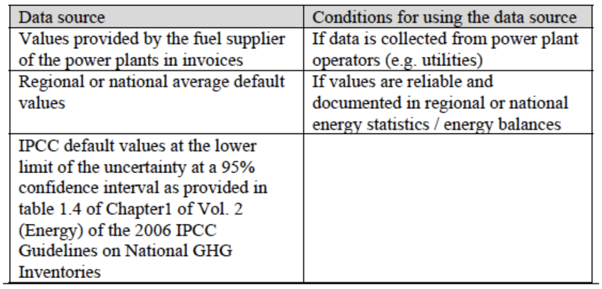
Additional comment	Abnormal and upset conditions at the power plant will be as a result of off gas quality (composition and temperature) or quantity (pressure). Fluctuations in these parameters always involve the de-loading or stopping of engines due to the automated engine protection systems that are 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.

Data / Parameter	6. $EG_{m,y}$
Unit	MWh
Description	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y*
Source of data	Public information based on the national utility information for the South African national grid. Official statistics, publicly available will be used.
Value(s) applied	Refer to Appendix 4, **Table 17: Information for the calculation of the build margin for validation purposes**
Measurement methods and procedures	The information is not metered by the Project Participant, but will be collected from publicly available information. There are no measurement methods applied.
Monitoring frequency	The data will be collected annually from the public sources.
QA/QC procedures	This data is not monitored on the site, but is collected from published information. Therefore, no specific quality control procedures are applied.
Purpose of data	Calculation of baseline emissions
Additional comment	The purpose of the data is the calculation of the build margin emission figure. 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.

Ciska Terblanche 12/9/21 11:35 AM
Deleted: **Table 15: Information for the calculation of the build margin for validation purposes**

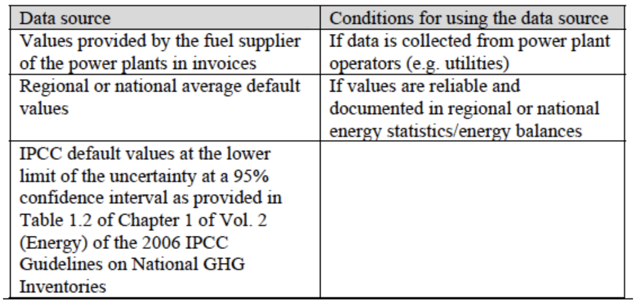
Data / Parameter	7. $F_{i,m,y}$
Unit	Mass or volume unit
Description	Amount of fossil fuel type *i* consumed by power unit *m* in year *y*
Source of data	Public information based on the national utility information for the South African national grid. Official statistics, publicly available and reliable data source (national utility).
Value(s) applied	**Refer to Appendix 4, Table 17: Information for the calculation of the build margin for validation purposes**
Measurement methods and procedures	The information is not metered by the Project Participant, but will be collected from publicly available information. There are no measurement methods applied.
Monitoring frequency	The data will be collected yearly from the public sources.
QA/QC procedures	This data is not monitored on the site, but is collected from published information. Therefore, no specific quality control procedures are applied.
Purpose of data	Calculation of baseline emissions
Additional comment	The purpose of the data is the calculation of the build margin emission figure. 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.

Ciska Terblanche 12/9/21 11:35 AM
Deleted: Table 15: Information for the calculation of the build margin for validation purposes

<table>
<tr><td>Data / Parameter</td><td>8. $EF_{CO2,i,y}$</td></tr>
<tr><td>Unit</td><td>tCO_2/GJ</td></tr>
<tr><td>Description</td><td>CO_2 emission factor of fossil fuel type <i>i</i> in year <i>y</i></td></tr>
<tr><td>Source of data</td><td>
<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>Values provided by the fuel supplier of the power plants in invoices</td><td>If data is collected from power plant operators (e.g. utilities)</td></tr>
<tr><td>Regional or national average default values</td><td>If values are reliable and documented in regional or national energy statistics / energy balances</td></tr>
<tr><td>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</td><td></td></tr>
</table></td></tr>
</table>

Value(s) applied	Other Bituminous Coal: 89.5 (t CO_2/TJ) Other Kerosene: 70.8tCO_2/TJ For Diesel: 72.6 tCO_2/TJ For validation purposes: 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. 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."
Measurement methods and procedures	The information is not metered by the Project Participant, but will be collected from publicly available information or from IPCC figures. There are no measurement methods applied.
Monitoring frequency	The data will be collected yearly from the public sources.
QA/QC procedures	This data is not monitored on the site, but is collected from published information. Therefore, no specific quality control procedures are applied.
Purpose of data	Calculation of baseline emissions
Additional comment	The purpose of the data is the calculation of the build margin emission figure. Value applied as a constant.

Data / Parameter	9. $NCV_{i,y}$
Unit	GJ/mass or volume unit
Description	Net calorific value (energy content) of fossil fuel type *i* in year *y*

<table>
<tr><td>Source of data</td><td>
<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>Values provided by the fuel supplier of the power plants in invoices</td><td>If data is collected from power plant operators (e.g. utilities)</td></tr>
<tr><td>Regional or national average default values</td><td>If values are reliable and documented in regional or national energy statistics/energy balances</td></tr>
<tr><td>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</td><td></td></tr>
</table></td></tr>
<tr><td>Value(s) applied</td><td>Coal (GJ/ton)
Eskom: Coal (GJ/ton)
2011/12 – 19.6
Other Kerosene –42.4GJ/ton
Diesel- 41.4GJ/ton

• For coal: Eskom published data, <i>Source: Appendix 66_Eskom Divisional Report 2012 pages 88.</i> 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
• For Diesel: 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 D16</td></tr>
<tr><td>Measurement methods and procedures</td><td>The information is not metered by the Project Participant, but will be collected from publicly available information or from IPCC figures. There are no measurement methods applied.</td></tr>
<tr><td>Monitoring frequency</td><td>The data will be collected yearly from the public sources.</td></tr>
<tr><td>QA/QC procedures</td><td>This data is not monitored on the site, but is collected from published information. Therefore, no specific quality control procedures are applied.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comment</td><td>The purpose of the data is the calculation of the build margin emission figure.</td></tr>
</table>

Data / Parameter	10.$\eta_{m,y}$
Unit	%
Description	Average net energy conversion efficiency of power unit *m* or *k* in year *y*

Source of data	Use either: • Documented manufacturer's specifications (if the efficiency of the plant is not significantly increased through retrofits or rehabilitations); or • For grid power plants: data from the utility, the dispatch center or official records if it can be deemed reliable; or • The default values provided in the table in Annex 1 (if available for the type of power plant)
Value(s) applied	Refer to CER calculation spreadsheet in the calculation for the Build margin. Sub-critical Power stations implemented before 2000: Efficiency is 37% Sub-critical Power stations implemented after 2000: Efficiency is 39% Open cycle diesel implemented after 2000: Efficiency is 39.5%
Measurement methods and procedures	The information is not metered by the Project Participant, but will be collected from publicly available information or from IPCC figures. There are no measurement methods applied.
Monitoring frequency	The data will be collected yearly from the public sources or from Annex 1.
QA/QC procedures	If the data obtained from the manufacturer, the utility, the dispatch center of official records is significantly lower than the default value provided in Annex 1 for the applicable technology, project proponents should assess the reliability of the values, and provide appropriate justification if deemed reliable. Otherwise, the default values provided in Annex 1 shall be used
Purpose of data	Calculation of baseline emissions
Additional comment	Information is used to calculate the build margin emission factor

B.7.2. Sampling plan

\>>

Not applicable in the case of this project activity as no sampling is done for monitoring purposes.

B.7.3. Other elements of monitoring plan

\>>

7.3.1 Management team for the facility during construction

The ultimate responsibility for the construction of the waste gas to electricity plant lies with Hernic. Hernic will have a project manager on site who will oversee the project team. The following positions will exist in the team:

1 x Project Sponsor

1 x Project Manager

1 x Snr Process Engineer

1 x Jnr Process Engineer

1 x Snr Mechanical Engineer

1 x Jnr Mechanical Project Engineer

1 x Snr Electrical Engineer

1 x Jnr Electrical Project Engineer

Programming is outsourced

1 x Snr Civil Engineer

1 x Quantity Surveyor

1 x Civils & Structures Site Superintendent

QA/QC is outsourced.

1 x Site Manager

1 x Planner

1 x site storeman

7.3.2 Management structure for the facility during operation is provided below. After commissioning of the waste gas to electricity plant, Hernic is responsible for the operation and maintenance of the site.

1 x Plant Manager (day shift only)

1 x Engine Specialist (day shift only)

4 x Operators (3-shift system)

4 x Assistants (3-shift system)

7.3.3 Monitoring Equipment

Electricity meters will measure the quantity of electricity supplied to Hernic. 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

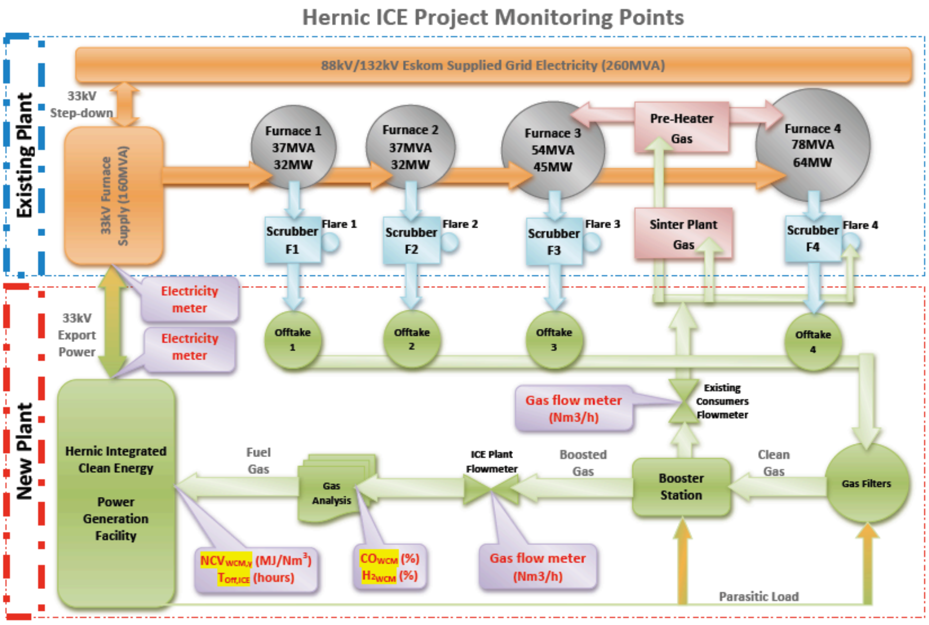
The following data will be monitored by Hernic:

- Nett quantity of electricity supplied to Hernic;
- Electricity consumption of additional plant equipment used in the project activity during start up.

(ii) Equipment

Electricity meters will be installed on the electrical feeds to Hernic – one main meter and one check meter. The metering configuration is illustrated in **Figure 7** below.

Figure 7: Electricity meters layout for the power plant supplying electricity to Hernic



7.3.4 Monitoring Equipment

Electricity meters will measure the nett quantity of electricity generated by the project activity. 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.

(iii) Data to be monitored during the crediting period

The following data will be monitored by Hernic:

- Quantity of electricity supplied to Hernic (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 as described in the monitoring parameters.
- Also the parameters described in Annex 4 will be monitored.

(iv) Equipment

<u>Electricity meters</u> will measure the quantity of electricity generated and the amount of electricity

imported from the grid for cold starts. 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.

Two electricity meters will be installed on the electrical feeds to Hernic – one main meter and one check meter. The metering configuration is illustrated in Figure 7: Electricity meters layout for the power plant supplying electricity to Hernic below.

Ciska Terblanche 12/9/21 11:35 AM
Deleted: Figure 7: Electricity meters layout for the power plant supplying electricity to Hernic

(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 MVA/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) 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. Backups will be kept 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

Hernic 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 Hernic.

(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 Hernic 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 Power Plant Manager before it is accepted and stored.

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.

(ix) Storage of data

As per methodology ACM0012, all data collected as part of the monitoring plan will be archived electronically, and will be kept for a minimum if two years at the end of the crediting period.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>

1 January 2013

The project start date is the date on which the order for the equipment will be placed.

C.1.2. Expected operational lifetime of project activity

>>

16 Years 3 months (120,000 hours equivalent)

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>

Fixed crediting period

C.2.2. Start date of crediting period

>>

01 April 2014

C.2.3. Length of crediting period

10 Years 0 Months

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>

Overall, the proposed project is expected to have a net positive environmental impact due to improved efficiencies, resulting in a lower environmental footprint per tonne of product produced by Hernic Ferrochrome (please refer to Appendix 35, Section 8, Environmental Impact Statement). This is due primarily to:

- Reduced carbon footprint due to the extraction of energy from waste gases, thereby offsetting Eskom grid demand
- Corresponding reduction in distribution and transfer losses from the national electricity grid
- Reduced overall water use due to the off-setting of Eskom supplied power which is largely generated at coal fired power stations with wet cooling towers.
- The reduction of PM and Cr(VI) emissions
- The use of onsite slags as aggregate for building, thus reusing a waste stream as well as reducing the environmental risk associated with the waste through encapsulation for disposal.

No transboundary impacts were identified in the environmental impact study.

D.2. Environmental impact assessment

>>

The environmental impact assessment (EIA) for the proposed project activity 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.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

Public participation process

The EIA Regulations promulgated under section 24 of the National Environmental Management Act 107 of 1998 (NEMA)[25], sets out the minimum requirements regarding public participation by interested and affected parties (I&APs). Appendix 47_Puplic Participation Process according to National Environmental Management Act.pdf, provides a description of the requirements of the EIA with which the consultants complied.

Potential stakeholders were identified and engaged through the following means:

1. Newspaper advertisement: An advertisement was placed in the local newspaper (The Brits Pos) on 17 November 2011 notifying the public of Hernic’s intention to apply for amendment of Environmental Authorisation and inviting interested and affected parties to register as stakeholders. (Refer to Appendix 35, page 53).
2. Three notices were placed at main site entrances notifying of Hernic’s intention to apply for amendment of Environmental Authorisation and inviting I&APs to register (Refer to Appendix 35, page 54-56).
3. Correspondence with government departments with jurisdiction related to the proposed development (e.g. DEAT, DWAF, Madibeng Local Municipality)
4. Correspondence with the ward councillor for the area.
5. Personal invitations were sent to pre-identified persons and organisations expected to have an interest in the project.
6. A background information document was issued to registered I&APs.
7. The Environmental Impact Report was distributed to all registered I&APs for review and comment.

E.2. Summary of comments received

>>

No comments from stakeholders had been received at the time of submission of the Environmental Impact Report (Refer to Appendix 35, page 57).

---

[25] These Regulations were published in GNR 385, 386 and 387 in Government Gazette 28753 dated 21 April 2006 and came into force on 3 July 2006.

E.3. Report on consideration of comments received

>>

Minutes were taken at the meetings, however, no comments were received.

SECTION F. Approval and authorization

>>

The letter of approval is awaited from the DNA.

- - - - -

Appendix 1: Contact information of project participants

Organization name	Hernic Ferrochrome (Pty) Ltd
Street/P.O. Box	PO Box 4534
Building	n/a
City	Brits
State/Region	Gauteng
Postcode	0250
Country	South Africa
Telephone	+27 12 381 1100
Fax	+27 12 381 1111
E-mail	ken@hernic.co.za
Website	www.hernic.co.za
Contact person	Kenichiro Tauchi
Title	Head of Strategy & Corporate Dev
Salutation	Mr
Last name	Tauchi
Middle name	n/a
First name	Kenichiro
Department	
Mobile	+27 82 738 3607
Direct fax	
Direct tel.	+27 12 381 1292
Personal e-mail	ken@hernic.co.za

Appendix 2: Affirmation regarding public funding

No public funding is used in the development or implementation of the project activity.

Appendix 3: Applicability of selected methodology

No further information in this section.

Appendix 4: Further background information on ex ante calculation of emission reductions

The following information are presented in this Annex:

1. Baseline emissions of Waste Gas Streams
2. The determination of the grid emission factor

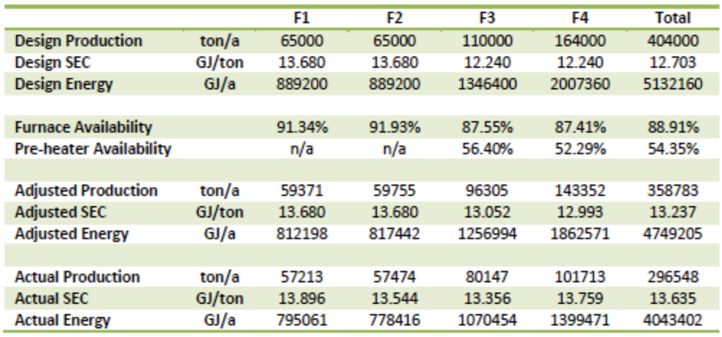
1. Baseline Emissions of Waste Gas Streams

It is a specific requirement of the CDM system to verify the existing use and application of the waste gas to ensure that:

- No existing waste gas based electricity generation takes place at present; and
- No existing waste gas consumers will be starved as a result of the new project activity.

For this purpose, design and engineering drawings of existing equipment were inspected to establish which equipment are current consumers of the waste gas. In addition, various site visits and physical site inspections were conducted to verify whether any electricity or steam generation equipment has been implemented on the site. To the same end, capital expenditure reports and income statements were scrutinized to verify that no electricity or steam generation equipment was purchased by Hernic in the past and no energy has historically been sold by Hernic to third parties.

In order to demonstrate the reduction in Carbon Footprint of the complex as a whole, effected by the new project, it is necessary to demonstrate current and future energy reliance of the plant by way of energy balances.



		F1	F2	F3	F4	Total
Design Production	ton/a	65000	65000	110000	164000	404000
Design SEC	GJ/ton	13.680	13.680	12.240	12.240	12.703
Design Energy	GJ/a	889200	889200	1346400	2007360	5132160
Furnace Availability		91.34%	91.93%	87.55%	87.41%	88.91%
Pre-heater Availability		n/a	n/a	56.40%	52.29%	54.35%
Adjusted Production	ton/a	59371	59755	96305	143352	358783
Adjusted SEC	GJ/ton	13.680	13.680	13.052	12.993	13.237
Adjusted Energy	GJ/a	812198	817442	1256994	1862571	4749205
Actual Production	ton/a	57213	57474	80147	101713	296548
Actual SEC	GJ/ton	13.896	13.544	13.356	13.759	13.635
Actual Energy	GJ/a	795061	778416	1070454	1399471	4043402

Table 4-5: Hernic Furnace Energy Balance For 2011

Source: Appendix 22_Waste gas assessment Report

Sinter Plant Balance

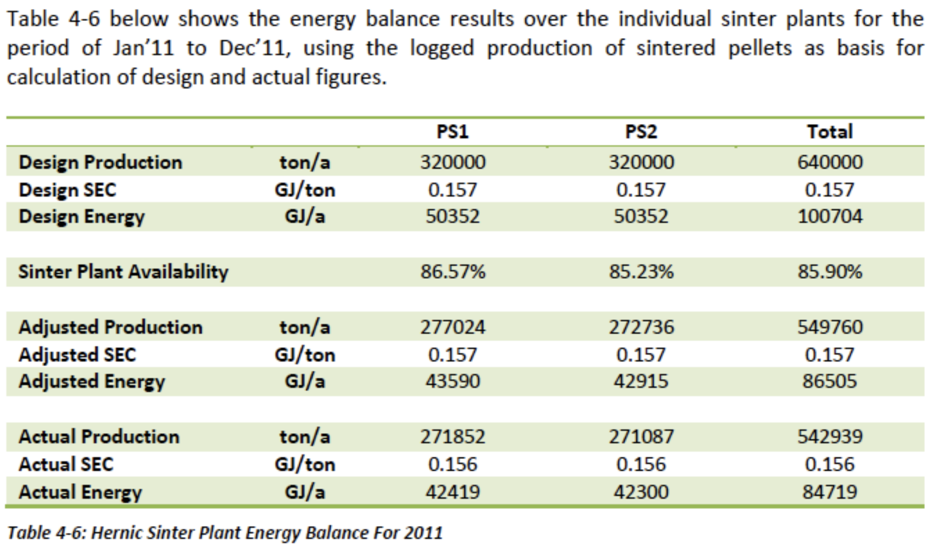


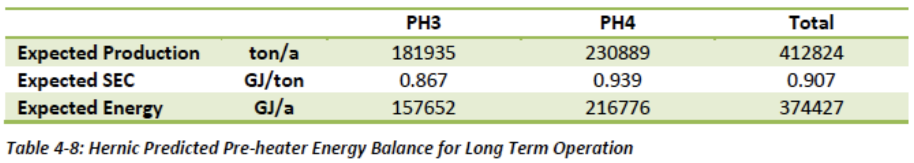
Table 4-6 below shows the energy balance results over the individual sinter plants for the period of Jan'11 to Dec'11, using the logged production of sintered pellets as basis for calculation of design and actual figures.

		PS1	PS2	Total
Design Production	**ton/a**	320000	320000	640000
Design SEC	**GJ/ton**	0.157	0.157	0.157
Design Energy	**GJ/a**	50352	50352	100704
Sinter Plant Availability		86.57%	85.23%	85.90%
Adjusted Production	**ton/a**	277024	272736	549760
Adjusted SEC	**GJ/ton**	0.157	0.157	0.157
Adjusted Energy	**GJ/a**	43590	42915	86505
Actual Production	**ton/a**	271852	271087	542939
Actual SEC	**GJ/ton**	0.156	0.156	0.156
Actual Energy	**GJ/a**	42419	42300	84719

Table 4-6: Hernic Sinter Plant Energy Balance For 2011

Source: Appendix 22_Waste Gas Assessment Report

Preheating Balance Results



		PH3	PH4	Total
Expected Production	**ton/a**	181935	230889	412824
Expected SEC	**GJ/ton**	0.867	0.939	0.907
Expected Energy	**GJ/a**	157652	216776	374427

Table 4-8: Hernic Predicted Pre-heater Energy Balance for Long Term Operation

Source: Appendix 22_Waste Gas Assessment Report

In Annex 4, the monitor parameters are discussed that will be monitored in future in order to demonstrate the use of waste gas in the preheaters and sinter/pelletising plants.

2. 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 (EFy) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) determined ex ante and build margin (BM) determined ex post

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 post.
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.

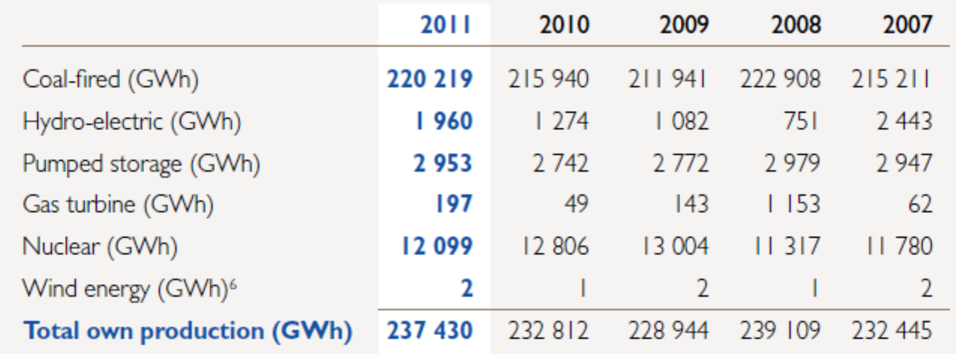
Step 2: Choose whether to include off-grid power plants in the project electricity system

Off-grid power plants are not included in the calculations as information is not available.

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

Motivation for using the Simple Operating Margin

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



	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: 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 for the five years prior to the project submitted for validation.

Data vintage for the simple operating margin

In terms of data vintages, the *ex ante* option is 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 is used for all the coal-fired power stations because the national utility published the net electricity generation for each power plant and therefore the data is available in the public domain. Therefore, a CO_2 emission factor for each coal fired power plant can be determined. *Option A2* is applied to determine the power station emission factor for the four single cycle turbines stations (Acacia, Ankerlig, Port Rex and Gourikwa) running on diesel or kerosene because the information regarding historic fuel consumption for each of these turbine power stations is not available for the necessary years at the time of submitting the PDD for validation. Therefore, Option A2, which is the conservative approach, is taken to determine the emission factors for these four power stations and the relevant default efficiency factors provided in Annex 1 of the Tool are applied.

Determination of $EF_{grid,OMsimple,y}$

Option A - Based on the net electricity generation and a CO_2 emission factor of each power unit

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:

$EF_{grid,OMsimple,y}$ = 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 $EF_{EL,m,y}$ with Option A1

Option A1:

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

Equation 2

Where:

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)

$FC_{i,m,y}$ = Amount of fossil fuel type i consumed by power unit m in year y (Mass or volume unit)

$NCV_{i,y}$ = Net calorific value (energy content) 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

For the four single cycle turbines, option A2 from guidance in Step 4 (a) is used and the default values provided in Annex 1 are used to determine the parameter $\eta_{m,y}$ for validation purposes. Open cycle diesel implemented after 2000: Efficiency is 39.5% and before 2000 the efficiency is 30%, as per Annex 1 in the Tool.

Determination of $EF_{EL,m,y}$ with Option A2:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}}$$

Where:

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$EF_{CO2,m,i,y}$ = Average CO_2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/GJ)
$\eta_{m,y}$ = Average net energy conversion efficiency of power unit *m* in year *y* (ratio)
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

Table 15: Power stations in the Operating Margin

No.	Name of Power Unit/country	Net Electricity Generation (MWh) *Source: Appendix 61_FuelConsumptionElectricityGen.xls puplished by* Eskom. Source for single cycle gas turbines for 2010/11: Appendix 61_GEF data Final_vr1 published by Eskom Website short cut access is:			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/			Net Calorific Value of Main Fuel (GJ/t (GJ/mass or volume unit)) *Source: Appendix 66_Eskom Integrated Report 2011, page 324*			Generation technology for Option A2	Emission Factor Caluculation Option
		2008-2009	2009-2010	2010-2011		2008-2009	2009-2010	2010-2011	2008-2009	2009-2010	2010-2011		
Electricity import													
i-1	International imports *(Source:*	12,189,000	13,754,000	13,613,000									
i-2	IPPs *(Source: Eskom*	0	0	1,833,000									
Electricity generation in the project electricity system													
1	Arnot	11,987,281	13,227,864	12,194,878	Other Bituminous Coal	6,395,805	6,794,134	6,525,670	19.1	19.22	19.45		A1
2	Duvha	21,769,489	22,581,228	20,267,508	Other Bituminous Coal	11,393,553	11,744,606	10,639,393	19.1	19.22	19.45		A1
3	Hendrina	12,296,687	12,143,292	11,938,206	Other Bituminous Coal	7,122,918	6,905,917	7,139,198	19.1	19.22	19.45		A1
4	Kendal	23,841,401	23,307,031	25,648,258	Other Bituminous Coal	15,356,595	13,866,514	15,174,501	19.1	19.22	19.45		A1
5	Kriel	18,156,686	15,906,816	18,204,910	Other Bituminous Coal	9,420,764	8,504,715	9,527,185	19.1	19.22	19.45		A1
6	Lethabo	23,580,232	25,522,698	25,500,366	Other Bituminous Coal	16,715,323	18,170,227	17,774,699	19.1	19.22	19.45		A1
7	Matimba	26,256,068	27,964,141	28,163,040	Other Bituminous Coal	13,991,453	14,637,481	14,596,842	19.1	19.22	19.45		A1
8	Majuba	22,676,924	22,340,081	24,632,585	Other Bituminous Coal	12,554,406	12,261,833	13,020,512	19.1	19.22	19.45		A1
9	Matla	21,863,400	21,954,536	21,504,422	Other Bituminous Coal	12,689,387	12,438,391	12,155,421	19.1	19.22	19.45		A1
10	Tutuka	21,504,122	19,847,894	19,067,501	Other Bituminous Coal	11,231,583	10,602,839	10,191,709	19.1	19.22	19.45		A1
12	Ankerlig	78,772	26,992	108,518	Gas/Diesel Oil							Oil -Open cycle	A2
13	Gourikwa	43,927	15,052	60,515	Gas/Diesel Oil							Oil -Open cycle	A2
14	Acacia	10,151	3,478	13,984	Other Kerosene	0.0	0.0	381				Oil -Open cycle	A2
15	Port Rex	10,151	3,478	13,984	Other Kerosene	0.0	0.0	242				Oil -Open cycle	A2
24	Camden *	6,509,079	7,472,070	7,490,836	Other Bituminous Coal	3,876,211	4,732,163	4,629,763	19.1	19.22	19.45		A1
25	Grootvlei	1,249,556	2,656,230	3,546,952	Other Bituminous Coal	674,538	1,637,371	2,132,979	19.1	19.22	19.45		A1
26	Komati	0	1,016,023	2,060,141	Other Bituminous Coal	0	664,497	1,271,010	19.1	19.22	19.45		A1

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

Table 16: 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		-		-		-	
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
11	Ankerlig	78,772	0.6617	26,992	0.6617	108,518	0.6617
12	Gourikwa	43,927	0.6617	15,052	0.6617	60,515	0.6617
13	Acacia	10,151	0.8496	3,478	0.6617	13,984	0.8496
14	Port Rex	10,151	0.8496	3,478	0.6617	13,984	0.8496
15	Camden *	6,509,079	1.0180	7,472,070	0.6617	7,490,836	0.8496
16	Grootvlei	1,249,556	0.9228	2,656,230	1.0604	3,546,952	1.0468
17	Komati	0	-	1,016,023	1.1250	2,060,141	1.0740
18		-	-	-	-	-	-
19		-	-	-	-	-	-
20		-	-	-	-	-	-
Annual Electricity		224,022,925		229,742,904		235,862,603	
Simple Operating Margin CO2 Emission Factor		EFgrid, OMsimple,y1	0.9270	EFgrid, OMsimple,y2	0.9208	EFgrid, OMsimple,y3	0.9215
Operating Margin Emission Factor(t-CO_2/MWh)							0.9230

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. The file has been updated and is now named GEF data Final_vr1 published 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/			Net Calorific Value of Main Fuel (GJ/t (GJ/mass or volume unit)) *Source: Appendix 66_Eskom Integrated Report 2011, page 324*			Emission factor of electricity import (CO2-t/MWh)			Emission Factor Caluculation Option
			2006-2007	2007-2008	2008-2009	2009-2010	2010-2011		2008-2009	2009-2010	2010-2011	2008-2009	2009-2010	2010-2011	2008-2009	2009-2010	2010-2011	
Electricity import																		
i-1	International imports *(Source:*				12,189,000	13,754,000	13,613,000								0	0	0	
i-2	IPPs *(Source: Eskom*				0	0	1,833,000								0	0	0	
Electricity generation in the project electricity system																		
1	Arnot	1980	15,938,102	11,905,060	11,987,281	13,227,864	12,194,878	Other Bituminous Coal	6,395,805	6,794,134	6,525,670	19.1	19.22	19.45				A1
2	Duvha	3450	31,550,562	23,622,732	21,769,489	22,581,228	20,267,508	Other Bituminous Coal	11,393,553	11,744,606	10,639,393	19.1	19.22	19.45				A1
3	Hendrina	1895	16,083,288	13,756,351	12,296,687	12,143,292	11,938,206	Other Bituminous Coal	7,122,918	6,905,917	7,139,198	19.1	19.22	19.45				A1
4	Kendal	3840	34,164,855	26,517,420	23,841,401	23,307,031	25,648,258	Other Bituminous Coal	15,356,595	13,866,514	15,174,501	19.1	19.22	19.45				A1
5	Kriel	2850	22,468,695	17,762,398	18,156,686	15,906,816	18,204,910	Other Bituminous Coal	9,420,764	8,504,715	9,527,185	19.1	19.22	19.45				A1
6	Lethabo	3558	32,052,833	25,701,723	23,580,232	25,522,698	25,500,366	Other Bituminous Coal	16,715,323	18,170,227	17,774,699	19.1	19.22	19.45				A1
7	Matimba	3690	34,983,880	29,021,742	26,256,068	27,964,141	28,163,040	Other Bituminous Coal	13,991,453	14,637,481	14,596,842	19.1	19.22	19.45				A1
8	Majuba	3843	22,828,565	23,680,971	22,676,924	22,340,081	24,632,585	Other Bituminous Coal	12,554,406	12,261,833	13,020,512	19.1	19.22	19.45				A1
9	Matla	3450	30,864,194	24,549,833	21,863,400	21,954,536	21,504,422	Other Bituminous Coal	12,689,387	12,438,391	12,155,421	19.1	19.22	19.45				A1
10	Tutuka	3510	23,389,829	20,980,242	21,504,122	19,847,894	19,067,501	Other Bituminous Coal	11,231,583	10,602,839	10,191,709	19.1	19.22	19.45				A1
12	Ankerlig	1327	34,153	635,131	78,772	23,367	130,241	Gas/Diesel Oil										A2
13	Gourikwa	740	19,045	354,180	43,927	22,612	62,233	Gas/Diesel Oil										A2
14	Acacia	171	4,401	81,844	10,151	2,187	992	Other Kerosene	0.0	0.0	381							A2
15	Port Rex	171	4,401	81,844	10,151	889	5,507	Other Kerosene	0.0	0.0	242							A2
24	Camden	1600	2,815,982	5,171,057	6,509,079	7,472,070	7,490,836	Other Bituminous Coal	3,876,211	4,732,163	4,629,763	19.1	19.22	19.45				A1
25	Grootvlei	1200	0	237,138	1,249,556	2,656,230	3,546,952	Other Bituminous Coal	674,538	1,637,371	2,132,979	19.1	19.22	19.45				A1
26	Komati	1000	0	0	0	1,016,023	2,060,141	Other Bituminous Coal	0	664,497	1,271,010	19.1	19.22	19.45				A1

Table 16: Emission factors for Power stations in the Operating margin

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		-		-		-	
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
11	Ankerlig	78,772	0.6617	26,992	0.6617	108,518	0.6617
12	Gourikwa	43,927	0.6617	15,052	0.6617	60,515	0.6617
13	Acacia	10,151	0.8496	3,478	0.6617	13,984	0.8496
14	Port Rex	10,151	0.8496	3,478	0.6617	13,984	0.8496
15	Camden *	6,509,079	1.0180	7,472,070	0.6617	7,490,836	0.8496
16	Grootvlei	1,249,556	0.9228	2,656,230	1.0604	3,546,952	1.0468
17	Komati	0	-	1,016,023	1.1250	2,060,141	1.0740
18		-	-	-	-	-	-
19		-	-	-	-	-	-
20		-	-	-	-	-	-
Annual Electricity		224,022,925		229,742,904		235,862,603	
Simple Operating Margin CO2 Emission Factor		EFgrid, OMsimple,y1	0.9270	EFgrid, OMsimple,y2	0.9208	EFgrid, OMsimple,y3	0.9215
Operating Margin Emission Factor(t-CO_2/MWh)							0.9230

Source: GEF Spreadsheet for calculating the operating margin, Sheet "OM"

Step 5 Calculate the build margin (BM) emission factor

Data Vintage – Ex post

Table 17: Information for the calculation of the build margin for validation purposes

No.	Name of Power Unit/country	Date Commissioned			Installed Capacity (MW) *Source: Appendix 61B_GEFdata Final_vr1 published by Eskom*	Net Electricity Generation (MWh) *Source: Appendix*	Main Fuel Type/ Energey Source	Main Fuel Consumption (t (mass or volume unit))	Net Calorific Value of Main Fuel (GJ/t (GJ/mass or volume unit))	Generation technology for Option A2	Emission Factor Caluculation Option	Built more than 10 years ago	The sample group of power units			
		Year	Month	Day		*2010-2011*		2010-2011	2010-2011				SET5-units	SET≥20%	SETsample-CDM	SETsample-CDM->10yrs
Electricity generation in the project electricity system																
1	Arnot	1971	9	21	1980	12,194,878	Other Bituminous Coal	6,525,670	19.5		A1	+				
2	Duvha	1980	1	18	3450	20,267,508	Other Bituminous Coal	10,639,393	19.5		A1	+				
3	Hendrina	1970	5	12	1895	11,938,206	Other Bituminous Coal	7,139,198	19.5		A1	+				
4	Kendal	1988	10	1	3840	25,648,258	Other Bituminous Coal	15,174,501	19.5	Coal-Subcritical	A2	+		+		+
5	Kriel	1976	5	6	2850	18,204,910	Other Bituminous Coal	9,527,185	19.5		A1	+				
6	Lethabo	1985	12	22	3558	25,500,366	Other Bituminous Coal	17,774,699	19.5		A1	+				
7	Matimba	1987	12	4	3690	28,163,040	Other Bituminous Coal	14,596,842	19.5		A1	+				
8	Majuba	1996	4	1	3843	24,632,585	Other Bituminous Coal	13,020,512	19.5	Coal-Subcritical	A2	+		+		+
9	Matla	1979	9	29	3450	21,504,422	Other Bituminous Coal	12,155,421	19.5		A1	+				
10	Tutuka	1985	6	1	3510	19,067,501	Other Bituminous Coal	10,191,709	19.5		A1	+				
11	Koeberg	1985	7	25	1800	12,099,000	Nuclear	0			A1	+				
12	Ankerlig *(Sou*	2007	1	1	1327	108,518	Gas/Diesel Oil			Oil -Open cycle	A2		+	+	+	+
13	Gourikwa (So	2007	2	1	740	60,515	Gas/Diesel Oil			Oil -Open cycle	A2		+	+	+	+
14	Acacia (Sour	1976	5	13	171	13,984	Other Kerosene	381		Oil -Open cycle	A2	+				
15	Port Rex (Sou	1976	9	30	171	13,984	Other Kerosene	242		Oil -Open cycle	A2	+				
16	Colley Wobbles	1985	1	1	42	124,539	Hydro					+				
17	First Falls	1979	2	1	6	17,791	Hydro					+				
18	Gariep	1979	9	8	360	1,067,474	Hydro					+				
19	Ncora	1983	3	1	2	5,930	Hydro					+				
20	Second Falls	1979	4	1	11	32,617	Hydro					+				
21	Van Der Kloof	1977	1	1	240	711,649	Hydro					+				
22	Drakensberg	1981	6	17	1000	2,109,286	Hydro					+				
23	Palmiet	1988	4	18	400	843,714	Hydro					+				
24	Camden **	2005	4	1	1600	7,490,836	Other Bituminous Coal	4,629,763	19.5	Coal-Subcritical	A2		+	+	+	+
25	Grootvlei	2008	3	31	1200	3,546,952	Other Bituminous Coal	2,132,979	19.5	Coal-Subcritical	A2		+	+	+	+
26	Komati	2009	1	5	1000	2,060,141	Other Bituminous Coal	1,271,010	19.5	Coal-Subcritical	A2		+	+	+	+
27	Wind (Source:	2002	12	31	3	2,000	Wind							+	+	+

Ciska Terblanche 12/9/21 11:35 AM

Deleted: 15

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

$\text{SET}_{5\text{-units}}$ are shown in the table below.

SET5-units						
No.	Name of power unit and source of information	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 ($t\text{-}CO_2$)
26	Komati	2009	Other Bituminous Coal	2,060,141	0.8262	1,701,993
25	Grootvlei	2008	Other Bituminous Coal	3,546,952	0.8262	2,930,328
13	Gourikwa	2007	Gas/Diesel Oil	60,515	0.6617	40,041
12	Ankerlig	2007	Gas/Diesel Oil	108,518	0.6617	71,803
24	Camden *	2005	Other Bituminous Coal	7,490,836	0.8262	6,188,583

Source of information:
***Grootvlei: Re-commissioned power plant,** Eskom Holdings Limited Integrated Report 2011, page 148
****Komati: Re-commissioned power plant,** Eskom Annual Report 2010, page 126,
http://financialresults.co.za/2010/eskom_ar2010/downloads/eskom_ar2010.pdf
*****Camden: 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) ($\text{SET}_{\geq 20\%}$).

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

SET≥20%						
No.	Name of power unit and source of information	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 ($t\text{-}CO_2$)
25	Grootvlei	2008	Other Bituminous Coal	3,546,952	0.8262	2,930,328
13	Gourikwa	2007	Gas/Diesel Oil	60,515	0.6617	40,041
12	Ankerlig	2007	Gas/Diesel Oil	108,518	0.6617	71,803
24	Camden *	2005	Other Bituminous Coal	7,490,836	0.8262	6,188,583
27	Wind	2002	Wind	2,000	0.0000	0
8	Majuba	1996	Other Bituminous Coal	24,632,585	0.8708	21,450,321
4	Kendal	1988	Other Bituminous Coal	25,648,258	0.8708	22,334,780

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

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 that 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. It is assumed that the Bethlehem Hydro plant delivers the expected MWh per year that is indicated in the PDD on page 12, i.e. 34,031 MWh.

SETsample-CDM						
No.	Name of power unit and source of information	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)
28	Bethlehem Hydro	2009	Hydro	34,031	0.0000	0
25	Grootvlei	2008	Other Bituminous Coal	3,546,952	0.8262	2,930,328
13	Gourikwa	2007	Gas/Diesel Oil	60,515	0.6617	40,041
12	Ankerlig	2007	Gas/Diesel Oil	108,518	0.6617	71,803
24	Camden *	2005	Other Bituminous Coal	7,490,836	0.8262	6,188,583
27	Wind	2002	Wind	2,000	0.0000	0

$AEG_{SET\ sample\ CDM} < 0.2 \times AEG_{total}$. 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 and source of information	Year commissioned	Fuel Type Energey Source	Net Electricity Generation (MWh/y) of the latest year	CO2 Emission Factor (t-CO₂/MWh) of the latest	CO2 Emissions (t-CO₂)
26	Komati	2009	Other Bituminous Coal	2,060,141	0.8262	1,701,993
28	Bethlehem Hydro	2009	Hydro	0	0.0000	0
25	Grootvlei	2008	Other Bituminous Coal	3,546,952	0.8262	2,930,328
13	Gourikwa	2007	Gas/Diesel Oil	60,515	0.6617	40,041
12	Ankerlig	2007	Gas/Diesel Oil	108,518	0.6617	71,803
24	Camden *	2005	Other Bituminous Coal	7,490,836	0.8262	6,188,583
27	Wind	2002	Wind	2,000	0.0000	0
8	Majuba	1996	Other Bituminous Coal	24,632,585	0.8708	21,450,321
4	Kendal	1988	Other Bituminous Coal	25648258	0.8708	22,334,780
Total				**63,549,804**		**54,717,850**
Build Margin Emission Factor (t-CO₂ /MWh)						0.8610

NOTE: Copied from the spreadsheet for calculating the Build and Combined margins. For sources of information please see the GEF spreadsheets.

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 power units included in the build margin *m* correspond to the sample group $SET_{sample\text{-}CDM\text{->}10yrs}$, therefore, option A2 from guidance in Step 4 (a) is used and the default values provided in Annex 1 are used to determine the parameter $\eta_{m,y}$ for validation purposes.

The emission factor for each power unit is calculated applying Option A2

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

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}}$$

Where:

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)

$EF_{CO2,m,i,y}$ = Average CO_2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/GJ)

$\eta_{m,y}$ = Average net energy conversion efficiency of power unit *m* in year *y* (ratio)

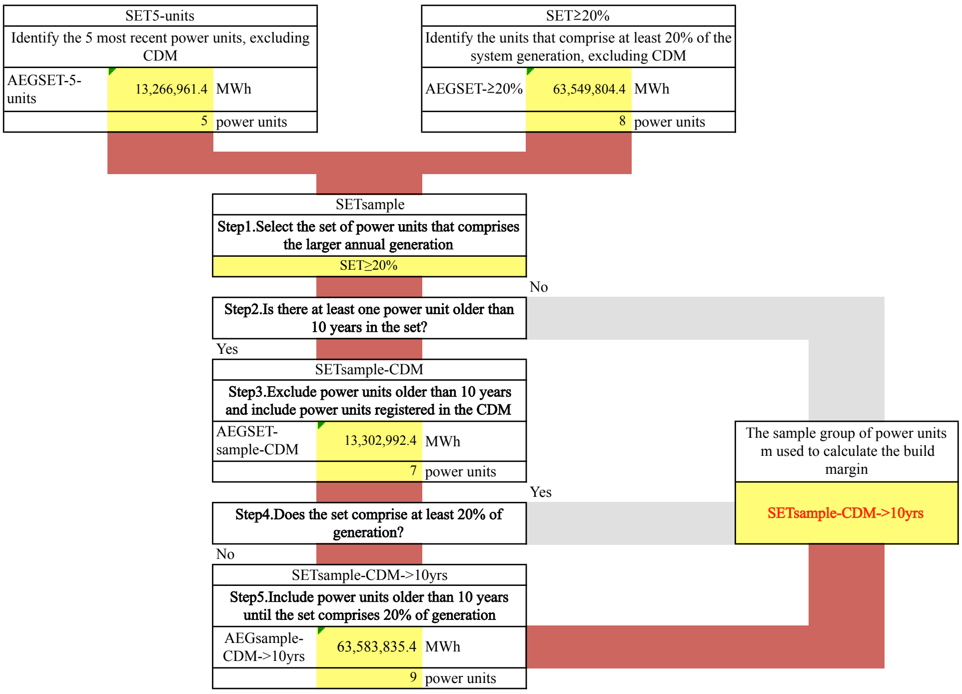
m = All power units serving the grid in year *y* except low-cost/must-run power units

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

As per Annex 1 of the Tool the following efficiencies apply:
Sub-critical Power stations implemented before 2000: Efficiency is 37%
Sub-critical Power stations implemented after 2000: Efficiency is 39%
Open cycle diesel implemented after 2000: Efficiency is 39.5%

The BM is calculated as 0.8610 tCO2/MWh (refer to GEF spreadsheet, Sheet BM)

The diagram below demonstrates the build margin determination process in diagram format. The diagram can be found in the grid emission spreadsheet on sheet 'BM Diagram'.



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:

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

Equation 4

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
w_{OM} = Weighting of operating margin emissions factor (%)
w_{BM} = Weighting of build margin emissions factor (%)
The methodology specifies default values of wOM = 0.5 and wBM = 0.5.

The combined margin is calculated as 0.8920 tCO_2/MWh (refer to GEF spreadsheet to calculate the Build margin and the Combined margin, Sheet CM, Cell I10).

Appendix 5: Further background information on monitoring plan

Figure 8 provides a layout of the monitoring points that are monitored for the purpose of demonstrating that no waste gas is diverted from previous uses, and Table 18: Detail information for the waste gas parameters monitoring plan

Point	**Description of parameter**	**Monitoring Equipment or measurement method**	**Units measured**	**Units calculated**	**Frequency of monitoring**	**Quality procedures**	**The data recorded**
C	CV Value of waste gas used at the Power Plant	Individual Gas Analysers for CO and H2	**%CO and %H2**	**NCV in MJ/Nm3**	Monitored continuously, logged at 30second intervals	The equipment / meters will be calibrated and maintained in accordance with manufacturer’s specifications. Records of calibrations will be kept for verification purposes.	%CO, %H2, NCV
D	Energy from CO gas (waste gas) consumed by the pre-heaters	Newly installed volumetric flow meter.	**Nm3/hour** (CV calculated from Point C instrument in MJ/Nm^3)	**GJ/hour** (flow*CV)	Continuous monitoring will be done and the data will be logged continuously on the FMT SCADA system. A monthly report running from the 1st of the month to the last day of the month will be compiled with the results for that month.	The equipment / meters will be calibrated and maintained in accordance with manufacturer’s specifications. Records of calibrations will be kept for verification purposes.	Gas Flow to- and Energy Consumption of the Pre-heaters
B	Energy from CO gas (waste gas) consumed by the Sinter Plants	Newly installed volumetric flow meter.	**Nm3/hour** (CV calculated from Point C instrument in MJ/Nm^3)	**GJ/hour** (flow*CV)			Gas Flow to- and Energy Consumption of the Sinter Plants
K	Total Propane gas used for Hernic	Gas supplier invoices supplied by Hernic	**GJ/annum**	**GJ/ton pellets**	All invoices will be captured and the information will be compiled into an annual consumptio	The propane consumption will be used in the mass and energy balance to verify the total energy consumption	Total propane gas use (GJ/annum).

Ciska Terblanche 12/9/21 11:35 AM
Deleted: Figure 14

Point	**Description of parameter**	**Monitoring Equipment or measurement method**	**Units measured**	**Units calculated**	**Frequency of monitoring**	**Quality procedures**	**The data recorded**
					n for the energy balance.	for sintering with the use of waste gas for sintering, based on the annual pellet production.	
A	Energy from CO gas (waste gas) consumed by the Power Plant	Newly installed volumetric flow meter.	**Nm3/hour** (CV calculated from Point C instrument in MJ/Nm^3)	**GJ/hour** (flow*CV)	Continuous monitoring will be done and the data will be logged continuously on the EOS SCADA system. A monthly report running from the 1st of the month to the last day of the month will be compiled with the results for that month.	The equipment / meters will be calibrated and maintained in accordance with manufacturer's specifications. Records of calibrations will be kept for verification purposes.	Gas Flow to- and Energy Consumption of the Power Plant
E	Energy from CO gas (waste gas) consumed by the Control flare	Newly installed volumetric flow meter.	**Nm3/hour** (CV calculated from Point C instrument in MJ/Nm^3)	**GJ/hour** (flow*CV)			Gas Flow to- and Energy Consumption of control flare

provides more detail regarding the monitoring parameters that are included in the monitoring plan. CO gas refers to the CO-rich waste gas. PG refers to propane rich gas, which is purchased by Hernic.

All data will be stored for two years after the crediting period of the project activity ends.

Ciska Terblanche 12/9/21 11:35 AM
Deleted: Table 16: Detail information for the waste gas parameters monitoring plan
Description of parameter
... [1]

Figure 8: Schematic diagram of monitors to be implemented under the project activity, in addition to the ones described above in the monitoring section

Ciska Terblanche 12/9/21 11:35 AM

Deleted: 14

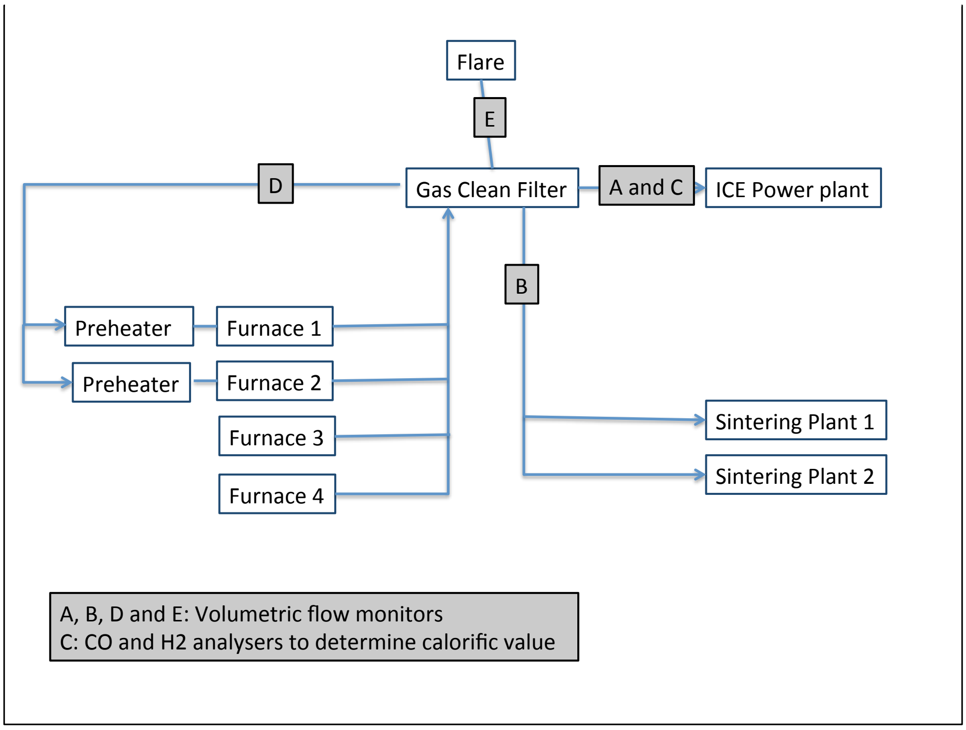


Table 18: Detail information for the waste gas parameters monitoring plan

Point	Description of parameter	Monitoring Equipment or measurement method	Units measured	Units calculated	Frequency of monitoring	Quality procedures	The data recorded
C	CV Value of waste gas used at the Power Plant	Individual Gas Analysers for CO and H2	**%CO and %H2**	**NCV in MJ/Nm3**	Monitored continuously, logged at 30second intervals	The equipment / meters will be calibrated and maintained in accordance with manufacturer's specifications. Records of calibrations will be kept for verification purposes.	%CO, %H2, NCV
D	Energy from CO gas (waste gas) consumed by the pre-heaters	Newly installed volumetric flow meter.	**Nm3/hour** (CV calculated from Point C instrument in MJ/Nm^3)	**GJ/hour** (flow*CV)	Continuous monitoring will be done and the data will be logged continuously on the FMT SCADA system. A monthly report running from the 1st of the month to the last day of the month will be compiled with the results for that month.	The equipment / meters will be calibrated and maintained in accordance with manufacturer's specifications. Records of calibrations will be kept for verification purposes.	Gas Flow to- and Energy Consumption of the Pre-heaters
B	Energy from CO gas (waste gas) consumed by the Sinter Plants	Newly installed volumetric flow meter.	**Nm3/hour** (CV calculated from Point C instrument in MJ/Nm^3)	**GJ/hour** (flow*CV)			Gas Flow to- and Energy Consumption of the Sinter Plants
K	Total Propane gas used for Hernic	Gas supplier invoices supplied by Hernic	**GJ/annum**	**GJ/ton pellets**	All invoices will be captured and the information will be compiled into an annual consumption for the energy	The propane consumption will be used in the mass and energy balance to verify the total energy consumption for sintering	Total propane gas use (GJ/annum).

Ciska Terblanche 12/9/21 11:35 AM
Deleted: 16

Point	Description of parameter	Monitoring Equipment or measurement method	Units measured	Units calculated	Frequency of monitoring	Quality procedures	The data recorded
					balance.	with the use of waste gas for sintering, based on the annual pellet production.	
A	Energy from CO gas (waste gas) consumed by the Power Plant	Newly installed volumetric flow meter.	**Nm3/hour** (CV calculated from Point C instrument in MJ/Nm^3)	**GJ/hour** (flow*CV)	Continuous monitoring will be done and the data will be logged continuously on the EOS SCADA system. A monthly report running from the 1st of the month to the last day of the month will be compiled with the results for that month.	The equipment / meters will be calibrated and maintained in accordance with manufacturer's specifications. Records of calibrations will be kept for verification purposes.	Gas Flow to- and Energy Consumption of the Power Plant
E	Energy from CO gas (waste gas) consumed by the Control flare	Newly installed volumetric flow meter.	**Nm3/hour** (CV calculated from Point C instrument in MJ/Nm^3)	**GJ/hour** (flow*CV)			Gas Flow to- and Energy Consumption of control flare

Appendix 6: Summary of post registration changes

- - - - -

History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03	EB 25, Annex 15 26 July 2006	
02	EB 14, Annex 06b 14 June 2004	
01	EB 05, Paragraph 12 03 August 2002	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		

Page 95: [1] Deleted	Ciska Terblanche	2012/09/21 11:35 AM

Table 16: Detail information for the waste gas parameters monitoring plan

Point	**Description of parameter**	**Monitoring Equipment or measurement method**	**Units measured**	**Units calculated**	**Frequency of monitoring**	**Quality procedures**	**The data recorded**
C	CV Value of waste gas used at the Power Plant	Individual Gas Analysers for CO and H2	**%CO and %H2**	**NCV in MJ/Nm3**	Monitored continuously, logged at 30second intervals	The equipment / meters will be calibrated and maintained in accordance with manufacturer's specifications. Records of calibrations will be kept for verification purposes.	%CO, %H2, NCV
D	Energy from CO gas (waste gas) consumed by the pre-heaters	Newly installed volumetric flow meter.	**Nm3/hour** (CV calculated from Point C instrument in MJ/Nm^3)	**GJ/hour** (flow*CV)	Continuous monitoring will be done and the data will be logged continuously on the FMT SCADA system. A monthly report running from the 1st of the month to the last day of the month will be compiled with the results for that month.	The equipment / meters will be calibrated and maintained in accordance with manufacturer's specifications. Records of calibrations will be kept for verification purposes.	Gas Flow to- and Energy Consumption of the Pre-heaters
B	Energy from CO gas (waste gas) consumed by the Sinter Plants	Newly installed volumetric flow meter.	**Nm3/hour** (CV calculated from Point C instrument in MJ/Nm^3)	**GJ/hour** (flow*CV)			Gas Flow to- and Energy Consumption of the Sinter Plants
K	Total Propane gas used for Hernic	Gas supplier invoices supplied by Hernic	**GJ/annum**	**GJ/ton pellets**	All invoices will be captured and the	The propane consumption will be used in the mass	Total propane gas use (GJ/annum).

Point	Description of parameter	Monitoring Equipment or measurement method	Units measured	Units calculated	Frequency of monitoring	Quality procedures	The data recorded
					information will be compiled into an annual consumption for the energy balance.	and energy balance to verify the total energy consumption for sintering with the use of waste gas for sintering, based on the annual pellet production.	
A	Energy from CO gas (waste gas) consumed by the Power Plant	Newly installed volumetric flow meter.	**Nm3/hour** (CV calculated from Point C instrument in MJ/Nm^3)	**GJ/hour** (flow*CV)	Continuous monitoring will be done and the data will be logged continuously on the EOS SCADA system. A monthly report running from the 1st of the month to the last day of the month will be compiled with the results for that month.	The equipment / meters will be calibrated and maintained in accordance with manufacturer’s specifications. Records of calibrations will be kept for verification purposes.	Gas Flow to- and Energy Consumption of the Power Plant
E	Energy from CO gas (waste gas) consumed by the Control flare	Newly installed volumetric flow meter.	**Nm3/hour** (CV calculated from Point C instrument in MJ/Nm^3)	**GJ/hour** (flow*CV)			Gas Flow to- and Energy Consumption of control flare