



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

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

Project title: Market Coke Waste Heat Recovery Project

Version number: V01.1

Date: 25 January 2012 (V01)

18 May 2012 (V01.1 – updated in line with Designated Operational Entities' (DOE) recommendations)

A.2. Description of the project activity:

Exxaro Resources Limited (Exxaro) plans to construct the Market Coke Plant (the project facility) at their Grootegeluk Coal Mine in the Limpopo Province of South Africa. The Bankable Feasibility Study (BFS) for the project facility has been completed and the potential to generate electricity from waste heat recovered in the Market Coke Waste Heat Recovery Plant (the project activity) is being investigated through the completion of a Pre-feasibility Study (PFS)¹. The project activity and the project facility will independently seek approval from Exxaro's Board of Directors due to the need for carbon revenue for the project activity (see section B.5. below)¹.

The project activity will utilise waste heat recovered from the coke oven flue gas (waste gas, off-gas) after tertiary combustion, produced as part of the coking pyrolysis process in the project facility to produce electricity.

During the coking pyrolysis process, coal from the Grootegeluk Coal Mine is heated in coke ovens in the absence of oxygen (air), driving off volatile matter in the coal to produce market coke. Large volumes of hot coke oven flue gases are produced in the coking pyrolysis process and these hot waste gases contain energy in the form of waste heat which can be recovered. In the project activity, steam is produced in waste heat recovery boilers (WHRB) using the waste heat recovered from the hot coke oven flue gas after tertiary combustion. The steam is expanded through turbines to produce mechanical energy used to drive alternators to produce electricity.

The project activity is expected to have a gross installed capacity of 60MW and the objective of the project activity is to supply the electricity produced, 462 000 MWh/yr, to the internal grid of the Grootegeluk Coal Mine thereby displacing more carbon intensive electricity from the South African national grid operated by Eskom (the baseline) and therefore also lessening the burden on the national grid. Additionally, the project activity is expected to result in greenhouse gas (GHG) emissions reductions of approximately 450 912 tCO₂e/yr. The baseline or business as usual practice would be to combust the hot coke oven flue gases in flue gas ducts (tertiary combustion) and vent the waste heat to atmosphere.

The project activity and project facility will be located at the Grootegeluk Coal Mine on the farm Daarby 458 LQ, approximately 25km west of the town of Lephalale (formerly Ellisras), in the Limpopo Province of South Africa.

¹ Exxaro, 2012a.



The project facility and the project activity make important and noteworthy contributions to the sustainable development of South Africa². The project activity displaces the carbon intensive electricity of the national grid and is expected to result in GHG emissions reductions of approximately 450 912.00tCO₂e/yr.

Located within the existing Grootegeluk Coal Mine, the project activity will not affect local or regional biodiversity. The proposed site is located on an area currently utilised as a construction lay-down area within the mine, and as such will not affect “greenfields” sites on the mine further mitigating the disturbance of ecosystems and biodiversity.

Approximately 275 direct jobs will be created during the operational lifetime of the project facility and the project activity, with more jobs expected to be created during the construction phase³.

Additionally, as described in sections D.1. and D.2. below, the scoping phase of the environmental impact assessment (EIA) process has identified potential environmental impacts and has outlined the plan of study for the EIA. Moreover, the project’s environmental impacts will be assessed and appropriate mitigation measures will be identified and implemented in the project’s design and operation³.

A.3. Project participants:

Table 1 below provides a list of the project participants:

Table1: Project participants

Name of Party involved (*) (host indicates a Host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of South Africa (host)	Exxaro Resources Limited	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		
Note: When the PDD is filled in support of a proposed new methodology (form CDM-NM), at least the Host Party(ies) and any known project participant (e.g. those proposing a new methodology) shall be identified.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

² Department of Energy (DOE), 2011. Designated National Authority (DNA) Letter Of No Objection (LONO).

³ Synergistics, 2012. Market Coke Plant and Co-generation Plant - Draft Environmental Scoping Report.



Country: Republic of South Africa.

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

Province: Limpopo Province.

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

Town/ City: Lephalale (formerly Ellisras).

Municipality: Lephalale Local Municipality, within the Waterberg District Municipality.

A.4.1.4. Details of physical location, including information allowing the unique identification of this <u>project activity</u> (maximum one page):
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The project activity will be located at the Grootegeluk Coal Mine on the farm Daarby 458 LQ, approximately 25km west of the town of Lephalale (formerly Ellisras), in the Limpopo Province of South Africa. The coordinates for the project are: 23.6453° South and 27.5544° East and refer to point R9 of Figure 3 below.

Figure 1 below provides the location of the Grootegeluk Coal Mine, where the project activity will be located, while Figure 2 provides the location of the project activity within the boundaries of the Grootegeluk Coal Mine. Also, a preliminary site layout diagram is provided in Figure 3.

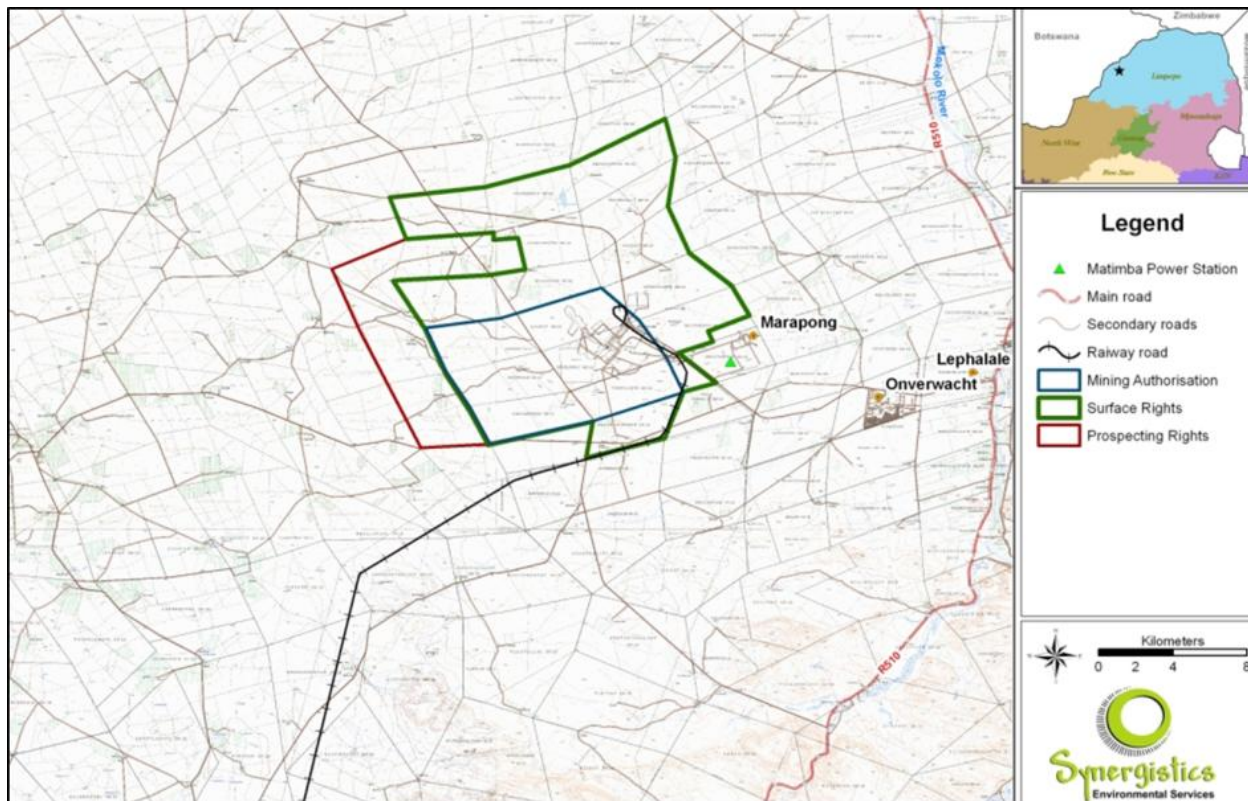


Figure 1: Location of the Grootegeluk Coal Mine in the Limpopo Province of South Africa (Source: Synergistics Environmental Services³).

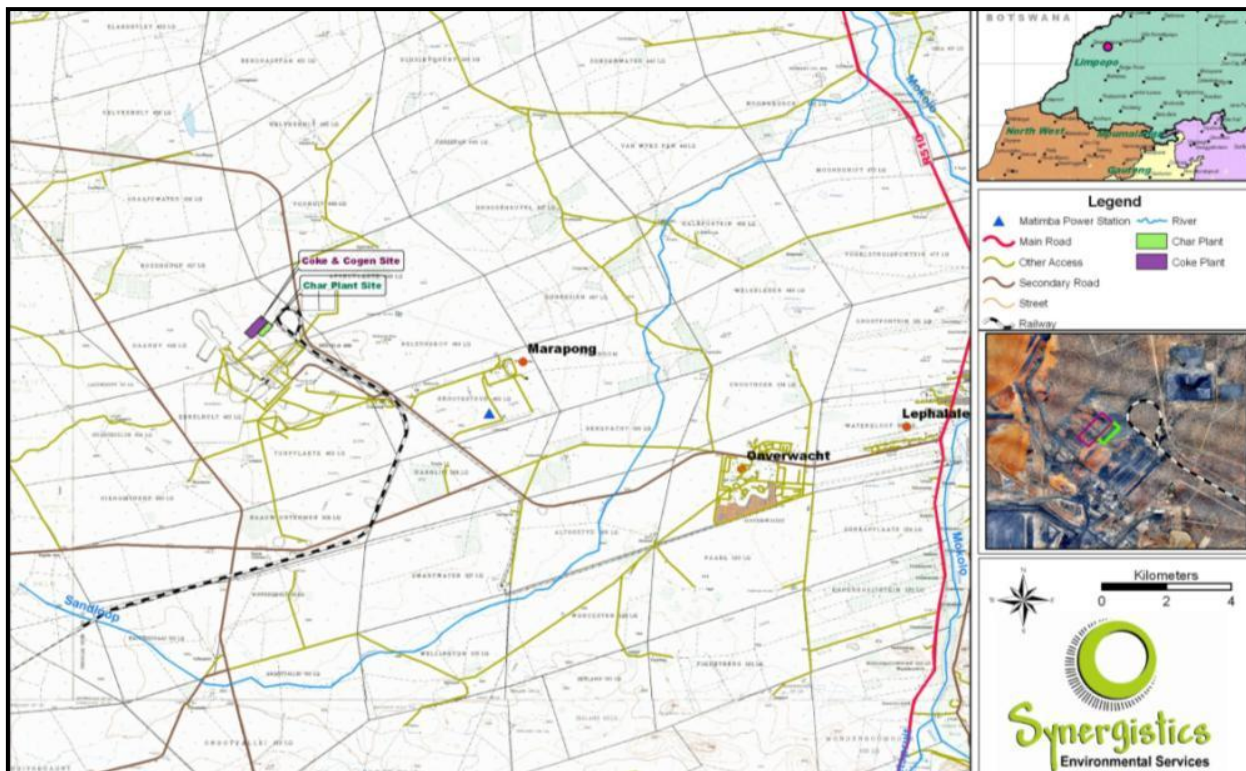


Figure 2: Location of the Market Coke Waste Heat Recovery Plant within the Grootegeluk Coal Mine (Source: Synergistics Environmental Services³).

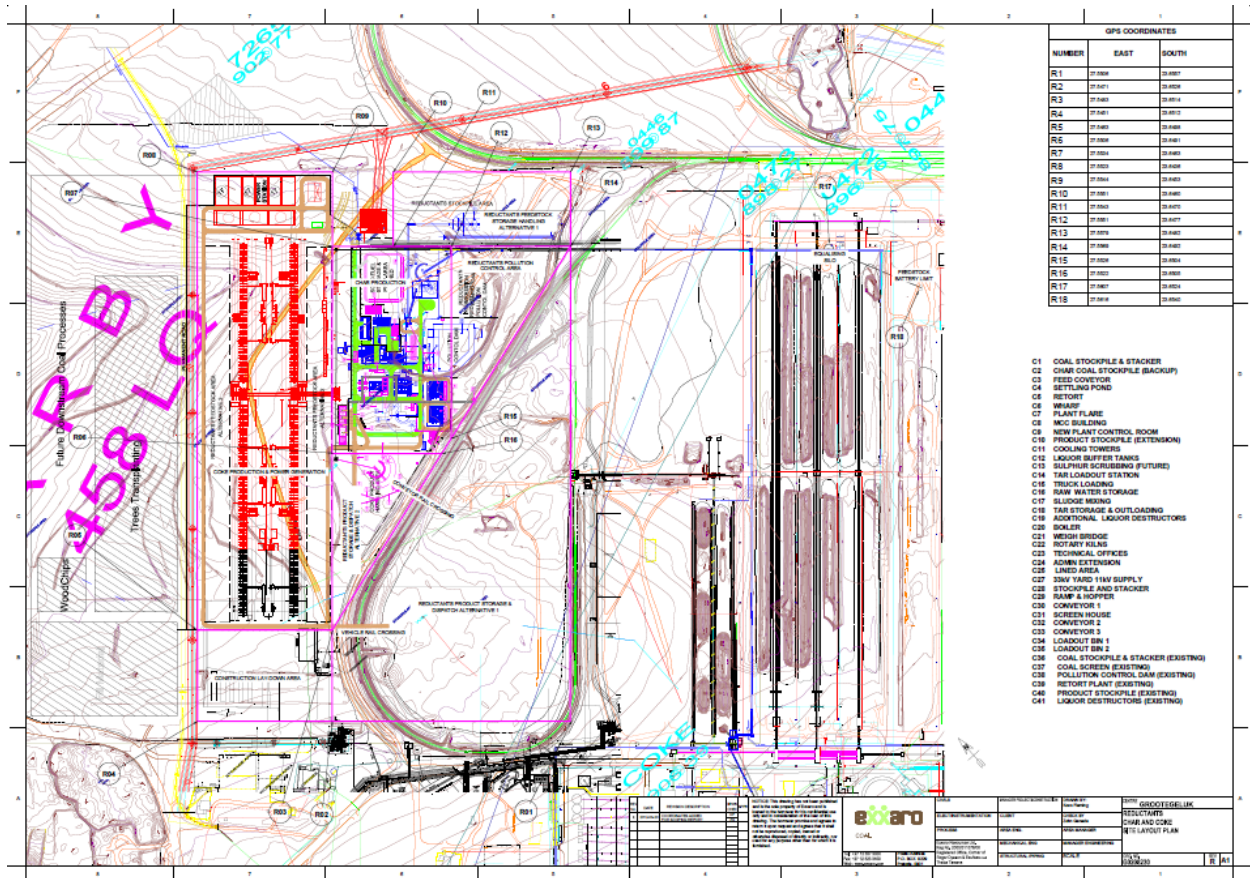


Figure 3: Preliminary site layout diagram (Exxaro Grootegeluk Coal Mine⁴).

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

The project falls within Sectoral Scope 01 Energy industries (renewable - / non-renewable sources) and Sectoral Scope 04 Manufacturing industries.

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

The project activity will use standard technology and equipment to recover the hot waste gas and energy incorporating the gas system, waste heat boilers, a standard steam system with turbines, generators, switchgear and control systems. A simplified process flow diagram for the project activity is provided in Figure 4 below.

⁴ Exxaro 2012b.

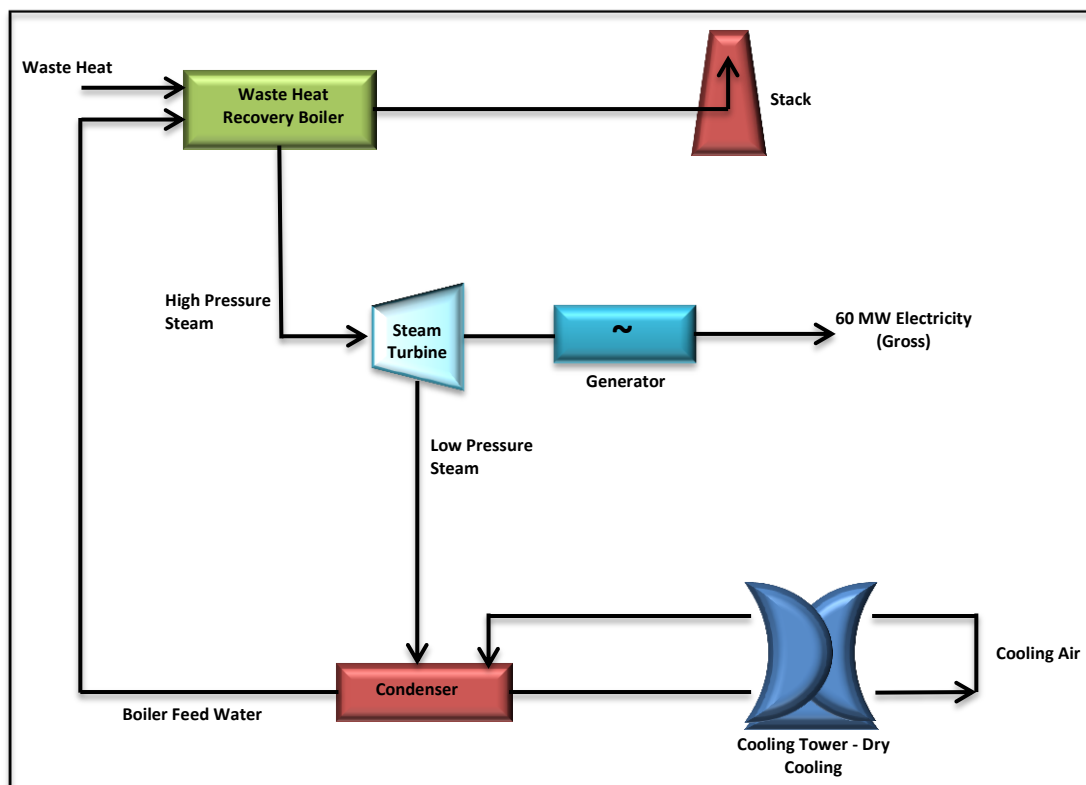


Figure 4: Simplified process flow diagram for the Market Coke Waste Heat Recovery Plant

As can be seen from Figure 4 above, waste heat from the tertiary combustion of the coke oven flue gas from the project facility enters the project activity at the WHRB where it is used to raise steam for use in the steam turbine. The steam is expanded through the turbine driving a shaft connected to the generator producing approximately 462 000 MWh/yr electricity. The project activity's expected plant load factor is 96%⁵.

The technology employed is mature and the equipment is available from a large number of manufacturers and is to a large extent interchangeable. The only deviation from the standard is that the project activity will utilize dry (air) cooling technology as opposed to a conventional wet cooling technology and system, as a result of the general water shortage in the region thereby enhancing its sustainable development and environmental benefits (even though the wet cooling technology and system would be cheaper and would also allow the generation of more power). However, although the technology utilised is considered to be standard and mature technology, the use of this technology in the coke manufacturing process is considered to be first of its kind in South Africa, as demonstrated in section B.5. below.

The project boundary includes the proposed Market Coke Plant as the project facility, containing the coke ovens where the waste heat is generated after tertiary combustion of the coke oven flue gas and the associated and co-located Market Coke Waste Heat Recovery Plant (the project activity) containing the

⁵ Engineering and Projects Company (E&PC), 2011. Exxaro Energy Coke Waste Heat Recovery Project: Process Design Criteria.



gas system, WHRB, steam system with turbines, generators (alternators), switchgear, control systems and ancillary equipment. The South African national electricity grid operated by Eskom which currently supplies electricity to the Grootegeluk Coal Mine prior to the project activity, shall also form part of the project boundary for the purposes of determining the baseline. Emissions which fall outside of the project boundary, include the ongoing mining operations at the Grootegeluk Coal Mine as well as the operation of the project facility. The project activity will result in the displacement of GHG intensive electricity supplied from the South African national grid and will therefore target carbon dioxide (CO₂) reductions. Figure 5 below provides a detailed process flow diagram delineating the project activity.

The baseline (see section B.4 below) is the continuation of the status quo whereby the Grootegeluk Coal Mine's electricity is supplied from the South African national grid and the usual practice for the project facility would be to combust and vent the coke oven flue gas emitted from the coke ovens.

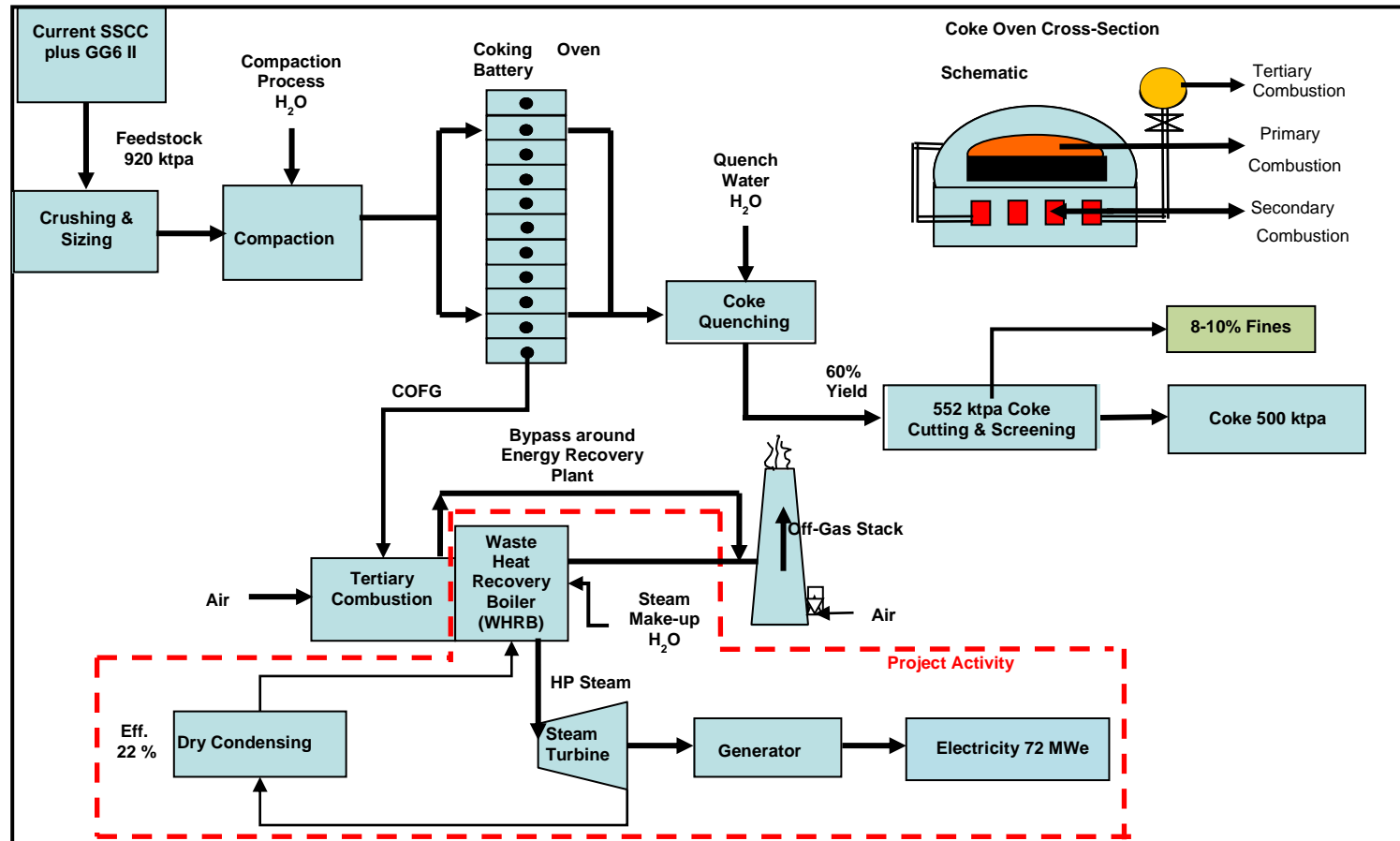


Figure 5: Detailed process flow diagram delineating the project activity

Project facility process description

Semi-soft coking coal (SSCC) is conveyed from coal stockpiles within the existing Grootegeluk Coal Mine and stored in concrete silos and coal storage bins (hoppers). The SSCC is crushed and sized before compaction, where it is loaded from a hopper into a compacting box. Hydraulic compaction will be used which involves the compression of the SSCC layers from the top by a hydraulically activated compression plate. Water is added during compaction to increase the strength of the resulting coal cake.

The shaped and compacted coal cake is then loaded onto charging / pushing cars and is “charged” (fed) into the coke ovens. Once in the coke oven, the pyrolysis process begins through the combustion of the volatile gases which are released from the coal cake during heating. This is where the coke ovens make available the waste heat after tertiary combustion of the hot coke oven flue gases for utilisation in the project activity. As can be seen from the figure below, from the ducts below the coke oven floor, the hot coke oven gases are drawn into the flues that run across the length of the coke oven battery. Tertiary combustion of the hot coke oven flue gases takes place within the flues as air is fed in. The waste heat is transported along the flues, before the waste heat is recovered in the waste heat recovery boilers for use in the project activity.

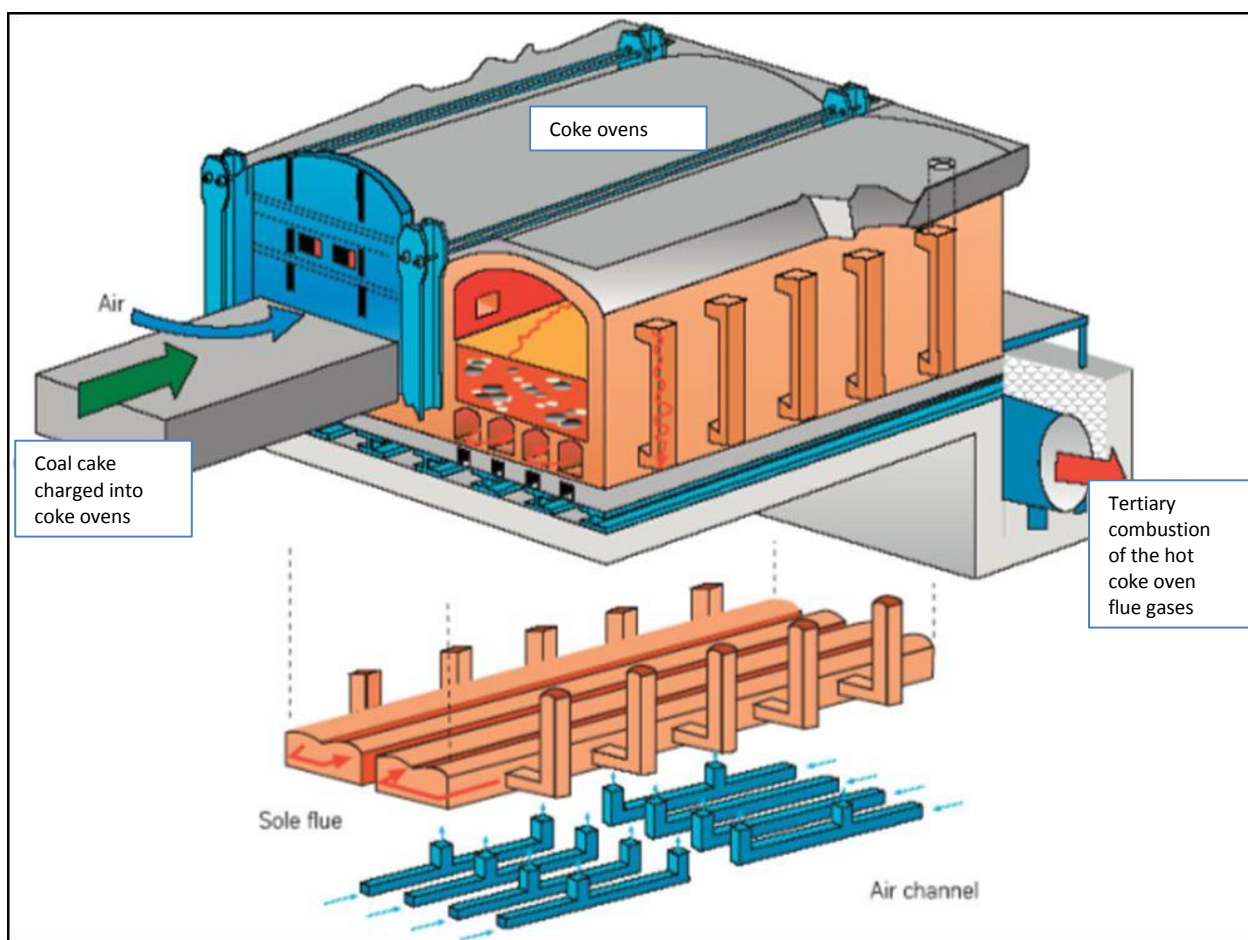


Figure 6: Schematic example of coke ovens and coking pyrolysis process

*Project activity process description*

As mentioned previously and as can be seen from Figure 4 above, the battery limit between the project facility and the project activity is the point at which the hot coke oven flue gases, after tertiary combustion, enters the waste heat recovery boilers. The expected thermodynamic conditions, including temperature and flow rate, of the waste heat is given in the table below.

Table 2: Waste heat conditions at WHRB inlet⁶

Description	Value	Unit
Flow rate	583 139	Nm ³ /hr
Temperature	1 230	°C
Energy Available	274	MW

The thermodynamic cycle for the project activity is the “Rankine cycle”. The cycle is the basis for conventional power generating stations and consists of a steam source such as the WHRB which utilise the waste heat from the tertiary combustion of the hot coke oven flue gas at an approximate temperature of 1 230°C to convert water to high-pressure steam. In the steam cycle, water is first pumped into the WHRB at medium to high pressure. It is then heated utilising the waste heat to the boiling temperature in the range of 480°C to 540°C, depending on the pressure.

The pressurised steam is then expanded through a multi-stage turbine to a lower steam pressure and exhausted to a condenser at vacuum conditions. An extraction condensing turbine will be utilised. The rotational energy generated, is transferred by the turbine output shaft to the generator which generates electricity. The condensate from the condenser returns to the feed water pumps for further use and continuation of the cycle. The anticipated technical parameters for major equipment utilised in the project activity are provided in the table below.

Table 3: Anticipated technical parameters of major equipment⁶

Waste Heat Recovery Boilers (WHRBs)	Turbine and generator units
Units: 4	Units: 2
Boiler thermal efficiency (estimated): 85% (to be confirmed (tbc))	Steam temperature at turbine inlet (estimated): 480°C (tbc)
Blowdown (estimated): 3% (tbc)	Steam pressure at turbine inlet (estimated): 65 Bar (tbc)
Steaming capacity per boiler (estimated): 286 t/hr (to be confirmed (tbc))	Specific steam consumption (overall) (estimated): 4.76kg/kW
Feedwater temperature (estimated): 110°C (tbc)	Turbine capacity (estimated): 30MWe (tbc)
Feedwater Pressure (a) (estimated): 81 Bar(a) (tbc)	
Boiler outlet steam temperature (estimated): 485°C (tbc)	

⁶ E&PC, 2011. Exxaro Energy Coke Waste Heat Recovery Project: Energy and Material Balance.



The steam system includes the waste heat recovery boilers and turbines, ducting, pumps, piping, cladding and civil work but also associated equipment like piping, valves, electrical equipment, automation, instrumentation, de-aerators, fans, stacks, condensers, cooling towers and the water treatment plants.

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

A fixed, ten (10) year crediting period for the project activity will be utilised. The project activity will result in the displacement of GHG intensive electricity supplied from the South African national grid and will therefore target CO₂ reductions.

The estimated emissions reductions of the project activity over the 10 year crediting period are summarized in the table below:

Table 4: Estimated emissions reductions

Year	Annual estimation of emission reductions in tonnes of CO₂e
2015 (01/08/2015 - 31/12/2015)	189 383
2016	450 912
2017	450 912
2018	450 912
2019	450 912
2020	450 912
2021	450 912
2022	450 912
2023	450 912
2024	450 912
2025 (01/01/2025 - 31/07/2025)	261 529
Total estimated reductions (tonnes of CO₂e)	4 509 120
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO₂e)	450 912

A.4.5. Public funding of the project activity:

Official Development Assistance (ODA) or public funding has not and will not be used in the development and implementation of the project⁷.

⁷ Exxaro, 2012c.

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

The approved baseline and monitoring methodology to be employed for the project activity is:

“ACM0012: Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects (ACM0012 / Version 04.0.0, Sectoral Scopes: 01 and 04, EB 60)”

Relevant methodological tools utilised include:

- *“Tool to calculate the emission factor for an electricity system (Version 2.2.1, EB 63, Annex 19)”⁸;*
- *“Tool for the demonstration and assessment of additionality (Version 6.0.0, EB 65, Annex 21)”⁸;*

The relevant scope and applicability criteria of the tools are assessed and demonstrated for use in the tables below.

Table 5: Scope and applicability criteria analysis of the Tool to calculate the emission factor for an electricity system

Tool scope and applicability criteria	Applicability of tool for use in the project activity
This methodological tool determines the CO ₂ emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the “combined margin” emission factor (CM) of the electricity system. The CM is the result of a weighted average of two emission factors pertaining to the electricity system: the “operating margin” (OM) and the “build margin” (BM). The operating margin is the emission factor that refers to the group of existing power plants whose current electricity generation would be affected by the proposed CDM project activity. The build margin is the emission factor that refers to the group of prospective power plants whose construction and future operation would be affected by the proposed CDM project activity.	The project activity results in the displacement of electricity generated by power plants in the South African national grid (the electricity system) owned and operated by Eskom. As such, the tool is utilised to calculate the combined margin (CM) emissions factor of the grid. The project activity and the application of the tool thus complies with the criterion and is suitable for use.
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).	The tool is utilised to estimate the OM, BM and CM of the grid for the purposes of determining the baseline emissions. The project activity substitutes grid electricity that would have otherwise supplied the recipient facility, the Grootegeluk Coal Mine. The criterion is satisfied and the tool is applicable for use.
Under this tool, the emission factor for the project electricity system can be calculated either for grid power plants only or, as an option, can include off-grid power plants. In the latter case, the conditions specified in	As can be seen from section B.6.1. below, although this step of the tool is optional, only grid power plants are included in the calculation. As such there is no requirement to meet the conditions specified in Annex 2

⁸ Available online at <http://cdm.unfccc.int/Reference/tools/index.html>



Tool scope and applicability criteria	Applicability of tool for use in the project activity
<p>“Annex 2 - Procedures related to off-grid power generation” should be met. Namely, the total capacity of off-grid power plants (in MW) should be at least 10% of the total capacity of grid power plants in the electricity system; or the total electricity generation by off-grid power plants (in MWh) should be at least 10% of the total electricity generation by grid power plants in the electricity system; and that factors which negatively affect the reliability and stability of the grid are primarily due to constraints in generation and not to other aspects such as transmission capacity.</p>	<p>of the tool. The criterion is therefore satisfied and the use of the tool is applicable.</p>
<p>Note that this tool is also referred to in the “Tool to calculate project emissions from electricity consumption” for the purpose of calculating project and leakage emissions in case where a project activity consumes electricity from the grid or results in increase of consumption of electricity from the grid outside the project boundary.</p>	<p>Project and leakage emissions are calculated according to ACM0012 as described in section B.6.1. below. The project activity does not consumer electricity from the grid and does not result in an increase of electricity from the grid outside of the project boundary. The criterion is fulfilled and the tool is applicable for use.</p>
<p>In case of CDM projects the tool is not applicable if the project electricity system is located partially or totally in an Annex I country.</p>	<p>The project electricity system comprises the South African national grid owned and operated by Eskom and is neither partially or totally located in an Annex I country. The tool is therefore applicable for use in the project activity.</p>

Table 6: Scope and applicability criteria analysis of the Tool for the demonstration and assessment of additionality

Tool scope and applicability criteria	Applicability of tool for use in the project activity
<p>This tool provides for a step-wise approach to demonstrate and assess additionality. These Steps include:</p> <ul style="list-style-type: none"> (a) Identification of alternatives to the project activity; (b) Investment analysis to determine that the proposed project activity is either: 1) not the most economically or financially attractive, or 2) not economically or financially feasible; (c) Barriers analysis; and (d) Common practice analysis. 	<p>The steps provided in the tool are applied and furthermore are considered to have been applied correctly, according to the requirements of the tool. The tool is therefore applicable for use since the criterion is satisfied.</p>
<p>Based on the information about activities similar to the proposed project activity, the common practice analysis is to complement and reinforce the investment and/or barriers analysis. The Steps are summarized in the flow-chart on page 2 of this document.</p>	<p>As can be seen in section B.5. below, the common practice analysis is utilised to complement the investment analysis. Furthermore the Steps are applied in accordance with the requirements of the tool and the criterion is satisfied, thereby the tool is applicable for use.</p>
<p>The document provides a general framework for demonstrating and assessing additionality and is applicable to a wide range of project types. Some project types may require adjustments to this general framework.</p>	<p>ACM0012 requires that the assessment and demonstration of additionality be carried out according to the latest version of the Tool for the demonstration and assessment of additionality, as such the tool is applied as is and no adjustments have been made to the general framework. The tool is therefore applicable for use.</p>
<p>This tool does not replace the need for the baseline</p>	<p>The baseline scenario has been determined in</p>



Tool scope and applicability criteria	Applicability of tool for use in the project activity
<p>methodology to provide a step-wise approach to identify the baseline scenario. Project participants that propose new baseline methodologies shall ensure consistency between the determination of additionality of a project activity and the determination of a baseline scenario. Project participants can also use the “Combined tool to identify the baseline scenario and demonstrate additionality”, which provides a procedure for baseline scenario identification as well as additionality demonstration.</p>	<p>accordance with ACM0012, where realistic and credible alternatives have been identified in a step wise approach for the most plausible baseline scenario. The tool has therefore not replaced the need for the baseline methodology to provide a step-wise approach to identify the baseline scenario and is therefore applicable for use.</p>

Guideline documents utilised include:

- “Guidelines on the assessment of investment analysis (Version 05, EB 62, Annex 5)”
- “Guidelines on additionality of first-of-its-kind project activities (Version 01.0, EB 63, Annex 11)”
- “Guidelines on common practice (Version 01.0, EB 63, Annex 12)”

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

Provided in the table below is an applicability analysis of the project activity against the criteria set out in ACM0012:

Table 7: Applicability analysis of ACM0012 against the project activity

ACM0012 Applicability Criteria	Project Activity
<p>The consolidated methodology is applicable to project activities implemented in an existing or Greenfield facility converting waste energy carried in identified WECM stream(s) into useful energy. The WECM stream may be an energy source for:</p> <ul style="list-style-type: none"> • 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. 	<p>The project activity is the construction and operation of the new (Greenfield) Market Coke Waste Heat Recovery Plant⁵. The project activity utilises waste heat carried in the coke oven flue gas after tertiary combustion (the identified waste energy carrying medium (WECM)) produced in the greenfield Market Coke Plant (the project facility) as part of the coking pyrolysis process to generate 462 000 MWh/yr net electricity⁶. The project activity subscribes to the criterion and ACM0012 is therefore suitable for use.</p>
<p>In the absence of the project activity, the WECM stream:</p> <p>(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</p> <p>(b) Would be partially recovered, and the unrecovered portion of WECM stream would be flared, vented or remained unutilized at the existing or Greenfield project facility.</p>	<p>In the absence of the project activity, the WECM would not be recovered and would be combusted and vented to atmosphere^{10, 11}. Thus, the criterion is applicable to the project activity, and ACM0012 is suitable for use.</p>



ACM0012 Applicability Criteria	Project Activity
<p>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”.</p>	
<p>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.</p>	<p>Although the project activity produces electricity only, no waste pressure is recovered and therefore ACM0012 is applicable to the project activity^{5,6}.</p>
<p>Regulations do not require the project facility to recover and/or utilize the waste energy prior to the implementation of the project activity.</p>	<p>Current regulations require that the coke oven flue gas to be combusted before being vented to atmosphere in order to comply with environmental air quality regulations⁹. However, no South African regulations require the use of the waste energy. The project activity subscribes to this criterion and ACM0012 is therefore suitable for use.</p>
<p>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.</p>	<p>Both the project activity and project facility are Greenfield facilities and will therefore be treated as such for further analysis in this document⁵. ACM0012 is therefore suitable for use.</p>
<p>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.</p>	<p>Under abnormal conditions (emergencies, plant shut down etc.) of either the project facility or project activity, waste energy released will not form part of the emissions reductions calculations and therefore ACM0012 is suitable for use.</p>
<p>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.</p>	<p>The only identified WECM for the project activity is the waste heat contained in the hot coke oven flue gas after tertiary combustion produced as part of the coking pyrolysis process in the project facility⁶. Multiple waste gas streams are therefore not utilised in the project activity and therefore ACM0012 is suitable for use.</p>
<p>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</p>	<p>In the absence of the project activity, the WECM would be combusted and vented in full, and would not be partially recovered^{10,11}. Additionally, the project activity utilises the WECM to generate electricity as the only output of the project activity and does not utilise</p>



ACM0012 Applicability Criteria	Project Activity
the purpose of supplying heat of reaction.	the WECM for heat of reaction ⁶ . Thus, ACM0012 is suitable for use.
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 recovers waste heat contained in the coke oven flue gas after tertiary combustion produced as part of the coking pyrolysis process in the project facility and does not recover waste energy from a single and or combined cycle power plant ⁵ . Furthermore, the project activity is a Greenfield plant producing power (electricity) only and is not a cogeneration plant and is therefore applicable to ACM0012.
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 project activity is a Greenfield plant and will therefore employ a technical lifetime for equipment that is equal to the technically designed operational lifetime for equipment from its first commissioning. ACM0012 is thus suitable for use.
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.	As can be seen from section B.5. below, there are no waste energy generation facilities within South Africa that use waste energy, therefore Annex 1 and Annex 2 of the methodology are not applicable. ACM0012 is suitable for use.
In addition, the applicability conditions included in the tools referred to above apply.	The project activity complies with the applicability conditions stated in the relevant tools as demonstrated in section B.1., tables 5 and 6, thus ACM0012 is suitable for use.

As can be seen from the above table, the project activity fulfils the required applicability criteria for ACM0012 and therefore ACM0012 is an appropriate methodology for the project activity.

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

The project boundary includes the proposed project facility, containing the coke ovens where the coke oven flue gas is generated and the associated and co-located project activity containing the gas system, waste heat recovery boilers, steam system with turbines, generators, switchgear, control systems and ancillary equipment (refer to Figure 5 above for a diagram delineating the project boundary). The South African national electricity grid operated by Eskom which supplies the electricity to the Grootegeluk Coal Mine, shall also form part of the project boundary for the purposes of determining the baseline and grid emissions factor (GEF).

Provided in the table below are the emission sources and gases that are included in the project boundary for the purpose of calculating baseline emissions and project emissions:



Table 8: Summary of the emission sources and gases that are included or excluded in the project boundary

Source		Gas	Included?	Justification / Explanation
Baseline	Electricity generation, grid or captive source	CO ₂	Included	Main emission source.
		CH ₄	Excluded	Excluded for simplification. This is conservative.
		N ₂ O	Excluded	Excluded for simplification. This is conservative.
Project Activity	Supplemental fossil fuel consumption at the project plant	CO ₂	Included	Main emission source.
		CH ₄	Excluded	Excluded for simplification.
		N ₂ O	Excluded	Excluded for simplification.
	Supplemental electricity consumption	CO ₂	Included	Main emission source.
		CH ₄	Excluded	Excluded for simplification.
		N ₂ O	Excluded	Excluded for simplification.

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

In accordance with ACM0012 realistic and credible alternatives have been identified in a step wise approach for the most plausible baseline scenario. Realistic and credible alternatives have been determined for:

- Waste energy use in the absence of the project activity; and
- Power generation in the absence of the project activity for each recipient facility if the project activity involves electricity generation for that recipient facility.

Since the project activity does not generate heat (process heat and/or heat of reaction) or mechanical energy as outputs, realistic and credible alternatives have not been identified for these.

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

As per ACM0012, “the baseline scenario is identified as the most plausible baseline scenario among all realistic and credible alternative(s)”.



Furthermore, ACM0012 states that “therefore any alternative identified for the project activity should provide the same amount of heat, power or mechanical energy that is provided by the project activity...”.

Table 9 below provides an analysis of realistic and credible alternatives for the use of waste energy in the absence of the project activity:

Table 9: Realistic and credible alternative analysis for waste energy

Alternative		Realistic and credible alternative? (Yes / No)	Justification / Explanation
W1	WECM is directly vented to the atmosphere without incineration	No	The WECM for the project activity is the waste heat contained in the coke oven flue gas after tertiary combustion ⁵ . In terms of South African air quality regulations the project facility is required to comply with the relevant regulations and thus directly venting the WECM (the coke oven flue gas to the atmosphere without incineration) is not considered to be a realistic and credible alternative ⁹ . W1 is therefore not a realistic and credible alternative.
W2	WECM is released to the atmosphere (for example after incineration) or waste heat is released (or vented) to the atmosphere or waste pressure energy is not utilized	Yes	As mentioned for W1 above, combustion (incineration) of the coke oven flue gas is required in order for the project facility to comply with South African air quality regulations. As such, after tertiary combustion of the coke oven flue gas, the waste heat would be released to the atmosphere, W2 is therefore a realistic and credible alternative.
W3	Waste energy is sold as an energy source	No	None of the existing operations at the Grootegeluk Coal Mine, regardless of their proximity to the project activity, have the potential to utilise the waste heat generated by the project facility ^{10,11} . The waste energy (the waste heat) would remain utilised and therefore there does not exist the opportunity to sell the waste energy as an energy source. W3 is thus not considered to be a realistic and credible alternative.
W4	Waste energy is used for meeting energy demand at the recipient facility(ies)	No	As above for W3, none of the existing operations at the Grootegeluk Coal Mine (the recipient facility) have the potential to utilise the waste energy for meeting

⁹ Department of Environmental Affairs (DEA), 2010. National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEMAQA) – Government Notice No. 248 (GN 248 of 31 March 2010).

¹⁰ Exxaro, 2012d.

¹¹ Exxaro, 2012e.



Alternative		Realistic and credible alternative? (Yes / No)	Justification / Explanation
			their energy demand, therefore W4 is not a realistic and credible alternative.
W5	A portion of the quantity or energy of WECM is recovered for generation of heat and/or electricity and/or mechanical energy, while the rest of the waste energy produced at the project facility is flared/released to atmosphere/ unutilised	No	According to the Pre-feasibility Study (PFS), the total heat available from the coke oven flue gas produced in the project facility after tertiary combustion and ducting losses is 275MW ¹² . As such this whole amount was utilised in the energy optimisation model developed to quantify the process design criteria for the project activity, in order for the project activity to produce the required level of power for use at the recipient facility. Therefore recovering only a portion of the energy of the WECM is not considered feasible since the power produced would not be sufficient to satisfy the needs of the recipient facility, W5 is thus excluded as a realistic and credible alternative.
W6	All the waste energy produced at the facility is captured and used for export electricity generation or steam	No	As above for W3 and W4, none of the existing operations at the Grootegeluk Coal Mine, regardless of their proximity to the project facility, have the potential to utilise the waste energy generated by the project facility ^{10, 11} . Additionally, the use of the waste energy for export electricity generation would require a project similar to the proposed project activity, and is therefore not considered to be a realistic and credible alternative for the use of waste energy in the absence of the project activity. W6 is thus excluded as a realistic and credible alternative to the project activity

As can be seen from Table 9 above, W2 is the only realistic and credible alternative for the use of waste energy in the absence of the project activity.

For power generation, realistic and credible alternatives have been analysed Table 10 below:

Table 10: Realistic and credible alternative analysis for power generation

Alternative		Realistic and credible alternative? (Yes / No)	Justification / Explanation
P1	Proposed project activity not undertaken as a CDM project activity	No.	The revenues generated from the sale of CERs generated from the project activity are key to the project activity's

¹² E&PC, 2011.Exxaro Energy Coke Waste Heat Recovery Project: Process Concept Design.



Alternative		Realistic and credible alternative? (Yes / No)	Justification / Explanation
			feasibility, as assessed and demonstrated in section B.5. below. Without revenues from the sale of CERs, the project will not go ahead and therefore, P1 is not a realistic and credible alternative.
P2	On-site or off-site existing fossil fuel fired cogeneration plant	No.	The project activity produces power (electricity) only and therefore a fossil fuel fired cogeneration plant, on-site or off-site, is not a realistic and credible alternative and P2 is excluded ^{5, 6} . Additionally, there is no existing on-site or off-site fossil fuel fired cogeneration plant ^{10, 11} .
P3	On-site or off-site Greenfield fossil fuel fired cogeneration plant	No.	As above for P2 – the project activity produces power only and therefore a Greenfield fossil fuel fired cogeneration plant, located either on-site or off-site, is not considered to be a realistic and credible alternative and P3 is therefore excluded.
P4	On-site or off-site existing renewable energy based cogeneration plant	No.	As above for P2 – the project activity produces power only and therefore an existing renewable energy based cogeneration plant, located either on-site or off-site, is not considered to be a realistic and credible alternative and P4 is therefore excluded.
P5	On-site or off-site Greenfield renewable energy based cogeneration plant	No.	As above for P2 – the project activity produces power only and therefore a Greenfield renewable energy based cogeneration plant, located either on-site or off-site, is not considered to be a realistic and credible alternative and P5 is therefore excluded.
P6	On-site or off-site existing fossil fuel based existing identified captive power plant	No.	Power is currently obtained from the national grid and while the grid is supplied from predominantly fossil fuel fired power stations, the Grootegeluk Coal Mine is not supplied with electricity directly from an existing identified captive power plant ¹³ . Therefore P6 is not considered to be a realistic and credible alternative and is excluded.

¹³ Exxaro, 2012f.



Alternative		Realistic and credible alternative? (Yes / No)	Justification / Explanation
P7	On-site or off-site existing identified renewable energy or other waste energy based captive power plant	No.	As above for P6 – power is currently supplied from the national grid and not from existing identified renewable energy or other waste energy based captive power plants. P7 is therefore not a realistic and credible alternative and is excluded.
P8	On-site or off-site Greenfield fossil fuel based captive plant	No.	As can be seen from section B.6.1. below, the annual average power generation from the five most recently constructed coal-fired power stations in South Africa is 23 796 369MWh/yr. The construction and operation of an on-site or off-site greenfield fossil fuel based captive plant is therefore not considered to be a realistic and credible alternative to the project activity since this would not provide the same amount of power that is provided by the project activity (462 000 MWh/yr). P8 is therefore excluded as a realistic and credible alternative.
P9	On-site or off-site Greenfield renewable energy or other waste energy based captive plant	No.	As above for P8 and as can be seen from section B.6.1. below, with approximately 92% of electricity supply in South Africa from coal-fired power stations, the construction and operation of an on-site or off-site greenfield renewable energy or other waste energy based captive plant is not considered to be a realistic and credible alternative to the project activity. P9 is therefore excluded as a realistic and credible alternative.
P10	Sourced from grid-connected power plants	Yes.	This is the status quo and current situation and is therefore P10 included as a realistic and credible alternative.
P11	Existing captive electricity generation using waste energy (if the project activity is captive generation using waste energy, this scenario represents captive generation with lower efficiency or lower recovery than the project activity)	No.	There is no existing use of waste energy and the project activity is a Greenfield plant and does not represent an efficiency improvement ^{10, 11} . P11 is therefore not considered to be a realistic and credible alternative and is excluded.
P12	Existing cogeneration using waste energy, but at a lower efficiency or	No.	As above for P2 and P11– the project activity is a Greenfield plant and does not represent an efficiency or recovery



Alternative	Realistic and credible alternative? (Yes / No)	Justification / Explanation
lower recovery		improvement. Also, the project activity is not a cogeneration plant and produces only power. P12 is not considered to be a realistic and credible alternative.

Based on Table 10 above, the only realistic and credible alternative for power generation is P10.

Therefore, the outcome of Step 1 is a scenario of W2 and P10, as summarised and described in Table 11 below:

Table 11: Realistic and credible baseline scenario matrix

Scenario	Baseline alternative/ option		Scenario description
	Waste energy	Power	
1	W2	P10	Waste energy would be combusted and vented and power would be supplied from the national grid.

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 (e.g. alternatives where barriers are prohibitive or which are clearly economically unattractive).

Step 2 has been undertaken in section B.5. below and is therefore not repeated here for simplification.

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.

As can be seen from Step 1 above and section B.5. below, Scenario 1 is the only remaining realistic and credible alternative, thus Step 3 is not required.

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

The table below provides the timeline for the proposed project activity and illustrates that the potential for carbon revenue from the project activity was a key determinant to proceed with the project.

Table 12: Timeline of key milestones associated with the development of the proposed project activity

Description / Milestone	Date
Project initiated as PFS.	06/2010
PFS complete.	01/02/2011 ⁵
Tender issued for CDM consulting services	28/02/2011 ¹⁴

¹⁴ Exxaro, 2012g.



Description / Milestone	Date
Environmental impact assessment (EIA) consultant appointed.	04/2011 ¹⁵
Camco appointed as CDM consultant.	09/06/2011 ¹⁶
Prior Consideration Notice submitted to the CDM Executive Board (EB) and the South African Designated National Authority (DNA).	27/06/2011 ¹⁷
Confirmation of receipt of the Prior Consideration Notice received from the South African DNA.	28/06/2011
Project Identification Note (PIN) submitted to the South African DNA.	06/09/2011 ¹⁸
Letter of No Objection (LONO) received from the South African DNA.	28/09/2011 ¹⁹
Expected construction start date.	08/2013
Expected date of project commissioning.	08/2015

ACM0012 requires that the assessment and demonstration of additionality be carried out according to the latest version of the “*Tool for the demonstration and assessment of additionality*”, which at the time of writing this document is Version 6.0.0, EB 65, Annex 21. As such and in line with the tool, the step-wise approach to demonstrate and assess additionality has been carried out below:

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

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

From section B.4. above, Step 1 and Step 2 result in there being only one realistic and credible alternative scenario to the project activity, namely Scenario 1 which is the business as usual practice and continuation of the current situation (the baseline). This is in line with and in accordance with the “*Tool for the demonstration and assessment of additionality*” (Version 6.0.0, EB 65, Annex 21), which states that “*realistic and credible alternative(s) available to the project participants or similar project developers that provide outputs or services comparable with the proposed CDM project activity*” and includes alternative “g”, which is selected here since it is considered to be the same as Scenario 1, where:

“(g) *If applicable, continuation of the current situation (no project activity or other alternatives undertaken).*”

Outcome of Sub-step 1a:

¹⁵ Exxaro, 2012h.

¹⁶ Exxaro, 2012i.

¹⁷ Prior Consideration Notice, 2011.

¹⁸ Project Identification Note (PIN), 2011.

¹⁹ Letter of No Objection (LONO), 2011.



The outcome of Sub-step 1a is therefore that the identified realistic and credible alternative scenario to the project activity is Scenario 1.

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

Scenario 1 as described in Table 11 above is in compliance with all mandatory laws and regulations. As mentioned previously, waste gas would need to be combusted and vented in accordance with relevant health, safety and environmental legislation. The legislation is however not prescriptive in the manner or method of combustion and is aimed rather at ensuring emissions are within certain health, safety and environmental standards for air quality. Furthermore, no legislation in South Africa requires that the waste heat produced as a result of combustion be recovered or utilised in any way.

Outcome of Sub-step 1b:

Scenario 1 is therefore identified as a realistic and credible alternative scenario to the project activity since it is in compliance with mandatory legislation and regulations. Step 2 is therefore undertaken below.

Step 2: Investment analysis

Step 2 is undertaken to demonstrate that the proposed project activity is not economically or financially feasible, without the revenue from the sale of certified emission reductions (CERs).

Sub-step 2a: Determine appropriate analysis method

Version 6.0.0 of the “*Tool for the demonstration and assessment of additionality*” provides three options available as appropriate analysis methods, namely:

- Option I. Simple cost analysis
- Option II. Investment comparison analysis
- Option III. Benchmark analysis

Since Option I. is appropriate to project activities and alternative scenarios that generate no financial or economic benefits other than CDM related income, it is deemed not to be an appropriate analysis method because the project activity is expected to generate revenues from the sale of CERs as well as electricity to the recipient facility. Additionally, Option II is not considered to be an appropriate analysis method since the only realistic and credible alternative, Scenario 1, does not require investment and is not a similar investment project. Therefore, the project activity will utilise Option III. Benchmark analysis is the appropriate analysis method.

Sub-step 2b: Option III. Benchmark analysis method

The Internal Rate of Return (IRR) is used as the financial indicator for the project. More specifically, the post-tax equity IRR is used as it is considered to be an appropriate IRR in order to allow comparison to



the NERSA (2011)²⁰ published return on equity, which is a post-tax benchmark. Therefore, in order to assess whether the project activity is financially attractive, this equity IRR is compared to the NERSA benchmark equity IRR, a post-tax return on equity figure of 17%.

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

Major parameters and inputs used in the calculation of the equity IRR are listed in Table 13 below:

Table 13: Parameters and inputs to the IRR

Parameter/ Input	Amount/ Value	Unit	Source / Reference
Technical (General)			
Capacity (Net)	60.00	MWe	Pre-feasibility Study (PFS) ¹²
Capacity factor	0.96		PFS ⁵
Electrical output (Net)	462 000 .00	MWh/yr	Calculated
Project lifetime	20.00	yrs	PFS
Capital Expenditure (CAPEX)			
Hard CAPEX (plant and equipment)	1 063 310 191	ZAR	PFS ²¹
Soft CAPEX (development and non-financing costs)	558 950 256	ZAR	PFS ²¹
Operational Expenditure (OPEX)			
Fixed OPEX	71 880 000	ZAR	PFS
Variable OPEX (Yrs 1 - 3)	8 709 120	ZAR	PFS
Variable OPEX (Yrs 4 - 20)	10 342 080	ZAR	PFS
Financial Structure			
Debt	0	%	PFS
Equity	100	%	PFS
Revenues			
Electricity tariff	557.70	ZAR/MWh	Calculated
Carbon revenue	29 408 481.00	ZAR/yr	Calculated
Other financial parameters / inputs			
Company income tax rate	28.00	%	South African Revenue Services (SARS)
Value added tax (VAT)	14.00	%	SARS

Suitability of parameters / inputs to IRR calculation

Parameters and inputs to the return on equity calculation have been sourced from the PFS compiled by the engineering, procurement and construction (EPC) contractor, Engineering and Projects Company (E&PC), an independent engineering consulting company. The PFS utilised CAPEX figures based on

²⁰ NERSA, 2011. NERSA Consultation Paper: Cogeneration Regulatory Rules and Feed-In Tariffs, 19 January 2011. Page 17 of 23.

²¹ E&PC, 2011. Exxaro Energy Coke Waste Heat Recovery Project: Steam and Power Generation - 2x30MWe Genset.



quotations received from equipment manufacturers as well as the experience of E&PC in building similar projects.

CAPEX and OPEX

The PFS compiled by E&PC provided expected CAPEX and OPEX figures based on quotations received from equipment manufacturers as well as the experience of E&PC in building similar projects.

Revenues

The tariff utilised to calculate revenues from electricity is considered to be an appropriate figure since it is based on the actual tariff charged to the Grootegeluk Coal Mine for the period October 2010 to November 2011 and escalated according to NERSA approved electricity tariff increases²² and thus reflects the savings accrued to Exxaro as an income.

IRR calculation

Table 10 shows the real equity IRR with and without the income from CER revenue compared to the benchmark IRR. As can be seen from Annex 3-1, and based upon the above parameters and inputs, the equity IRR without CER revenue is 6.5%, which is well below the benchmark return on equity of 17%.

Table 14: IRR results summary

Description	Without CER revenues	Benchmark
Equity IRR	6.5%	17%

Therefore, as can be seen from above, the project's equity IRR suggests that it is not financially attractive when compared to the benchmark real return on equity and is therefore financially additional.

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

A sensitivity analysis was conducted to show that the conclusion regarding the financial attractiveness is sufficiently robust to reasonable variations in the parameters and inputs to the return on equity. In other words, that the investment analysis could consistently support the conclusion that the project activity undertaken without the CDM, will not be financially attractive. Accordingly, IRR sensitivity to CER price is not included in the following analysis. The sensitivity analysis was carried out using the range of +10% and -10%.

The following variables were included in the sensitivity analysis:

- Hard and Soft CAPEX (Total CAPEX)
- Fixed and Variable OPEX (Total OPEX)
- Electricity tariff
- Electrical output

The results of the sensitivity are shown in Table 15 below:

Table 15: Sensitivity for materially significant parameters / inputs

Variable	-10%	0%	+10%
Total CAPEX	8.0%	6.5%	5.2%

²² NERSA MYPD 2011.

Total OPEX	7.0%	6.5%	6.0%
Electricity tariff	4.6%	6.5%	8.2%
Electrical output	4.7%	6.5%	8.2%
Benchmark	17%	6.5%	17%

Provided in Figure 7 below is a graph illustrating the sensitivity analysis carried out.

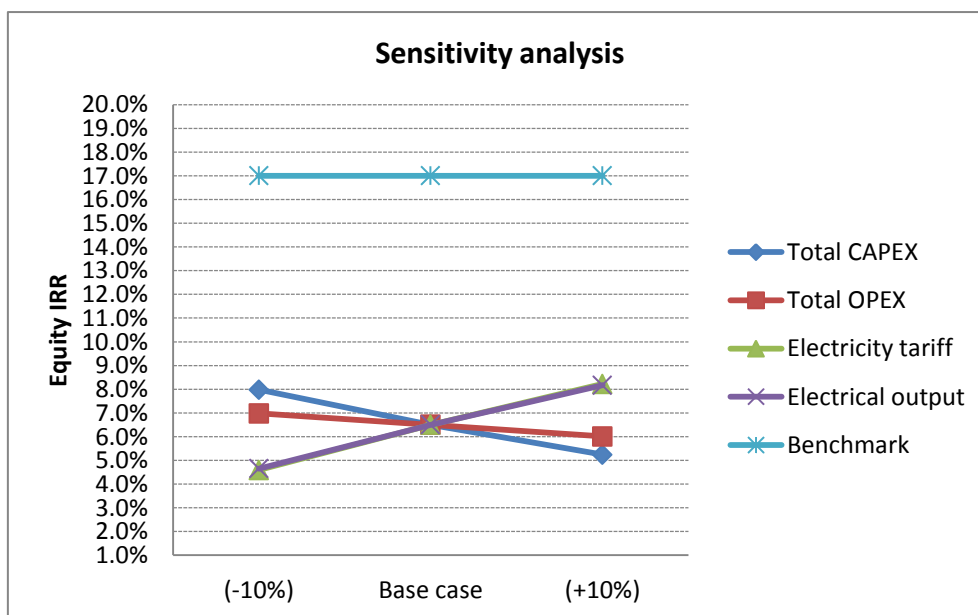


Figure 7: Sensitivity analysis graph

It can be observed that despite variation in the key parameters and inputs, the equity IRR remains below the benchmark. The investment analysis provides a valid argument in favour of additionality as this analysis consistently supports the conclusion that the project activity is not economically or financially attractive.

Outcome of Step 2:

The proposed CDM project activity is not financially or economically attractive. The revenue from the sale of CERs improves the financial attractiveness of the project activity’s real equity IRR.

Table 16 below shows the required variation of the materially significant financial parameters to make the equity IRR reach the benchmark of 17%.

Table 16: Variation of parameters / inputs to reach benchmark

Total CAPEX	-50%
Electricity tariff	+75%
Electrical output	+75%

From Table 16 above, it can be seen that should the Total CAPEX decrease by 50%, or the Electricity tariff and the Electrical output increase by 75%, the project activity will reach the equity benchmark of



17%. However, it is unlikely that these parameters will vary to such a high degree and therefore these variations reflect an unrealistic scenario. Moreover, it is not likely that the Total CAPEX will decrease by as much as 50% since the CAPEX was calculated based on quotations received from equipment manufacturers as well as the experience of E&PC in building similar projects. Thus the Total CAPEX is more likely to increase.

Additionally, the Electricity tariff is based upon the actual electricity tariff for the Grootegeluk Coal Mine for the period October 2010 to November 2011 which has been escalated in line with NERSA²² approved tariff increases. The Electrical output of the project activity is already based on a 96% plant load factor and therefore is not possible to increase the electrical output by 75%.

Step 3: Barrier analysis

Since the barrier analysis is an optional step within the “*Tool for the demonstration and assessment of additionality*”, it has not been undertaken here.

Step 4: Common practice analysis

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

As the default and in line with the “*Guidelines on common practice (Version 01.0, EB 63, Annex 12)*”, the applicable geographic area is that of the geo-political boundaries of South Africa. Currently in South Africa, there are only 3 coke manufacturing plants²³. These include plants located at:

- Vanderbijlpark – 6 coke batteries with gas cleaning and by-product recovery;
- Pretoria – 1 coke battery with gas cleaning and by-product recovery; and
- Newcastle – 3 coke batteries with gas cleaning and by-product recovery.

As such and as can be seen from the above mentioned coke manufacturing plants, there are no coke batteries either of the non-recovery type or the heat recovery type in operation in South Africa.

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

From *Sub-step 4a* above, it can be seen that no similar activities are located within the applicable geographic area. In line with version 6.0.0 of the “*Tool for the Demonstration and Assessment of Additionality*”, the following steps have been carried out in order to evaluate any similar options that are occurring:

Step 1: Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.

Step 2: In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Step 1, as the proposed project activity and have started commercial operation before the start date of the project. Note their number N_{all} . Registered CDM project activities and projects activities undergoing validation shall not be included in this step;

Step 3: Within plants identified in Step 2, identify those that apply technologies different that the technology applied in the proposed project activity. Note their number N_{diff} .

²³ CNI Technologies, 2012. Coke Making Facilities in South Africa.



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.

Thus:

Step 1: The applicable output range of the project activity is 27.5MW (-50%) to 82.5MW (+50%).

Step 2: As can be seen in Sub-step 4a above, while there are currently no plants that deliver the same output or capacity in the applicable geographic area within the applicable output range of the proposed project activity as calculated in Step 1, the 3 coke manufacturing plants identified in Sub-step 4a are included here for . Therefore, $N_{all} = 0$.

Step 3: Since, as identified in Sub-step 4a above, there are no plants that apply technologies different than the technology applied, $N_{diff} = 0$.

Step 4: The factor is calculated as:

$$F = 1 - N_{diff} / N_{all}$$

Where:

$$N_{diff} = 0;$$

$$N_{all} = 0$$

Thus, $F = 1 - 0/0 = 1$. Also, $N_{all} - N_{diff} = 0 - 0 = 0$, which is less than 3. As such, since $F = 1$ and is greater than 0.2 and $N_{all} - N_{diff} = 0$ which is less than 3, the project activity is not common practice and satisfies Sub-step 4a and Sub-step 4b.

In conclusion, it is only through the inclusion of CDM revenues that the project activity becomes financially more attractive. Also, the intention to register the project activity under the CDM was a key determinant to proceed with the project. The project activity is therefore additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Baseline emissions calculation

As per ACM0012, baseline emissions for the year y , are determined using equation “1”:

$$BE_y = BE_{En,y} + BE_{flst,y}$$

Where:

BE_y = The total baseline emissions during the year y in tCO₂

$BE_{En,y}$ = The baseline emissions from energy generated by the project activity during the year y in tCO₂



$BE_{flst,y}$ = Baseline emissions from fossil fuel combustion, if any, either directly for flaring of waste gas or for steam generation that would have been used for flaring the waste gas in the absence of the project activity (tCO₂), calculated as per equation 26. This is relevant for those project activities where in the baseline steam is used to flare the waste gas

Since the project activity does not combust fossil fuels either directly for flaring of waste gas or for steam generation that would have been used for flaring the waste gas in the absence of the project activity and would not in the baseline utilise steam to flare the waste gas, $BE_{flst,y} = 0$ and equation “1” simplifies to:

$$BE_y = BE_{En,y}$$

Section B.4 above describes the only realistic and credible alternative to the project activity, which is a scenario comprising W2 and P10 where waste energy would be flared and power would be supplied from the national grid. This scenario conforms to “Scenarios 1 and 2” as defined in ACM0012, as such equation “2” is used to calculate $BE_{En,y}$:

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

Where:

$BE_{Elec,y}$ = Baseline emissions from electricity during the year y in tCO₂

$BE_{Ther,y}$ = Baseline emissions from thermal energy (due to heat generation by elemental processes) during the year y (tCO₂)

The project activity produces electricity only, therefore $BE_{Ther,y} = 0$ and equation “2” simplifies to:

$$BE_{En,y} = BE_{Elec,y}$$

Baseline emissions from electricity ($BE_{Elec,y}$) generation are calculated according to “Case 1” and using equation “3” of ACM0012:

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

Where:

$BE_{elec,y}$ = Baseline emissions due to displacement of electricity during the year y (tCO₂)

$EG_{i,j,y}$ = The quantity of electricity supplied to the recipient j by generator, which in the absence of the project activity would have been sourced from source i (the grid or an identified source) during the year y in MWh

$EF_{elec,i,j,y}$ = The CO₂ emission factor for the electricity source i (gr for the grid, and is for an identified source), displaced due to the project activity, during the year y (tCO₂/MWh)



- f_{wcm} = Fraction of total electricity generated by the project activity using waste energy. This fraction is 1 if the electricity generation is purely from use of waste energy. Depending upon the situation, this factor is estimated using the equations in section 3.1
Note: For a project activity using waste pressure to generate electricity, the electricity generated from waste pressure should be measurable and this fraction is 1
- f_{cap} = Factor that determines the energy that would have been produced in project year y using waste energy generated at a historical level, expressed as a fraction of the total energy produced using waste source in year y . The ratio is 1 if the waste energy generated in project year y is the same or less than that generated at a historical level. The value is estimated using the equations in section 3.2. For Greenfield facilities, f_{cap} is 1. If the procedure in Annex 1 concludes that the waste energy would have been partially utilised in the “reference waste energy generating facilities” this fact will be captured in the factor $f_{practice}$ (refer to equations 22, 23, 24 and 25 for the use of factor $f_{practice}$)

The recipient, j , of the electricity in this instance is the Grootegeluk Coal Mine and the electricity source, i , is the South African national grid.

All the waste energy is utilised in the project activity to generate electricity, thus $f_{wcm} = 1$, while $f_{cap} = 1$ also, since the project activity is a Greenfield facility. Equation “3” is consequently simplified to:

$$BE_{elec,y} = 1 * 1 * \sum_j \sum_i (EG_{i,j,y} * EF_{elec,i,j,y})$$

$EF_{elec,i,j,y}$ is the grid emissions factor (GEF) for the South African grid, which is calculated utilising V2.2.1 of the “*Tool to calculate the emission factor for an electricity system*” (Version 2.2.1, EB 63, Annex 19). Thus, the following six (6) steps of the baseline methodology procedure of the tool are utilised, namely:

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

Step 1: Identify the relevant electricity systems

As South Africa’s national utility, Eskom is responsible for the supply of approximately 95% of the country’s electricity, with approximately 92% supplied from large-scale coal-fired power stations^{24, 25}. As above for B.3, the relevant electricity system is the South African National grid, which comprises the following plants and types:

Table 17: Power plants comprising the South African national grid²⁶.

²⁴ Department of Energy (DOE), 2010. South African Energy Synopsis 2010. Directorate: Energy Information Management, Process Design and Publications.

²⁵ Eskom, 2011. Integrated Report 2011.



Plant no.	Power station	Installed capacity (MW)	Generation technology	Energy source / Fuel type
1	Arnot	1 980	Coal Subcritical	Other Bituminous Coal
2	Duvha	3 450	Coal Subcritical	Other Bituminous Coal
3	Hendrina	1 895	Coal Subcritical	Other Bituminous Coal
4	Kendal	3 840	Coal Subcritical	Other Bituminous Coal
5	Kriel	2 850	Coal Subcritical	Other Bituminous Coal
6	Lethabo	3 558	Coal Subcritical	Other Bituminous Coal
7	Matimba	3 690	Coal Subcritical	Other Bituminous Coal
8	Majuba	3 843	Coal Subcritical	Other Bituminous Coal
9	Matla	3 450	Coal Subcritical	Other Bituminous Coal
10	Tutuka	3 510	Coal Subcritical	Other Bituminous Coal
11	Koeberg	1 800	Nuclear	Nuclear
12	Camden	1 600	Coal Subcritical	Other Bituminous Coal
13	Grootvlei	1 200	Coal Subcritical	Other Bituminous Coal
14	Komati	1 000	Coal Subcritical	Other Bituminous Coal
15	Imports	Not available (N/a)	N/a	N/a

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

Although this step is optional, Option I: Only grid power plants are included in the calculation, is selected here.

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

V2.2.0 of the “Tool to calculate the emission factor for an electricity system” provides one of the following methods for calculation the operating margin emission factor (EF_{grid,OM,y}):

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

Since Option (b) Simple adjusted OM as well as Option (c) Dispatch data analysis both require data which is not publicly available in South Africa, namely load duration data and detailed running dispatch

²⁶ Accessed online at <http://www.eskom.co.za/c/article/236/cdm-calculations/> and <http://www.eskom.co.za/content/calculationTable.htm>



data respectively, they are deemed not feasible for use to calculate the operating margin of the electricity system. Moreover, while an *ex ante* method (discussed in more detail below) has been chosen, (c) requires an *ex post* method to calculate the operating margin of the electricity system which is not applicable to historical data and also requires annual monitoring. Therefore, Options (b) and (c) are not feasible for use.

Additionally, Option (d) Average OM is suitable only for electricity systems where low cost/must run power plants generate more than 50% of the electricity supplied to the grid, which as demonstrated below, is not the case in South Africa and therefore Option (d) is not feasible for use. This leaves Option (a) Simple OM as the appropriate method to determine the operating margin.

Option (a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation. Low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid and typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. Based on an average of the five most recent years for which data is available, the annual average electricity generation in South Africa was approximately 240 154 551MWh, of which low cost/must run resources contributed approximately 9 478 800MWh or approximately 4% (see the table below for the calculation of the figures).

Table 18: Net electricity calculation²⁶.

Plant no.	Power station	Generation technology	Low cost/must run (Yes / No)	Net electricity generation (EGm,y) (MWh)				
				2006	2007	2008	2009	2010
1	Arnot	Coal Subcritical	No	11 495 036	15 938 102	11 905 060	11 987 281	13 227 864
2	Duvha	Coal Subcritical	No	24 479 488	31 550 562	23 622 732	21 769 489	22 581 228
3	Hendrina	Coal Subcritical	No	12 410 151	16 083 288	13 756 351	12 296 687	12 143 292
4	Kendal	Coal Subcritical	No	26 461 793	34 164 855	26 517 420	23 841 401	23 307 031
5	Kriel	Coal Subcritical	No	20 510 202	22 468 695	17 762 398	18 156 686	15 906 816
6	Lethabo	Coal Subcritical	No	22 498 940	32 052 833	25 701 723	23 580 232	25 522 698
7	Matimba	Coal Subcritical	No	28 401 085	34 983 880	29 021 742	26 256 068	27 964 141
8	Majuba	Coal Subcritical	No	17 620 119	22 828 565	23 680 971	22 676 924	22 340 081
9	Matla	Coal Subcritical	No	23 782 480	30 864 194	24 549 833	21 863 400	21 954 536
10	Tutuka	Coal Subcritical	No	16 500 638	23 389 829	20 980 242	21 504 122	19 847 894
11	Koeberg	Nuclear	Yes		11 293 000	11 780 000	11 317 000	13 004 000
12	Camden	Coal	No	756 540	2 815 982	5 171 057	6 509 079	7 472 070



Plant no.	Power station	Generation technology	Low cost/must run (Yes / No)	Net electricity generation (EG _{m,y}) (MWh)				
				2006	2007	2008	2009	2010
		Subcritical						
13	Grootvlei	Coal Subcritical	No	-	-	237 138	1 249 556	2 656 230
14	Komati	Coal Subcritical	No	-	-	-	-	1 016 023
15	Imports	N/a	N/a	-	-	10 624 000	10 998 000	9 162 000
Total electricity generation				204 916 472	278 433 785	245 310 667	234 005 925	238 105 904
Average annual generation				240 154 551				
Low cost/must run generation				-	11 293 000	11 780 000	11 317 000	13 004 000
Average annual low cost/must run generation				9 478 800				
% of low cost/must run				3.95%				

As can be seen from the table above, low cost/must run resources constituted approximately 4% of average annual generation for the grid for the last five (5) years. Thus, Option (a) Simple OM is appropriate for use.

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

The Simple OM is calculated *ex ante*, using a 3-year generation-weighted average based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation. Furthermore, Option A: Based on the net electricity generation and a CO₂ emission factor of each power unit of the Simple OM method is utilised. 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:

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

Where:

- $EF_{\text{grid,OMsimple,y}}$ = Simple operating margin CO₂ emission factor in year y (tCO₂/MWh)
 $EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
 $EF_{EL,m,y}$ = CO₂ emission factor of power unit m in year y (tCO₂/MWh)
m = All power units serving the grid in year y except low-cost / must-run power units
y = The relevant year as per the data vintage chosen in Step 3

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



Since data on data on fuel consumption and electricity generation is available, Option A1 is utilised to determine the emission factor ($EF_{EL,m,y}$), as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \times NCV_{i,y} \times EF_{CO_2,i,y}}{EG_{m,y}}$$

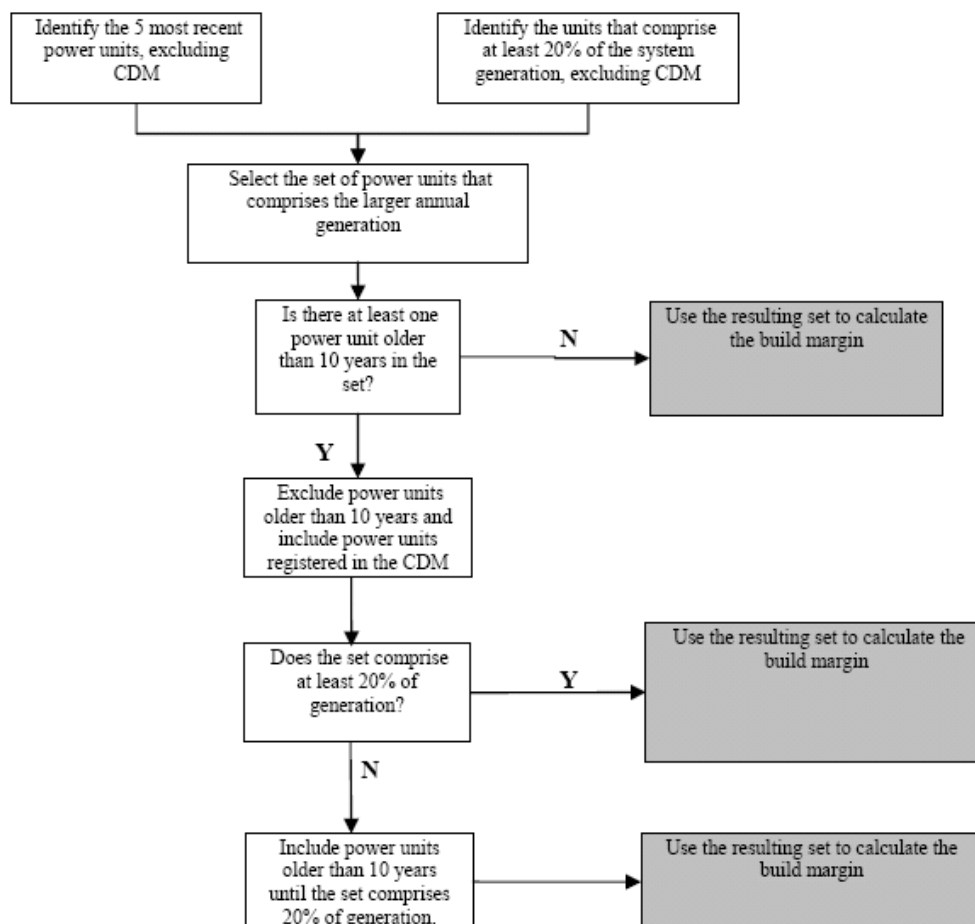
Where:

$EF_{EL,m,y}$	= CO ₂ emission factor of power unit m in year y (tCO ₂ /MWh)
$FC_{i,m,y}$	= Amount of fossil fuel type i consumed by power unit m in year y (Mass or volume unit)
$NCV_{i,y}$	= Net calorific value (energy content) of fossil fuel type i in year y (GJ/mass or volume unit)
$EF_{CO_2,i,y}$	= 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)
m	= All power units serving the grid in year y except low-cost/must-run power units
i	= All fossil fuel types combusted in power unit m in year y
y	= The relevant year as per the data vintage chosen in Step 3

Therefore, according to the calculations carried out in Annex 3, the $EF_{grid,OMsimple,y} = 0.966$ tCO₂/MWh.

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

In order to calculate the build margin (BM) of the grid, the tool provides the following procedure (carried out step wise below):



Identify the 5 most recent power units, excluding CDM ($SET_{5-units}$)

The 5 units that started to supply electricity most recently to the grid include:

Table 19: Five most recent power plants.

Commissioning order	Plant No.	Power Station	Commissioning date	CDM	Electricity generation ($EG_{m,v}$)
1	8	Majuba	01/04/1996	No	22 340 081
2	4	Kendal	01/10/1988	No	23 307 031
3	7	Matimba	04/12/1987	No	27 964 141
4	6	Lethabo	22/12/1985	No	25 522 698
5	10	Tutuka	01/06/1985	No	19 847 894
Annual electricity generation ($AEG_{SET-5-units}$)					118 981 845

Identify the units that comprise at least 20% of the system generation, excluding CDM ($SET_{\geq 20\%}$)

The annual electricity generation of the grid in 2010 (AEG_{total}) was 238 105 904MWh, with 20% of the generation equal to 47 621 181MWh. Of the above 5 units, $SET_{5-units}$, that started to supply electricity most recently to the grid, Majuba, Kendal and Matimba comprise $SET_{\geq 20\%}$, with 73 611 253MWh.



Select the set of power units that comprises the larger annual generation

Of SET_{5-units} and SET_{≥20%}, the set of power units that comprises the larger annual electricity generation is SET_{5-units} with 118 981 845MWh.

Is there at least one power unit older than 10 years in the set?

Yes - since all the power units in SET_{5-units} are older than 10 years, the procedure is further carried out below.

Exclude power units older than 10 years and include power units registered in the CDM

No power units are registered under the CDM and the next step is carried out below.

Does the set comprise at least 20% of generation?

No – there are no power units registered with the CDM that can be included as per the step above.

Include power units older than 10 years until the set comprises 20% of generation

In a step-wise approach, power units older than ten years are added to the sample until the sample comprises 20% of generation. As such, the SET_{≥20%} including Majuba, Kendal and Matimba with 73 611 253MWh comprise the SET_{sample} and SET_{≥20%} are used to calculate the build margin below utilising equation “13” of the tool.

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

Where:

$EF_{\text{grid,BM},y}$	= 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)
$EF_{\text{EL},m,y}$	= 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

Therefore, according to the calculations carried out in Annex 3, the $EF_{\text{grid,BM},y} = 0.986\text{tCO}_2/\text{MWh}$.

Step 6: Calculate the combined margin emissions factor

The combined margin (CM) emissions factor ($EF_{\text{grid,CM},y}$) is calculated using the Weighted average CM method, Option A and equation “14” of the tool, as follows:

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

Where:

$EF_{\text{grid,CM},y}$	= Combined margin (CM) emissions factor in year y (tCO ₂ /MWh)
$EF_{\text{grid,BM},y}$	= Build margin CO ₂ emission factor in year y (tCO ₂ /MWh)
$EF_{\text{grid,OM},y}$	= 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 (%)

Since the project activity is not a wind and solar power generation project activity, the default values for according to the tool of $w_{OM} = 0.5$ and $w_{BM} = 0.5$ are utilised. Therefore according to the calculations carried out in Annex 3, the $EF_{grid,CM,y} = 0.976tCO_2/MWh$.

Project emissions calculation

Project emissions include emissions due to (1) combustion of auxiliary fuel to supplement waste gas/heat and (2) electricity emissions due to consumption of electricity for cleaning of gas before being used for generation of energy or other supplementary electricity consumption. Project emissions are calculated according to equation “41” of the methodology:

$$PE_y = PE_{AF,y} + PE_{EL,y}$$

Where:

PE_y = Project emissions due to the project activity (tCO₂)

$PE_{AF,y}$ = Project activity emissions from on-site consumption of fossil fuels by the unit process(es) and/or co-generation plant(s) if they are used as supplementary fuels due to non-availability of waste energy to the project activity or due to any other reason (tCO₂)

$PE_{EL,y}$ = Project activity emissions from on-site consumption of electricity for gas cleaning equipment or other supplementary electricity consumption (tCO₂) (as per Table 1: Summary of gases and sources included in the project boundary)

According to ACM0012: “*Note: If the electricity was consumed in gas cleaning equipment in the baseline as well, project emissions due to electricity consumption for gas cleaning can be ignored.*”

The above statement is taken to be the same for other supplementary electricity consumption. The project activity will supply electricity to the Grootegeeluk Coal Mine, the recipient facility which includes the proposed project facility and project activity, and supplementary electricity consumption is thus calculated as part of the baseline and is accordingly ignored here and $PE_{EL,y} = 0$.

Since the project activity does not consume fossil fuels in the unit process (the project facility), or due to non-availability of waste energy to the project activity or due to any other reason, $PE_{AF,y} = 0$. Moreover, the non-availability of waste energy for the project activity have been calculated as part of the baseline, where $EG_{i,j,y}$ (MWh) is calculated taking into account the planned / designed electrical output of the project activity taking into account planned and unplanned outages. Thus, $PE_y = 0$.

Leakage emissions calculation

No leakage is applicable under ACM0012.

Emission reductions calculation

Emission reductions due to the project activity during the year y are calculated according to equation “42” of ACM0012:

$$ER_y = BE_y - PE_y$$



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 , applicable to Scenario 2

As indicated above, $PE_y = 0$, thus equation “42” simplifies to $ER_y = BE_y$.

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

Data and parameters available at validation include:

Data / Parameter:	$EF_{elec.i,y}$
Data unit:	tCO ₂ /MWh
Description:	The CO ₂ emission factor for the electricity source i (gr for the grid, and is for an identified source), displaced due to the project activity, during the year y (tCO ₂ /MWh)
Source of data used:	Calculated utilising V2.2.1 of the “Tool to calculate the emission factor for an electricity system”.
Value applied:	0.976
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per applied tool, this value has been calculated <i>ex-ante</i> . The calculations for the tool will be made available during validation.
Any comment:	

Data / Parameter:	$EF_{grid,OMsimple,y}$
Data unit:	tCO ₂ /MWh
Description:	Simple operating margin CO ₂ emission factor in year y .
Source of data used:	Calculated utilising V2.2.1 of the “Tool to calculate the emission factor for an electricity system”.
Value applied:	0.966
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per applied tool, this value has been calculated <i>ex-ante</i> . The calculations for the tool will be made available during validation.
Any comment:	

Data / Parameter:	$EF_{EL,m,y}$
Data unit:	tCO ₂ /MWh
Description:	CO ₂ emission factor of power unit m in year y .
Source of data used:	Calculated utilising V2.2.1 of the “Tool to calculate the emission factor for an electricity system”.
Value applied:	0.973



Justification of the choice of data or description of measurement methods and procedures actually applied :	As per applied tool, this value has been calculated <i>ex-ante</i> . The calculations for the tool will be made available during validation.
Any comment:	

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

>>

Baseline emissions calculation

From section B.6.1 above, $BE_y = BE_{En,y}$ and $BE_{En,y} = BE_{Elec,y}$.

Also, $BE_{elec,y} = 1 * I * \sum_j \sum_i (EG_{i,j,y} * EF_{elec,i,j,y})$, where $EG_{i,j,y} = 462\ 000\ .00MWh$ (according to the PFS) and $EF_{elec,i,j,y} = 0.976tCO_2/MWh$. Thus:

$$BE_{elec,y} = 1 * I * \sum_j \sum_i (462\ 000\ .00MWh * 0.976tCO_2/MWh) = 450\ 912.00\ tCO_2$$

Project emissions calculation

From section B.6.1 above, $PE_{EL,y} = 0$ and $PE_{AF,y} = 0$, thus, $PE_y = 0 + 0 = 0\ tCO_2$.

Leakage emissions calculation

No leakage is applicable under ACM0012.

Emission reductions calculation

From section B.6.1 above, $ER_y = BE_y$. Thus, $ER_y = 450\ 912.00\ tCO_2$.

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

Year	Annual estimation of emission reductions in tonnes of CO ₂ e
2015 (01/08/2015 - 31/12/2015)	206 600
2016	450 912
2017	450 912
2018	450 912
2019	450 912
2020	450 912
2021	450 912
2022	450 912
2023	450 912
2024	450 912
2025 (01/01/2025 - 31/07/2025)	285 304
Total estimated reductions (tonnes of CO₂e)	4 919 040
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO₂e)	450 912

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

Data / Parameter:	$EG_{i,j,y}$
Data unit:	MWh
Description:	Quantity of electricity supplied to the recipient j by the generator, which in the absence of the project activity would have sourced from i^{th} source (i can be either grid or identified source) during the year y in MWh
Source of data:	Recipient facility(ies) and generation plant measurement records
Measurement procedures (if any):	The quantity of electricity supplied to the recipient will be measured continuously using electricity meters. The meter readings will be aggregated monthly for use in the monitoring report.
Monitoring frequency:	Monthly
QA/QC procedures:	The information will be saved onto Exxaro's Supervisory Control and Data Acquisition (SCADA) system. Meters will be calibrated and maintained according to the manufacturer's specifications.
Any comment:	

Data / Parameter:	Abnormal operation of the project facility including emergencies and shut down
Data 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:	Operation of project facility
Measurement procedures (if any):	
Monitoring frequency:	Daily, aggregated annually
QA/QC procedures:	
Any comment:	This parameter has to be monitored to demonstrate that no emission reduction is claimed for the hours during the abnormal operation of the part of project facility which have impact on waste energy generation and recovery. The abnormality can be in terms of violation of operational parameters, poor quality product, emergencies or shutdown

B.7.2. Description of the monitoring plan:

The monitoring plan will ensure that emission reductions are accurately monitored, recorded, and reported.

Overall project management

Exxaro has a clear and well defined management and organisational structure. This is illustrated in the operation organogram below:

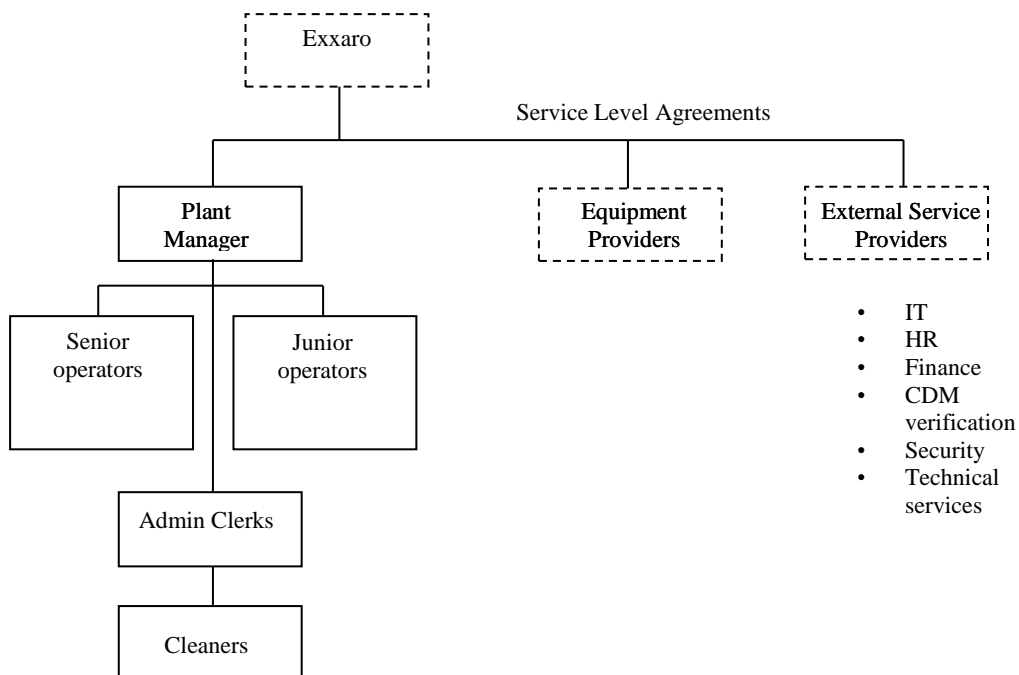


Figure 8: Operational organogram

Monitoring equipment

Electricity meters will measure the quantity of electricity supplied to the recipient facility. The meters are likely to be 4-quadrant billable class meters that are bi-directional – this means that they subtract any electricity used by the project activity during start up, or when the project activity is not producing electricity. Electricity meters will be installed on the feeds to the recipient facility. A metering diagram is provided below.

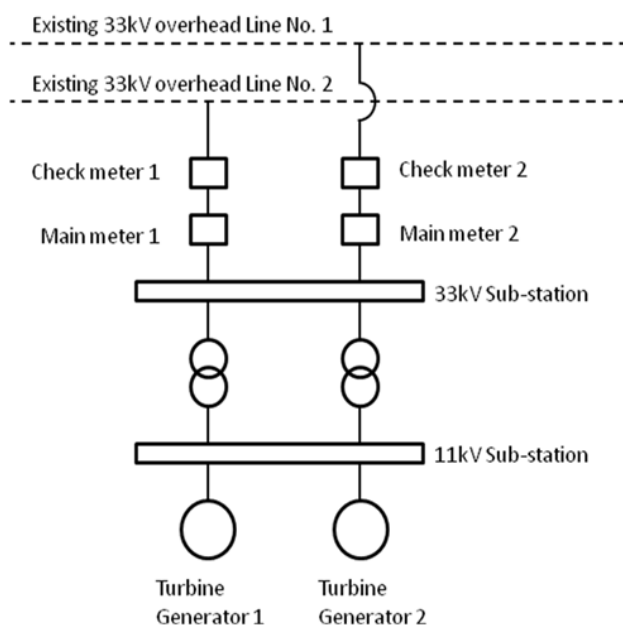


Figure 9: Metering diagram

Monitoring accuracy

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

Data collection and storage

On a monthly basis, the project activity plant manager (or other designated employee) and a representative from Grootegeluk Coal Mine will read electricity meters to determine the quantity of electricity produced by the project activity. The electricity readings will be logged electronically for the purposes of calculating emission reductions.

The information will be saved onto the Exxaro's SCADA system, as well as Exxaro's on-site financial systems. Backups will be kept both on- and off-site, and all of the data will be available for CDM verification. As per ACM0012, all data collected as part of the monitoring plan will be archived electronically, and will be kept for a minimum of two years at the end of the crediting period.

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

>>

Completion date:

18/05/2012

Contact information of responsible person(s)/entity(ies):*Person:*

Mr. Glen Louwrens

*Entity:*

Carbon Asset Management Company Pty Ltd (Camco)

*Postal address:*P.O Box 70,
Woodlands Office Park,
Woodmead 2080, South Africa*Physical address:*Building 18
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Woodmead Johannesburg
2080 South Africa*Tel:* +27 11 253 3400*Fax:* +27 11 804 1038*Email:* glen.louwrens@camcoglobal.com**SECTION C. Duration of the project activity / crediting period****C.1. Duration of the project activity:****C.1.1. Starting date of the project activity:**

>>

The starting date of the project activity is the expected construction contract signing date, which is quarter 2 (Q2) of 2013.

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

Twenty (20) years.

C.2. Choice of the crediting period and related information:**C.2.1. Renewable crediting period:****C.2.1.1. Starting date of the first crediting period:**

Not applicable (N/a).

C.2.1.2. Length of the first crediting period:



N/a.

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

A single ten (10) year crediting period has been chosen for the project activity. The starting date of the first crediting period is the start date of project commissioning, which is expected 2015/08/01.

C.2.2.2. Length:

10 years.

SECTION D. Environmental impacts

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

The project facility and the project activity make important and noteworthy contributions to the sustainable development of South Africa. The scoping phase of the environmental impact assessment (EIA) process has identified potential environmental impacts and has outlined the plan of study for the EIA. Synergistics Environmental Services (Pty) Ltd (Synergistics) has been appointed by Exxaro as the independent environmental consultant to undertake the Scoping EIA and EIA.

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

The impacts which may be significant for the project activity include: air quality, surface and ground water quality, social and economic impacts. As such, specialist input and studies will be conducted for the following environmental components:

- Air Quality Assessment.
- Traffic Impact Assessment.
- Surface Water Assessment.
- Groundwater Assessment.

The key legislation applicable to the proposed project activity includes:

- The National Environmental Management Act (No. 107 of 1998) (NEMA);
- The Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA);
- The National Water Act (No. 36 of 1998) (NWA); and
- The National Environmental Management: Air Quality Act (No. 39 of 2004) (NEMAQA).



The Scoping EIA and EIA will be conducted in line with the above mentioned legislation, additionally, the EIA process has been developed to ensure that it complies with GNR 543 Sections 26 to 33 and the associated guidelines as well as the requirements of the MPRDA. Synergistics, as the independent EIA consultant, has deemed that the environmental process followed to date meets the requirements of the legislation to ensure that the regulatory authorities receive sufficient information to enable them to make an informed decision to accept the scoping report and approve the plan of study for EIA.

SECTION E. Stakeholders' comments

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

Comments by local stakeholders were invited and compiled through a local stakeholders meeting which was held on Tuesday 13 December 2011. Invitation to the meeting was advertised in the local newspaper the Mogol Pos and was supplemented by posters which were on display in a number of locations around Lephale.

The purpose of the meeting was to introduce stakeholders and interested parties to the project activity and to provide a platform from which comments could be gathered. The agenda of the consultation meeting included an introduction and attendance register sign in, a presentation of the project, a questions and answers section, followed by a summary and next steps of the consultation to conclude.

E.2. Summary of the comments received:

A number of general and technical questions were raised throughout the stakeholder consultation. A sample of these questions is listed below:

Q: Would the project go ahead if the project is not registered as a CDM project?

A: The project would not go ahead since the revenue from the sale of CERs is a key determinant for the project to proceed.

Q: At what stage in the CDM registration cycle is the project at currently?

A: The project is currently entering the Validation stage.

Q: Does the project produce any by-products, such as tar or phenols?

A: The project does not produce any by-products such as tar or phenols since all of the volatiles are fully combusted in the flue ducts and tertiary combustion chamber.

Q: Will the project facility, the Coke Plant, be run 24hrs?

A: Yes. The project facility operates as a batch process where batteries of coke ovens will be operational over a 24hr period.

Q: Has the technology been utilised overseas?

A: The technology has to a large extent been utilised overseas, however it is considered to be the first application of this technology in South Africa.

Q: Will the electricity produced be utilised on site or exported to the grid?

A: The electricity produced will be utilised on site.



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

The stakeholder consultation was well attended by local representatives who showed a keen interest in the proposed project. A number of interesting questions were raised and answered. No objections to the project were made.

Due account of any comments received is included in the EIA process explained in sections D.1. and D.2. above.

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

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Represented by:	Project Manager
Title:	Project Manager
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Direct tel:	
Personal e-mail:	



Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Refer to Exxaro, 2012c.



Annex 3

BASELINE INFORMATION

Exxaro Market Coke Waste Heat Recovery Project - Grid Emissions Factor (GEF) Calculation

References:

- <http://www.eskom.co.za/c/article/236/cdm-calculations/>
- <http://www.eskom.co.za/content/calculationTable.htm>

The grid emissions factor (GEF) for the South African grid, is calculated utilising V2.2.0 of the "Tool to calculate the emission factor for an electricity system". The following six (6) steps of the baseline methodology procedure of the tool are utilised, namely:

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

Step 1: Identify the relevant electricity systems

The relevant electricity system is the South African National grid, which comprises the following plants and types:

Plant no.	Power Station / Plant name	Commissioning date	Installed capacity (MW)	Generation technology / type	Fuel type /energy source
1	Arnot	21/09/1971	1980	Coal Subcritical	Other Bituminous Coal
2	Duvha	18/01/1980	9450	Coal Subcritical	Other Bituminous Coal
3	Hendrina	12/05/1970	1895	Coal Subcritical	Other Bituminous Coal
4	Kendal	01/10/1988	3840	Coal Subcritical	Other Bituminous Coal
5	Kriel	06/05/1976	2850	Coal Subcritical	Other Bituminous Coal
6	Lethabo	22/12/1985	3558	Coal Subcritical	Other Bituminous Coal
7	Matimba	04/12/1987	3690	Coal Subcritical	Other Bituminous Coal
8	Majuba	01/04/1996	3843	Coal Subcritical	Other Bituminous Coal
9	Matla	29/09/1979	3450	Coal Subcritical	Other Bituminous Coal
10	Tutuka	01/06/1985	3510	Coal Subcritical	Other Bituminous Coal
11	Koeberg	21/07/1984	1800	Nuclear	Nuclear
12	Camden	21/12/1966	1600	Coal Subcritical	Other Bituminous Coal
13	Grootvlei	29/06/1969	1200	Coal Subcritical	Other Bituminous Coal
14	Komati	30/06/1969	1000	Coal Subcritical	Other Bituminous Coal
15	Imports	N/a	N/a	N/a	N/a

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

Although this step is optional, Option 1: Only grid power plants are included in the calculation, is selected here.

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

See PDD for detailed description of selection.

Plant no.	Power Station / Plant name	Generation technology	Low cost/must run (Yes / No)	Net electricity generation (EGm,y) (MWh)				
				2007	2008	2009	2010	2011
1	Arnot	Coal Subcritical	No	11,495,036	15,938,102	11,905,060	11,987,281	13,227,864
2	Duvha	Coal Subcritical	No	24,479,488	31,550,562	23,622,732	21,769,489	22,581,228
3	Hendrina	Coal Subcritical	No	12,410,151	16,083,288	13,756,351	12,296,687	12,143,292
4	Kendal	Coal Subcritical	No	26,461,793	34,164,855	26,517,420	23,841,401	23,307,031
5	Kriel	Coal Subcritical	No	20,510,202	22,468,695	17,762,398	18,156,686	15,906,816
6	Lethabo	Coal Subcritical	No	22,498,940	32,052,833	25,701,723	23,580,232	25,522,698
7	Matimba	Coal Subcritical	No	28,401,085	34,983,880	29,021,742	26,256,068	27,964,141
8	Majuba	Coal Subcritical	No	17,620,119	22,828,565	23,680,971	22,676,924	22,340,081
9	Matla	Coal Subcritical	No	23,782,480	30,864,194	24,549,833	21,863,400	21,954,536
10	Tutuka	Coal Subcritical	No	16,500,638	23,389,829	20,980,242	21,504,122	19,847,894
11	Koeberg	Nuclear	Yes	-	11,293,000	11,780,000	11,317,000	13,004,000
12	Camden	Coal Subcritical	No	756,540	2,815,982	5,171,057	6,509,079	7,472,070
13	Grootvlei	Coal Subcritical	No	-	-	237,138	1,249,556	2,656,230
14	Komati	Coal Subcritical	No	-	-	-	-	1,016,023
15	Imports	N/a	N/a	-	-	10,624,000	10,998,000	9,162,000
Total electricity generation				204,916,472	278,433,785	245,310,667	234,005,925	238,105,904
Average annual generation								240,154,551
Low cost/must run generation					11,293,000	11,780,000	11,317,000	13,004,000
Average low cost/must run generation								9,478,800
% of low cost/must run								3.95

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Option (a) Simple OM is appropriate for use.

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

Option A: Based on the net electricity generation and a CO2 emission factor of each power unit of the Simple OM method is utilised.

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

Where:

EF_{grid,OMsimple,y} = Simple operating margin CO2 emission factor in year y (tCO2/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} = CO2 emission factor of power unit m in year y (tCO2/MWh)

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

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



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Determination of EFEL,m,y

Since data on data on fuel consumption and electricity generation is available, Option A1 is utilised to determine the emission factor (EFEL,m,y), as follows:

EFEL,m,y = (sum of FC_i,m,y * NCV_i,y * EFCO2,i,y) / EGm,y

Where:

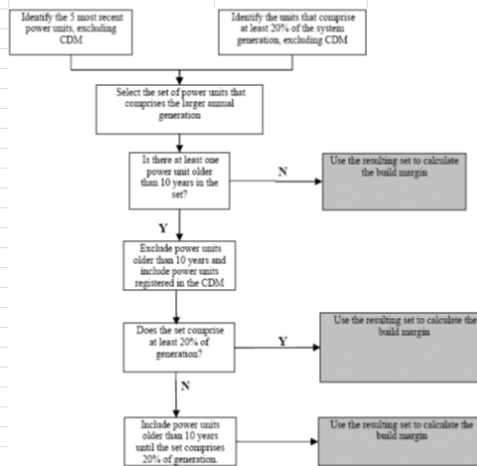
- EFEL,m,y = CO2 emission factor of power unit m in year y (tCO2/MWh)
FCi,m,y = Amount of fossil fuel type i consumed by power unit m in year y (Mass or volume unit)
NCVi,y = Net calorific value (energy content) of fossil fuel type i in year y (GJ/mass or volume unit)
EFCO2,i,y = CO2 emission factor of fossil fuel type i in year y (tCO2/GJ)
EGm,y = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
m = All power units serving the grid in year y except low-cost/must-run power units
i = All fossil fuel types combusted in power unit m in year y
y = The relevant year as per the data vintage chosen in Step 3

Table with columns: Plant no., Power Station / Plant name (m), Installed capacity (MW), Generation technology, Energy Source / Fuel Type (i), Net Calorific Value (NCVi,y) (GJ/t), Fuel CO2 Emission Factor (EFCO2,i,y) (tCO2/GJ), Efficiency, 2007/08 (Fuel Consumption, Electricity Generation, Emission Factor), 2008/09 (Fuel Consumption, Electricity Generation, Emission Factor), 2009/10 (Fuel Consumption, Electricity Generation, Emission Factor).

Therefore, Egrid,OMsimple,2009/10 = 0.966

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

In order to calculate the build margin (BM) of the grid, the tool provides the following procedure (see PDD for the procedure carried out step wise):





SET>20% including Majuba, Kendal and Matimba with 73,611,253MWh comprise the SET sample and SET>20% are used to calculate the build margin below utilising equation "13" of the tool.

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

Where:
 EF_{grid,BM,y} = Build margin CO2 emission factor in year y (tCO2/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} = CO2 emission factor of power unit m in year y (tCO2/MWh)
 m = power units included in the Build margin
 y = Most recent historical year for which power generation data is available

Plant no.	Power Station / Plant name (m)	Installed capacity (MW)	Generation technology	Energy Source / Fuel Type (i)	2009/10	Emission Factor of Power unit m (EF _{EL,m,y}) (tCO2/MWh)
					Electricity Generation (EG _{m,y}) (MWh)	
8	Majuba	3843	Coal Subcritical	Other Bituminous Coal	22,340,081	0.978
4	Kendal	3840	Coal Subcritical	Other Bituminous Coal	23,307,031	1.060
7	Matimba	3690	Coal Subcritical	Other Bituminous Coal	27,964,141	0.932
					EF_{grid,BM,y}	0.986

Therefore, EF_{grid,BM,y} = 0.986

Step 6: Calculate the combined margin emissions factor
 The combined margin (CM) emissions factor (EF_{grid,CM,y}) is calculated using the Weighted average CM method, Option A and equation "14" of the tool:

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

Where:
 EF_{grid,BM,y} = Build margin CO2 emission factor in year y (tCO2/MWh)
 EF_{grid,OM,y} = Operating margin CO2 emission factor in year y (tCO2/MWh)
 w_{OM} = Weighting of operating margin emissions factor (%)
 w_{BM} = Weighting of build margin emissions factor (%)

Therefore:

EF _{grid,OM,y}	w _{OM}	EF _{grid,BM,y}	w _{BM}	EF _{grid,CM,y}
0.966	0.5	0.986	0.5	0.976

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Annex 4

MONITORING INFORMATION
