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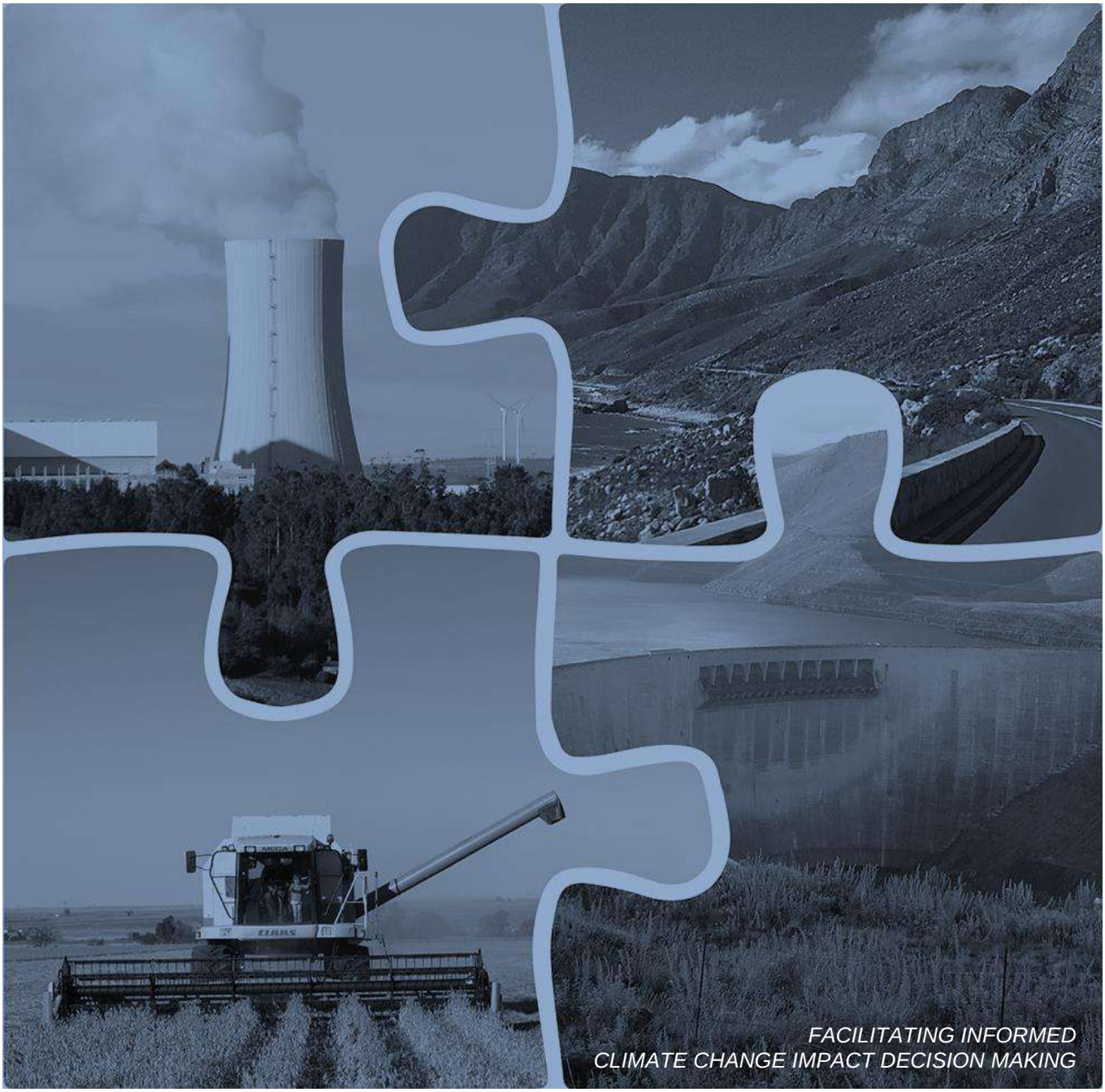
Greenhouse Gas Emissions Assessment for the proposed extensions to Exxaro Central Coal (Pty) Ltd.'s Dorstfontein East Coal Mine Near Kriel, Mpumalanga

Draft Report (Issue 2)

April 2021



Report Preparation and Document Management:

	Issue 1	Issue 2	Revision 1
Issue/Revision Name:	Greenhouse Gas Emissions Assessment for the proposed extensions to Exxaro Central Coal (Pty) Ltd.'s Dorstfontein East Coal Mine Near Kriel, Mpumalanga	Greenhouse Gas Emissions Assessment for the proposed extensions to Exxaro Central Coal (Pty) Ltd.'s Dorstfontein East Coal Mine Near Kriel, Mpumalanga *Updates to the report:* • *Updated list of infra-structure (Section 1.2); and* • *Inclusion of a Surface Infrastructure Layout Plan (Figure 2).* *The above updates did not result in a change to the report outcome, or a change to any other sections of this report.*	
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Date:	22 March 2021	8 April 2021	
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EXECUTIVE SUMMARY

Introduction and Project Summary

This Greenhouse Gas (GHG) Emissions Assessment provides the GHG Inventory (also called a "Carbon Footprint") for the proposed extension of the existing approved underground mining area and development of supporting infrastructure at the Dorstfontein East Coal Mine (DECM). It also determines the impact significance of the calculated emissions and provides recommendations to reduce the most significant GHG emissions associated with the project. This Report was prepared as part of the environmental regulatory process for the proposed extension, as is required in terms of the National Environmental Management Act (Act 107 of 1998), the Mineral and Petroleum Resources Development Act (Act 28 of 2002), *inter alia*, and other relevant legislation.

Exxaro Central Coal (Pty) Ltd (hereafter 'ECC') has appointed Digby Wells Environmental (hereafter 'Digby Wells') to undertake the environmental regulatory process for the proposed project. Cornerstone Environmental Consultants (Pty) Ltd. (hereafter 'Cornerstone') has been appointed by Digby Wells to prepare this GHG Emissions Assessment as part of the environmental regulatory process.

Dorstfontein East Coal Mine is located about 16 km east of the town of Kriel, in the Mpumalanga Province of South Africa. The mine is located in the Nkangala District Municipality and the Emalahleni Local Municipality.

What are Greenhouse Gasses (GHGs) and why is it important?

GHGs in the atmosphere - mainly carbon dioxide, nitrous oxide, methane and water vapour - trap heat from the sun, raising the temperature on earth. Without greenhouse gases, the Earth would be too cold to support most forms of life.

The amount of GHGs in the earth's atmosphere has increased sharply in the past century, largely as a result of the burning of fossil fuels such as oil, coal and gas. The temperature on the Earth's surface is increasing, and scientific evidence clearly shows the increase of GHGs are largely to blame.

(Burley & Haslam, 2008)

GHG Inventory

This GHG Inventory for the proposed DECM underground mining extension project has been prepared using the 'Technical Guidelines for Monitoring, Reporting and Verification of GHG Emissions by Industry', issued by the Department of Environmental Affairs (DEA) in April 2017. The GHG Inventory includes GHG emissions from all three phases of the proposed project, namely construction, operational, and the decommissioning and closure phases.

The total estimated Scope 1 and Scope 2 GHG emissions during the construction phase for the proposed project will be **5 892,76 tonnes Carbon Dioxide equivalent (tCO_2e)**.

The total annual Scope 1 and Scope 2 operational phase GHG emissions for Operational Phase Year-1 is **25 484,15 tCO_2e**.

The total estimated annual decommissioning and closure phase GHG emissions are estimated at about **5 892,76 tCO_2e**.

The majority of GHG emissions associated with proposed extensions to the DECM for the construction and decommissioning phases will be from purchased electricity (Scope 2 emissions). For the operational phase, the most significant emissions will be from fugitive emissions during coal mining, as well as from purchased electricity.

Impact Assessment

The following approaches were applied to determine the impact significance of operational phase GHG emissions (which accounts for the bulk of emissions associated with this operation) on global climate change:

- Benchmarking GHG emissions against pre-defined thresholds;
- Benchmarking GHG emissions against product unit emission intensity; and
- Considering the contribution of GHG emissions from the project to South Africa's National net GHG emissions, as well as National emissions from coal mining.

The analyses in the preceding sub-sections can be summarised into the following main findings:

- Based on pre-defined thresholds, which are in line with the IFC Performance Standards, the Equator Principles and the EBRD, the intensity (or magnitude) of the proposed extensions to the DECM operational phase emissions of 25 484,15 tCO_2e (Operational Phase Year-1) can be regarded as being **medium-low.**
- The emission intensity of coal mined will be **0,02 tCO_2e/t**. This translates to a **low** intensity (or magnitude) compared to the coal mining sector industry benchmark value of 0.108 tonne CO2e/t.
- The percentage contribution of the proposed project towards South Africa's annual GHG emissions will be between 0,004% and 0,008%, and the percentage contribution towards the annual GHG emissions from coal mining and handling in South Africa will be about 0.016%. The potential intensity (or magnitude) of this contribution is regarded as being **low**.

Based on the above, the **overall intensity (or magnitude)** of the GHG emissions from the proposed project on current and potential regional and cumulative global climate change is regarded as **low**. This intensity rating translates into a **low overall significance** rating.

GHG Emissions Management and Recommendations

It is recommended that the ECC should investigate the technical and financial feasibility of implementing emission-reduction initiatives associated with its Eskom purchased electricity consumption and mobile equipment. Recommendations include, amongst others, using solar and/or wind-powered electricity instead of Eskom purchased electricity and diesel-fuelled generators, and investigating on-site processes to identify potential areas for process optimisation, energy efficiency, and improved energy management, etc.

More than 60% of the projected GHG emissions associated with the operational phase of the proposed project will be fugitive emissions of methane (CH_4). Mitigation through technological innovation is of paramount importance for the underground coal mining sector. It is therefore recommended that ECC implement one, or a combination of technologies which would contribute towards reducing CH_4 emissions from the underground coal mining activities. The following technologies could be investigated, and the most feasible and cost-effective option(s) should be identified: CH_4 flaring, methane purification, power generation using methane, production of methanol and carbon black, thermal flow, catalytic flow, and catalytic monolith reactor technologies, mine methane utilization in gas turbines, and/or Carbon trading.

It is also recommended that a GHG Management Plan be prepared and implemented for ECC . The goal of the GHG Management Plan should be to achieve optimal economically sustainable energy and carbon savings. The GHG Management Plan should ideally include, *inter alia*, implementation of an energy and GHG emission management programme to assist with analysing and identifying opportunities at the operations to reduce energy consumption and GHG emissions, as well as measuring of GHG emissions on an annual basis.

Reasoned Specialist Opinion

The overall intensity (or magnitude) of the GHG emissions from the proposed project on current and potential regional and cumulative global climate change is regarded as being of a **low significance**. It should, however, be kept in mind that the burning of the coal for electricity production is taking place off site, by Eskom. This would be a significant GHG emission, but is a Scope 3 emission for ECC , and are therefore not reported on in this report. Therefore, even though the overall intensity of the GHG emissions associated with the proposed project is expected to be of low significance, the current off-site (Scope 3) impact from coal burning for electricity generation will be high. Eskom will however report on these emissions as Scope 1.

It is recommended that the proposed project should be approved, with the condition that feasible and cost-effective emission reduction alternatives should be investigated and implemented, as recommended above.

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List of Acronyms and Abbreviations

AFOLU	Agriculture, Forestry and Other Land Use
AR5	IPCC's First Assessment Report
CDM	clean development mechanism
CFRR	catalytic flow reversal reactors
CH_4	methane
CMR	Catalytic monolith reactor
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide equivalent
Cornerstone	Cornerstone Environmental Consultants (Pty) Ltd.
Cu	Copper
DEA	Department of Environmental Affairs
DECM	Dorstfontein East Coal Mine
DEROs	desired emission reduction outcomes
DMR	Department of Mineral Resources
DoE	Department of Energy
DREAD	Department of Rural, Environment and Agricultural Development
EAPASA	Environmental Assessment Practitioner's Association of South Africa
EBRD	European Bank of Reconstruction and Development
ECC	Exxaro Coal Central (Pty) Ltd.
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
FOLU	Forestry and Other Land Use
GDP	Gross Domestic Product
Gg	Gigagram
GHG	Greenhouse Gas
GWC	growth without constraints
GWP	Global Warming Potential
ha	hectare
HFCs	hydrofluorocarbons
IAIAsa	International Association for Impact Assessment, South Africa
IEA	International Energy Agency
IEP	Integrated Energy Plan 2016
IFC	International Finance Corporation
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
IWUL	Integrated Water Use License
kV	Kilovolt

LoM	Life-of-Mine
LTMS	Long Term Mitigation Scenario
LULUCF	land-use, land-use change and forestry
Mt	Million tonnes
Mtpa	Million tonnes per annum
MTSF	Medium-Term Strategic Framework
NA	Not applicable
NAR	nett as received
NCCRP	National Climate Change Response Policy
NDP	National Development Plan
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEMAQA	National Environmental Management: Air Quality Act, 2004 (Act No.39 of 2004)
NGERs	National Greenhouse Gas Emissions Reporting Regulations, 2017 (Notice 275 of 2017)
N_2O	nitrous oxide
NSSD	National Strategy for Sustainable Development
PAMs	Policies and Measures
PFCs	perfluorocarbons
PGE	platinum group element
PGMs	platinum group metals
PPD	peak, plateau and decline
RBS	required by science
RoM	Run-of-Mine
RSA	Republic of South Africa
SA	South Africa
SA-LEDS	South Africa's first Low Emission Development Strategy
SETs	Sectoral Emissions Targets
SF_6	sulphur hexafluoride
t	Tonne (1000 kg)
tCO_2e	Tonnes of Carbon Dioxide equivalent
Technical Guidelines	Technical Guidelines for Monitoring, Reporting and Verification of Greenhouse Gas Emissions by Industry, published by the DEA in April 2017
TFRR	thermal flow reversal reactors
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WBCSD	World Business Council for Sustainable Development
WEM	With existing measure
WRI	World Resources Institute

Glossary of Terms

Activity data	Data on the magnitude of human activity resulting in emissions or removals taking place during a given period of time (WRI & WBCSD, 2004).
Base year	A historic datum (a specific year or an average over multiple years) against which a company's emissions are tracked over time (WRI & WBCSD, 2004).
Control	The ability of a company to direct the policies of another operation. More specifically, it is defined as either operational control (the organisation or one of its subsidiaries has the full authority to introduce and implement its operating policies at the operation) or financial control (the organisation has the ability to direct the financial and operating policies of the operation with a view to gaining economic benefits from its activities) (WRI & WBCSD, 2004).
Emission factor	A factor allowing GHG emissions to be estimated from a unit of available activity data (e.g. tonnes of fuel consumed, tonnes of product produced) and absolute GHG emissions (WRI & WBCSD, 2004).
Equity share	The equity share reflects economic interest, which is the extent of rights a company has to the risks and rewards flowing from an operation. Typically, the share of economic risks and rewards in an operation is aligned with the company's percentage ownership of that operation, and equity share will normally be the same as the ownership percentage (WRI & WBCSD, 2004).
Greenhouse gas (GHG)	For the purposes of this GHG Emissions Assessment, GHGs are the six gases listed in the Kyoto Protocol: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulphur hexafluoride (SF_6) (WRI & WBCSD, 2004).
GHG Protocol Corporate Accounting and Reporting Standard methodology ("GHG Protocol")	Provides internationally recognised requirements and guidance for companies and other organisations preparing a corporate-level GHG emissions inventory.
Global warming potential (GWP)	A factor describing the radiative forcing impact (degree of harm to the atmosphere) of one unit of a given GHG relative to one unit of CO_2 (WRI & WBCSD, 2004).
Intended Nationally Declared Contribution (INDC)	A term used under the United Nations Framework Convention on Climate Change (UNFCCC) for reductions in greenhouse gas emissions that all countries that signed the UNFCCC were asked to publish in the lead up to the 2015 United Nations Climate Change Conference held in Paris, France in December 2015.
Operational boundaries	The boundaries that determine the direct and indirect emissions associated with operations owned or controlled by a company. This assessment allows a company to establish which operations and sources cause direct and indirect emissions, and to decide which indirect emissions to include that are a consequence of its operations (WRI & WBCSD, 2004).
Organisational boundaries	The boundaries that determine the operations owned or controlled by a company, depending on the consolidation approach taken (equity or control approach) (WRI & WBCSD, 2004).
tCO_2e	The universal unit of measurement to indicate the global warming potential (GWP) of each greenhouse gas, expressed in terms of the GWP of one unit of carbon dioxide. It is used to evaluate releasing (or avoiding releasing) different greenhouse gases against a common basis (WRI & WBCSD, 2004).

1 Introduction and Project Summary

This Greenhouse Gas (GHG) Emissions Assessment provides the GHG Inventory (also called a "Carbon Footprint") for the proposed extension of the existing approved underground mining area and development of supporting infrastructure at the Dorstfontein East Coal Mine (DECM). It also determines the impact significance of the calculated emissions and provides recommendations to reduce the most significant GHG emissions associated with the project. This Report was prepared as part of the environmental regulatory process for the proposed extension, as is required in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), *inter alia*, and other relevant legislation.

Exxaro Central Coal (Pty) Ltd holds an approved Mining Right with reference number MP 30/5/1/2/3/2/1(51)MR for opencast and underground mining at the DECM situated in the Mpumalanga Province, South Africa. In terms of the project description information received from Digby Wells, the current proposal aims to extend the existing approved underground mining area [approved under the ownership of Total Coal South Africa (Pty) Ltd.] and introduce supporting infrastructure to achieve this. Exxaro Central Coal aims to extend the underground mining area of the 2 Seam and 4 Seam associated with the Mining Right.

Exxaro Central Coal has appointed Digby Wells Environmental (hereafter 'Digby Wells') to undertake the environmental regulatory process for the proposed Project. Cornerstone Environmental Consultants (Pty) Ltd. (hereafter 'Cornerstone') has been appointed by Digby Wells to prepare this GHG Emissions Assessment as part of the environmental regulatory process.

1.1 Project Location

DECM is located about 16km east of the town of Kriel, in the Mpumalanga Province of South Africa. The mine is located in the Nkangala District Municipality and the eMalahleni Local Municipality. Refer to **Figure 1**.

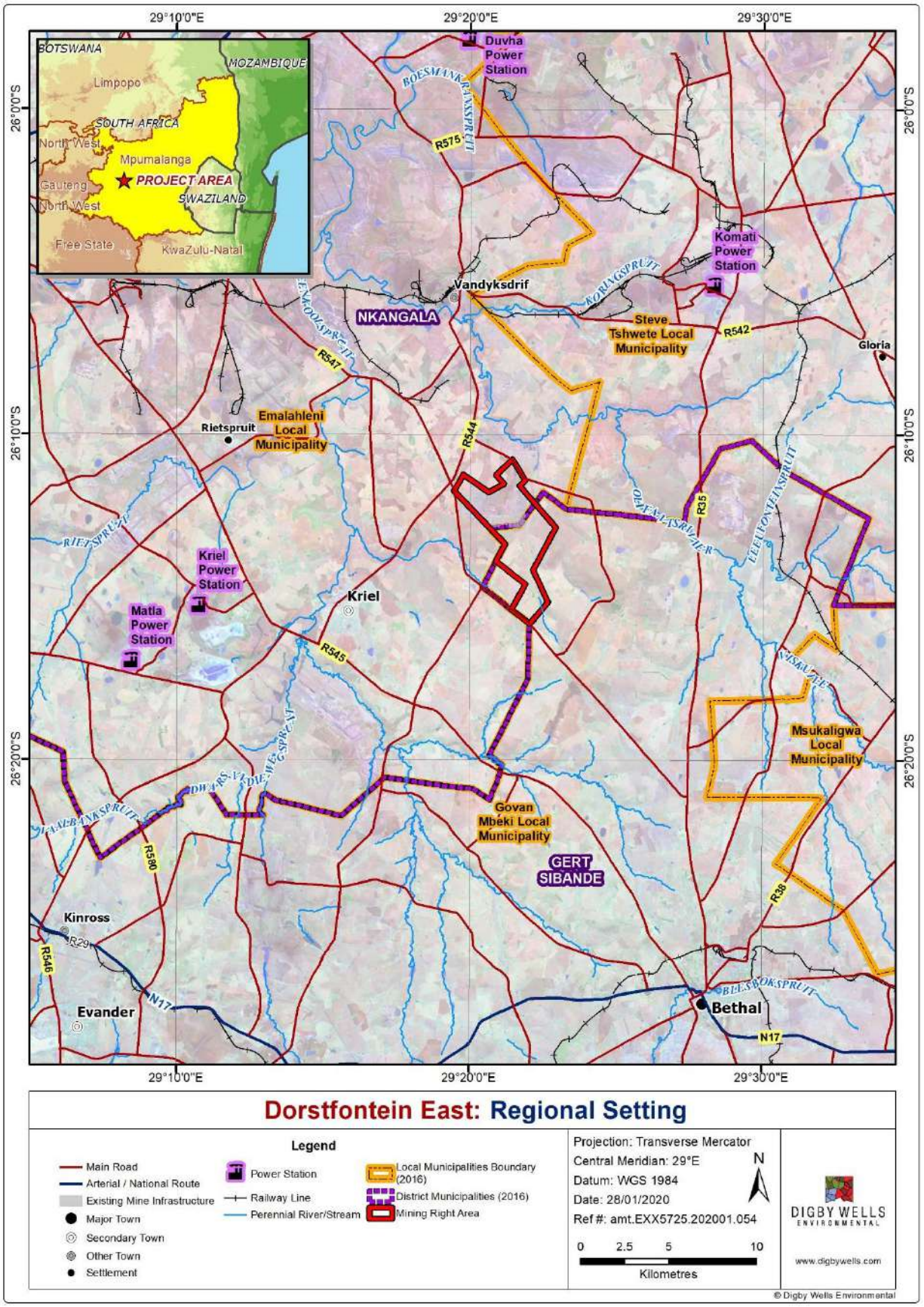

Figure 1: Location of the Dorstfontein East Coal Mine.

1.2 Project Description

The required infrastructure proposed for the extension includes (see **Figure 2** below):

- Portal ventilation fan;
- Sewage Treatment Plant;
- Water Treatment Plant;
- Potable Water storage tank;
- Erikson Pond;
- A new 22 kV overhead powerline from the existing substation to a new 22kV substation;
- Run of Mine (RoM) Stockpile conveyor at portal;
- Change house;
- Lamp room;
- Office;
- Clinic;
- Stores;
- Workshop area;
- Stone dust silo; and
- Coal discard processing plant.

An environmental regulatory process comprising of an amendment and consolidation of the Environmental Management Programme (EMPr) and Integrated Water Use License (IWUL) is required for the new proposals, and is being undertaken by Digby Wells.

Access shall be through an entrance portal through the existing Pit 2. Dorstfontein East Coal Mine is also approved to undertake underground mining of deeper coal reserves. The underground mining operations will be accessed from the existing Pit 2 open cast operations. The underground mining operation was approved as part of the existing EMPr report. Subsequently, additional coal reserves have been identified for mining which are not covered under the existing approval. Dorstfontein East Coal Mine therefore intends to further extend the Life-of-Mine (LoM) through the exploitation of these identified additional coal reserves.

The expanded underground mining activities will annually produce about 1 357 453 tonnes of 5300 nett as received (NAR) export and Eskom supplied coal (ECC, 2021).

Electricity will be supplied by Eskom from an existing 22kV substation.

1.2.1 Construction Phase

The infrastructure listed above will be established within an already disturbed area during the construction phase.

Construction phase timing: It is envisaged that construction will take approximately 12 months.

Transportation for the construction phase:

- About 45 15t trucks will be used to transport construction material during the construction phase.
- Construction material will mainly be transported from Kriel, eMalahleni (previously Witbank) and Johannesburg.

1.2.2 Operational Phase

The operational phase will entail undertaking of the proposed expanded underground mining activities and use of the associated infrastructure. The existing internal road network will be utilised where possible.

1.2.3 Decommissioning and Closure Phase

Decommissioned mine areas will be re-grassed and revegetated to as close to the pre-mining land use as possible.

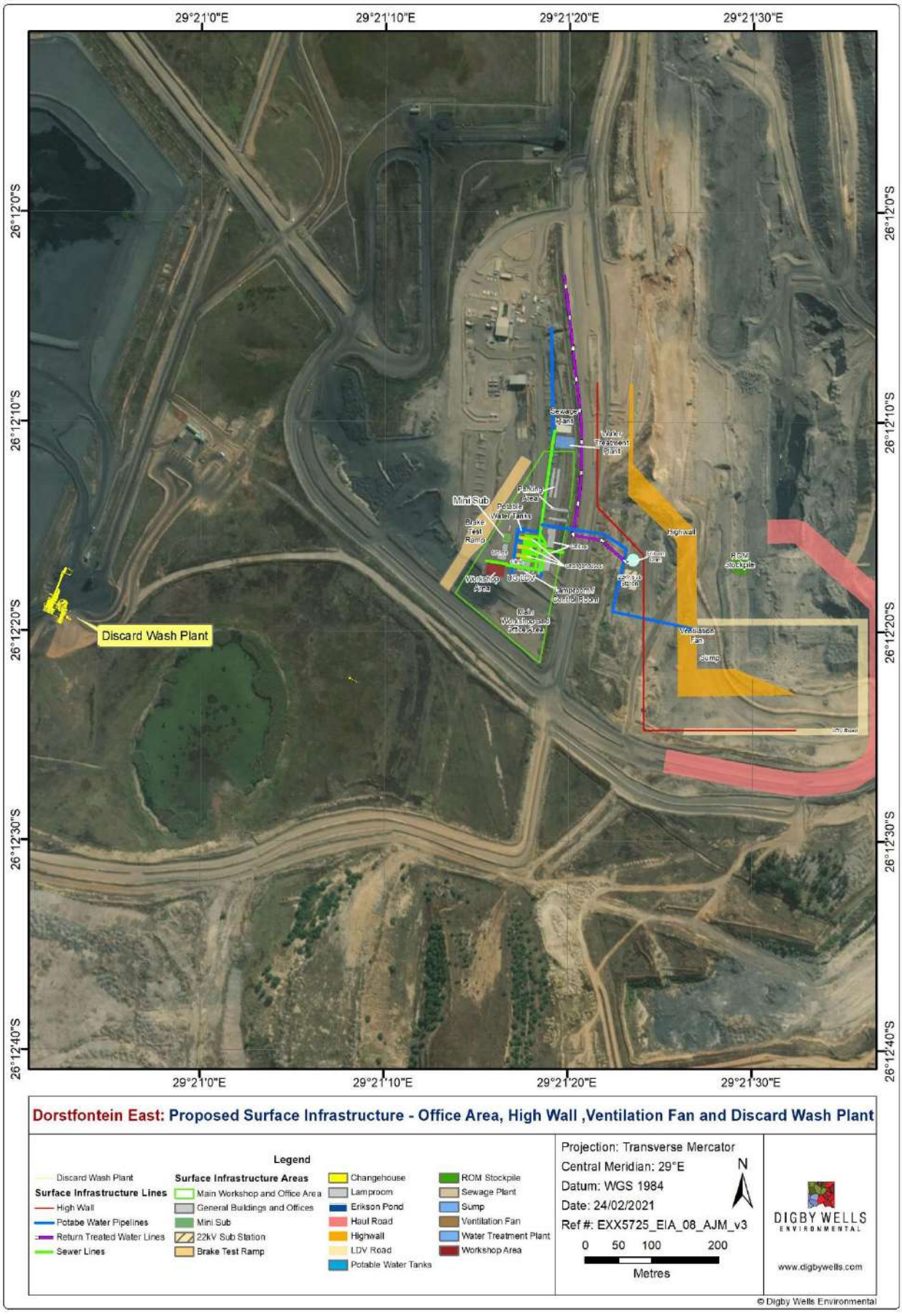

Figure 2: Surface Infrastructure Layout (Image source: Digby Wells, 2021).

1.3 Scope of Work

The scope of work for this report, based on which Cornerstone has been appointed, is as follows:

1. **Prepare a GHG Assessment and GHG Management Plan** as part of the environmental regulatory process for the proposed extension of the existing approved underground mining area and development of supporting infrastructure at the DECM.
2. Address the **potential impacts of the proposed project on climate change** (i.e. GHG emissions, thus climate change 'mitigation').
3. **GHG Assessment and Management Plan steps/scope:**
    - **Step 1: Preliminary Scoping**
        - Obtain and review all relevant data and information available (project description, etc.)
        - Identify and describe the likely GHG considerations relevant to the project that should be addressed in detail (e.g. identify processes that could generate GHG emissions, etc.).
        - Identify and summarise the relevant legislation as it relates to GHG emissions.
        - Identify and summarise relevant national, provincial, and regional inventories to which the project will contribute, if any.
        - Collect industry information and determine industry profile.
        - Collect project specific GHG emission information, as is referred to in more detail below.
    - **Step 2: Calculate Project GHG Emissions (GHG Inventory / Carbon Footprint Report)**
        - Revise the 2017 GHG estimations for the facility with the emissions associated with the expanded operations[1]: Quantify the project's projected direct and indirect GHG emissions, for the construction, operational and decommissioning phases of the proposed Options 1 and 2[2], and convert to carbon dioxide equivalents (CO_2e), in line with the relevant quantification methodology.
    - **Step 3: Assess GHG Considerations and Determine Impact Significance**
        - Compare operational phase project GHG emissions with the 2017 GHG emissions for the operations (existing information), industry profile, and with national, provincial, and regional inventories, action plans or best practices for the sector/class of projects, as available. See Footnote 1 below.
        - Discuss whether the project would enhance or impede the attainment of applicable national/provincial GHG reduction, as relevant.
        - Determine impact significance: Describe the regional and cumulative global climate change impacts to which the proposed project would contribute (i.e. the impact of the proposed project on climate change).
    - **Step 4: GHG Management and Mitigation Plan.**
        - If the project is likely to result in medium or high emissions, or depart from industry or jurisdictional profiles:
            - It will be clarified how project design takes, and could take, GHG reduction and minimisation considerations into account. This would include aspects such as optimal materials resourcing, process optimisation, energy management and energy efficiency.

[1] Note 1: No 2017 GHG data has been made available by the client by the time of preparing this report. This GHG Report therefore does not include a 2017 comparison.
[2] Note 2: Only one project option was provided by Digby Wells in the Project Description.

- Alternative energy supply opportunities will be considered, including renewable sources, if relevant, whilst remaining mindful of any technical and financial constraints which are deemed pertinent.
- Further alternatives that could provide technically and financially feasible and cost-effective options to reduce project-related GHG emissions during the design and operation of the project will be considered.

▪ The above information will be delivered in the format of a GHG Emissions Assessment Report.

1.3.1 Specialist Report Content Requirements

In terms of Regulation 23(5) of the NEMA Environmental Impact Assessment (EIA) Regulations, 2014 (as amended), a specialist report must contain all information set out in Appendix 6 to the EIA Regulations of 2014, as amended. The table below lists the relevant requirements, indicates whether the relevant information is included in this report or not, and provides cross-references as to where the relevant information can be found in this report.

Table 1: Specialist Report requirements in terms of Appendix 6 of the EIA Regulations of 2014, as amended.

Appendix 6 of the EIA Regulations of 2014, as amended		Included (Yes, No or NA)	Section of this report
1.(1) A specialist report prepared in terms of the EIA Regulation of 2014, as amended, must contain -			
(a)	details of - (i) the specialist who prepared the report; and	**Yes**	**Section 1.4 and Annexure A**
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	**Yes**	**Annexure A**
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	**Yes**	**Annexure B**
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	**Yes**	**Section 1.3**
(cA)	an indication of the quality and age of base data used for the specialist report;	**Yes**	**Chapters 3 and 4**
(cB)	a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	**Yes, as far as possible**	**Chapter 5**
(d)	the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	**NA**	**NA**
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	**Yes**	**Chapter 3**
(f)	details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	**NA**	**NA**
(g)	an identification of any areas to be avoided, including buffers;	**NA**	**NA**
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	**NA**	**NA**
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	**Yes**	**Section 3.3**
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	**Yes**	**Chapter 5**
(k)	any mitigation measures for inclusion in the EMPr;	**Yes**	**Chapter 6 and 7**
(l)	any conditions for inclusion in the environmental authorisation;	**NA**	**NA**

Appendix 6 of the EIA Regulations of 2014, as amended		Included (Yes, No or NA)	Section of this report
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	**Yes**	**Chapter 7**
(n)	a reasoned opinion - (i) whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	**Yes**	**Chapter 7**
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	**NA – public participation as part of EIA process**	**NA**
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	**NA**	**NA**
(q)	any other information requested by the competent authority.	**NA**	**NA**
2.	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	**NA**	**NA**

1.4 About Cornerstone Environmental Consultants (Pty) Ltd.

Cornerstone is a dynamic environmental consulting company that provides high-quality environmental management, GHG and climate change consulting services. We offer trusted advice and support informed climate change impact decision making based on a unique combination of experience, qualifications and research in the GHG, climate change, impact assessment and project management fields.

We are passionate about climate change and environmental management, especially about integrating climate change mitigation and adaptation considerations into environmental assessments and planning processes. Cornerstone strives to be involved in projects where we can add value and make a positive difference. The Cornerstone team believes in attention to detail, but also in understanding the "bigger picture". The methodology applied by Cornerstone is based on national and international best practice, international guidelines and standards.

This report was prepared by Mari de Villiers of Cornerstone. Mari holds a Masters' Degree in Environmental Management and has more than 16 years' experience as an environmental and GHG assessment consultant. She has undertaken several courses to further her career, the most notable being the Management Development Programme at the University of Stellenbosch Business School, an Institute of Environmental Management and Assessment (IEMA) Approved Carbon Footprint Management Course, and several courses presented by Carbon Action in Greenhouse Gas Inventories, Verification and Validation, amongst others. She is a member of the GHG Management Institute, a registered Environmental Assessment Practitioner with the Environmental Assessment Practitioner's Association of South Africa (EAPASA Registration Number: 2019/1160); and a member of the International Association for Impact Assessors, South Africa (IAIAsa).

2 Legislative Context and Baseline Description

The subsections below provide a baseline description of the South African climate change landscape, a broad overview on the country's climate change policy regime, summarises the International Finance Corporation (IFC) Performance Standards and Equator Principle thresholds, and provides industry information as are applicable to this GHG Emissions Assessment.

2.1 Baseline Description of the South African Climate Change Landscape

The role of the United Nations' (UN) Intergovernmental Panel on Climate Change (IPCC) is to assess - on a comprehensive, objective, open and transparent basis - the latest scientific, technical and socio-economic literature produced in the world (Gilder & Swanepoel, 2018). The IPCC's Fifth Assessment Report (AR5) was released in four parts between 2013 and 2014 and provides information on the current state of knowledge relevant to climate change (Davis *et al*, 2018). The Sixth Assessment Report was still underway at the time of preparing this report, and will be available during 2021 (IPCC, 2021).

The AR5 offers the following messages for Africa (Gilder & Swanepoel, 2018):

- Africa's climate is already changing, and the impacts are already being felt;
- Further climate change is inevitable in the coming decades;
- African governments can help to promote ambitious global action on climate change mitigation;
- Some low-carbon development options may be less costly in the long run and could offer new economic opportunities for Africa; and
- Africa stands to benefit from integrated climate change adaptation, mitigation and development approaches.

The key regional climate change projections for Southern Africa are as follows (Davis *et al*, 2018):

- Temperature
  - Temperatures over southern African are expected to increase most notably over the central interior of the region, with smaller increases over coastal areas. Temperature increases of 1 to 2 °C are projected for the near future.
  - For the far future, increases of more than 4 °C is plausible for the over central interior of southern Africa. In general, winter and summer show the greatest increase in temperature.
- Rainfall:
  - A drying trend is observed over Namibia and Angola extending south-eastwards to Zambia, Zimbabwe, Botswana, the southern region of Mozambique and the Limpopo province of South Africa. Decreases in rainfall are projected to occur most strongly in summer, which is the main rainfall season in these regions. This drying trend is expected to increase over time.
  - Significantly drier winters are projected for the southwestern Cape of South Africa.
  - Despite predictions of general drying over most of southern Africa, slight to moderate rainfall increases are projected over the central interior and south-eastern parts of South Africa, west coast of Madagascar, Tanzania, eastern Democratic Republic of the Congo and the northern region of Mozambique for the near and mid-future time period. These increases in rainfall are projected to occur in spring and summer.
  - There is also a tendency towards an increase in intensity of rainfall (extreme events), which is also linked to the strong heating of the earth's surface.
- Extreme weather events
  - A general increase in the frequency of extreme rainfall events (20 mm of rain falling within 24 hours) is likely over the eastern parts of the continent and the western parts of Madagascar. The increasing trend amplifies towards the end of the century (2080-2100).
  - Over the rest of the region the future trend in extreme rainfall is inconsistent with reductions expected over the interior of the continent and most notably over the eastern half of South Africa.

- Coastal storm surges are expected to increase due to sea level rise and an increase in the frequency and intensity of sea storms, accompanied by increases in wave heights. Even if the intensity of sea storms remains unchanged, higher sea levels will mean that smaller storms are likely to have an increased impact on the coastline.
- South Africa is projected to become warmer and the increase in average temperature is projected to occur in association with an increase in very hot days (number of days when the maximum temperature exceeds 35 °C) and heatwave events.
- The occurrence of fires is closely linked with climate and increases in temperature combined with an increase in dry spells in some areas may result in wildfires affecting larger areas and fires of increased intensity and severity.
- Low temperatures, including the number of frost days, have decreased in frequency and are expected to become less frequent in the future.

2.2 South African Energy Planning and Policy Regime

The Integrated Resource Plan (IRP) 2010-2030 and the Integrated Energy Plan 2016 are the main contributors to the current energy regime in South Africa. The sections below provide more information on these documents, and its relevance to the proposed coal mine extension project.

2.2.1 Integrated Resource Plan for Electricity 2019

The IRP 2010-2030 is an electricity infrastructure development plan based on least-cost electricity supply and demand balance, considering security of supply and the environment (minimize negative emissions and water usage) (RSA, 2019a). At the time of promulgation, it was envisaged that the IRP would be a "living plan" to be revised regularly.

The promulgated IRP 2010-2030 identified the preferred generation technology required to meet expected demand growth up to 2030 (RSA, 2019a). It incorporated government objectives such as affordable electricity, reduced GHG emissions, reduced water consumption, diversified electricity generation sources, localisation and regional development (RSA, 2019a).

Since the promulgated IRP 2010-2030, the following capacity developments have taken place (RSA, 2019a):

- A total 6 422 MW under the Renewable Energy Independent Power Producers Programme has been procured, with 3 876 MW operational and made available to the grid.
- In addition Independent Power Producers have commissioned 1 005 MW from two Open Cycle Gas Turbine peaking plants.
- Under the Eskom build programme, the following capacity has been commissioned: 1 332 MW of Ingula pumped storage, 1 588 MW of Medupi, 800 MW of Kusile and 100 MW of Sere Wind Farm.
- In total, 18 000MW of new generation capacity has been committed to.

Besides capacity additions, a number of assumptions have changed since the promulgation of IRP 2010-2030. Key assumptions that changed include the electricity demand projection, Eskom's existing plant performance, as well as new technology costs (RSA, 2019a). These changes necessitated the review and update of the IRP which resulted in the IRP 2019, which was gazetted on 18 October 2019.

According to the IRP 2019, approximately 24 100 MW of coal power plants are planned to be decommissioned in the period beyond 2030 to 2050 (RSA, 2019a).

One of the decisions which also emerged from the IRP 2019 is that South Africa should not sterilise the development of its coal resources for purposes of power generation, instead all new coal power projects must be based on high efficiency, low emission technologies and other cleaner coal technologies.

2.2.2 Integrated Energy Plan 2016

The development of a National Integrated Energy Plan 2016 (IEP) was envisaged in the White Paper on the Energy Policy published in 1998 and, in terms of the National Energy Act, 2008 (Act No. 34 of 2008), the Minister of Energy is mandated to develop and, on an annual basis, review and publish the IEP in the Government Gazette (DoE, 2016).

The purpose of the IEP is to provide a roadmap of the future energy landscape for South Africa which guides future energy infrastructure investments and policy development (DoE, 2016). The development of the IEP is a continuous process as it needs to be reviewed periodically to consider changes in the macroeconomic environment, developments in new technologies and changes in national priorities and imperatives, amongst other factors (DoE, 2016). Since change is on-going, the plan must remain relevant.

South Africa is a fast-emerging economy which needs to balance the competing need for continued economic growth with its social needs and the protection of the natural environment (DoE, 2016).

The IEP analyses current energy consumption trends within different sectors of the economy (i.e. agriculture, commerce, industry, residential and transport) and uses this to project future energy requirements, based on different scenarios (DoE, 2016). Different assumptions are made on economic development and the structure of the economy and consider the impact of key policies such as environmental policies, energy efficiency policies, transport policies and industrial policies, amongst others; these assumptions are then used to inform the scenarios (DoE, 2016). The IEP then determines the optimal mix of energy sources and technologies to meet those energy needs in the most cost-effective manner for each of the scenarios (DoE, 2016). The associated environmental impacts, socio-economic benefits and macroeconomic impacts are also analysed (DoE, 2016). The IEP therefore focuses on determining the long-term energy pathway for South Africa, taking into account a multitude of factors which are embedded in the eight objectives (DoE, 2016).

Four key scenarios were developed, namely the Base Case, Environmental Awareness, Resource Constrained and Green Shoots scenarios (DoE, 2016).

The IEP recommends, *inter alia*, a diversified energy mix which reduces reliance on a single or a few primary sources. It states that coal should continue to play a role in electricity generation; however, investments need to be made in new and more efficient technologies, such as new supercritical pulverised fuel power plants with flue-gas desulphurisation (DoE, 2016).

In terms of environmental considerations, the IEP states that energy policies should support the pursuit of low emission limit targets, and ongoing work by the Department of Environmental Affairs to determine Desired Emissions Reduction Outcomes (DEROs) should proceed (DoE, 2016). New technologies should also be implemented for all coal-fired power plants to ensure that environmental legislation is met (DoE, 2016).

2.3 South Africa's Climate Change Policy Regime

South Africa is one of the highest emitters of GHGs per capita per Gross Domestic Product (GDP) in the world; even though the country is a contributor to the problem, it is also vulnerable to the impacts of climate change (Winkler, 2014).

The South African Government recognises climate change as "*one of the greatest threats to sustainable development*" and believes that "*climate change, if unmitigated, has the potential to undo or undermine many of the positive advances made in meeting South Africa's own development goals and the Millennium Development Goals*" (RSA, 2011:9). To illustrate its intent to fulfil its obligations towards both current and future generations, South Africa ratified the United Nations Framework Convention on Climate Change (UNFCCC) in August 1997 and acceded to the Kyoto Protocol in March 2002 (RSA, 2009). Further, South Africa committed to a 42% reduction in GHG emissions by 2030 under the Copenhagen Accord in 2009.

The development of effective responses to climate change mitigation (i.e. reducing GHG emissions) and adaptation (i.e. lowering the risks posed by the consequences of climatic changes) and a shift to a low-carbon economy, have also been identified in the National Development Plan (NDP) as two of the sub-outcomes and actions for the country's Medium-Term Strategic Framework (MTSF) (DEA, 2014a). Reduced GHG emissions, climate change impacts and improved air quality is furthermore also set as Output 2 in the Presidential Outcome 10. An effective response to climate change is also identified as Priority 5 in the National Strategy for Sustainable Development (NSSD) (DEA, 2011). Climate change mitigation and adaptation is therefore a strategic topic of high priority in South Africa's development planning.

The government's vision for an effective response to climate change is contained in the National Climate Change Response Policy (NCCRP) dated October 2011. The Response is guided by principles set out in the Constitution, the Bill of Rights, the NEMA, as amended, the Millennium Declaration, the UNFCCC and the Kyoto Protocol (RSA, 2011:5, 9). The NCCRP supplies South Africa with a clear roadmap on how the impacts of climate change should be managed through interventions in social, economic and environmental sectors.

This GHG Assessment Report, and therefore also the following sections, focusses on climate change 'mitigation' and not climate change 'adaptation'.

2.3.1 South Africa Low-emissions Development Strategy 2050

Through the Paris Agreement, Parties to the UNFCCC have agreed to limit the increase in the global average temperature to well below 2°C above preindustrial levels, and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels (RSA, 2020). Article 4 of the Agreement sets out Nationally Determined Contributions (NDCs) as the instrument countries must develop to present their part of the global effort to "reach global peaking of greenhouse gas emissions as soon as possible… on the basis of equity and in the context of sustainable development and efforts to eradicate poverty". The South Africa Low-emissions Development Strategy 2050 has been prepared in response to Article 4 of the Paris Agreement, and presents South Africa's first Low Emission Development Strategy (SA-LEDS). Through submitting this document to the UNFCCC South Africa reiterates its commitment to achieving the Paris goals.

The following three key climate policy documents provide the foundation on which the SA-LEDS has been developed:

- The National Development Plan (NDP);
- The National Climate Change Response Policy; and
- The Climate Change Bill.

More information on the last two policy documents is provided in the sections following this section.

The stated vision for SA-LEDS is as follows (RSA, 2020):

> *"South Africa follows a low-carbon growth trajectory while making a fair contribution to the global effort to limit the average temperature increase, while ensuring a just transition and building of the country's resilience to climate change."*

In the absence of an agreed quantitative articulation of the vision, the Peak, Plateau, Decline Emissions Trajectory Range, as reflected in the NCCRP and NDP, is used as the benchmark against which the performance of SA-LEDS will be measured (RSA, 2020). The Climate Change Bill, described later, makes provision for regular updates of this trajectory, through which it can be better placed within the context of the Paris Agreement (RSA, 2020).

2.3.1.1 SA-LEDS GHG Emissions Mitigation Measures

The strategy centres on measures currently being implemented by government to address mitigation across the four key sectors of the economy, namely **energy**, **industry**, **AFOLU** and **waste** (RSA, 2020). It also presents planned cross-sectoral measures that will contribute to driving mitigation action.

The proposed underground coal mining extensions to the DECM relate to the first sector, namely energy.

Decarbonisation of energy supply will largely be driven through the Integrated Energy Plan, the Integrated Resource Plan and the Industrial Biofuels Strategy (RSA, 2020).

The SA-LEDS also supports the implementation of a selection of measures to reduce energy demand, or limit growth in energy demand, as the economy and population grows (RSA, 2020):

- The National Energy Efficiency Strategy;
- Support for increased uptake of solar water heaters;
- The National Building Regulations and Buildings Standards Act; and
- Promotion of cleaner mobility.

These measures not only contribute to reductions in emissions associated with fossil fuels, but also to energy security and energy access.

Cross-Cutting Measures

In addition to the measures specific to individual sectors described, four cross-cutting measures that will support low carbon development are in various stages of being implemented (RSA, 2020):

- **Carbon Tax**: The Carbon Tax Act was brought into effect from 1 June 2019, which gives effect to the polluter pays principle and aims to price carbon by internalising the negative costs of emitting GHGs. The tax rate is set at R120 per tonne of CO_2e. To allow businesses time for transition, a basic tax-free allowance of 60% will initially apply to all emissions, with further allowances depending on the activities. The tax structure will be revised post-2021 to align with the proposed mandatory carbon budgets.
- **Sectoral Emissions Targets (SETs)**: The national emissions trajectory will be translated into Sectoral Emission Targets or SETs, which are quantitative GHG emission targets allocated to an emitting sector or sub-sector, over a defined time period. Individual national government departments will be tasked with developing and implementing Policies and Measures (PAMs) to ensure emissions from within a sector or sub-sector remain within SET limits.
- **Carbon Budgets**: Carbon Budgets set a maximum volume of emissions from certain activities that individual entities are allowed to emit over three rolling five-year periods. By assigning a Carbon Budget to an entity, a signal is provided as to the degree of GHG mitigation that is required within a specific time period, with a penalty being imposed if the budget allocation is exceeded. Furthermore, by providing entities with an understanding of how budgets are likely to be assigned in future phases to keep overall national emissions within the bounds of the national emissions trajectory, which will continue to be revised downward in keeping with the Paris Agreement, they are sensitised to how mitigation requirements may change in the future. The system thereby provides an opportunity for entities to plan ahead.
- **Phasing out of inefficient fossil fuel subsidies/incentives**: As a member of the G20, where countries have committed to phasing out inefficient fossil fuel subsidies, South Africa has indicated willingness to identify and minimise their harmful impacts, taking cognisance of its developmental state. South Africa should consider participating in a fossil fuel subsidy peer review within the G20 framework to facilitate the sharing of experience and mutual learning among G20 members as the next step in identifying inefficient fossil subsidies within the economy.

2.3.2 National Climate Change Response Policy

In terms of the NCCRP, emissions should peak in the period from 2020 to 2025, remain stable for around a decade, and decline thereafter in absolute terms (RSA, 2011). This is also referred to as the “peak, plateau and decline (PPD) trajectory”, used as the initial benchmark against which the efficacy of mitigation actions will, in terms of the NCCRP, be measured.

The "PPD trajectory" is summarised as follows (RSA, 2011):

- South Africa's GHG emissions peak in the period 2020 to 2025 in a range with a lower limit of 398 000 000 tCO_2e, and upper limits of 583 000 000 tCO_2e and 614 000 000 tCO_2e for 2020 and 2025 respectively.
- South Africa's GHG emissions will plateau for up to ten years after the peak within the range with a lower limit of 398 000 000 tCO_2e and upper limit of 614 000 000 tCO_2e.
- From 2036 onwards, emissions will decline in absolute terms to a range with lower limit of 212 000 000 tCO_2e and upper limit of 428 000 000 tCO_2e by 2050.

Amidst various challenges in this regard, recent developments in the legislative regime points to a clear progress to meeting the commitments contained in the NCCRP. These measures include emissions caps and carbon budgets, carbon pricing in the form of cap and trade schemes and carbon taxes, carbon capture and storage, and the use of alternative energy (Lehmann, 2016).

2.3.3 National Climate Change Bill, 2018

The National Climate Change Bill, 2018 (Government Gazette 41689, Notice No. 636) was published for public comment on 8 June 2018. It will form the legislative foundation for the climate change adaptation and mitigation response in South Africa (RSA, 2020). The purpose of the Bill is to build the Republic's effective climate change response and the long term, just transition to a climate resilient and lower carbon economy and society in the context of an environmentally sustainable development framework; and to provide for matters connected therewith (RSA, 2018).

The National Climate Change Bill addresses issues related to institutional and coordination arrangement across the three spheres of government namely national, provincial and local (RSA, 2018). It further highlights the need for the spheres of government and entities, sectors as well as business to respond to challenges of climate change (RSA, 2018). The bill further addresses matters relating to the national adaptation to impacts of climate change, GHG emissions and removals, and policy alignment and institutional arrangements (RSA, 2018).

With respect to mitigation, the Bill provides for future review and determination of the national greenhouse gas emissions trajectory; determination of sectoral emissions targets for emitting sectors and subsectors; and allocation of carbon budgets (RSA, 2020).

2.3.4 Carbon Tax Act, 2019 – applicability to underground coal mining

Underground coal mining (IPCC Code 1B1ai) is listed in Schedule 2 of the Carbon Tax Act, 2019, as an activity which is liable for carbon tax. Schedule 2 does not provide a threshold, implying that all underground coal mining operations are liable for carbon tax, irrespective of the size of the operation (RSA, 2019b).

In terms of Schedule 2, the basic tax-free allowance of 60% apply to underground mining operations, with a further 10% fugitive emissions allowance, a 10% trade exposure allowance, as well as a 5% performance allowance, carbon budget allowance and offset allowance (RSA, 2019b). The maximum total allowances for this sector are therefore 95% (RSA, 2019b).

2.3.5 Intended Nationally Determined Contribution Report

South Africa submitted its first Intended Nationally Determined Contribution (INDC) Report to the UNFCCC in 2015, in accordance with decision 1/CP.19 and 1/CP.20 of the Conference of the Parties to the UNFCCC. South Africa is required to submit INDC reports every 5 years.

South Africa's mitigation component of its INDC moves from a "deviation from business-as-usual" form of commitment and takes the form of a "PPD trajectory" (RSA, 2015). The emissions trajectory range which has been committed to, is in line with the NCCRP, as is described above. This will be the benchmark against which the efficacy of mitigation actions will be measured (RSA, 2015).

The policy instruments under development, in terms of the INDC, include a carbon tax, desired emission reduction outcomes (DEROs) for sectors, company-level carbon budgets, as well as regulatory standards and controls for specifically identified GHG pollutants and emitters (RSA, 2015).

2.3.6 South Africa's National GHG Inventory

The Draft 7th National GHG Inventory Report for South Africa was published for public comment by the Department of Environmental Affairs (DEA) during September 2020. The report documents South Africa's national GHG inventory for the year 2017, and on the GHG trends for the period 2000 to 2017 (DEA, 2020). It was prepared in accordance with the guidelines provided by the UNFCCC and follows the 2006 IPCC Guidelines and IPCC Good Practice Guidance (DEA, 2020).

According to Draft 7th National GHG Inventory Report, South Africa's GHG emissions [excl. Forestry and Other Land Use (FOLU)] were 452 347 Gg CO_2e in 2000 and increased by 103 316 Gg CO_2e (or 22.8%) by 2017 (DEA, 2020). Emissions increased slowly over the 17-year period with an average annual growth rate of 1.34%. The Energy sector is the largest contributor (79.1% in 2017) to emissions (excl. FOLU) and is responsible for 90.3% of the increase over the 17-year period (DEA, 2020).

The Agriculture, Forestry and Other Land Use (AFOLU) sector is an overall source; however, this source has been reducing due to the increasing *Land sink* (DEA, 2020). This sink meant the emissions (excl. FOLU) were reduced by 7.4% in 2017. Emissions (incl. FOLU) were estimated at 513 140 Gg CO_2e in 2017 and showed an increase of 17.9% since 2000 (DEA, 2020). The Land sink increased from 2011 which caused an increase in the reduction of the emissions (incl. FOLU) between 2011 and 2017 (DEA, 2020).

Table 2: GHG emissions calculated for South Africa for 2000, 2005, 2010, 2015 and 2017 sector (Source: DEA, 2020).

Year	Total Emissions (excl. FOLU)	Total Emissions (incl. FOLU)
	Gg CO_2e	Gg CO_2e
2000	452 347,1	431 819,2
2005	502 799,4	497 776,7
2010	549 659,5	536 938,7
2015	553 950,1	520 218,2
2017	555 663,2	513 140,0

2.3.7 South Africa's Projected GHG emissions

Based on the NCCRP and the INDC, South Africa's projected GHG emissions between 2020 and 2050 will be between 398 000 000 tCO_2e and 428 000 000 tCOe, following the PPD (see section 3.2.2 above, and **Table 3** below).

The boundaries of the Long-Term Mitigation Scenario (LTMS) framework are defined by a 'growth without constraints' (GWC) emission scenario, which was based on an assumption of growth without any carbon constraint, and a 'required by science' (RBS) emission scenario (DEA, 2014b). RBS is a theoretical scenario which assumes that South Africa implements mitigation to the extent required by science to meets its fair contribution towards global emission reductions (DEA, 2014b). The same scenarios inform the PPD emissions trajectory referred to above. The PPD approach therefore represents a top-down approach.

The scenarios and mitigation actions developed in the LTMS study showed that the gap between GWC and RBS could not be fully closed if all the identified mitigation actions were implemented (DEA, 2014b).

Table 3: GHG emission projections based on Long Term Mitigation Scenario (LTMS) Growth Without Constraints (GWC) and PPD, in tCO_2e (Source: DEA, 2014b).

	2010	2020	2030	2040	2050
Growth Without Constraints (GWC)	546,974,000	749,325,000	1,004,933,000	1,297,991,000	1,638,695,000
Peak, Plateau and Decline (PPD)					
Upper Boundary	547,000,000	583,000,000	603,667,000	552,000,000	428,000,000
Lower Boundary	398,000,000	398,000,000	398,000,000	336,000,000	212,000,000
Range	149,000,000	185,000,000	205,667,000	216,000,000	216,000,000

In 2014, the DEA issued South Africa's GHG Mitigation Potential Analysis (DEA, 2014b). The study identified and analysed mitigation options in key economic sectors. In the process, an updated projection of national GHG emissions into the future has been developed, along with marginal abatement cost curves for key sectors and subsectors (DEA, 2014b).

In the GHG Mitigation Potential Analysis, the national mitigation potential (assuming 100% implementation of all identified mitigation options) is estimated at 100 000 000 tCO_2e in 2020, 340 000 000 tCO_2e in 2030 and 852 000 000 tCO_2e in 2050 (DEA, 2014b). This represents a reduction of reference case with existing measure (WME) emissions of 15%, 40% and 54% in 2020, 2030 and 2050, respectively (DEA, 2014b). The WEM projection incorporates the impacts of climate change mitigation actions including climate change policies and measures implemented to date.

Assuming all identified mitigation potential is implemented, the GHG Mitigation Potential Analysis indicate that emissions decrease in absolute terms in both 2020 and 2030 (DEA, 2014b). But in 2050, and for all other levels of implementation of abatement potential, no absolute emission reductions relative to 2010 are achieved (DEA, 2014b). The assumptions driving the decarbonisation of South Africa's Electricity supply (which are aligned to the Integrated Resource Plan, 2010), effectively place a cap on the mix of coal and other energy sources (such as renewables, biofuels and nuclear power) between 2010 and 2030 (DEA, 2014b). Beyond this horizon, the share of coal and non-coal-based power in South Africa is effectively held constant – with growth in supply driven by demand from end-use sectors (DEA, 2014b).

The PPD trajectory (**Table 3**) is applied in this GHG Assessment Report (see **Table 11**), since it represents South Africa's current official commitment.

2.3.8 Greenhouse Gas Reporting Regulations, and Technical Guidelines

The National Greenhouse Gas Emissions Reporting Regulations, 2017 (Notice 275 of 2017) (NGERs) were published on 3 April 2017 under section 53(aA), (o) and (p) read with section 12 of the National Environmental Management: Air Quality Act, 2004 (Act No.39 of 2004) (NEMAQA). It establishes the legislative framework for a National GHG reporting system. The purpose of the Regulations is to introduce a single national reporting system for the transparent reporting of GHG emissions, which will be used (RSA, 2017a):

> "*(a) to update and maintain a National GHG Inventory;*
> *(b) for the Republic of South Africa to meet its reporting obligations under the UNFCCC and instrument treaties to which it is bound; and*
> *(c) to inform the formulation and implementation of legislation and policy*."

Technical Guidelines for Monitoring, Reporting and Verification of Greenhouse Gas Emissions by Industry was published by the DEA in April 2017. It must be read with the NGERs. The purpose of the Technical Guidelines is to provide guidance to reporting companies on methodologies to apply when quantifying GHG emissions from those activities listed in Table 5.2 of the Guidelines (Table 5.2 of the Guidelines provide the IPCC source categories and their associated thresholds). The Technical Guidelines were used when preparing this Report, as per Section 3.1 below.

The South African National Atmospheric Emission Inventory System (NAEIS) is an online national reporting platform for air pollutants and greenhouse emission inventories of the republic (RSA, 2021). The NAEIS overarching objective is to provide all stakeholders with relevant, up-to-date and accurate information on South Africa's emissions profile for informed decision making (RSA, 2021).

It is understood that the DECM is registered on the NEEIS, and regularly submits the required information on the system.

2.4 International Reporting Thresholds

International reporting thresholds such as the IFC's Performance Standards and the Equator Principles provide useful insight and context to this assessment. It is summarised below.

2.4.1 IFC Standards and Reporting Thresholds

Sections 7 and 8 of the IFC Performance Standards on Environmental and Social Sustainability, *Standard 3: Resource Efficiency and Pollution Prevention*, applies to GHG Emissions Assessments:

> "*Greenhouse Gases*
>
> *7. In addition to the resource efficiency measures described above, the client will consider alternatives and implement technically and financially feasible and cost-effective options to reduce project-related GHG emissions during the design and operation of the project. These options may include, but are not limited to, alternative project locations, adoption of renewable or low carbon energy sources, sustainable agricultural, forestry and livestock management practices, the reduction of fugitive emissions and the reduction of gas flaring.*
>
> *8. For projects that are expected to or currently produce more than 25,000 tonnes of CO_2-equivalent annually[3], the client will quantify direct emissions from the facilities owned or controlled within the physical project boundary, as well as indirect emissions associated with the off-site production of energy[4] used by the project. Quantification of GHG emissions will be conducted by the client annually in accordance with internationally recognised methodologies and good practice*[5]." (IFC, 2012)

The IFC Performance Standards therefore sets an annual GHG quantification and reporting threshold of more than 25,000 tonnes of CO_2e.

2.5 Equator Principles and Reporting Thresholds

Further to the IFC Standards, the Equator Principles are also often applicable to GHG Assessments, depending on the source of funding for a project.

In terms of the Equator Principles, a developer that is seeking funding from a financial institution that subscribes to the Equator Principles is required to publicly report on its combined Scope 1 and Scope 2 GHG emissions if it exceeds 100,000 tonnes of CO_2e annually, for the operational phase of the Project, during the life of the loan

[3] *The quantification of emissions should consider all significant sources of greenhouse gas emissions, including non-energy related sources such as methane and nitrous oxide, among others.*

[4] *Refers to the off-site generation by others of electricity, and heating and cooling energy used in the project.*

[5] *Estimation methodologies are provided by the Intergovernmental Panel on Climate Change, various international organisations, and relevant host country agencies.*

(Equator Principles, 2013). An analysis to evaluate less GHG intensive alternatives is also required if this threshold is exceeded (Equator Principles, 2013).

The Equator Principles also encourage clients to report publicly on projects emitting over 25,000 tonnes, in line with the IFC Performance Standards (Equator Principles, 2013).

2.6 Industry Information

The following sections provide information on the likely GHG considerations relevant to the proposed extensions to the Dorstfontein underground coal mine, as well as the industry emission intensity.

2.6.1 Relevant GHG considerations

The following GHG emissions are generally associated with coal mining activities (Pandey *et al*, 2018; DEA, 2017):

- **Fugitive emissions of methane (CH_4) and CO_2**: Emissions of CH_4 produced during coal production, including emissions from underground mining, opencast working, and activities after coal mining (such as coal transport and storage).
- **CO_2 emissions implied in net purchased electricity**: CO_2 emissions occurring at the power enterprise that produces the electrical power consumed by the mining operation.
- **CO_2 emissions from on-site fuel combustion**: Emissions of CO_2 from the stationary or mobile combustion of fossil fuels (e.g. in boilers, burners, turbines, heaters, incinerators, and internal combustion engines, etc.).

In the USA, emissions from coal mines were 67.3 million tons of CO_2e in 2015, of which 60.9 million tons were from underground mining and 6.4 million tons from surface mining (Pandey *et al*, 2018). Fugitive CH_4 emissions from underground coal mining are therefore a significant contributor to GHG emissions, compared to open cast coal mining.

2.6.2 Industry Emission Intensity Benchmark

The Carbon Tax Act, 2019 (RSA, 2019b) defines "*emissions intensity benchmark"* as:

"the result of the measurement in respect of an activity that creates greenhouse gas emissions -

(a) expressed as a predetermined value of the quantity of specified greenhouse gas emissions;

(b) in relation to an activity that is differentiated from other activities by means of a product, a type of fuel or a technology; and

(c) compared against the quantity of greenhouse gas emissions, in relation to an identical activity undertaken by another person;"

According to the "*Draft Regulations: Greenhouse Gas Emissions Intensity Benchmarks Prescribed For The Purpose of Section 11 of the Carbon Tax Act, 2019"*, published by National Treasury in 2019, the coal mining sector industry benchmark value, is **0.108 tonne $CO2_e$/tonne** ore mined (National Treasury, 2019).

3 Methodology

The sub-sections below describe the methodology used for quantifying the GHG emissions associated with the proposed underground extensions to the DECM.

3.1 GHG Inventory Methodology

A GHG Inventory (also called a "Carbon Footprint") is a quantified list of an organisation's GHG emissions and sources. GHGs, for the purpose of this report, are the six gases listed in the Kyoto Protocol as well as the National Greenhouse Gas Emissions Reporting Regulations, 2017 (Notice 275 of 2017) (NGERs), namely Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulphur hexafluoride (SF_6). In a GHG Inventory, the total tonnes of carbon dioxide equivalent (CO_2e) emissions from an organisation is calculated by multiplying activity data with the emissions factor relevant to the activity data and multiplying that with the relevant global warming potential (GWP). A GWP is a factor that describes the radiative forcing (degree of harm to the atmosphere) of one unit of a given GHG relative to one unit of CO_2 (WRI & WBCSD, 2004). By using GWPs, GHG emissions can be standardised to a CO_2e.

This GHG Inventory for the proposed underground extensions to the DECM has been prepared using the 'Technical Guidelines for Monitoring, Reporting and Verification of GHG Emissions by Industry', issued by the DEA in April 2017 in terms of the NGERs. The Technical Guidelines are largely based on the 2006 IPCC Guidelines (DEA, 2017), but provide additional guidance and commentary for estimating GHGs in the South African context (such as country specific calorific values for fuels).

The Technical Guidelines and the NGERs refer to a reporting company as a "data provider". A data provider is any person in control of or conducting an activity listed under the IPCC source categories and their associated thresholds (i.e. Table 5.2 of the Technical Guidelines). The Technical Guidelines are largely concerned with direct (Scope 1) emissions arising from these activities (DEA, 2017).

The 2006 IPCC National Inventories Guidelines and the Technical Guidelines follow a Tiered approach. This allows the data provider to follow an approach appropriate for the subsector in a specific period in time (DEA, 2017). The Tiers are defined as follows:

- Tier 1: A bare minimum method using readily available statistical data on the intensity of processes (activity data) and default emission factors. This method is the simplest method and has the highest level of uncertainty.
- Tier 2: Similar to Tier 1 but uses technology or country specific emission factors. Tier 2 methods reduce the level of uncertainty:
- Tier 3: Tier 3 is defined as any methodology more detailed than Tier 2 and might include amongst others, process models and direct measurements. Tier 3 methods have the lowest level of uncertainty.

In terms of Table 5.2 in the Technical Guidelines, reporting on emissions from **"Coal Mining" (1B1a)** should be on either Tier 2 or Tier 3 (DEA, 2017). In terms of Table 5.2 in the Technical Guidelines, Coal Mining has not been assigned a reporting "threshold", meaning that the data provider must report activity data and greenhouse gas emissions irrespective of the size of greenhouse gas emissions and the scale of the operation of the activity (DEA, 2017).

The Tier 2 approach will be used in this GHG Assessment Report. The Technical Guidelines provides different calculation methodologies to be applied for the "during coal mining" calculations. For this GHG Assessment Report, Method 2 was used, which is also applicable to Tier 2. See **Box 1** below. The Technical Guidelines also provide a specific method for calculating emissions associated with the "post coal mining" scenario, which was also applied in the calculations below. See **Box 2** below.

Box 1: "During coal mining" CH_4 calculation method: Method 2, to be used for Tier 2 (Source:* DEA, 2017*).

During coal mining

Method 1&2: IPCC Tier 1&2 approach;

For tiers 1 and 2 the following methodology is followed:

CH_4 emissions = (CH_4 Emission Factor) x (Opencast and/or Underground Coal Production) x (CF)

Where units are:

- Methane Emissions (Gg per year)
- CH_4 Emission Factor (m^3 per tonne) (See B.1 in annexure B)
- Opencast/Underground Coal Production (tonne per year)
- CF = Conversion Factor: This is the density of CH_4 and converts volume of CH_4 to mass of CH_4. The density is taken at 20°C and 1 atmosphere pressure and has a value of 0.67×10^{-6} Gg m^{-3}

Box 2: "Post coal mining" CH_4 calculation method (Source:* DEA, 2017*).

Post mining emissions:

CH_4 emissions = (CH_4 Emission Factor) x (Opencast and/or Underground Coal Production) x (CF)

Where units are:

- Methane Emissions (Gg per year)
- CH_4 Emission Factor (m^3 per tonne) (see B.1 in annexure B)
- Underground Coal Production (tonne per year)
- CF = Conversion Factor: This is the density of CH_4 and converts volume of CH_4 to mass of CH_4. The density is taken at 20°C and 1 atmosphere pressure and has a value of 0.67×10^{-6} Gg m^{-3}

3.1.1 Activity Data

In terms of Section 21 (Coal Mining) of the Technical Guidelines, "activity data" is the amount of coal mined, stored or transported (DEA, 2017). In preparation for the activity data on coal mining for the purpose of quantifying fugitive emissions, the following guidance must be observed (DEA, 2017):

- Amount of coal should be reported based on Run-of-Mine (ROM) statistics and not saleable coal. Using saleable coal statistics leads to underestimation of emissions from coal mining;
- Company reporting should indicate the type of mine that it is operating (Opencast and/or underground); and
- In quantifying CH_4 emissions from post-mining activities (storage), the same amount of ROM coal mining statistics used for CH_4 emissions from production should be applied.

3.1.2 Scope of this GHG Inventory

3.1.2.1 Organisational Boundaries

Organisational boundaries are those boundaries that determine the operations owned or controlled by a company, depending on the consolidation approach taken (control or equity approach) (WRI & WBCSD, 2004). The organisational boundaries therefore determine which business units, facilities or physical operations, owned or controlled by a company, are included in the GHG Inventory.

Under the operational control approach, a company accounts for all emissions by entities and activities that are controlled by the organisation; under this approach, the organisation therefore has full authority to introduce and implement its operational policies at an operation. The equity share approach reflects economic interest; under this approach, a company therefore accounts for the GHG emissions from operations according to its share or equity in the operation.

Section 8(1) of the NGERs state that the reporting boundary must be based on operational control (DEA, 2017). This means that data providers should account for 100% of the GHG emissions and/or removals from facilities over which they have operational control (DEA, 2017).

This GHG Inventory therefore reports on the GHG emissions associated with ECC's proposed extensions to the DECM, based on the **operational control approach**.

3.1.2.2 Operational Boundary

Operational boundaries are those boundaries that determine the direct and indirect emissions associated with operations owned or controlled by a company (WRI & WBCSD, 2004).

Emissions accounted for in GHG Inventories can be divided into Scope 1 emissions (direct GHG emissions from sources owned or under operational control of the Project), Scope 2 emissions (indirect emissions from purchased electricity, heating/cooling or steam purchased for own consumption) and Scope 3 emissions (indirect emissions other than those covered in Scope 2). See **Figure 3** below.

In terms of the Technical Guidelines, **companies are only required to report direct emissions**, therefore Scope 1 emissions (DEA, 2017). **The scope of this GHG Inventory is, however, wider than that prescribed by the Technical Guidelines, since the objective of this report is to assess the potential impacts of the proposed project on climate change, and not to report on the company's GHG emissions in terms of the NGERs.** This GHG Inventory therefore includes Scope 2 emissions.

3.1.2.3 Project Phases

The three project phases associated with the proposed extensions to the DECM, as are described in more detail in Section 1.2 above, are:

- Construction phase (timeframe: about 12 months);
- Operational phase (timeframe: about 16 years); and
- Decommissioning and closure phase (timeframe: after concluding mining activities).

This GHG Inventory includes GHG emission estimations associated with all three project phases.

3.1.2.3.1 Construction Phase

The estimated GHG emissions from the following activities associated with the construction phase of the proposed extensions to the DECM project have been included in this GHG Inventory:

Scope 1:

- Mobile combustion (project-related fuel used in vehicles owned or controlled by ECC); and

- Stationary combustion (fuel used in generators, etc. owned or controlled by ECC).

Scope 2:

- Purchased electricity.

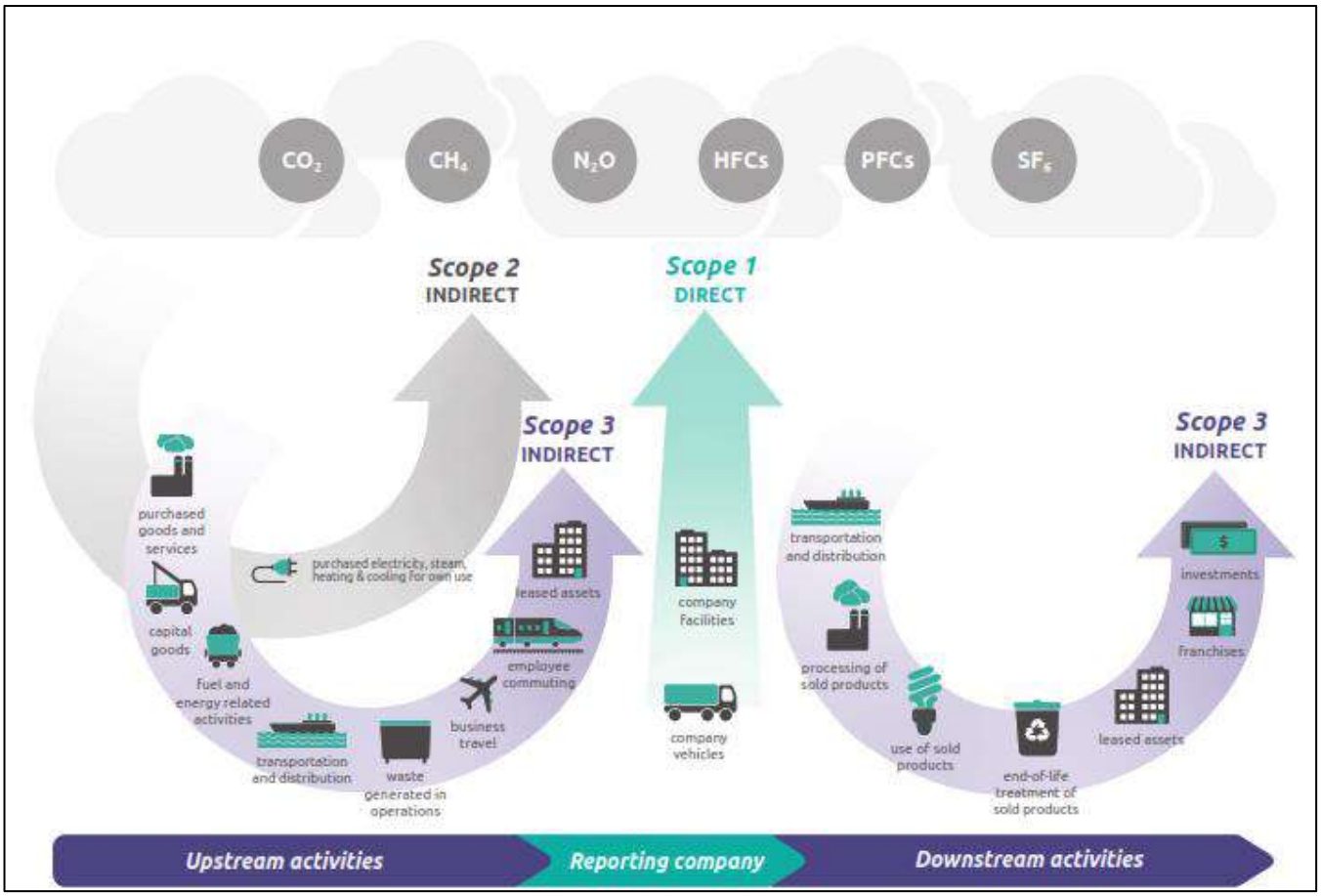

Figure 3: Overview of scopes and emissions across a value chain (Source: WRI & WBCSD, 2004).

3.1.2.3.2 Operational Phase

The estimated GHG emissions from the following activities associated with the operational phase of the proposed extensions to the DECM have been included in this GHG Inventory:

Scope 1:

- Mobile combustion (project-related fuel used in vehicles owned or controlled by ECC);
- Stationary combustion (fuel used in generators, etc. owned or controlled by ECC); and
- Fugitive emissions of CH_4 and CO_2 associated with underground mining during and post-mining coal handling (including transport) and storage.

Scope 2:

- Purchased electricity.

3.1.2.3.3 Decommissioning and Closure Phase

The estimated GHG emissions from the following the decommissioning and closure phase activities have been included in this GHG Inventory:

Scope 1:

- Mobile combustion (fuel used in vehicles owned or controlled by ECC); and
- Stationary combustion (fuel used in generators, etc. owned or controlled by ECC).

Scope 2:

- Purchased electricity.

The decommissioning and closure phase will mainly entail removal of surface infrastructure, earth movement and rehabilitation. Even though estimated emissions from this phase are included in this Inventory, it is noted that emissions associated with decommissioning and closure of projects are often very limited in context of a project's operational emissions.

3.1.2.3.4 Exclusions

The client has indicated that existing cleared areas will be used for construction of the surface infrastructure. This GHG Inventory was therefore prepared on the assumption that no further vegetation clearing will be undertaken.

This GHG Inventory does not include Scope 1 emissions from lubricant and grease consumption, since this is expected to be minimal, and will not have a significant effect on the overall GHG emissions. Emissions from lubricant and grease consumption could be included in future GHG Inventories.

This GHG Inventory does not include Scope 3 emissions. Examples of construction phase Scope 3 emissions are operational phase emissions at Eskom due to the use of the sold product, and emissions associated with the manufacturing of construction material, such as concrete and steel. Additional Scope 3 emissions associated with the operational phase of the project will include water consumption, employee commuting, waste to landfill, use of consumables such as steel grinding media which produced GHG emissions in their manufacture, emissions from off-site transport, etc. Scope 3 emissions, apart from offsite product use by Eskom, are expected to constitute a relatively small contribution towards the Project's GHG emissions and will not materially affect the results of the GHG Inventory. Scope 3 emissions could be included in subsequent assessments as applicable, even though it is not a requirement in terms of the Technical Guidelines.

3.1.3 Reporting Period

This GHG Inventory Report reports on the three project phases as are described in *Section 1.2* above. For the operational phase, it reports on the first full calendar year of operation of the extended facility (i.e. Year-1).

3.1.4 Calculation of Emissions Factors

Tables 4 and 5 below provide information regarding the calculation of the emission factors used in the GHG Inventory in Chapter 4.

Table 4: Emissions factor calculations and information sources.

Fuel Type	Emission Factor Information Source	Calorific Value (EC) Tj/kl or TJ/t	Emission Factors (EF)				CO2e Emission Factor (including Calorific Value)	CO2e EF Unit
			CO2 kg/TJ	CH4 (x 23) kgCO2e/TJ	N2O (x 296) kgCO2e/TJ	EF Total kgCO2e/TJ		
Diesel - mobile	Technical Guidelines: Annexures A, D and H (DEA, 2017)	0,0381	74 100,00	95,45	8 465,60	82 661,05	3,1494	kgCO2e/l
Diesel - stationary	Technical Guidelines: Annexures A, D and H (DEA, 2017)	0,0381	74 100,00	69,00	177,60	74 346,60	2,8326	kgCO2e/l
Puchased Electricity	Eskom 2020 Integrated Report: 213,2Mt CO2 emissions for 2020 / 205,64 TWh sold by Eskom						1,04	tCO2e/ MWh

Table 5: Underground coal mining emissions factors.

Activity	Emission Factor Information Source	Emission Factors (EF)			CH4 Conversion Factor (CF) Gg/m3
		CO2 m3CO2/ tonne	CO2 kgCO2/ kg	CH4 m3CH4/ tonne	
Underground Mining - During coal Mining	Technical Guidelines: Annexures B A, D and H (DEA, 2017)	0,077	0,000077		
				0,77	0,000000670
Underground Mining - Post-mining (handling and transport)		0,018	0,000018		0,000000670
				0,18	0,000000670

3.2 Impact Assessment Methodology

There are various challenges associated with assessing the impacts of project-scale GHG emissions on climate change, since project-scale impacts are often seen to represent an insignificant portion of global emissions.

The EIA impact assessment methodology used for EIA processes is based on the requirements of the NEMA EIA Regulations of 2014 (as amended) and enables the assessment of environmental issues, including: cumulative impacts, the severity of impacts (including the nature of impacts and the degree to which impacts may cause irreplaceable loss of resources), the extent of the impacts, the duration and reversibility of impacts, the probability of the impact occurring, and the degree to which the impacts can be mitigated.

EIA impact assessment methodology often calculates significance by applying a formula which entails ranking of the various criteria. Due to the cumulative effects, global scale and extended impact timelines associated with

climate change, it will not be appropriate to apply the typical EIA impact assessment methodology when assessing the impacts of project GHG emissions on climate change.

In order to address the above, this GHG Emissions Assessment for the EIA for the proposed extensions to the DECM applies a combination of the following alternative approaches to determine the impact significance of operational phase GHG emissions (which accounts for the bulk of emissions associated with this operation) on global climate change:

- Benchmarking GHG emissions against pre-defined thresholds;
- Benchmarking GHG emissions against product unit emission intensity; and
- Considering the contribution of GHG emissions from the project to the South Africa's National net GHG emissions as well as and National emissions from coal mining.

See Section 5 below for the GHG emission impact assessment.

3.3 Assumptions, Limitation and Exclusions

The following assumptions apply to this GHG Inventory:

- This GHG Inventory uses data and information that have been provided by ECC *via* Digby Wells. It is assumed that the data and information provided are correct.
- GHG Inventory information on current and historic GHG emissions at the DECM were not available at the time of preparing this GHG Emissions Assessment Report, even though such information was requested from the client. This Report therefore only focusses on the proposed underground extensions to the mine, and does not include the existing operations, nor a comparison of the emissions associated with the existing and proposed operations.
- It is assumed that the coal production numbers provided by the client is run-of-mine.
- It is assumed that CH_4 gas is not planned to be flared as part of the underground mining extensions.
- Further assumptions relating to the quantification of GHGs are specified in Chapter 4 below and assumptions regarding the impact assessment are specified in Chapter 5 below.

The limitations and exclusions that apply to this GHG Emissions Assessment are described in various sections of this report.

4 GHG Inventory Calculations for the proposed underground extensions to the DECM

The methodology followed to calculate the GHG Inventory for the proposed underground extensions to the DECM is described in *Section 3.1* above. The activity data used in the calculations below were sourced from ECC (via Digby Wells) in response to data requests, unless where otherwise indicated. Information regarding the calculation of emission factors as well as the sources of information are provided in **Table 4** and **Table 5** above.

4.1 GHG Emissions during the Construction Phase

The table below provides the estimated Scope 1 and Scope 2 GHG emissions from the construction phase of the proposed underground extensions to the DECM.

Table 6: Estimated Construction Phase GHG emissions.

Operational Activity	Units		Total consumption	CO2e Emission Factor (including Calorific Value)	Unit	Construction Phase (One year)		Percentage of emissions	Data Source, Assumptions, Notes
						Gigagrams of CO2e emissions	Tonnes of CO2e emissions		
Scope 1									
Mobile combustion	diesel	m3/a	120,00	3,15	kgCO2e/l	0,377926	**377,93**	6,41%	Activity data source: Provided by the client
Stationary combustion (fuel used in generators, etc. owned or Exxaro)	diesel	m3/a	1,00	2,83	kgCO2e/l	0,002833	**2,83**	0,05%	Activity data source: Provided by the client
Total scope 1						0,380759	**380,76**	**6,46%**	
Scope 2									
Purchased electricity	MWh/a		5 300,00	1,04	tCO2/MWh		**5 512,00**	**93,54%**	Activity data source: Provided by the client
Total scope 2 emissions							**5 512,00**	**93,54%**	
Total Scope 1 and 2 emissions							**5 892,76**	**100%**	

The following assumptions apply to the above calculations:

- No refrigerant gas consumption data has been provided.
- Emissions associated with land use and clearance were not included in the above assessment, since it is understood that all the proposed activities will take place on previously cleared land.
- The calculations do not include Scope 3 emissions.

4.2 GHG Emissions during the Operational Phase

The table below provides the estimated operational phase Scope 1 and Scope 2 GHG emissions for the first full year of operation (Operational Phase Year-1).

Table 7: Estimated Operational Phase GHG emissions.

Operational Activity	Units		Total consumption (annual)	CO2e Emission Factor (including Calorific Value)	CH4 Emission Factor	Unit	CH4 Conversion Factor Gg/m3	Operational Phase (Per year)		Percentage of emissions	Data Source, Assumptions, Notes
								Gigagrams of CO2e emissions	Tonnes of CO2e emissions		
Scope 1											
Mobile combustion	diesel	m3/a	180,00	3,15		kgCO2e/l		0,566889	**566,89**	2,224%	Activity data source: Provided by the client
Stationary combustion (fuel used in generators, etc. owned or controlled by Exxaro)	diesel	m3/a	0,60	2,83		kgCO2e/l		0,001700	**1,70**	0,007%	Activity data source: Provided by the client
During coal mining:											
Fugtive emissions from undergound coal mining - CO2 and NH4 (during coal mining)	coal	t/a	1 357 453,00	0,000077		kgCO2/kg		0,104524	**104,52**	63,615%	Activity data source: Provided by the client
	coal	t/a	1 357 453,00		0,77	m3CH4/tonne	0,00000067	16,11	**16 107,13**		
Emissions from post-mining coal handling and storage:											
Fugtive emissions from undergound coal mining - CO2 and NH4 (during coal mining)	coal	t/a	1 357 453,00	0,000018		kgCO2/kg		0,024434	**24,43**	1,573%	Activity data source: Provided by the client
	coal	t/a	1 357 453,00		0,018	m3CH4/tonne	0,00000067	0,38	**376,53**		
Total scope 1 emissions								0,57	**17 181,21**		
Scope 2											
Purchased electricity	MWh/a		7 983,60	1,0400	tCO2/MWh				**8 302,94**	32,581%	Activity data source: Provided by the client
Total scope 2 emissions									**8 302,94**		
Total Scope 1 and 2 emissions - Annual									**25 484,15**		

Fugitive GHG emissions associated with underground mining (Scope 1) is expected to contribute about 64% of the projects' annual operational phase GHG emissions. The fast majority of these emissions will be fugitive CH_4 emissions. This projection is in line with the finding of Pandey *et al*, 2018, according to whom CH_4 constitutes about 30% to 90% of GHGs emissions from coal mining.

The following assumptions apply to the above calculations:

- No refrigerant gas consumption data has been provided.
- The calculations do not include Scope 3 emissions. The use of the sold product (coal) by Eskom would emit a significant volume of GHGs and would be the most significant Scope 3 emission associated with this project. The inclusion of Scope 3 (indirect) emissions is not a requirement in terms of the Technical Guidelines (DEA, 2017). Eskom will need to report on these emissions as a Scope 1 emission.
- The above calculations assume no flaring.
- It is assumed that fuel and energy use associated with coal beneficiation (crushing, milling, and washing) if applicable, are included in the fuel and energy usage numbers provided by the client.

4.3 GHG Emissions during the Decommissioning and Closure Phase

The decommissioning and closure phase will mainly entail removal of surface infrastructure, earth movement and rehabilitation. Rehabilitation and remediation of the site by planting indigenous plants, shrubs and trees will have positive GHG implications through CO_2 sequestration. The EIA assesses the addition of about 16 years to the life of the mine; decommissioning and closure will therefore take place thereafter unless the life of mine is further

extended in the future. An annual emission estimation is provided below for the decommissioning and closure phase.

Table 8: Estimated Decommissioning and Closure Phase GHG emissions.

Operational Activity	Units		Total consumption	CO2e Emission Factor (including Calorific Value)	Unit	Construction Phase (One year)		Percentage of emissions	Data Source, Assumptions, Notes
						Gigagrams of CO2e emissions	Tonnes of CO2e emissions		
Scope 1									
Mobile combustion	diesel	m3/a	120,00	3,15	kgCO2e/l	0,377926	**377,93**	6,41%	Activity data source: Provided by the client
Stationary combustion (fuel used in generators, etc. owned or Exxaro)	diesel	m3/a	1,00	2,83	kgCO2e/l	0,002833	**2,83**	0,05%	Activity data source: Provided by the client
Total scope 1						0,380759	**380,76**	**6,46%**	
Scope 2									
Purchased electricity	MWh/a		5 300,00	1,04	tCO2/MWh		**5 512,00**	**93,54%**	Activity data source: Provided by the client
Total scope 2 emissions							**5 512,00**	**93,54%**	
Total Scope 1 and 2 emissions							5 892,76	100%	

The following further assumptions apply to the above calculations:

- The positive implications associated with carbon sequestration from revegetation of the site are not included in the above calculation, due to challenges associated with making reasonable assumptions and estimations.
- Emissions associated with transportation and removal of material off site are also not included in the calculation below, due to uncertainties regarding aspects such as the location of final waste disposal sites and the number of trips required.
- The calculations do not include Scope 3 emissions.

Emissions associated with decommissioning and closure of the project are expected to be very small in comparison with a project's operational emissions, as is illustrated in the Table above.

4.3.1 'Base Year' Information

A base year is a historic datum (a specific year or an average over multiple years) against which a company's emissions are tracked and compared over time (WRI & WBCSD, 2004). Base years should be retrospectively recalculated to reflect any additional or new information and changes in the company that would otherwise compromise the consistency and relevance of the reported GHG emissions information (WRI & WBCSD, 2004).

This report is a project specific GHG Inventory prepared for the proposed DECM underground coal mine extension. It is recommended that annual GHG inventories be prepared during the operational phase of the project. Exxaro Central Coal (Pty) Ltd should apply specific attention to the quality of data captured during the operational phase, to ensure that the data used in future GHG Inventories are true and correct. It is recommended that the GHG Inventory from the first full year of operation should be used as the base year.

5 GHG Impact Assessment

There are various challenges associated with assessing the impacts of project-scale GHG emissions on climate change, since project-scale impacts are often seen to represent an insignificant portion of global emissions, as is also mentioned in Section 3.2 above.

In order to address the above, this GHG Emissions Assessment for the proposed extensions to the DECM applies a combination of the following alternative approaches to determine the impact significance of operational phase GHG emissions (which accounts for the bulk of emissions associated with this operation) on global climate change:

- Benchmarking GHG emissions against pre-defined thresholds;
- Benchmarking GHG emissions against product unit emission intensity; and
- Considering the contribution of GHG emissions from the project to South Africa's National net GHG emissions as well as and National emissions from coal mining.

5.1 Benchmarking GHG emissions against pre-defined thresholds

The table below provides useful pre-defined thresholds for the benchmarking of annual GHG emissions. The thresholds are well-aligned with the reporting, assessment and mitigation requirement triggers of the IFC Performance Standards as well as the Equator Principles and the European Bank of Reconstruction and Development (EBRD).

Table 9: Benchmark thresholds for tCO_2e emissions emitted per annum (Source: Murphy & Gillam, 2013; EBRD, 2010).

GHG emissions (t CO_2e/annum)	Qualitative Rating	Proposed elements of assessment
< 10 000	Nominal / Negligible	None
10 000 – 25 000	Low	Quantitative, present data
25 000 – 100 000	Medium-Low	Quantify sector profile, place in context, identify possible mitigation, decide on further elements
100 000 – 1000 000	Medium-High	As above, AND Prepare GHG Management Plan; in the context of local program requirements, consider embodied emissions and potential for offsets
> 1000 000	High	As above

Based on the above thresholds, the operational phase **intensity (or magnitude)** of the GHG emissions that are projected to be emitted annually by the project during Operational Phase Year-1 (i.e. 25 484,15 tCO_2e) can be regarded as being **medium-low**. The elements of assessment required for the extensions to the DECM project, according to the above table, include quantifying the sector profile, placing it in context, identifying possible mitigation, and deciding on further elements.

5.2 Benchmarking performance against the industry

Using average emission intensity per product unit (i.e. CO_2e per product unit) in the same industry is useful for determining the impact significance of GHG emissions, which also allows comparison with emitters in the same industry. There are, however, many variables that influence the GHG intensity of mining-related production. Benchmarking any mining operation based on emission intensity should therefore be dealt with cautiously.

The table below provides the average emission intensity per tonne of coal mined as part of this proposed project.

Table 10: Extensions to the DECM - emission intensity factor.

Description	
Future scenario: Operational Phase Year-1	
Total calculated annual operational phase GHG emissions (t CO_2e)	25 484,15
Estimated average annual production of coal (t/annum)	1 357 453
DECM underground extension GHG emission intensity (t CO_2e /t coal)	**0,02**

The estimated average annual operational phase emission intensity of the coal produced from extensions to the DECM is 0,02 tCO_2e/t coal produced. According to the "*Draft Regulations: Greenhouse Gas Emissions Intensity Benchmarks Prescribed For The Purpose of Section 11 of the Carbon Tax Act, 2019*", published by National Treasury in 2019, the coal mining sector industry benchmark value, is **0.108 tonne $CO2_e$/tonne** ore mined (National Treasury, 2019). The intensity (or magnitude) of 0,02 tCO_2e/t for the project can be regarded as **low** compared to the comparable officially documented emission intensity for the industry.

5.3 Contribution to the National net GHG emissions and National emissions from coal mining

The table below indicates the percentage contribution of the proposed underground mining extension project to the annual National GHG emissions as per the scenarios projected in South Africa's GHG Mitigation Potential Analysis dated 2014 (DEA, 2014b). South Africa's National net GHG emissions were 513 140 Gg CO_2e in 2017 (DEA, 2020). This number, which was the most updated National GHG Inventory data available at the time of preparing this report, falls between the two boundaries projected for 2020 in the table below, but sits closer to the upper than the lower boundary.

Table 11: Estimated annual GHG emissions for South Africa between 2010 and 2050, and estimated percentage contribution of the DECM underground extension project (operational phase) to these emissions, as applicable.

Year	Growth Without Constraints (GWC) (DEA, 2014b)	PPD: Upper boundary (DEA, 2014b)	PPD: Lower boundary (DEA, 2014b)	Estimated annual GHG emissions – Dorstfontein underground mining extension Project from Operational Phase Year-1	Project % contribution to SA's projected national GHG emissions during the Operational Phase (Year-1)		
					GWC	PPD: Upper boundary	PPD: Lower boundary
2020	749 325 000,00	583 000 000,00	398 000 000,00				
2030	1 004 933 000,00	603 667 000,00	398 000 000,00	25 484,15	0,003%	0,004%	0,006%
2040	1 297 991 000,00	552 000 000,00	336 000 000,00	25 484,15	0,002%	0,005%	0,008%

Based on the above table, the percentage contribution of the proposed project towards South Africa's annual projected National GHG emissions will be between 0,004% - 0,008%, depending on the emission projection scenario. The potential **intensity (or magnitude)** of the project in terms of its contribution to the National net GHG emissions is therefore considered to be **low**.

This cannot, however, be used in isolation when assessing the significance of a project's potential impacts on climate change, since the geographical source of GHG emissions is irrelevant when considering the future impact of climate change. The percentage contribution from this project would also have been higher if the project was located in a country with smaller GHG emissions. The calculation of the percentage contribution towards the National net GHG emissions therefore merely provides a sense of scale and context of the project's emissions relative to the South Africa's emission, and should be used in combination with other reference benchmarks as discussed above and below.

GHG emissions from coal mining and handling for South Africa was 1 608 200 tCO_2e during 2017[6] (DEA, 2020). The emissions associated with the proposed underground mining extension will contribute about 0.016% to these emissions. This contribution is considered to have a **low** intensity (or magnitude).

The intensity (or magnitude) of the overall impact of the proposed project, considering its contribution to the National net GHG emissions and national emissions from coal mining, is considered to be **low**.

5.4 Conclusion: Project GHG emissions impact significance

Due to the global scale and long-term impacts of local GHG emissions on climate change, it would not be appropriate to apply the traditional EIA impact assessment methodology to GHG Emissions Assessments. The significance associated with the potential impacts on climate change from GHG emissions is rather based on *intensity* (or magnitude), which is based on a combination of criteria and benchmarks as described above. The categorisation of impact magnitude based on a set of pertinent criteria and making use of widely recognised standards as a measure of the level of impact, are in line with the industry norms.

The analyses in the preceding sub-sections can be summarised into the following main findings:

- Based on pre-defined thresholds, which are in line with the IFC Performance Standards, the Equator Principles and the EBRD, the intensity (or magnitude) of the proposed extensions to the DECM operational phase emissions of 25 484,15 tCO_2e (Operational Phase Year-1) can be regarded as being **medium-low.**
- The emission intensity of coal mined will be **0,02 tCO_2e/t**. This translates to a **low** intensity (or magnitude) compared to the coal mining sector industry benchmark value of 0.108 tonne CO_2e/t.
- The percentage contribution of the proposed project towards South Africa's annual GHG emissions will be between 0,004% and 0,008%, and the percentage contribution towards the annual GHG emissions from coal mining and handling in South Africa will be 0.016%. The potential intensity (or magnitude) of this contribution is regarded as being **low**.

Based on the above, the **overall intensity (or magnitude)** of the GHG emissions from the proposed project on current and potential regional and cumulative global climate change is regarded as **low**. This intensity rating translates into a **low overall significance** rating.

[6] The 2017 inventory was the latest National GHG Inventory available at the time of preparing this report.

6 GHG Emissions Management Recommendations

The majority of GHG emissions associated with proposed extensions to the DECM for the construction and decommissioning phases will be from purchased electricity (Scope 2 emissions). For the operational phase, the most significant emissions will be fugitive CH_4 emissions during coal mining, as well as emissions from purchased electricity. It is recommended that emissions management and mitigation efforts should start by focussing on these most significant emissions sources, and then move on to addressing the other GHG emission sources over the medium term.

The sections below provide an overview of the level of GHG management that is required for the proposed project in terms of the IFC Performance Standards and the Equator Principles, and then provide recommendations that are focussed on reducing GHG emissions from purchased electricity and operational phase fugitive emissions from mining.

Even though the client has not specifically requested for the project to comply with the IFC Performance Standards or the Equator Principles, they provide useful guidance in this context.

In terms of IFC Performance Standard 3.7, alternatives should be considered, and technically and financially feasible and cost-effective options should be implemented to reduce project-related GHG emissions during the design and operation of the project. These options may include but are not limited to: "*alternative project locations, adoption of renewable or low carbon energy sources, sustainable agricultural, forestry and livestock management practices, the reduction of fugitive emissions and the reduction of gas flaring*" (IFC, 2012). These measures are in addition to the resource efficiency measures described in the IFC Performance Standard 3.6.

Cost-effective options should therefore be considered and implemented to reduce GHGs associated with the proposed project during the design (pre-construction) and operational phase of the project. Options such as alternative project locations, sustainable agriculture and forestry, and livestock management practices are not applicable to the proposed underground mining extension project.

In terms of the Equator Principles, when combined Scope 1 and Scope 2 emissions are expected to be more than 100,000 tCO_2e/annum, an alternatives analysis should be conducted to evaluate less GHG intensive alternatives (Equator Principles, 2013). If the project were required to comply with the Equator Principles, an alternative analysis would therefore not have been required for this project, since the annual operational phase emissions is projected to fall below the specified threshold.

6.1 Renewable and low carbon energy sources

It is recommended that ECC should investigate the technical and financial feasibility of implementing a range of emission-reduction initiatives for its purchased electricity and mobile equipment. The following recommendations could be considered and implemented for all three project phases:

- Use solar and/or wind-powered electricity instead of Eskom purchased electricity and diesel-fuelled generators;
- Investigate on-site processes to identify potential areas for process optimisation, energy efficiency, and improved energy management;
- Implement a payload management system, or investigate options to improve the current system if such a system is already in place;
- Implement a diesel energy-efficiency management programme;
- Optimise the loading of haul trucks and adjust haul truck engines to ensure optimal energy efficiency;
- Investigate the use of biofuel as a fuel enhancer or partial fossil fuel substitute of the Project's diesel usage. Potential sources for biofuel could be used cooking oil (if available) or other vegetable oils such as palm oil, soybean oil, rapeseed oil or jatropha oil; and

- Investigate the use of ethanol blends, as will be allowable in terms of the vehicles' warranty. Ethanol is less costly to produce than biodiesel due to lower feedstock costs. The most common feedstocks for ethanol in Africa are sugarcane and molasses.

The use of biofuels may hold an opportunity for ECC to obtain carbon credits. The potential value of carbon credits produced from biofuels depends on the price of carbon and the savings in GHGs relative to fossil fuels. Carbon credits have not generally been available for biofuels, but they could become an important source of revenue in the future. The carbon market has grown rapidly, and efforts to reduce GHG emissions under the Kyoto Protocol or national programs are expected to lead to further growth and could lead to higher carbon prices. Biofuels have not benefited because they have only been certified as eligible for the Carbon Disclosure Mechanism of the Kyoto Protocol under very limited conditions, but that could change in the future (Mitchell, 2011).

It is important to note that the indirect impacts from biofuel production should also be considered during the above investigations, especially the impacts of potential deforestation for biofuel production on climate change, on the relocation of local communities, and the impacts of biofuel production on crop prices.

Most of the above recommended mitigation measures are also expected to be more cost-effective over the life of the mine.

6.2 Mitigation of operational phase fugitive CH_4 emissions

More than 60% of the projected GHG emissions associated with the operational phase of the proposed project will be fugitive emissions of CH_4. Mitigation through technological innovation is therefore of paramount importance for the underground coal mining sector.

Examples of existing technologies which would contribute towards combatting CH_4 emissions from coal mining operations include the following (Pandey *et al*, 2018):

- **CH_4 flaring**: CH_4 collected from boreholes during mining can be flared. Through combustion, the CH_4 is converted to CO_2, which has a lower GWP compared to CH_4.
- **Methane purification**: Utilization of mine CH_4 in its mixture form is not possible due to the presence of impurities such as N_2, O_2, CO_2, and water vapor. Several processes are available which are commonly used for gas purification.
- **Power generation using methane**: Coal mining is an energy-intensive process, which requires high electricity loads to run equipment. Mine CH_4-fired stationary power generation technologies such gas engines, gas turbines, and fuel cells can be used in mining of coal. These not only promote the reutilization of generated CH_4 but also reduce the energy consumption during the processes.
- **Production of methanol and carbon black**: Coal mine CH_4 can also be made available as a chemical feedstock for different chemical processes for the production of synthetic fuels and chemicals. Two potential applications in this field are methanol and carbon black production.
- **Thermal flow, catalytic flow, and catalytic monolith reactor technologies**: Thermal flow (TFRR) and catalytic flow (CFRR) reversal reactors employ the flow reversal principle to transfer heat from combustion of the CH_4 to the incoming air through a solid heat storage medium. This raises the ventilation air temperature to the ignition temperature of CH_4, resulting in emissions of CO_2 and water vapor. Catalytic monolith reactor (CMR) is a honeycomb type monolithic reactor, which performs a similar function but at low pressure with high mass flows, high geometrical area, and high mechanical strength. Monoliths consist of a structure of parallel channels with walls coated by a porous support containing catalytically active particles. Therefore, compared with the TFRR and CFRR units, the CMR unit should be more compact in terms of processing the same amount of ventilation air. All the three technologies perform a similar function, they vary in structural pattern and operating behaviours.
- **Mine methane utilization in gas turbines**: Following TFRR, CFRR, and CMR technologies, mitigation and utilization of mine CH_4 may also be achieved by using various gas turbines. Such turbines utilize heat from CH_4 combustion, which preheats the air in the range of 700 – 1000°C to drive the turbines.

- **Carbon Trading:** In terms of the Kyoto Protocol clean development mechanism (CDM), the reduction in GHG emissions from coal mining can be achieved by carbon trading. Carbon trading is an economic activity, which involves buying and selling of environmental services including GHGs from the atmosphere, which are identified and purchased by eco-consulting firms and then sold to individual or corporate clients to "offset" their polluting emissions. Under CDM, GHGs are traded with developed countries, thereby making its mitigation economically viable.

6.3 GHG Management Plan

It is recommended that a GHG Management Plan be prepared and implemented for all the phases of the proposed project. The goal of the GHG Management Plan should be to achieve the maximum economically sustainable energy and carbon savings. Such a management plan should ideally include, but not be limited to, the following:

- An energy and GHG emission management programme to assist in analysing and identifying opportunities at the operations to reduce energy consumption and GHG emissions. This should include measuring GHG emissions on an annual basis, as is also required for the operational phase in terms of the Technical Guidelines and Section 8 of the IFC Performance Standard 3.
- GHG emissions reduction projects and offsetting opportunities.
- Allocated responsibility to a key employee(s) that will be responsible and accountable for managing and reporting on the GHG emissions performance of the project on an annual basis.
- The GHG Management Plan should be updated regularly to ensure that the project complies with new South African policies and legislation relating to GHG emissions and climate change as it is promulgated.

7 Conclusions, Recommendations and Reasoned Specialist Opinion

The proposed underground extensions to the DECM is estimated to emit about 25 484,15 tCO_2e (Operational Phase Year-1) annually.

Based on the relevant thresholds and benchmarks, the **overall intensity (or magnitude)** of the GHG emissions from the project on current and potential regional and cumulative global climate change is regarded as **low**. This intensity rating translates into a **low** significance rating.

The majority of GHG emissions associated with proposed extensions to the DECM for the construction and decommissioning phases will be from purchased electricity (Scope 2 emissions). For the operational phase, the most significant emissions will be fugitive CH_4 emissions during coal mining, as well as CO_2e from purchased electricity. It is recommended that emissions management and mitigation efforts should start by focussing on the reduction of fugitive CH_4 emissions, as well as reduction of emissions from purchased electricity and mobile combustion.

7.1 Recommendations: Mitigation measures for inclusion into the EMPr

The measures described below should be included in the Environmental Management Programme (EMPr) for the DECM underground extensions EIA processes.

Table 12: Mitigation measures associated with <u>all three project phases</u>: GHG Management Plan.

ALL THREE PROJECT PHASES: GHG Management Plan		
PROJECT ACTIVITY (Environmental Aspect)	All construction, operational, and decommissioning and closure phase activities associated with the DECM underground extensions project.	
POTENTIAL IMPACT	Impact on global climate change due to the emission of GHGs.	
OBJECTIVE AND TARGET	Reduce the combined GHG emissions from the underground coal mining extensions by 2% annually.	
MITIGATION / MANAGEMENT MEASURES	**RESPONSIBLE PARTY/PERSON**	**TIMEFRAME**
Prepare and implement a GHG Management Plan at ECC . The GHG Management Plan should include, but not be limited to, the following: • An energy and GHG emission management programme to assist in analysing and identifying opportunities at the operations to reduce energy consumption and GHG emissions. This should include measuring GHG emissions on an annual basis, as is also required for the operational phase in terms of the Technical Guidelines and Section 8 of the IFC Performance Standard 3. • GHG emissions reduction projects and offsetting opportunities. • Allocated responsibility to a key employees(s) that will be responsible and accountable for managing and reporting on the GHG emissions performance of the project on an annual basis. • The GHG Management Plan should be updated regularly to ensure that the project complies with new South African policies and legislation relating to GHG emissions and climate change as it is promulgated.	ECC and Mine manager	Construction, Operational and decommissioning phase

Table 13: Construction phase mitigation measures: Renewable and low carbon fuel sources.

CONSTRUCTION PHASE: Renewable and low carbon fuel sources		
PROJECT ACTIVITY (Environmental Aspect)	Electricity use, and operation of mobile and stationary equipment on site.	
POTENTIAL IMPACT	Impact on global climate change due to the emission of GHGs.	
OBJECTIVE AND TARGET	Reduce GHG emissions from Eskom purchased electricity, and mobile and stationary combustion by 2% annually.	
MITIGATION / MANAGEMENT MEASURES	**RESPONSIBLE PARTY/PERSON**	**TIMEFRAME**
Implement a diesel energy-efficiency management programme.	Construction manager	Construction phase
Optimise the loading and operation of haul trucks to ensure optimal energy efficiency.	Construction manager	Construction phase

Table 14: Operational phase mitigation measures: Renewable and low carbon fuel sources.

OPERATIONAL PHASE: Renewable and low carbon fuel sources		
PROJECT ACTIVITY (Environmental Aspect)	Electricity use, and operation of mobile equipment and stationary equipment on site.	
POTENTIAL IMPACT	Impact on global climate change due to the emission of GHGs.	
OBJECTIVE AND TARGET	Reduce GHG emissions from Eskom purchased electricity, and mobile and stationary combustion by 2% annually.	
MITIGATION / MANAGEMENT MEASURES	RESPONSIBLE PARTY/PERSON	TIMEFRAME
Investigate the possible use of solar and/or wind-powered electricity to supplement Eskom purchased electricity and diesel-fuelled generators.	Mine manager	Operation
Investigate a payload management system or investigate options to improve the current system if such a system is already in place.	Mine manager	Operation
Implement a diesel energy-efficiency management programme.	Mine manager	Operation
Optimise the loading and operation of haul trucks and adjust haul truck engines to ensure optimal energy efficiency.	Mine manager	Operation
Investigate the use of biofuel as a fuel enhancer or partial fossil fuel substitute of the Project's diesel usage. Potential sources for biofuel could be used cooking oil (if available) or other vegetable oils such as palm oil, soybean oil, rapeseed oil or jatropha oil.	Mine manager	Operation
Investigate the use of ethanol blends, as will be allowable in terms of the vehicles' warranty. Ethanol is less costly to produce than biodiesel due to lower feedstock costs. The most common feedstocks for ethanol in Africa are sugarcane and molasses.	Mine manager	Operation

Table 15: Operational phase mitigation measures: Reduction of fugitive CH_4 emissions

OPERATIONAL PHASE: Reduction of fugitive CH_4 emissions	
PROJECT ACTIVITY (Environmental Aspect)	Fugitive CH_4 emissions produced from underground coal mining, including emissions from activities after coal mining, such as coal transport and storage.
POTENTIAL IMPACT	Impact on global climate change due to the emission of GHGs.
OBJECTIVE AND TARGET	Reduce fugitive CH_4 emissions by 5% annually.

MITIGATION / MANAGEMENT MEASURES	RESPONSIBLE PARTY/PERSON	TIMEFRAME
Implement one, or a combination, of the technologies which would contribute towards reducing CH_4 emissions from the underground coal mining activities. The following technologies could be investigated, and the most feasible and cost-effective option(s) should be identified: • CH_4 flaring, • Methane purification, • Power generation using methane, • Production of methanol and carbon black, • Thermal flow, catalytic flow, and catalytic monolith reactor technologies, • Mine methane utilization in gas turbines, and/or • Carbon trading.	ECC / Mine manager	Operation

Table 16: <u>Decommissioning and closure phase</u> mitigation measures: Renewable and low carbon fuel sources.

DECOMMISSIONING AND CLOSURE PHASE: Renewable and low carbon fuel sources	
PROJECT ACTIVITY (Environmental Aspect)	Electricity use, and operation of mobile and stationary equipment on site.
POTENTIAL IMPACT	Impact on global climate change due to the emission of GHGs.
OBJECTIVE AND TARGET	Reduce GHG emissions from Eskom purchased electricity, and mobile and stationary combustion by 2% annually.

MITIGATION / MANAGEMENT MEASURES	RESPONSIBLE PARTY/PERSON	TIMEFRAME
As far as possible, use solar and/or wind-powered electricity as supplemental options instead of fully relying on purchased electricity and diesel-fuelled generators.	Mine manager	Decommissioning and closure phase
Investigate a payload management system or investigate options to improve the current system if such a system is already in place.	Mine manager	Decommissioning and closure phase
Implement a diesel energy-efficiency management programme.	Mine manager	Decommissioning and closure phase
Optimise the loading of haul trucks to ensure optimal energy efficiency.	Mine manager	Decommissioning and closure phase
Investigate the use of biofuel as a fuel enhancer or partial fossil fuel substitute of the Project's diesel usage. Potential sources for biofuel could be used cooking oil (if available) or other vegetable oils such as palm oil, soybean oil, rapeseed oil or jatropha oil.	Mine manager	Decommissioning and closure phase
Investigate the use of ethanol blends, as will be allowable in terms of the vehicles' warranty. Ethanol is less costly to produce than biodiesel due to lower feedstock costs. The most common feedstocks for ethanol in Africa are sugarcane and molasses.	Mine manager	Decommissioning and closure phase

7.2 Reasoned Specialist Opinion

The overall intensity (or magnitude) of the GHG emissions from the proposed project on current and potential regional and cumulative global climate change is regarded as being of a **low significance**. It should, however, be kept in mind that the burning of the coal for electricity production is taking place off site, by Eskom. This would

be a significant GHG emission, but is a Scope 3 emission for ECC, and are therefore not reported on in this report. Therefore, even though the overall intensity of the GHG emissions associated with the proposed project is expected to be of low significance, the off-site (Scope 3) impact from coal burning for electricity generation will be high. Eskom will however report on these emissions as Scope 1.

It is recommended that the proposed project should be approved, with the condition that feasible and cost-effective emission reduction alternatives should be investigated and implemented, as recommended above.

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