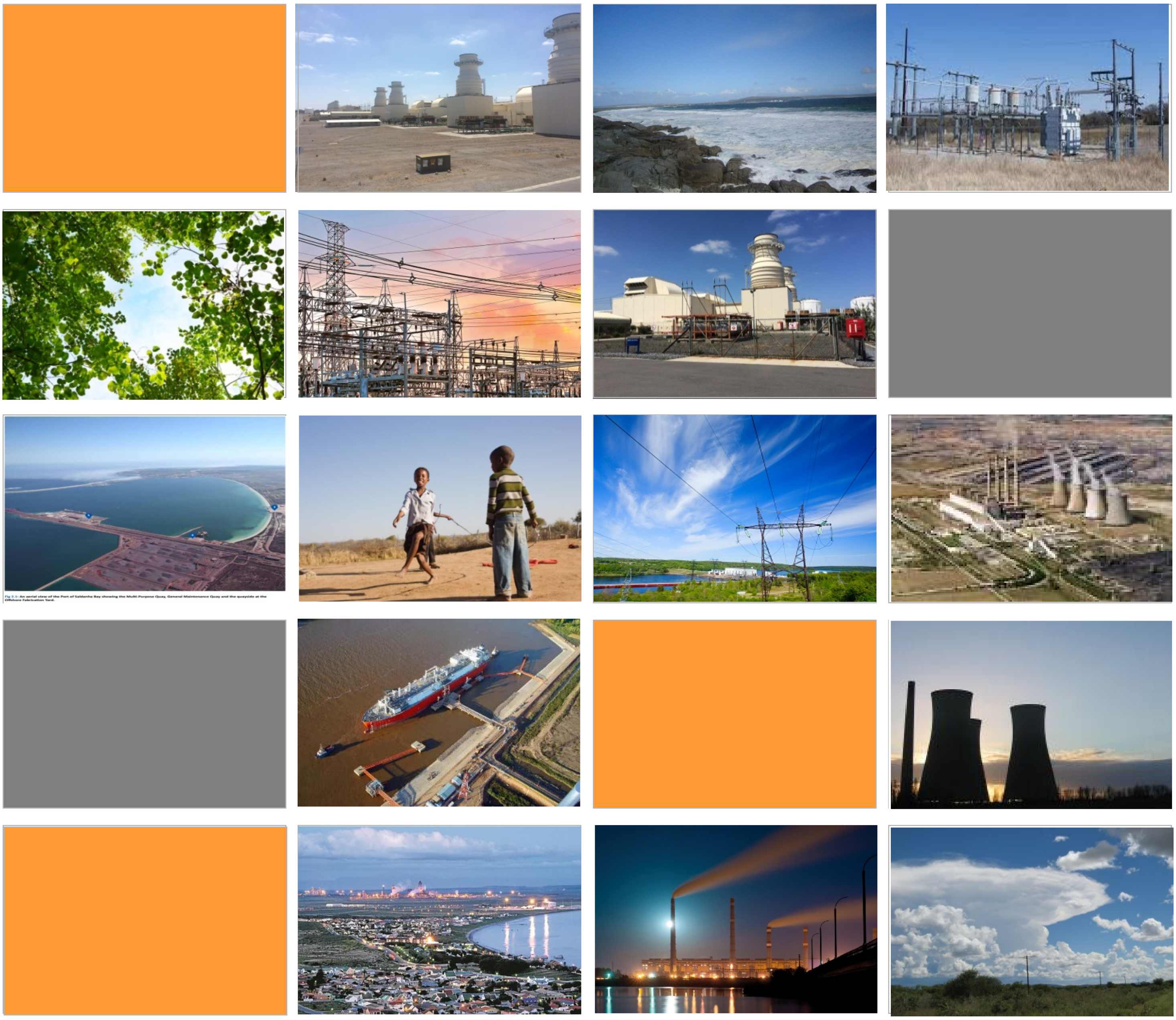

Greenhouse Gas (GHG) Study for a Gas-fired Independent Power Plant to Support Saldanha Steel and Other Industries in Saldanha Bay

Draft Report V0.2
ArcelorMittal
September 2016
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Greenhouse Gas (GHG) Study for a Gas-fired Independent Power Plant to Support Saldanha Steel and Other Industries in Saldanha Bay

Environmental Resources Management

Draft Report

Client: ArcelorMittal		Project No: 0315829
Summary and version history: V0.2 An assessment of the potential greenhouse gas (GHG) emissions as a result of the operation of the proposed gas-fired power plant was undertaken. The potential impact of GHG emissions are assessed in the context of South African and international benchmarks, and South Africa's energy and climate change policies.		Date: 06 September 2016 Approved by: Charles Allison
1	Draft Report	
	Compiled by: Sarah Bonham Reviewed by: Charles Allison & Stuart Heather-Clark	
This report has been prepared for ArcelorMittal in accordance with the terms and conditions of ERM's contract with ArcelorMittal for submission to commenting authorities and the Competent Authority in support of ArcelorMittal's application for an Environmental Authorization and for disclosure through the prescribed review process. Any other use, distribution or publication of this report is prohibited without the prior written approval of ERM and ArcelorMittal		**Distribution**: Public

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LIST OF ACCRONYMS

CCGT	Combined cycle gas turbine
CCS	Carbon capture and storage
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
COP	Conference of Parties (under UNFCCC)
CSP	Concentrated Solar Power
DEA	(South African) Department of Environmental Affairs
DoE	(South African) Department of Energy
EBRD	European Bank for Reconstruction and Development
EIA	Environmental Impact Assessment
EP	Equator Principles
ERA	(South African) Electricity Regulation Act
ESIA	Environmental and Social Impact Assessment
FOLU	Forestry and other land uses
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GUMP	(South Africa's) Gas Utilisation Master Plan
GW	Gigawatt
GWC	Growth without constraints (emissions trajectory under DEA's Mitigation Potential Analysis study)
GWP	Global Warming Potential
HRSG	Heat Recovery Steam Generator
IDZ	(Saldanha Bay) Industrial Development Zone
IEA	International Energy Agency
IEP	(South Africa's) Integrated Energy Plan
IFC	International Finance Corporation
INDC	Intended Nationally Declared Contribution (under UNFCCC)
IPCC	Intergovernmental Panel on Climate Change
IPCSA	International Power Consortium South Africa
IPP	Independent Power Producer
IPPPP	Independent Power Producer Procurement Program
IRP	Integrated Resource Plan for Electricity (South Africa)
kW(h)	Kilowatt (hour)
LHV	Lower heating value
LTMS	(South Africa's) Long Term Mitigation Scenarios
Mt	Megatonne (1 000 000 tonnes)
MW(h)	Megawatt (hour)
NCCRP	National Climate Change Response Policy (South Africa)
NDP	National Development Plan (South Africa)
OCGT	Open cycle gas turbine
PPA	Power Purchase Agreement
PPD	Peak, Plateau and Decline (GHG emissions trajectory)
PS	Performance Standard (PS1, PS2, etc. within the IFC

	Performance Standards)
PV	Photovoltaic
SC	Supercritical (steam conditions)
SO_2	Sulphur dioxide
tCO_2e	Tonnes of Carbon Dioxide equivalent
t	Tonne (1000 kg)
UNFCCC	United Nations Framework Convention on Climate Change
WBCSD	World Business Council for Sustainable Development
WAM	'With Additional Measures' (emissions trajectory under DEA's Mitigation Potential Analysis study)
WEM	'With Existing Measures' (emissions trajectory under DEA's Mitigation Potential Analysis study)
WOM	'Without Measures' (emissions trajectory under DEA's Mitigation Potential Analysis study)
WRI	World Resources Institute

Combined Cycle Gas Turbine (CCGT)	CCGT is the dominant gas-based technology for intermediate and base-load power generation. CCGT plants have basic components the same as the OCGT plants but the heat associated with the gas turbine exhaust is used in a heat recovery steam generator (HRSG) to produce steam that drives a steam turbine and generates additional electric power. Over the last few decades, impressive advancement in technology has meant a significant increase of the CCGT efficiency by raising the gas-turbine inlet temperature, with simultaneous reduction of investment costs and emissions.
GHG (Greenhouse Gas)	A gas that contributes to the greenhouse effect by absorbing infrared radiation. Unless indicated otherwise, GHG emissions are made up of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6.
Emissions factor	The average emission rate of a given GHG for a given source, relative to units of activity (e.g. tonnes CO_2e per litre diesel; tonnes CO_2e per kWh; etc.)
Equator Principles	A risk management framework adopted by financial institutions for determining, assessing and managing environmental and social risk in projects.
HRSG	A heat recovery steam generator or HRSG is an energy recovery heat exchanger that recovers heat from a hot gas stream. It produces steam that can be used in a process (cogeneration) or used to drive a steam turbine (combined cycle).
INDC (Intended Nationally Declared Contribution)	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.
National Communications (to UNFCCC)	Reports that must be submitted by all Parties to the UNFCCC in order to provide information on their GHG inventory and actions taken to address climate change.
Open Cycle gas Turbine (OCGT)	Open cycle gas turbines (OCGT) for electricity generation were introduced decades ago for peak-load service. Simple OCGT plants consist basically of an air compressor and a gas turbine aligned on a single shaft connected to an electricity generator. Filtered air is compressed by the compressor and used to fire natural gas in the combustion chamber of

	the gas-turbine that drives both the compressor and the electricity generator.
tCO_2e	Tonnes of carbon dioxide equivalent, a measure that expresses the impact of non-CO_2 greenhouse gases (CH_4, N_2O etc.) in terms of the equivalent amount of CO_2 that would create the same warming.

1 *INTRODUCTION*

This Report sets out an assessment of the greenhouse gas (GHG) emissions (carbon footprint) associated with the *1 507 MW Gas-fired Independent Power Plant to Support Saldanha Steel and Other Industries in Saldanha Bay* (The Project) in Saldanha, Western Cape Province, South Africa. The power plant is proposed by the International Power Consortium South Africa (IPCSA) as a solution to the requirement for stable, economical electricity over the long term at ArcelorMittal's Saldanha Steel site in Saldanha Bay. The Project is being developed as an independent power plant and, as required, will be developed as part of the South African Department of Energy (DoE)'s Gas to Power Programme (further information provided in *Section 3.1.2*). The impact of these GHG emissions (and therefore the impact of the Project in terms of contribution to global climate change) is assessed by way of comparing estimated annual GHG emissions from the plant with South Africa's baseline and projected annual GHG emissions, through reference to GHG magnitude scales for projects from various lender standards, and through the benchmarking of the project's emissions and energy performance against other gas-fired power stations as well as the current GHG intensity of the South African electricity grid. In addition, the degree to which the planned Project is consistent with South Africa's stated climate change and energy policy is also considered.

The Report also includes an assessment of measures for improving operational efficiency at the power plant, and highlights options to manage and reduce project-related GHG emissions during its operation.

Figure 1.1 illustrates the location of the proposed facility near Saldanha, Western Cape Province, South Africa. The Project will comprise two phases, namely:

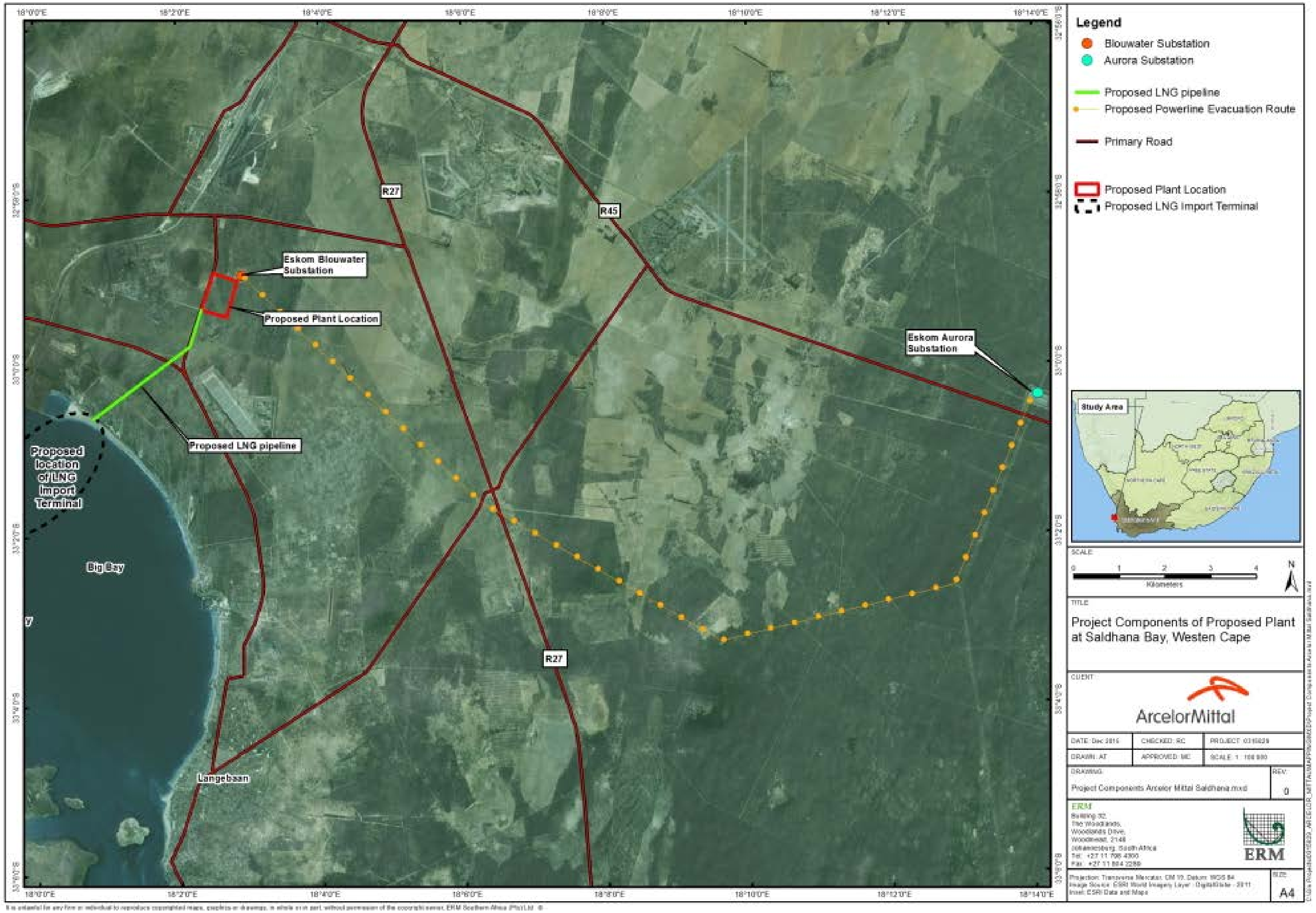
- Phase 1, in which six Siemens Trent60 open cycle gas turbines (OCGT, also known as simple cycle), each with a capacity of 42 MW at site conditions, will be installed in order to supply power to the Saldanha Steel site. Current plans are for five of these six turbines to operate at any one time, so total capacity for Phase 1 is 210 MW, with some redundancy to ensure continuous supply (1). It should be noted that thought will be given to converting at least two units to combined cycle for better efficiency at a later stage (2); and
- Phase 2, in which three Siemens SGT5-4000F combined cycle gas turbines (CCGT) will be installed, each with a capacity of 439.1 MW (total capacity 1 317.3 MW) at site conditions (3) (1). Power generated that

(1) Response to ERM's GHG data request from PowerConsult, dated 26 June 2016.
(2) As per information provided in the 'Updated Information for EIA Input and Consideration – 1 500 MW Saldanha Gas-to-Power Project' from PowerConsult, dated 12 June 2016.
(3) Response to ERM's GHG data request from PowerConsult, dated 26 June 2016.

is surplus to Saldanha Steel's requirements will be made available to industries within the Saldanha Industrial Development Zone (IDZ) and/or Municipalities within the Western Cape Province.

(1) Note that the total capacity according to the 210 MW (Phase 1) + 1 317.3 MW (Phase 2) is 1 527.3 MW. The slight discrepancy between this figure and the 1 507 MW mentioned for the whole plant is due to the estimated parasitic loads of the plant. This value will be confirmed upon final selection of the power plant equipment, and this report refers to an overall capacity of 1 507 MW.

Figure 1.1 Location of the proposed Gas-fired Power Plant at Saldanha, Western Cape Province



1.1 *ABOUT ERM*

ERM is a leading provider of sustainability services, covering the full spectrum of environmental, health and safety, risk and social consulting issues. ERM established a permanent presence in Sub-Saharan Africa in 2003 and has offices in South Africa (Cape Town, Durban, and Johannesburg), Kenya (Nairobi) and Mozambique (Maputo). ERM has over 180 staff involved in environmental and social projects throughout the continent.

ERM Southern Africa's Air Quality and Climate Change Practice comprises a team dedicated professionals with experience in a wide range of climate change mitigation and adaptation services. Since ERM established a presence in South Africa, we have developed over 60 carbon footprints in South Africa alone. In addition, we have reviewed South Africa's National Greenhouse Gas Inventory for two different reporting periods, financially quantified the physical risks of climate change for clients and assisted others with identifying realistic and achievable energy savings opportunities. ERM has supported numerous clients with GHG assessments in capital project development as part of the Environmental Impact Assessment (EIA) process in South Africa and globally, applying a methodology that draws on guidance from international lender standards including the International Finance Corporation (IFC), European Bank for Reconstruction and Development (EBRD) and Equator Principles (EP). The authors of this study have undertaken quantitative GHG emissions assessments across the power, oil and gas, mining and infrastructure sectors, and have significant experience in the development and application of GHG and energy management strategies more broadly. The main author of this study was Sarah Bonham, a Senior Consultant in ERM South Africa's Air Quality and Climate Change Practice, with David Mercer, a Technical Director in the same team, and Charles Allison, Partner for ERM UK's Air Quality and Climate Change team, providing support and reviews. Sarah Bonham joined ERM in 2010 and is a senior consultant in the Sustainability and Climate Change practice, based in Johannesburg, South Africa. Her experience spans the climate change mitigation and adaptation fields.

In the climate change mitigation field, Sarah has extensive experience in conducting carbon footprint studies for corporate clients in order to calculate Scope 1, 2 and 3 GHG emissions arising from their global operations, and in supporting clients with the annual disclosure on their climate change performance to the Carbon Disclosure Project (CDP). She has also conducted project-based GHG assessments as part of the ESHIA process.
In the adaptation field, her work involves assisting clients with assessing climate change risk on business assets and operations, and managing that risk through adaptation measures. She has worked on site-specific climate risk and adaptation assessments (e.g. as part of the ESHIA process), as well as assessments that cover global portfolios of assets and operations. Sarah holds an MSc in Environmental Technology (specialism: Business and Sustainability) from Imperial College London and a BA in Biological Sciences from Oxford University.

2 METHODOLOGY

2.1 IMPACT ASSESSMENT METHODOLOGY

A traditional impact assessment is conducted by determining how the proposed activities will affect the state of the environment prior to development of a project. In the case of GHG emissions, this process is complicated by the fact that the impact of GHG emissions on the environment cannot be quantified within a defined space and time.

The greenhouse effect occurs on a global basis and the geographical source of GHG emissions is irrelevant when considering the future impact on the climate. It is not possible to link emissions from a single source – such as the Project - to particular impacts in the broader study area.

As such, this specialist study does not consider the physical impacts of climate change resulting from increasing GHG emissions, but instead will assess the impact of the Project's GHG emissions by way of:

- Understanding the scale of the Project's GHG emissions by comparing total emissions to GHG magnitude ratings and scales for projects (developments) that have been developed by various international lender organisations or groupings, including the IFC, the EBRD, and the EP;
- Assessing the GHG performance of the Project relative to reference benchmarks on the GHG intensity of electricity production, including the GHG intensity of South Africa's grid electricity and of other gas-fired power plants; and
- Understanding of the impact of the Project on South Africa's national GHG emissions inventory, and consideration of the alignment of the Project with the country's climate policy and international GHG reduction commitments.

The 'Project' in the context of this study refers to the proposed (final) 1507 MW Gas-fired Independent Power Plant to Support Saldanha Steel and Other Industries in Saldanha Bay, and the Project's impact, in terms of GHG emissions (and contribution to global climate change), reflects GHG emissions from the operation of this power station.

2.1.1 Approach to Assessing Impact Significance

The following criteria are used in order to assess impacts for the purposes of the specialist studies within the Saldana Gas-fired Power Station EIA:

- **Type**: A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect);
- **Extent**, indicating the 'reach' of the impact;

- **Duration**, indicating the time period over which a resource / receptor is affected;
- **Scale**, indicating the size of the impact; and
- **Frequency**, giving a measure of the constancy or periodicity of the impact.
- The **magnitude**, which a function of extent, duration, scale and frequency and describes the degree of change that the impact is likely to impart on the resource / receptor; and
- The **sensitivity/vulnerability/importance** of the impacted resource/receptor.

Significance is subsequently assessed on the basis of the magnitude rating of the impact, and the sensitivity/vulnerability/importance rating for the resource/receptor, and ranked as either Negligible, Minor, Moderate, or Major.

In the context of climate change impacts associated with GHG emissions from the Project (this study), extent, duration, and frequency are the same irrespective of the Project context and the scale of its GHG emissions, and therefore do not form a good basis on which to assess the significance of the impacts associated with GHG emissions. Specifically, the extent of GHG (climate change) impacts is global, the duration of the impact is permanent (CO_2 has a residence time in the atmosphere of approximately 100 years), and the frequency of the impact is constant since GHG emissions will be produced throughout the lifetime of the plant.

As such, GHG impact significance is determined on the basis of the assessment of the scale of the GHG emissions from the plant using benchmarks from international lender standards, further informed by reference benchmarks on the GHG intensity of electricity production for similar facilities and according to the grid emissions factor in South Africa, as well as an analysis of the Project's alignment with South Africa's energy and climate change policies, as described above and also in *Section 4.2*.

2.2 *CARBON FOOTPRINT METHODOLOGY*

A carbon footprint is a measure of the estimated GHG emissions produced directly and indirectly by an individual, organisation, facility or product. The calculation of a carbon footprint generally involves the following equation.

Carbon footprint emissions = Activity data x Emissions factor x Global warming potential

- *Activity data* relates to the emission-causing activity, e.g. the combustion of fuel (gas, coal, diesel etc.);
- *Emission factors* ('EFs') convert the activity data into tonnes of the relevant GHG emitted; and

- *Global warming potentials* ('GWPs') (1) are applied to non-CO_2 GHGs to convert the result to carbon dioxide equivalent ('t CO_2e').

Good practice for calculating a carbon footprint dictates that actual activity data (e.g. m^3 of natural gas or litres of diesel consumed) for a financial year is used. Given that this project involves an estimation of a future carbon footprint for activities yet to begin, a series of assumptions have been made in order to forecast the activity data required to undertake this calculation. Activity data has been sourced from PowerConsult Engineering Ltd., the project engineers, using an excel-based GHG information request template issued by ERM and through follow-up communications by email.

The following methodologies have been used in order to estimate the GHG emissions from the plant:

- Greenhouse Gas (GHG) Protocol: Corporate Accounting & Reporting Standard (World Resources Institute/World Business Council for Sustainable Development);
- Intergovernmental Panel on Climate Change (IPCC) 2006 GHG Inventory guidelines; and
- American Petroleum Institute's (API) 2009 Compendium of Greenhouse Gas Emissions.

The latter (API Compendium) informed a material balance approach to calculating emissions from the combustion of natural gas at the power plant, based on fuel usage data and fuel carbon analyses. More detail on this methodology, as well as the data sources and any assumptions made, is given in *Section 4.1.*

2.3 *SCOPE OF THE CARBON FOOTPRINT*

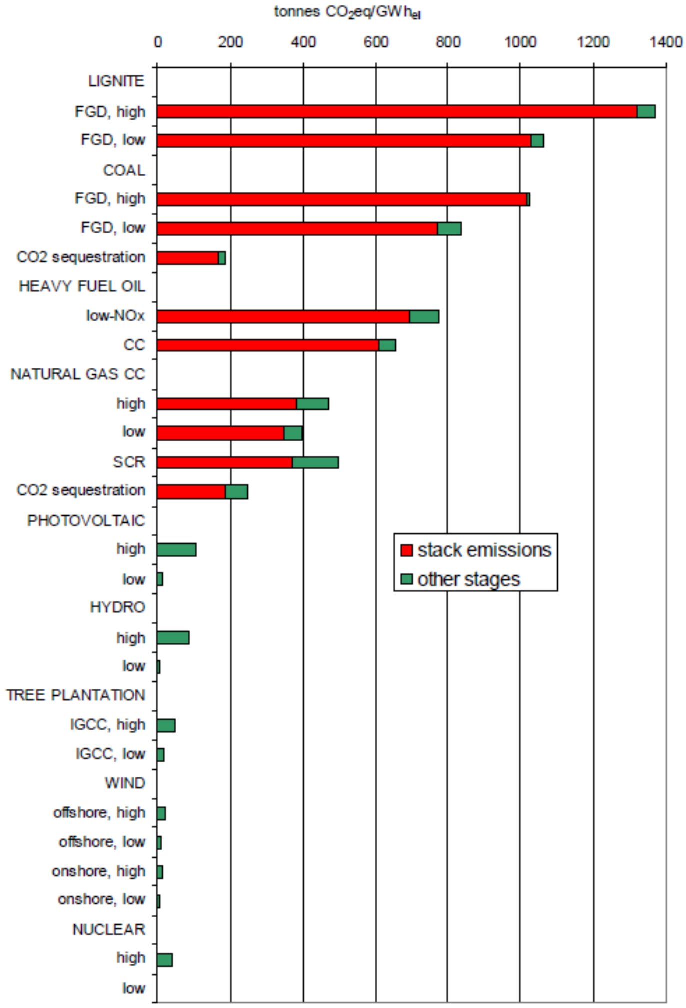
The carbon footprint includes all direct GHG emissions from sources owned or under the operational control of the Project ('Scope 1' emissions). Indirect emissions from the consumption of purchased electricity ('Scope 2' emissions) are not relevant because electricity needs for the power plant (i.e. for power plant auxiliary power) will be derived from the plant itself.

Emissions have been calculated for (total) 1 507 MW Project for the operational phase only. Emissions associated with the construction and eventual decommissioning of the Project are excluded from the assessment, since these are likely to be insignificant in the context of the Project's operational emissions arising from the combustion of CNG or LNG for power generation (World Energy Council, 2004). *Figure 2.1* illustrates the significance of the contribution

(1) A number of different gases contribute to the greenhouse effect. The effect that they have varies according to their relative ability to trap and retain radiant energy arriving at the Earth. These differences are reflected in the gases' global warming potentials (GWP), which are a measure of their greenhouse effect 'strength' relative to CO_2. The GWP of CO_2 is 1, methane (CH_4) is 25, and nitrous oxide (N_2O) is 298 for a 100 year time horizon. Figures are taken from the IPCC's Fourth Assessment Report, in line with the GHG Protocol.

of direct (stack) emissions to overall life cycle emissions from combined-cycle natural gas plants, in comparison to non-stack emissions from other life cycle stages.

Figure 2.1 ***Comparison of direct (stack) vs. indirect (other life cycle stages) emissions from different energy systems***



SCR = Selective catalytic reduction; CC = Combined cycle; and 'High' and 'Low' represent the highest (high) and lowest (low) values from various LCA studies assessed.
Source: World Energy Council (2004)

The timeframe for the phases of the Project (specific to the power plant itself) are illustrated in *Table 2.1* below, together with confirmation of which phases are in the scope of the GHG assessment.

Table 2.1 ***Project Phases in Scope***

Phase	**Timeframe**	**Duration**	**In / Out of Scope**
Construction – Phase 1: Total installed capacity of 252 MW • Installation of six open cycle Siemens Industrial Trent 60 gas turbines (T1, T2, T3, T4, T5 and T6), each with 42 MW capacity, to provide peak power.	Early 2017 to September 2018	15 – 18 Months	Out of Scope

Phase	Timeframe	Duration	In / Out of Scope
Construction – Phase 2: Total installed capacity 1 317 MW • Installation of three Siemens SGT5-4000F single shaft combined-cycle gas turbines each with 439.1 MW capacity.	2017/18 to 2019/20	18 - 20 months	Out of Scope
Operations – Phase 1: • 252 MW generating capacity but with five of the total six Trent 60 turbines running at any one time	September 2018	Approx. 30 years*	In Scope
Operations – Phase 2: • 1 317 MW generating capacity from the three Siemens SGT5-4000F combined-cycle gas turbines	Around 2020	Approx. 30 years*	In Scope
Decommissioning	(Estimated based on 30 years' operating life of plant): Around 2050	Not yet known	Out of Scope

*Initial plant life will be designed for 25 to 30 years. Upgrades during the life of the plant can increase the design life to 50 years.

Emission estimates for the future activities of the plant cover those activities which are under their direct operational control. The GHG Protocol divides emissions into three 'Scopes'. For the purposes of this study, only Scope 1 emissions have been estimated since Scope 2 emissions are not applicable (the plant will use its own electricity rather than grid electricity). The emission Scopes are defined as:

- Scope 1 – direct emissions from sources owned or under the operational control of the company;
- Scope 2 – indirect emissions from the consumption of purchased electricity; and
- Scope 3 – indirect emissions an optional reporting category allowing for other indirect emissions associated with, but not controlled by the company.

The concept of emission Scope is further illustrated in Figure 2.2.

Figure 2.2 GHG Scope Illustration

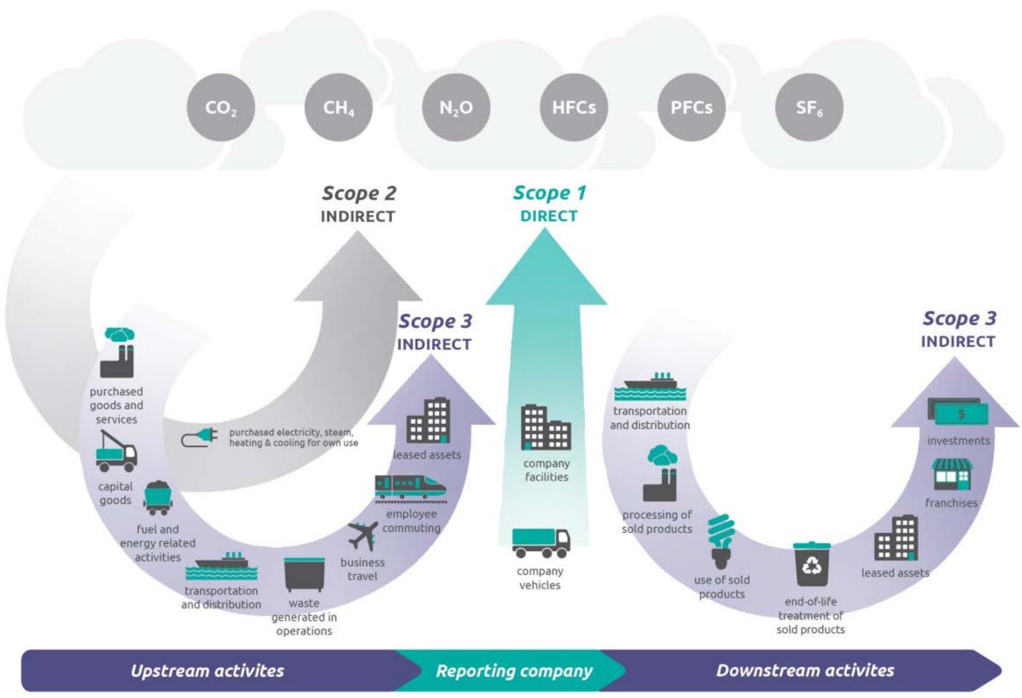


Figure courtesy of GHG Protocol

The following sources of Operational Phase emissions arising from activities under the operational control of the Project are included in the assessment:

- Scope 1 stationary combustion emissions from the combustion of natural gas to produce power (electricity); and
- Scope 1 stationary combustion emissions from the combustion of LPG used for cold start-ups at the power station in the event of all turbines cutting out (black start).

The following sources of Operational Phase emissions arising from activities under the operational control of the Project are *excluded* from the assessment, as these are considered to be negligible in comparison to the above emissions from the combustion of natural gas and LPG:

- Scope 1 emissions from non-energy products associated with the use of lubricants for machinery;
- Scope 1 emissions associated with on-site transport related activities;
- Scope 1 emissions associated with any physical or chemical process activity on site, such as processing of waste; and
- Fugitive emissions, such as fuel leakage from equipment and plant.

2.4 *ASSUMPTIONS*

The following should be noted with respect to any assumptions made for the purposes of this assessment:

- This study uses information and data on the Project given in the Scoping Report and given in response to ERM's GHG data request.
- This study refers to a variety of policy documents published by the South African government in order to undertake an analysis of South Africa's energy and climate policy, to describe South Africa's current national GHG emissions and inventory, and to project the country's GHG emissions forward to 2050 (done as part of the *Baseline Description*). In the absence of any information to suggest otherwise, the study assumes that existing policies and plans for both the energy sector and with respect to climate change mitigation will be implemented as described in existing policy documents. Any key assumptions made either in the policy documents or in any related analysis have been stated in the report.

2.5 *LIMITATIONS*

The limitations associated with the study are outlined below:

- As part of the Impact Assessment, the study gives a long-term view of GHG emissions from the Project, and in order to understand the implications of the Project on South Africa's current and future national GHG emissions, and the impact on the country's climate change mitigation commitments and reduction targets, GHG emissions from both the Project and South Africa as a whole are projected forward to 2050. The study uses information in published policy documents and plans to inform South Africa's future GHG trajectory, and assumes that the plant will operate as planned in the Scoping Report to 2050 (i.e. follows a constant GHG trajectory where annual GHG emissions are constant over time). Any changes with respect to national energy policy and planning, and with respect to the specific operating context and mandate for the Project, will affect the analysis in this study.
- This study does not include an assessment of emissions associated with the construction phase, or an assessment of Scope 3 emissions associated with the production and transport of fuel (LNG and CNG) to the plant. As discussed above, emissions from the construction phase are likely to be minimal compared to the emissions associated with the combustion of natural gas during operations. Emissions associated with the production and transport of fuel could be significant, but represent a source of indirect emissions that are not under the Project's operational control (Scope 3), and at present details on the source and transport of gas have not yet been confirmed. Considering the information available, the likely magnitude of the different emissions sources (with the bulk of life cycle emissions likely coming from the combustion of natural gas for power generation), and also guidance from the IFC Performance Standards (Performance Standard 3 on Resource Efficiency and Pollution Prevention states that '*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 used by the project*' and therefore focuses on Scope 1 and 2 emissions), this

study therefore focuses on an assessment of direct GHG emissions from the plant.

2.6 CONTENT OF THE SPECIALIST REPORT CHECKLIST

The content of this report has been prepared in terms of Regulation GNR 982 of 2014, Appendix 6, as shown in *Table 2.2*.

Table 2.2 Specialist Report Checklist

Contents of this report in terms of Regulation GNR 982 of 2014, Appendix 6	**Cross-reference in this report**
(a) details of— the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section 1.1 (About ERM) in the GHG assessment report
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Attached to this report
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Sections 1 (Introduction) and 2 (Methodology) of the full GHG Study
(d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A – no site visit was required for the GHG assessment. Section 4.1 and 2.2 of the full GHG study sets out the desk-based data collection process
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	Section 2 (Methodology) in the full GHG study
(f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	N/A – it is not posisble to link GHGs from the project to local, site-specific impacts so no site sensitivity assessment is undertaken. The specific GHG impact assessment methodology is described in Section 2 of the full GHG study
(g) an identification of any areas to be avoided, including buffers;	N/A – see (f) above
(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;	N/A – see (f) above
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2.4 (Assumptions) and 2.5 (Limitations) in the full GHG study
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;	The study results are presented in Section 4 (Impact Assessment). Mitigation measures are presented in Section 5 (Emissions Management Measures). It is not possible to identify alternatives in the context of this project for the reasons outlined in Section 5.6, and within the response to the DEA's comments, refer to Comments and Responses Report, Annex B of EIA.
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Annex B of EIA
(p) any other information requested by the competent authority.	N/A

3 BASELINE DESCRIPTION

This section presents the context in which the analysis of the Project's GHG emissions should be understood, and against which the Project's GHG and climate change impacts will be assessed. Specifically, it presents:

- South Africa's energy policy context, including the rationale for the IPP Procurement Programme (and specifically the Gas to Power IPP Programme, applicable to this Project);
- The country's climate policy context, including the national GHG emissions inventory, international GHG emission reduction commitments, and a future GHG trajectory under a range of scenarios;
- Reference benchmarks on the GHG intensity of gas-fired power plants using different technologies, and on the GHG intensity of South Africa's grid electricity; and
- Reference benchmarks from various international lender standards on the magnitude of GHG emissions from a project or development.

The above analysis is used to contextualise the Project's emissions and to assess the climate change impact of the Project in terms of GHG emissions into the atmosphere and contribution to global climate change, in addition to its contribution to South Africa's climate change commitments.

3.1 SOUTH AFRICA'S ENERGY LANDSCAPE

The 2013 National Development Plan (NDP) defines a long term vision for South Africa to 'Eliminate poverty and reduce inequality by 2030' and presents a range of national development priorities (e.g. education, provision of energy, and infrastructure) to achieve this. Various government departments contribute to the process and their agendas must be considered jointly to understand the dynamic between economic, social and environmental goals. From an energy perspective, the DoE is tasked with developing energy regulation, which comprises policy, action plans, and legislative directives, to ensure security of energy supply at the right price.

3.1.1 Energy Planning

White Paper on Energy Policy (1998)

The *White Paper on the Energy Policy of the Republic of South Africa (1998)* (hereafter 'White Paper') was prepared and finalised in 1998 in order to clarify the South African Government policy for the entire energy system, covering both supply and demand of energy for a decade. The major objectives stipulated in the White Paper included stimulating economic development, managing energy-related environmental impacts, and securing supply through diversity.

The White Paper specifically noted the Government's intention to allow for the entry of multiple players into the electricity generation market, to further the development of renewable energy technologies, and to allow for privately owned distribution (see *Section 3.1.2* for a discussion of the entry of IPPs into the energy market). The White Paper confirmed the potential for significant growth in South Africa's gas industry and nuclear energy.

From 1998 to 2008 however, no significant investments in additional electricity generation were made which resulted in an energy crisis and South Africa experiencing rolling electricity black outs in 2008. At this time, there was a shift to focus on demand-side management opportunities in the short-term whilst ensuring supply-side initiatives through the implementation of cross sector energy planning (Henneman et al., 2015). An overview of some of the key plans and policies that comprise Government's response to the energy crisis, and which are intended as a framework to create stability within the energy sector going forward, is presented below.

Integrated Resource Plan for Electricity 2010-2030 (2011)

In 2011 the DoE promulgated the first iteration of the *2010-2030 Integrated Resource Plan (IRP) for Electricity* ('IRP') (DoE, 2011). The IRP 2010-2030 (2011) constitutes a 20 year electricity capacity plan, formulated to guide decision making around electricity policy and the future make up of South Africa's total generation capacity between 2010 and 2030 in terms of the proportion of total electricity to be sourced from coal, nuclear, hydro/pumped storage, imported gas, wind, and solar, including Concentrated Solar Power (CSP) and Photovoltaic (PV). The IRP 2010-2030 (2011), having been promulgated by parliament in 2011 and published as a notice under the Electricity Regulation Act (ERA) No. 4 of 2006, provides the adopted legal basis for Government's electricity planning. It also aims to provide clarity around the Government's plans for acquisition of least-cost energy resources. The IRP 2010-2030 (2011) factored in GHG emissions more fully than previous plans for the electricity sector, through factoring in the GHG emissions limits specified in South Africa's Long term Mitigation Scenarios (LTMS) 2007 study (see *Section 3.2.1*), whilst also taking into account the impacts of the 2008 economic recession on electricity demand.

In 2010, 90% of South Africa's energy consumption was generated using coal, 5% using nuclear and 5% using hydropower (DoE, 2011). The IRP 2010-2030 (2011) proposed that South Africa would reduce its dependence on coal based electricity generation from 90% to 65% by 2030 and transition to alternative generation options, so that electricity generated using nuclear power would comprise 20% of the total electricity share in 2030, and 14% would be generated from renewables including wind and hydropower (5% each), PV (3%), and CSP (1%) [1]. This transition was intended to be supported by a shift in new build options expected to come on stream over the period 2010-2030,

(1) Renewables as defined per the IRP 2010-2030 (2011)

with coal expected to make up 29% (including Medupi and Kusile (1)), renewables (including imported hydropower and pumped storage) 40%, nuclear 17%, and gas 4% of the additional 56 539 capacity (2) (net 45 637 MW, including decommissioning of 10 902 MW) planned between 2010 and 2030 (3).

IRP 2010-2030 Update (2013)

The IRP 2010-2030 (2011) was designed to be a 'living document' with a two year review cycle. As such, in November 2013 the DoE issued a draft update of the document, hereafter IRP 2010-2030 (2013), for public comment. The original date set for Cabinet's final approval of the IRP 2010-2030 (2013) was established as March 2014 (DoE, n.d.1). Given the delay in finalising the update, both Eskom and the DEA's 2014 GHG Mitigation Potential Analysis study (see *Section 3.2.3*) defer to the data contained in the promulgated IRP 2010-2030 (2011) in the analysis applied to current and future electricity planning.

The draft update of the IRP 2010-2030 (2011) in 2013 followed a prolonged period of depressed economic growth which has a direct correlation to electricity demand in the country. The 2013 update estimated an overall peak generation demand of 6 600 MW less than the first iteration of the IRP and a different contribution from electricity generation technology options.

Table 3.1 below illustrates the proposed electricity generation mix for South Africa in 2030 based on the IRP 2010-2030 (2013) (column 3) and contrasts this to the original IRP 2010-2030 (2011), and existing electricity capacity as of 2010 (columns 1 and 2). The data presented in the table for 2030 (columns 2 and 3) reflect the 'base case' for 2030 as defined in the IRP process.

Table 3.1 ***Proposed electricity generation mix for 2030 based on the IRP 2010-2030 produced in 2011 and 2013 against 2010 baseline capacity***

Energy Technology Option in 2030	**2010 Baseline capacity in MW** (DoE, 2011) (4)	**IRP 2010-2030 (2011) Generation mix for 2030 in MW**(DoE, 2011) (5)	**IRP 2010-2030 (2013) Generation mix for 2030 in MW** (DoE, 2013b) (6)
Existing Coal*	34 435	34 821	36 230
New Coal**	N/A	6 250	2 450
CCGT (Combined Cycle Gas Turbine)	0	2 370	3 550
OCGT (Open Cycle Gas Turbine)	2 400	7 330	7 680
Hydro Imports***	0	4 109	3 000
Hydro Domestic	600	700	690

(1) Medupi and Kusile are two new large coal-fired power stations currently under construction by Eskom. Each will have a capacity of approximately 4 800 MW.

(2) The remaining 15% of planned new capacity comprises diesel Open Cycle Gas Turbines (OCGT) and co-generation.

(3) Note that the IRP factors in decommissioning of 10 902 MW, bringing net new build to 41 346 MW.

(4) Table 27 – Existing South African Generation Capacity Assumed for IRP

(5) Table 4 – Policy-adjusted IRP Capacity

(6) Table 2 – Technology options arising from IRP 2010 and the Update Base Case in 2030.

Energy Technology Option in 2030	**2010 Baseline capacity in MW** (DoE, 2011) [4]	**IRP 2010-2030 (2011) Generation mix for 2030 in MW**(DoE, 2011) [5]	**IRP 2010-2030 (2013) Generation mix for 2030 in MW** (DoE, 2013b) [6]
PS (Pumped Storage) (incl. Imports)***	1 400	2 912	2 900
Nuclear	1 860	11 400	6 660
PV (Photo-voltaic)	0	8 400	9 770
CSP (Concentrating Solar Power)	0	1 200	3 300
Wind	0	9 200	4 360
Other	730	890	640
Non-Eskom***	3 260	N/A	N/A
Total Installed Capacity (Eskom)	**40 635**	**N/A**	**N/A**
***Total Installed Capacity** (Eskom and non-Eskom)*	**43 895**	**89 532**	**81 230**

**Existing Coal in 2030 (columns 2 and 3) includes Medupi and Kusile (Eskom power stations currently under construction), which is do not play a role in 2010 Baseline Capacity. Existing coal indicated for 2030 in columns two and three therefore takes into account the decommissioning of older power stations*
***Including Coal Baseload IPP Programme*
****For the 2010 Baseline capacity as per IRP 2010-2030 (2011), imports for Hydro and Pumped Storage are incorporated into non-Eskom installed capacity. Based on detail in the draft updated IRP 2010-2030 (2013), non-Eskom installed capacity as of 2010 includes imported hydro (45%), coal-fired power plants (28%), co-generation (11%), medium-term power purchase program (8%), pumped storage (5%) and diesel temporary plants (3%)*

Additional cases are considered within the IRP 2010-2030 (2013) driven by varying assumptions for example around technology costs, economic growth, and potential extension of the lifespan of the existing Eskom fleet, though the 'base case' serves as the reference for planning.

Draft 2012 Integrated Energy Plan (IEP)

The purpose and objectives of the Integrated Energy Plan (IEP) are informed by the National Energy Act, 2008 (Act No. 34 of 2008) (1). The core purpose of the IEP is to guide the development of energy policies, the selection of appropriate technology to meet energy demand, and to guide investment in these technologies. It also aims to assist energy policy makers in understanding how energy policies contribute to other national policy imperatives (such as those espoused in the NDP). The focus of the IEP is not to ensure if or how energy needs are met, but rather a long term vision of for how energy can be optimally used. The IRP can be considered a sub-set of the IEP as it only focuses on electricity, with the IRP as an input into the IEP.

The IEP analyses the results of a Base Case, and five Test Cases with respect to future energy demand to 2050 in South Africa (DoE, 2013a). These cases integrate the data available on South Africa's energy and electricity landscape (including current policy implications) in order to model various scenarios for future energy use. The Base Case represents 'business as usual' where

(1) Specifically, Chapter 3 *Integrated Energy Planning* As per the Act, the Integrated Energy Plan must deal *inter alia* with issues relating to the supply, transformation, transport, storage of and energy demand – over a 20 year time horizon.

prevailing energy policy conditions are projected into the future, whilst the Test Cases model policy alternatives, including:

- The Peak, Plateau, Decline (PPD) Emissions trajectory (*PPD Emissions Limit Test Case*);
- Influence of no nuclear energy builds in future electricity mix (*Emissions Limit – No Nuclear Build Programme Case*);
- Influence of varying renewable energy targets (*Renewable Energy Target Case*);
- Influence of replacing nuclear with natural gas (*Emissions Limit Natural Gas Case*); and
- Influence of the constraints imposed by carbon taxes (*Carbon Taxes Case*).

These Test Cases are intended to integrate the objectives of a range of policies impacting the energy sector (1) including the broad goals of the NDP, the IRP and South Africa's National Climate Change Response Policy ('NCCRP', discussed in *Section 3.2*) and highlight their implications, for example through the introduction of a carbon tax, on future energy options and costs. The analysis produced in the IEP reveals that coal technologies continue to play an important role in energy generation across all test cases up to 2030, when the existing fleet of coal power plants are assumed to begin entering retirement. New coal generation, e.g. constructed after the IEP publication date, continues to contribute to electricity supply up to 2050 in only two of the cases (50 GW by 2050 in the Base Case and 30 GW in the Renewable Energy Target Case). Carbon Capture and Storage (CCS) technologies were not considered as options due to their relatively high cost (DoE, 2013a).

The importance of renewables in Government's energy planning are notable, given that wind and solar energy feature prominently across all test cases underpinning the IEP in terms of the final contribution these sources make to the total energy mix. New natural gas options do not feature prominently in any of the test cases. The DoE is however in the process of finalising a Gas Utilisation Master Plan (GUMP) for South Africa (IPP Gas, 2016) (further details below) (2). The IEP was made available for public consultation in 2013 and is still in the process of being finalised. The development of South Africa's electricity generation in recent years has been done against the promulgated IRP 2010-2030 (2011) (DoE, 2013a).

(1) The IEP identifies eight key objectives that form the basis of the criteria against which the IEP evaluates different policy alternatives and proposals, six of which are relevant to the energy sector, specifically;

1. Security of energy supply.
2. Minimise cost of energy.
3. Increase access to energy.
4. Diversify supply sources and primary energy carriers.
5. Minimise emissions from the energy sector.
6. Improve energy efficiency (reduce energy intensity of the economy).

(2) The GUMP has been conceived as a roadmap for the development of a gas economy in South Africa and aims to stimulate local demand for gas through a 'Gas to Power Programme'. Government anticipates that in alignment with the GUMP, the Gas to Power Programme will enable the development of South Africa's gas sector.

3.1.2 *Delivery of additional energy capacity: the Independent Power Producers Procurement Programme*

In May 2011, the DoE gazetted the Electricity Regulations on New Generation Capacity under the Electricity Regulation Act (ERA) of 2006 (No. 4 of 2006). The new regulations establish both the guidelines and rules pertaining to the procurement of energy from IPPs, as well as the structure and process of an IPP Bid Programme (Eskom, 2015). Specifically Section 34 (1) of the ERA notes that 'The Minister of Energy may, in consultation with the Regulator:

- determine that new generation capacity is needed to ensure the continued uninterrupted supply of electricity; an
- require that new generation capacity must-
    - be established through a tendering procedure which is fair, equitable, transparent, competitive and cost-effective, and
    - provide for private sector participation.'

The objectives of these regulations include the regulation of entry by a buyer and an IPP into a power purchase agreement (PPA), the facilitation of fair treatment and the non-discrimination between IPP generators and the buyer. The IPP Procurement Programme (IPPPP) Office was established in 2010 by the DoE, National Treasury and the Development Bank of Southern Africa (DBSA) with the primary mandate to procure energy from IPPs. The introduction of IPPs into South Africa's generation mix is deemed critical to ensure security of supply for South Africa. During the period of rolling blackouts in 2008 Eskom was operating at a reserve margin estimated at around 8% or lower, whilst global energy experts note that ideally a 10-15% reserve margin is required in a stable electricity system and South Africa is not currently operating within this range (Eberhard, 2008).

The procurement mandate of the IPPPP is aligned to the capacity allocated to the various electricity generation sources in the IRP 2010-2030 (2011) (1). As of 31 December 2015, six bidding rounds had been completed (comprising various bidding 'windows'), with 6 376 MW procured from renewable resources and 2 021 MW operationalised across 40 separate IPPs (IEEJ, 2016). The IPPPP Office has in addition indicated its intention to commence with the procurement of gas to power energy resources through the Gas to Power Programme and implementation of the GUMP, discussed in more detail in the section that follows.

Another imperative of the IPPPP is to introduce competitive pricing with respect to energy procurement. Whilst details of the IPP Gas procurement framework have yet to be finalised, it is likely that bidders will be obliged to convey the price at which capacity/energy will be sold and then evaluated on

(1) Some energy projects were developed prior to the gazetting of the New Generation Regulations, these include Eskom's current new build programme, the medium term power purchase programme (~400MW) and the DoE's open cycle gas turbine (OCGT) IPP project (~1020MW) (Eskom 2016).

a comparative basis (as per IPP Coal, 2016). Bidders will also be required to comply with South Africa's Broad Based Black Economic Empowerment (BBBEE), including ownership requirements [(1)], as well as to South Africa's environmental regulations.

The IPPPP mandate regarding capacity to be procured and progress of bidding processes and commercial operation dates are summarised in *Table 3.2* below. As indicated, the stage of bidding process and commercial date achieved or planned for operations vary across the energy carriers. The Renewable Energy IPPPP has achieved greatest maturity, as of December 2015 100% of the projects submitted in the first bid window had achieved financial close and grid connection, with a further 89% (window 2) and 5.8% (window 3) connected to the grid. This represents approximately 2 021 MW of connected capacity. In addition, 6 377 MW of renewable (wind, solar PV, solar CSP, landfill gas, biomass and small hydro) projects were procured between November 2011 and December 2015 (IEEJ, 2016).

Table 3.2 Overview of IPPPP to Date

Type of Energy Source	Total Planned Capacity (MW)	Stage of Bids	Commercial Operation Date
Renewable Energy*	13 225	Various Stages: Bids 1-3 have achieved financial close	Grid Connection across bid windows 1-3– new capacity to be added in phased approach
Imported Gas to Power	3 000	Preparation Phase	2021
Coal *local and cross border*	2 500	Bid Completed	2021 Onwards
Cogeneration	1 800	Bid Completed	2016 –2018
Floating Power Plants		Conceptualisation Phase – Project on Hold	N/A
Domestic and Piped gas	126	Preparation Phase	2018-2019
Peaking Power	1 020	Bid Completed	2015-2016

Source: IEEJ, 2016

The Gas to Power Programme and GUMP

The Ministers determinations require that 3 126 MW of baseload and/or mid-merit energy generation capacity is needed from gas-fired power generation to contribute towards energy security. The gas required for such power generation will be from both imported (3 000 MW) and domestic (126 MW) gas resources (DoE, n.d.2) (IEEJ, 2016). This forms the basis of the Gas to Power Programme.

(1) Specifically, 51% equity participation by South Africans and at least 30%of the shares in the project company owned by black South Africans.

The Gas to Power Programme is informed by the GUMP, which in turn supports the objectives of the IEP. The GUMP is a 30 year roadmap for the development of a gas economy in South Africa, outlining the potential and opportunity, and a plan for how this can be achieved.

A key challenge in developing the country's gas sector relates to bringing both gas demand and supply on stream at the same time. The Gas to Power programme aims to create significant demand for gas and enable the initial development of South Africa's gas industry. With the current absence of indigenous gas resources, gas will initially need to be imported in the form of liquefied natural gas (LNG) or compressed natural gas (CNG) by ship or by pipeline. In the longer term, the development of indigenous gas sources including shale gas, offshore production, and coalbed methane are targeted.

The procurement framework for both the domestic and imported gas programmes under the Gas to Power programme has now been developed, and a request for information (RFI) released and responses analysed in July 2015 in order to inform the request for proposals which is due to be released in the second quarter of the 2016/17 financial year (IEEJ, 2016) (IPP Projects, 2016). It should be noted that the proposed Project was initially developed outside of the Gas to Power Programme, primarily driven by the need to meet the power requirements of ArcelorMittal's Saldanha Steel plant. However, as required, the Project will be aligned with the Gas to Power Programme, and its implementation is aligned more broadly with the requirement to add additional capacity to the South African grid since it will help to reduce the load on the grid, and in Phase 2 will likely directly feed power into the grid.

3.2 *SOUTH AFRICA'S CLIMATE CHANGE LANDSCAPE*

The Department of Environmental Affairs (DEA) is responsible for ensuring delivery of South Africa's climate change commitments as laid out in the National Climate Change Response Policy (NCCRP), published in October 2011, and confirmed through South Africa's recent commitments to the United Nations Framework Convention on Climate Change (UNFCCC).

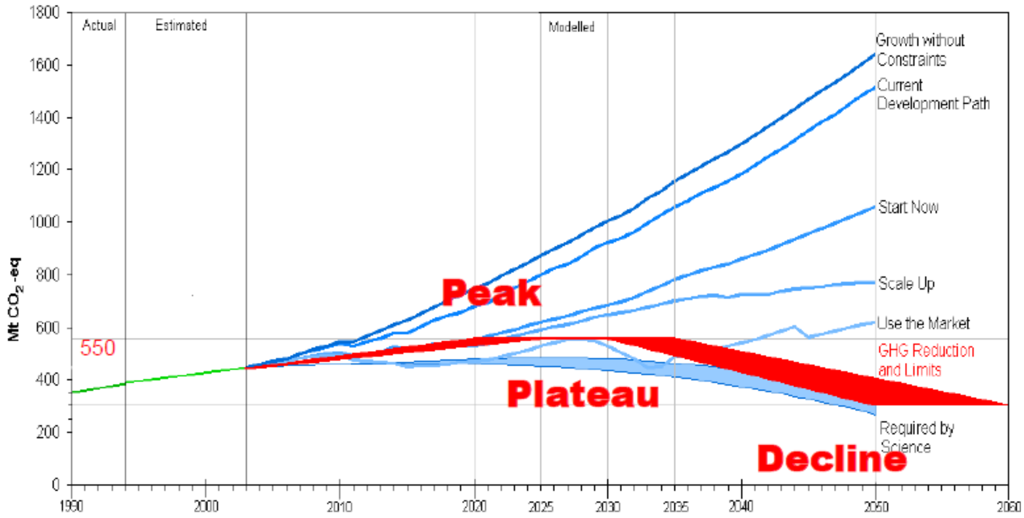
3.2.1 *National Climate Change Response Policy 2011*

The NCCRP establishes South Africa's approach to addressing climate change, including adaptation and mitigation responses. The NCCRP formalises Government's vision for a transition to a low carbon economy, through the adoption of the 'Peak, Plateau and Decline' (PPD) emissions trajectory. The NCCRP establishes the PPD as the benchmark against which South Africa's future mitigation actions will be measured (DEA, 2011). The research underpinning the PPD trajectory and its implications for future electricity generation are described in further detail in the sections below.

South Africa PPD Emissions Trajectory

In 2007, the Government commissioned the Long term Mitigation Scenarios (LTMS) report to investigate potential pathways for South Africa to mitigate its GHG emissions (DEAT, 2007). The Government published the results of the LTMS in 2008, and in 2009 used the PPD trajectory that emerged from the process (illustrated in *Figure 3.1*) to define its first climate mitigation pledge under the UNFCCC's Copenhagen Accord. The pledge stated the intention to 'take nationally appropriate mitigation action to enable a 34% deviation below the Business As Usual (BAU) emissions growth trajectory by 2020 and a 42% deviation below the BAU emissions growth trajectory by 2025' (DEA, 2010).

Figure 3.1 South Africa's 'Peak, Plateau and Decline' Trajectory



Source: South African Department of Environmental Affairs

Based on the PPD, South Africa's emissions should peak between 2020 and 2025, plateau for approximately a decade, and then decline in absolute terms thereafter. The South African Copenhagen pledge was conditional on a fair, ambitious and effective agreement being reached in the international climate change negotiations as well as the provision of financial resources, the transfer of technology, and capacity building support from developed countries to developing countries.

3.2.2 South Africa's Intended Nationally Determined Contribution (INDC)

Further to South Africa's Copenhagen pledge, the Government agreed to submit its Intended Nationally Determined Contribution (INDC) to the UNFCCC [1] in advance of the 21st Conference of Parties (COP) which took place at the end of 2015 in Paris, when 148 countries worldwide submitted

(1) INDCs refer to the overall reduction in the annual quantum of GHG emissions a country seeks to achieve over an agreed period of time. Preparation of INDCs is mandated by UNFCCC decisions 1/CP.19 and decision 1/CP.20, the latter specifying information for mitigation (paragraph 14); and in paragraph 12 providing options to communicate an adaptation component of an INDC (A-INDC), or "undertakings in adaptation planning". South Africa has submitted a single INDC, including adaptation, mitigation and an indicative required means of implementation for both.

their GHG reduction pledges to the UNFCCC, setting out the extent to which they intend to reduce their national GHG emissions.

South Africa's INDC submission takes account of the country's development imperatives. The 2025 target in the INDC corresponds to the same 2025 emissions target from the previous pledge. However, the 2009 pledge did not specify a BAU emissions scenario, whilst the INDC specifies an intended emissions range up to 2030 and includes an emissions 'peak', after which emissions will decline in absolute terms thereafter (DEA, 2015) (WRI, 2015).

South Africa's INDC notes that 'South Africa will use five-year periods of implementation at the national level, specifically, 2016-2020 focused on developing and demonstrating the mix of policies and measures that will be deployed in order to meet South Africa's Copenhagen pledge, and the periods 2021-2025 and 2026-2030 to achieve the INDC' (DEA, 2015) (1). The Government believes that this will enable South Africa's GHG emissions to peak between 2020 and 2025, plateau for approximately a decade and decline in absolute terms thereafter. Within the INDC, there is no specific discussion of the process that should be put in place to ensure that proposed developments will enable the delivery of South Africa's commitments.

3.2.3 *South Africa's National GHG Inventory*

Information on South Africa's annual GHG emissions has been derived from South Africa's GHG Inventory 2000-2010 (DEA, 2014b), and South Africa's INDC (UNFCCC, 2015). The Government, as a signatory to the UNFCCC, is obliged to submit a regular inventory of its GHG emissions. The first GHG inventory was prepared in 1998. The latest GHG inventory was produced for the period 2000-2010 (and submitted in 2014) and is aligned to the 2006 IPCC guidelines for National GHG Inventories.

South Africa's 2010 GHG emissions by sector are described in *Table 3.3.* In total, South Africa's GHG emissions in 2010 were estimated to be 544 million tonnes (Mt) CO_2e, excluding forestry and other land uses (FOLU) which are estimated as net carbon sinks. Including FOLU, total GHG emissions in 2010 are 518 Mt CO_2e. The energy sector is a large contributor to GHG emissions in South Africa, predominantly as a result of fossil fuel combustion. The GHG emissions from the energy sector alone in 2010 were 428 Mt CO_2e, which accounted for 78.7% of the total national GHG emissions (excluding emissions from FOLU (DEA, 2014b) (UNFCCC, 2015). Eskom accounted for 55% of South Africa's total accumulated emissions over the period 2000-2010.

Table 3.3 ***South Africa 2010 GHG Emissions by Sector***

Sector	Emissions (t CO_2e)	% total emissions (excl. FOLU) by sector

(1) Achieving the PPD/INDC commitments suggests that a combination of investment in abatement technologies, taxes and incentives will be required to meet South Africa's future emissions targets. A discussion of these aspects is however out of the scope of the GHG impact assessment.

Sector	Emissions (t CO_2e)	% total emissions (excl. FOLU) by sector
Energy	428 368 000	79%
Industrial processes*	44 351 000	8%
Agriculture Forestry and Other Land Uses (excl. FOLU)	51 789 000	10%
Agriculture Forestry and Other Land Uses (incl. FOLU)	25 714 000	5%
Waste	19 806 000	4%
Total (excluding FOLU)	*544 314 000*	
Total (including FOLU)	*518 239 000*	

Source: DEA, 2014b

*Note coal used for metallurgic processes is accounted for under industrial processes to avoid double counting

**Emissions per sector calculated against total (excluding FOLU)

As described, under the INDC, national emissions in 2025 and 2030 will be limited to between 398 and 614 Mt CO_2e (compared to 544 Mt CO_2e excluding FOLU / 518 Mt CO_2e including FOLU in 2010). The Government has stated in the INDC that the long term objective is to reduce GHG emissions to 428 Mt CO_2e by 2050, after having declined in absolute terms from 2036 onwards. It should be noted that the Government has also stated that these goals could change as and when new information becomes available. The baseline from which these reductions are to be achieved is established as 2016 (DEA, 2015).

South Africa's projected GHG emissions up to 2050 to meet the INDC (or PPD) were unbundled by the DEA in a GHG Mitigation Potential Analysis for South Africa (DEA, 2014a). The study presented the projection of national GHG emissions into the future, based on economic growth projections aligned to the medium term growth scenario defined in the IEP of 4.2% per annum and long term projection of 4.3% as per the 2012 Medium Term Budget Policy Statement (DEA, 2014a), as well as power sector commitments as defined the IRP 2010-2030 (2011). Both the upper and lower range of the INDC commitments are reflected in *Table 3.4* below.

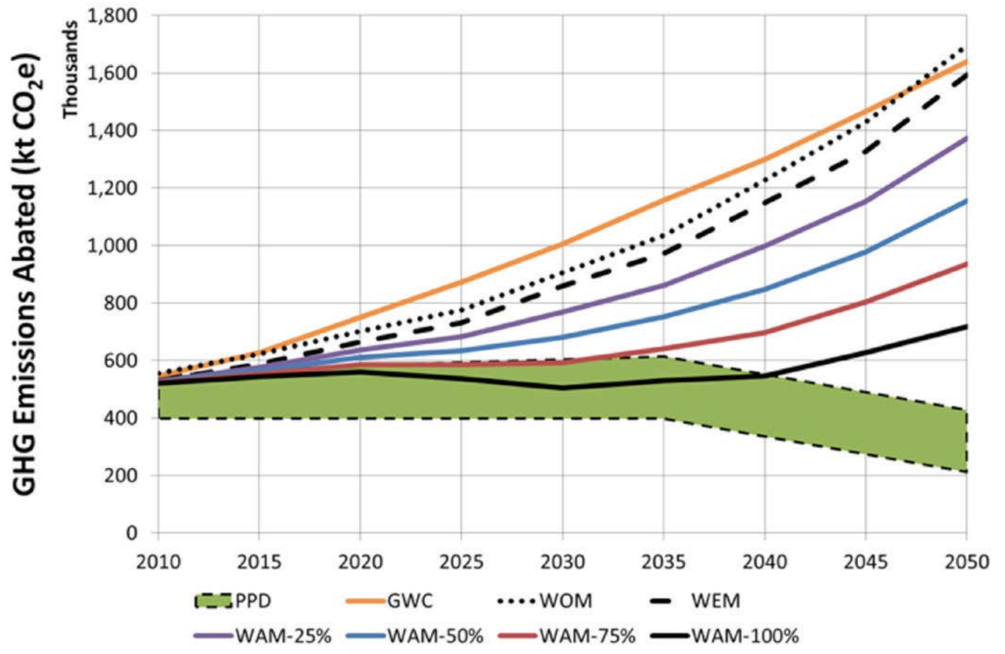
Table 3.4 Projected GHG Emissions for South Africa based on its INDC to the UNFCCC

Year	Estimated annual emissions – South Africa (t CO_2e) - PPD Lower Range	Estimated annual emissions – South Africa (t CO_2e) - PPD Upper Range
2020	398 000 000	583 000 000
2025	398 000 000	614 000 000
2030	398 000 000	614 000 000
2035	398 000 000	614 000 000
2040	336 000 000	552 000 000
2045	274 000 000	490 000 000
2050	212 000 000	428 000 000

Source: DEA (2011); DEA (2014a). Based on PPD emissions trajectory and assuming linear decline to INDC targets by 2050 from 2035 levels.

In the DEA's 2014 GHG Mitigation Potential Analysis study, the potential GHG abatement available to South Africa was considered against the PPD/ INDC commitments to 2050. The analysis presented numerous GHG emissions trajectories that assumed the implementation of identified mitigation options to varying degrees, specifically: 'Growth without Constraints' (GWC) (1), 'Without Measures' (WOM) (2), 'With Existing Measures' (WEM) (3), and 'With Additional Measures' (WAM) (4), and compared these against the PPD trajectory (DEA, 2014a). *Figure 3.2* illustrates the results of the assessment.

Figure 3.2 *National GHG Emissions Trajectories*



Source: DEA, 2014a.

The results illustrate a gap between the PPD trajectory, and the country's emissions trajectory under the various mitigation scenarios. Only the WAM-75% (which implements 75% of national mitigation potential) and the WAM-100% (which implements 100% of national mitigation potential) track within the defined limits of the PPD trajectory for a period of time:

- WAM-75% tracks within the upper range up until 2030; and
- WAM-100% tracks within the PPD trajectory up until 2040.

Beyond 2040, the emissions trajectories from all the mitigation scenarios (including WAM-100%) cease to track the PPD trajectory, suggesting that the current national mitigation potential identified is not sufficient to bring about the PPD trajectory. However, it should be noted that the Mitigation Potential Analysis considered the IRP 2010-2030 (2011) projections for the energy sector, and since the planning horizon for the IRP 2010-2030 (2011) is established at 20

(1) GWC refers to growth without constraints imposed by GHG emissions reduction targets (i.e. without applying mitigation measures). The GWC trajectory was developed as part of the LTMS study referenced in *Section* ***Error! Reference source not found.***.

(2) The WOM is a projection of emissions from 2000 to 2050 which assumes that no climate change mitigation actions have taken place, i.e. does not take into account the mitigation actions actually implemented to date.

(3) WEM incorporates the impacts of climate change mitigation actions including climate change policies and measures implemented to date. The projections follow the actual path of observed emissions for the period 2000 to 2010.

(4) National abatement pathways based on WAM projection assume different levels of implementation of the national mitigation potential (100%, 75%, 50%, and 25%).

years, coal and non-coal based energy sources were assumed to hold constant after this time. However, as stated in *Section 3.1,* specific targets have been established for the decommissioning of old Eskom coal fired power stations by 2025 and the decommissioning of power stations once they have reached the end of a 50 year lifespan (DoE, 2011). It is assumed that with subsequent revisions of the IRP, a longer time horizon will be considered, and (as indicated in the IEP) when factoring in the retirement of some of the existing coal-fired power station fleet beyond 2030, these trajectories may start to track the PPD more closely. The Mitigation Potential Analysis study concluded that more 'aggressive decarbonisation' of South Africa's energy supply will be needed in future iterations of the IRP if the targets set out in the PPD are to be achieved (DEA, 2014a).

3.3 *EMISSIONS INTENSITY OF THE SOUTH AFRICAN GRID AND OF GAS-FIRED POWER PLANTS*

The emissions intensity of electricity production varies depending on how the electricity is produced. The burning of carbon-rich fossil fuels in coal or natural gas fired thermal power plants produces significant GHG emissions, whereas renewable technologies (such as wind or solar) produce very little emissions during operation. The carbon or emissions intensity of electricity can be assessed by measuring and comparing the GHG emissions per unit of electricity produced, i.e. t CO_2e per MWh, across different plants. This metric (emissions intensity) is correlated to the heat rate and thermal efficiency of the plant, i.e. the amount of energy used by the plant to produce one kWh of electricity (a higher thermal efficiency means that a higher proportion of the energy consumed by the plant is converted into electricity for distribution to the grid).

Since the mix of energy sources used to generate electricity for the grid varies across geographies, so does the emissions intensity of each country's electrical grid. The grid emissions factor reflects the amount of GHGs (expressed as tonnes of CO_2e) emitted per MWh electricity generated. The African average grid emissions factor was 0.596 kg CO_2e per kWh for 2011 (using the latest published data). Specific countries, for example Mozambique which has historically relied on hydropower to produce grid electricity (1), have a much lower factor (0.001 kg CO_2e /kWh for the same year). In light of national commitments made under the UNFCCC to reduce GHG emissions, many countries, including South Africa, are developing policies and plans to reduce the use of high carbon energy sources for grid electricity production and increase the use of renewables in their generation mix (see *Section 3.1.1*). As such, and key in assessing the GHG impact of this Project, it is important to understand how the emissions intensity of a proposed power plant compares relative to other, similar power plants using the best available technology, and how it will affect the current and future grid emissions intensity for the country. These reference benchmarks for the Project are presented below.

(1) IEA, 2013. IEA Statistics: CO_2 emissions from Fuel Combustion – Highlights, 2013 Edition

3.3.1 *South African Electrical Grid Emissions Factor*

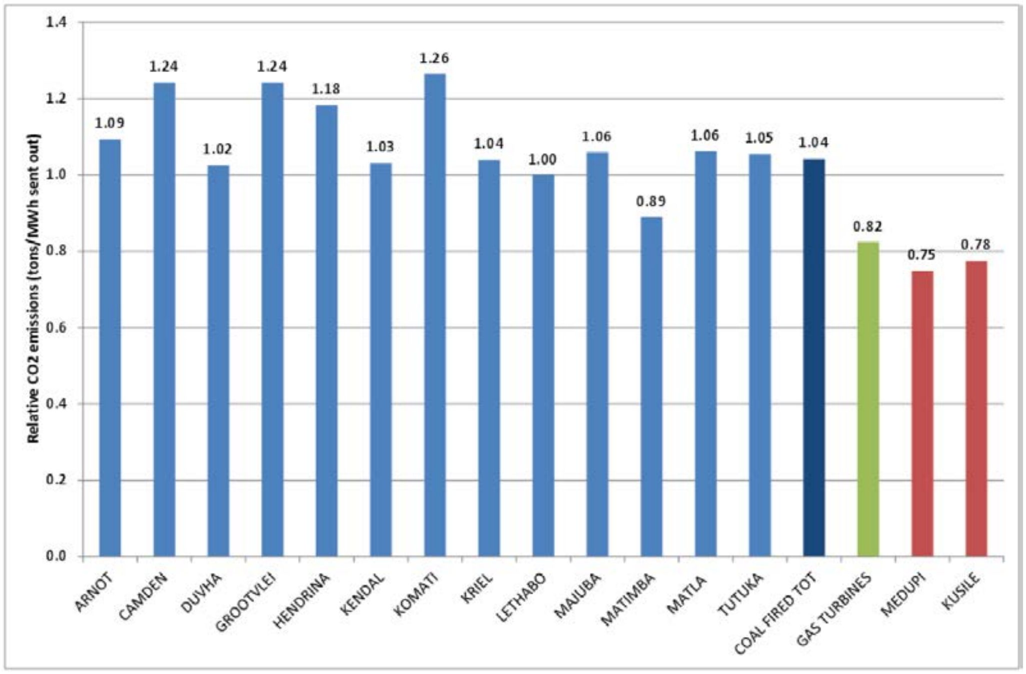
In South Africa, the national electricity grid is owned and operated by Eskom, a state-owned company. Eskom generates approximately 95% of the country's electricity, and is responsible for electricity transmission and distribution to consumers across the country (Eskom, 2015). Approximately 90% of Eskom's electricity comes from coal fired power plants (Eskom, 2016). Eskom has an aging fleet, with 81% of the operating coal-fired power plants being older than 20 years as of 2012. Prior to 2015, all of Eskom's coal fleet made use of subcritical steam conditions. The use of supercritical (SC) and ultra-supercritical (USC) coal-fired technologies allows higher efficiencies and lower GHG emissions (per MWh generated). Two major coal fired power plants currently under construction by Eskom: Kusile and Medupi. Kusile (4 800 MW, comprising six 800 MW units) is expected to enter commercial operations in the late 2017, and will use supercritical steam conditions. Medupi (similar capacity and number of units as Kusile) will also use supercritical steam, and the first unit (Unit 6) began feeding power into the South African national grid in 2015 (ESI Africa, 2015).

For the period 1 April 2014 to 31 March 2015, Eskom's published grid emissions factor was **1.01 t CO_2e per MWh** (Eskom, 2015). This factor is based on total emissions of CO_2e associated with production facilities, and total electricity generated (from coal, gas, nuclear, hydropower, pumped storage, and wind energy), excluding that which is consumed by Eskom, and excluding losses from transmission and distribution. There is no publically available information or published emissions factor to account for the overall South African grid emissions intensity (i.e. including the additional 5% generated by IPPs or imported), but, with Eskom responsible for the generation of the bulk of the country's electricity (95%), this is unlikely to make a material difference to the published factor from Eskom.

Eskom published data on the emissions intensity of its different plants in 2010/11, illustrating the emissions (t CO_2e) per MWh sent out (*Figure 3.3*). The average emissions intensity of its existing gas-fired power stations in 2010/11 was **0.82 t CO_2e per MWh** (Eskom, 2011) [(1)]. However, it is important to note that Eskom's gas power plants (comprising Ankerlig, Gourikwa, Acacia and Port Rex) all run on liquid fuels (diesel and kerosene) rather than natural gas.

(1) It is not stated whether MWh sent out used to calculate these metrics includes losses associated with transmission and distribution.

Figure 3.3 *Emissions intensity of Eskom's coal (individual) and gas (average) power plants in 2010-11*



Source: Eskom (2011)

3.3.2 *Emissions Intensity of Gas-Fired Power Plants*

The emissions intensity of coal-fired power plants can be assessed through the emissions per kWh or MWh generated (t CO_2e / kWh or t CO_2e / MWh). This is also related to the thermal efficiency rating for a power plant (expressed as a percentage and representing the proportion of fuel input energy converted into kWh). Plants with higher thermal efficiencies have lower CO_2 emissions per unit of electricity generated (IEA, 2014).

The efficiency of gas-fired power plants varies depending on the choice of technology, natural gas properties, local climatic conditions, operating and maintenance practices, and plant age. For example, one study into the energy efficiency of power generation across 12 geographies (1) showed that average gas-fired efficiencies from gas-fired power plants in 2009 to 2011 ranged from 34% (France) to 53% (United Kingdom and Ireland) (Ecofys, 2014). When comparing natural gas to coal, gas-fired power plants have higher thermal efficiencies and emit around half as much GHGs per MWh produced than coal plants (C2ES, n.d.) (IEA ETSAP, 2010).

Key in influencing the thermal efficiency and emissions intensity of gas-fired power plants is the choice of technology used – namely whether the plants use simple or open-cycle (OCGT) or combined-cycle technologies (CCGT). OCGT plants comprise a gas turbine connected to an electrical generator. The gas

(1) The countries included in this study were Australia, China, France, Germany, India, Japan, Nordic countries (Denmark, Finland, Sweden and Norway), South Korea, United Kingdom and Ireland, and the United States. For the comparison of CO_2 intensity, Canada and Italy were added as additional countries.

turbine is composed of a compressor, where air is compressed, a combustion chamber in which fuel is added and combusted, and the gas turbines, in which the hot, compressed air is expanded, driving both the compressor and the electric power generator. CCGT plants also use gas turbines to drive an electrical generator, but unlike OCGT plants recover waste heat from the turbine exhaust in a heat recovery steam generator (HRSG) to generate steam which is run through a separate steam turbine to provide additional electricity. Through the use of both a gas and a steam turbine, the latter harnessing waste heat, CCGT plants can produce up to 50% more electricity from the same fuel than a simple-cycle plant (OCGT) and are therefore significantly more efficient as illustrated in *Table 3.5*. Whilst OCGT plants are less efficient, they are quicker and cheaper to build, and have good operational flexibility (they can be started up quickly, hence why OCGT plants are often used to provide peak load or standby service).

Table 3.5 Thermal efficiency and emissions intensity of OCGT vs. CCGT gas plants

Technology	**Thermal efficiency (LHV, net)**	**CO_2e intensity factor (LHV, net)** t CO_2/ MWh
Open cycle gas turbine (OCGT)	30-40%	0.48 – 0.58
Combined cycle gas turbine (CCGT)	50-60%	0.34 – 0.40

Sources: IEA ETSAP (2010), C2ES (n.d.), IPIECA (n.d.)

Further, more drastic, reduction in GHG emissions from fossil fuel based power plants (and the GHG intensity of the electricity they generate), would require carbon capture and storage (CCS). CCS comprises three integrated stages: the capture and compression of CO_2 emitted from the plant; transport of the (supercritical or dense phase) CO_2, and CO_2 storage through injection into selected geological formations (or storage and utilisation for enhanced oil recovery). CCS applied to coal-fired power plants has the potential to reduce CO_2 emissions to below 100g (0.1kg) CO_2e / kWh (IEA, 2012). However, the use of CCS technologies creates cost challenges, and the increase in plant auxiliary energy consumption for the capture process can result in a reduction in thermal efficiency of 7-10%. Furthermore, demonstration of CCS has, to date, focused on coal rather than natural gas power plants, and the technology has not yet been applied in South Africa. That said, a CCS Roadmap has been developed for South Africa, and CCS demonstration plant is planned, together with the required CCS policies and legal and regulatory frameworks (SACCCS, 2016).

3.4 MAGNITUDE SCALE FROM INTERNATIONAL LENDER STANDARDS

An additional perspective on the magnitude of the Project's GHG emissions is provided by standards that are applied to developments at an international level. *Table 3.6* shows a magnitude scale for project-wide GHG emissions that is derived from, and in line with, a number of current international lender organisations or groupings, such as International Finance Corporation (IFC) standards, the European Bank for Reconstruction and Development's (EBRD) GHG assessment methodology and the Equator Principles (EP).

Table 3.6 Magnitude scale for project-wide GHG emissions based on wider standards

Project-Wide GHG Emissions / annum	Magnitude Rating
>1 000 000 tonnes CO_2e	Very Large
100 000 – 1 000 000 tonnes CO_2e	Large
25 000 – 100 000 tonnes CO_2e	Medium
5 000 – 25 000 tonnes CO_2e	Small
<5 000 tonnes CO_2e	Negligible

IFC reporting thresholds

The IFC's *Performance Standard 3: Resource Efficiency and Pollution Prevention* defines a reporting threshold for annual GHG emissions of 25 000 t CO_2e, and requires clients to '*…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*' (IFC, 2012).

EBRD reporting thresholds

An annual GHG emissions threshold of 25 000 t CO_2e has also been adopted by the EBRD within its new Environmental and Social Policy, which entered into force in November 2014. This updated policy reduces the GHG reporting threshold within projects that the EBRD supports from 100 000 to 25 000 t CO_2e per year, and requires annual client quantification and reporting of these emissions. EBRD guidance on assessment of GHG emissions also defines a series of categories and thresholds for different project types (shown in *Table 3.7)* (EBRD, 2010).

Table 3.7 EBRD GHG Emissions Reporting Categories

GHG Emissions / annum	Magnitude Description
> 1 000 000 t CO_2e	High
100 000 – 1 000 000 t CO_2e	Medium-High
20 000 – 100 000 t CO_2e	Medium-Low
< 20 000 t CO_2e	Low
Not defined	Negligible

Equator Principles reporting thresholds

The EPs require all projects, in all locations, to conduct an alternatives analysis to evaluate less GHG intensive alternatives when combined Scope 1 and Scope 2 operational emissions are expected to be more than 100 000 t of CO_2 equivalent annually. In addition, the EP require that the client (should) report combined Scope 1 and Scope 2 Emissions, publicly on an annual basis, during the operational phase for projects emitting over 100 000 t of CO_2 equivalent annually. It notes further that clients would be 'encouraged' to report publicly on projects emitting over 25 000 t of CO_2e (EP, 2014).

Owing to the limitations associated with assessing the magnitude of GHG emissions from a project using national GHG emissions as a benchmark, discussed in detail above, the magnitude scale presented in *Table 3.7* will be used in order to assess the magnitude of emissions from the Project.

4 IMPACT ASSESSMENT

4.1 GHG EMISSIONS FROM THE PROJECT

As noted in *Section 2.2*, GHG emissions from the Project are assessed by applying emissions factors to activity data relating to any GHG-causing Project activities.

In order to collect the activity data required for the assessment, the following activities were undertaken:

- The Project Scoping Report (1), prepared by ERM and dated 11 April 2016, and updated information on the Project provided in June 2016 (2) was reviewed in order to inform the data request; and
- Based on the review, a detailed GHG Information Request was developed in order to collect the activity data required for the assessment (e.g. quantities of natural gas to be combusted in each Phase).

Using the activity data provided together with the information in the Scoping Report and further information provided in response to ERM's GHG data request, the relevant GHG emissions factors were applied in order to estimate total emissions of GHGs from the Project in each Phase, expressed as 'carbon dioxide equivalents' (CO_2e), per year.

It should be noted that the emissions factor specific to the natural gas that will be used by the plant (i.e. based on the composition of different carbon containing compounds in the natural gas) was calculated using the API compendium equations (3) (API, 2009), and equated to 2.0255 kg CO_2 / m^3.

Table 4.1 summarises the Project's estimated annual GHG emissions during Operations (Phase 1 and 2). Total estimated annual emissions for the first Phase of the Project (210 MW), assuming 8 400 operating hours per year, are 920 712 t CO_2e (0.92 Mt t CO_2e). For the second Phase (1 317 MW), annual emissions are estimated to be 3 677 050 t CO_2e (3.68 Mt t CO_2e). Cumulatively, after the completion of Phase 2, total annual emissions from both Phases (i.e. with the five 42 MW Trent60s and three 439.1 MW SGT6-4000F turbines running concurrently) are estimated to be 4 597 761 t CO_2e. Assuming the same load factor and operating patterns, and not factoring in a decrease in

(1) ArcelorMittal Scoping Study for a Gas-fired Independent Power Plant to Support Saldanha Steel and Other Industries in Saldanha Bay. ERM Final Report – 11 April 2016.

(2) Updated Information for EIA Input and Consideration: 1 500 MW Saldanha Gas-to-Power Project. PowerConsult. 12 June 2016

(3) Specifically, Equations 4-9, 4-10, and 4-11 within Section 4.3 'Fuel Combustion Emissions Estimated from Fuel Composition and Usage'.

thermal efficiency over time, total (cumulative) estimated emissions over the 30 year lifetime of the 1 507 MW (1) plant are in the range of 138 Mt CO_2e.

Table 4.1 ***Estimated GHG emissions arising from the operation of the Power Plant***

Operational activity	Estimated Annual Emissions in Phase 1 (210 MW) (t CO_2e)	Estimated Annual Emissions in Phase 2 (1 317 MW) (t CO_2e)	Estimated Annual Emissions Phase 1 + 2 (1 507 MW) t CO_2e)	Data Source, Notes and Assumptions
Natural gas combustion for power production	920 633	3 676 971	4 597 604	Natural gas combustion volumes estimated based on: 16 327 920 GJ per year (Phase 1) and 65 213 074 GJ per year (Phase 2) (Engineer calculation); Lower Heating Value (LHV) for natural gas of 35 924 kJ / Nm^3 (2); and natural gas emissions factor of 2.0255 kg CO_2 / m^3 (ERM calculation based on API Compendium methodology) (API, 2009)
Propane combustion in Gensets for back-up power	79	79	158	Estimated annual propane consumption based on one black start event every 5 years, assuming: average site load 2.5 MW; 220 kg propane per MWh generated; and 10 days' outage per event (Source: Response to ERM GHG data request by PowerConsult (3). Applies IPCC 2006 Net calorific values (47.3 MJ / kg), carbon content (17.2 kg C / GJ, and CH_4 (0.001 kg CH_4 / GJ) and N_2O (0.0001 kg N_2O / GJ) emissions factors for Propane (IPCC, 2006a; IPCC, 2006b).
Total	**920 712**	**3 677 050**	**4 597 761**	

Table 4.2 illustrates the thermal efficiency of the plant, and the emissions intensity of grid electricity generated (using annual estimated emissions above and annual estimated generated electricity in MWh). These metrics are used to inform the benchmarking in *Section 4.2.2* (Impact Assessment chapter).

Table 4.2 ***Saldanha Gas-Fired Power Plant GHG emissions intensity and thermal efficiency***

	Phase 1 (210 MW)	Phase 2 (1 317 MW)	Phase 1 + 2 (1 507 MW)	Data Source, Notes and Assumptions

(1) See *Footnote* 1 on *Page 2* on the slight discrepancy between the 1 507 nameplate capacity, and the sum of capacity from turbines in Phase 1 (5 x 42 MW Trent 60 gas turbines) and Phase 2 (3 x 439.1 MW SGT5-4000F turbines) (sum = 1 527.3 MW).

(2) Response from PowerConsult to ERM on ERM's GHG Data Request – 26 June 2016.

(3) Email to ERM from Adrian Venzo, PowerConsult, 28 June 2016

	Phase 1 (210 MW)	Phase 2 (1 317 MW)	Phase 1 + 2 (1 507 MW)	Data Source, Notes and Assumptions
Total estimated annual emissions (t CO2e)	920 712	3 677 050	4 597 761	Estimated total annual GHG emissions from the plant (calculations in *Table 4.1*)
Total annual electricity generation (MWh)	1 802 598	11 065 320	12 867 918	Plant net power (214.6 MW Phase 1 + 1 317.3 MW Phase 2) * 8 400 (annual operating hours)
Electricity emissions intensity (t CO_2e / MWh, or kg CO_2e / kWh)	**0.51**	**0.33**	**0.36**	Total annual emissions divided by total annual electricity output
Thermal efficiency	**39.93**	**58.30**	**56.51**	Thermal efficiency for Phase 1 and 2 using lower heating values (LHV) (Source: Response to ERM GHG data request) [1]

It should be noted that the GHG intensity factor, 0.36 t CO_2e per MWh for Phase 1 and 2 combined, reflects the emissions intensity of electricity generated by the plant for distribution. The total MWh output used to calculate the emissions intensity excludes auxiliary power consumption by the plant, and excludes losses from transmission and distribution.

Finally, it is important to note that two of the Project's objectives relate to 'Education' and 'Demonstrating Technology', and that the Project plans to install 400 kW of renewable energy – namely solar PV – which will be used to provide stand-by emergency DC power and will power various features and activities including the main building LED lighting as well as the security lighting. The use of renewable (low carbon) energy to power these auxiliary processes will help to further reduce the emissions intensity of the plant.

4.2 *GHG IMPACT ASSESSMENT*

A traditional impact assessment is conducted by determining how the proposed activities will affect the state of the environment described in the baseline. As noted in *Section 2.1*, in the case of GHG emissions, this process is complicated by the fact that the impact of GHGs on the environment cannot be quantified within a defined space and time. The greenhouse effect occurs on a global basis and the point source of emissions is irrelevant when considering the future impact on the climate. CO_2 has a residence time in the atmosphere of approximately 100 years by which time emissions from a single point source have merged with other anthropogenic and natural (e.g. volcanic) greenhouse gas emissions. Therefore it is not possible to link emissions from a single source – such as the Project – to particular impacts in the broader study area.

(1) Response to ERM's information request from PowerConsult, 23 June 2016

Considering the above, the impact assessment for the Project's GHG emissions is based on an assessment of the magnitude of estimated annual GHG emissions, and the Project's contribution to global climate change. Because South Africa has not specifically defined thresholds to understand GHG emissions impact or magnitude within its Environmental Impact Assessment or National Environmental Management Act legislation, this assessment of magnitude (i.e. the scale of GHG emissions from the Project) is based on a GHG magnitude rating scale developed from international lender standards including IFC, EBRD, and EP. The magnitude of the Project's emissions relative to South Africa's current and future projected GHG emissions is also presented, but owing to the significant limitations associated with using national GHG emissions as a way to understand the magnitude of a project's emissions, this comparison is not used to inform significance.

In addition to the above assessment of the magnitude and therefore significance of the Project's GHG emissions, the GHG impact assessment is informed by the following key aspects:

- Assessing the GHG performance of the Project relative to reference benchmarks on the GHG intensity of electricity production, including the GHG intensity of South Africa's grid electricity and of other gas-fired power plants; and
- Understanding of the impact of the Project on South Africa's national GHG emissions inventory, and consideration of the alignment of the Project with the country's climate policy and international GHG reduction commitments.

4.2.1 *Magnitude of the Project's GHG emissions*

The estimated annual emissions from Phase 1 (210 MW) and 2 (1 317 MW), individually, are 920 712 t CO_2e and 3 667 050 t CO_2e respectively. Total estimated annual emissions from the final 1 507 MW Project are 4 597 761 t CO_2e during Operations. Further discussion on the magnitude of these emissions compared to South Africa's total GHG emissions, and from the perspective of emissions from a single point-source or project, is given below.

Contribution of the Project to South Africa's national GHG inventory

Table 4.3 illustrates the magnitude of the Project's emissions relative to South Africa's national GHG emissions. Historical emissions data from 2010 is used, and for subsequent (and future) dates, the PPD trajectory (defined in South Africa's NCCRP and forming the basis of South Africa's mitigation commitments within the INDC presented to the UNFCCC in the 21st Conference of Parties (COP21) in Paris, December 2015) is used in order to project national emissions forward to 2050.

Table 4.3 ***Estimated GHG Emissions from the 1 507 MW Gas-Fired Power Plant Relative to Projected GHG Emissions for South Africa***

Year	Estimated annual emissions – South Africa (t CO_2e)– PPD Lower Range	Estimated annual emissions – South Africa (t CO_2e)– PPD Upper Range	Estimated annual emissions – Saldana Gas-Fired 1 507 MW Project (t CO_2e)*	Saldana Gas-Fired 1 507 MW Project % contribution to South Africa's projected national GHG emissions (as a % of upper and lower Range PPD trajectory)
2020*	398 000 000	583 000 000	4 597 761	0.8 – 1.2%
2025	398 000 000	614 000 000	4 597 761	0.7 – 1.2%
2030	398 000 000	614 000 000	4 597 761	0.7 – 1.2%
2035	398 000 000	614 000 000	4 597 761	0.7 – 1.2%
2040	336 000 000	552 000 000	4 597 761	0.8 – 1.4%
2045	274 000 000	490 000 000	4 597 761	0.9 – 1.7%
2050	212 000 000	428 000 000	4 597 761	1.1 – 1.2%

* Assumes Phase 2 will have commenced operations by 2020

Source: DEA (2011) and DEA (2014a) (estimated annual emissions for South Africa using lower and upper ranges of PPD). A linear decline to INDC targets by 2050 from 2035 levels is assumed.

As illustrated above, the Project's GHG emissions are estimated to comprise 0.8 – 1.2% of South Africa's national emissions in 2020, rising to 1.1 – 1.2% in 2050. It should be noted that a number of assumptions are made with respect to estimating the Project's contribution to national GHG emissions:

- It is assumed that South Africa's GHG trajectory follows that set out in the Government's PPD trajectory (i.e. assuming that South Africa meets its commitments under the UNFCCC);
- The GHG trajectory for South Africa also assumes no change to the country's climate policy and INDC; however it should be noted that countries will be required to update their national GHG reduction commitments (INDCs) every five years, and each new submission should be more ambitious than the previous submission (the 'ratchet' mechanism): as such, future emissions trajectories may incorporate increasingly ambitious cuts;
- The GHG trajectory also assumes certain GDP growth rates (which influence national GHG emissions): should actual growth rates deviate significantly from these, the emissions trajectory may also need revising; and
- The Plant is assumed to operate at a baseload of 1 507 MW, 96% load factor (8 400 operating hours per year), through to 2050, and GHG emissions from the plant are also assumed to hold constant over time. It is however possible that future changes to dispatch rules may necessitate load following, weekend shut downs, two-shifting, or other operational changes. Such changes in operating regime will alter GHG emissions: a shift to cycling can result in increased wear on the plant and therefore reduced efficiencies and increased GHG emissions per MWh generated; however total GHG emissions on an annual basis are likely to decrease if there is a reduction in overall operating time.

Whilst the above analysis helps to give a sense of the scale of the Project's emissions relative to South Africa's emissions, there are significant limitations associated with using national GHG inventories to understand the magnitude of a Project's emissions. This is because the greenhouse effect occurs on a global basis, and the geographical source of emissions is irrelevant when considering the future impact on the climate; the climate change impact associated with the emissions of one tonne of CO_2e is the same, regardless of the source or location. Whilst this is true, the contribution of different countries to global GHG emissions varies significantly, and using the scale of a country's GHG emissions to assess the magnitude of GHG emissions from a particular project would suggest that the GHG impacts from a certain project are less significant if it is sited in a country with comparatively large GHG emissions, than if the same project with the same emissions was sited in a country with much smaller GHG emissions. This isn't the case however, for a global impact like climate change. In addition, owing to the nature of the national and global GHG emissions, which result from a vast number of individual projects across many sectors (power, transport, land use, infrastructure, built environment, etc.), individual projects are unlikely to look significant (i.e. represent a material proportion or percentage) of emissions relative to emissions on a national scale.

Bearing this in mind, the above analysis of the Project's GHG emissions relative to South Africa's national GHG emissions helps to add context to the impact assessment, but is not used as the basis for the assessment of the Project's GHG and climate change impacts. Instead, other reference benchmarks are used to inform the impact assessment, discussed in the sections that follow.

Scale of the Project's Emissions relative to GHG Magnitude Scale from Wider Standards

As described in *Section 3.4*, various international lender organisations including the IFC, EBRD and EP, give guidance on the scale of a Project's GHG emissions based on thresholds of annual emissions that trigger requirements for quantifying, reporting and mitigating Project GHG emissions. The magnitude scale derived from these organisations is illustrated in *Table 4.4*.

Table 4.4 Magnitude scale for project-wide GHG emissions based on wider standards

Project-Wide GHG Emissions / annum	Magnitude Rating
>1 000 000 tonnes CO_2e	Very Large
100 000 – 1 000 000 tonnes CO_2e	Large
25 000 – 100 000 tonnes CO_2e	Medium
5 000 – 25 000 tonnes CO_2e	Small
<5 000 tonnes CO_2e	Negligible

Based on the magnitude scale above, and considering the estimated annual GHG emissions from the final 1 507 MW Project (4 597 761 t CO_2e), the magnitude of the project's GHG impact is considered to be **Very Large**. It should be noted that, in the absence of abatement technologies such as CCS (which has historically almost exclusively been applied to coal – rather than gas - fired power plants), most if not all fossil-fuel based power plants will fall into this category by nature of their significant GHG emissions.

4.2.2 Benchmarking performance against other gas-fired power stations

The Project's estimated emissions intensity and stated thermal efficiency are compared to benchmarks for alternative gas-fired power plant technologies in *Table 4.5* below.

Table 4.5 Benchmarking emissions intensity and thermal efficiency of the Project against alternative gas-fired power plant technologies

Coal-fired power plant name / technology	Thermal efficiency (LHV, net)	CO_2e intensity factor (LHV, net)	Reference
The Project	39.93% (Phase 1); 58.30% (Phase 2); 56.51% (combined)	0.51 kg CO_2e / kWh (Phase 1); 0.33 kg CO_2e / kWh (Phase 2); 0.36 kg CO_2e / kWh (combined)	ERM calculations – see *Table 4.2*
Open cycle gas turbine (OCGT)	30 – 40%	0.48 – 0.58 kg CO_2e / kWh	IEA ETSAP (2010), C2ES (n.d.), IPIECA (n.d.)
Combined cycle gas turbine (CCGT)	50 – 60%	0.34 – 0.40 kg CO_2e / kWh	IEA ETSAP (2010), C2ES (n.d.), IPIECA (n.d.)
CCGT with Carbon capture & storage (CCS)*	Reduction of 7-8%	0.04 kg CO_2e / kWh	IEA GHG (2012)

* Based on a techno-economic study on CO_2 capture at natural gas fired power plants modelled using plant simulation software. Reflects results for post-combustion capture technologies.

The results from the benchmarking assessment highlight the following key messages:

- Thermal efficiency for Phase 1 (comprising six Siemens Trent60, 42 MW OCGT plants) is reported to be 39.93% (net), and the emissions intensity is estimated to be 0.51 tCO_2e/MWh. This is within the expected range and is at the higher end of what can be expected (i.e. the proposed plant has relatively high thermal efficiency and low GHG intensity) for OCGT technologies;
- Thermal efficiency for Phase 2 (comprising three Siemens SGT5-4000F 439.1 MW CCGT plants) is reported to be 58.30% (net), and emissions intensity is estimated to be 0.33 tCO_2e/MWh. This is on the higher end of what can be expected for CCGT technologies (i.e. relatively high thermal efficiency and low GHG intensity), and represents a significant improvement on Phase 1 from a GHG emissions perspective; and
- There is the potential for CCS to reduce the GHG intensity of fossil fuelled power plants significantly, though with a penalty on thermal efficiency which decreases due to the additional auxiliary power

required for the carbon capture technologies. However, as noted, CCS technologies have to date almost exclusively been applied at coal-fired power plants, and the technology has not yet been demonstrated in South Africa, so this is not at present considered to be a viable option for the Saldanha Steel gas-fired power plant.

It is important to note the drivers for the selection of the different technologies for the Saldanha Steel gas-fired power plant, notably the choice of OCGT technologies in Phase 1 and CCGT technologies in Phase 2. Whilst CCGT allows for higher thermal efficiencies and lower emissions of GHGs per unit of power produced, OCGT infrastructure can be built more quickly with lower capital costs. Considering the current challenges faced by the Saldanha Steel plant in relation to securing sufficient power at a stable price, OCGT is selected for Phase 1 in order to obtain power in the fastest possible time, whilst CCGT is selected for Phase 2 in order to take advantages of the improved efficiencies offered by this technology (1). As noted previously, thought will be given to converting at least two of the Phase 1 units to combined cycle for better efficiency at a later stage.

4.2.3 *Implications of the Project on the South African grid emissions factor*

As noted in *Section 4.1*, the GHG intensity factor for the plant is estimated to be **0.51 t CO_2e / MWh** in Phase 1 and **0.33 t CO_2e / MWh** in Phase 2, based on total estimated annual GHG emissions and total electricity generated and sent to the grid (i.e. excluding plant auxiliary consumption and any losses from transmission and distribution). For Phase 1 and 2 combined, based on total estimated annual GHG emissions and total electricity generated, the emissions intensity is estimated to be **0.36 t CO_2e / MWh.**

By comparison, the emissions intensity of the electricity generated by Eskom (representing 95% of electricity generated and distributed in the South African electrical grid), for the period 1 April 2014 to 31 March 2015, as published by Eskom, was **1.01 t CO_2e / MWh** (further discussion in *Section 3.3.1*). This factor is based on total GHG emissions from Eskom facilities (noting that 90% of Eskom's power in 2014-15 was generated from coal and the remaining 10% from low-carbon energy sources), and total electricity generated and sent to the grid, excluding Eskom (auxiliary) consumption and excluding transmission and distribution losses.

The above analysis suggests that the emissions intensity of the electricity generated by the Project represents a significant improvement relative to the current grid emissions factor for South Africa. It also represents an improvement relative to the emissions intensity of Eskom's gas power plants, which have historically run on liquid fuels (diesel and kerosene), and which in 2011 were reported to have an average intensity of **0.82 t CO_2e / MWh.**

(1) Scoping Study for a Gas-fired Independent Power Plant to Supply Saldanha Steel and Other Industries in Saldanha Bay - Final Scoping Report (dated 11 April 2016)

4.2.4 *Alignment with South Africa's climate change policy and international GHG mitigation commitments*

As noted in *Sections 3.1* and *3.2*, the Government has developed a number of energy and climate change focused policies and plans that are relevant to this Project. With the energy sector contributing 79% of South Africa's national GHG emissions in 2010, it is important to consider both energy and climate change policies and plans in conjunction in order to understand how the Project is aligned with South Africa's international GHG mitigation commitments. Drawing on the analysis presented in *Sections 3.1* and *3.2*, the following key points are noted:

- As described South Africa possesses a legacy of electricity management that saw limited investment in new power infrastructure, resulting in the strain on Eskom's existing fleet of power plants and an unstable electricity grid. The impacts of this were most notable during the periods of rolling black-outs and 'load shedding' that occurred between 2007 and 2015 when demand exceeded capacity;
- The promulgated IRP 2010-2030 (2011) represents the legal basis for Government's electricity planning. Despite the fact that the economic and electricity landscape in South Africa has changed substantially since 2011, the data contained in the IRP 2010-2030 (2011) has been adopted by Eskom and in Government's electricity planning documents (albeit with the acknowledgement of these limitations), as well as by the IPP Office, and allows for 3 126 MW of new generation capacity from gas-fired power generation to be installed by 2030 through the Gas to Power Programme, as part of a transition to lower-carbon electricity generation and in order to stimulate South Africa's gas economy;
- In order to understand the extent to which the Project is aligned with South Africa's climate change policy and mitigation commitments, it is important to understand the extent to which the IRP 2010-2030 (2011) (which gives provision for additional gas-fired power plants) and the PPD trajectory set out in the NCCRP (which sets out the country's GHG mitigation commitments) are aligned. Note that this analysis is undertaken on the assumption that this development forms part of the 3 126 MW of additional gas-based energy generation capacity provided for in the IRP 2010-2030 (2011) and that electricity generation and proposed power projects will be aligned to the IRP and not exceed it. The DEA's 2014 Mitigation Potential Analysis study considered potential GHG abatement available to South Africa and mapped future emissions trajectories according to numerous scenarios. The results of the study illustrated that more 'aggressive decarbonisation' of South Africa's energy supply will be needed in future iterations of the IRP if the targets set out in the PPD are to be achieved. Whilst this is true, the following should be noted:
    - The study used the IRP 2010-2030 (2011) generation mix to estimate GHG emissions from the energy sector, and assumed that the generation mix would hold constant after 2030 until

2050. However, future updates of the IRP extending to later time periods e.g. 2040 and 2050 are likely to incorporate measures such as the retirement of some of the existing coal-fired power station fleet which will reduce emissions and may help to ensure emissions are more closely aligned to the PPD trajectory; and
  - Whilst the study findings highlight some uncertainty as to the role of coal in the country's generation mix post-2030, the increase in gas-based generation capacity will help to reduce the emissions-intensity of South Africa's grid.

In conclusion, there is a clear mandate from the DoE for the procurement of additional capacity from gas-fired power plants, and whilst there is some uncertainty as to the level of electricity generation that will come from coal post-2030 and how this aligns to the longer-term PPD trajectory for national GHG emissions, the introduction of new gas-based power will help to bring about the transition to a lower carbon energy mix required in order to meet the country's climate change commitments.

4.2.5 Project GHG impact significance rating

The GHG impact significance rating for the plant is based on the magnitude of GHG emissions. This differs to a traditional ESIA study where significance is based on a combination of the magnitude and likelihood of an impact. This is because likelihood is irrelevant in the context of GHG emissions given that increased levels of GHG emissions will result from the project, and given the body of scientific evidence linking GHG emissions to global climate change impacts.

The above analysis shows that the magnitude of the Project's GHG emissions, estimated to be 4 597 761 t CO_2e annually during operations on completion of Phase 2, is '**Very Large**', as per the benchmarks from international lender standards which apply the highest rating ('Very Large') to projects emitting >1 000 000 t CO_2e per annum. Relating this to the impact significance scale being used for the project, this translates to an overall significance rating of **Major (Negative)**. As noted, in the absence of abatement technologies such as CCS, most (if not all) coal and gas power plants will fall into this category by nature of their significant GHG emissions.

Whilst the Project's GHG emissions and therefore climate change impacts are significant, these findings should be considered in the context of the following positive impacts associated with the Project in relation to efficiency and impact on the South African average grid factor:

- The power plant (notably Phase 2 which uses combined cycle technologies) has a high thermal efficiency (Phase 2: 39.93%; Phase 2: 58.3%) and low emissions intensity (Phase 1: 0.51 t CO_2e / MWh; Phase 2: 0.33 t CO_2e / MWh) both in terms of what is achievable for gas-fired power plants, and also when compared to coal-fired power plants [(1)]; and

- The emissions intensity of electricity generated by the power plant (0.51 t CO_2e / MWh in Phase 1 and 0.33 t CO_2e / MWh in Phase 2, or 0.36 t CO_2e / MWh for Phases 1 + 2 combined) is a significant improvement on the average emissions intensity of Eskom's plants of 1.01 t CO_2e / MWh. With electricity generated in Phase 2 likely to feed into the national grid, this Project will therefore help to contribute to a reduction in the average grid emissions intensity.

Finally, it is also important to note that the Project is being developed in line with South Africa's energy policy, which (through the IRP 2010-2030) seeks to increase installed capacity in order to meet increasing demands on the grid, and which (through the GUMP and the Gas to Power IPP Programme) seeks to initiate the development of South Africa's gas economy.

(1) For comparative purposes, coal-fired power plants have thermal efficiencies in the range of 30 – 38 % (subcritical plants) or 38 – 45 % (plants using supercritical steam technologies), and corresponding emissions intensities of > 0.88 t CO2e / MWh (subcritical plants), or 0.67 – 0.88 t CO2e / MWh (supercritical plants). Source: IEA (2012a), IEA (2012b), and Michener (2012).

5 *EMISSIONS MANAGEMENT MEASURES*

The 1 507 MW (Phase 1 + 2 combined) Project's annual GHG emissions are estimated to be 4 597 761 t CO_2e during operations. As noted above, whilst the emissions intensity (t CO_2e per MWh) is relatively low and represents a significant improvement on the emissions intensity of Eskom's existing coal and gas-fired power plants, this level of absolute emissions is considered to be 'Very High' when benchmarking against a project-wide emissions magnitude scale based on various international lender standards, as expected for a fossil fuel based power plant. As such, measures should be implemented to monitor and manage energy consumption (thermal efficiency) and GHG emissions. Specific emissions management measures are presented in this section.

5.1 *EMISSIONS MANAGEMENT THROUGH OPTIMISATION OF PLANT THERMAL EFFICIENCY*

It is important that the plant's thermal efficiency is be maximised throughout the life of the plant in order to reduce the gas consumption and therefore GHG emissions per unit of electricity (i.e. kWh or MWh) generated. The plant should seek to identify specific measures that can be implemented in order to maximise thermal efficiency and therefore minimise GHG intensity over time. This will need to be based on a plant specific assessment informed by the operations and maintenance (O&M) requirements for the equipment in question, and assessments should be carried out upon final selection of the equipment and, subsequent to the commencement of operations, periodically.

5.2 *MANAGING POTENTIAL FUTURE CHANGES TO OPERATING PHILOSOPHY*

Whilst noting that, at present, the assumption is for the plant to operate for 8 400 hours per year (96% load factor) throughout its lifetime, it will be important to manage any changes to operating philosophy should these arise for example as a result of changes in grid dispatch rules (this will mainly be applicable to the three Siemens SGT5-4000F turbines in Phase 2 which are likely to feed electricity into the grid). Whilst noting that any reduction in the operating time or load factor (i.e. annual power generation in MWh) is likely to result in decreased total annual emissions from the plant, such changes to cycling philosophies could have an adverse impact on thermal efficiency and GHG intensity per MWh generated as a result of increased start-ups and wear and tear on the plant. As such, the potential impact of any future changes in operating philosophy should be investigated and managed for example through upgrades to plant hardware and modifications to operating practices, as applicable.

5.3 *CONVERSION OF PHASE 1 OCGTS TO CCGTS*

The Project documents note the potential for converting at least two of the 42 MW Trent60 OCGTs in Phase 1 to combined cycle at a later stage for improved efficiency [(1)]. Whilst noting that the technological and economic feasibility of such a change will need to be assessed when that time comes, it is recommended that the option to make such a change is reviewed periodically and implemented when possible, and on as many of the six Trent60 turbines as is feasible. This will allow the Project to benefit from the much improved efficiencies and reduced emissions associated with the use of combined cycle technologies, and will improve the GHG profile of the plant.

5.4 *ENERGY AND EMISSIONS MANAGEMENT PLAN*

The development and implementation of a GHG management plan is critical if GHG emissions from the plant are to be managed over time. Since GHG emissions are primarily driven by the fuel consumption at the plant and are closely linked to the plant's heat rate and thermal efficiency, this can take the form of a combined thermal efficiency and GHG management plan. Key elements of a thermal efficiency / GHG management plan include:

- Development of an overarching policy statement indicating the Plant's commitments with respect to minimising GHG emissions and implementing actions to ensure optimum emissions management;
- Measuring GHG emissions on an annual basis [(2)], which will require data on:
    - the total amount of gas consumed, its chemical properties and GHG emissions factor; and the consumption of any other fuels such as LPG for the black starts; and
    - Plant heat rate / thermal efficiency should be closely monitored over time as this is closely correlated to the GHG intensity of the plant.
- Setting short, medium and long-term targets relating to maximising and maintaining heat rate / thermal efficiency and GHG intensity (t CO_2e per MWh generated) over time, against which performance can be assessed;
- Tracking South Africa's evolving GHG and energy related regulations, including the implications / requirements for the Plant of the proposed carbon tax, GHG reporting regulations, and energy reporting regulations, all of which are currently in draft form but likely to be finalised in 2016 or 2017;
- Identifying and implementing heat rate improvement / GHG reduction projects, based on any deviations from expected heat rate and knowledge of required maintenance or upgrades. Internal and

(1) Updated Information for EIA Input and Consideration: 1 500 MW Saldanha Gas-to-Power Project. PowerConsult. 12 June 2016

(2) For example, IFC Performance Standard 3 requires that 'For projects which are expected to or currently produce more than 25 000 tonnes of CO_2e-equivalent annually'… 'Quantification of GHG emissions will be conducted by the client annually in accordance with internationally recognized methodologies and good practice'

external energy audits should be used to help identify opportunities for performance improvement, and a business case can be developed for each area of opportunity to help prioritise projects. More significant projects can be implemented during the major maintenance overhauls as scheduled by the Plant;
- Allocating responsibility to key individuals such that someone (or a team of individuals) is responsible and accountable for managing and reporting on the GHG performance of the plant;
- Communicating the Plan, including its key objective and any actions being taken, to staff working at the plant to ensure buy-in;
- Encouraging employee participation in the GHG management plan, including contribution of ideas relating to opportunities for improvement; and
- Reporting progress over time with respect to annual gas consumption and GHG emissions, GHG reductions / heat rate improvements achieved, and progress against targets set.

The Department Of Energy (DOE) is currently developing an Energy Efficient Monitoring System (EEMS) to track the efficient consumption of energy within South Africa and the trends involved. The DOE will need reliable data from all legal entities operating in the most intensive sectors of the economy and they have set certain thresholds, that if exceeded will require certain steps to be taken:

- Companies using 400 terajoules or more per annum will be required to submit a detailed energy management plan; and
- The energy management plan must include an energy baseline determined in accordance with SANS 50001, as well as areas of energy efficiency savings potential and energy performance indicators. Additionally, it will be required to submit a list of technically and financially viable measures that can be put in place to meet the savings potential

5.5 *USE OF ON-SITE RENEWABLE ENERGY*

As noted in Section 4.1, the Project plans to make use of solar PV energy to meet some of the plant's auxiliary load requirements. As a low or 'no' carbon form of energy, solar PV provides a means of reducing the emissions intensity of the plant and of the electricity it produces. Renewable energy can play a key role in the site's GHG emissions management plan and further opportunities to install more renewable capacity on-site should be investigated going forwards.

5.6 *GHG IMPACT SIGNIFICANCE RATING POST-MITIGATION*

The above measures will help to ensure that GHG emissions are minimised as far as possible over the project's lifetime. It is important to note that the only mitigation technology with the potential to achieve deep cuts on GHG emissions from a combined-cycle gas power plant is CCS, which (as discussed) has yet to be demonstrated in South Africa. Thus, whilst it is important that the above measures are implemented as part of the project's EMP, the residual (post-mitigation) impact rating for the project will remain as Major (Negative).

In the context of the project's climate change impacts (i.e. GHG emissions), cumulative impacts can be considered as the combined impacts that result from the emission of GHGs from this development together with other existing and planned developments. Cumulatively, GHG emissions from developments and human activities across the globe are contributing to global climate change, which impacts ecosystems and communities across the globe in complex and varied ways. Whilst it is beyond the scope of this study to address global climate change impacts, cumulative impacts can be considered in the context of the combined effect of developments at a national level, and implications on South Africa's climate change mitigation commitments.

The cumulative impact with respect to GHG emissions from this project and other developments in South Africa, and implications with respect to South Africa's GHG mitigation commitments, is addressed in Section 4.2.4. The analysis is based on assessing the alignment between the power sector generation plans in the IRP 2010-2030 (2011) and the PPD trajectory that forms the basis of South Africa's climate change mitigation commitments, assuming that this development forms part of the 3 126 MW of additional gas-based energy generation capacity provided for in the IRP 2010-2030 (2011) and that electricity generation and proposed power projects will be aligned to the IRP and not exceed it.

As noted, the DEA's Mitigation Potential Analysis study conducted in 2014 illustrated that, based on the IRP's projections for the energy sector and considering national mitigation potential, the PPD trajectory can only be tracked up to 2040 but after this point national GHG emissions exceed the boundaries depicted in the PPD. However, as noted, the study used the IRP 2010-2030 (2011) generation mix to estimate GHG emissions from the energy sector, and assumed that generation mix would hold constant after 2030 until 2050. It is likely, however, that future updates of the IRP extending to later time periods will incorporate measures to help reduce emissions from the power sector, including the retirement of some of the existing coal-fired fleet and increased low carbon electricity generation. It should also be noted that an updated IRP is due to be promulgated, and will likely depict a different energy outlook on the basis of more up-to-date economic growth forecasts.

Detailed analysis will need to be undertaken on future iterations of the IRP that extend to later time periods in order to make a statement with respect to cumulative GHG impacts from this and other power sector developments, and alignment with South Africa's climate change policies and GHG mitigation commitments.

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environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for environmental authorisation National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014

PROJECT TITLE

Environmental Impact Assessment for a Gas-fired Independent Power Plant to Support Saldanha Steel and Other Industries in Saldanha Bay

Specialist:	Climate change specialist		
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4.2 The specialist appointed in terms of the Regulations_

I, Sarah Bonham ______________________, declare that --

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Name of company (if applicable): ERM Southern Africa

Date: 20 July 2016

Sarah Bonham

Senior Consultant
Sustainability and Climate Change

Sarah Bonham joined ERM in 2010 and is a Senior Consultant in the Sustainability and Climate Change practice, based in Johannesburg, South Africa. She transferred into the practice from the ERM London office in July 2014.

Sarah's main area of experience is in climate change risk and adaptation. Her work involves assisting clients with the assessment climate change risk and vulnerability, and the management of that risk through the identification and implementation of adaptation measures. She has worked on site-specific climate risk and adaptation assessments as well as assessments that cover global portfolios of assets and operations, and has collaborated with various climate modelling institutions through the course of her work. She has also supported clients with water risk assessments and disclosure, and water strategy.

In the climate change mitigation field, Sarah has conducted Greenhouse Gas (GHG) assessments for proposed developments as part of the ESHIA process, and has significant experience in conducting carbon footprint studies for corporate clients in order to calculate Scope 1, 2 and 3 GHG emissions arising from their global operations. She also supports clients with the annual disclosure on their climate change performance to the Carbon Disclosure Project (CDP). Sarah also has experience in corporate GHG, biodiversity and water strategies, and has worked with industry associations on the development of papers relating to policies and incentives around Carbon Capture and Storage (CCS).

Fields of Competence

- Climate Change Risk & Adaptation
- Climate science
- Sustainability Strategy: Energy/Carbon, Water and Biodiversity
- Carbon Footprinting & Disclosure
- GHG Assessments for EIAs

Education

- MSc (Environmental Technology) specialising in Business and Sustainability, Imperial College London, 2010
- MA Oxon (Biological Sciences), University of Oxford, 2009

Languages

- English

Key Industry Sectors

- Power
- Food & Beverage
- Agrichemicals
- Oil & Gas
- Mining

Publications

- Sarah Bonham et al, CO2 Capture Project: *Regulatory Challenges and Key Lessons Learned from Real World Development of CCS Projects.* 2012
- Sarah Bonham et al, CO2 Capture Project: *Local Community Benefit Sharing Mechanisms for CCS Projects*. 2013

Selected Project Experience

Climate Change Specialist Study: Coal-fired Power Plant, South Africa, 2016
Lead Consultant
Sarah conducted a detailed greenhouse gas assessment as part of an EIA for a coal-fired power plant in South Africa. A detailed review of project documentation, including the feasibility study, was undertaken and additional data collected in order to calculate GHG emissions from the plant's operations in accordance with IPCC / GHG Protocol Guidelines. The impact of the plant's emissions was assessed by way of comparing emissions against South Africa's historic and future projected national GHG emissions, comparing performance against GHG intensity benchmarks from similar projects and GHG magnitude benchmarks from numerous international lender standards, and considering the project's alignment with South Africa's energy and climate change policies and GHG mitigation commitments. Emissions and energy management measures were proposed for integration into the EMP. Sarah is currently conducting the climate resilience assessment for the project.

Climate Change Specialist Study: Rail & Port EIA Project, Mozambique, 2014 - 2016
Lead Consultant
Sarah conducted the greenhouse gas assessment as part of the ESHIA for a proposed rail and port project in Mozambique. ESHIA and related project documentation was reviewed to identify key GHG emission sources. Annual GHG emissions were estimated according to IPCC / GHG Protocol Guidelines, after which an assessment of the impact of the GHG emissions associated with the project was conducted, based on a review of Mozambique's GHG emissions and reduction commitments under UNFCCC, and international lender standards relating to GHG emissions. Potential mitigation measures (opportunities to reduce emissions and use resources more efficiently) and GHG management plans were recommended. In addition, an assessment of climate risk was conducted. Climate projections for the project area were analysed (using IPCC AR5 climate model outputs) and an analysis of how the climate projections could affect the Specialist Study impact assessments was undertaken in order to ensure climate change was factored into the remainder of the Impact Assessment.

Carbon and Water Strategy, South Africa, Investment Holding Company, 2015 & 2016.
Project Manager
Sarah is the project manager on numerous work streams for this investment holding company. The program of work is focused on calculating its subsidiaries' carbon and water footprints, identifying climate change and water risks and opportunities across the group, and reporting this as part of its public disclosure to the Climate Change and Water CDP Programmes. In addition, in 2016, Sarah is supporting the company with the setting of GHG intensity metrics and reduction targets and an emissions reduction strategy in order to drive environmental performance improvement across the Group. Carbon and water strategies are being developed for diverse companies spanning the mining, production, beverage, hospitality, and gaming sectors.

Carbon Footprint and Regulatory Analysis, South Africa Mining & Ferro-Alloys Producer, 2015-2016.
Project Manager
Sarah is managing the carbon footprint and regulatory assessment for this global company's South African ferro-alloy mining and smelting operations. GHG emissions from the mines and ferro-alloy smelter were assessed using IPCC and GHG Protocol (WBCSD/WRI) methodologies, and a subsequent assessment of how the operations may be captured by South Africa's upcoming energy and carbon regulations was undertaken.

Climate Risk and Adaptation Assessment Guidelines, Multinational Mining Company, Global, 2013 - 2015
Consultant
ERM was commissioned to develop guidance for the client's global operations on how to assess climate change risks and adaptation options at mining sites in operation and under development across the world. Sarah led on the development case studies of climate risk and adaptation assessments undertaken by existing operations to be used as a basis for the guidance documents. The guidelines and case studies focused on integrating climate change into standard operational risk management procedures in order to ensure risks were logged, tracked, and actively managed over the mines' lifecycles.

Climate change screening tool, Multinational Power Sector Client, Asia, 2015
Lead Consultant
Sarah was the lead consultant and climate change expert working on the development of a GIS-based climate risk screening tool for CLP Group. The tool incorporates historical data on climate and weather events, as well as IPCC AR5 climate change projections according to two scenarios. Sarah led on the development of the Guidelines accompanying the tool, designed to give CLP to have ownership of the tool such that they can run climate risk screenings for existing and new assets.

Climate Change Adaptation Study for Renewable Energy Assets, India and China, CLP Group, 2013 - 2014
Lead Consultant
Sarah was the lead consultant in this study which assessed climate change risk and identified and prioritised climate change adaptation options for selected renewable energy assets, including a hydropower plant in China and a wind farm in India. Sarah was responsible for running the site visits and climate risk workshops for each asset, and undertook the risk and adaptation assessments for each site. ERM, working closely with a team of engineers and with the operations, maintenance, procurement, HSE and finance functions on site, identified a number of adaptation options to address the key risks, and by performing a cost-benefit analysis for each of the proposed adaptation measures was able to prioritise the most cost-effective actions for the site.

Climate Change Risk Assessment, UK, Confidential Global Agrocommodities Client, 2011 & 2015
Consultant
ERM was commissioned by a multinational agribusiness to carry out an assessment of the physical risks of climate change on global operations for the year 2025 including increased costs of asset damage and business interruption arising from extreme weather events; and cost impacts resulting from certain crops losing viability in growing regions (for example due to drought or water scarcity). ERM conducted a quantitative assessment of risks associated with historic impacts from extreme weather and of the impact of climate change on the value at stake. A subsequent assignment in 2015 aimed to update the 2010/11 study as well as to enhance the robustness of the assessment of future climate change through incorporation of more recent climate change projections and engagement with staff to test assumptions made in overlaying climate change projections on existing vulnerabilities.

Climate Change Specialist Study, Oil and Gas EIA, Kazakhstan
Consultant
ERM was commissioned to undertake a Climate Change Specialist Study assessing greenhouse gas emissions and physical climate risks and adaptation options as part of an EIA for the expansion of an oil and gas facility in Kazakhstan. Sarah assisted with the physical climate change risk assessment and identification of adaptation options as part of the study.

Climate Change Risk and Adaptation Assessment, UK, Oil & Gas Producer, 2012 – 2013
Consultant
Sarah was part of a team working to identify climate-related risks for a new oil and gas development and to identify potential risk mitigation measures. The project required a climate baseline to be developed for the area, and local climate change projections to be analysed. The interaction of climate variables with project assets and operations were then analysed in order to identify and prioritise climate risks and to identify risk mitigation and adaptation measures.

Strategic Water Risk Assessment, UK, Global Agribusiness, 2013
Consultant
Sarah was the lead coordinator for this global project with the overarching aim of defining water-related strategic sustainability risks and opportunities with the potential to impact the client's growth strategy over the next 15 years. The work involved risk modelling, workshop engagement and development of future water risk scenarios considering growth plans, likely competition for water resources from other users in existing and future regions of operation, regulatory changes with regards to water abstraction licences, future demographics, and the predicted effects of climate change on water availability.

Carbon footprinting and reporting, South Africa, Multinational Telecommunications Company, 2014 – 2015
Consultant
Sarah supported this multinational telecommunications company (based in Africa) with the calculation of its carbon footprint in 2014-15. Direct (Scope 1) and indirect (Scopes 2 and 3) emissions were calculated for each country of operation using bespoke carbon calculator tools developed by ERM. The emissions data was aggregated at the company level and reported externally. ERM also supported the client with the identification, analysis and quantification of energy efficiency and emission reduction opportunities across its operations.

Strategic Energy Management, South Africa, Confidential Mining and Chemicals Company, 2015
Project Manager
ERM was commissioned to develop a strategic energy management approach and plan for an energy-intensive chemicals company. The work was partly funded by the Private Sector Energy Efficiency (PSEE) programme and involved the development of an Energy Management Plan and Policy (including a 5-year plan to track and implement energy reduction opportunities), an energy awareness

campaign for all staff, energy management training for senior staff, and embedding energy in procurement.

Climate Change Strategy, South Africa, Platinum Producer, 2015
Project Manager
This study involved developing a climate change framework for the client. Existing climate change and sustainability policies and procedures were reviewed, and interviews conducted with key internal stakeholders to understand the current approach to managing climate change risks and opportunities. A detailed review was undertaken of the previously conducted climate change vulnerability assessment, which assessed both direct climate change risks to operations, as well as indirect risks resulting from the impact of climate change on communities, and recommendations made. The resulting climate change framework included a climate change policy statement, the framework, and associated implementation plan.

Local community benefit sharing options for CCS projects, CO2 Capture Project (CCP) (2013)

Sarah was the project manager for this study on local community benefit sharing mechanisms and options for CCS projects. A review of local community benefit sharing experience across the energy, mining, and waste sectors was conducted, and four projects in the energy sector (including one CCS project) were explored in greater detail through interviews in order to gain 'on-the-ground' insights into the benefit sharing process and specific mechanisms employed. Findings were analysed in the context how community benefit sharing might apply for a CCS development.

Review of regulatory issues for carbon capture and storage projects, CO2 Capture Project (CCP) (2012)

Sarah managed this CCS regulatory review commissioned by the CO2 Capture Project. The study focused on the latest regulatory developments in CCS across four jurisdictions (Australia, Canada, U.S. and Europe). Case studies and interviews were used to gain insights from both project developers and regulators on the project approval process and to identify the key gaps and challenges in existing regulatory frameworks, and to make recommendations for project developers going through the approval process.

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Project Title:	Greenhouse Gas (GHG) Study for a Gas-fired Independent Power Plant to Support Saldanha Steel and Other Industries in Saldanha Bay
CES Engagement No.:	ERM_REV_160706
Client Name:	ERM Southern Africa (Pty) Ltd
Client Address:	240 Main Road Cape Town 7780

GHG Assessment Peer Review Report & Assurance Statement

Report Number	**Date**
Version 01.0	18 July 2016

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DISCLAIMER

K2013179818 (Pty) Ltd, trading as **CarbEnviro Service** exercised all care, skill and diligence in this assurance assessment and our findings and conclusions are based on objective evidence (materials, information, data and other evidence) gathered from sources believed to be reliable and correct and we've truthfully and accurately reflected our verification activities. Whilst every endeavour has been made by CarbEnviro Services to ensure that information provided is correct and relevant, to give confidence to all parties that rely upon a GHG assertion, this report is of necessity, based on information that could reasonably have been sourced within the time period allocated, and is dependent on information provided by the client's management and/or its representatives.

It should, accordingly, not be assumed that all possible and applicable observations and/or measures are included in this report as this assessment report represents a sample of assessable parameters, as designed into the verification and sampling plan to measure the data and information to the level of assurance as agreed with the client to determine if there are any material errors, omissions or misrepresentations.

As a subsequent event, should additional information become available or if any facts that could materially affect the assurance statement are discovered by the GHG Programme, the client for whom the report is prepared, their consultant or CarbEnviro Services after issuance of the assurance statement CarbEnviro Services reserves the right to address the matter and revise the statement, as required.

This report and assurance statement is solely for the benefit and use of ERM and ArcelorMittal, with consent provided for its submission to the competent authority, in order to satisfy the reporting requirement for the environmental impact assessment, but without CarbEnviro Services accepting or assuming any responsibility or liability to any other party who may have access to the peer review report or place reliance on the assurance statement.

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Executive Summary

ERM Southern Africa (Pty) Ltd appointed CarbEnviro Services (registered as K2013179818 (Pty) Ltd) to conduct an independent peer review of the Greenhouse Gas (GHG) Assessment for a Gas-fired Independent Power Plant to Support Saldanha Steel and Other Industries in Saldanha Bay, as part of the Environmental Impact Assessment being conducted for their client (ArcelorMittal). The aim of the assessment was to verify whether the Scope 1 and Scope 2 emissions determined for the operational phase of the proposed gas fired power plant were accurate, complete, transparent, consistent and relevant. CarbEnviro Services followed the principles and requirements of ISO 14064-3: *Specification with guidance for the validation and verification of greenhouse gas assertions* and considered the guidance provided by the *Greenhouse Gas Protocol, the IPCC GHG Inventory guidelines* and the API *Compendium of Greenhouse Gas Emissions Estimation Methodologies for the Oil and Natural Gas Industry* (referred to as the “API *Compendium*”) for Limited Assurance. Based on the assessment activities undertaken, CarbEnviro Services provides limited assurance and is of the opinion that there is no evidence that the GHG calculations presented for the operational phase of the gas power plant are not materially correct and are not a fair representation of the GHG data and information and were not prepared in accordance with the principles and requirements of the GHG Protocol Corporate Accounting and Reporting Standard.

CarbEnviro Services verified the information, data, assumptions and emission factors applied from source documents, third party evidence and from expert opinions provided by the project engineers, to verify the GHG emissions calculations, provided in a separate calculation spreadsheet, were accurate and complete.

The methodology applied by CarbEnviro Services used during the peer review assessment included:

- Interviews conducted telephonically with ERM (the carbon service providers);
- Data verification and document review;
- Evaluation of GHG data and integrity assessment of the GHG calculation tool; and
- Peer Review Report and Statement.

The assessment activities performed by CarbEnviro Services included the following:

Action / Activity	Date / Period
Project initiation discussion - telephonic	06 July 2016
Project appointment	13 July 2016
Data verification and document review	13 – 15 July 2016
Peer Review Report & Statement	18 July 2016

The GHG Assessment for the operational phase of the gas power plant included LPG and natural gas combustion in stationary devices, and took indirect GHG emissions into consideration. The Peer Review determined that the GHG assessment for combustion emissions from stationary devices was compiled in accordance with GHG Protocol Corporate Accounting and Reporting Standards (2004) and applied the IPCC (2006) GHG Inventory guidelines and the methodology provided in the API Compendium (2009) for determining the emission factor for the natural gas to be processed. The total GHG emissions reported for the expected 30-year lifetime of the gas plant (**137,932,839 tCO_2e**) could be considered reasonable; taken the overstatement of GHG emissions for Phase 2 (expected to come on-line 12-24 months after Phase 1) and the understatement of other GHG emissions related to the lifecycle of the project, and not included in the draft GHG Assessment.

Known exclusions, not covered by this peer review, include the GHG emissions associated with the construction phase of the proposed gas power plant, the transmission of the gas along the proposed gas pipeline from the harbor in Saldanha Bay, the regasification of the LNG prior to the gas turbines, combustion emissions from mobile equipment on site, process, venting, flaring and fugitive emissions from stationary equipment on site, and other GHG sources, sinks and reservoirs due to the project activity (such as methane emissions from waste water treatment, and reduction of GHG emissions due to the generation and consumption of solar energy on site.

The purpose of an independent peer review of a carbon footprint calculation is to increases the credibility and trust of customers and key stakeholders, while providing project management with confidence for setting realistic targets and making wise investment decisions.

Abbreviations

API	American Petroleum Institute
CH_4	Methane
CO_2	Carbon Dioxide
GHG	Greenhouse gas
GWP	Global warming potential
HFC	Hydrofluorocarbon
IPCC	Intergovernmental Panel on Climate Change
ISO	International Standards Organization
kWh	Kilo-watt hour (electricity consumption)
LPG	Liquefied Petroleum Gas
MW	Mega watt
MWh	Mega-watt hour (electricity consumption)
N_2O	Nitrous Oxide
PFC	Perfluorocarbon
SF6	Sulphur Hexaflouride
tCO_2e	Tonnes Carbon Dioxide equivalents

1. Background, Scope & Objectives

ERM Southern Africa (Pty) Ltd appointed K2013179818 (Pty) Ltd, trading as **CarbEnviro Service** to conduct an independent peer review of a GHG assessment performed as part of an environmental impact assessment (EIA) study for establishing a new Gas Power Plant in Saldanha Bay. ERM's client, the Independent Power Producer (IPP), requires peer reviews to be conducted on all specialist studies undertaken for the EIA. ERM has compiled the GHG Assessment in accordance with their internal procedures, as supported by the API Compendium methodology, for the operational phase of the proposed Gas Power Plant. CarbEnviro Services provides this peer review report solely for the benefit of ERM and their client, and consents to the release of the report and review statement to the competent authorities, as required for the EIA process.

The objective of this engagement is to provide an independent peer review of the GHG Assessment compiled by ERM, and to determine whether:

- their client's Terms of Reference are acceptable for this specialist study within the context of the proposed project and site location;
- the methodology is clearly explained and acceptable;
- findings are acceptable, and scientifically defensible (through reviewing data evidence);
- the mitigation measures and recommendation measures proposed are appropriate;
- the literature referenced in the report are appropriate;
- the document is well-written and easy to understand; and
- to describe any shortcoming to this study.

The client's Terms of Reference in the Plan of Study for the EIA was:

- Boundary definition – confirming which phases are in scope (e.g. construction, operations, etc.)
- GHG baseline study – understanding South Africa's current and projected national annual GHG emissions, presenting a magnitude scale for project-wide GHG emissions based on international lender standards to be used in the impact assessment
- Data collection & carbon footprint calculation – review project documentation to identify and quantify key GHG emission sources from the project, and quantifying emissions using emissions factors from IPCC, GHG Protocol and other widely recognized standards;

- Impact assessment – comparing annual GHG emissions from the plant to national emissions, international lender standards, and any available benchmarks, and
- Emission control / mitigation measures – proposing measures to maximize resource efficiency and to minimize GHG emissions.

The peer review scope will include an assessment of the identification of the project boundary, methodologies selected, assumptions applied and the integrity of the GHG calculations. Areas for improvement identified during the course of the peer review assessment are raised as a **Recommendation (REC)** and include instances where the GHG standard (e.g. The GHG Protocol, IPCC GHG Inventory Guideline or the API Compendium) requirements have not been met and/or there is a risk that the project carbon footprint would be determined incorrectly, or where there is insufficient detail or clarity in the documentation to enable a peer review decision to be made.

2. Project Boundaries

ERM elected to apply guidance from the IFC Performance Standards (Performance Standard 3 on Resource Efficiency and Pollution Prevention) which states that '*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 used by the project*' and therefore focused on determining the direct GHG emissions from the plant during its operational phase, as the project activity would not import energy produced off-site for project consumption. The study did not include an assessment of Scope 3 emissions associated with the production and transport of fuel (LNG and CNG) to the plant emissions. While acknowledging that emissions associated with the production and transport of fuel could be significant, ERM stated that this represent a source of indirect emissions that are not under the Project's operational control (Scope 3), and at present details on the source and transport of gas have not yet been confirmed.

REC01. Further clarity on the ownership of the gas, the marine vessels and proposed new gas pipeline from the harbor to the project site, as well as maintenance responsibilities for the gas pipeline and marine vessels is required to determine whether this infrastructure, equipment and vehicles, and the associated GHG emissions from these would indeed fall outside of the project boundary. GHG emissions would include

a. transit loss emissions (from loading, ballasting and storage emissions) and additional GHG emissions from maintenance of gas pipeline infrastructure (e.g. SF_6 gas to condition pipes);

b. fugitive emissions from valves along the pipeline route;
c. power load required to pump gas to the plant; and
d. Regasification of the LNG once it reaches site.

3. GHG baseline study

The draft GHG Assessment Report presents the context of South Africa's energy and climate policies and includes the current and projected national GHG emissions inventory, South Africa's international GHG emission reduction commitments, the future GHG trajectory under a range of climate and development scenarios, and benchmarks the GHG intensity for the proposed gas-fired power plant against the GHG intensity of South Africa's grid electricity. The magnitude scale for the project's GHG emissions is presented in relation to international lender standards, as used in the impact assessment.

> **REC02**. Further clarity on the project's baseline impacts would demonstrate equivalence in type and level of activity of products/services provided between the project and the baseline scenario (i.e. energy consumption by ArcelorMittal and other users in the absence of the proposed project) and the project's GHG sources, sinks and reservoirs (e.g. the qualification of solar and other renewable energy for on-site use) to enable optimal disbursement of electricity generated by the natural gas. The GHG Protocol for Project Accounting (2005) offers sound guidance on this.

4. Emissions Data & Reporting

CarbEnviro Services assessed whether the GHG assessment calculations were accurate, complete, transparent, consistent, and relevant.

The draft GHG Assessment included emissions from propane combustion in Gensets and emissions from natural gas combustion in the gas turbines operating at maximum capacity (i.e. stationary device combustion sources), and excludes Scope 1 emissions "from non-energy products associated with the use of lubricants for machinery, on-site transport related activities, emissions associated with any physical or chemical process activity on site (such as processing of waste), and fugitive emissions, such as fuel leakage from equipment and plant" (ERM, 2016).

The API Compendium (2009) discusses GHG emissions associated with gas processing plant and states "process vents from dehydration, gas sweetening, pneumatic devices, and non-routine activities may result in CH_4 emissions. Fugitive equipment leaks are also a source of CH_4 emissions. Combustion sources, such as boilers, heaters, engines, and flares result in CO_2 emissions, as well as smaller quantities of N_2O and CH_4 emissions”. Please refer to section 4 (below) for additional information on the review findings on the emissions calculations.

The emission sources for Gas Processing Plants identified in the API (2009) are:

GAS PROCESSING	CO_2	N_2O	CH_4	Peer Review:
COMBUSTION SOURCES – Stationary Devices				**Fuel Type: Natural Gas** The calculations conducted assume gas turbines run at full capacity throughout the year. This is considered to be a conservative calculation. **Fuel Type: LPG** 26.4 tonnes per year (estimation based on average total site load and likelihood of black start event), converted to GJ, “using a calorific value of 47.3 GJ/tonne (Defra 2016)”. GHG calculation, based on assumptions and data provided by project engineer.
Boilers/steam generators	**X**	**X**	**X**	
Dehydrator reboilers	**X**	**X**	**X**	
Heaters/treaters	**X**	**X**	**X**	
Fire pumps	**X**	**X**	**X**	
Internal combustion (IC) engine generators	**X**	**X**	**X**	
Reciprocating compressor drivers	**X**	**X**	**X**	
Turbine electric generators	**X**	**X**	**X**	
Turbine/centrifugal compressor drivers	**X**	**X**	**X**	
Flares	**X**	**X**	**X**	
Catalytic and thermal oxidizers	**X**			
Incinerators	**X**	**X**	**X**	
COMBUSTION SOURCES – Mobile Sources				Fuel consumption for company owned vehicles (mobile sources) are not included in the GHG calculation.
Other company vehicles	**X**	**X**	**X**	
Planes/helicopters	**X**	**X**	**X**	
Supply boats, barges	**X**	**X**	**X**	
INDIRECT SOURCES				GHG emissions from indirect sources are determined as zero correctly, if no Eskom electricity or other heat/stream power is to be imported onto site.
Electricity imports	**X**	**X**	**X**	
Process heat/steam imports	**X**	**X**	**X**	
VENTED SOURCES – Process Vents				GHG emissions from process vents, other vents, maintenance/ turnaround events, and non-routine activities are not calculated separately in the carbon footprint, and may contribute up to 20% of the carbon footprint over the lifecycle of the project – refer to **REC04**.
Dehydration processes	**X (*)**		**X**	
Dehydrator Kimray pumps	**X (*)**		**X**	
Gas sweetening processes	**X (*)**		**X**	
Sulphur recovery units	**X**			
VENTED SOURCES – Other Venting				
Storage tanks and drain vessels	**X (*)**		**X**	
Pneumatic devices	**X (*)**		**X**	
Chemical injection pumps	**X (*)**		**X**	
VENTED SOURCES – Maintenance/Turnarounds				
Gas sampling and analysis	**X (*)**		**X**	
Compressor blowdowns	**X (*)**		**X**	
Compressor starts	**X (*)**		**X**	
Vessel blowdown	**X (*)**		**X**	
VENTED SOURCES – Non-routine Activities				
Emergency shutdown (ESD)/ emergency safety blowdown (ESB)	**X (*)**		**X**	
Pressure relief valves (PRVs)	**X (*)**		**X**	

Fire suppression				
FUGITIVE SOURCES				GHG emissions from equipment leaks ‘from valves, flanges, pump seals, compressor seals, relief valves, sampling connections, process drains, open-ended lines, and other miscellaneous component types’ are not calculated separately in the carbon footprint. Methane emissions form waste water treatment could be significant and may prove to be an additional fuel source for the proposed project (refer to **REC02**).
Equipment component leaks	**X (*)**		**X**	
Wastewater treatment	**X**		**X**	
Air conditioning/refrigeration				

Footnotes: X Indicates if CO_2, CH_4, or N_2O emissions may result from the source.
*Emission estimation approach is provided in API (2009), but only applicable to CO_2-rich streams. Significance of these sources depends on the CO_2 concentration and source-specific emission rate.

Other GHG emissions associated with the operation of a gas plant could include emissions of SF_6 from electrical transmission and distribution equipment, and from the use of SF_6 as a tracer gas to detect leaks along gas pipelines. HFC and PFC emissions from refrigeration and air conditioning equipment. These are usually considered significant if they are larger than 5% of the GHG inventory, and would be considered Scope 1 emissions if the equipment is owned or operated by the gas plant.

Other GHG emissions due to the project activity, would include methane emissions from waste water treatment, and may offer an additional source of energy for the project site.

REC03. The GHG Assessment could be updated to include all direct emissions listed by the API (2009) for gas plants, such as the combustion sources from all stationary and mobile devices, vented sources (such as process vents, other vents, maintenance/turnaround vents and non-routine activities), and emissions from fugitive sources, or a conservative adjustment could be applied to account for all Scope 1 emissions.

The draft GHG Assessment Report presented findings from the World Energy Council (2004) to illustrate the significance of the contribution of direct (stack) emissions to overall life cycle emissions from combined-cycle natural gas plants, in comparison to indirect (other life cycle stages) emissions and ERM proposed that GHG emissions from the construction phase as likely to be minimal compared to the emissions associated with the combustion of natural gas during the operational phase. Furthermore, considering the availability of information, the likely magnitude of the different emissions sources (with the bulk of life cycle emissions likely coming from the combustion of natural gas for power generation), and also guidance from the IFC Performance Standards, ERM elected not to determine GHG emissions for the construction phase.

The illustration from the World Energy Council (2004) shows that emissions from ‘other life cycle stages’ for a Natural Gas Combined Cycle energy system make up 15-20% of the direct (stack) emissions, which would equate to about 20 million tCO_2e (calculated over the lifetime of the project, assumed to be 30 years). While this may be considered small in magnitude in comparison to the project’s direct emissions, it is non-the-less contribute significant and would contribute to Earth’s global warming impacts, given the cumulative effects of greenhouse gasses accumulated in the atmosphere. It may be argued further that a large proportion of GHG emissions in the construction phase fall within Scope 3, which is considered optional reporting under the GHG Protocol Corporate Accounting and Reporting Standard. The GHG Protocol Guide for Construction Companies (ENCORD, 2012) indicates that the embodied GHG emissions of the materials purchased for the construction phase can make up a significant proportion of the CO_2e emissions and the guide was developed to assist construction projects in capturing and reporting on their key emissions sources, thereby meeting best practice, and to sometimes influence the selection of materials to reduce embodied GHG emissions (through use of natural / renewable materials, increasing recycled content of materials and reducing quantities of energy intensive materials). The project’s construction materials to be used are estimated as 35,000 tons of bulk cement and concrete aggregate, 800 tons of re-bar steel and 6,500 tons of equipment and structural steel. The extensive paved areas on the site, proposed for storm water harvesting, will have a substantial carbon footprint due to the amount of cement to be used (as 450,800 m^2 of the site is proposed to be concrete-paved).

REC04. Please consider applying a conservative estimate and report the associated assumptions for determining GHG emissions for the construction phase, as a 15-20% discrepancy in the carbon footprint over the lifecycle of the gas plant could be considered significant.

5. Evaluation of GHG calculations

Interviews were conducted telephonically with the GHG Assessment team and a desk top evaluation of the project documents and GHG calculation spreadsheet revealed the following:

1. The calculations, conversions rate and emission factors applied for electricity production from the natural gas turbines, are correct, with the exception of the final calculation of the total GHG emissions over the lifetime of the power plant (assumed to be 30 years for both Phase 1 and Phase 2). As Phase 2 will be coming on-line 12-24 months after phase one, the total emissions for Phase 2 should be calculated for 28-29 years. Therefore, the GHG emissions reported for electricity generation are overstated by between 3,68 and 7,35 million tCO_2e (refer to **REC05**);
2. The GHG emissions calculation for the operational phase do not include process/vented emissions, fugitive emissions, combustion emissions from mobile sources or other GHG emissions sources due to the project activity, such as methane emissions from waste water treatment (refer to **REC03**). The GHG Assessment may be considered incomplete as emission removals due to energy generated from renewable solar resources (refer to **REC02**) and additional information regarding the project boundary is required (refer to **REC01**);
3. The GHG emissions for the construction phase have not been determined, and therefore the total GHG Assessment report may be understated by up to 20% (refer to **REC04**);
4. The data and assumptions applied in the calculations are as reported by the project engineers and are recorded transparently in the calculation spreadsheet, along with references to other data sources used;
5. The methodology and formulae applied to determine the GHG emissions are not presented transparently in the calculation spreadsheet, making the traceability of these calculations difficult now, and repeatability for future annual reporting could be streamlined (refer to **REC05**).

REC05. Correct the total GHG emissions for the estimated 30-year lifetime of the project to reflect the projected emissions for Phase 2 (for 28-29 years only), and include the steps and equations applied to calculate each parameter and include a transparent description of these.

6. Verification Standard applied

CarbEnviro Services applied the principles and requirements of ISO 14064-3: *Specification with guidance for the validation and verification of greenhouse gas assertions* during the independent peer review of the data reported by ERM in the GHG Assessment for the operational phase of the proposed Gas Power Plant in Saldanha Bay compiled for ArcelorMittal. The GHG Accounting and Reporting Principles were followed to determine whether the GHG assertion represents a faithful, true and fair account of the proposed projects carbon footprint. These principles include:

Relevance: the identification/selection of the inventory boundary and the GHG sources, sinks and reservoirs appropriately reflect those of the project and are included in the calculations.

Completeness: all GHG emission sources and activities within the selected inventory boundary were account for and report, and assessed the disclosure/justification of any specific exclusion.

Consistency: the data collection procedures and methodologies applied to determine the GHG emissions are consistent, which allows for meaningful and repeatable comparisons of emissions over time, and records and documentation of changes to the data, inventory boundary, methods, emission factors and any other relevant factors were maintained.

Transparency: all relevant issues (e.g. monitoring methods, calculations, assumptions, uncertainties) are explained in a factual and coherent manner, allowing for transparent quantification of the GHG emissions.

Accuracy: correct monitoring/measurement, estimates, assumptions, calculations and reporting to ensure that the quantification of GHG emissions is systematically neither over nor under the actual emissions, and that uncertainty in the reported data is minimized.

CarbEnviro Services assessed whether the principles and requirements of the GHG Protocol, the IPCC GHG Inventory Guidelines and the API Compendium of Greenhouse Gas were applied in developing and reporting the project's carbon footprint.

7. Roles and Responsibilities

ERM, a leading sustainability services provider, is conducting an environmental impact assessment (EIA) study for the proposed 1 507 MW Gas-fired Independent Power Plant to Support Saldanha Steel and Other Industries in Saldanha Bay, Western Cape Province, South Africa. The power plant is proposed by the International Power Consortium South Africa (IPCSA) as a solution to the requirement for stable, economical electricity over the long term at ArcelorMittal's Saldanha Steel site in Saldanha Bay. (ERM, 2016). The GHG Assessment for the proposed gas power plant was included as part of the EIA study and project team representatives interviewed during the peer review process were:

Client representative	Role
Sarah Bonham	Senior Consultant, Sustainability and Climate Change
Clair Alborough	Senior Consultant, Sustainability and Climate Change
Clemence McNulty	Principal Consultant, Sustainability & Climate Change
Stephan van den Berg	Project Manager, Environmental Impact Assessment
David Mercer	Technical Director, Air Quality and Climate Change

CarbEnviro Services was appointed by ERM to conduct an independent peer review of the GHG Assessment complied for the operational phase of the proposed gas power plant, and the assessment team responsible for conducting the document review, calculation assessment and data analysis was:

Assessment Team	Role
Mandy Momberg	Peer Reviewer

Details and credentials of the peer review team are included in Annex A.

8. Assurance Opinion

CarbEnviro Services conducted an independent peer review of the GHG Assessment compiled for the proposed 1,507 MW Gas-fired Independent Power Plant to Support Saldanha Steel and Other Industries in Saldanha Bay, Western Cape Province, South Africa. Based on the information provided and the assessment activities undertaken in the timeframe given CarbEnviro Services is of the opinion that the principles and requirements of the GHG Protocol Corporate Accounting and Reporting Standard were followed by ERM. CarbEnviro Services concluded that there is no evidence to suggest that the data applied in the GHG Assessment calculations are not a faithful, true and fair account of the GHG emissions from combustion sources from stationery device and indirect sources within the boundary of the project. The guidance provided by the API Compendium for determining GHG emissions from the transmission of natural gas to a processing plant and from combustion sources from mobile devices, process emissions, vented sources and fugitive sources within a gas processing plant could be applied to ensure GHG assertion reporting is complete, accurate, relevant and reported transparently and consistently.

To our knowledge the data and information provided for the gas turbines, the LPG consumption and indirect sources of GHG emissions are correct for the operational phase (estimated at 30 years) and known data exclusions, include combustion emissions from other stationery devices and mobile sources, process and venting emissions, emissions from flaring and other fugitive emissions.

9. Assurance Statement

CarbEnviro Services is an independent third-party and provides assurance in accordance with the requirements of the ISO 14064-3: *Specification with guidance for the validation and verification of greenhouse gas assertions* and performs verification functions within the specifications of the ISO 14065:2007, *Greenhouse gases — Requirements for greenhouse gas validation and verification bodies for use in accreditation or other forms of recognition*. During July 2016 CarbEnviro Services conducted an independent peer review of the GHG Assessment (carbon footprint) compiled by ERM as part of the EIA study for the proposed *1,507 MW Gas-fired Independent Power Plant to Support Saldanha Steel and Other Industries in Saldanha Bay, Western Cape Province, South Africa*. The GHG Assessment for the operational phase of the gas power plant included LPG and natural gas combustion in stationary devices, and took indirect GHG emissions into consideration. The Peer Review determined that the GHG assessment for combustion emissions from stationary devices was compiled in accordance with GHG Protocol Corporate Accounting and Reporting Standards and applied the IPCC (2006) GHG Inventory guidelines and the methodology provided in the API Compendium for determining the emission factor for the natural gas to be processed. The total GHG emissions reported for the expected 30-year lifetime of the gas plant (**137,932,839 tCO_2e**) could be considered reasonable; taken the overstatement of GHG emissions for Phase 2 (expected to come on-line 12-24 months after Phase 1) and the understatement of other GHG emissions related to the lifecycle of the project, and not included in the draft GHG Assessment.

Known exclusions, not covered by this peer review, include the GHG emissions associated with the construction phase of the proposed gas power plant, the transmission of the gas along the proposed gas pipeline from the harbor in Saldanha Bay, the regasification of the LNG prior to the gas turbines, combustion emissions from mobile equipment on site, process, venting, flaring and fugitive emissions from stationary equipment on site, and other GHG sources, sinks and reservoirs due to the project activity (such as methane emissions from waste water treatment, and reduction of GHG emissions due to the generation and consumption of solar energy on site.

The assurance statement is provided to ERM and ArcelorMittal for submission to the competent authorities, in order to satisfy the terms required for the environmental impact assessment, but without CarbEnviro Services accepting or assuming any responsibility or liability to any other party who may have access to the peer review report or place reliance on the assurance statement.

This assurance statement is issued by:

Peer Reviewer and Engagement Director	
Signed: Mandy Momberg	Date: 18 July 2016

Annex A: Credentials of the Peer Reviewer

Company Profile

CarbEnviro Services offers a range of environmental and climate change related services, with a large component being the auditing and assessment of information and data used for energy, environment and sustainability reporting. The independent validation and/or verification of an organization's greenhouse gas (GHG) inventory, GHG emissions reduction or removals enhancement projects and other environmental parameters (e.g. water use and waste disposal) provides assurance to the intended users of the information. In addition, CarbEnviro Services is in a position to assist businesses with addressing their environmental concerns through implementing environmental management systems, environmental due diligence assessments, compliance audits, environmental impact assessments and waste management strategies.

Quality Management Systems

CarbEnviro Services has implemented and maintains a quality management system internally in accordance with the requirements of *ISO9001 Quality Management Systems Requirements* and also the *ISO 14065 Greenhouse Gases – Requirements for greenhouse gas validation and verification bodies for use in accreditation or other forms of recognition*, supported by the *ISO 14064-3 Specification with guidance for the validation and verification of greenhouse gas assertions*, with the intention of obtaining SANAS accreditation.

CarbEnviro Services provides consultation and internal review of an organization's management system in accordance with the requirements of international standards, such as:

- *ISO 90001 Quality Management Systems - Requirements*
- *ISO 14001 Environmental Management Systems - Requirements with guidance for use;*
- *ISO17020 Conformity assessments - Requirements for the operation of various types of bodies performing inspection;*
- *ISO 17021 Conformity assessments - Requirements for bodies providing audit and certification of management systems; and the*
- *CDM Validation and Verification Standard*

Greenhouse Gas Inventories and Carbon Footprint Reports

CarbEnviro Services provides assurance of GHG assertions and energy use data, including electricity use and fossil fuels combusted. Confidence in ones data and reporting system is helpful to business owners, investors, corporations and regulators and allows for informed decision making and aids in addressing corporate risks. An understanding of one's carbon baseline and greenhouse gas emissions enables the identification of energy (and cost) reduction opportunities, target setting for reducing business and corporate GHG emissions and risks and identifying low carbon business opportunities. CarbEnviro Services provides independent third party assessment and verification of greenhouse gas data presented in Carbon Footprint Reports, determined in line with GHG standards such as the *ISO14064-1 Specification with guidance at the organizational level for quantification and reporting of greenhouse gas emissions and removals* and the *GHG Protocol*. As more and more organizations are electing to disclose their greenhouse gas emissions and climate change strategies through the Carbon Disclosure Project (CDP), an independent review and assessment of the data reported and GHG emissions factors applied is beneficial to lend credibility and transparency to the process.

Carbon Tax Verification

CarbEnviro Services is well placed to provide internal and/or external assurance of data, information and systems required for carbon taxation in South Africa, which is due in 2017. A '*carbon tax'* can be considered an environmental tax levied on the carbon content of fuels, and should spark initiatives within businesses to become more energy efficient and environmentally friendly. Businesses will be required to measure and report their fuel consumption and greenhouse gas emissions and the data reported must be supported by credible evidence.

Environmental & Ecological Assessments

CarbEnviro Services provides various environmental assessments for clients in the mining, motor and manufacturing, communications, agriculture and waste industries, including environmental due diligence assessments, financial provisioning for mine closure, environmental impact assessments, environmental management plans and waste management plans and strategies. Ecological assessments include evaluation of veld conditions, wildlife assessments, game stocking plans, predator management plans and biodiversity action plans and species lists.

Environmental Performance Indicators

CarbEnviro Services provides internal and external review and verification of an organization's environmental accounting and reporting system in accordance with the Global Reporting Initiative (GRI) standard and/or internal corporate standards, thus enabling informed decision-making which leads to measurable improvements to a company's triple bottom-line, resulting in even more sustainable and cost-savings practices. The independent assessment of the environmental performance indicators (such as water, energy, greenhouse gasses, hazardous and non-hazardous waste and recycling) leads to an accurate disclosure to external parties (capital shareholders, creditors, authorities and other interested parties) of the organization's non-financial information and sustainability performance.

Validations and Verifications of CDM and other carbon trading projects

CarbEnviro Services is experience in validating and verifying Clean Development Mechanism (CDM) project activities throughout Africa, having sub-contracted as Lead Validator and Verifiers to accredited Designated Operational Entities like PricewaterhouseCoopers and ERM Certification and Verification Services. Certified Emission Reductions (CERs) are issued for the avoided emissions verified under the CDM programme, enabling emissions trading under the Kyoto Protocol.

BEE Status

CarbEnviro Services is an Exempt Micro Enterprise (EME) with a 100% Recognition as a Level 4 Contributor to B-BBEE.

Engagement Team Profile

Mandy Momberg – Engagement Director & Peer Reviewer

Mandy Momberg has over 25 years' experience in climate change, environmental sustainability and biodiversity related matters. Mandy's climate change experience includes the validation and verification of Clean Development Mechanisms (CDM) projects, verification of greenhouse gas inventories and climate change risk assessments. She had a seven-year tenure in government; dealing with environmental sustainability matters; including the assessment and evaluation of Environmental Impact Assessments (EIAs) and the assessment of Environmental Management Programmes (EMPs) for mining activities. Mandy has experienced in environmental due diligence, assurance assessments, rehabilitation requirements and financial provisions for mine closures. Mandy spent two years in the mining industry and gained hands-on experience in land sterwardship, waste management, closure liabilities and environmental management systems. She designed and implemented the Biodiversity Action Plan for Palabora copper mine, bordering the Kruger National Park, and which forms part of that open ecosystem. Mandy has over 10 years' experience in the conservation industry and designed and implemented the Natural Resource Management Plans for Pilanesberg National Park and the Magaliesberg Protected Natural Environment. Mandy has extensive experience in developing, implementing and maintaining quality management systems for accredited certification and inspection bodies (against the ISO 14065, ISO 17020 and ISO 17021 standards).

Mandy has a BTech: Nature Conservation and further training in various environmental matters; including environmental law, environmental risk assessments, environmental auditing, air pollution control, water pollution control and waste management. Mandy has over 900 audit hours and is a qualified and experienced ISO 14001 Environmental Management Systems assessor, an ISO 9001 Quality assessor, a CDM Validator and Lead Verifier, and a Systems and GHG Technical Assessor for the South African National Accreditation System (SANAS) for the ISO 14065 standard. Mandy is a member of the Climate Reality Leadership Corp, under the Chairmanship of Al Gore (former Vice President of the United States of America), and serves on UNISA's Advisory Board for the EXXARO Chair for Business and Climate Change.

Annex B: Document List

NO	DOCUMENT NAME	DATED
1	API (2009). *Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Natural Gas Industry*. Compiled by the American Petroleum Institute. Available at: http://www.api.org/~/media/files/ehs/climate-change/2009_ghg_compendium.pdf [Accessed 14 June 2016]	2009
2	ENCORD (2012). Construction $C0_2e$ Measurement Protocol – A Guide to reporting against the Greenhouse Gas Protocol for construction companies, Version 1.0. Compiled by ENCORD - European Network of Construction Companies for Research and Development.	May 2012
3	ERM (2016). Greenhouse Gas (GHG) Assessment for a Gas-fired Independent Power Plant to Support Saldanha Steel and Other Industries in Saldanha Bay (draft report). Prepared for ArcelorMittal as part of the EIA study for the proposed Gas Power Plant.	June 2016
4	ERM (2016). Saldanha Bay IPP GHG assessment v0.7.xls. Prepared for ArcelorMittal as part of the EIA study for the proposed Gas Power Plant.	June 2016
5	ERM (2016) ToR included in the Plan of Study for the EIA (email extract).	13 July 2016
6	IPCSA (2016), E.I.A. Updated IPCSA 1500 MW Saldanha Bay. Updated Information for EIA Input and Consideration, 1500 MW Saldanha Gas-to-Power. Project Ref. No.: #1026.1.3	12 June 2016
7	IPCC (2006). Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy. Chapter 1 Introduction. Authors Amit Garg (India), Kainou Kazunari (Japan), and Tinus Pulles (Netherlands).	2006
8	IPCC (2006) Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy. Chapter 2. Stationary Combustion. Authors Darío R. Gómez (Argentina) and John D. Watterson (UK). Branca B. Americano (Brazil), Chia Ha (Canada), Gregg Marland (USA), Emmanuel Matsika (Zambia), Lemmy Nenge Namayanga (Zambia), Balgis Osman-Elasha (Sudan), John D. Kalenga Saka (Malawi), and Karen Treanton (IEA).	2006
9	WRI/WBCSD (2004). *Greenhouse Gas (GHG) Protocol: Corporate Accounting & Reporting Standard*. Revised Edition. World Resources Institute/World Business Council for Sustainable Development ISBN 1-56973-568-9.	March 2004
10	WRI/WBCSD (2005). *The GHG Protocol for Project Accounting* World Resources Institute/World Business Council for Sustainable Development ISBN 1-56973-598-0.	November 2005

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Ref/Project number	0315829 – EIA for a Gas-fired Independent Power Plant to Support Saldanha Steel and Other Industries in Saldanha Bay
Subject	ERM's response to comments from the Independent Peer Review conducted on the greenhouse gas (GHG) specialist study
Date	19 July 2016

ERM Southern Africa (Pty) Ltd appointed CarbEnviro Services (registered as K2013179818 (Pty) Ltd) to conduct an independent peer review of the Greenhouse Gas (GHG) Assessment for a Gas-fired Independent Power Plant to Support Saldanha Steel and Other Industries in Saldanha Bay, as part of the Environmental Impact Assessment (EIA) being conducted for ERM's client (ArcelorMittal).

A limited Assurance Statement was provided by CarbEnviro Services, in which several recommendations were provided (shown in bold below). This memo contains ERM's response to the specific recommendations contained within the Peer Review Report.

1. **REC01: Further clarity on the ownership of the gas, the marine vessels and proposed new gas pipeline from the harbour to the project site, as well as maintenance responsibilities for the gas pipeline and marine vessels is required to determine whether this infrastructure, equipment and vehicles, and the associated GHG emissions from these would indeed fall outside of the project boundary. GHG emissions would include:**
    a. **transit loss emissions (from loading, ballasting and storage emissions) and additional GHG emissions from maintenance of gas pipeline infrastructure (e.g. SF6 gas to condition pipes);**
    b. **fugitive emissions from valves along the pipeline route;**
    c. **power load required to pump gas to the plant; and**
    d. **regasification of the LNG once it reaches site.**

At present, detailed information on the suppliers of the natural gas, the transport of the gas to the port, and indeed operations at the gas import terminal (which has yet to be developed) is not available. Furthermore, these activities will fall outside of the project boundary, as per guidance from the IFC that states that such indirect activities do not need to be quantified as part of the GHG assessment for a proposed development.

Whilst the gas pipeline (approximately 5 km) does fall inside the boundary of the broader EIA, detailed studies on fugitive emissions from the pipeline have not been conducted and fugitive emissions were excluded from the scope of the GHG assessment as they are not likely to be material. In addition, the power requirements for pumping gas to the plant and the regasification of

LNG on reaching the site are not considered to be significant sources of GHG emissions relative to the magnitude of emissions arising from the combustion of natural gas at the plant (as per the World Energy Council 2004 study referenced in the report, which indicates that 80% or more of life cycle emissions from gas power plants are direct stack emissions associated with operations). ERM considered that a disproportionate effort would be required in order to include these sources in the assessment, relative to the magnitude of emissions likely to result from these activities.

2. **REC02: Further clarity on the project's baseline impacts would demonstrate equivalence in type and level of activity of products/services provided between the project and the baseline scenario (i.e. energy consumption by ArcelorMittal and other users in the absence of the proposed project) and the project's GHG sources, sinks and reservoirs (e.g. the qualification of solar and other renewable energy for on-site use) to enable optimal disbursement of electricity generated by the natural gas. The GHG Protocol for Project Accounting (2005) offers sound guidance on this.**

The approach taken by ERM for the impact assessment is to assess the baseline environment – in the absence of the project – and then to assess the project's likely impacts on this baseline environment. The power station will provide power to ArcelorMittal's Saldanha Steel power plant and other industries in the area, and this power will be additional to the existing power supplied to the area via the national grid. From a project perspective, the baseline GHG impacts are zero, since the power station does not currently exist. The impact assessment therefore quantifies the estimated GHG emissions from the plant when it is operational, and the impact that of these new and additional GHG emissions on South Africa's national GHG emissions levels and on global climate change. An analysis of the GHG emissions intensity of electricity generated by the plant compared to the GHG emissions intensity of the national grid is included within the report in order to understand how the GHG performance of the power plant compares to baseline grid emissions intensity.

3. **REC03: The GHG Assessment could be updated to include all direct emissions listed by the API (2009) for gas plants, such as the combustion sources from all stationary and mobile devices, vented sources (such as process vents, other vents, maintenance/turnaround vents and non-routine activities), and emissions from fugitive sources, or a conservative adjustment could be applied to account for all Scope 1 emissions.**

At present, detailed information relating to the above listed emissions sources is not available, and detailed studies to generate this data were not requested as part of the GHG information request on the assumption that the emissions arising from these activities are likely to be insignificant relative to the emissions arising from the combustion of the natural gas for power generation (as per the 2004 World Energy Council life cycle emissions assessment study). ERM notes that the inclusion of such sources will not alter the magnitude rating for the project's GHG emissions ('very large', at > 1 000 000 tCO_2e per annum) or the impact magnitude rating.

4. **REC04: Please consider applying a conservative estimate and report the associated assumptions for determining GHG emissions for the construction phase, as a 15-20% discrepancy in the carbon footprint over the lifecycle of the gas plant could be considered significant.**

ERM notes that the 15-20% discrepancy in the carbon footprint (which reflects the estimated proportion of GHG emissions coming from life cycle stages other than direct GHG emissions from the stack during operations) encompasses all other life cycle stages – including construction, but also fuel extraction and processing, fuel transport, end-of-life processes such as waste incineration and disposal, ancillary infrastructure such as supplier facilities, and transmission and distribution infrastructure and losses. As such, emissions associated with the construction of the power plant will be a portion of these additional emissions, and more detailed studies would be needed to understand the likely percentage contribution specifically associated with construction emissions.

ERM has scoped the GHG assessment such that the focus is placed on the largest source of emissions – namely the combustion of natural gas in the turbines for the generation of electricity. At this stage of the project's development, detailed information on activities taking place across other life cycle stages is not available. For this reason, and also in line with the GHG Protocol's GHG accounting guidance (specifically the guidance relating to boundary-setting according to the operational control approach where indirect value chain emissions are an optional reporting category), other life cycle stages – including construction – are stated exclusions from the assessment. Whilst including an estimate of construction emissions would increase the completeness of the assessment, it will not alter the magnitude rating for the project's emissions (which is 'very large', i.e. >1 000 000 tCO_2e per annum) or the impact magnitude rating, or the findings in relation to the need for mitigation measures.

5. **REC05: Correct the total GHG emissions for the estimated 30-year lifetime of the project to reflect the projected emissions for Phase 2 (for 28-29 years only), and include the steps and equations applied to calculate each parameter and include a transparent description of these.**

ERM notes the following information in the project Scoping Report: 'As the development process of the site is yet to fully begin, detailed decommissioning plans have not yet been formulated; however the initial plant life will be designed for 25 to 30 years. Upgrades during the life of the plant can increase the design life to 50 years'. As such, there is some uncertainty with regard to the project lifetime and dates of decommissioning. Considering this uncertainty, ERM assumed a 'best estimate' of 30 years' operating time for Phase 1 and 2 operations in order to provide a high level estimate of total, cumulative emissions over the project's lifetime (reported as being 'in the range of' 138 Mt CO_2e) and does not feel that there is sufficient information at this stage to increase the accuracy of this estimate. Furthermore, small deviations from this number are unlikely to change the findings and conclusions from the GHG assessment in relation to the magnitude of GHG emissions from the project, and the associated climate change impacts.