APPENDIX E1 – Climate Change Impact Assessment

CLIMATE CHANGE IMPACT ASSESSMENT REPORT

PROPOSED 750MW COMBINED CYCLE GAS TURBINE POWER PLANT IN RICHARDS BAY, CITY OF UMHLATHUZE LOCAL MUNICIPALITY, KING CETSHWAYO DISTRICT MUNICIPALITY, KWAZULU-NATAL

COMPILED BY PROMETHIUM CARBON FOR:

NEMAI CONSULTING

ON BEHALF OF

MABASA ENERGY AND FUELS (PTY) LTD

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KEY TERMS AND DEFINITIONS

Adaptive capacity[1]	Adaptive capacity is a set of factors which determine the capacity of a system to generate and implement adaptation measures. These factors relate largely to available resources of human systems and their socio-economic, structural, institutional, and technological characteristics and capacities.
Climate change impacts[1]	The consequences of realised risks on natural and human systems, where risks result from the interactions of climate-related hazards (including extreme weather and climate events), exposure, and vulnerability. Impacts generally refer to effects on lives; livelihoods; health and well-being; ecosystems and species; economic, social and cultural assets; services (including ecosystem services); and infrastructure. Impacts may be referred to as consequences or outcomes and can be adverse or beneficial.
Climate change[1]	The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as: '*a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods*. The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition and climate variability attributable to natural causes.
Climate exposure[1]	The presence of people; livelihoods; species or ecosystems; environmental functions, services and resources; infrastructure; or economic, social or cultural assets in places and settings that could be adversely affected.
Climate resilience[1]	The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure while also maintaining the capacity for adaptation, learning and transformation.
Climate variability[1]	Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability).
Climate Vulnerability[1]	The propensity or predisposition to be adversely affected and encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.

[1] IPCC, 2022: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. *et al.*(eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 37–118, doi:10.1017/9781009325844.002.

Direct emissions	GHG emissions that occur from sources that are controlled or owned by an organisation. Direct emissions are labelled Scope 1 emissions in the GHG Protocol Corporate Standard and Category 1 emissions in SANS 14064 Part 1 (2021).
Extreme weather[2]	Unexpected, unusual, or unforeseen weather which differs significantly to the usual weather pattern, such as droughts, floods, extreme rainfall, and storms.
Greenhouse Gas (GHG) [1]	Greenhouse gases (GHGs) are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of terrestrial radiation emitted by the Earth's surface, the atmosphere itself and by clouds. This property causes the greenhouse effect. The IPCC Assessment Reports deals with the following GHGs, carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4), Sulphur hexafluoride (SF6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).
Indirect emissions	GHG emissions that are a consequence of the activities of the reporting entity but occur at sources owned or controlled by another entity. Indirect emissions are classified as Scope 2 emissions for energy indirect emissions and Scope 3 emissions for other indirect emissions in the GHG Protocol Corporate Standard. SANS 14064 Part 1 (2021) classifiers indirect emissions as Category 2 through Category 6 emissions.
Resilience[3]	The capacity of interconnected social, economic and ecological systems to cope with a hazardous event, trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure.
Sensitivity[1]	Sensitivity determines the degree to which a system is adversely or beneficially affected by a given climate change exposure and is a function of the natural and socio-economic context of a particular site.
Shared Socioeconomic Pathways (SSPs)[4]	The Shared Socioeconomic Pathways (SSPs) are scenarios developed by the Intergovernmental Panel on Climate Change (IPCC) to assess societal and economic developments and how these could affect greenhouse gas emissions and climate change. They are designed to facilitate the integration of climate change research, including climate impacts, adaptation, and mitigation.

2 GIZ. 2014. The vulnerability sourcebook. Gesellschaft für Internationale Zusammenarbeit, Bonn, Germany.

3 IPCC, 2021: Annex VII: Glossary [Matthews, J.B.R., *et al.* (eds.)]. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. *et al.* (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 2215–2256, doi:10.1017/9781009157896.022

4 Riahi, K. *et al.* 2017. The Shared Socioeconomic Pathways and their energy, land use, and GHG emissions implications: An overview. Global Environmental Change 42: 153-168.

Shared Socioeconomic Pathway 1 (SSP1)[4]	Taking the Green Road (Low challenges to mitigation and adaptation). A gradual but widespread shift to a more sustainable development pathway. This narrative emphasises inclusive development and respects environmental boundaries. The world shifts gradually, but pervasively, toward a more sustainable path, emphasising more inclusive development that respects perceived environmental boundaries. Management of the global commons slowly improves, educational and health investments accelerate the demographic transition, and the emphasis on economic growth shifts toward a broader emphasis on human well-being. Driven by an increasing commitment to achieving development goals, inequality is reduced both across and within countries. Consumption is oriented toward low material growth and lower resource and energy intensity.
Shared Socioeconomic Pathway 2 (SSP2)[4]	Middle of the Road (Medium challenges to mitigation and adaptation) or status quo. The world follows a path in which social, economic, and technological trends do not shift markedly from historical patterns. Development and income growth proceeds unevenly, with some countries making relatively good progress while others fall short of expectations. Global and national institutions work toward but make slow progress in achieving sustainable development goals. Environmental systems experience degradation, although there are some improvements and overall, the intensity of resource and energy use declines. Global population growth is moderate and levels off in the second half of the century. Income inequality persists or improves only slowly and challenges to reducing vulnerability to societal and environmental changes remain.
Shared Socioeconomic Pathway 3 (SSP3)[4]	Regional Rivalry - A Rocky Road (High challenges to mitigation and adaptation). A resurgent nationalism, concerns about competitiveness and security, and regional conflicts push countries to increasingly focus on domestic or, at most, regional issues. Policies shift over time to become increasingly oriented toward national and regional security issues. Countries focus on achieving energy and food security goals within their own regions at the expense of broader-based development. Investments in education and technological development decline. Economic development is slow, consumption is material-intensive, and inequalities persist or worsen over time. Population growth is low in industrialized and high in developing countries. A low international priority for addressing environmental concerns leads to strong environmental degradation in some regions.
Shared Socioeconomic Pathway 5 (SSP5)[4]	Fossil-fuelled Development - Taking the Highway (High challenges to mitigation, low challenges to adaptation). This world places increasing faith in competitive markets, innovation and participatory societies to produce rapid technological progress and development of human capital as the path to sustainable development. Global markets are increasingly integrated. There are also strong investments in health, education, and institutions to enhance human and social capital. At the same time, the push for economic and social development is coupled with the exploitation of abundant fossil fuel resources and the adoption of resource and energy intensive lifestyles

around the world. All these factors lead to rapid growth of the global economy, while global population peaks and declines in the 21st century. Local environmental problems like air pollution are successfully managed. There is faith in the ability to effectively manage social and ecological systems, including by geo-engineering if necessary. There is faith in the ability to effectively manage social and ecological systems, including by geo-engineering if necessary.

SSP5-8.5 is widely regarded as a worst-case, no policy scenario rather than 'business as usual' as it was originally framed as. This would result in a ~5°C mean temperature rise by 2100 relative to pre-industrial levels. This scenario is gradually becoming more implausible as such a pathway would require a fivefold increase in coal use by the end of the century, for which most estimates believe could not be accounted for given the extent of recoverable coal reserves. SSP5-8.5 is further deemed unlikely given the declining costs in clean energy sources and thus the greater uptake of these.

Vulnerability[1] Vulnerability is defined as the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes.

ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
AR6	Sixth Assessment Report
CCGT	Combined Cycled Gas Turbine
CCPP	Combined Cycle Power Plant
CCIA	Climate Change Impact Assessment
CDSB	Climate Disclosure Standards Board
CH_4	Methane
CMIP6	The Coupled Model Intercomparison Project Phase 6
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DFFE	Department of Forestry, Fisheries and the Environment
DMRE	Department of Mineral Resources and Energy
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EBRD	European Bank for Reconstruction and Development.
EHS	Environmental, Health, and Safety
EIA	Environmental Impact Assessment
GASIPPPP	Gas Independent Power Producers Procurement Programme
GCI	Global Change Institute
GCM	Global climate models
GHG	Greenhouse gas
GMP	Gas Master Plan
GNSS	Global Navigation Satellite System
GWP	Global Warming Potential
HILP	High Impact Low Probability
HRSGs	Heat Recovery Steam Generators
IDP	Integrated Development Plan
IDZ	Industrial Development Zone
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
IPPPP	Independent Power Producers Procurement Programme
IRP	Integrated Resource Plan
ISO	International Organization for Standardization
kV	Kilovolt

LNG	Liquified Natural Gas
Mt	Megatonnes
$MtCO_2e$	Megatonnes of carbon dioxide equivalent
MW(h)	Megawatt hours
N_2O	Nitrous Oxide
NDC	Nationally Determined Contribution
NOx	Nitrogen oxides
NPAES	National Protected Area Expansion Strategy
O&M	Operations and Maintenance
RBIDZ	Richards Bay Industrial Development Zone
RCP	Representative Concentration Pathways
SANS	South African National Standard
SCA	Supreme Court of Appeal
SETs	Sectoral emission targets
SSP	Shared Socio-economic Pathway
tCO_2e	Tonnes of carbon dioxide equivalent
UNFCCC	United Nations Framework Convention on Climate Change
UUW	uMngeni-uThukela Water
WRI	World Resources Institute
ZET	Zululand Energy Terminal

DECLARATION OF INDEPENDENCE

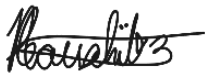
The authors of this report do hereby declare their independence as consultants appointed by Nemai Consulting ("Nemai") on behalf of Mabasa Energy and Fuels (Pty) Ltd (Project applicant) to undertake a Climate Change Impact Assessment (CCIA) Report for the proposed 750 MW Combined Cycle Power Plant (CCPP) & Associated Infrastructure Project situated in Richards Bay ("the 750 MW CCPP Project" or "the Project"). Other than fair remuneration for the work performed the specialists have no personal, financial business or other interests in the project activity. The objectivity of the specialists is not compromised by any circumstances and the views expressed within this report are their own.



Robbie Louw



Shannon Murray



Camden Nauschutz



Kaylee van den Bosch

DETAILS OF THE SPECIALIST TEAM

Promethium Carbon is a South African climate change and carbon advisory company with offices in Johannesburg and Cape Town. The company has been active in the climate change and carbon management space since 2004.

Promethium Carbon's climate change impact studies include an estimation of the carbon footprint of the activity or group of activities, as well as the vulnerability of the activity/ies to climate change. Promethium Carbon has calculated GHG inventories for over 60 entities and is proficient in applying the requirements of ISO/SANS 14064 and the GHG Protocol's accounting standards, as well as South Africa's GHG Reporting Guidelines. Promethium Carbon has also assisted around 40 clients develop climate change risk assessments, which includes the compilation of climate change specialist reports. Promethium Carbon's assessments include thorough analysis of historical and projected weather data specific to the region in which the client operates.

Robbie Louw is the founder and director of Promethium Carbon. He has over 18 years of experience in the climate change industry. Robbie holds both a BCom Honours Degree in Economics, as well as a BSc degree in Chemical Engineering. Robbie has significant experience with regards to climate change mitigation and adaptation. Robbie's chemical engineering background combined with his extensive experience in climate change has led to him leading several projects related to climate change risk and vulnerability, energy development and developing climate change mitigation and adaptation alternatives. His experience over a period of 35 years covers the chemical, mining, minerals process and energy fields, in which he was involved in R&D, project, operational and management levels. Robbie is currently a member of The Southern African Institute of Mining and Metallurgy and the Institute of Directors in South Africa (IoDSA). In addition, Robbie is also a member of the Technical Working Group of the Climate Disclosure Standards Board (CDSB). Robbie's experience in climate change includes, but is not limited to:

- Climate change risk and vulnerability assessments for large mining houses;
- Extensive experience in preparing carbon footprints. The team under his leadership has performed carbon footprint calculations for major international corporations operating complex businesses in multiple jurisdictions and continents;
- Carbon and climate strategy development for major international corporations;
- Climate change impact assessments for various companies and projects;
- Climate change scenario planning and analysis, particularly in terms of the recommendations of the Taskforce on Climate-related Financial Disclosure; and
- In depth understanding of South Africa's climate change regulations and carbon tax requirements.

Shannon Murray is a Principal Climate Change Advisor at Promethium Carbon, where she has worked since 2021. She holds BA and LLB degrees from the University of the Witwatersrand and has completed training in energy, environmental, and international law through the Wits Mandela

Institute, as well as professional development on Article 6 of the Paris Agreement, environmental legal risk, and climate action planning through the UNDP and other institutions. Admitted as an attorney of the High Court of South Africa in 2019, she practised in commercial litigation before transitioning to climate advisory and is currently on the non-practising roll with the Law Society of South Africa.

At Promethium, Shannon has led and contributed to diverse climate change and sustainability projects across the public and private sectors, both locally and internationally. Her work includes advising on carbon market transactions and regulatory frameworks, supporting climate targets and preparing CCIAs for mining, energy, and infrastructure developments. She has also supported the development of Article 6 implementation frameworks, municipal renewable energy accounting for net-zero tracking, and the delivery of climate finance and carbon market capacity-building in East and West Africa. Shannon has led and contributed to CDP Climate and Water disclosures, as well as GHG emissions footprinting and climate risk and vulnerability assessments. She brings a combination of legal expertise and climate policy insight, with a focus on mitigation and adaptation planning, climate risk, carbon markets, and climate disclosure.

Camden Nauschutz is a Climate Change Advisor at Promethium Carbon. He holds a Master's degree in Environmental Science from the University of the Witwatersrand, where his research focused on assessing the drivers of water vulnerability and water scarcity in the City of Johannesburg. His work examined socio-economic and service delivery factors influencing household-level vulnerability and included the development of a Water Vulnerability Index to assess exposure and adaptive capacity in an urban context.

At Promethium Carbon, Camden has worked on a range of climate change projects across the mining, energy, waste management, and consumer goods retail sectors, supporting both public and private sector clients. He has worked extensively on Climate Change Impact Assessments within the mining and energy generation sectors, with particular emphasis on the quantification and interpretation of greenhouse gas inventories for project-level assessments and the evaluation of associated climate-related risks and impacts. He also contributes to Climate Change Risk and Vulnerability Assessments through the assessment of climate-related vulnerability and adaptation responses. In addition, he supports clients with GHG reporting, carbon footprint development, climate disclosure projects, GHG reporting, carbon tax calculations, and the modelling of emissions trajectories and reduction targets. His work integrates emissions accounting with climate risk and adaptation analysis to support regulatory climate assessment processes.

Kaylee van den Bosch is a Climate Change Advisor (Cand.Sci.Nat.) at Promethium Carbon who holds Master of Science degree in Animal, Plant and Environmental Science from University of the Witwatersrand. Her postgraduate thesis focused on the conservation, ecology, and botany of an endangered medicinal tree species in Southern Africa. Her professional involvement encompasses various projects such as Carbon Disclosure Project (CDP) report preparation; Carbon footprint reporting, Target Setting; Climate Change Impact Assessments; Carbon Program eligibility studies and ESG Frameworks.

REPORT STRUCTURE AND REFERENCE IN TERMS OF NEMA REGULATIONS (2014) AS AMENDED, APPENDIX 6

NEMA Regulations (2014) (as amended) - Appendix 6	Relevant section in report
Details of the specialist who prepared the report	Pages xv-xvi
The expertise of that person to compile a specialist report including a curriculum vitae	Pages xv-xvi
A declaration that the person is independent in a form as may be specified by the competent authority	Page xiv
An indication of the scope of, and the purpose for which, the report was prepared	Sections 1 and 4
An indication of the quality and age of base data used for the specialist report	Sections 5.3.5, 5.5.3 and 5.5.5
A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Sections 5.3, 6.2 and 7
The duration date and season of the site investigation and the relevance of the season to the outcome of the assessment	No site investigation was undertaken. This was a desktop study based on available project information, spatial data and published climate datasets.
A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 5
Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternative	Sections 2.1, 2.2, 2.4, 6.1.7 and 7.2.4
An identification of any areas to be avoided, including buffers	Sections 7.2.4, 8.2 and 9
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	Figure 1; Figures 14–20 provide spatial climate and hazard context relevant to environmental sensitivities.
A description of any assumptions made and any uncertainties or gaps in knowledge	Sections 5.3.5, 5.5.5 and 6.1.6
A description of the findings and potential implications of such findings on the impact of the proposed activity or activities	Sections 6, 7 and 9
Any mitigation measures for inclusion in the EMPr	Section 8.1 and 8.2
Any conditions for inclusion in the environmental authorisation (EA)	None specifically proposed. See Section 3.5.2 and Section

NEMA Regulations (2014) (as amended) - Appendix 6	Relevant section in report
	8, which clarify that the measures are non-binding recommendations for consideration and do not prescribe conditions of EA.
Any monitoring requirements for inclusion in the EMPr or EA	Section 8
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised and regarding the acceptability of the proposed activity or activities	Section 10
A description of any consultation process that was undertaken during preparing the specialist report	None
A summary and copies of any comments received during any consultation process and where applicable all responses thereto	None
Any other information requested by the competent authority	None

1 INTRODUCTION

Promethium Carbon has been appointed by Nemai Consulting (Pty) Ltd, the independent Environmental Assessment Practitioner (EAP), to conduct a Climate Change Impact Assessment (CCIA) as part of the Environmental Impact Assessment (EIA) process for the proposed 750MW Combined Cycle Power Plant (CCPP) in Richards Bay ("the Project"). The Project is being developed by Mabasa Energy and Fuels (Pty) Ltd and is located in Alton North within Ward 2 of the City of uMhlathuze, approximately 1.5 km from the Richards Bay Central Business District (CBD). The project site falls within the uMhlathuze Local Municipality and the King Cetshwayo District Municipality and lies adjacent to the Richards Bay Industrial Development Zone (IDZ).

Following the promulgation of the Integrated Resource Plan (IRP) in 2019, the Minister of Mineral Resources and Energy determined that the procurement of new generation capacity is required to ensure energy security and that approximately 3000 megawatts (MW) would be procured, to be generated from gas. The Gas Independent Power Producers Procurement Programme (GASIPPPP) was identified by the Department of Mineral Resources and Energy (DMRE) as the appropriate programme to procure the new generation capacity. The Applicant intends to bid for the GASIPPPP and/or other suitable energy markets.

The proposed 750MW CCPP is a large-scale gas-to-power project designed to contribute reliable, dispatchable electricity to the grid. The facility will use Combined Cycle Gas Turbine (CCGT) technology, combining gas and steam turbines to maximise thermal efficiency by recovering exhaust heat through Heat Recovery Steam Generators (HRSGs) to generate additional electricity via steam turbines. The Project will operate on natural gas derived from regasified liquefied natural gas (LNG), supplied via a dedicated gas pipeline connected to the proposed Zululand Energy Terminal (ZET) gas distribution supply take-off point for Richards Bay consumers. Although the associated pipeline and grid connection infrastructure fall outside the scope of the current environmental authorisation (EA) application, these components are functionally linked to the Project and are therefore considered in the climate change assessment.

Although the ZET is undergoing a separate EA process, it constitutes functionally linked and dependent infrastructure for the operation of the proposed CCGT Power Plant. Accordingly, for the purposes of this CCIA, greenhouse gas (GHG) emissions associated with the operation of the ZET are considered on a proportional basis, based on calculated gas offtake associated with the Project's capacity and operating profile. The inclusion of ZET-related operational emissions is for climate change assessment purposes and does not imply any determination regarding terminal capacity allocation, commercial arrangements, or the outcome of the separate EA process for the ZET.

Supporting infrastructure associated with the Project will include the generation equipment (gas turbines, HRSGs units and steam turbines), cooling and water management systems, hydrocarbon storage and handling infrastructure, and electrical infrastructure required to export electricity to the Eskom transmission network. This will also include on-site substation infrastructure, transformers and associated switchgear and protection systems. The Project is intended to provide

dispatchable generation capacity that contributes to grid reliability and supports electricity supply during periods of increased demand and reduced output from variable renewable energy sources.

This CCIA aims to assess the Project's contribution to climate change through its GHG emissions and evaluate the Project's exposure and resilience to current and future climate change risks. Given the Project's scale and the increasing scrutiny of fossil fuel infrastructure in South Africa, this assessment is a critical input into the EA process, supporting regulatory review and potential legal scrutiny.

This CCIA is designed to achieve the following objectives:

- Determine the Project's contribution to climate change by:
  - Identifying Project activities and infrastructure contributing to GHG emissions (notably from fuel combustion);
  - Compiling a GHG inventory for the Project across relevant lifecycle phases;
  - Assessing the Project's GHG emissions in relation to South Africa's national climate change policy framework and objectives, and international commitments; and
  - Identifying and proposing measures to mitigate the Project's emissions, where applicable.
- Determine the resilience of the Project to climate change by:
  - Assessing projected climate change risks and trends for the region;
  - Identifying vulnerabilities in the Project's core operations, value chain, and surrounding environmental and social systems; and
  - Recommending adaptation measures to enhance climate resilience.

This assessment considers the full lifecycle of the Project, from construction and operation through to decommissioning, and evaluates both the Project's contribution to climate through an emissions assessment and the potential impacts of projected climate change on the Project and its surrounding context. This assessment adopts a methodological approach that integrates climate policy context, climate risk assessment, and the use of spatially explicit climate and vulnerability data, in line with international best practice.

2 PROJECT DESCRIPTION

The proposed Project comprises the development of a 750 MW CCGT power plant to be developed for connection to the national electricity grid. The facility is designed to operate as a dispatchable electricity generation plant and will be located within the Alton North industrial area of Richards Bay in the City of uMhlathuze Local Municipality, KwaZulu-Natal, as described in Section 2.1 below.

Electricity will be generated using CCGT technology, which integrates two thermodynamic cycles to maximise efficiency. In this configuration, natural gas is combusted in gas turbine generators to produce electricity, while the high-temperature exhaust gases produced during combustion are directed to HRSGs. The HRSGs recover waste heat from the exhaust gases to produce steam, which is then used to drive a steam turbine generator to generate additional electricity. This

combined cycle configuration allows for higher thermal efficiency compared to simple-cycle gas generation, thereby improving fuel utilisation and reducing the carbon intensity of electricity generation relative to conventional fossil fuel power plants.

The proposed plant will consist of two gas turbine generators, two HRSG units, and one steam turbine generator configured in a 2+2+1 arrangement, together forming a single combined cycle power block. The plant will be designed for base-load operation of approximately 500 MW in simple cycle mode and up to 750 MW in combined cycle mode, operating on a continuous basis depending on grid demand and operational requirements.

The power plant will operate on natural gas supplied from the planned ZET at the Port of Richards Bay. The Applicant will secure the supply and delivery of natural gas from this terminal development. While the natural gas pipeline and electrical grid connection infrastructure associated with the supply of fuel and transmission of electricity fall outside the scope of the current EA application and will be subject to separate planning and approval processes once final routing and design are confirmed, they constitute functionally linked infrastructure for the operation of the Project. Accordingly, where relevant to the assessment of GHG emissions, cumulative climate impacts, and climate-related risks and vulnerabilities, such infrastructure is considered within the scope of this CCIA, where feasible.

In addition to the primary gas fuel supply, the plant will include limited on-site storage and handling of hazardous materials, including systems associated with plant operation and maintenance. This includes a small back-up diesel generator used to support plant start-up and emergency operations, as well as other ancillary systems required for safe and reliable plant operation.

The proposed facility will also include associated balance-of-plant infrastructure, including cooling systems, water management systems, electrical infrastructure such as a 275 kV switchyard and step-up transformers, and other supporting infrastructure required for the operation and maintenance of the plant and the export of electricity to the national grid.

2.1 Locality

The proposed 750 MW CCGT power plant and its associated infrastructure will be located on Erf 16673 within Phase 1F of the Richards Bay Industrial Development Zone (RBIDZ) in Alton North, Richards Bay, approximately 1.5 km from the Richards Bay Central Business District (CBD) (Figure 1). The site falls within the jurisdiction of the City of uMhlathuze Local Municipality and the King Cetshwayo District Municipality in KwaZulu-Natal Province.

The project site covers an area of approximately 12.7 hectares[5] and is located within a designated industrial development zone intended to accommodate energy and heavy industrial infrastructure. Access to the site is provided via Alumina Allee Road, which runs along the eastern boundary of the property. The surrounding area is characterised by established industrial and port-related infrastructure associated with the RBIDZ and the Port of Richards Bay, reflecting the role of the area in supporting large-scale industrial and energy developments.

The proposed Project will include associated balance-of-plant infrastructure, including generation equipment, cooling and water management systems, electrical infrastructure and supporting operational facilities. Although the detailed routing and development of the external transmission infrastructure is subject to separate planning and regulatory processes, this infrastructure is functionally linked to the Project and is therefore considered in the climate change assessment to the extent relevant and based on the information available at this stage.

The Project's location shown in Figure 1 informs the assessment of climate-related physical risks and vulnerabilities presented in section 7 of this report.

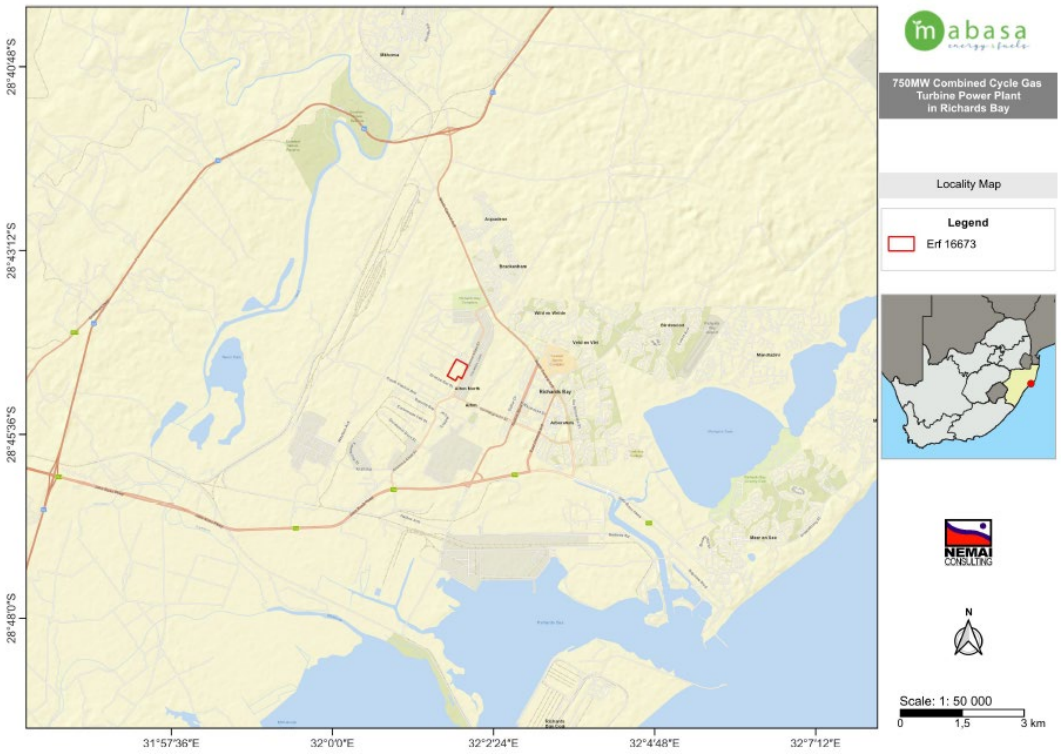


Figure 1: 750MW CCGT Facility Locality Map[6]

[5] Note: The carbon stock assessment is based on a shapefile-derived footprint of approximately 19 ha, which is larger than the described 12.7 ha site extent and was adopted as a precautionary assessment boundary.

[6] Scoping Report, March 2026: Proposed 750MW Combined Cycle Gas Turbine Power Plant in Richards Bay, City of uMhlathuze Local Municipality, King Cetshwayo District Municipality, KwaZulu Natal. Nemai Consulting (Pty) Ltd.

2.2 Proposed Infrastructure and Activities

The proposed plant will utilise combined cycle technology, integrating gas turbines and steam turbines to improve energy efficiency. The facility will consist of two gas turbine generators, two HRSGs, and one steam turbine generator configured in a 2+2+1 arrangement, together forming a single combined-cycle power block capable of producing up to 750 MW in combined cycle operation and approximately 500 MW in simple cycle mode, on a twenty-four hours a day, seven days a week basis.

The proposed power plant will include key infrastructure components required for electricity generation and plant operations. Primary generation infrastructure will include gas turbines with associated air intake and filtration systems, HRSG units for heat recovery, and a steam turbine coupled to an electrical generator. Each gas turbine will be equipped with exhaust stacks and associated emission control systems for the safe release of combustion gases.

The facility will incorporate supporting cooling and water management infrastructure, including systems required to condense steam and recycle water within the steam cycle. This will include condensers, cooling towers, and associated cooling water systems, together with water reticulation infrastructure and water treatment facilities required to produce water of the necessary quality for the steam cycle and other plant processes.

A demineralized water storage tank and system will provide boiler feedwater to the HRSG's and make-up water to the closed cycle cooling water system. The Cooling Water Plant will include one induced draft cooling tower system catering to the cooling water requirements of the steam turbine condenser, with make-up water sourced from the freshwater system. The closed cooling water system will consist of plate heat exchangers and pumps and will serve the cooling requirements of the Gas Turbine Generator (GTG) auxiliaries, Steam Turbine Generator (STG) auxiliaries, and HRSG auxiliary systems.

Ancillary infrastructure will include balance-of-plant systems, such as pumps, heat exchangers, transformers, plant control systems, and supporting electrical equipment. Additional facilities will include on-site hydrocarbon storage for operational materials such as lubricants and oils, a small backup diesel generator to support plant start-up and emergency operations, and supporting infrastructure including access roads, fencing and security infrastructure, laydown and storage areas, warehouses, workshops, and operations and maintenance (O&M) buildings.

The plant will have a dedicated fire protection system comprising water storage, a pumping system, and a pressurised ring main complete with fire hydrants positioned along the ring main, firefighting equipment, a sprinkler system for the offices, fire extinguishers, and a deluge system for the switchyard.

The plant will have adequate drainage to remove surface water from the site. Oily water separators positioned around the site will collect any spillage and/or wash water from maintenance operations

on key equipment. These separators will be designed to discharge treated grey water into the drainage system at an acceptable quality level.

Electrical infrastructure will include an on-site substation and a 275 kV switchyard, incorporating step-up transformers and associated switchgear required for the export of electricity to the national transmission network. The plant will connect to the grid via external transmission infrastructure, which is functionally linked to the Project and considered in the climate change assessment, although its detailed routing and separate approval requirements are not part of this application process.

Construction activities associated with the proposed development will include site preparation and establishment, earthworks, foundation construction, installation of mechanical and electrical plant components, development of cooling and water infrastructure, construction of plant buildings and support facilities, installation of electrical infrastructure, and commissioning of the plant.

Operational activities will include natural gas supply management, routine electricity generation though the combustion of regasified LNG in the power plant, operation of cooling and water treatment systems, emissions monitoring, and scheduled maintenance of plant equipment and associated infrastructure.

The CCPP comprises the following stages:

1. Electricity generation via the gas turbine (primary cycle)

Natural gas is combusted in the gas turbine combustion chamber where compressed air is mixed with fuel to produce high-temperature, high-pressure gases. These gases expand through the turbine blades, causing the turbine shaft to rotate and drive an electrical generator to produce electricity.

2. Heat recovery from exhaust gases

High-temperature exhaust gases from the gas turbines are directed to the HRSG units, where waste heat is captured and used to produce high-pressure steam. This heat recovery process improves the overall efficiency of the plant by utilising energy that would otherwise be lost.

3. Additional electricity generation via the steam turbine (secondary cycle)

Steam produced by the HRSG units is routed to a steam turbine, where it expands through turbine blades to generate additional mechanical energy. This energy drives a generator connected to the steam turbine, producing additional electricity and improving the overall thermal efficiency of the facility.

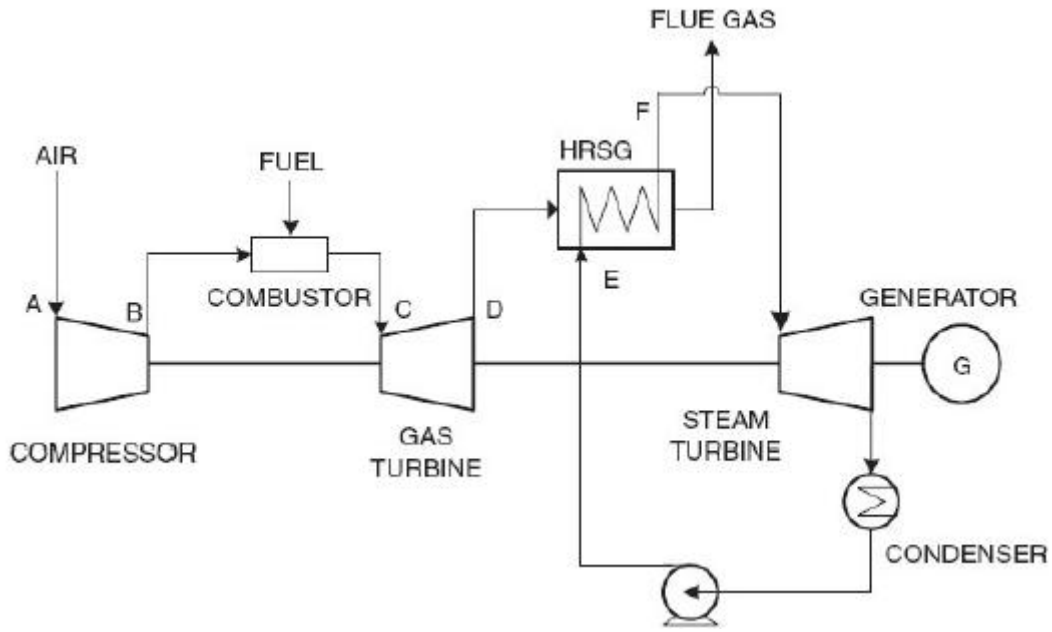


Figure 2: Schematic flow diagram of CCPP[7]

2.3 Project Context

2.3.1 Core operations

The proposed 750 MW CCPP will comprise of two General Electric Frame 9 gas turbines, two HRSGs, and one steam turbine generator. This configuration allows the plant to operate at approximately 500 MW in simple cycle mode and up to 750 MW in combined cycle mode, providing dispatchable electricity generation to support grid reliability.

Natural gas supplied to the facility will be used as the primary fuel source for electricity generation. In addition to the primary gas supply, the plant will include limited on-site diesel storage to support a black-start generator, enabling safe start-up and restart capability during grid disruptions or plant outages.

Electricity generated by the power plant will be exported to the national electricity grid via an on-site switchyard and associated generator step-up transformers, which will raise the voltage from the generator output level to the grid voltage level. The development of the external transmission infrastructure and grid connection falls outside the scope of the current EA process and will be addressed through separate planning and regulatory processes.

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[7] Scoping Report, March 2026: Proposed 750MW Combined Cycle Gas Turbine Power Plant in Richards Bay, City of uMhlathuze Local Municipality, King Cetshwayo District Municipality, KwaZulu Natal. Nemai Consulting (Pty) Ltd.

For the purposes of this CCIA, the Project is therefore assessed as a dispatchable electricity generation facility supplying electricity to the national transmission system, consistent with the project's intended role within South Africa's evolving electricity generation mix.

2.3.2 Value chain

The Project's value chain includes upstream, on-site, and downstream components that collectively enable fuel supply, electricity generation, and delivery of electricity to the grid. This framing supports the assessment of indirect GHG emissions and climate-related risks across the Project lifecycle.

Upstream, the Project depends on the supply of natural gas derived from LNG imports into the Port of Richards Bay (via the intended ZET), together with the infrastructure required to deliver natural gas to industrial users in the Richards Bay area. The reliability of plant operations will therefore depend on the availability and resilience of LNG import, regasification, and gas transmission infrastructure.

At the site level, the value chain includes natural gas combustion for electricity generation using combined cycle gas turbine technology, together with associated balance-of-plant systems. These include gas turbines, HRSGs, a steam turbine generator, cooling and water systems, electrical infrastructure, and plant control systems, as well as limited diesel storage for a black-start generator.

Downstream, the Project's primary output is electricity exported to the grid via the on-site switchyard and associated transformers. The external transmission infrastructure required to connect the plant to the wider grid is excluded from the scope of the current EA process but is considered in this CCIA, where applicable.

2.3.3 Broader social context

The Project site is located within the broader Richards Bay industrial and port environment in Alton North, within Phase 1F of the RBIDZ. The surrounding area is characterised by industrial facilities, port-related infrastructure, and logistics networks, with nearby residential areas located within the City of uMhlathuze Local Municipality in the King Cetshwayo District Municipality, KwaZulu-Natal.

The Project's broader social context includes considerations related to employment opportunities, infrastructure services, housing availability, and long-term energy supply reliability within the regional economy. The Richards Bay area plays a key role in supporting industrial activity and export-oriented industries, and the availability of reliable electricity supply is an important factor in sustaining economic activity in the region.

This CCIA does not undertake detailed socio-economic analysis, as these aspects are addressed through separate specialist studies as part of the EIA process. However, a high-level assessment of regional social vulnerability to climate change is included in Section 7.2.3. This assessment draws

on spatial vulnerability mapping developed by the CSIR's Green Book[8] and relevant municipal indicators to highlight how climate risks such as flooding and extreme weather events may intersect with existing socio-economic vulnerabilities in the Richards Bay region.

2.3.4 Broader environmental context

As part of the broader EIA process for the proposed CCGT power plant, a suite of specialist studies has been conducted or initiated to inform project planning and impact mitigation[9]. These include, but are not limited to:

- A Heritage Impact Assessment
- A Terrestrial Biodiversity Impact Assessment, Plant Species Assessment & Animal Species Assessment
- An Aquatic Biodiversity Impact Assessment
- A Hydrology Assessment
- A Noise Impact Assessment
- A Traffic Impact Assessment
- A Geotechnical Assessment
- An Air Quality Impact Assessment
- A Health Impact Assessment
- A Socio-Economic Assessment
- A Social Impact Assessment

These studies collectively inform project layout considerations, the management of environmental sensitivities, and mitigation planning during construction and operation. The Project site is located within an established industrial landscape and has been selected to align with existing land use planning and infrastructure corridors. Notwithstanding the industrial character of the site, environmental receptors in the broader region, including wetlands, surface water systems, and coastal/estuarine processes associated with Richards Bay, remain relevant to the broader environmental context, particularly under climate change conditions.

Accordingly, this CCIA considers how projected climate change (including increased temperatures, shifts in rainfall intensity and patterns, and extreme storm events) may influence environmental systems and infrastructure performance in the region. A high-level overview of these broader environmental risks under future climate conditions is provided in section 7.2.4 to inform resilience planning and adaptive design considerations.

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8 CSIR, n.d. Green Book: Risk Profiles Available here

9 Scoping Report, March 2026: Proposed 750MW Combined Cycle Gas Turbine Power Plant in Richards Bay, City of uMhlathuze Local Municipality, King Cetshwayo District Municipality, KwaZulu Natal. Nemai Consulting (Pty) Ltd. Pages 150 and 151.

3 REGULATORY BACKGROUND

This section outlines the legal and policy framework relevant to the consideration of climate change in environmental decision-making in South Africa, as applicable to the proposed 750 MW CCPP. The application of this framework to the Project, including emissions quantification, climate risk assessment, significance evaluation and mitigation/adaptation measures, is addressed in subsequent sections of this report.

3.1 The legal precedent for climate change impact assessments in South Africa

In South Africa, the primary legislative framework for environmental governance is the *National Environmental Management Act* (NEMA). The 2014 EIA Regulations, promulgated under NEMA, were primarily designed to regulate activities that affect the local environment. Applying these instruments to a global issue like climate change presents certain methodological and interpretive challenges, particularly where impacts are global, non-localised and unfold over long time horizons.

This CCIA is informed by both national legal developments and international best practice. The key legal milestones are discussed below.

3.1.1 Thabametsi Case

The inclusion of climate change considerations in South Africa's environmental assessment processes was affirmed through the judgment in *EarthLife Africa Johannesburg v Minister of Environmental Affairs and Others* (2017 (2) SA 519 (GNP))[10], (the *Thabametsi* case). The matter concerned a legal challenge to the granting of EA for the proposed *Thabametsi* coal-fired power station, on the basis that the climate change implications of the project had not been assessed or considered.

The Court held that climate change considerations were relevant and necessary for informed decision-making under NEMA, even in the absence of an explicit statutory requirement or detailed regulatory guidance at the time. The Court stated that:

"[…] the legislative and policy scheme and framework overwhelmingly support the conclusion that an assessment of climate change impacts and mitigating measures will be relevant factors in the environmental authorisation process,

[10] In *Earthlife Africa Johannesburg v Minister of Environmental Affairs and others [2017] 2 All SA 519 (GP)* Murphy J found that "the legislative and policy scheme and framework overwhelming support the conclusion that an assessment of climate change impacts and mitigating measures will be relevant factors in the EA process, and that consideration of such will best be accomplished by means of a professionally researched climate change impact report."

and that consideration of such will best be accomplished by means of a professionally researched climate change impact report."

While the Court did not prescribe a specific methodology or statutory form for such assessments, the judgment confirmed that climate-related impacts fall within the scope of relevant environmental considerations under NEMA. The judgment further clarified that climate change assessment entails a two-pronged approach, namely:

- the assessment of the impact of the proposed project on climate change, particularly through GHG emissions; and
- the assessment of the impact of climate change on the project, including climate-related risks, vulnerability, and resilience.

In the absence of detailed national guidance following the judgment[11], CCIAs in South Africa have been grounded in NEMA's principles, including sustainable development, the precautionary approach, and intergenerational equity, and informed by best-available climate science and recognised international standards. The *Thabametsi* case therefore remains the foundational legal precedent guiding the scope, purpose, and relevance of CCIAs in South Africa.

3.1.2 Eskom Gas-to-Power

Further guidance on the consideration of climate change impacts within the EA process has been provided by the Supreme Court of Appeal in *South Durban Community Environmental Alliance and Another v Minister of Forestry, Fisheries and the Environment and Others (479/2023) [2025] ZASCA 134*[12], which concerned Eskom's proposed 3 000 MW CCPP at Richards Bay.

The matter arose from a challenge to the EA granted for the construction and operation of the Richards Bay CCPP. The applicants raised concerns relating to the adequacy of the assessment of climate change impacts, the consideration of reasonable and feasible alternatives, the treatment of cumulative impacts (including associated gas infrastructure), and public participation.

On appeal, the Supreme Court of Appeal set aside the EA and clarified the obligations of competent authorities under NEMA when considering applications in terms of sections 24 and 24O. The Court further confirmed that the assessment of reasonable and feasible alternatives forms an integral component of EA decision-making, and that cumulative impacts must be

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[11] Subsequent to the *Thabametsi* judgment, the DFFE published a Draft National Guideline for the Consideration of Climate Change Implications in Applications for Environmental Authorisations, Atmospheric Emission Licences and Waste Management Licences (October 2025) for public comment, in terms of section 24J of the NEMA. This draft guideline is not yet enacted but provides emerging national guidance on the scope, timing and content of climate change assessments, and is discussed further in Section 3.3 of this CCIA.

[12] *South Durban Community Environmental Alliance and Another v The Minister of Forestry, Fisheries and the Environment and Others* [2025] ZASCA 134 (17 September 2025). SAFLII. Available here

assessed in a manner that includes interdependent and enabling infrastructure that forms part of the overall development proposal.

For purposes of this CCIA, this jurisprudence reinforces the need for climate-related information sufficient to inform the competent authority's evaluation of climate impacts, reasonable alternatives, cumulative effects and the need and desirability of the proposed activity.

3.2 The Climate Change Act

South Africa's climate change regulatory framework has advanced with the enactment of the Climate Change Act, 2024 (Act No. 22 of 2024), which partially commenced in March 2025. The Act establishes a legislative basis for the national and subnational climate change response, including the setting of emission reduction targets, climate risk management measures, and reporting obligations for identified GHG emitters.

While CCIAs are not explicitly referenced in the Climate Change Act, provisions addressing climate change response implementation and the integration of climate considerations into planning processes reinforce the relevance of climate-related information for decision-making. The Act also introduces regulatory instruments such as sectoral emissions targets (SETs) and carbon budgets intended to align emissions at sectoral and entity level with South Africa's mitigation objectives under its Second Nationally Determined Contribution (NDC).

Carbon budgets are intended to define allowable GHG emissions per entity over a specified period and may be linked, through other legislation, to elevated carbon tax rates where budgets are exceeded. Regulations and procedures required to operationalise SETs and carbon budgets are expected to be developed through further regulatory processes and public consultation.

In addition to mitigation, the Act places emphasis on adaptation and resilience. It provides for climate risk and vulnerability considerations to be integrated into planning and response measures, reinforcing the relevance of assessing climate-related physical risks and adaptive capacity in the context of major infrastructure developments.

3.3 Draft National Guideline for the Consideration of Climate Change Implications in Applications for Environmental Authorisations, Atmospheric Emission Licences and Waste Management Licences

Following the *Thabametsi* case, and in response to the increasing integration of climate change considerations into environmental decision-making, the DFFE published a revised Draft National Guideline for the Consideration of Climate Change Implications in Applications for EAs,

Atmospheric Emission Licences and Waste Management Licences for public comment in October 2025[13], in terms of section 24J of NEMA.

The Draft Guideline is non-binding and remains subject to refinement following the public consultation process. Notwithstanding its draft status, it provides the most recent indication of government's intended approach to integrating climate change considerations into environmental assessment and licensing processes and serves as contextual and interpretive guidance for the preparation of CCIAs in support of EA applications.

The Draft Guideline clarifies that climate change considerations form part of the broader EIA process under NEMA and should be addressed in a manner that is proportionate to the nature, scale and risk profile of the proposed activity. It identifies three broad circumstances that may necessitate the consideration of climate change implications, namely whether a proposed activity:

- is likely to result in GHG emissions, either directly or indirectly;
- may affect ecological infrastructure or carbon stocks through land-use change or disturbance; and/or
- may be vulnerable to projected climate change impacts, including changes in temperature, rainfall patterns, extreme weather events, sea-level rise or other climate-related hazards.

Where one or more of these circumstances apply, the Draft Guideline anticipates that climate change implications should be assessed with a level of detail commensurate with the potential significance of the impacts and risks identified. For energy-generation projects, including gas-to-power facilities, the Draft Guideline places particular emphasis on the consideration of project-level and cumulative GHG emissions, the assessment of reasonable and feasible alternatives, and the evaluation of physical climate risks and resilience over the operational life of the project.

The Draft Guideline further reinforces the need for climate change assessments to be informed by best-available science, to apply a precautionary and risk-averse approach where uncertainty exists, and to ensure transparency in the communication of assumptions, limitations and confidence levels. It also highlights the importance of alignment with existing legislative instruments, including the National Greenhouse Gas Emission Reporting Regulations and the Climate Change Act, while recognising that not all projects will trigger mandatory emissions reporting or carbon-budget requirements.

Accordingly, this CCIA has been prepared with due regard to the Draft Guideline where relevant, while being grounded primarily in the requirements of NEMA, the EIA Regulations, applicable case law, and best-available climate science.

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[13] Department of Environment, Forestry and Fisheries. *Draft Guidelines, on the Consideration of Climate Change Implications in Applications for Environmental Authorisations, Atmospheric Emission Licenses, and Waste Management Licenses. 2025*, Paragraph 6. Available here

3.4 International best practice

Where South African legislation and guidance provide limited procedural detail on specific aspects of climate change assessment, it is common practice for CCIAs to draw, where relevant, on internationally recognised reference frameworks to support scientific transparency and consistency. In this context, this CCIA has had regard to elements of the International Finance Corporation (IFC) Performance Standards and the Equator Principles as sources of international good practice, without treating them as binding requirements.

The IFC Performance Standards offer a widely recognised framework for identifying, assessing, and managing environmental and social risks at project level, including risks related to climate change. Of relevance to this CCIA are provisions relating to the integration of climate risk into environmental and social impact assessment processes, the identification of potential adverse effects, and the consideration of appropriate mitigation and adaptation measures. While the Performance Standards address a broad range of topics beyond the scope of this assessment, selected principles relating to climate risk, resource efficiency and resilience have informed aspects of the analytical approach adopted.

The Equator Principles provide a global risk management framework applied by financial institutions in the context of project finance. These principles require alignment with national legislation, the IFC Performance Standards and the World Bank Group Environmental, Health, and Safety (EHS) Guidelines, and include high-level expectations regarding the identification and management of environmental and social risks, including climate-related risks. The Equator Principles are broader and less prescriptive than the IFC Performance Standards in their treatment of climate change but are relevant in highlighting the increasing expectation for climate risks to be transparently identified and disclosed at project level.

Together, these frameworks provide useful contextual reference points for the consideration of climate-related risks and impacts, particularly where national guidance is evolving. In this CCIA, they have been used to inform good practice in the assessment of climate change implications, while the scope, methodology and conclusions of the assessment remain grounded primarily in the requirements of NEMA, the EIA Regulations and applicable South African legal precedent. The table below summarises the IFC Performance Standards and Equator Principles most relevant to climate change considerations and indicates their general areas of applicability:

Table 1: IFC Performance Standards and Equator Principles relevant to climate change

IFC Performance Standards	Equator Principles
Performance Standard 1 requires the identification and assessment of environmental and social risks and impacts as part of the ESIA process, including consideration of climate-related risks and appropriate mitigation and monitoring measures where relevant.	Principle 1 requires the assessment and management of environmental and social risks and impacts, including climate-related risks, across the project lifecycle.

IFC Performance Standards	Equator Principles
Performance Standard 4 addresses community health and safety risks and requires the identification and management of risks that may be exacerbated by changing environmental and climatic conditions.	Principle 2 requires projects to be developed on the basis of appropriate environmental and social impact assessment processes, which may include consideration of climate-related impacts where relevant.
Performance Standard 6 focuses on biodiversity conservation and sustainable management of living natural resources, recognising climate change as a factor that may affect ecosystems, habitats and ecosystem services.	Principle 3 encourages alignment with applicable international standards and good practice, including those relevant to the identification and management of climate-related risks and impacts.

3.5 Considerations beyond regulatory requirements

In addition to addressing applicable legislative and regulatory requirements, this CCIA includes certain analyses and disclosures that extend beyond the requirements of South Africa's climate change regulatory framework. These elements are provided to support a more comprehensive understanding of the Project's potential climate-related impacts, risks, and management opportunities over both the near and longer term.

3.5.1 Global Warming Potentials and Time Horizons

The Intergovernmental Panel on Climate Change (IPCC) defines Global Warming Potentials (GWPs) as a standardised metric to compare the cumulative radiative forcing of different GHGs relative to carbon dioxide (CO_2) over a specific time horizon. The 100-year GWP is the internationally accepted default metric and is used by the IPCC, the United Nations Framework Convention on Climate Change (UNFCCC), and most national GHG inventory systems, including that of South Africa.

In line with this practice, the CCIA quantifies emissions using 100-year GWPs in accordance with National GHG Reporting Regulations No. 40762 of 2017 and its amendments[14], the Carbon Tax Act, and the DFFE's Methodological Guidelines (2022). This ensures that the Project's emissions are comparable to South Africa's NDC targets and consistent with the country's obligations under the Paris Agreement.

Although the 100-year GWP is the exclusive metric for regulatory and compliance reporting, this CCIA also provides estimates using 20-year GWP values, specifically for methane (CH_4), to illustrate near-term climate risks. While these shorter time horizons are not part of South Africa's regulatory framework, their inclusion provides stakeholders with greater visibility on the short-

[14] Department of Environmental Affairs (DEA) (2016) *National Greenhouse Gas Emission Reporting Regulations*. Pretoria: DEA (Now DFFE). Available here and here:

lived but intense warming effect of methane. All 20-year GWP figures are included for informational purposes only, in support of transparency and short-term climate risk.

3.5.2 Mitigation and Adaptation Measures Provided for Consideration

The mitigation and adaptation measures presented in this report are provided as recommendations for consideration by the Project Proponent, the EAP, and the competent authority, in support of informed decision-making regarding the Project's emissions management and climate resilience over its operational life. Where appropriate, these measures may be considered for inclusion in the EMPr. This report does not prescribe conditions of EA, the determination of whether any measure should be secured through the EMPr and/or reflected as a condition of EA rests with the competent authority.

4 Scope of The Climate Change Impact Assessment

Informed by the regulatory and policy framework described in Section 3, this CCIA has been undertaken to assess:

(a) the contribution of the proposed 750 MW CCPP Project and its associated and dependent infrastructure to climate change; and
(b) the resilience of the proposed Project to the impacts of climate change over its anticipated operational life.

The scope of the CCIA is informed by the principle that climate change impacts are inherently cumulative and global in nature, while recognising that the nature and extent of cumulative assessment required at project level must remain proportionate, evidence-based, and aligned with the respective roles of the project proponent and the competent authority.

Accordingly, the CCIA comprises the following components:

(a) Impact of the Project on Climate Change

The CCIA includes an assessment of the project's GHG emissions profile, comprising:

- A GHG inventory quantifying emissions associated with the construction, operation, and decommissioning phases of the proposed 750 MW CCPP Project, and all associated and dependent infrastructure required for the development and operation of the Project, expressed in carbon dioxide equivalent (CO_2e).
- Identification of the sources of direct (Scope 1) and indirect (Scope 2 and relevant Scope 3) emissions associated with the Project, using internationally recognised and transparent accounting methodologies.
- Consideration of cumulative climate impacts arising from the proposed Project together with its associated infrastructure, including fuel supply, transmission connections, and ancillary facilities, insofar as such infrastructure is functionally linked to the Project and reasonably foreseeable.

- Scenario-based consideration of potential avoided emissions only where relevant, noting that such analysis does not constitute a justification for emissions, nor a determination of energy policy, but serves to contextualise the Project's emissions within the broader electricity generation landscape.
- Identification of technically and economically feasible mitigation measures aimed at:
    - Reducing direct and indirect GHG emissions,
    - Improving operational efficiency and emissions intensity, and
    - Supporting alignment with South Africa's evolving climate policy framework, where applicable.

The CCIA does not seek to quantify or model the cumulative emissions of other existing or future industrial activities, electricity generation facilities, or unrelated third-party developments in the Richards Bay region or elsewhere. Such an approach is neither methodologically appropriate nor feasible in the context of climate change, given that emissions are global whose impacts are not confined to local or regional spatial boundaries.

The assessment of broader, system-wide cumulative emissions and regional emissions trajectories falls within the mandate of the competent authority, which is best placed to consider project-level emissions information alongside national GHG inventories, sectoral pathways, energy planning instruments, and South Africa's international climate commitments.

Accordingly, even where access to national or sectoral emissions reporting platforms may be available, this CCIA limits its scope to assessing the Project's contribution to global emissions, considered in relation to South Africa's national climate goals, emissions trajectories, and international commitments.

The evaluation of how individual projects collectively align with national emissions pathways and climate commitments falls within the mandate of the competent authority, which is uniquely positioned to consider project-level emissions information alongside national GHG inventories, sectoral budgets, energy planning instruments, and South Africa's obligations under international climate agreements.

(b) Resilience of the Project to Climate Change

The CCIA assesses the extent to which the proposed Project may be affected by current and future climate conditions, through:

- A description of baseline climatic conditions and projected climate trends for the Richards Bay region, including temperature increases, precipitation variability, and changes in the frequency and intensity of extreme weather events, based on appropriate climate datasets.
- Identification and evaluation of physical climate risks that may affect core infrastructure and operations, including:
    - Coastal vulnerability (sea level rise, storm surge, and coastal erosion),
    - Water availability and resource constraints,

- Heat stress impacts on infrastructure and personnel, and
- Increased storm intensity or frequency.

- Consideration of climate-related risks to the LNG supply and logistics interfaces that are functionally linked to the proposed Project, including climate-related disruptions at the Port of Richards Bay and associated onshore infrastructure, insofar as such risks could reasonably affect the availability, reliability or continuity of gas supply to the proposed facility.

In addition, the CCIA identifies and evaluates mitigation and adaptation measures aimed at:

- Minimising the Project's contribution to climate change; and
- Reducing the vulnerability of the proposed Project and its associated infrastructure to the foreseeable impacts of climate change over its design life.

These measures are presented to support informed environmental decision-making and do not substitute for, or pre-empt, cumulative or strategic assessments undertaken by the competent authority under broader planning and regulatory processes.

4.1 Climate change context receiving environment

Climate change is a global phenomenon that transcends geographical boundaries. GHG emissions, once released, disperse and circulate in the atmosphere, contributing to climate change on a planetary scale, regardless of where they originate. As such, emissions from a specific project cannot be directly linked to measurable, site-specific climate impacts. This characteristic distinguishes climate change from many other environmental impacts, which are typically localised and traceable to a defined source.

Consistent with the principles articulated in *Thabametsi*, and as further clarified by the *Eskom Gas-to-Power* judgment, this CCIA assesses the Project's contribution to climate change through the quantification and contextualisation of its emissions profile, rather than through an attempt to attribute specific climate impacts to the Project footprint or surrounding area. The assessment accordingly focuses on the Project's emissions as a contribution to cumulative global emissions, recognising that climate change impacts arise from the aggregate concentration of GHGs in the atmosphere over time.

However, because the climatic effects of GHG emissions are inherently non-localised, this assessment does not attempt to spatially attribute cumulative climate change impacts from other LNG, fuel import, or industrial distribution projects in the Richards Bay area. Cumulative local environmental effects (e.g., air quality, traffic) are addressed in other specialist studies where spatial attribution is appropriate. This CCIA maintains its focus on systemic climate drivers and the Project's emissions contribution within a global and national context.

Often, climate change is confused with air pollution. Although these concepts are related environmental issues, they have distinct characteristics and impacts. The main distinction lies in the timeframe of their occurrences: the effects of air pollution can be immediate or brief, as seen in respiratory issues during smog events, while climate change unfolds gradually over extended

periods, such as the temperature rise observed over a decade or longer. Distinguishing between climate change and air pollution can be a challenging task.

The figure below illustrates how implementing a project that emits GHGs directly impacts the global carbon emissions inventory. As the project emits GHG emissions over time, it contributes to the annual global emissions, which in turn affects the global energy balance, leading to the GHG effect and ultimately contributing to global climate change. This understanding, that GHG emissions contribute to a global problem that cannot be managed at a purely local level, underpins the formation of international climate governance mechanisms such as the UNFCCC, the Kyoto Protocol, and the Paris Agreement.

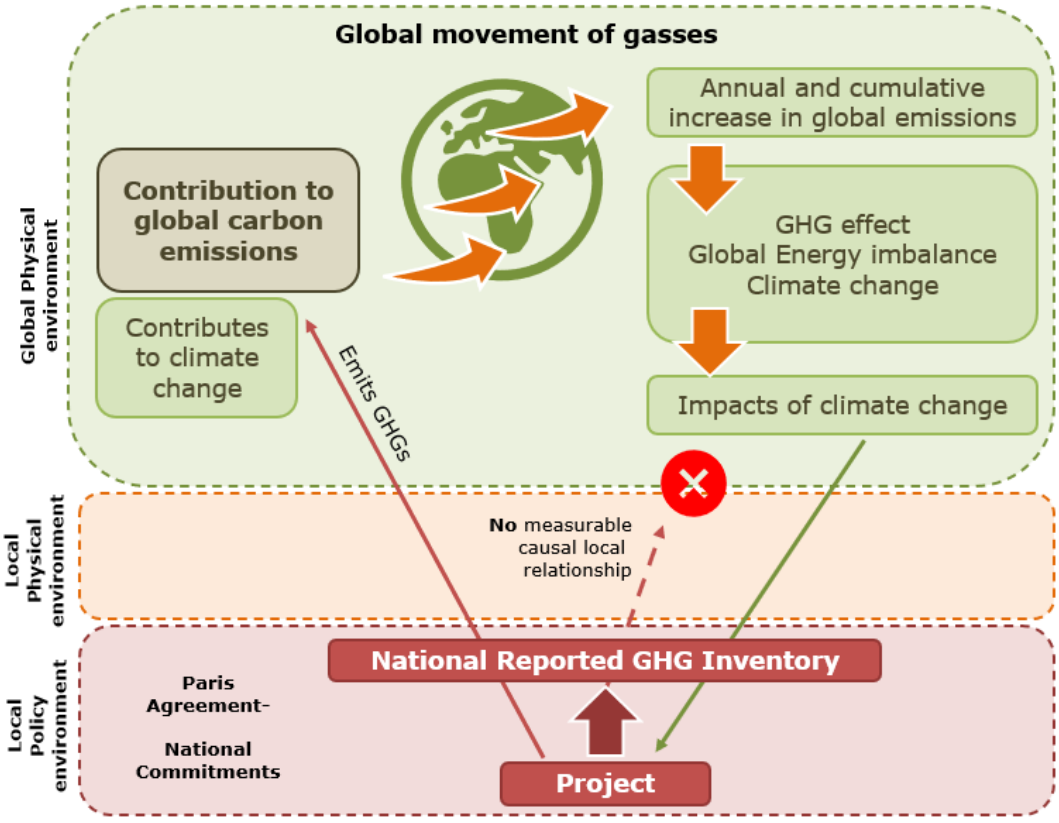


Figure 3: Relationship between a project's GHG emissions and local climate change impacts.

Nevertheless, climate change needs to be considered from two perspectives, the physical environment, and the policy environment.

4.1.1 Global Physical Environment

It is important to reiterate that a **global increase in GHG emissions can be directly linked to climate change.** There exist sufficient reputable data sources indicating the historical increase in annual global emissions, as illustrated in Figure 4, along with the rise in global cumulative emissions since the industrial revolution.

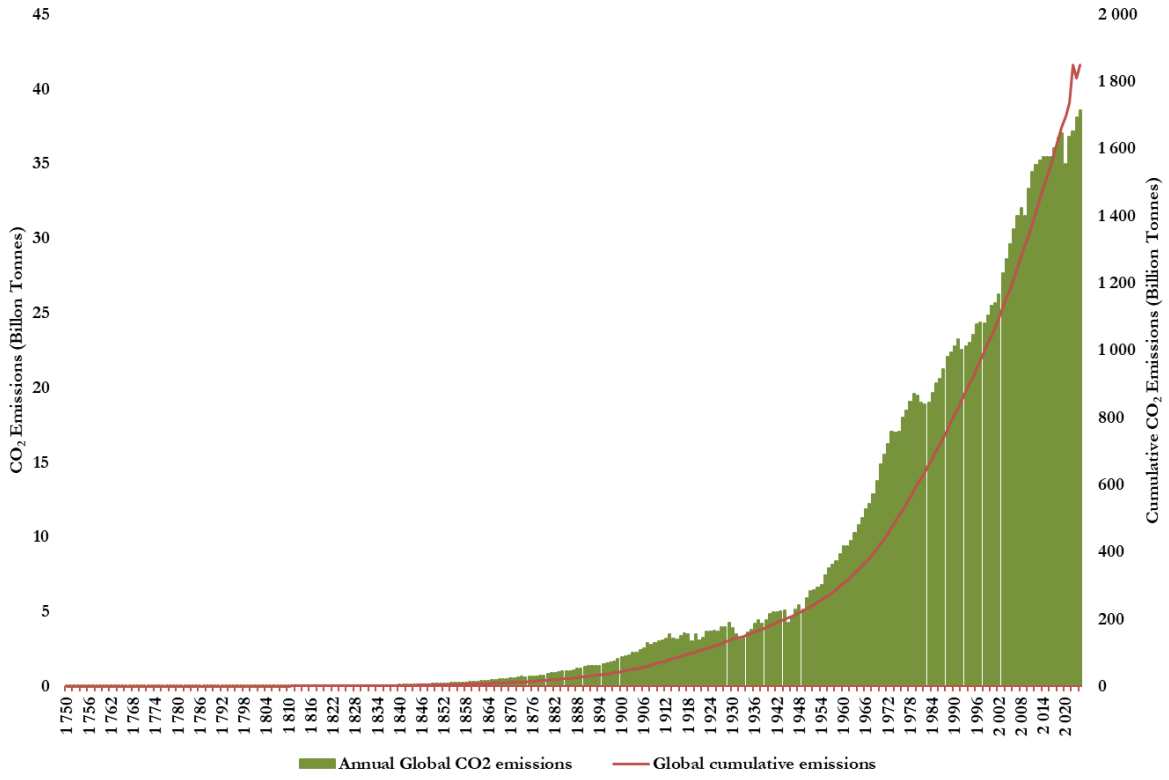


Figure 4: Global annual CO_2 emissions for the period between 1750 and 2024 the primary axis, and the cumulative CO_2 emissions for the period between 1750 and 2024 on the secondary axis. [15]

As indicated in the above Figure 4 the annual CO_2 emissions have increased consistently year-on-year since 1750, with 2024 recording the highest global emissions at 38.6 billion tCO_2.[16] However, the cumulative emissions are a critical factor to consider. **Since GHGs can persist in the atmosphere for years to centuries**, cumulative emissions reflect the historical and ongoing contribution of human activities to the greenhouse effect and climate change globally. As illustrated, cumulative emissions **rose from approximately 108 million tCO_2 in 1760 to 1 849 billion tCO_2 in 2024**.

Climate change indicators are measurable parameters or phenomena that scientists use to track and assess changes in the Earth's climate system over time. These indicators provide evidence of climate change and its impacts on various aspects of the environment. Examples include:

- **Temperature Anomalies:** Monitoring changes in average global temperatures and temperature anomalies helps identify trends in warming or cooling patterns over time.
- **Sea Level Rise:** Measuring sea level changes and coastal inundation events provides insights into the melting of ice sheets, thermal expansion of seawater, and impacts on coastal regions.

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[15] Global Carbon Budget (2025)- obtained from Our World in Data, as available at Annual CO_2 emissions (ourworldindata.org)

[16] The data used in this analysis does not in include 2025.

- **GHG Concentrations**: Monitoring concentrations of GHGs (e.g., carbon dioxide, methane, nitrous oxide) in the atmosphere helps assess the role of human activities in driving climate change.
- **Extreme Weather Events:** Analysing trends in extreme weather events, such as heatwaves, droughts, heavy rainfall, hurricanes, and wildfires helps assess the influence of climate change on the frequency and intensity of these events.

The impact of increased global emissions can be demonstrated using global average temperature anomalies. Data on global temperature anomalies for both the Northern and Southern Hemispheres has been collected since 1844, indicating a consistent annual increase in temperature per year in the Southern Hemisphere above 0 °C, starting from 1983, as shown in Figure 5. In 2024, the Southern Hemisphere experienced its highest recorded average temperature anomaly of 0.77 °C.

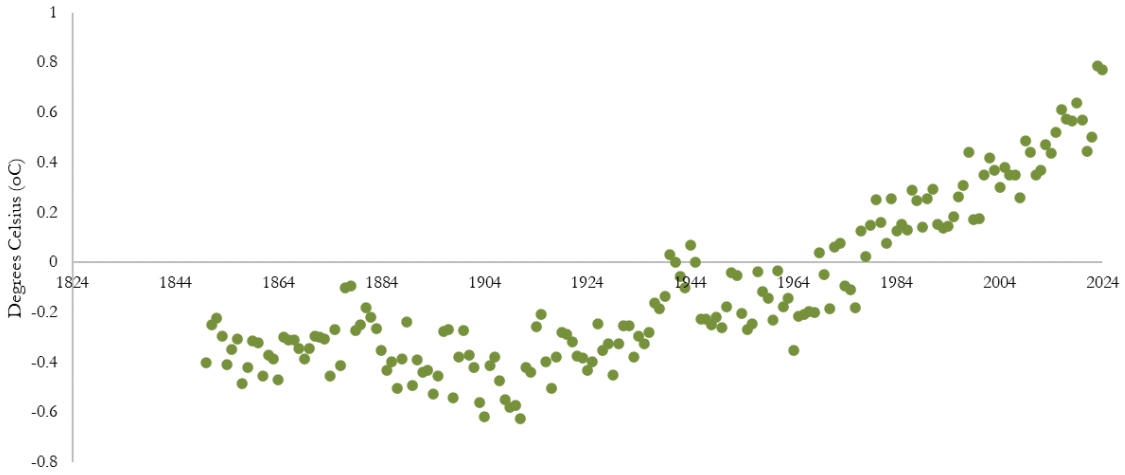


Figure 5: Annual average temperature anomalies in the Southern Hemisphere for the period between 1850 and 2024.[17]

Similarly, the Northern Hemisphere has also observed an annual increase in temperature above 0°C since 1986, with the highest recorded average temperature anomaly for 2024 being 1.5°C. Comparatively, these trends highlight the noticeable impact of increased emissions on global temperatures in both hemispheres.

[17] Met Office Hadley Centre (2023) – processed by Our World in Data. "Mean" [dataset]. Met Office Hadley Centre, "HadCRUT5 HadCRUT.5.0.2.0" [original data].

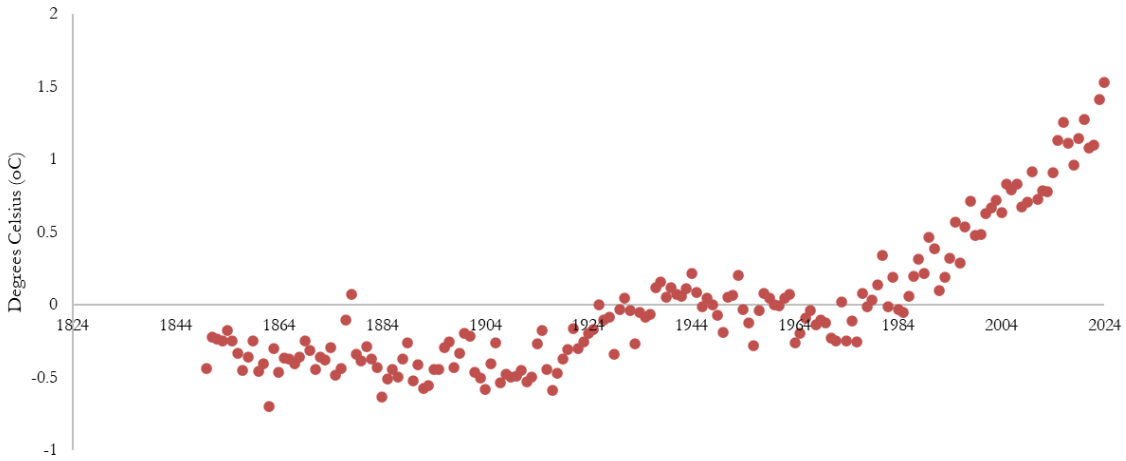


Figure 6: Annual average temperature anomalies in the Northern Hemisphere for the period between 1850 and 2024.[18]

These global trends in GHG emissions and temperature anomalies provide the foundation for South Africa's national climate commitments and inform regional climate risk projections. While the proposed Project represents a small fraction of global emissions, its emissions contribute incrementally to the national inventory and are assessed accordingly. These trends also underpin the local climate projections used to evaluate the Project's exposure to physical climate risks in section 7.

4.1.2 South African Emissions

Since 1884, South Africa has followed the global trend of increasing annual CO_2 emissions. For example, in 1884 the annual emissions were calculated at **21 000 tCO_2** compared to the **439 million tCO_2 in 2024**. Similarly, South Africa's cumulative emissions increased from **24 million tCO_2 in 1898 to 22 billion tCO_2 in 2024.**

[18] Met Office Hadley Centre (2023) – processed by Our World in Data. "Mean" [dataset]. Met Office Hadley Centre, "HadCRUT5 HadCRUT.5.0.2.0" [original data].

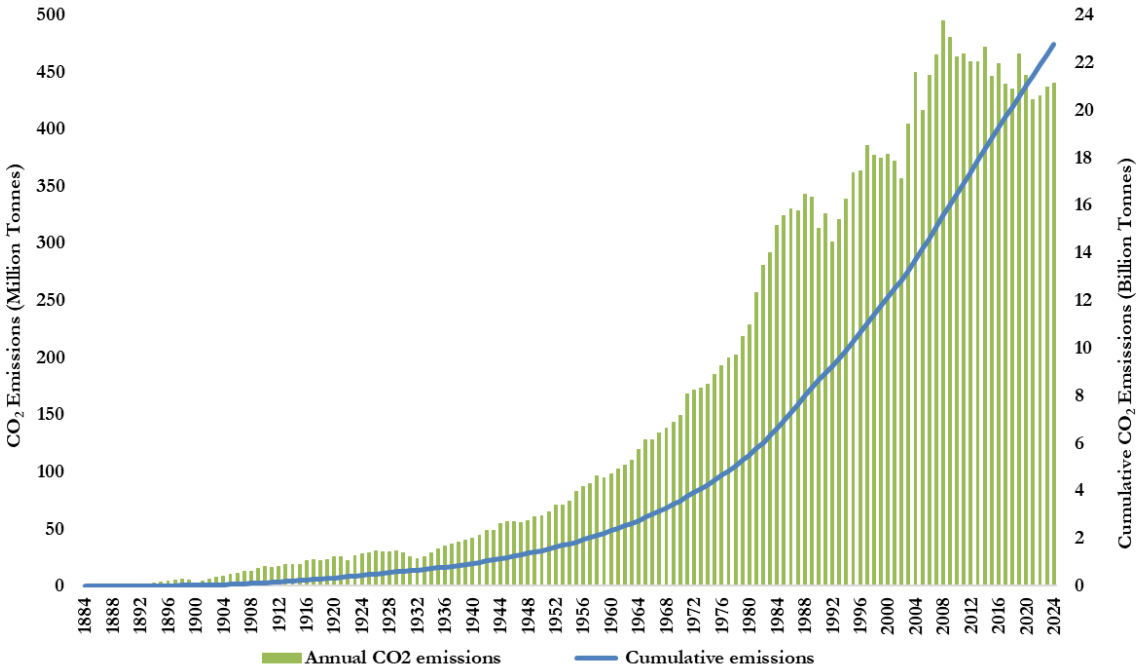


Figure 7: South African annual CO_2 emissions for the period between 1884 and 2024 the primary axis, and the cumulative CO_2 emissions for the period between 1884 and 2024 on the secondary axis.[19]

South Africa's contribution to global carbon emissions amounted to approximately 22 billion tCO_2. To contextualise this, it represents a **1.3% share of global cumulative emissions** (1 849 billion tCO_2) up to 2024, which is illustrated in Figure 8 below.

[19] Global Carbon Budget (2023)- obtained from Our World in Data, as available here Annual CO_2 emissions (ourworldindata.org). The date in this data set was limited to 2020, for both cumulative and annual emissions as the data from Global Carbon Budget deviates slightly from South Africa's National GHG Inventory for both 2000-2015 and 2000-2022.

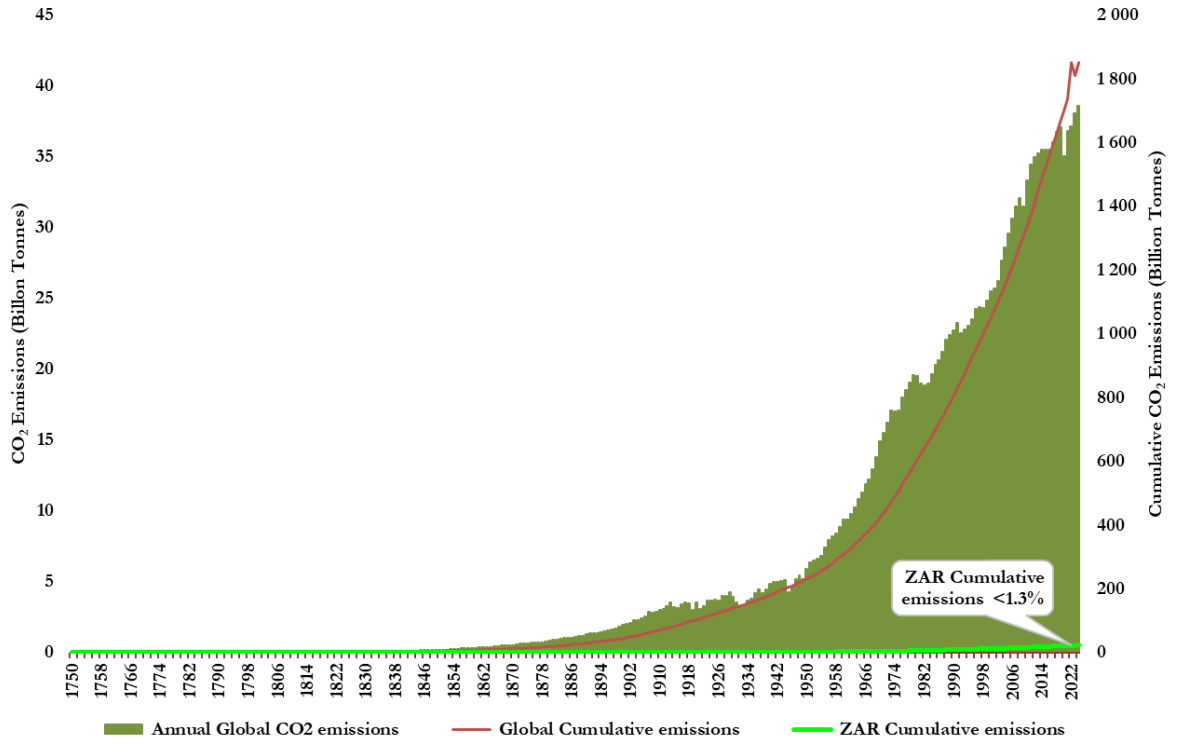


Figure 8: Global annual CO_2 emissions and global cumulative CO_2 emissions for the period between 1750 and 2024 compared to the South African cumulative CO_2 emissions between 1884 and 2024.[20]

South Africa's cumulative emissions position the country among globally significant emitters. In fulfilment of its obligations under the Paris Agreement, South Africa has submitted its second NDC[21], which sets out updated economy-wide mitigation targets and a progressively more ambitious emissions reduction trajectory, informed by the principle of a just transition. Within this national policy context, the emissions profile of the proposed 750 MW CCPP Project is assessed to provide context for decision-making.

5 Approach and Methodology

The methodology used for this CCIA was informed by:

- The nature of climate change;
- The development timeframes of the proposed Project;
- The long-term climate change impacts anticipated for the Project and surrounding areas; and
- Available climate data for variables specifically relevant to the Project.

[20] Global Carbon Budget (2023)- obtained from Our World in Data, as available here.
[21] Republic of South Africa (2025). South Africa's Second Nationally Determined Contribution under the Paris Agreement, 2025. United Nations Framework Convention on Climate Change (UNFCCC). Available here

The climate-related impacts and vulnerabilities relevant to the Project and surrounding areas will be considered throughout this CCIA.

5.1 Evaluating the Impact of the Project on Climate Change

The EIA reporting requirements[22] listed in Table 2 below, set out the criteria to describe and assess local environmental impacts. However, climate change is a global, cumulative phenomenon, and these criteria are only partially applicable to the assessment of a project's contribution to climate change. Conventional EIA impact-rating methodologies were developed primarily for biophysical and social impacts expressed at local or regional scale and are therefore not fully suited to evaluating the global consequences of project-level GHG emissions. In this context, it is necessary also to consider South Africa's climate policy environment, as this reflects the country's international commitments, national priorities, emissions reduction objectives, and long-term development pathway in relation to climate change.

Table 2: EIA Criteria.

Nature	A description of what causes the effect, what will be affected and how it will be affected. *In the case of climate change assessments, the nature of the impact is the contribution of the Project to global anthropogenic climate change.*
Intensity (I)	The intensity is the magnitude of the environmental impact under consideration. These impacts can be positive or negative and range from negligible change to severe irreversible change. *The EIA reporting requirements were developed to describe and assess environmental impacts. Although GHG emissions can be quantified, the conventional EIA framework does not provide recognised thresholds for assigning a site-specific intensity rating to a project's contribution to global climate change.*
Extent (E)	An indication of whether the impact will be local (limited to the immediate area or site of development), regional, national, or international. Part of the site is considered very low, the whole property - low, affecting immediate neighbours - medium, local area - high and regional/national - very high. *In the case of climate change assessments, the extent is global, as GHG emissions contribute to global atmospheric concentrations and anthropogenic climate change.*
Duration (D)	An indication of the lifetime of the impact. Impacts are quantified as follows: less than a year is very low, between 1 and 5 years is low, between 5 and 10 years is medium, between 10 and 20 years is high and longer than 20 years is very high. *While emissions are generated during the life of the Project, their contribution to climate change persists beyond project closure and is effectively permanent on human timeframes.*

[22] Republic of South Africa, 2014 as amended. EIA Regulations: Section 3(j) Appendix 1 and Appendix 3 (Scope of assessment and content of Basic Assessment Report and EIA, respectively). Available here

Probability (P)	An indication of the likelihood of the impact occurring. The scale of probability ranges from unlikely to definite. The IPCC has reported that it is 95% certain that man-made emissions are the main cause of current observed climate change[23]. *Where a project results in GHG emissions, its contribution to anthropogenic climate change is certain, even if the scale of that contribution varies.*
Consequence (C)	The consequence of the impacts is a function of the intensity, extent and duration, and assesses the overall consequence of the impacts.
Significance (S)	The significance of the impacts is calculated as: S=C x P

The regulatory framework in South Africa does not yet provide guidance on the relative intensity of GHG emission impacts. In response, Promethium Carbon has developed an approach that, rather than attempting to assign a localised impact rating to actions with inherently global consequences, focuses on assessing contributions to climate change within a more policy-aligned and practical context.

A set of evaluation criteria is applied to the Project, as stated in Table 3, to provide a sound assessment of the Project's contribution to national mitigation and adaptation efforts.

Table 3: Climate Change Policy Evaluation Criteria

Criterion	Evaluation Approach
Global Climate Change Contribution	The Project's GHG inventory will be assessed through a carbon footprint assessment that captures both: **Annual and Lifetime operational** GHG emissions, comprising: - Direct emissions from sources that are owned or controlled by the project or company; and - Indirect emissions from sources outside the project or company's direct control, but that occur because of the project's activities, including upstream emissions associated with the extraction, production, processing, liquefaction, transportation, regasification, and pipeline transmission of natural gas supplying the Project. **Construction and Decommissioning phases'** GHG emissions, including those from: - The production and transport of construction materials, - The dismantling of infrastructure and the handling, transport, and disposal or recycling of materials and equipment, - Energy use during construction activities.

[23] IPCC. 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

Criterion	Evaluation Approach
	These emissions will be assessed collectively to determine the Project's cumulative contribution to national and global GHG concentrations and to climate change over the Project's lifetime.
National Policy Alignment	Assess whether the proposed project, its associated infrastructure, and its operational objectives are situated within South Africa's national climate change and energy policy framework. This framework comprises adopted legislation and strategic policy instruments that guide the country's climate mitigation trajectory, electricity system planning, and energy sector development. The Project is considered within this framework in terms of its relevance to electricity supply security, its emissions profile relative to alternative generation technologies, and its role within South Africa's evolving energy transition, recognising that final determinations regarding policy alignment and trade-offs are the responsibility of the competent authority. Key policies and Acts include, but are not limited to: - NEMA - National Climate Change Response Policy (2011)[24] - Just Transition Framework (2022)[25] - Climate Change Act (2024)[26] - Draft Gas Master Plan (2024)[27] - Integrated Resource Plan (2025)[28] - Second Nationally Determined Contribution (2025)[29] - Proposed Gas Sector Roadmap to 2050 (NERSA, 2025)[30] While not all instruments explicitly address LNG facilities, they collectively establish the enabling policy environment within which the Project needs to be assessed for alignment with South Africa's climate and energy transition objectives.
Provincial Policy Alignment	The Project's alignment with provincial climate priorities is assessed based on the KwaZulu Natal's climate policy landscape, including:

[24] Department of Environmental Affairs. (2011). *National Climate Change Response White Paper*. Available here
[25] Presidential Climate Commission (PCC). (2023). *Just Transition Framework – Final Report and Recommendations, June 2022*. Available here
[26] Republic of South Africa. (2024). *Climate Change Act 22 of 2024*. Government Gazette No. 50966. Available here
[27] Republic of South Africa (2024) Department of Mineral Resources and Energy: Gas Master Plan: Comments invited, 26 April 2024. Pretoria: Government Printing Works. Available here
[28] Republic of South Africa, Department of Electricity and Energy (2025). *Integrated Resource Plan 2025*. Government Gazette No. 53596, 28 October 2025. Available here
[29] Republic of South Africa (2025). South Africa's Second Nationally Determined Contribution under the Paris Agreement, 2025. United Nations Framework Convention on Climate Change (UNFCCC). Available here
[30] National Energy Regulator of South Africa (NERSA) (2025) *Summary of Gas Strategy Report*. Pretoria: NERSA. Available here and here

Criterion	Evaluation Approach
	- KwaZulu-Natal's Strategy for a Green Economy (2012)[31] - KwaZulu-Natal Systemic Conservation Plan (2012)[32] - KwaZulu-Natal 2035 Provincial Growth and Development Strategy (2016)[33] - KwaZulu-Natal Provincial Norms and Standards for Climate Change and Energy Efficiency in Land Use Management (2020)[34] - KwaZulu-Natal Draft Spatial Development Framework (2021)[35]
Municipal Policy Alignment	The Project is located within the jurisdiction of uMhlathuze Municipality, which has adopted various climate-relevant plans that frame local responses to mitigation and adaptation. These include: - uMhlathuze Local Economic Development Strategy Review: Economic Transformation and Job Creation Roadmap (2022)[36] - uMhlathuze Municipality 5th Generation Spatial Development Framework 2022/2023 - 2026/2027 Final (2022)[37] - uMhlathuze Integrated Development Plan (IDP) 2022-2027[38] - uMhlathuze Adaptation Action Plan (2024)[39] - uMhlathuze Sustainable Development Goals (2024)[40]
Project Specific Context	Evaluation of the Project's activities and its impact on climate change should align with the Project objective, which is often a response to a public commercial project bid. In this context, prioritising project alternatives solely based on reduced GHG emissions (climate change impacts) may not always be relevant. In the case of this CCIA, the Applicant intends to bid for the GASIPPPP and/or other suitable energy markets. While altering the nature of project activities might not be appropriate, exploring alternatives should include considerations beyond GHG emissions.

[31] KwaZulu-Natal Department of Economic Development, Tourism and Environmental Affairs. n.d. (2012). *Developing KwaZulu-Natal Green Economy Strategy, Volume 4*. Available here

[32] South African National Biodiversity Institute (SANBI) (2012). *2012 KwaZulu-Natal Systematic Conservation Plan (KZNSCP)*. Available here

[33] KwaZulu-Natal Provincial Government (2016) *KwaZulu-Natal 2035 Provincial Growth and Development Strategy*. Pietermaritzburg: KwaZulu-Natal Provincial Government. Available here

[34] KwaZulu-Natal Planning Norms and Standards Committee. 2020. *Adopted Provincial Norms and Standards for Climate Change and Energy Efficiency in Land Use Management*. Chief Directorate: Municipal Planning. Available here

[35] KwaZulu-Natal Department of Cooperative Governance and Traditional Affairs (2021) *KwaZulu-Natal Provincial Spatial Development Framework (Draft PSDF): June 2021*. Pietermaritzburg: KwaZulu-Natal Department of Cooperative Governance and Traditional Affairs. Available here

[36] City of uMhlathuze Municipality. (2022). *Local Economic Development Strategy Review: Economic Transformation and Job Creation Roadmap*. Available here

[37] City of uMhlathuze, 2022. *Fifth Generation Spatial Development Framework 2022/2023–2026/2027*. [pdf] City of uMhlathuze. Available here

[38] City UMhlathuze Municipality. (2022). *Fifth Generation Integrated Development Plan 2022/2027*. Available here

[39] CSIR, 2024. Adaptation Action Plan for uMhlathuze Local Municipality PHSHDAs. GIZ, DFFE, DHS, the HDA & City of uMhlathuze. Available here

[40] City of uMhlathuze Municipality. 2024. *Voluntary Local Review (VLR) Report 2024*. Available here

Criterion	Evaluation Approach
	These may include geographical optimisation and/or appropriateness of technological design of the Project, and the potential to incorporate best available technology (BAT), practices or climate-responsive alternatives.
Best Available Technology (BAT)	While national policy and the project specific context might govern the nature of the project activity, projects should consider the BAT for the relevant nature of the project. The market penetration, national availability and cost-feasibility of BAT should however also be considered in the context of the project activity in relation to climate change mitigation and socio-economic impacts. Annual GHG emissions from the operational phase of the Project's activities should also consider national and global emissions intensity benchmarks[41], to assess whether emissions intensities are within a reasonable ballpark, or whether alternative BAT is available and should be applied to reduce emissions intensities, and therefore climate change impacts.

5.1.1 Polycentric integrative approach

A polycentric approach to the Project requires a holistic assessment of its environmental, social, and economic impacts on both the local and broader community. Section 2(4)(b) of NEMA[42] mandates that environmental management must be integrated, recognising that all elements of the environment are interlinked. Accordingly, decision-making must account for cumulative impacts on ecosystems, people, and socio-economic systems, and must seek the best practicable environmental option. Sustainable development, as outlined in NEMA, requires the integration of social, economic, and environmental considerations throughout the Project's planning, implementation, and evaluation phases, ensuring that the needs of both present and future generations are met.

This specialist assessment adopts a polycentric and holistic approach by evaluating both positive and negative impacts across geographical, physical, biological, social, economic, and cultural dimensions. This approach ensures:

- Comprehensive impact evaluation, in which all relevant factors are considered to provide a balanced and integrated assessment.
- Risk identification and mitigation planning, enabling informed decision-making that minimises adverse impacts, enhances benefits, and ensures alignment with the environmental management principles set out in Section 2 of NEMA.

[41] Sources of national intensity benchmarks: National Treasure, Draft Regulations: Greenhouse Gas Emissions Intensity Benchmarks Prescribed for the Purpose of Section 11 of the Carbon Tax Act, 2019, December 2019 and global emissions intensity benchmark, as relevant to the type of project.

[42] National Environmental Management Principles. Available here

By integrating local governance, industry stakeholders, and environmental policies, this polycentric approach ensures that the Project aligns with national sustainability objectives while fostering climate resilience, regulatory compliance, and socio-economic development.

5.2 GHG emissions quantification

The GHG inventory for the proposed 750 MW CCPP has been developed based on the project configuration, fuel type, operating profile and supporting infrastructure described in Section 2. The inventory provides an estimate of the Project's direct and indirect GHG emissions across relevant lifecycle phases, with particular emphasis on the operational phase, during which the majority of emissions are expected to occur.

The GHG quantification focuses on activities and emission sources that are necessary for the construction and operation of the CCPP, including the combustion of natural gas in gas turbines, auxiliary fuel use, electricity consumption, and material and energy-related emissions associated with construction activities. Upstream and downstream emissions associated with the supply of natural gas and the delivery of electricity are considered where relevant for contextual purposes, consistent with the approach defined in Table 3, Section 5.

In addition to the project-level quantification requirements of ISO 14064-2:2019, the assessment is informed by ISO 14067:2018 to guide the identification of relevant life-cycle stages and activities associated with the natural gas supply chain[43]. ISO 14067 is applied to ensure that all material upstream and downstream GHG emission sources associated with fuel production, processing, transportation, and delivery are appropriately considered within the defined system boundary, without altering the project-based accounting approach.

5.2.1 GHG Emissions Impact (ISO 14064-2:2019)

The preparation of a GHG inventory is based on identifying all relevant activities and their associated emission sources, and quantifying the emissions generated by these sources.

Relevant South African environmental laws (under NEMA) do not yet, at the time of writing this report, provide adequate guidelines for CCIAs[44]. Accordingly, this report draws on internationally recognised best practice and is informed by the *Thabametsi* and *Eskom Gas-to-Power* judgements discussed in section 3.1 above.

As described above, the Project's contribution to climate change was assessed in line with **ISO 14064-2:2019**. This internationally recognised standard offers a framework for **quantifying, monitoring, and reporting GHG emissions and removals at the project level** and is widely

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[43] ISO 14067:2018. Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification. Available here

[44] South Africa's DFFE is in the process of providing further guidelines for CCIAs. However, these guidelines are only in draft and have not yet been published.

applicable across sectors and technologies. It is applied in combination with the following reference documents:

- **South Africa's *Methodological Guidelines for quantification of Greenhouse Gas Emissions*[45]:** These Methodological Guidelines aim to offer guidance and emission factors for data providers in estimating GHG emissions. The guidelines help reporting companies apply appropriate methodologies for quantifying GHG emissions from specific listed activities. While many South African companies have voluntarily reported GHG emissions, the government now mandates reporting, with these guidelines facilitating compliance.
- **Intergovernmental Panel on Climate Change (IPCC)[46]:** The Emission Factor Database (EFDB) is a platform supported by the National Greenhouse Gas Inventories Programme (NGGIP), which is managed by the IPCC Task Force on National Greenhouse Gas Inventories (TFI). EFDB is intended to be a recognised library, where users can find emission factors and other parameters with background documentation or technical references that can be used for estimating GHG emissions and removals.
- **Annual Report/Articles:** The South African grid electricity emission factor is calculated by Promethium Carbon annually with the use of the latest available Eskom Annual report.
- **Department for Energy Security and Net Zero (DESNZ previously DEFRA)[47]:** These emission conversion factors are for use by UK-based and international organisations to report on GHG emissions.

The principles as required by ISO 14064-2 that guide the approach for this CCIA are summarised in Table 4 below.

Table 4: ISO 14064-2 principles

Relevance	Selecting all the GHG sources, sinks, reservoirs, data and methodologies that are appropriate.
Completeness	Including all the GHG emissions and removals relevant to the proposed project.
Consistency	Enable meaningful comparisons to be made with other GHG related information.
Accuracy	Reducing bias and uncertainties as far as is practical.
Transparency	Disclosing sufficient and appropriate GHG related information to allow intended users to make decisions with reasonable confidence.
Conservativeness	Avoiding overestimation of benefits or underestimation of emissions.

45 Department of Forestry, Fisheries and the Environment. *Methodological Guidelines for Quantification of Greenhouse Gas Emissions*. 2022. Available here

46 Intergovernmental Panel on Climate Change. *Emission Factor database. 2023*. Available here

47 Department for Energy Security and Net Zero. *Greenhouse gas reporting: conversion factors 2025*. 2025. Available here

The Project's GHG emissions are quantified using ISO 14064-2:2019 which provides a structured, internationally recognised methodology for assessing GHG impacts at the Project level. Clause 6 of the standard outlines a series of required steps, which are applied as discussed below.

5.2.1.1 Project Description[48]

The Project is clearly defined in terms of its physical scope, purpose, and key components. This includes the development and operation of a 750 MW CCPP, associated LNG import and regasification infrastructure, and supporting facilities, including the gas pipeline connecting the ZET to the power plant. The Project description further outlines the key operational activities, technologies employed, and the anticipated construction, operational, and decommissioning timelines.

Defining the Project in this manner establishes the system boundary for the GHG inventory and sets the foundation for identifying emission sources and understanding how the Project may influence GHG flows across its life cycle. It also provides the basis for identifying relevant emission sources, sinks, and reservoirs (SSRs) and for determining material indirect emissions that occur because of the Project's activities, consistent with the requirements of ISO 14064-2:2019.

5.2.1.2 Identification of Relevant GHG Sources, Sinks, and Reservoirs (SSRs)[49]

All points where GHGs may be emitted (sources), removed (sinks), or stored (reservoirs) are identified and categorised. This includes emissions from fuel combustion during construction, land disturbance, energy consumption, and any fugitive emissions. SSRs are further classified as:

- **Controlled**: under direct project control (e.g., on-site fuel combustion for electricity generation, auxiliary fuel use, and energy consumption).
- **Related**: indirectly linked but not controlled (e.g., upstream emissions associated with the extraction, production, processing, transportation, and delivery of natural gas and the production of construction materials).
- **Affected**: external systems impacted by project-induced changes (e.g., the potential displacement of emissions elsewhere).

5.2.1.3 Determining the GHG Baseline[50]

A baseline scenario is established to reflect the emissions that would occur in the absence of the proposed Project. For the purpose of this CCIA, the baseline scenario represents a *without-project* scenario, in which the CCPP and all associated infrastructure are not developed. Under this

[48] ISO 14064-2:2019, Clause 6.2
[49] ISO 14064-2:2019, Clauses 6.3 and 6.5
[50] ISO 14064-2:2019, Clause 6.4

scenario, no Project-related construction, operational, or decommissioning activities occur, and no emissions are attributable to the Project.

In the absence of verified and project-specific information on an alternative electricity supply configuration or displaced generation pathway, the baseline scenario for Project-attributable activities is defined as a zero-emissions baseline. This is considered conservative, as all quantified GHG emissions are attributed to the proposed Project, and no emissions are credited to the baseline scenario. This baseline applies solely to emissions that would be generated by the proposed Project and does not imply that no emissions occur within the broader electricity system in the absence of the Project. This approach avoids the risk of underestimating the Project's contribution to climate change and ensures transparency in the attribution of emissions.

The baseline scenario parameters considered for this Project are shown in Table 5.

Table 5: Baseline Scenario Parameters and Assumptions (Without Project)

Parameter	Baseline (Without Project)	Justification
Electricity generation	No electricity generation attributable to the Project	Project not developed under the without-project scenario
Power plant infrastructure	No construction or operation of CCPP infrastructure	Proposed facilities not implemented
Fuel supply and gas infrastructure	No LNG import, regasification, or gas transmission infrastructure	Project-related fuel supply does not occur
Energy consumption	Zero energy consumption attributable to Project activities	Conservative definition of project-attributable baseline
Land disturbance	Current authorised footprint	No expansion into new areas

5.2.1.4 GHG Quantification and Impact Evaluation[51]

Emissions for both the baseline and project scenarios are quantified for each life-cycle stage using activity data (e.g., quantities of fuel or materials used) and reliable emission factors from sources such as the IPCC or DESNZ. Differences are shown as net changes, where positive values indicate higher emissions under the project scenario and negative values indicate reductions under the project scenario. The net change in emissions is calculated as the difference between baseline and project totals. Where possible, uncertainties are addressed and conservative assumptions are applied to ensure the credibility of the results.

[51] ISO 14064-2:2019, Clauses 6.7 and 6.8

All emissions and removals are calculated using appropriate activity data and emission factors, by applying the formula:

Emissions (tCO_2e) = Activity Data x Emission Factor

The emission and conversion factors applied in the calculation of the Project's SSRs, are aligned with the following principles:

- Derived from a recognised origin;
- Appropriate for the GHG source concerned;
- Current at the time of quantification;
- Take account of quantification uncertainty and are calculated in a manner intended to yield accurate and reproducible results; and
- Consistent with the intended use of the GHG inventory.

Emission factors were sourced from the Department of Environmental Affairs' *Methodological Guidelines for quantification of Greenhouse Gas Emissions*. The use of South African–specific emission factors improve calculation accuracy and is preferred, as these align with the national GHG Emissions Reporting Regulations. The South African grid emission factor is calculated by Promethium Carbon on an annual basis, in accordance with the GHG Protocol's Scope 2 Guidance, and using data provided in Eskom's Annual Report. The emission factors used for other indirect (related and affected) emissions were sourced from supplier-specific factors (where available), DESNZ, IPCC and National Energy Technology Laboratory[52] databases.

The net emissions are quantified using the equation below. A negative net change indicates emissions added/emitted to the atmosphere, whereas a positive result indicates emissions removed/ reduced from the atmosphere.

Net Change = Baseline Emissions - Project Emissions

5.2.1.5 Limitations and Assumptions

The Project's GHG inventory and associated impact assessment were compiled based on data obtained through a desktop review. Where data was not available, appropriate assumptions were made. Furthermore, it was assumed that the following aspects of the Project will contribute immaterially towards the emissions of the Project during the operational, construction and decommissioning phases:

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[52] Roman-White, S., Rai, S., Littlefield, J., Cooney, G. and Skone, T.J. (2019) *Life cycle greenhouse gas perspective on exporting liquefied natural gas from the United States: 2019 update*. National Energy Technology Laboratory (NETL), U.S. Department of Energy. Available here

- Construction and decommissioning emissions: Construction and decommissioning emissions were estimated using a screening-level approach and conservatively assumed to account for approximately 0.4% of total operational GHG emissions[53]. This assumption is intended to account for all construction and end-of-life activities in the absence of detailed project-specific data.
- Upstream fuel supply emissions: Country-specific life-cycle emission factors for natural gas supplied from Angola and Mozambique were not available at the time of assessment. Life-cycle emission factors for natural gas sourced from Algeria were therefore applied as a conservative proxy for these supply scenarios, while U.S. specific life-cycle emission factors were applied for the U.S. supply scenario, based on data availability.

5.2.2 Carbon stock

Potential carbon stock impacts associated with vegetation clearance and soil disturbance within the proposed development footprint were assessed using a combination of spatial datasets and carbon stock sources. The Project development area was first visualised in Google Earth using the available KMZ boundary files to understand the site extent, surrounding land cover, and aboveground biomass context. Aboveground biomass (AGB) was assessed using Earth Map[54], while belowground biomass (BGB) was estimated by applying the IPCC Guidelines for National Greenhouse Gas Inventories default ratio of BGB to AGB. Soil organic carbon (SOC) was not derived from Earth Map, as the relevant layer was not available or functional for this assessment, and was instead obtained from the FAO GloSIS[55] dataset for the Project area. The resulting carbon stock assessment is presented in section 6.1.3 below.

5.2.3 Assessment of Potential Alternatives

This section outlines the approach used to identify and consider potential alternatives to the proposed Project, in accordance with the draft climate change guideline requirements.

The purpose of the alternatives assessment is to demonstrate that the proposed development was considered against credible electricity generation options capable of performing a comparable role within the national electricity system. The assessment is not intended to replicate national electricity planning exercises or undertake detailed system optimisation modelling, but rather to evaluate whether realistic alternatives exist that could deliver similar functional outcomes with materially different climate implications.

The assessment is undertaken in the context of the proposed Project's intended participation in the GASIPPPP and/or other suitable energy markets, as well as the associated fuel-supply

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53 Spath, P.L. & Mann, M.K., 2000, *Life Cycle Assessment of a Natural Gas Combined-Cycle Power Generation System*, National Renewable Energy Laboratory. Available here.

54 Earth Map. Available here

55 Food and Agriculture Organization of the United Nations (FAO) *GloSIS: Global Soil Information System.* Available here

assumptions for gas-fired generation at Richards Bay. Within that project development context, certain alternatives, such as non-generation options, site alternatives, and fundamentally different fuel-supply arrangements, were not advanced as primary project-level alternatives through the Scoping process. Notwithstanding these constraints, this CCIA considers a broader range of technology and fuel alternatives on a high-level comparative basis in order to provide climate-related context and to assess whether other electricity generation options could reasonably perform a similar system function with materially different emissions implications.

In this CCIA, the assessment considered alternatives across the following broad categories:

1. Renewable Energy-Based Alternatives
2. Nuclear power
3. Coal-fired generation
4. Gas-fired technology alternatives
5. Alternative fuels
6. No-go option

Alternatives were identified based on technologies and fuel types recognised within South Africa's electricity sector and reflected in national planning instruments, including the IRP. Each alternative was assessed qualitatively, considering emissions characteristics, operational suitability, infrastructure and spatial requirements, as well as the feasibility of implementation at the scale of the proposed development.

The findings of this assessment are presented in Section 6.1.7, which discusses the suitability of the identified alternatives in comparison with the proposed Project.

5.2.4 Cumulative emissions

Cumulative emissions are defined as the sum of GHG emissions over a defined period, typically the lifecycle of a project, within a defined boundary. In accordance with the Draft Guideline, this CCIA quantifies the Project's emissions on an annual basis, including direct and indirect emissions (including upstream), and aggregates these estimates to derive a lifecycle cumulative emissions total.

For the purposes of this CCIA, cumulative emissions are assessed only in relation to the proposed 750 MW CCPP as an integrated development, including all components and activities required for its construction and functional operation. The Project's GHG inventory therefore constitutes a project-level lifecycle cumulative emissions assessment, as it captures emissions associated with the full suite of functionally linked infrastructure necessary to enable the Project, including fuel handling and delivery systems, on-site energy use, and electricity export connections. This approach is consistent with lifecycle assessment principles as applied at project level, while remaining proportionate to the role and purpose of a CCIA.

The CCIA does not quantify or aggregate emissions from other existing or future third-party developments in the Richards Bay area or elsewhere. While such developments may contribute to

overall national or regional emissions profiles, GHG emissions are globally mixed and their climatic effects are not spatially confined in the same manner as other environmental impacts. Accordingly, the cumulative emissions quantified in this CCIA represent the Project's contribution to cumulative atmospheric GHG loading. This can be considered by the competent authority alongside broader emissions information available through national inventories, sectoral planning instruments, and relevant policy frameworks.

5.3 Cumulative impacts

Cumulative impact describes how the effects of an activity may become material when considered together with other impacts over time and across related activities. As discussed in Section 3.1.2, the judgment confirms that, where a development comprises multiple listed activities, the assessment needs to consider the overall development context and the combined impacts of those activities, rather than assessing the main facility in isolation. In the context of climate change, cumulative impact arises primarily through the accumulation of GHG emissions in the atmosphere. The cumulative climate impact of the proposed development is therefore assessed as the Project's incremental contribution to cumulative atmospheric GHG accumulation, based on its quantified annual and lifecycle emissions and the functionally linked components included within the assessment boundary of this CCIA.

For climate change, cumulative impact arises primarily through the accumulation of GHG emissions in the atmosphere, rather than through spatially localised cause-effect relationships. The cumulative climate impact of the proposed development is therefore assessed as the Project's incremental contribution to global GHG accumulation, based on the quantified cumulative lifecycle emissions and the emissions associated with functionally linked infrastructure included within the assessment boundary.

This approach is also consistent with the Draft Guideline, which requires consideration of direct, indirect and cumulative impacts, while recognising that the evaluation of broader system-wide cumulative effects (including levels of acceptable change and alignment with policy thresholds) falls within the mandate of the competent authority.

5.3.1 Cumulative contribution framing

The Project's cumulative GHG impact is framed by reference to its quantified annual and lifecycle emissions, in order to explain the causal mechanism by which the proposed development contributes to climate change in a manner that is proportionate to a project-level CCIA.

Emissions generated by the Project and associated activities add to the long-lived atmospheric stock of GHGs. In turn, this increases radiative forcing over time and contributes incrementally to global climate change. On this basis, the Project's cumulative climate impact is interpreted as its incremental contribution to global atmospheric GHG accumulation, as represented by its quantified annual and lifecycle emissions.

The cause-effect pathway may be summarised as follows:

a) The Project and its associated activities generate direct and indirect GHG emissions (including upstream emissions, where these fall within the defined inventory boundary),
b) These emissions accumulate in the atmosphere, increasing the long-lived stock of GHGs,
c) The increased atmospheric stock contributes incrementally to radiative forcing and global climate change, and
d) Climate change manifests through biophysical and socio-economic impact pathways that are considered, where relevant, in the broader EIA process and in the assessment of the Project's climate-related physical risks and vulnerabilities.

Existing cumulative climate impact is represented by the present atmospheric GHG burden, together with prevailing national and sectoral emissions trajectories within which the Project's emissions will occur. The Project's contribution is therefore evaluated as an incremental addition to that existing burden, based on its quantified annual and lifecycle emissions profile. Consideration of how that contribution relates to national emissions pathways, mitigation objectives, sectoral constraints, or broader questions of acceptable change forms part of the wider policy and decision-making context addressed in this report and ultimately falls to the competent authority, informed by the emissions evidence presented in this CCIA.

5.3.2 Spatial extent

The spatial extent of the cumulative climate impact arising from the Project's GHG emissions is global. The receiving environment for climate forcing is the atmosphere, within which GHGs disperse and contribute to a globally mixed atmospheric stock. Although emission sources and associated infrastructure are geographically discrete, the climatic effect of those emissions is not confined to the Project site or the Richards Bay area but is experienced at the global scale. Accordingly, the spatial extent of the Project's cumulative climate impact is assessed as global.

5.3.3 Current and future plans, frameworks, developments and activities

For emissions, cumulative climate impact is not spatially constrained to a local or municipal area. A local inventory of all current or future emitting activities in the Richards Bay area would therefore not provide a meaningful basis for assessing the Project's cumulative climate impact at project level. Accordingly, this CCIA does not attempt to quantify or aggregate emissions from unrelated third-party developments in the Richards Bay area or elsewhere. Rather, the assessment focuses on the proposed Project's quantified emissions, together with those of associated and functionally linked infrastructure included within the assessment boundary, insofar as such infrastructure may influence the Project's emissions profile or lifecycle assumptions.

This includes consideration, where relevant and reasonably foreseeable, of associated infrastructure and activities forming part of the Project's broader development context and functionally linked to its operation, such as fuel import, handling and delivery systems and electricity transmission infrastructure required for the Project's operation. These components are considered insofar as they may materially influence the Project's direct or indirect emissions,

emissions profile, or operating assumptions over time. The assessment of how the Project's emissions, together with emissions from unrelated developments, relate to broader regional or national emissions trajectories, sectoral pathways, carbon budgets, or climate policy objectives forms part of the wider decision-making context and ultimately falls within the mandate of the competent authority. In this CCIA, those broader frameworks are used to contextualise the Project's emissions, but not to replace strategic or system-wide cumulative assessment.

5.3.4 Interpretation of significance for GHG emissions

Emissions differ fundamentally from conventional biophysical impacts typically assessed within EIAs. Once released, GHGs disperse through the atmosphere and contribute cumulatively to climate change through incremental increases in atmospheric GHG concentrations. Their effects are global, cumulative and long-lived, rather than spatially confined to the Project site or immediate surroundings.

Due to these physical characteristics, the application of conventional EIA significance-rating criteria, such as spatial extent, duration, probability, reversibility and irreplaceability, has limited utility in differentiating between projects in the context of GHG emissions. For emitting activities, these criteria will generally indicate global extent, long-term or effectively permanent duration on human time scales, and certainty of occurrence once emissions are released, irrespective of the specific project under consideration. In this context, a conventional matrix-based significance rating is not relied upon as the primary basis for interpreting the significance of the Project's emissions.

While the Draft National Guideline contemplates a generic significance-rating framework for assessing the impact of projects on emissions, this CCIA adopts a narrative, evidence-based interpretation that is better suited to the global and cumulative nature of climate change. This approach is also consistent with the broader methodology set out in Section 5.1 and Table 3, which recognises that climate change impacts are only partially amenable to standard EIA rating methods and therefore evaluates the Project's contribution through quantified emissions, cumulative contribution, and policy context.

Accordingly, the significance of the Project's emissions is interpreted primarily with reference to:

a) the magnitude of the Project's quantified annual and lifecycle GHG emissions;
b) the persistence of those emissions and their contribution to cumulative atmospheric GHG loading over the Project life; and
c) the Project's emissions in the context of South Africa's national climate commitments, mitigation objectives and broader energy-policy framework.

This interpretation draws directly on the quantified results presented in Section 6, including the Project's annual and lifecycle emissions inventory, and is read together with the cumulative contribution framing set out in Section 5.3.1 and the policy-context assessment in Sections 5.4 and 6.2.

5.3.5 Uncertainties and confidence

Uncertainty is described for both the quantified emissions inputs and the interpretation of the Project's cumulative climate impact. Key sources of uncertainty include assumptions regarding operating profiles and load factors, fuel characteristics and supply-chain performance, upstream emissions factors, upstream methane leakage rates and the evolution of electricity system parameters over the Project life. These uncertainties may affect both annual emissions estimates and the lifecycle emissions total. Conservative assumptions are applied where appropriate, and the implications of uncertainty for confidence in the assessment outcomes are clearly described.

5.4 South African Policy Environment

At the global level, the principle of common but differentiated responsibilities and respective capabilities was established during the 1992 Earth Summit in Rio de Janeiro and underpins the UNFCCC, which states:

"The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities".

This principle recognises that all nations share a common responsibility to address global environmental challenges, while acknowledging that countries do not bear the same level of responsibility or capacity to respond. It reflects that developed countries have historically contributed more to GHG emissions and generally have greater technological and financial capacity to address climate change, while developing countries may require support in implementing mitigation and adaptation measures in light of their lower capacity and development priorities.

International climate action has significantly influenced the development and implementation of domestic climate policy, including through the adoption and ratification of the Paris Agreement. The Paris Agreement, adopted in 2015 under the UNFCCC, seeks to hold the increase in global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit warming to 1.5°C. It requires Parties to prepare, communicate and maintain NDCs, setting out their emissions reduction targets and climate actions, with progression over time towards increased ambition.

South Africa has a well-established and evolving policy environment relating to climate change. The National Climate Change Response Policy (NCCRP), published in 2011, forms the basis of South Africa's climate policy ambition and informed the development of the country's NDC. South Africa submitted its first NDC in 2015, which was updated in September 2021 to reflect enhanced ambition in line with the Paris Agreement. The updated NDC commits South Africa to a "peak and decline" emissions trajectory, with absolute emissions targets of 398–510 million tCO_2e by 2025 and 350–420 million tCO_2e by 2030. South Africa's Second NDC (2025) maintains the 2026–2030 mitigation target range set in the 2021 update and extends this trajectory by introducing a new economy-wide absolute emissions target for the next implementation period

(2031–2035). Specifically, the Second NDC sets a single-year mitigation target for 2035 of 320–380 million tCO_2e.[56]

The Climate Change Act, 2024 (Act No. 22 of 2024), assented to on 23 July 2024 and partially commenced on 17 March 2025, establishes a legal framework for coordinated climate action in South Africa. It introduces key regulatory tools, including:

- Sectoral emission targets,
- Carbon budgets for identified emitters, and
- An adaptation-planning framework, including climate change needs and response assessments and adaptation strategies and plans across the national, provincial and municipal spheres of government.

While detailed regulations and methodologies under the Climate Change Act are still being developed, the Act is in force and its objects, principles, and framework provisions already provide relevant statutory context for environmental and planning processes, including the consideration of climate change impacts in CCIAs.

In addition to these national policy commitments, the GHG Emissions Reporting Regulations (2017) remain in effect. These require qualifying facilities to report process, fugitive and combustion emissions in accordance with the thresholds listed in Annexure 1.[57] The Annexure outlines reportable activities using the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Facilities that meet or exceed these thresholds are considered "data providers" and are required to submit GHG emissions and activity data for all relevant IPCC source categories where their operational capacity meets or exceeds the applicable thresholds.

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[56] Department of Forestry, Fisheries and the Environment, *South Africa's Second Nationally Determined Contribution under the Paris Agreement*, October 2025. Available here.

[57] Department of Forestry, Fisheries and the Environment, *Amendments to the National GHG Emission Reporting Guidelines*, September 2020. Available here.

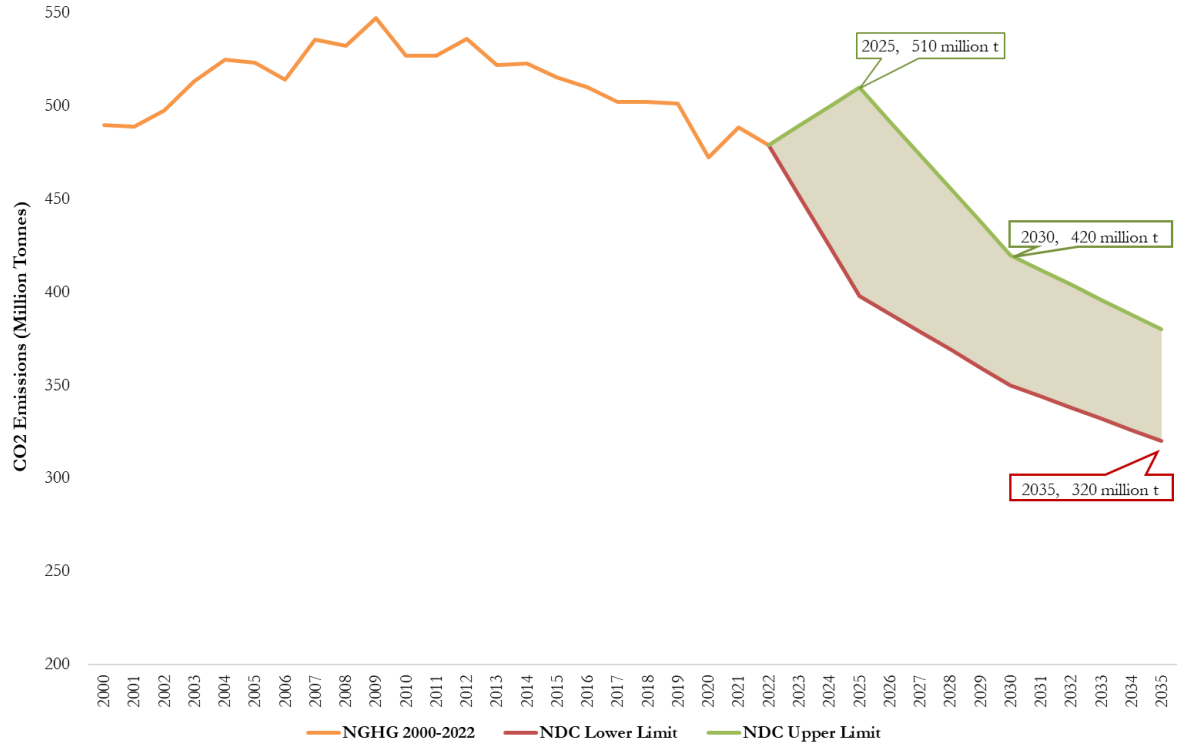


Figure 9: South Africa's annual emissions from 2000 to 2022[58] with the upper and lower limits of the first (2025 - 2030; updated) and second (2030 - 2035) NDC in millions tCO_2e.[59]

Unlike many developing countries that present both "conditional" and "unconditional" targets, South Africa's NDC expresses a single target range. However, it notes that implementation is based on the assumption that support will be provided and that substantial multilateral support is required. This remains consistent with the principle of common but differentiated responsibilities and respective capabilities under the UNFCCC.

The policy environment reflected in international instruments such as the Paris Agreement, together with domestic instruments including the NCCRP, the Climate Change Act, the GHG Emissions Reporting Regulations, and the IRP, provides the policy context within which this CCIA has been undertaken. The IRP (2019)[60] identified gas as part of South Africa's future electricity mix and allocated 3 000 MW of new gas capacity to be procured to 2030. The IRP 2025[61] strengthens this position by incorporating a committed 6 GW gas CCGT programme by 2030 as part of the proposed balanced plan for maintaining security of supply during the period in which

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58 Department of Forestry, Fisheries and the Environment, *National GHG Inventory Report for South Africa, 2000-2022,* May 2024. Available here. The 'Emissions with AR5 GWPs excluding Land Use, Land-Use Change and Forestry (LULUCF)' was used.

59 Department of Forestry, Fisheries and the Environment, *South Africa's Second Nationally Determined Contribution under the Paris Agreement*, October 2025. Available here.

60 Department of Electricity and Energy, *Integrated Resource Plan 2019*, October 2019. Available here.

61 Department of Electricity and Energy, *Integrated Resource Plan 2025*, October 2025. Available here.

significant coal-fired capacity is expected to shut down in the early 2030s. IRP 2025 further states that the minimum annual capacity factor of the 6 GW CCGT fleet is 51% from 2030 to 2040, indicating a role extending beyond a purely peaking function. The IRP is therefore an important electricity-planning instrument for purposes of this assessment. At the same time, the CCIA must consider the project within the broader climate-law framework, including the Climate Change Act and South Africa's nationally determined contribution, and must assess the project's climate-change implications on that basis.

Furthermore, IRP 2025 recognises that the realisation of gas-to-power by 2030 depends on the timely development of appropriate fuel supply and associated infrastructure. In this regard, the plan indicates that gas supply availability and related infrastructure development are material implementation considerations for the gas-to-power programme. IRP 2025 also contemplates the conversion of existing diesel-fired peaking plant to natural gas as primary energy, reflecting a broader policy trajectory toward increased gas use in the electricity sector.

IRP 2025 also frames near-term implementation around gas capacity that has been determined for procurement and assumed to come online by 2030. It records that the Ministerial Determination for gas was gazetted for 3 000 MW through GASIPPPP Bid Window 1, although 2 000 MW has currently been offered to the market, with the balance to be provided at a later date. The IRP nevertheless assumes that the full 3 000 MW will be available on the grid by 2030 and explicitly considers a scenario in which this gas capacity does not materialise. This implementation-risk framing is carried through the IRP's scenario analysis, where the principal constraints relate to securing adequate gas supply at an appropriate price, developing the required gas infrastructure, and ensuring transmission readiness to integrate the capacity onto the grid.

Accordingly, IRP 2025 is an important electricity-planning instrument for purposes of this assessment, particularly in relation to the anticipated role of gas-to-power in maintaining security of supply over the period to 2030 and beyond. However, the project must still be assessed within the broader climate-law and policy framework, including the Climate Change Act and South Africa's nationally determined contribution, and the CCIA must evaluate the project's climate implications on that basis.

5.5 Project vulnerability to climate change

The impacts of climate change are likely to result in increased climate-related vulnerabilities for the Project. Climate change management should therefore not be limited to emissions reductions (i.e., mitigation) but should also consider measures for increasing the resilience of the Project (i.e., adaptation) to climate change. Identifying impacts of climate change on the Project's operations are considered in this assessment.

5.5.1 International best practice

In the absence of detailed regulatory guidance in South Africa specific to CCIAs, particularly with respect to the assessment of climate vulnerability and adaptation, this assessment has been

informed by established international best practice. These frameworks are applied selectively and proportionately, recognising the scale, nature, and purpose of a project-level CCIA within the EIA process.

The methodologies and analytical approaches adopted are intended to ensure that the assessment of climate-related risks and vulnerabilities is structured, transparent, and consistent with globally recognised principles, while remaining appropriate to the local regulatory and decision-making context.

The international best practice frameworks that have informed this assessment include the following:

- **ISO 14091:2021 - Adaptation to climate change: Guidelines on vulnerability, impacts and risk assessment**[62]
    - The assessment is informed by ISO 14091:2021, which provides guidance for assessing risks related to the potential impacts of climate change, including present and future climate risks. The standard describes how vulnerability is understood and how climate risk assessments can be developed and implemented in a structured manner and indicates that such assessment provides a basis for adaptation planning, implementation, and monitoring and evaluation. While ISO 14091 is not a project-specific EIA standard, it provides a relevant and internationally recognised framework for assessing climate hazards, exposure, sensitivity, adaptive capacity, and risk in the context of project-level climate vulnerability analysis.
- **GIZ Framework for Climate Change Vulnerability Assessments**[63]
    - The assessment draws on the conceptual structure promoted by the GIZ, which defines vulnerability as a function of climate hazards, exposure, and sensitivity, moderated by adaptive capacity. This framework provides a clear and widely applied basis for identifying climate stressors, receptors, and potential impacts, and for structuring qualitative vulnerability analysis at project level
- **International Finance Corporation (IFC) Performance Standards**
    - The assessment is informed by the climate-related risk and resilience principles embedded within the IFC Performance Standards. While the most recent consolidated update dates to 2012, the IFC Performance Standards remain widely recognised and applied in international project finance and infrastructure assessments, including in relation to climate risk screening and adaptive management.
- **European Bank for Reconstruction and Development (EBRD) Principles**[64]
    - Relevant EBRD principles have been considered to inform the identification and management of climate-related risks, including the integration of climate change

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62 ISO 14091:2021, Adaptation to climate change - Guidelines on vulnerability, impacts and risk assessment. Available here

63 GIZ Framework for Climate Change Vulnerability Assessments. Available here

64 European Bank for Reconstruction and Development (EBRD) Principles. Available here

considerations into project design, operational resilience, and environmental management systems. These principles support a risk-based, proportionate approach to climate adaptation planning.

- **The Equator Principles**[65]
  - The Equator Principles have been referenced as a high-level benchmark for international project finance practice, particularly with respect to the integration of climate change risks into environmental and social risk assessment processes. While not prescriptive at a methodological level, the Equator Principles reinforce the expectation that material climate-related risks are identified, assessed, and managed as part of responsible project development.

5.5.2 Key areas of vulnerability

The resilience and vulnerability assessment undertaken for this CCIA identifies four key areas associated with the proposed Project that may be vulnerable to climate change-related impacts. These areas reflect both the physical assets of the Project and its broader operational, social, and environmental context (Table 6).

Table 6: Key Areas of Impact

Area of Impact	Relevance
The core operations	The Project's operational assets and supporting infrastructure may be exposed to climate-related stressors over its operational life. This includes the gas turbines, heat recovery steam generators, steam turbine, auxiliary systems, electrical infrastructure, cooling and water management systems, fuel gas supply and metering infrastructure, on-site buildings, and stormwater management infrastructure. Climate stressors such as increased ambient temperatures, extreme rainfall events, flooding, and coastal conditions may affect operational efficiency, equipment performance, maintenance requirements, and infrastructure integrity if not adequately managed through design and operational controls.
The value chain (both upstream and downstream)	The Project is dependent on an external natural gas supply and associated logistics, as well as downstream electricity transmission and offtake arrangements. Climate-related disruptions affecting fuel supply infrastructure, transport routes, port operations, or electricity transmission systems could indirectly affect Project operations. In addition, longer-term transition-related factors, such as evolving climate policy, carbon pricing mechanisms, and market responses to decarbonisation, may influence operating costs, supply chain stability, and the economic context in which the Project operates.
The social environment (surrounding/	The Project interacts with the surrounding social environment through employment, skills development, and indirect economic activity. Climate change impacts such as increased frequency of heatwaves, extreme weather events, or damage to local

[65] The Equator Principles Available here

Area of Impact	Relevance
impacted communities)	infrastructure may exacerbate existing social vulnerabilities, affect workforce health and productivity, or place additional pressure on municipal services. These factors may indirectly influence construction and operational activities, workforce availability, and community perceptions of the Project if not appropriately managed.
The natural environment	Climate change may influence the condition and functioning of the natural environment in and around the Project area, including terrestrial and coastal systems. Changes in rainfall patterns, increased intensity of storm events, temperature increases, and sea-level rise may affect ecosystem services such as stormwater attenuation, flood regulation, and water availability.

5.5.3 Data used

The vulnerability assessment utilised various data sources in the process of determining the critical vulnerability factors relevant to the Project. Data sources are limited to those that are publicly available and, where possible, using the most up-to-date data from reputable international or local data repositories.

The South African National Biodiversity Institute (SANBI), working with partners such as the Global Change Institute (GCI), produces municipal and district climate change fact sheets to provide a consistent, decision-support snapshot of past climate conditions, observed trends, and projected future changes across key variables (e.g., temperature, rainfall, extremes and drought). The SANBI fact sheets[66] were used as an evidence base for the local climate hazard context of Richards Bay (within King Cetshwayo District), to highlight the direction and confidence of key changes, and inform which climate risks require site-specific analysis using complementary datasets (e.g., coastal storms and sea-level rise). The factsheets' future projections are built from CMIP6 and CORDEX-CORE multi-model ensembles and focuses solely on low-mitigation (SSP5-8.5 and RCP 8.5) futures.

The fact sheets use calibrated climate-science terminology to communicate strength of evidence and uncertainty (Table 7). Terms such as "virtually certain", "likely", and similar describe the assessed likelihood of a given change (i.e., how probable it is), while "low/medium/high confidence" reflects the strength of the underlying evidence and agreement across sources or models.[3] In practice, high-likelihood statements (e.g., "virtually certain" warming) can be treated as strong planning signals, whereas results flagged with low confidence (often for rainfall totals and some drought metrics) should be interpreted more cautiously, used to indicate possible

[66] Global Change Institute (GCI), University of the Witwatersrand & South African National Biodiversity Institute (SANBI) 2024, *King Cetshwayo District Municipality climate change fact sheet: KwaZulu-Natal, South Africa*, SANBI & Wits GCI, Pretoria/Johannesburg. Available here

directions of change rather than precise outcomes, while still being considered in risk framing where consequences could be significant.[67]

Table 7: Climate terminology

Terminology	Associated Probability	Confidence level
Virtually certain	99 – 100%	Very high
Very likely	90 – 100%	Very high
Likely	66 – 100%	High
Marginally likely	56 – 65%	Medium
More likely than not	50 – 55%	Low
About as likely as not	33 – 66%	Uncertain
Unlikely	0 – 33%	High
Very unlikely	0 – 10%	Very high
Exceptionally unlikely	0 – 1%	Very high

These tools and data were used in conjunction with site-specific datasets, relevant environmental specialist reports, and national and municipal climate adaptation frameworks applicable to the Richards Bay area. This integrated approach ensured that localised climate vulnerabilities, such as flood risk and heat stress, were appropriately incorporated into the risk assessment.

5.5.4 Determining project vulnerability and resilience

The overall vulnerability of the Project to climate change impacts is determined by identifying the exposure, vulnerability, and adaptive capacity of the region in which the Project lies. The IPCC Sixth Assessment Report[68] defines vulnerability as: "*the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.*" This definition aligns with the method for determining the Project's climate-related vulnerability, proposed Figure 10 below.

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[67] Intergovernmental Panel on Climate Change (IPCC) 2010, *Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties*, IPCC, Geneva; and IPCC 2021, *Climate Change 2021: The Physical Science Basis (AR6 Working Group I)*, Cambridge University Press, Cambridge.

[68] IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. *et al.* (eds.)]. Cambridge University Press. In Press.

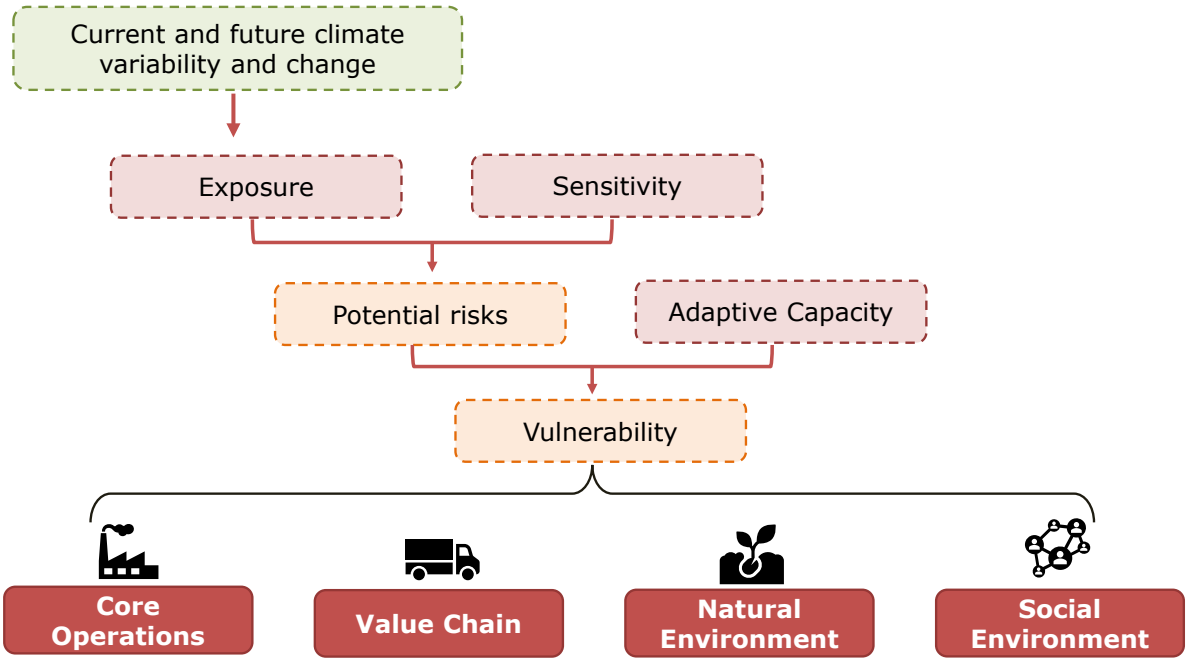


Figure 10: Interrelations of exposure, sensitivity and adaptive capacity, which serve as the foundation of the vulnerability assessment

Assessing vulnerability to climate change is inherently complex due to the uncertainty of projected impacts and the nature of extreme climate-related events. While several vulnerability assessment frameworks exist, including South Africa's National Climate Risk and Vulnerability Assessment Framework, most are qualitative and designed for strategic planning, which can limit their direct applicability in project-level impact assessments.

In this CCIA we have used and adapted the SANS: Risk management - Risk assessment techniques SANS 31010:2010 / IEC/ISO 31010:2009 Probability-Consequences (Impacts) matrix. This matrix introduces a scoring element similar to the impact significance scoring of a project as per South Africa's NEMA EIA 2014 Regulations, as amended.

The matrix provides a score for each climate impact based on its likelihood/probability of happening and the consequences/impact on the proposed project/development (Figure 11). These are both determined through expert opinion and informed by the experience and knowledge of previous events of relevance to the project or region. The climate event's extent, magnitude/severity and duration are taken into consideration in determining the consequence/impact. The assessment would normally be made for a time in the future that is suitable for the project's expected lifetime, however, in the case of projected climate-related impacts, the timeline of potential impacts is considered up to the year 2050.

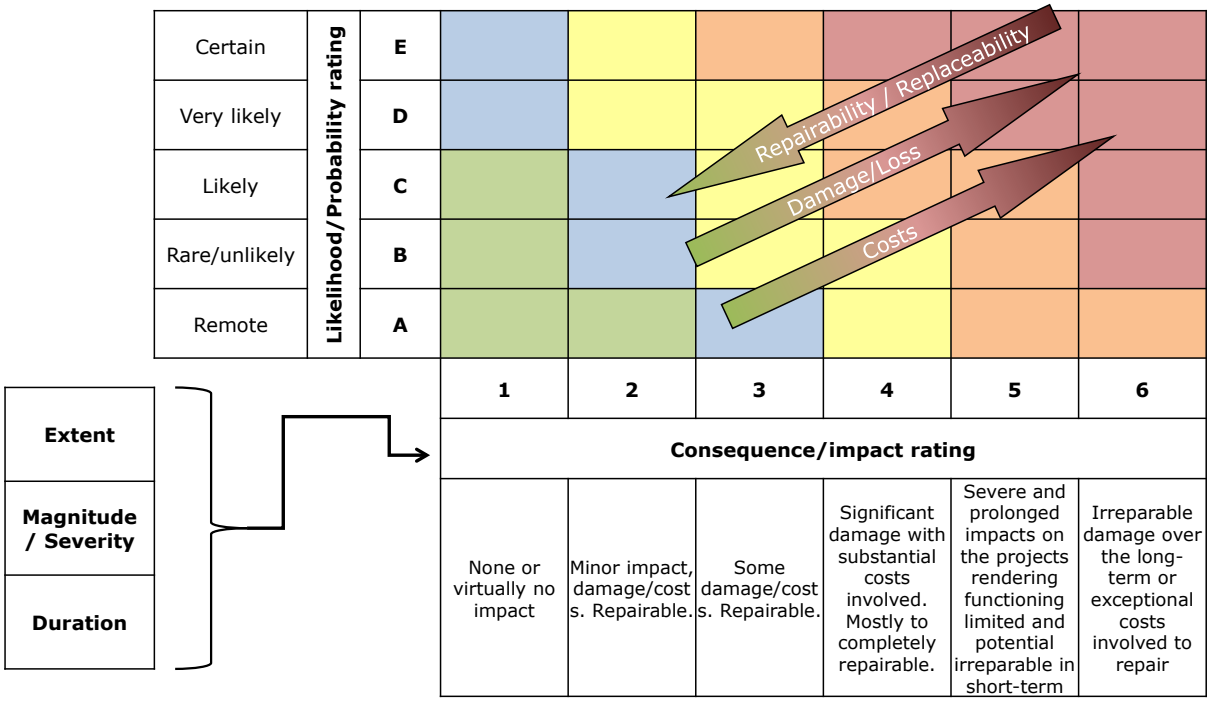


Figure 11: Risk assessment matrix used for determining climate change impacts on a project/development.

5.5.5 Limitations and assumptions

The Project's vulnerability to climate change is assessed using available datasets. Climate data was extracted and analysed at the finest scale possible, however, it is important to acknowledge that modelling climate variables remains complex, particularly at localised scales.[69] Future climate projections typically have a coarser resolution than observed or reanalysed historical climate data, which may introduce a level of uncertainty. While every effort was made to utilise data specific to the proposed 750MW CCPP in Richards Bay some datasets represent aggregated trends over a larger area rather than precise site-level conditions.

Uncertainties in climate projections should be carefully considered by the project developer, as increasing climate variability may affect the long-term operational performance and asset durability of the Project. For example, changes in rainfall intensity, ambient temperatures, or wind exposure may influence maintenance requirements, equipment performance, or logistics planning. Despite these limitations, the overall climate risk trends remain valid, and the findings provide a basis for adaptation planning for the Project.

[69] Bourne, A, P. de Abreu, C. Donatti, S. Scorgie, and S. Holness. 2015. A Climate Change Vulnerability Assessment for the Namakwa District, South Africa: The 2015 revision. Available here

6 PROJECT CONTRIBUTION TO CLIMATE CHANGE

6.1 Methodology

This section applies the approach set out in Section 5.2 (Approach and Methodology) to quantify the Project's contribution to climate change, without repeating the generic methods.

The assessment boundary covers the proposed CCPP (750 MW) and its associated infrastructure, including LNG import and regasification facilities, on-site plant infrastructure, and the gas pipeline connecting the ZET to the power plant. Emissions associated with downstream electricity transmission and distribution beyond the point of connection to the grid fall outside the scope of this assessment.

Consistent with Section 5.2, relevant sources, sinks and reservoirs (SSRs) are identified for:

- **Construction**: energy use during site preparation and construction activities, as well as emissions arising from the production and transportation of construction materials, plant, and equipment required for the development of the CCPP and its associated infrastructure, limited land-clearing where applicable.
- **Operation**: the combustion of natural gas for electricity generation, auxiliary fuel consumption, electricity use for plant operations, and upstream emissions associated with the extraction, processing, liquefaction, transportation, regasification, and delivery of natural gas to the CCPP.
- **Decommissioning**: the dismantling, removal, and recycling or disposal of Project infrastructure at the end of the Project's operational life.

The without-project scenario reflects the continuation of the existing electricity supply system in the absence of the CCPP and its associated LNG and gas transmission infrastructure. Due to the absence of verified and project-specific information on alternative electricity generation configurations or displaced generation pathways, a quantified baseline of 0 tCO_2e has been adopted as a conservative reference to avoid understating project-attributable emissions. (This does not imply zero real-world emissions from the existing system.)

Activity data are multiplied by recognised emission factors (South Africa-specific where available; otherwise, IPCC/other recognised sources). Results are reported as net change relative to the baseline using:

Net Change = Baseline − Project (negative values indicate a net addition of emissions).

Sources assessed as immaterial (e.g., small volumes of construction/municipal waste transport, intermittent backup-generator use, minor decommissioning activities) are excluded unless better data becomes available.

The assessment applies the principles of relevance, completeness, consistency, accuracy, transparency and conservativeness. Key assumptions and uncertainties are noted alongside the results.

The quantified results and interpretations are presented in the subsections that follow.

6.1.1 Baseline Scenario

The baseline scenario for this CCIA was developed in accordance with Clause 6.4 of ISO 14064-2:2019, which requires that a baseline represents conditions that would most likely occur in the absence of the project activity or proposed amendment. It serves as the reference case against which any net changes in GHG emissions from the amendment are evaluated.

For this assessment, the baseline scenario represents a without-project scenario, in which the CCPP and all associated LNG import, regasification, and gas transmission infrastructure are not developed. Under this scenario, no CCPP-related construction, operational, or decommissioning activities occur.

At the time of assessment, verified and project-specific information on alternative electricity generation configurations or displaced generation pathways is not available. As a result, a zero-emissions baseline has been conservatively adopted for CCPP-attributable activities. This approach ensures that all quantified emissions are attributed to the proposed Project and that the CCPP's contribution to climate change is not underestimated.

This approach aligns with ISO 14064-2 guidance on credibility and conservativeness and ensures that the climate impact of the proposed infrastructure is not underestimated. The baseline is therefore not intended to imply that no emissions currently occur, but rather to provide a transparent and conservative reference point against which the Project's GHG impact can be assessed.

As a result, all emissions quantified in this CCIA are considered additional to this zero-emissions baseline and reflect the net climate change contribution of the proposed infrastructure.

6.1.2 GHG Emissions

This section quantifies the GHG emissions associated with the proposed CCPP and its associated infrastructure over the Project life cycle. Emissions are reported as tonnes CO_2-equivalents (tCO_2e) using 100-year and 20-year GWP, consistent with international best practice. A conservative baseline of zero tCO_2e is applied for the Project's activities, in line with the baseline scenario described in Section 6.1.1.

The results are grouped into construction and decommissioning and O&M phases and are presented based on an assumed operational life of 25 years.

Table 8 presents quantified GHG emissions by phase using both 100-year and 20-year GWPs, while Table 9 and Table 10 present the emissions disaggregated by scope using 100-year and 20-year GWPs, respectively. Results are provided for natural gas supply scenarios assuming imports from Angola and the United States of America (USA). At the time of assessment, country-specific life-cycle emission intensities for natural gas supplied from Angola were not publicly available or suitable for application. Life-cycle emission factors for natural gas sourced from Algeria were therefore applied as a conservative proxy for the Angola supply scenario, to avoid underestimation of upstream fuel supply emissions.

Table 8: Lifecycle GHG emissions by phase under 100-year and 20-year GWP

Source Phase	Angola		United States of America	
	Annual GHG emissions (tCO_2e/year)	Emissions over the life of Project (tCO_2e)	Annual GHG emissions (tCO_2e/year)	Emissions over the life of Project (tCO_2e)
100-year GWP				
Construction and Decommissioning (C&D) Phase	-	360 107	-	360 107
Operation and Maintenance	3 692 084	92 299 374	3 631 248	90 778 491
Total Emissions	**3 692 084**	**92 659 481**	**3 631 248**	**91 138 598**
20-year GWP				
Construction and Decommissioning (C&D) Phase	-	431 607	-	431 607
Operation and Maintenance	4 602 024	115 047 894	4 236 680	105 914 278
Total Emissions	**4 602 024**	**115 479 501**	**4 236 680**	**106 345 885**

Table 9: Lifecycle GHG emissions by scope under 100-year GWP

Source Phase	Angola		United States of America	
	Annual GHG emissions (tCO_2e/year)	Emissions over the life of Project (tCO_2e)	Annual GHG emissions (tCO_2e/year)	Emissions over the life of Project (tCO_2e)
Scope 1 and 2[70]				
Diesel Combustion	219	4 375	219	4 375
Natural gas combustion	2 287 320	57 183 000	2 287 320	57 183 000
Total Direct Emissions	**2 287 539**	**57 187 376**	**2 287 539**	**57 187 376**
Scope 3				
Construction and Decommissioning (C&D) Phase	-	360 107	-	360 107
Diesel Production	47	949	47	949
Domestic Pipeline Transport	320 260	8 006 494	320 260	8 006 494
Employee Commuting	277	5 532	277	5 532
Fugitive Emissions	114 346	2 858 658	114 346	2 858 658
Liquefaction	204 756	5 118 906	199 506	4 987 652
LNG Regasification	21 001	525 016	21 001	525 016
Natural Gas Gathering & Boosting	252 008	6 300 192	257 258	6 431 446
Natural Gas Processing	94 503	2 362 572	94 503	2 362 572
Natural Gas Extraction	346 511	8 662 764	110 253	2 756 334
Tanker Berthing & Deberthing	7 875	196 881	7 875	196 881
Tanker Transport	42 960	1 074 011	218 382	5 459 558

[70] For the purposes of this assessment, Scope 2 emissions are reported together with Scope 1 emissions. The proposed Project is designed to be electrically self-sufficient through on-site gas-fired power generation, with no reliance on grid-supplied electricity during normal operations. Electricity consumption is therefore intrinsically linked to on-site fuel combustion and is appropriately classified as a direct emission source.

Source Phase	Angola		United States of America	
	Annual GHG emissions (tCO_2e/year)	Emissions over the life of Project (tCO_2e)	Annual GHG emissions (tCO_2e/year)	Emissions over the life of Project (tCO_2e)
Water Consumption	1	24	1	24
Total Scope 3	**1 404 545**	**35 472 106**	**1 343 710**	**33 951 222**
Total Emissions	**3 692 084**	**92 659 481**	**3 631 248**	**91 138 598**

Table 10: Lifecycle GHG emissions by scope under 20-year GWP

Source Phase	Angola		United States of America	
	Annual GHG emissions (tCO_2e/year)	Emissions over the life of Project (tCO_2e)	Annual GHG emissions (tCO_2e/year)	Emissions over the life of Project (tCO_2e)
Scope 1 and 2				
Diesel Combustion	218	4 359	218	4 359
Natural gas combustion	2 288 823	57 220 577	2 288 823	57 220 577
Total Direct Emissions	**2 289 041**	**57 224 937**	**2 289 041**	**57 224 937**
Scope 3				
Construction and Decommissioning (C&D) Phase	-	431 607	-	431 607
Diesel Production	47	949	47	949
Domestic Pipeline Transport	441 013	11 025 336	435 763	10 894 082
Employee Commuting	277	5 532	277	5 532
Fugitive Emissions	308 238	7 705 947	308 238	7 705 947
Liquefaction	204 756	5 118 906	278 258	6 956 462
LNG Regasification	26 251	656 270	26 251	656 270
Natural Gas Gathering & Boosting	388 512	9 712 796	378 012	9 450 288
Natural Gas Processing	131 254	3 281 350	131 254	3 281 350
Natural Gas Extraction	761 273	19 031 830	162 755	4 068 874
Tanker Berthing & Deberthing	8 400	210 006	8 400	210 006
Tanker Transport	42 960	1 074 011	218 382	5 459 558
Water Consumption	1	24	1	24
Total Scope 3	**2 312 983**	**58 254 564**	**1 947 639**	**49 120 948**
Total Emissions	**4 602 024**	**115 479 501**	**4 236 680**	**106 345 885**

The GHG profile is predominantly driven by the operational phase, which accounts for more than 99% of total life-cycle emissions under both the 100-year and 20-year GWP metrics. This is primarily due to the continuous combustion of natural gas for electricity generation over the assumed 25-year operational life, which represents the primary source of Scope 1 emissions and the single largest contributor to the Project's overall GHG inventory.

Construction and decommissioning activities represent a comparatively small component of total life-cycle GHG emissions, accounting for less than 1% of cumulative emissions. These emissions are primarily associated with the production and transport of construction materials and end-of-life dismantling activities and are minor when considered relative to long-term operational emissions.

From a scope perspective, direct emissions (Scopes 1 and 2)[71], driven primarily by the combustion of natural gas for electricity generation, represent the largest share of total emissions for both gas supply scenarios. Indirect emissions (Scope 3) also contribute materially to the Project's footprint, with the most significant components arising from the upstream natural gas supply chain. These include gas extraction, processing, gathering and boosting, liquefaction, pipeline transmission, tanker transport, and regasification. Observed differences between the Angola and United States supply scenarios are largely attributable to variations in upstream extraction emissions and marine transport distances, with the USA scenario exhibiting higher tanker transport emissions, while the Angola scenario shows relatively higher emissions associated with natural gas extraction activities.

Across both GWP time horizons, the analysis indicates that opportunities to reduce the Project's GHG emissions are largely associated with the operational phase. Potential reductions relate to improvements in plant efficiency, optimisation of operating performance, and measures aimed at reducing emissions from the upstream natural gas supply chain. In comparison, interventions during the construction and decommissioning phases would have a relatively limited influence on the Project's overall life-cycle GHG emissions due to the comparatively small contribution these phases make to total emissions.

The calculation draws on the following project-specific activity data:

[71] For the purposes of this assessment, Scope 2 emissions are reported together with Scope 1 emissions. The proposed Project is designed to be electrically self-sufficient through on-site gas-fired power generation, with no reliance on grid-supplied electricity during normal operations. Electricity consumption is therefore intrinsically linked to on-site fuel combustion and is appropriately classified as a direct emission source.

Table 11: Project Activity Data used to calculate CCPP's GHG Inventory

Activity Data	Value	Source
Power Plant Generation Capacity	750 MW	Provided by client- Scoping Report pg. 49
Operational hours	24 hours/day	Provided by client- Scoping Report pg. 49
Employees/contractors during construction	1 300	Proportionality calculation performed based on assumptions informed by comparable CCGT projects.
Employees/contractors during operation	70	Proportionality calculation performed based on assumptions informed by comparable CCGT projects.
Water Consumption during operational phase	772 000 kilolitre/year	Proportionality calculation performed based on assumptions informed by comparable CCGT projects.
Utilisation factor	100%	Assumption based on continuous plant operation (24 hours per day)
Diesel Stationary Combustion	1 320 litres/month	Proportionality calculation performed based on assumptions informed by comparable CCGT projects.
Diesel Mobile Combustion	3 750 litres/month	Proportionality calculation performed based on assumptions informed by comparable CCGT projects.
Combined Cycle Gas Turbine (CCGT) efficiency	60%	Efficiency assumed at 60%, representing the midpoint of the 58–62% range reported for comparable CCGT projects.
Life of Plant	25 years	Provided by client- Scoping Report pg. 63
Construction and Decommissioning emissions relative to operational emissions for Life of Plant	0.4%	Based on Life Cycles Assessment of a Natural Gas Power Generation System.[72] [73]
Amount of LNG consumed	2 311 tonnes/day	Calculated based on operational hours and capacity
Shipping Distance from USA to Richard's Bay	18 300 km	Estimated using sea distance calculator[74]
Shipping Distance from Angola to Richard's Bay	3 600 km	Estimated using sea distance calculator[71]
Length of pipeline from Zululand Terminal to CCPP	5 km	Provided by client - Scoping Report pg. 4 Assumed gas supply from or near the Port of Richard's Bay which is approximately 5km.

The emission factors used for this assessment are presented in Annexure A.

[72] Spath, P.L. & Mann, M.K., 2000, *Life Cycle Assessment of a Natural Gas Combined-Cycle Power Generation System*, National Renewable Energy Laboratory. Available here

[73] Due to the limited data available, the construction emissions associated with this Power Plant were approximated considering that the reference above indicates 0.4% for both construction and decommissioning of the total operation emissions of the plant.

[74] Sea distance Calculator. Available here

6.1.3 Carbon stock

The proposed 750 MW CCGT Project is located within an already modified industrial area. According to the site sensitivity findings, the development area is characterised mainly by grassland, alien vegetation and other transformed habitats that no longer support natural vegetation. As a result, the carbon stock associated with vegetation within the development footprint is expected to be relatively low.

For the purposes of this CCIA, the carbon stock assessment has been undertaken using specialist spatial footprint developed using GIS for the proposed development and associated infrastructure required for the functioning of the Project. Although the project description refers to an extent of ~12 ha, the shapefile-derived footprint amounts to just under 19 ha. This larger footprint has been adopted as a precautionary and conservative basis for the assessment, as it more appropriately reflects the full area potentially affected by the proposed development.

Carbon stock potentially affected by the Project was estimated as the sum of aboveground biomass (AGB), belowground biomass (BGB) and soil organic carbon (SOC). The total GHG impact associated with disturbance of this carbon stock was calculated using the following equation:

$$(AGB + BGB + SOC) \times (44/12)$$

Depending on the project area, its habitat and the amount of AGB that is present, BGB may be negligible. This assessment follows a conservative approach by calculating the BGB using the IPCC Guidelines for National GHG Inventories default values for the ratio of BGB to AGB[75].

The factor of 0.47 is the IPCC default carbon fraction used to convert dry biomass (AGB/BGB) to tonnes of carbon (tC)[76], while the factor 44/12 is used to convert tonnes of carbon to tonnes of carbon dioxide equivalent (tCO_2e), thereby allowing the estimated carbon stock loss to be expressed in a standard GHG metric.

Given the modified nature of the site and the relatively limited biomass expected within the development footprint, BGB was not directly measured but was conservatively estimated using the IPCC default ratio of BGB to AGB.

Based on the spatial files for the proposed infrastructure, the assessment indicates that the Project area supports a relatively low carbon stock. The results presented in Table 12 therefore provide a standardised and precautionary estimate of the potential carbon stock that may be affected by the proposed development. However, the actual carbon stock loss associated with the Project may be

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75 Available at: Proposal to integrate AFOLU (iges.or.jp) page 49. The Project is situated in a region with a subtropical humid climate. In this area, the ratio of belowground biomass to aboveground biomass is 0.20, reflecting that the aboveground biomass is less than 125 tonnes per hectare.

76 IPCC default conversion factor used for humid subtropical ecological zone (AGB <125 tonnes/ha). Available: here

lower in practice, given the already disturbed condition of the site and the extent of historical anthropogenic modification.

Table 12: Carbon stock assessment of the proposed 750MW CCGT project

	Phase area	Tonne Biomass	Tonnes Carbon/ha	Tonnes Carbon for infrastructure area	GHG impact
AGB	19 ha	196 tonnes AGB	5 tonnes C/ha	92 tonnes C	338 tCO_2e
BGB		38 tonnes BGB	1 tonne C/ha	18 tonnes C	67 tCO_2e
SOC		-	72 tonnes C/ha	1 368 tonnes C	5 016 tCO_2e
					5 421 tCO_2e

6.1.4 Net Emissions

The Net emissions represent the additional GHG impact of the Project relative to the without-project baseline. As noted in Section 5.2.1 and 6.1, the baseline has been conservatively set at **0 tCO_2e** due to incomplete verifiable data on the existing abstraction system. The Project therefore introduces new, attributable emissions across construction, operation, and decommissioning. The net emissions are calculated as:

$$Net\ change = Baseline\ Emissions - Project\ Emissions$$

Table 13: Net life-cycle GHG emissions

Item	tCO_2e	Notes
Angola Scenario		
Baseline (without project)	0	Conservative zero-emissions reference
Project emissions (life-cycle total)	92 659 481	Construction, O&M, decommissioning phases
Emissions from carbon stock loss	5 421	
Net emissions (Baseline − Project)	− 92 664 902	Net increase in emissions attributable to the project
United States of America Scenario		
Baseline (without project)	0	Conservative zero-emissions reference
Project emissions (life-cycle total)	91 138 598	Construction, O&M, decommissioning phases
Emissions from carbon stock loss	5 421	
Net emissions (Baseline − Project)	− 91 144 019	Net increase in emissions attributable to the project

The negative values indicate a net increase in emissions relative to the baseline for both gas supply scenarios. The Project results in a net life-cycle increase of approximately 92.7 million tCO_2e under the Angola supply scenario and around 91.1 million tCO_2e under the United States of America supply scenario. No emission reductions or removals are claimed, and the results reflect the full life-cycle emissions attributable to the Project, including operational emissions and emissions associated with carbon stock loss. This reinforces the importance of mitigation measures (see

Section 8), particularly targeting construction materials and workforce transport, which dominate the footprint.

As set out in Sections 5.3.1 and 5.3.4, the Project's emissions are global in extent and cumulative in nature. The quantified annual and lifecycle emissions presented above therefore represent the Project's contribution to cumulative atmospheric GHG concentrations, rather than a localized impact.

The significance of the Project's emissions is accordingly interpreted in terms of their magnitude, persistence and cumulative contribution, and their relevance to national mitigation objectives, rather than through a conventional EIA significance-rating scale.

6.1.5 Avoided emissions

The CCPP will supply electricity to the national grid and will be dispatched in accordance with system requirements. At the project assessment stage, it is not possible to determine which generation sources electricity from the CCPP may displace, as dispatch outcomes are influenced by electricity demand, generation availability, fuel prices, transmission constraints, and broader electricity sector developments. Accordingly, no assumption is made in this CCIA that electricity generated by the CCPP will replace coal-fired generation.

A scenario-based assessment has nevertheless been undertaken to illustrate the potential GHG implications under defined and hypothetical electricity system conditions. These scenarios are intended to provide contextual insight into possible system-level outcomes and do not represent forecasts of grid operation or expected project performance.

Within the South African electricity system, coal-fired power stations currently represent the predominant source of generation. Under certain conditions, electricity generated by the CCPP could be dispatched in place of coal-fired generation, resulting in a lower emissions intensity per unit of electricity supplied, reflecting the lower life-cycle GHG intensity of natural gas relative to coal. Gas-fired generation from the CCPP may also operate in conjunction with renewable energy sources to support system reliability during periods of low renewable output, which may further influence the extent of coal displacement at the system level.

On this basis, two illustrative substitution scenarios are considered:

- Coal displacement scenario, in which electricity generated by the CCPP displaces coal-fired electricity generation on an equivalent energy basis.
- Increased renewable energy scenario, in which higher renewable energy penetration is supported by dispatchable gas-fired generation, resulting in additional displacement of coal-fired generation during periods of low renewable output.

The results of this scenario analysis are summarised in Table 14, which presents the potential avoided emissions associated with each scenario for natural gas supply from Angola and the United States of America, expressed on both an annual and lifetime basis.

Table 14: Potential Avoided Emissions GHG emissions

Item	Annual GHG emissions (tCO_2e/year)	Emissions over the life of plant (tCO_2e)
Angola Scenario		
Emissions Avoided (from coal Baseline)	2 420 665	60 516 622
Potential Emissions Avoided with increased RE	8 760 919	219 022 981
United States of America Scenario		
Emissions Avoided (from coal Baseline)	2 476 667	61 916 668
Potential Emissions Avoided with increased RE	8 760 919	219 022 981

The avoided emissions presented in Table 14 reflect conditional, scenario-based outcomes and are provided to support interpretation of the CCPP's potential interaction with the electricity system under defined assumptions, rather than to imply expected or guaranteed emissions outcomes.

6.1.6 Assumptions, data and uncertainty

The GHG inventory was developed using available project design information together with recognised emission factors, with conservative assumptions applied where project-specific data was not available.

- **Activity data**: Key activity data inputs, including plant capacities, expected operating hours, the anticipated length of the operating period, and pipeline distances, were sourced from the Scoping Report and associated project documentation. Where data gaps were identified, proportionality-based calculations were applied or, where appropriate, credible assumptions were adopted based on comparable CCGT projects.
- **Emission factors**: South Africa–specific factors are applied wherever available, notably for diesel combustion and grid electricity (including transmission losses). Where local factors are unavailable, internationally recognised values are used, supplemented by standard IPCC stoichiometric conversions.
- **Materiality and exclusions:** Emission sources expected to contribute negligibly to the overall GHG inventory were excluded at this stage of the assessment. These include small volumes of municipal waste transport, limited operation of backup generators, and minor activities associated with the decommissioning phase. These sources may be incorporated in future updates should more detailed project information become available.
- **Uncertainty and conservativeness**. Data confidence is considered high for capital materials and electricity consumption, and moderate for commuting and end-of-life logistics. To avoid underestimation, a conservative zero baseline was adopted and South Africa–specific or upper-bound emission factors were applied where project-specific data is unavailable. These uncertainties do not alter the overall finding that operation of the power plant and combustion of LNG is the dominant contributor to the Project's emissions footprint.

6.1.7 Assessment of Potential Alternatives

This section presents a high-level assessment of potential alternatives to the proposed Project. The assessment considers electricity generation options that could, in principle, deliver provide utility-scale supply to the national grid and fulfil a similar system function to the proposed development. Alternatives are assessed relative to the role of the Project, which is to provide dispatchable, large-scale electricity generation capable of responding to system demand and supporting grid stability within the South African electricity system.

The consideration of certain project-level alternatives is constrained by the proposed procurement and fuel-supply context. The Project is intended to participate in the GASIPPPP and/or other suitable energy markets and, within that framework, non-generation alternatives were not assessed as project alternatives during the Scoping process. Similarly, no site alternatives were assessed for the selected site within the RBIDZ. No fuel alternatives were assessed further at Scoping level, as facilities proposed within the City of uMhlathuze for participation in the GASIPPPP are required to secure fuel through TNPA's natural gas terminal, and the proposed plant is configured to operate on natural gas. A technology alternative was, however, considered at Scoping level, and the no-go option was retained for assessment during the EIA phase.

In this CCIA, alternative technologies and fuels are nevertheless discussed on a high-level comparative basis to provide context and to inform the assessment of the proposed Project within the broader electricity planning and climate policy environment. This discussion is included for comparative context and does not replace the project-level alternatives process undertaken through Scoping and the EIA.

Electricity generation technologies perform different functions within a power system, and meaningful comparison requires consideration of whether an alternative can deliver a comparable level of reliability, responsiveness, and scale. The assessment therefore considers technical feasibility, emissions performance, spatial and infrastructure requirements, implementation timeframes, fuel availability, and alignment with national energy policy as well as system conditions specific to South Africa.

6.1.7.1 Renewable Energy-Based Alternatives

Renewable energy technologies, including solar photovoltaic and wind generation, were considered both as standalone options and in combination with battery energy storage systems. Renewable energy is strongly supported within South Africa's policy framework and forms a core component of the country's long-term decarbonisation pathway.

In the South African context, solar and wind generation are inherently variable, with output dependent on weather conditions, diurnal cycles and seasonal patterns. Periods of low wind and low solar output can occur concurrently across large geographic areas, including KwaZulu-Natal, and may coincide with high electricity demand. At utility scale, variable renewable generation does not provide dispatchable supply in the same operational manner as thermal generation without additional system support. This is reflected in current national transmission planning, which

anticipates the integration of approximately 56 GW of new generation capacity between 2025 and 2034 and identifies a corresponding need for major transmission expansion, including nearly 14 500 km of new transmission lines and 133 000 MVA of transformer capacity, to connect and accommodate the evolving generation mix[77].

Battery energy storage systems can mitigate short-term variability and provide important system support services. In South Africa, however, commercially deployed and procured utility-scale battery systems are presently oriented toward relatively short-duration applications, including peak support, renewable energy integration, and ancillary services, rather than storage designed to sustain supply over prolonged periods of low renewable output[78;79]. Storage capacity capable of maintaining electricity supply through extended low-generation periods would therefore require battery systems substantially larger than those currently deployed or being procured in South Africa, with corresponding implications for project footprint, grid integration requirements, capital cost and operational complexity. Achieving supply characteristics comparable to dispatchable thermal generation using variable renewable energy would also require a broader system configuration, including additional storage capacity, expanded network capability, and sufficient renewable generation to charge storage during periods of favourable resource availability.

Renewable energy technologies are therefore better understood as a central and expanding component of the electricity system, but not as a direct one-for-one substitute for sustained dispatchable thermal capacity when operating in isolation.

6.1.7.2 Nuclear Power

Nuclear power was considered as a low-carbon electricity generation option capable of continuous operation. While nuclear technology offers low operational GHG emissions, its applicability in South Africa is constrained by very high capital costs, complex regulatory and institutional requirements, and long development timelines[80, 81, 82]. Nuclear projects typically require more than a decade from initiation to commissioning, limiting their relevance for addressing current and near-term electricity supply constraints within the national energy system.

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77 See NTCSA, *Transmission Development Plan 2025–2034 Public Report*. Available here

78 The BESIPPPP Bid Window 3 programme provides for battery storage technology with a minimum duration of 4 hours at contracted capacity and states that projects will provide capacity, energy and ancillary services, including reserve services. See IPP Storage, *Battery Energy Storage IPP Programme Bid Window 3*, and DMRE announcement of preferred bidders under Bid Window 3.

79 Eskom's BESS rollout comprises Phase 1 at 199 MW / 833.16 MWh and Phase 2 at 144 MW / 616 MWh, and Eskom describes the programme as supporting grid stability, renewable energy integration, ancillary services and network support. See Eskom, *Battery Energy Storage System – Distribution*

80 Office of Energy Efficiency & Renewable Energy (DOE/NREL), 2024. Nuclear – Electricity Annual Technology Baseline 2024. National Renewable Energy Laboratory, Golden, CO. Available here

81 Leung, M. et al., 2024. The commoditization of civil nuclear power. Nature Communications (or PMC, depending on venue), 15, Article 3978. Available here

82 Zio, E., 2025. Nuclear power technology: an analysis and informed perspective. Frontiers in Nuclear Engineering, 6, Article 1501247. Available here

Operational characteristics of nuclear power also limit flexibility in adjusting output, reducing its suitability in a system increasingly characterised by variable renewable energy. In the South African context, nuclear power does not represent a practical or timeous alternative to the proposed Project.

6.1.7.3 Coal-Fired Generation

Coal-fired power generation was considered as an alternative due to its continued dominance in South Africa's electricity mix. Coal-based generation is associated with high GHG emissions intensity and significant air quality impacts, including emissions of sulphur dioxide, nitrogen oxides, particulate matter, and ash disposal requirements. Even under high-efficiency configurations, coal-fired generation remains materially more emissions-intensive than gas-based alternatives and is increasingly exposed to regulatory, financial, and transition risks.

Given South Africa's legal and policy context, climate commitments, and the recent finding of unlawfulness in relation to the provision for new coal-fired power in IRP 2019, coal-fired generation does not represent an environmentally acceptable or policy-aligned alternative to the proposed development[83].

6.1.7.4 Gas-Fired Technology Alternatives

Alternative gas-fired electricity generation technologies were assessed, including open cycle gas turbines and internal combustion engine power plants. These technologies offer varying levels of operational flexibility and deployment speed but are generally less efficient than combined cycle configurations when applied at utility scale.

Open Cycle Gas Turbine technology offers rapid start-up capability and high operational flexibility but operates at lower thermal efficiency than combined cycle systems. This results in higher fuel consumption and higher GHG emissions per unit of electricity generated, which limits suitability for sustained or baseload electricity generation at the scale required for the Project.

Internal combustion engine power plants provide modularity and relatively short construction timelines and are commonly applied in small- to medium-scale or distributed generation contexts. When applied at utility scale, internal combustion engines are associated with lower efficiency, higher maintenance intensity, and increased local air pollutant emissions relative to combined cycle technology. These characteristics reduce their suitability for continuous large-scale electricity generation in the Richards Bay context.

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[83] In *African Climate Alliance and Others v Minister of Mineral Resources and Energy and Others* (56907/2021) [2024] ZAGPPHC 1271 ("#CancelCoal"), the High Court declared IRP 2019 unlawful and invalid to the extent that it made provision for 1 500 MW of new coal-fired power, and also set aside the related ministerial determination and NERSA concurrence to that extent. Available here

Combined Cycle Gas Turbine technology achieves the highest efficiency among commercially available gas-fired options by recovering waste heat for additional electricity generation. Higher efficiency reduces fuel demand and GHG emissions per unit of electricity and improves overall environmental performance. From a system perspective, CCGT technology provides the operational flexibility required to respond to demand fluctuations and variability in renewable energy output while maintaining high operational efficiency and utilisation rates.

6.1.7.5 Alternative Fuels

Alternative fuels were assessed as potential substitutes for liquefied natural gas for electricity generation for the proposed Project. The assessment considered fuel availability at utility scale, infrastructure readiness, supply security, emissions performance, cost, and compatibility with large CCPP operation in the South African context.

Hydrogen was considered as a potential low-carbon fuel option. In South Africa, hydrogen production is currently at an early stage of development and remains largely focused on pilot projects, research initiatives, and export-oriented strategies. Domestic availability of low-carbon hydrogen at the volumes required to support a 750 MW CCPP is currently limited. Large-scale hydrogen production also depends on substantial renewable electricity input and electrolysis capacity, both of which remain constrained. Transport, storage, and handling infrastructure for hydrogen is not established at scale, and material compatibility, safety requirements, and turbine conversion considerations further limit near-term applicability. Hydrogen therefore does not represent a feasible primary fuel alternative for the proposed Project within the anticipated development timeframe.

Biomethane was also considered. In South Africa, biomethane production is limited in scale and geographically dispersed, with existing and planned projects primarily associated with landfill gas, wastewater treatment works, and agricultural residues. These projects are typically designed to support localised energy use or grid injection at modest volumes. Feedstock availability, competing waste management priorities, and the absence of a mature national biomethane market constrain the ability of biomethane to supply the continuous, high-volume fuel demand associated with utility-scale electricity generation [84] , [85] , [86] While biomethane may present future blending opportunities, it does not constitute a viable standalone fuel alternative for the Project.

Synthetic gases and e-fuels were considered conceptually. These fuels require complex production processes, high energy inputs, and significant supporting infrastructure, and are currently associated with high costs and limited commercial deployment. In the South African context,

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[84] South African National Energy Development Institute (SANEDI), 2023. The state of waste-to-energy research in South Africa. SANEDI, Pretoria. Available here

[85] Rasimphi, T. et al., 2024. Challenges, opportunities, and possible interventions in biogas development in Limpopo Province, South Africa. Energy Nexus, 13, Article 100215. Available here

[86] Sanusi, I.A. et al., 2025. *Sustainable biofuel production from waste potato residue: biogas and biomethane potential in South Africa. Energy Nexus*, 18, Article 100602. Available here

synthetic fuel pathways remain focused on niche applications and longer-term research and development rather than near-term utility-scale electricity generation. Supply certainty, cost competitiveness, and lifecycle emissions performance remain key constraints.

Propane was also assessed as a potential alternative fuel for electricity generation. Propane has a higher carbon intensity per unit of energy compared to natural gas and is primarily utilised in South Africa for residential, commercial, and small-scale industrial applications. Existing propane supply chains are not configured to support sustained, high-volume consumption at the scale required for a utility-scale power station[87, 88]. Reliance on propane for continuous electricity generation would introduce fuel security risks and higher operating costs and would not offer an emissions advantage relative to natural gas-based generation[87, 88, 89, 90]. Propane is therefore not considered a suitable alternative fuel for the proposed Project.

Overall, while alternative fuels may play an increasing role in South Africa's longer-term energy transition, current limitations related to fuel availability, infrastructure readiness, supply security, and cost mean that they do not represent feasible primary fuel alternatives for the proposed Project. LNG remains the only fuel capable of supporting efficient, dispatchable, utility-scale electricity generation at Richards Bay within the Project timeframe, while retaining flexibility to accommodate future fuel diversification should such options become viable.

6.1.7.6 No-Go Alternative

The no-go alternative represents the scenario in which the proposed Project is not developed and no additional dispatchable gas-fired generation capacity is introduced at the Project site. Under this scenario, the anticipated electricity supply from the Project would not be realised, and the existing and planned electricity generation mix would continue to supply demand within the national grid. In the South African context, this would likely result in continued reliance on the existing generation fleet, which is predominantly coal-based, together with the ongoing integration of renewable energy and other new generation capacity as procured through national programmes.

From a climate change perspective, the no-go alternative would avoid the direct GHG emissions associated with the construction and operation of the proposed Project. However, it would not necessarily result in an equivalent reduction in overall system emissions, as unmet electricity demand or system constraints may be addressed through alternative generation sources with differing emissions profiles. In addition, the absence of new dispatchable capacity may have implications for grid reliability and the integration of variable renewable energy, which relies on complementary flexible generation to maintain system stability.

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87 International Energy Agency (IEA), 2022. Gas Market Report. Available here
88 Department of Mineral Resources and Energy (DMRE), 2024. Gas Master Plan. Available here
89 Intergovernmental Panel on Climate Change (IPCC), 2019. 2019 Refinement to the 2006 IPCC Guidelines. Available here
90 International Energy Agency (IEA), 2023. World Energy Outlook 2023. Available here

The no-go alternative therefore provides an important reference case for assessing the climate change implications of the proposed Project, recognising that the environmental trade-offs associated with this option are linked to broader system dynamics, including the performance and evolution of the national electricity supply mix.

6.2 Cumulative impact within the national policy context

The proposed Project is assessed within the context of South Africa's national electricity planning, procurement and climate policy framework. In national policy terms, the Project is relevant as a proposed 750 MW CCPP in Richards Bay, intended to supply dispatchable electricity generation capacity to the grid. Consistent with the Scoping Report, the Applicant intends to bid for the GASIPPPP and/or other suitable energy markets. The Project's policy relevance is therefore considered in relation to its proposed role as a gas-to-power facility within the national electricity supply framework, rather than as a standalone response to South Africa's energy or climate policy objectives.

From a cumulative national policy perspective, the Project is therefore best understood as one potential element of the broader evolution of South Africa's electricity system. Its relevance arises from the fact that gas-fired generation continues to form part of the country's procurement framework for new generation capacity. That policy and procurement context is relevant to the assessment, but it does not in itself determine environmental acceptability. The Project must still be assessed on its own merits, including its GHG emissions, cumulative climate implications and consistency with NEMA and the broader climate change regulatory framework.

6.2.1 Section 34 determinations and procurement context

Electricity planning instruments such as the IRP provide strategic direction on South Africa's future electricity mix, but they do not in themselves authorise the procurement or development of specific projects. Procurement of new generation capacity is implemented through ministerial determinations issued under section 34 of the Electricity Regulation Act, together with the applicable procurement documentation.

In respect of gas-to-power and the GASIPPPP BW1 RFP, the Minister issued a section 34 determination that new generation capacity is required to ensure continued electricity supply, and that approximately 3 000 MW of new generation capacity from gas-fired power generation facilities should be procured to ensure energy security. Additionally, the GASIPPPP was identified as the appropriate programme through which that capacity would be procured[91].

The BW1 overview further states that the programme was designed to procure 2 000 MW of new land-based gas-fired generation capacity anywhere within South Africa, while the remaining 1 000

[91] Electricity Regulations Act (No. 4 of 2006): Determination under section 34(1) of the Electricity Regulations on New Generation Capacity. Government Notice No. 1015, Government Gazette No. 43734, 25 September 2020. Available here

MW was reserved for a separate procurement process in Zone 13 of the Coega Special Economic Zone.

6.2.1.1 Procurement considerations for the proposed 750MW CCPP

The implementation of the proposed Project is contingent on the availability of an appropriate procurement pathway in addition to EA under NEMA. The Project does not proceed automatically because gas-fired generation forms part of national planning and procurement policy; it remains dependent on the outcome of the relevant competitive procurement processes.

For facilities located within the City of uMhlathuze, the BW1 overview states that bidders are required to secure fuel through the Port Authority natural gas terminal. It further states that the Department will limit the amount of MW to be awarded to facilities located within the City of uMhlathuze to a maximum of 1 000 MW, subject to a discretion to procure additional MW in certain circumstances[92].

In this context, the proposed 750 MW Project falls within the locational procurement allocation described for the City of uMhlathuze. The relevant procurement issue is therefore not whether the assessed capacity exceeds the stated locational cap, but whether the Project is able to compete successfully within the applicable procurement framework and satisfy the bid requirements.

The BW1 overview also makes clear that the RFP is a solicitation of bid responses and not an offer to enter into a contractual relationship with any bidder. It provides the basis on which compliant bids may be evaluated and preferred bidders selected.

6.2.1.2 Environmental approval considerations considering recent case law

Authorisations under NEMA cannot be justified solely on the basis of alignment with high-level policy or planning instruments[93]. The existence of a section 34 determination and a procurement framework may explain why a project of this nature has been proposed, but it does not predetermine whether environmental authorisation should be granted.

The competent authority must still consider the Project's impacts, alternatives, GHG emissions, cumulative effects and broader environmental acceptability in terms of NEMA. In that sense, the section 34 and procurement context is relevant, but not determinative.

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92 Republic of South Africa, DMRE (2023). Overview of the RfPs for New Generation Capacity under the First Bid Submission Phase of the Gas IPP Procurement Programme. Tender No. DMRE/015/2023/24: Gas IPPPP RfP Summary.pdf. Available here

93 This was reaffirmed in *South Durban Community Environmental Alliance and Another v The Minister of Forestry, Fisheries and the Environment and Others [2025] ZASCA 134*, where the Supreme Court of Appeal held, in relation to Eskom's proposed 3 000 MW Richards Bay gas power plant, that broader energy policy and planning context did not displace the obligation under NEMA to assess the project's environmental impacts, cumulative effects, and need and desirability on a project-specific basis. See footnote 12 above.

6.2.1.3 Emissions and conservative assumptions

The GHG assessment in this CCIA applies a conservative full-capacity operational scenario to avoid understating potential climate impacts at the assessment stage. This is appropriate because the Project's actual dispatch profile, utilisation rate and operating regime will depend on procurement outcomes, contractual arrangements, electricity system requirements, fuel availability and operational constraints. The Scoping Report also identifies climate change and emissions during construction and operation, including cumulative impacts, as issues requiring assessment.

For that reason, this CCIA assesses the Project based on its full assessed capacity rather than a reduced assumed utilisation scenario. Should the Project ultimately operate at a lower load factor, actual operational emissions would scale accordingly. The use of conservative assumptions is intended to support informed environmental decision-making and does not imply certainty regarding procurement success, operating intensity or final commercial arrangements.

6.2.2 Policy environment: Project contribution

The Project's estimated greenhouse gas contribution must be considered within the context of South Africa's national emissions trajectory and mitigation commitments. Figure 12 illustrates the Project's estimated annual emissions relative to the upper and lower bounds of South Africa's Second NDC range. On this basis, the Project's estimated annual emissions of approximately 3.7 million tCO_2e would represent about 0.9% of the 2030 NDC upper limit of 420 million tCO_2e and about 1.2% of the 2035 lower-limit trajectory of 320 million tCO_2e. The Project would therefore constitute a relatively small, but not insignificant, contribution in national terms.

The Project's contribution is considered in this CCIA against the national policy and planning context, rather than as a direct determinant of South Africa's overall compliance with its NDC. The NDC operates at national level and reflects economy-wide mitigation commitments, while this assessment addresses the Project's estimated emissions and their significance within this broader trajectory. The Project's emissions are therefore relevant to the national policy context because they would add to the emissions burden that must be managed within South Africa's declining emissions pathway.

The Project's approximate contribution over the 2026 to 2030 period is illustrated in Figure 12 and reflects the Project's estimated Scope 1, 2 and 3 emissions over that period relative to the upper and lower bounds of South Africa's NDC range. All three scopes are presented in order to provide a life-cycle representation of the Project's greenhouse gas contribution within the national policy context.

Although Scope 3 emissions are not regulated directly through the EIA framework, they have been quantified and included in the below Figure and are reported in detail in Section 6.1.2 and 6.1.4. These include upstream emissions associated with LNG extraction, processing, liquefaction, shipping, regasification and transmission. Their inclusion provides a more complete life-cycle representation of the Project's GHG implications. At the same time, these emissions arise outside the direct operational control of the project proponent and, in some cases, outside South Africa's

territorial jurisdiction. Their inclusion is therefore intended to support a transparent assessment of the Project's broader climate implications, while recognising the limits of project-level control and regulatory reach.

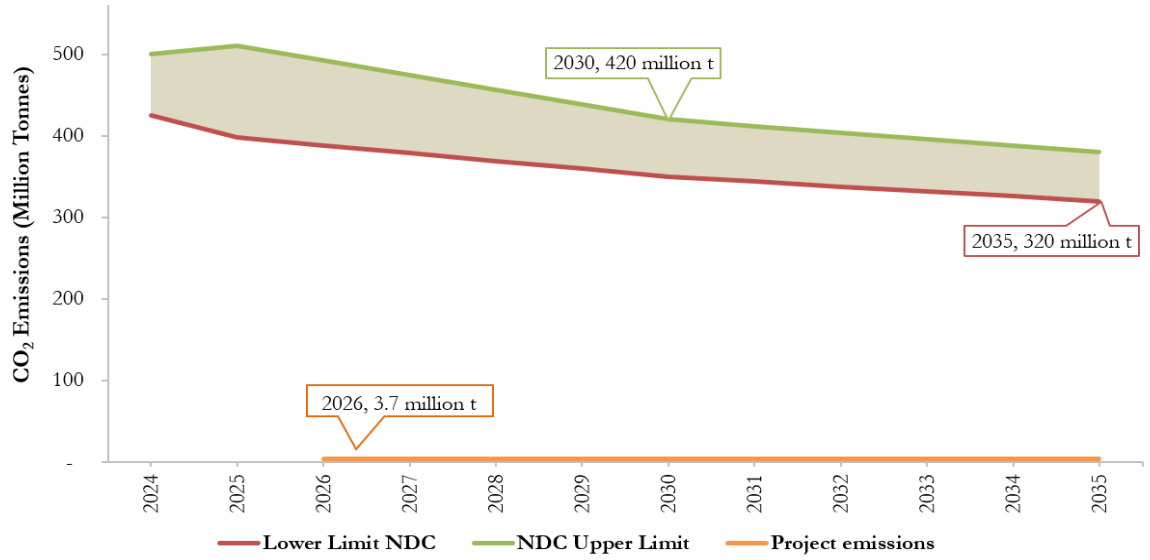


Figure 12: Project contribution to South Africa's NDC targets (upper and lower target limits)

It should be noted that Figure 12 presents the Project's full lifecycle emissions on a 100-year GWP basis, consistent with the basis used for South Africa's national GHG reporting and NDC. This includes Scope 1, Scope 2 and relevant Scope 3 emissions. South Africa's NDC, however, is based on territorial emissions. The comparison therefore provides conservative policy context rather than a direct like-for-like attribution of Project emissions to the NDC. The Project's direct emissions are approximately 2.29 million tCO_2e/year, equivalent to approximately 0.5% of the 2030 upper NDC limit and 0.7% of the 2035 lower-limit trajectory.

IRP 2025 provides the current national electricity planning context and confirms that gas-fired generation remains part of South Africa's electricity planning framework. Within that context, the proposed Project may be regarded as consistent, in principle, with a planning framework that continues to make provision for dispatchable gas-fired capacity as part of the future electricity mix. That planning context is relevant to the assessment, but it does not in itself determine environmental acceptability or project approval.

The Draft Gas Master Plan, published for comment on 26 April 2024, is also relevant as part of the broader policy context, as it reflects continued governmental consideration of gas supply, infrastructure and utilisation in South Africa. However, it remains draft policy and should not be treated as a final adopted planning instrument for purposes of this assessment. The subsequently

introduced Gas Bill[94] does not replace the draft plan at this stage, but would, if enacted, provide a statutory framework for the preparation, review and publication of a Gas Master Plan.

6.3 Project context considerations

The Project is proposed within the established industrial and port-linked context of the broader RBIDZ and associated industrial infrastructure. In this CCIA, that context is relevant primarily because it informs the setting within which the Project's climate-related impacts, dependencies and constraints are assessed, rather than as a standalone basis for environmental acceptability. The Project is also intended to bid under the GASIPPPP and/or other suitable energy markets, which forms part of its broader development context.

From a project-context perspective, the Richards Bay setting is relevant because the proposed development forms part of a wider industrial, logistics and energy-related landscape. This includes surrounding industrial activities, port-related infrastructure and functionally linked gas-supply arrangements, all of which are relevant to the assessment of cumulative climate implications and climate-related vulnerabilities. In this respect, the Project is not considered in isolation, but within the broader physical and operational context in which it would be developed and operated.

The Project may also give rise to ancillary regional socio-economic benefits, particularly during construction and operation, including employment, local procurement and skills transfer. However, these potential benefits do not alter the Project's primary character as a fossil-fuel-based electricity generation facility and do not in themselves determine environmental acceptability. Detailed socio-economic implications are addressed through the broader EIA process and associated specialist studies.

6.3.1 Carbon lock-in

The Project will result in ongoing direct and indirect emissions associated with the combustion of natural gas for electricity generation over the operational life of the facility, as well as upstream emissions associated with gas production and supply. As a long-lived power generation asset utilising a fossil fuel, the Project presents a potential risk of carbon lock-in, whereby continued operation over several decades could contribute to sustained fossil fuel use within the electricity system.

This risk, however, needs to be considered within the current South African electricity context, which remains heavily reliant on coal-based generation with significantly higher emissions intensity and declining operational reliability. Within national policy, natural gas is recognised as a transitional fuel capable of supporting emissions reduction in the medium term by displacing

[94] Republic of South Africa. 2026. Gas Bill [B 6—2026]. Pretoria: Government of South Africa. Available here

higher-emission coal generation and enabling the integration of renewable energy through variable and dispatchable operation.

Unlike inflexible baseload generation technologies, CCGT power plants are capable of variable operation, peaking, and moderate-load dispatch. This operational flexibility reduces the risk of long-term lock-in by allowing the CCPP to adapt its role within the electricity system as the generation mix evolves and as renewable energy penetration increases. The Project's contribution to carbon lock-in is therefore assessed relative to its functional role in supporting system flexibility rather than as a standalone driver of long-term fossil fuel dependence.

To further mitigate potential lock-in risks, the Project can be designed and operated in a manner that supports future adaptability, including consideration of efficiency optimisation, emissions management measures, and compatibility with evolving fuel specifications, where technically and economically feasible. Such considerations support alignment with South Africa's long-term decarbonisation trajectory and Second NDC, without assuming or committing to specific future fuel transitions at this stage.

The CCPP's location within the IDZ may also support longer-term system transitions by enabling coordinated planning and integration with broader electricity sector developments. The assessment of carbon lock-in therefore recognises both the Project's emissions profile and its transitional role within a coal-dominated system undergoing structural change.

6.4 Best available technology and project design

The proposed power plant incorporates technology that is widely recognised as best available technology (BAT) for large-scale gas-fired dispatchable electricity generation. The facility will utilise CCGT technology, which integrates gas turbines HRSGs and a steam turbine to maximise energy recovery from the combustion process. In this configuration, high-temperature exhaust gases from the gas turbines are captured by the HRSGs to produce steam, which is then used to drive a steam turbine and generate additional electricity. By recovering waste heat, combined cycle plants achieve substantially higher thermal efficiency and lower GHG emissions intensity than simple-cycle gas turbines.

The 2+2+1 combined cycle configuration enables the facility to operate flexibly in both simple-cycle mode (approximately 500 MW) and combined-cycle mode (up to approximately 750 MW), allowing the plant to provide dispatchable generation while maintaining high efficiency during normal operation. Modern F-class combined cycle plants typically achieve efficiencies approaching 58–60%, which reduces fuel consumption and associated GHG emissions per unit of electricity generated when compared with older gas turbine technologies or coal-fired power generation.

International assessments identify CCGT technology as the most efficient commercially available fossil-fuel power generation technology currently deployed at utility scale[95].

The gas turbine technology incorporates advanced dry low-NOx (DLN) combustion systems, which premix fuel and air prior to combustion to minimise the formation of nitrogen oxides (NOx), and keep below ~25 parts per million by volume, dry (ppmvd).[96] This approach represents established best practice in modern gas-fired power generation and enables emissions to be controlled at source rather than relying primarily on end-of-pipe treatment technologies. The use of natural gas as the primary fuel also results in lower emissions of sulphur dioxide, particulate matter and heavy metals relative to coal-fired or liquid fuel power generation.

The plant design incorporates integrated digital control systems, which enable optimisation of turbine performance and improves plant reliability and operational efficiency. This allows real-time optimisation of combustion conditions, improved load-following capability, and rapid response to fluctuations in electricity demand. Such operational flexibility is particularly important in electricity systems with increasing penetration of variable renewable energy sources, where dispatchable generation technologies are required to provide balancing capacity and grid stability.

Within the category of fossil-fuel-based dispatchable generation technologies, high-efficiency combined cycle gas turbine plants are widely recognised as the lowest-emitting and most efficient commercially proven technology available at utility scale. The IPCC identifies natural gas plants as having lower lifecycle GHG emissions per unit of electricity than coal-fired power plants, primarily due to their higher thermal efficiency and the lower carbon intensity of natural gas. In addition, the European Commission's Best Available Techniques Reference Document for Large Combustion Plants[97] identifies high-efficiency combined cycle gas turbines with low-NOx combustion technology as representing BAT for natural gas-fired power generation facilities.

The selected technology therefore reflects best available technology for a facility of this scale and operational role, balancing high efficiency, operational flexibility, and reduced emissions intensity while supporting dispatchable electricity supply within a transitioning energy system.

7 Project Vulnerability to Climate Change

7.1 Projected climate changes

Understanding future climate change impacts relies on analyses of both near-historical observations and future projected and modelled climate data. Weather-related risks relevant to the

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95 Energy Policy Group (2025). Combined Cycle Gas Turbine (CCGT). A Romanian Perspective. EPG Reports, January 2025. Available here

96 Consistent with international emissions benchmarks for modern gas turbine installations.

97 Thierry Lecomte, José Félix Ferrería de la Fuente, Frederik Neuwahl, Michele Canova, Antoine Pinasseau, Ivan Jankov, Thomas Brinkmann, Serge Roudier, Luis Delgado Sancho; Best Available Techniques (BAT). Reference Document for Large Combustion Plants; EUR 28836 EN. Available here

Project are primarily driven by increasing temperatures and declining rainfall. However, high-impact, low-probability (HILP) events, such as extreme rainfall and flooding, pose significant risks in the context of increasing global climate variability.

7.1.1 Current climate

The Project falls within the temperate, no dry season, hot summer (Köppen-Geiger) climate zone[98], experiencing a humid subtropical climate where summers are warm with rainfall, whilst winters are mild and relatively dry (Figure 13). The mean annual temperature for the project area is 21.25°C.[99] Mean maximum temperatures range from 29°C in early summer (December and January) to 23°C in winter (June and July). Mean minimum temperatures range from 15°C in winter to 23°C in summer (Figure 13).

The near historic mean annual rainfall is approximately 1 007 mm/year. Rainfall peaks in January to March with >100 mm per month and there is less than 40 mm of rainfall per month during winter months (June to August). Richards Bay experienced several years of heavy rainfall between 1995 and 2000, but overall rainfall has remained relatively stable since 1980.

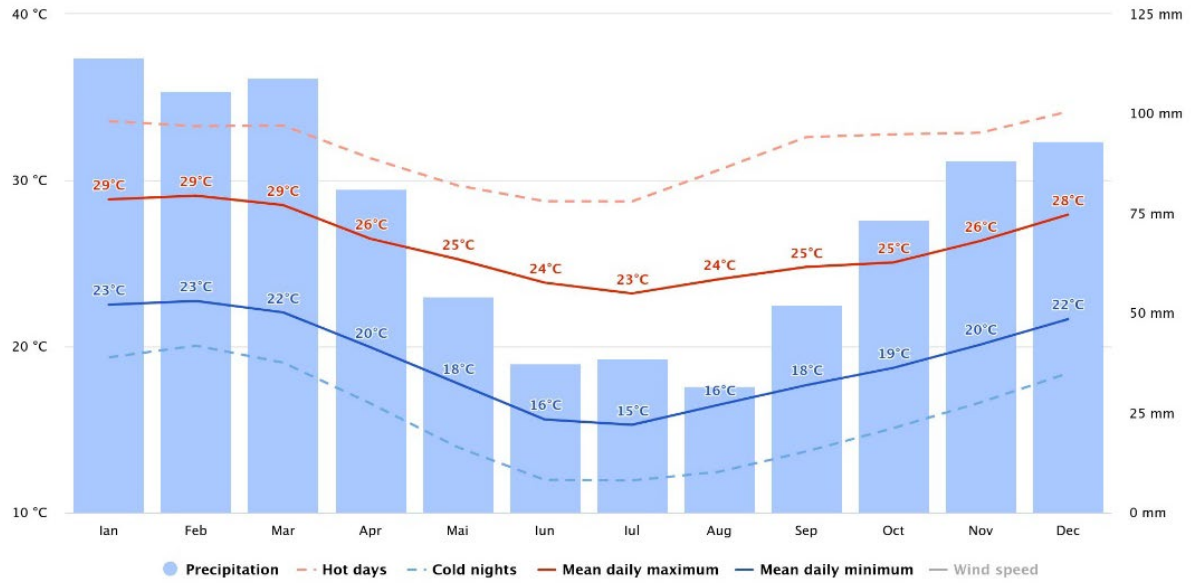


Figure 13: Average historical temperature and precipitation for Richards Bay over the last 30 years. Data source: Meteoblue[100]

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98 Beck, H. E. *et al.* 2018. Present and future Köppen-Geiger climate classification maps at 1-km resolution. *Sci. Data* **5**:180214 doi: 10.1038/sdata.2018.214.

99 CSIR. 2023. Umhlathuze Municipality, GreenBook Risk Profile Tool. CSIR: Pretoria. Available: here

100 Available at: Simulated historical climate & weather data for Richards Bay - Meteoblue

The mean wind speed at the project site is approximately 6.8 m/s, peaking in November. The prevailing winds are from the northeast between March and October and southeast from October to March.[101]

7.1.2 Climate trends and projected climate change

7.1.2.1 Temperature

Mean annual temperature across the district (1981–2000 baseline) ranges from ~17 °C in the north-west to ~21 °C and higher along the coast and the Richards Bay area. An increase in the observed mean annual temperature and warm extremes is classified as virtually certain. Observed very hot days range from <7 days/year in the western interior to ~14 days/year for Richards Bay.

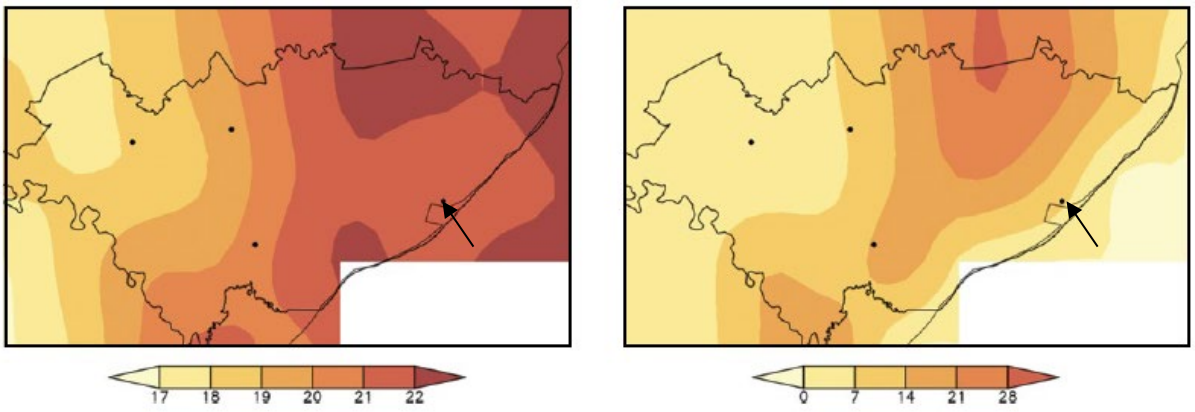


Figure 14: Observed (1981–2000) mean annual temperature (℃; left) and very hot days (exceeding 35 ℃, right). The black arrow indicates the development location. Source: SANBI KZNP King Cetshwayo District Municipality Factsheet.

Temperature and warm extremes are projected to increase (virtually certain) across future periods. District-average warming is virtually certain and may be as high as ~1 °C in the near future (2021–2040), and under low mitigation may approach ~2.5 °C (mid-future, 2041–2060) and ~4.0 °C (far-future, 2081–2099). Warming is expected to be accompanied by increases in warm extremes such as heatwaves and high fire danger days (virtually certain).

Near-future	Mid-future	Far-future
(2021–2040)	(2041–2060)	(2081–2099)

[101] WeatherSpark. Average Weather in Richards Bay, KwaZulu-Natal, South Africa Year-Round. Available here

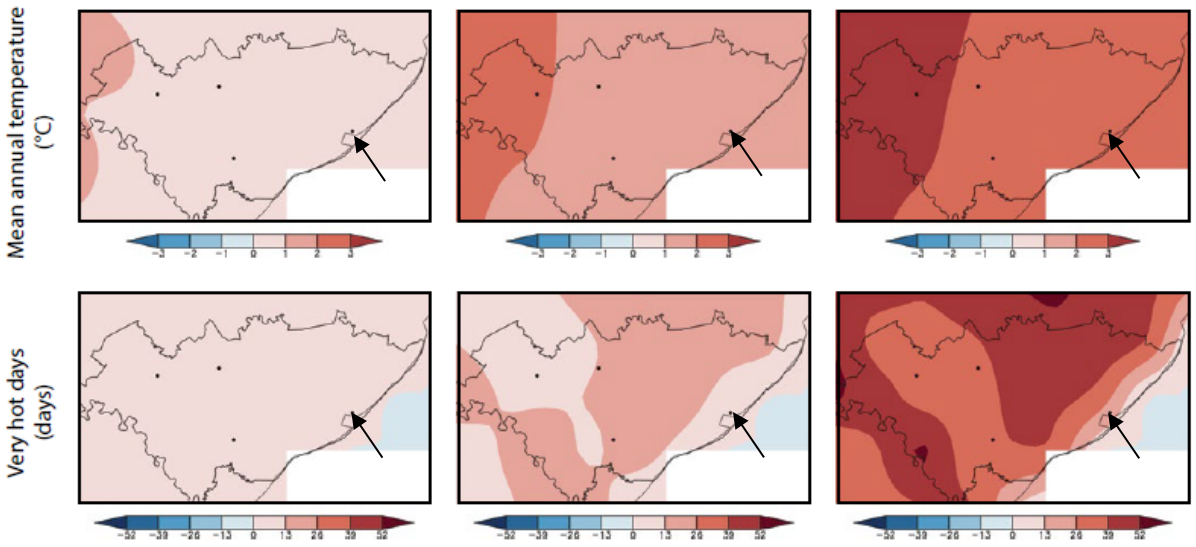


Figure 15: Projected mean annual temperature (°C) and very hot days (exceeding 35°C) for near-, mid- and far futures under RCP8.5. The black arrow indicates the development location. Source: SANBI KZNP King Cetshwayo District Municipality Factsheet.

7.1.2.2 Precipitation

Mean annual rainfall baseline (1981–2000) ranges from ~800 mm in the north-west to >1 300 mm in the north-eastern coastal parts, and >1 200mm in the general Richards Bay area. Observed trends indicate a decrease in mean annual rainfall (low confidence) alongside an increase in the frequency of extreme rainfall events (high confidence). The observed mean annual number of extreme rainfall days ranges up to ~16 days/year over the north-eastern coastal parts and ~14 days/year for Richards Bay.

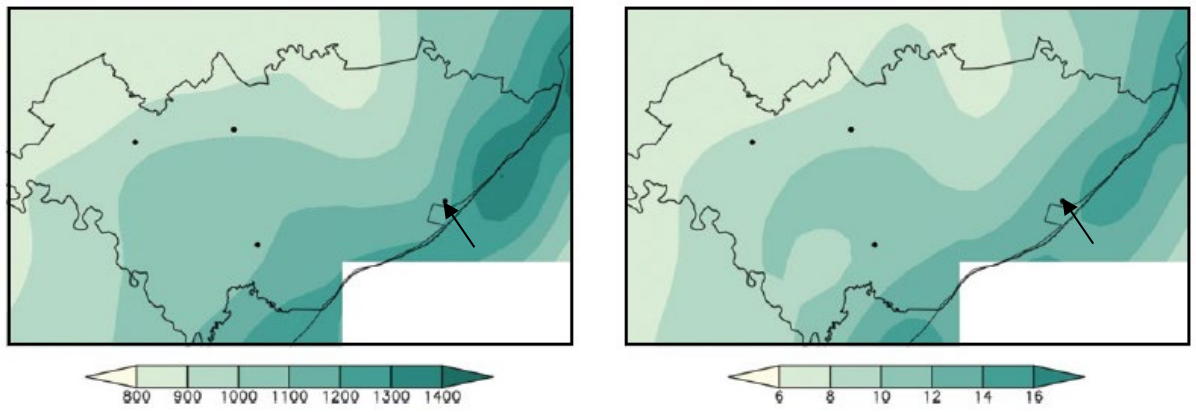


Figure 16: Observed (1981 - 2000) mean annual rainfall (mm, left) and; extreme rainfall days (over 20mm, right) for near-, mid- and far futures under RCP8.5. The black arrow indicates the development location. Source: SANBI KZNP King Cetshwayo District Municipality Factsheet.

Projections indicate an increase in mean annual rainfall in the near-future (low confidence), but a shift towards decreases in the mid- and far-future (low confidence). In contrast, the signal for

extremes is stronger: an increase in the frequency of extreme rainfall events is projected with high confidence (described as "likely"). For the Project, this supports a hazard framing in which intense rainfall events become more frequent, even where the direction of change in total annual rainfall remains uncertain.

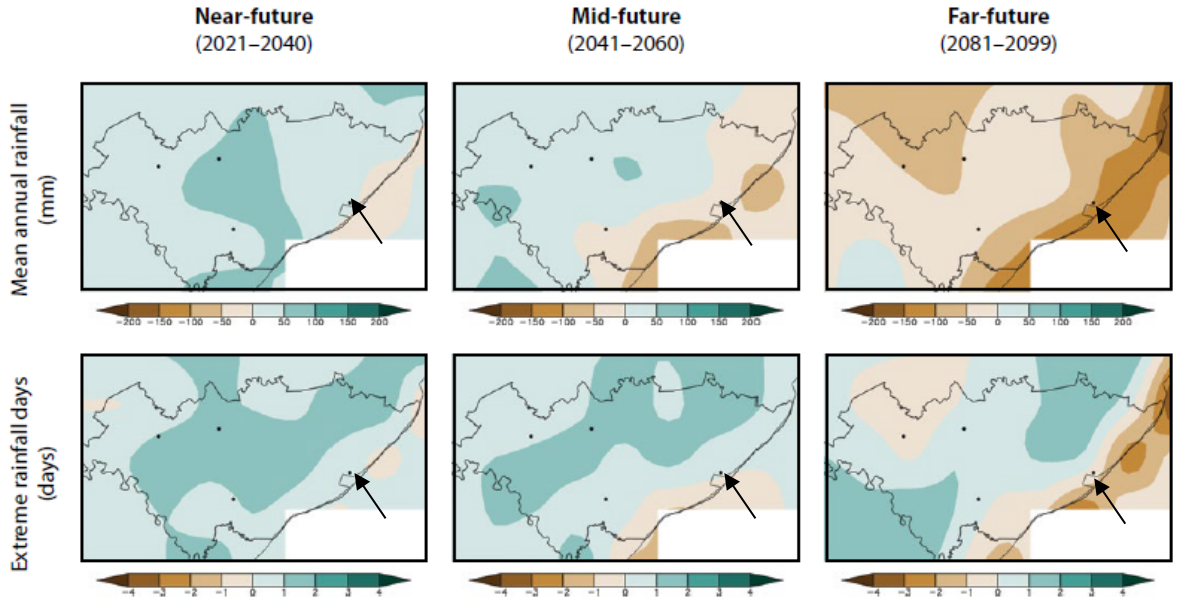


Figure 17: Projected mean annual rainfall (mm) and extreme rainfall days (exceeding 20mm) for near-, mid- and far futures under RCP8.5. The black arrow indicates the development location. Source: SANBI KZNP King Cetshwayo District Municipality Factsheet.

7.1.2.3 Water stress and drought

World Resources Institute (WRI) Aqueduct Dashboard[102] indicates that the project site is in a low-medium water-stressed basin with extremely high-water use, with current drought risk rated as medium. Under the current trajectory, overall water stress and seasonal water variability are expected to remain low-medium through to 2050. The SANBI-Wits GCI fact sheet similarly signals increasing drought pressure, noting observed increases in meteorological and agricultural drought (low confidence) and projecting further increases in the near- and mid-future (low confidence) and the far-future (medium confidence), driven in part by virtually certain warming that raises evaporative demand and can shift rainfall toward heavier events separated by longer dry spells. Taken together, these projections suggest a growing likelihood of episodic water stress for Richards Bay over time, even where the direction of change in mean rainfall remains uncertain.

7.1.2.4 Sea level rise

Observed relative sea level at the Richards Bay tide gauge (1993–2018) is rising at 2.7 ± 0.6 mm/yr (with a corresponding satellite-at-gauge trend of 2.4 ± 1.1 mm/yr), alongside a small but negative

[102] World Resources Institute (2021) Aqueduct Water Risk Atlas. Available here

vertical land motion signal at the co-located Global Navigation Satellite System (GNSS) station (-0.2 ± 0.5 mm/yr), which implies slight local subsidence that can add to relative sea-level rise.[103] In hazard terms, this climate-change-driven background rise increases baseline coastal water levels and therefore amplifies the reach and damages of storm tides, surge and wave run-up during extreme events. The Richards Bay risk profile[104] links warming oceans to the likelihood of more severe and more frequent coastal storms/cyclones, and models coastal water levels using storm events (1:10 to 1:100 year) combined with sea-level rise scenarios of 0.3 m (medium-future) and 1.0 m (long-term). While the modelled direct coastal flood footprint for Richards Bay is described as very small (attributed to high coastal foredunes), the report flags that the unconsolidated sandy shoreline and dunes are vulnerable to erosion during coastal storms, and that future risk will rise if urban development expands into delineated coastal risk zones.

According to IPCC AR6 projections, global mean sea level change is expected to increase by 10-40 cm by 2050 under different SSPs (Figure 18) with the earliest expected 0.5 m rise by 2060 under SSP5-8.5 (very high emissions scenario).[105]

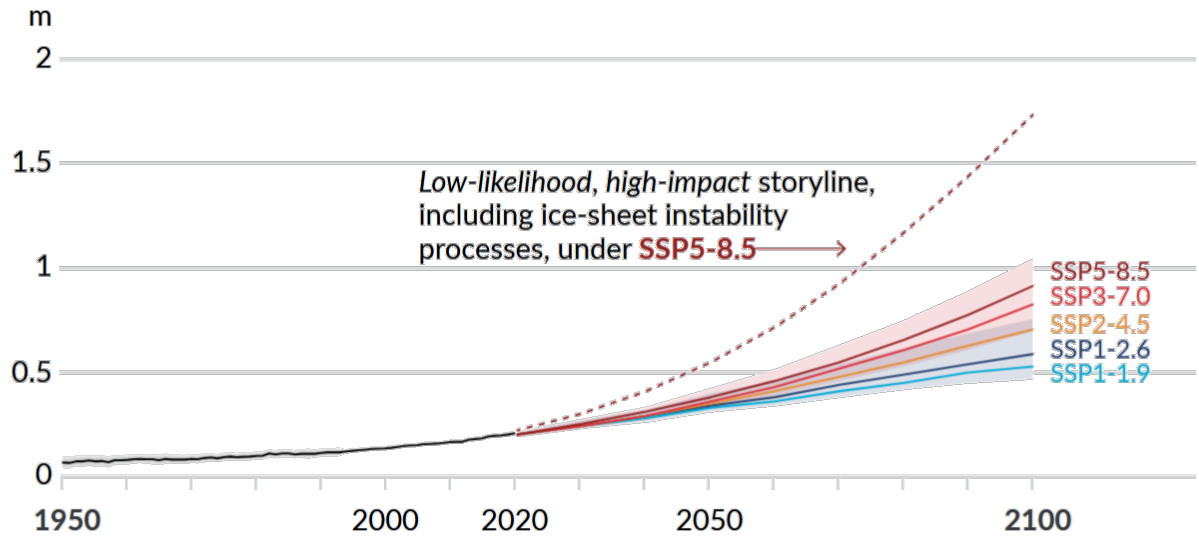


Figure 18: Global mean sea level change relative to 1900.

7.1.3 High Impact, Low Probability (HILP) Events

Atmospheric changes under high GHG emission scenarios are projected to increase the intensity of extreme weather systems affecting the north-east coast of South Africa, including cut-off low

[103] Ghomsi, F.E.K.G., Erkoç, M.H., Raj, R.P., Pirti, A., Bonaduce, A., Abiodun, B.J. & Stroeve, J. (2025) Sea level trends along the South African coast from 1993 to 2022 using XTRACK altimetry, tide gauges, and GNSS measurements. Scientific Reports, 15:4946. Available here.

[104] CSIR (2023) Richards Bay PHSHDA: Climate Risk Profile Report (16 October 2023). Compiled by CSIR; funded by GIZ; partners include DFFE, DHS, HDA & uMhlathuze Local Municipality. Available here

[105] IPCC (2021) Climate Change 2021: The Physical Science Basis. Summary for Policymakers (WGI AR6), Intergovernmental Panel on Climate Change. Available here

pressure systems and tropical cyclones. These hazards are often characterised as HILP events: they may be infrequent and difficult to forecast with precision, but they can cause disproportionate and potentially catastrophic damage. For the Project, this means planning for rare but severe events to ensure rapid recovery and continuity of operations if they occur.

Although the likelihood of HILP events is inherently uncertain, climate change is increasing the frequency and/or intensity of extreme hazards, which reduces the usefulness of historical conditions as a sole basis for design. New developments, such as the proposed CCPP, should therefore incorporate HILP events into risk assessments and engineering specifications using forward-looking climate information (including scenario-based projections), rather than relying only on past storm records.

The proximity of the CCPP to low-lying coastal terrain increases exposure to extreme rainfall and wind-related impacts during severe coastal storms. HILP events could damage critical infrastructure, electrical systems, and mechanical equipment, leading to unplanned downtime, supply chain disruption, and elevated repair and maintenance costs. To reduce these risks, adaptation measures should be embedded in design and operations, including elevating sensitive assets above design flood levels, incorporating flood protection (e.g., barriers and controlled drainage), designing for extreme wind loads, and ensuring cooling and drainage systems are resilient under heat and high-rainfall conditions.

Overall, the Project should be designed to withstand and recover from HILP hazards consistent with a more volatile coastal climate. Integrating these considerations early will strengthen resilience, reduce lifecycle costs, and improve operational reliability under future climate conditions.

7.1.3.1 Storms and storm-related weather impacts

Coastal storms and related impacts such as storm surges are likely to have the foremost impact on the proposed Project. There is wide agreement in the climate science community that an increase in global average temperature is correlated with an increase in weather extremes.[106] Of relevance for the Richards Bay area is the trend of tropical storms and low-pressure systems such as cut-off lows[107] that bring widespread rain.

Subtropical lows present a significant and increasing risk. The April 2022 floods in KwaZulu-Natal, triggered by a cut-off low with subtropical characteristics, resulted in 544 fatalities, the

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[106] Arias, P.A. *et al.* 2021. Technical Summary. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. *et al.* (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 33−144. doi:10.1017/9781009157896.002.

[107] Anti-cyclonic depression that results when air in the mid-atmosphere moving in an easterly direction is disturbed and through the development of a trough. This trough generally intensifies to form a low-pressure system that 'cuts off' from the westerly often resulting in heavy rainfall for several days. They are most common in spring and autumn.

destruction of over 7 000 homes, and damages exceeding US$3.5 billion. Though centred around Durban and eThekwini, the event also caused operational disruptions in Richards Bay, highlighting vulnerabilities in port accessibility and local infrastructure. Subtropical systems, often asymmetrical and driven by upper-atmospheric conditions, can produce rainfall comparable to cyclones but are more difficult to predict. An attribution study using Conformal Cubic Atmospheric Model simulations concluded that climate change increased the rainfall intensity of the 2022 event by 40%.[108] This underscores the growing risks these systems pose to logistics and infrastructure resilience in coastal South Africa.

Southern Africa's east coast also faces increasing vulnerability to high-intensity tropical cyclones, a trend identified by the Wits GCI as one of three critical climate tipping points. [109] These cyclones, fuelled by warming ocean waters in the Mozambique Channel, have the potential to bring catastrophic flooding and infrastructure damage to coastal and inland regions.

Historical cyclone events such as Cyclone Idai (2019) and Cyclone Freddy (2023) exemplify the devastating impact of these storms. Cyclone Idai, a Category 4 system, caused extensive flooding, crop destruction, and over 1 500 fatalities across multiple countries. Cyclone Freddy, notable for its longevity and intensity, struck Mozambique twice in 2023, resulting in significant loss of life and displacement. Data from other major storms, including Cyclone Kenneth (2019) and Cyclone Eloise (2021), show a trend of increasing storm strength and associated precipitation levels, highlighting an intensifying risk profile.[110,111]

Analysis from the National Ocean and Atmospheric Administration IBTrACS dataset indicates that the tracks of tropical cyclones are shifting southward and westward, closer to the mainland.[112] This spatial change raises the likelihood of direct impacts on ports and infrastructure along the Southern African coast, including in Richards Bay and Durban. These shifts, visualised through changes in storm latitude and longitude over time, suggest an increased risk of inland penetration, with implications for both coastal and hinterland operations (Figure 19 and Figure 20).

Rapid cyclone intensification trends are leading to shorter warning times and heightened disaster risks. This makes emergency response planning, reinforced infrastructure, and upgraded stormwater systems essential for mitigating flood risks and ensuring operational continuity during extreme weather events.

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108 Engelbrecht, F.A., Steinkopf, J., Chang, N. et al. Extreme event attribution using km-scale simulations reveals the pronounced role of climate change in the Durban floods. Commun Earth Environ 6, 506 (2025). https://doi.org/10.1038/s43247-025-02460-5

109 Engelbrecht, F. (2023). Projections of Future Climate Change and Climate Change Tipping Points in Southern Africa. Global Change Institute, University of the Witwatersrand. Available here

110 Mercy Corps. (2019). The facts: Cyclone Idai's effect on southern Africa. Available here

111 ReliefWeb. (2023). Southern Africa: Snapshot of Tropical Cyclone Freddy's Impact (February – March 2023). Available here

112 National Ocean and Atmospheric Administration, 2025. International Best Track Archive for Climate Stewardship (IBTrACS) Project, Version 4.01. Available here

Projections under different climate scenarios indicate a potential increase in the intensity of Category 4 and 5 cyclones, with extreme precipitation and stronger wind speeds expected to rise significantly under high-emissions pathways. According to the IPCC AR6, a 5-10% increase in the proportion of Category 4 and 5 cyclones is projected due to warmer oceans and increased moisture availability under a SSP1-2.6 scenario, despite little to no expected change in overall tropical cyclone frequency. While under a SSP5-8.5 emission scenario the total cyclone frequency may decrease by 10-20% and the intensity of the most extreme storms are projected to increase by 30-50%, with 10-15% stronger peak winds and 15-30% more precipitation per event.[113]

Therefore, it is well established that climate change is expected to escalate both the intensity and potential destructiveness of cyclones[113] and presents potentially severe risks to operational resilience.

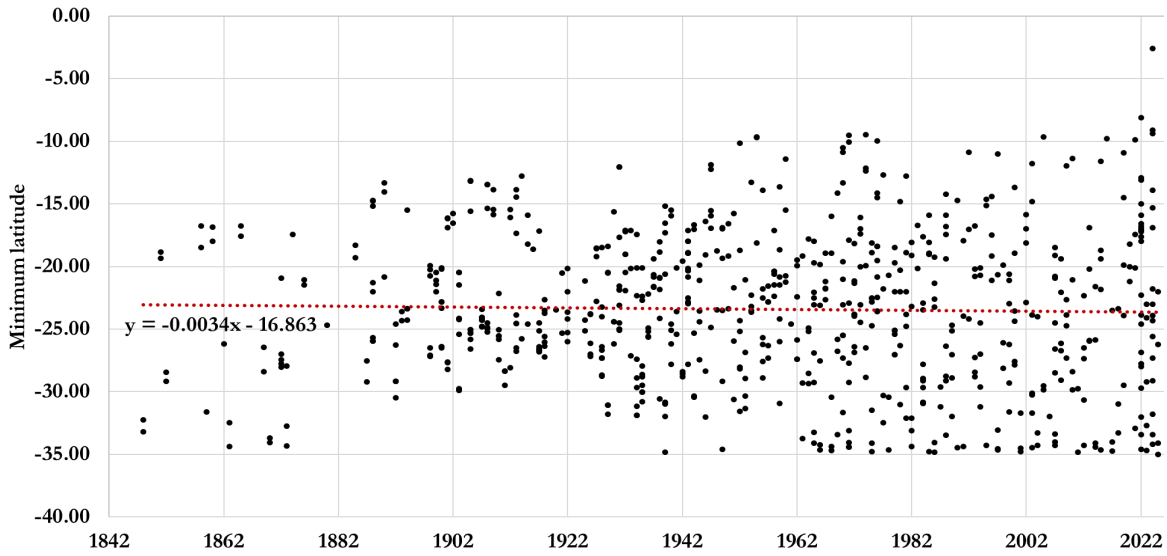


Figure 19: Minimum latitude of cyclones from 1842 to 2023

[113] IPCC, 2021. Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. [Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S.L., et al. (eds.)]. Cambridge University Press. Available here

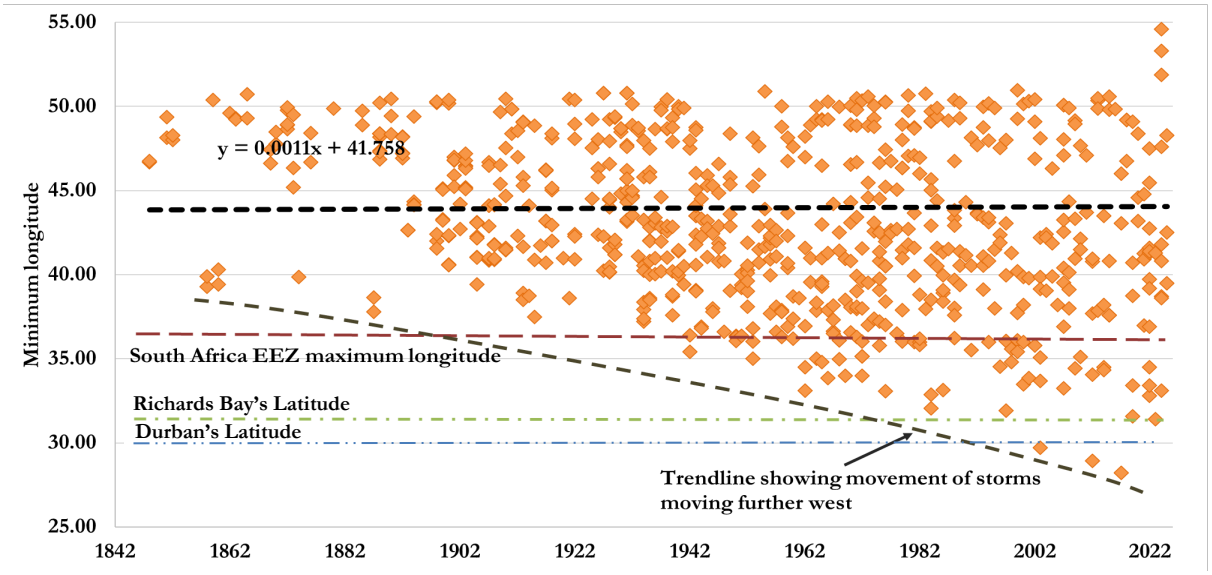


Figure 20: Minimum longitude of cyclones from 1842 to 2023

7.1.3.2 Sea surges and wave action resulting from storm activity

One of the key impacts of coastal and tropical storms are the associated storm surges that result from the high-wind speeds interacting with the ocean surface. In the region, the veering away of cyclones from the continent in a south-easterly direction, or those that become semi-stationary, result in the largest swells experienced. A combination of high sustained onshore winds and the storm area are the two primary variables that influence wave impact. Storm surges are among the leading causes of damage and loss of life from tropical storms.

Although less vulnerable than sandy coastlines and coastal plains, harbours and ports remain at risk. The areas surrounding the Port of Richards Bay are likely to be affected by a combination of sea level rise, tides and storm surges.[114] The coastal flooding risk for Richards Bay is classified as medium risk in the medium-term.[115] The development area of the Project is located outside any vulnerable areas of major sea-level rise or sea surge (approximately 8.7 km inland), at least in the short to medium term.

7.1.4 Summary

Observed climate conditions across King Cetshwayo District are warm and humid, with mean annual temperatures increasing from ~17 °C in the north-western interior to ~21 °C and higher along the coast (including the Richards Bay area). Increasing temperature and increases in warm extremes are virtually certain, with Richards Bay already experiencing comparatively high frequencies of very hot days (exceeding 35°C). Looking ahead, district-average temperatures are

[114] CSIR (2023) *Green Book Risk Profile Tool.* Available here
[115] World Resources Institute (n.d.) *Aqueduct.* Available here

virtually certain to increase across all future periods, with warming of ~1°C possible in the near-term and substantially higher warming under low mitigation pathways by late century. This will increase the likelihood of heatwaves and compound hazards such as high fire danger days.

Rainfall patterns show a strong coastal gradient, with baseline mean annual rainfall increasing from ~800 mm in the north-west to >1 300 mm in the north-eastern coastal zone. Observations suggest a decrease in mean annual rainfall (low confidence), but a high-confidence increase in extreme rainfall frequency, with Richards Bay and adjacent coastal areas experiencing some of the highest observed extreme rainfall-day frequencies. Projections maintain low confidence in the direction of change in total annual rainfall by mid-century, but the signal for extremes is stronger: extreme rainfall events are likely to become more frequent, reinforcing a hazard framing of more intense rainfall episodes even where mean rainfall trends remain uncertain.

Hydrologically, projections indicate growing drought and water-stress pressure over time. The Project is in a low-medium water-stressed basin with extremely high water use, and current drought risk is medium, with overall stress and seasonal variability expected to remain low-medium through ~2050 on current trajectories [116]. Consistent with this, local evidence points to increasing meteorological and agricultural drought pressure over time (with confidence increasing toward the far future), driven in part by virtually certain warming that raises evaporative demand and can lengthen dry spells between heavier rainfall events.

Coastal processes introduce an additional long-term hazard pathway. Observed sea level at Richards Bay increased by 2.7 ± 0.6 mm/yr.[103] IPCC AR6 projections indicate further rise of ~10-40 cm by 2050 across scenarios, with ~1 m possible by 2100 under very high emissions.[105] This will increase baseline coastal water levels and can amplify storm surge and coastal flooding impacts during severe weather.

Finally, the site's coastal proximity elevates exposure to HILP events, including severe coastal storms, cut-off lows with subtropical characteristics, and tropical cyclones. The intensity of extreme weather systems affecting South Africa's north-east coast is projected to increase, making it less reliable to rely only on past conditions to inform design. These events can cause disproportionate damage (flooding, wind damage, electrical/mechanical failure, access disruption), requiring explicit design and operational planning for rare but severe conditions (e.g., elevation and flood protection of critical assets, extreme wind loading, stormwater and drainage, and emergency response and recovery planning).

Table 15: Summary of the historical and projected climate projections for the Project site.

Hazard	Historical	Projected trend	Confidence
Mean annual temperature	~21 °C+	Warming continues (near/mid/far futures)	Virtually certain
Very hot days	~14 days/year	Increasing in future periods	Virtually certain

[116] World Resources Institute (2021) Aqueduct Water Risk Atlas. Water stress. Available here

Hazard	Historical	Projected trend	Confidence
Mean annual rainfall	>1 007 mm/year	Increases in near-future; then decreases in mid-/far-future (direction uncertain)	Low confidence
Extreme rainfall days	~14 days/year; increasing historically	More frequent intense rainfall events	Observed: High confidence; projected: Likely
Droughts	Increasing	Further increases (near/mid); far-future increase	Observed: Low confidence; near/mid: Low confidence; far: Medium confidence
Sea level rise	1.06 mm/yr	+10-40 cm by 2050; ~1 m by 2095	High confidence (increase certain)

7.2 Vulnerability assessment

Vulnerability is defined as the propensity or predisposition to be adversely affected by climate change, including climate variability and extremes[117]. Assessing the vulnerability of the Project to climate change considers the potential impacts of climate change on the Project's infrastructure, operations, workforce, and value chain and identifies strategies to enhance resilience.

The uMhlathuze Local Municipality has experienced climate-related events, including prolonged drought, inland flooding, intense sea swells and increased coastal storm events. These can pose a significant risk to the area and consequently, the Project.

In this section, the impact of the projected climate changes on the core operations, value chain and broader environmental and socio-economic contexts of the Project area are discussed.

7.2.1 Core operations

7.2.1.1 Physical Risks

The core operations of the Project comprise the construction and operation of a 750 MW CCPP and its associated on-site infrastructure. Key operational systems include two General Electric Frame 9 gas turbines, two HRSGs, and one steam turbine generator.

Natural gas is the primary fuel source for electricity generation. In addition, the CCPP will include limited on-site diesel storage to support a black-start generator, enabling safe start-up and restart capability during grid disruptions or plant outages.

[117] IPCC, 2022: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. *et al.* (eds.)]. Cambridge University Press. In Press.

Electricity generated by the power plant will be exported to the national electricity grid via an on-site switchyard and associated generator step-up transformers, which will raise the voltage from the generator output level to the grid voltage level.

As such, the Project's operational vulnerability is influenced primarily by the resilience of power generation infrastructure, water and cooling systems, on-site electrical systems, and the reliability of the upstream gas supply interface and transmission connection.

The key physical risks relevant to the CCPP are summarised below.

Temperature

Mean annual temperatures are projected to continue warming in the near, mid and far-future with very high confidence, alongside an increase in the frequency of very hot days.

This presents a key physical risk to both construction and operation of the Project:

- Operational performance losses: Gas turbines experience reduced efficiency and output under higher ambient temperatures due to reduced air density. This may reduce dispatchable output during periods of peak heat, when electricity demand is also likely to increase due to cooling loads.
- Cooling system strain: The air-cooled condenser system and closed cooling water systems may experience increased thermal load and higher energy use to maintain design operating temperatures.
- Equipment overheating risks: Electrical systems (transformers, switchgear), instrumentation, and control systems may be exposed to higher thermal stress, increasing failure risk if not designed for future temperature extremes.
- Worker health and safety: Rising temperatures will increase heat stress risk for workers during construction and routine maintenance activities, potentially reducing productivity and increasing occupational health risks.
- Fire risk: Hotter and drier periods may increase the likelihood of vegetation fires or industrial fires in the surrounding industrial area, which can affect onsite safety and air intake systems.

These risks can largely be mitigated through climate-resilient equipment selection, thermal design margins, passive heat shielding, cooling optimisation, heat stress protocols for workers, and emergency response planning.

Precipitation

Projected trends indicate that rainfall totals are uncertain (low confidence), but extreme rainfall days are likely to increase, with high confidence in observed trends and likely increases in intensity in future.

This presents risks for the CCPP related to flooding, erosion, stormwater management, and operational disruption:

- Stormwater system overload: Increased intensity rainfall could exceed the design capacity of stormwater drainage infrastructure, resulting in pooling, inundation of low-lying infrastructure, or water ingress into buildings and electrical enclosures.
- Foundation and structural risk: Prolonged saturation, runoff concentration, and erosion could compromise foundations or structural integrity of heavy equipment platforms if not adequately engineered.
- Access disruption: Extreme rainfall may damage access roads and limit vehicle movement, affecting O&M activities.
- Electrical hazards: Substation equipment, transformers and switchgear are particularly vulnerable to flooding or standing water, requiring effective drainage and elevation design.

These risks are best addressed through conservative stormwater design, elevation of sensitive equipment, flood routing controls, erosion stabilisation, redundancy in drainage capacity, and emergency protocols for severe weather events.

Drought

Drought risk is projected to increase, though confidence varies across time horizons, with a general trend toward more frequent drought conditions under climate change. Even though CCPPs are not as water intensive as traditional coal plants, approximately 772 000 kilolitres of water is still required per year for cooling system support, water treatment, cleaning, and fire response.

Key vulnerabilities include:

- Reduced municipal reliability: Extended droughts may strain municipal supply in uMhlathuze, affecting operational reliability, emergency response capacity and supply prioritisation.
- Higher cooling demands during drought periods: Hotter conditions and drought periods are likely to coincide, increasing cooling demand while water availability may decline.
- Fire suppression requirements: Drier conditions increase fire risk while placing pressure on water supply systems.

Mitigation includes ensuring adequate water storage resilience, water-efficient operational design, drought response planning, and coordination with municipal service providers.

Coastal Impacts

Sea level rise is projected to increase (+10-40 cm by 2050; approximately 1 m by 2100)[105].[105] While the CCPP itself is not located directly on the coastline, the Project remains exposed indirectly through its reliance on Richards Bay port infrastructure and coastal storm conditions affecting:

- LNG import scheduling and terminal reliability;
- port access and infrastructure integrity;
- gas supply consistency to the ZET distribution system.

This creates a supply-side climate vulnerability, particularly during major storm events or compound coastal flooding conditions affecting port operations.

7.2.2 Value chain

The Project's value chain includes upstream dependencies (fuel supply and gas delivery infrastructure), on-site generation and operations, and downstream grid delivery and offtake dynamics.

7.2.2.1 Upstream Value Chain

Upstream, the Project depends on LNG import and regasification infrastructure at Richards Bay, particularly the proposed ZET LNG terminal and associated gas distribution network that is expected to supply local gas consumers. The ability of the CCPP to operate as intended will depend on the timing, throughput and reliability of LNG import capacity, regasification performance, and gas distribution pipeline connectivity between the ZET supply take-off point and the CCPP site. The key upstream climate risks are summarised in Table 16.

Table 16: Climate change impacts on the upstream value chain of the proposed 750MW CCGT Project

Item	Possible climate change impacts
Fuel supply (LNG Import and regasification at Port)	- Coastal storms and storm surges may disrupt shipping, port offloading, and terminal operations, delaying LNG deliveries and affecting fuel availability. - Sea level rise amplifies storm surge impacts and could increase infrastructure exposure, raising operating costs and requiring climate adaptation at the terminal. - High winds and heavy rainfall events may disrupt port activity, delay vessels, and constrain logistics during extreme events.
Gas distribution infrastructure (pipeline and take-off point)	- Increased rainfall intensity may increase erosion, undermine pipeline supports, and contribute to corrosion risks through persistent wet conditions. - Flooding events may disrupt inspection, maintenance access, and management. - Higher temperatures may increase thermal stress on pipeline materials and control systems.
Water supply	- The CCPP will use municipal water primarily for process, cooling, emergency fire-system and general potable use. - Water for the plant will be supplied via bulk municipal/industrial water infrastructure, with the Applicant engaging uMngeni-uThukela Water (UUW) to confirm and secure supply. - The plant design includes a freshwater storage reservoir with ~50,000 m³ capacity (approximately two days storage), which will: • Provide operational buffer/storage • Supply fire water requirements *Drought conditions* The uMhlathuze Local Municipality is classified as a region with low to medium water stress and has previously experienced periods of drought,

Item	Possible climate change impacts
	during which Level 4 water restrictions were imposed. While future drought conditions may place additional pressure on local water resources, the proposed CCPP is not considered to be a water-intensive operation.
Transport	LNG will be delivered to the proposed ZET LNG terminal at the Port. *Increased rainfall and flooding events* Extreme rainfall events may result in damage and disruption of the roads in the area, causing potholes and increased maintenance requirements, potentially impacting the delivery of LNG. In addition, LNG storage infrastructure and equipment may be at greater risk of inundation, leading to product damage, access delays and disruptions in site operations.

7.2.2.2 Downstream Value Chain

Downstream, the Project's primary output is electricity delivered into the gird. As a dispatchable facility, the CCPP is expected to support grid reliability, provide flexible generation capacity, and complement periods of reduced renewable output.

Table 17: Climate change impacts on the downstream value chain of the proposed 750MW CCGT Project

Item	Aspects affected by the impacts of climate change
Grid stability risk from extreme events	*Extreme weather events* Flooding, storms, and heatwaves may damage transmission infrastructure or create operational constraints on grid dispatch.
Heat-driven electricity demand spikes	*Increasing temperatures* Increased very hot days may increase peak load requirements, placing additional demand on dispatchable generation.
Road access for maintenance and services	*Extreme weather events* Extreme rainfall or storms can delay access for transmission maintenance and repairs.

7.2.3 Broader social context

The uMhlathuze Local Municipality demonstrates relatively low socio-economic vulnerability at a provincial scale, reflecting a well-established industrial base and access to services. However, this does not fully reflect underlying economic and infrastructure pressures that are relevant to climate risk.

Richards Bay functions as a key industrial and logistics hub, with economic activity driven by manufacturing, mining, port operations, and associated infrastructure[118]. This concentration of industrial activity increases systemic exposure to climate hazards, particularly where infrastructure

[118] KwaZulu-Natal Top Business, 2026. *City of uMhlathuze, Vision into Action. A provincial Priority.* Available here

(e.g., transport networks, water supply systems, and energy distribution) may be disrupted by extreme weather events.

While bulk services such as water and electricity are generally available, growing population and industrial demand place pressure on existing infrastructure, potentially constraining adaptive capacity under future climate stressors such as drought, flooding, and extreme heat. The presence of both municipal and Eskom-supplied electricity further reflects a complex service environment, where disruptions may have cascading effects across sectors.

The region also faces economic vulnerability, including relatively high unemployment and reliance on industrial activity.[119] This may reduce resilience to climate-related disruptions, particularly where extreme events impact employment, supply chains, or industrial productivity.

From a climate perspective, coastal processes and extreme weather events are key regional risk drivers. Richards Bay is exposed to:

- Flooding and storm events, which may affect low-lying and industrial areas;
- Coastal erosion and storm surge, particularly along the northern coastline;
- Infrastructure disruption risks, including impacts to transport corridors and port operations.

These factors highlight that, while the municipality has a relatively strong economic base, its dependence on infrastructure and industrial systems introduces climate vulnerability pathways that are relevant to the Project.

7.2.4 Broader environmental context

The Project is located within an established industrial landscape in the RBIDZ, aligned with heavy industrial zoning and existing infrastructure corridors. However, several environmental receptors remain relevant to climate risk, particularly wetlands, surface water systems, and coastal/estuarine processes associated with Richards Bay.

Projected climate change is expected to increase pressure on these systems through more intense rainfall events, increased flood frequency, prolonged dry periods, and sea level rise. These changes may result in enhanced erosion, flooding, and pollutant mobilisation, altered wetland function and ecological service delivery, reduced ecological resilience during drought conditions, and longer-term shifts in estuarine and coastal dynamics.

7.2.4.1 Climate and Weather Conditions

The region experiences a temperate subtropical climate characterised by warm to hot, humid summers and mild winters, with average summer maximum temperatures exceeding 28°C. The

[119] City of uMhlathuze Sustainable Development Goals (SDGs) Voluntary Local Review (VRL): Baseline Report, Version 2, 2025. Available here

coastal location adjacent to the Indian Ocean moderates temperature variability but contributes to consistently high humidity and exposure to coastal weather systems, such as coastal lows and cold fronts.

This baseline climate increases the sensitivity of the receiving environment to climate change, particularly in relation to intensified rainfall, flooding, and increasing thermal stress.

7.2.4.2 Water Resources and Wetlands

Water resources, wetlands, and associated ecosystems are critical components of the receiving environment and are closely linked to climate risk. The uMhlathuze Municipality contains ecologically significant systems, including freshwater wetlands, coastal lakes and pans, coastal forests, and major river systems such as the Mhlathuze and Nsezi Rivers.[120] The Project site is located within a Priority Focus Area in terms of the National Protected Area Expansion Strategy (NPAES).[121]

Within the RBIDZ Phase 1F, several wetlands were historically infilled to enable industrial development, although some systems have been retained. Of relevance to the Project, the on-site wetland has been partially infilled, while a conserved wetland (remainder of Wetland B) persists approximately 500 m to the south-west.[122] The site forms part of a broader hydrological system connected to Richards Bay Harbour, integrating surface water, estuarine, and coastal processes.

These systems continue to provide important ecological functions, including flood attenuation, water quality regulation, and carbon sequestration, although their capacity may be constrained by historical modification and increasing abstraction pressures. Climate change is expected to increase pressure through intensified runoff and flooding, altered freshwater inflows, and increased water stress during drought periods, potentially reducing ecological function and increasing downstream risks. Stormwater management and protection of downstream water resources will therefore be key considerations, to be informed by specialist studies and detailed design.

7.2.4.3 Land Use, Air Quality and Environmental Management

The RBIDZ is characterised by predominantly industrial land use, with significant transformation resulting from historical and ongoing industrial, agricultural, and urban development. This has created a modified landscape with reduced natural buffering capacity and an existing air quality environment influenced by industrial emissions.

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120 City of uMhlathuze, 2022. *Fifth Generation Spatial Development Framework 2022/2023–2026/2027*. [pdf] City of uMhlathuze. Available here

121 National Protected Area Expansion Strategy for South Africa, 2018. Available here

122 Scoping Report, March 2026: Proposed 750MW Combined Cycle Gas Turbine Power Plant in Richards Bay, City of uMhlathuze Local Municipality, King Cetshwayo District Municipality, KwaZulu Natal. Nemai Consulting (Pty) Ltd.

While air quality is actively managed, it remains potentially sensitive, particularly under changing climate conditions. Climate change may influence this environment through increasing temperatures, which can enhance the formation of certain pollutants, as well as through changes in atmospheric dispersion patterns that may affect pollutant concentrations. In addition, the concentration of industrial activity increases the risk of pollutant mobilisation during extreme rainfall events and places reliance on engineered systems such as stormwater infrastructure, which may be vulnerable to exceedance under future climate conditions.

Environmental management in the region is guided by established frameworks, including EA processes and biodiversity offset guidelines.[123] These provide a basis for managing impacts, but their effectiveness will depend on the extent to which climate resilience is incorporated into design and implementation. Measures such as emission control technologies, continuous air quality monitoring, stormwater management, and rehabilitation with indigenous species will remain important to ensure compliance, manage cumulative impacts, and enhance resilience to flooding, erosion, and ecological stress under future climate conditions.

7.2.5 Summary

The following table provides an overview of the potential climate change impacts that may affect the resilience of the proposed Project. This summary serves to highlight the areas of vulnerability and inform the identification of appropriate adaptation and risk management measures throughout the Project's lifecycle.

Table 18: Summary of the potential climate change impacts on the resilience of the proposed 750MW CCGT Project

Operational component	Climate risk	Potential impacts
Core operations	Increased temperatures	- Heat stress on equipment - Fugitive emissions - Material fatigue
	Increased rainfall/ flooding	- Overwhelmed stormwater systems - Site access delays - Structural damage
	Drought	- Strain on municipal supply - Impaired cooling/emergency systems
Value Chain	Increased rainfall (flooding)	- Pipeline corrosion - Road damage - Delivery delays
	Storm surges	- Port operations disruption
	Extreme weather events	- Transport route disruption - Increased insurance and adaptation costs
Social environment	Extreme weather evens	- Water stress for communities - Public health risks

[123] Daniels, S. L., and Vand Der Merwe, D., 2022. Scientific Terrestrial Services, 2022. Terrestrial Assessment for the Proposed Phase 1F Development of the Richard's Bay Industrial Development Zone (RBIDZ). Available here

Operational component	Climate risk	Potential impacts
		- Service delivery pressure
Natural environment	Extreme weather events	- Coastal erosion - Wetland degradation - Habitat loss
	Drought	- Reduced ecological function - Wetland carbon sequestration loss

7.2.6 Project vulnerability assessment

The vulnerability of the Project to different physical risks associated with projected climate changes was determined using the SANS: Risk management - Risk assessment techniques SANS 31010:2010 and IEC/ISO 31010:2009 Probability-Consequences (Impacts) matrix, and considered a conservative, near worst-case scenario.

The assessment shown in Figure 21 based on a timeline up to 2050. The risks of rainfall changes and rainfall intensity are difficult to predict, being stochastic in nature, and with inherent uncertainty in future projections for these. If they do occur, these events could pose the most significant impacts on the Project. Mitigating these will largely depend on the adaptive capacity of the Project and its proponent, as well as important stakeholders.

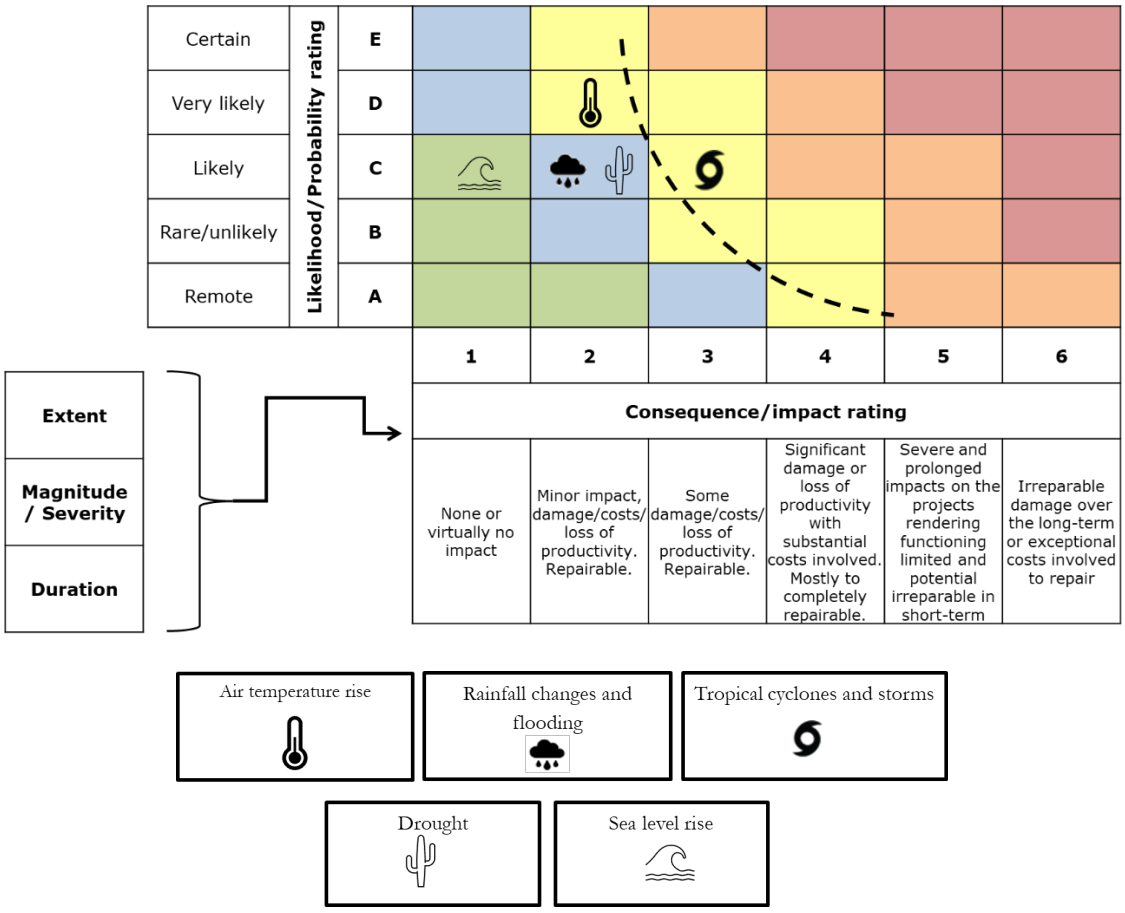


Figure 21: The proposed 750MW CCPP Project vulnerability assessment outcome

The assessment indicates that the CCPP Project is exposed to the following vulnerabilities:

1. *Air temperature rise and extreme temperatures:* Temperature increases averaged across the district in the near-future are virtually certain and may be as high as 1.5 °C. Under a low mitigation scenario, further temperature increases are virtually certain and may approach 2.5 °C in the mid-future and 4.0 °C in the far-future. Increases in average temperature will be accompanied by increases in warm temperature extremes such as heatwaves and high fire danger days (virtually certain). Elevated ambient temperatures may impact worker health and safety, reduce labour productivity, and increase the cooling load for sensitive equipment. The overall risk is considered moderate, as the anticipated temperature increases are incremental and can be managed through standard occupational health and site design measures.
2. *Rainfall changes and rainfall intensity:* intense rainfall events are projected to become more frequent (high confidence), even where the direction of change in total annual rainfall remains uncertain. Heavy rains could affect key operational processes (e.g., loading/unloading, maintenance of equipment) as well as storage (flooding of terminals). Extreme rainfall events may temporarily overwhelm stormwater infrastructure, resulting in short-term inundation of low-lying areas and potential impacts on electrical and ancillary infrastructure. These risks are moderate, with impacts likely to be short-term and repairable, although they could affect insurance costs and contingency planning.
3. *Sea level rise:* The proposed CCPP is to be located inland and is not expected to be directly impacted by sea level rise over its operational life. However, reliance on the Port of Richards Bay introduces indirect exposure. Long-term sea level rise may amplify storm surges during extreme weather events, potentially affecting port operations and LNG delivery schedules. The risk to the project site is low, but upstream dependencies warrant consideration in resilience planning.
4. *Tropical cyclones and storms:* the likelihood of HILP events are difficult to determine due to the stochastic nature of these extreme events. Though the probability of occurrence is low, the potential consequences are high. Business continuity planning and structural resilience measures are necessary to mitigate these risks, particularly for port and transport infrastructure dependencies.
5. *Water stress and drought:* The Project is not a water-intensive facility, but some processes, such as vapouriser cooling, cleaning, and fire suppression, require reliable water access. Drought and increased evaporation may stress municipal supply systems. The overall water risk is low, but resilience planning should account for extended dry periods.

The vulnerabilities identified for the Project are not isolated; they often interact in ways that can amplify overall risk. For example, increased temperatures can exacerbate water stress, as higher evaporation rates reduce water availability, potentially impacting both cooling processes and employee health. Similarly, sea level rise, while a long-term concern, can magnify the effects of storm surges and coastal flooding during extreme weather events like tropical cyclones. These events can damage critical infrastructure, disrupt supply chains, and strain the Project's operational resilience.

8 Project Mitigation and Adaptation Recommendations

In line with international best practice, including the principles set out in IFC Performance Standard 1[124], climate change mitigation and adaptation considerations should be integrated into the design, construction, and operation of the proposed CCPP.

The measures outlined below are non-binding recommendations intended to support informed decision-making and the progressive management of climate-related risks and impacts. They do not constitute proposed conditions of authorisation and would be subject to technical feasibility, operational requirements, and commercial considerations.

8.1 Non-Binding mitigation measures to reduce the impact of the project on climate change

The following measures are aimed at limiting the Project's emissions within the scope of influence of a gas-fired CCPP, with emphasis on operational efficiency and good construction practice:

1. Optimise plant efficiency through combined cycle operation, appropriate turbine selection, and operational controls to minimise fuel use and emissions per unit of electricity generated.
2. Implement energy-efficient design and equipment selection for auxiliary systems, including motors, pumps, compressors, and lighting, to reduce indirect electricity demand during operation.
3. Apply good practice construction management measures to limit emissions during construction, including efficient equipment use, minimisation of idling, and consolidation of material deliveries where feasible.
4. Maintain regular inspection, maintenance, and performance optimisation of turbines, heat recovery systems, and auxiliary equipment to ensure sustained operational efficiency and minimise emissions over the plant lifecycle.
5. Implement leak detection and repair (LDAR) programmes to identify and minimise fugitive methane emissions from gas handling and associated infrastructure.
6. Prioritise local or regional sourcing of bulk construction materials, where practicable, to reduce transport-related emissions and support regional economic activity.
7. Maintain transparent monitoring and reporting of operational emissions, to support ongoing emissions management and regulatory reporting requirements.

[124] International Finance Corporation, 2012, Policies and Standards - *Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts* (2012), IFC [Website] Available here

8.2 Non-binding adaptation measures to increase the Project's resilience to climate change

The following measures are recommended to enhance the Project's resilience to identified physical climate risks, including extreme rainfall, flooding, coastal climatic influences, and heat stress, as described in Section 7 of the CCIA:

1. Incorporate climate change considerations into site layout and detailed design, ensuring that critical infrastructure is positioned on suitably elevated and engineered platforms within the relatively flat coastal plain. Site grading should account for low relief (±40–43 m above mean sea level) and minimise localised ponding and flood risk.
2. Design stormwater systems to integrate with existing RBIDZ infrastructure, including the stormwater canal along the western boundary of the site. Systems should be sized to accommodate increased rainfall intensity and ensure controlled discharge without overloading downstream channels.
3. Although no rivers traverse the site, runoff is conveyed via the stormwater canal to downstream watercourses. Design measures should therefore ensure attenuation, flow control, and water quality management to prevent increased flooding or erosion risks downstream under extreme rainfall events.
4. Given the flat topography and expected increase in runoff due to hard surfaces, the implementation of erosion control and flow dissipation measures (e.g. attenuation ponds, swales, energy breakers) to maintain pre-development hydrological conditions and avoid sediment transport, should be considered.
5. Select materials and equipment suitable for high humidity (~80%), saline air influence, and moderate coastal wind regimes. Corrosion-resistant materials and protective coatings should be prioritised to maintain plant integrity and reduce lifecycle maintenance risks.
6. Confirm availability and reliability of bulk water services for plant operations and auxiliary uses, and incorporate water efficiency and reuse measures where feasible, recognising dependence on regional infrastructure and potential climate-related supply variability.
7. Integrate climate-related risks (e.g., intense rainfall, flooding, heatwaves, infrastructure failure) into emergency preparedness and response planning, ensuring that response systems remain functional under extreme conditions and align with plant safety requirements.
8. Engage with RBIDZ management and relevant authorities to ensure alignment of stormwater management, infrastructure resilience, and emergency response systems across the broader industrial zone.

9 NEEDS AND DESIRABILITY ASSESSMENT

Table 19 presents the Needs and Desirability Assessment undertaken for the Project, in alignment with the evaluation criteria set out in section 5.1.

Table 19: Needs and Desirability Assessment Outcome

Criterion	Project alignment with Evaluation Approach
Global Climate Change Contribution	The GHG inventory for the proposed Project was developed in accordance with the ISO 14064-2:2019 and informed by ISO 14067:2018, covering emissions associated with the construction, operational and decommissioning phases. The inventory uses two GWP time horizons to assess emissions: • The **100-year GWP**, which is the standard baseline for national and international reporting, including under the IPCC, UNFCCC, and most carbon pricing and disclosure frameworks. This aligns with how South Africa and other countries quantify their official GHG inventories and emissions reduction targets. • The **20-year GWP** is included to provide the Project's near-term climate impact, particularly the short-lived but intense warming effect of methane (CH_4). Although not formally applicable for policy purposes, it offers decision-makers insight into the time-sensitive dimensions of climate risk. **Construction and Decommissioning Phase Emissions** Construction-related GHG emissions are estimated at: • 360 107 tCO_2e (100-year GWP) and 431 607 tCO_2e (20-year GWP) for both the Angola and United States of America natural gas supply scenarios. These emissions arise primarily from the manufacture and transport of construction materials, construction activities and end-of-life dismantling. **Operational Phase Emissions** • **Angola supply scenario:** - 100-year GWP: ~ 3 692 084 tCO_2e/year, totalling ~92.3 million tCO_2e over the 25-year Project life. - 20-year GWP: ~ 4 602 024 tCO_2e/year, totalling ~115.1 million tCO_2e over the 25-year Project life. • **United States of America supply scenario:** - 100-year GWP: ~ 3 631 248 tCO_2e/year, totalling ~90.8 million tCO_2e over the plant's lifetime. - 20-year GWP: ~ 4 236 680 tCO_2e/year, totalling ~105.9 million tCO_2e. **Potential Avoided Emissions** Electricity generated by the proposed Project will be dispatched to the national grid in accordance with system requirements. As dispatch outcomes depend on system demand, plant availability, fuel prices and network constraints, no assumption is made that the Project will directly replace coal-fired generation. A scenario-based assessment was undertaken to illustrate potential system-level outcomes under defined assumptions. Two illustrative scenarios were considered:

Criterion	Project alignment with Evaluation Approach
	Coal displacement scenario, in which electricity generated by the CCPP displaces coal-fired electricity on an equivalent energy basis. • Increased renewable energy scenario, in which dispatchable gas-fired generation supports higher renewable penetration and results in additional coal displacement. Under the coal displacement scenario, potential avoided emissions are estimated at: • Angola supply scenario: ~ 2 420 665 tCO_2e/year (~60.5 million tCO_2e over 25 years). • United States supply scenario: ~ 2 476 667 tCO_2e/year (~61.9 million tCO_2e over 25 years). Under the increased renewable energy support scenario, potential avoided emissions are estimated at: • Both supply scenarios: ~ 8 760 919 tCO_2e /year (~219 million tCO_2e over the Project life). These values represent conditional, scenario-based outcomes and do not constitute guaranteed or directly attributable emission reductions. Although the Project's emissions represent less than 0.1% of global GHG emissions, they are material in a national context and require appropriate mitigation and management measures, as outlined in Section 8. While gas-fired generation provides dispatchable capacity and supports grid stability as part of South Africa's transition pathway, its emissions contribute to the cumulative atmospheric GHG burden and must be actively managed over the Project lifecycle.
Policy Alignment	**National policy**
	• **NEMA:** NEMA provides the overarching framework for environmental decision-making and requires that development be socially, environmentally and economically sustainable. In the context of this Project, it requires integrated consideration of climate-related, cumulative and other environmental impacts, together with appropriate mitigation and management measures. The CCIA supports this process by assessing the Project's emissions, climate risks, and mitigation and adaptation responses. • **National Climate Change Response Policy (2011):** The White Paper sets out South Africa's approach to mitigation and adaptation in support of a climate-resilient, lower-carbon economy. The Project recognises the need to address emissions while also taking account of energy security, economic development and social priorities. In this context, the Project is not itself a mitigation measure, but the CCIA is consistent with the White Paper's approach by quantifying emissions, considering cumulative climate impacts, and assessing physical climate risks.

Criterion	Project alignment with Evaluation Approach
	• **IRP (2025):** The IRP 2025 is the current national electricity generation planning framework and recognises the continued role of dispatchable and flexible generation capacity in maintaining system adequacy and reliability during the energy transition. In this context, the proposed CCPP is consistent with the IRP's recognition of gas-fired generation as a transitional technology that can support grid stability and complement variable renewable energy. This consistency is contextual rather than absolute, as the Project's contribution to supply security must still be weighed against its material GHG emissions and the risk of long-term carbon lock-in. • **Second Nationally Determined Contribution (2025):** The second NDC sets South Africa's national mitigation and adaptation commitment under the Paris Agreement and is relevant because it establishes the broader national emissions trajectory within which the Project must be assessed. The Project is not a designated mitigation action and does not directly advance the NDC's emissions reduction ambition. Its relevance is that its emissions add to the national inventory and must therefore be transparently quantified and considered in relation to South Africa's climate commitments and long-term decarbonisation objectives. • **Just Transition Framework (2022):** The Just Transition Framework provides the national framework for a transition to a low-carbon and climate-resilient economy in a manner that is fair and development-oriented. In this regard, the Project must be considered not only in terms of technical need, but also in terms of its implications for long-term transition pathways, regional development and resilience. In this context, the Project may support near to medium-term electricity reliability and economic activity, but its consistency with a just transition is conditional, given that gas is a transitional fossil fuel and the Project may contribute to carbon lock-in if not carefully managed. • **Climate Change Act (2024):** This Act establishes the legislative framework for South Africa's climate response and just transition to a low-carbon and climate-resilient economy. It reinforces the need to assess both GHG implications and climate-related risks, and to situate project-level decision-making within broader national climate objectives. The CCIA therefore responds to this framework by assessing both mitigation and adaptation considerations. • **Draft Gas Master Plan (2024)** The Plan provides draft policy direction for the development of South Africa's gas sector, including gas supply, infrastructure and downstream demand. It recognises the potential role of gas in the energy mix and in gas-to-power development. The Project is broadly consistent with this draft policy direction insofar as it would use imported LNG to provide dispatchable generation capacity, although the document remains a draft and should not be treated as determinative on its own.

Criterion	Project alignment with Evaluation Approach
	• **Proposed Gas Sector Roadmap to 2050 (NERSA, 2025):** NERSA's gas strategy work provides a sectoral perspective on gas as a transitional energy source that can support energy security and system flexibility alongside increasing renewable energy. It supports the broader strategic rationale for gas-to-power infrastructure in suitable locations such as Richards Bay. However, it is more appropriately treated as contextual strategy material rather than binding national policy.
	Provincial Policy
	• **KwaZulu-Natal's Strategy for a Green Economy (2012)** The Strategy promotes sustainable economic growth, resource-efficient infrastructure and job creation, while recognising the need to manage environmental and climate-related risks. The Project is broadly consistent with these objectives through its contribution to electricity supply reliability within an established industrial area and through the incorporation of efficiency and climate risk considerations. • **KwaZulu-Natal Draft Spatial Development Framework (2021)** The provincial spatial framework promotes the concentration of development within existing nodes and serviced areas and seeks to guide land use away from unsuitable or sensitive areas. The Project is consistent with this spatial direction through its location in the Alton industrial area adjacent to the RBIDZ, with access to existing infrastructure and transport corridors. • **KwaZulu-Natal Provincial Growth and Development Strategy (PGDS, 2016)** The PGDS prioritises inclusive economic growth, infrastructure investment, employment creation and environmental sustainability, and recognises reliable infrastructure as a key enabler of provincial development and competitiveness. The Project is broadly consistent with these priorities through its contribution to electricity supply reliability in a strategic industrial region, subject to environmental safeguards and impact management through the EIA process. • **KwaZulu-Natal 2035 Provincial Growth and Development Strategy (2016)** The province's long-term development framework to 2035 emphasises resilient infrastructure and economic competitiveness. The Project provides dispatchable generation capacity within a major industrial node and by requiring design and operational planning that responds to climate-related hazards over the Project life. • **KwaZulu-Natal Systemic Conservation Plan (2012)** This biodiversity planning framework identifies CBAs and ecological support areas needed to meet provincial conservation targets. The Project's consistency with this framework is conditional, as the site overlaps mapped sensitive areas, while also being described as degraded and transformed. Alignment therefore depends on applying the mitigation hierarchy, confirming sensitivities through specialist

Criterion	Project alignment with Evaluation Approach
	studies, and ensuring residual impacts are acceptable in relation to provincial biodiversity objectives. • **KwaZulu-Natal Provincial Norms and Standards for Climate Change and Energy Efficiency in Land Use Management (2020)** This framework promotes climate-responsive land use planning, consideration of future climate hazards and improved energy efficiency. The Project is broadly consistent with this approach through climate-informed design and risk management measures, including flood, stormwater and heat resilience considerations, and through the use of combined-cycle technology, which is more efficient than simple-cycle alternatives.
	Municipal Policy
	• **uMhlathuze Local Economic Development Strategy Review: Economic Transformation and Job Creation Roadmap (2022)** This strategy emphasises infrastructure-led growth, industrial development and job creation. This Project is broadly consistent with these priorities through its contribution to electricity supply reliability in a major industrial and port-linked economy, and through construction and operation-phase employment and local procurement, subject to environmental constraints and mitigation measures identified through the EIA process. • **uMhlathuze Integrated Development Plan (IDP) 2022-2027** The IDP prioritises economic development, infrastructure investment and climate-responsive service delivery. The Project is broadly consistent with these objectives through its location in an established industrial area, its contribution to electricity supply security, and the incorporation of measures to manage climate-related risks such as flooding, drought and heat. • **uMhlathuze Adaptation Action Plan (2024)** The Adaptation Action Plan identifies increasing risks from extreme rainfall, flooding and heat, including risks affecting strategic economic and industrial areas. The Project broadly aligns with this plan through the inclusion of climate risk considerations in design and operation, including stormwater management, protection of critical infrastructure and emergency preparedness, while recognising that regional climatic hazards may also affect operational reliability and associated fuel supply chains. • **uMhlathuze Sustainable Development Goals (2024)** The municipality's 2024 SDG reporting framework promotes sustainable infrastructure, inclusive economic development and climate action. The Project aligns with these objectives through certain aspects such as infrastructure investment, employment creation, and the assessment of climate risks and emissions in this CCIA, while recognising that gas-fired generation is transitional and requires ongoing emissions management.

Criterion	Project alignment with Evaluation Approach
	• **uMhlathuze Municipality 5th Generation Spatial Development Framework (SDF) 2022/2023 - 2026/2027 Final (2022)** This framework directs investment toward existing industrial and development nodes, including areas associated with the IDZ and port-industrial activity. The Project reflects this spatial direction through its location in the Alton industrial area adjacent to the IDZ. However, consistency with municipal spatial objectives remains conditional, as mapped biodiversity sensitivities occur in the broader area and the Project footprint overlaps mapped CBA areas. Alignment therefore depends on applying the mitigation hierarchy and appropriately managing biodiversity and watercourse-related sensitivities through specialist studies and design refinement.
Project Specific Context	The proposed 750 MW LNG-to-power CCPP is located within Phase 1F of the Richards Bay IDZ, in an established industrial and port-linked area with access to existing bulk infrastructure and functionally linked fuel supply and grid connection corridors. In this context, the Project is assessed as a dispatchable electricity generation facility intended to bid into the GASIPPPP and/or other suitable energy markets, rather than as a standalone response to national energy or climate policy. Its primary function is to provide flexible generation capacity to support grid reliability and complement variable renewable energy, and this functional role is relevant when considering project-level need, alternatives and technology choice. At the same time, the site is not unconstrained: the broader area includes mapped biodiversity sensitivities, and the Project is in a climatic setting exposed to increasing temperatures, high rainfall, more frequent extreme rainfall events and HILP events. These factors do not preclude development, but they do mean that the Project must be considered in light of both its industrial-location advantages and its environmental and climate-related constraints, which are addressed through the EIA process and this CCIA.
Best Available Technology	• **Best Available Technology: Base Load** The proposed CCPP applies best available technology for utility-scale, dispatchable gas-fired electricity generation through a combined cycle configuration, in which electricity is generated by gas turbines and waste heat is recovered via heat recovery steam generators to drive a steam turbine, improving overall thermal efficiency. This configuration is more efficient and less emissions-intensive per unit of electricity generated than simple-cycle gas turbine alternatives and conventional coal-fired generation. The plant is also designed to operate flexibly in both simple-cycle and combined-cycle modes to support grid stability and complement variable renewable energy. The use of modern heavy-duty gas turbine technology and dry low-NOx combustion systems further supports reliable, efficient operation with lower local pollutant emissions.

10 Opinions and Recommendations of the Project

Based on the findings of this CCIA, the following professional opinions are provided in relation to the proposed LNG CCPP. These opinions consider the Project's exposure to climate-related physical risks, its quantified GHG emissions, and its relevance to the applicable national, provincial and municipal climate and energy policy context.

10.1 Climate-related physical risks and site context

The proposed CCPP is located within an established industrial area in Richards Bay, where the main climate-related risks include increasing temperatures, extreme rainfall, localised flooding, and disruption to upstream infrastructure and logistics during severe storm events. The Project site is not expected to be directly affected by sea-level rise over its operational life, although indirect exposure remains relevant through reliance on port and fuel-supply infrastructure. HILP events, including severe coastal storms, cut-off low systems with subtropical characteristics, and tropical cyclones, are also relevant in the regional context and may have disproportionate consequences despite their low probability.

These risks are not considered, in themselves, to preclude the proposed development. The climate-related findings of this CCIA should, however, inform detailed design and operational resilience planning, particularly in relation to flood management, stormwater design, structural resilience, emergency preparedness, and business continuity for upstream supply-chain disruption.

10.2 Contribution to climate change

The proposed Project will result in a net increase in GHG emissions relative to the baseline and will make a cumulative contribution to atmospheric GHG concentrations over its life cycle. Although the selected combined cycle configuration is more efficient and less emissions-intensive per unit of electricity generated than simple-cycle gas turbines and conventional coal-fired generation, the Project remains a fossil-fuel-based development. The CCIA finds that the Project's contribution is relatively small, but not insignificant, in national terms.

The avoided-emissions scenarios included in the CCIA are illustrative and do not demonstrate guaranteed or directly attributable emission reductions. The Project's GHG emissions therefore remain a material consideration for decision-making.

10.3 Alignment with energy and climate policy

The proposed Project is relevant to the current electricity planning and procurement context in South Africa, including the procurement context for dispatchable gas-fired generation. However, the CCIA makes clear that this context is relevant, but not determinative. Alignment with planning or procurement instruments does not, in itself, predetermine whether EA should be granted. That determination remains dependent on the competent authority's consideration of the Project's

impacts, alternatives, GHG emissions, cumulative effects, and broader environmental acceptability in terms of NEMA.

Accordingly, it is the opinion of the CCIA specialists that there are no climate-related reasons, arising from this assessment alone, to oppose Environmental Authorisation for the proposed Richards Bay CCPP and associated infrastructure. The Project is considered suitable for consideration within the IDZ context, taking into account its role as dispatchable generation, its assessed physical climate risks, and its quantified contribution to global emissions.

ANNEXURE A

Table 20: Emission factors and Assumptions for GHG Inventory

Activity	Value	Unit	Source
SCOPE 1 - EMISSION FACTORS			
100 Year GWP			
Stationary Combustion of Diesel	0.002658	tCO_2e/Litre	Calculated by Promethium Carbon
Mobile Combustion of Diesel	0.002954	tCO_2e/Litre	Calculated by Promethium Carbon
Stationary Combustion of Diesel	0.0000355	TJ/Litre	Converted MJ/Litre to TJ/Litre
Stationary Combustion of Diesel	74 885	$kgCO_2e$/TJ	Calculated by Promethium Carbon
Stationary Combustion of Diesel	74 638	$kgCO_2$/TJ	South African Methodological Guidelines-2022 Annexure A
Stationary Combustion of Diesel	3	$kgCH_4$/TJ	South African Methodological Guidelines-2022 Annexure A
Stationary Combustion of Diesel	0.6	kgN_2O/TJ	South African Methodological Guidelines-2022 Annexure A
Mobile Combustion of Diesel	74 638	$kgCO_2$/TJ	South African Methodological Guidelines-2022 Annexure A
Mobile Combustion of Diesel	4.15	$kgCH_4$/TJ	South African Methodological Guidelines-2022 Annexure A
Mobile Combustion of Diesel	28.6	kgN_2O/TJ	South African Methodological Guidelines-2022 Annexure A
Stationary Combustion Natural Gas	56 153	$kgCO_2e$/TJ	Calculated by Promethium Carbon
Stationary Combustion Natural Gas	56 100	$kgCO_2$/TJ	South African Methodological Guidelines-2022 Annexure A
Stationary Combustion Natural Gas	1	$kgCH_4$/TJ	South African Methodological Guidelines-2022 Annexure A
Stationary Combustion Natural Gas	0.1	kgN_2O/TJ	South African Methodological Guidelines-2022 Annexure A
20 Year GWP			
Stationary Combustion of Diesel	0.00266	tCO_2e/Litre	Calculated by Promethium Carbon
Mobile Combustion of Diesel	0.00294	tCO_2e/Litre	Calculated by Promethium Carbon
Stationary Combustion of Diesel	74 989	TJ/Litre	Converted MJ/Litre to TJ/Litre
Stationary Combustion of Diesel	74 638	$kgCO_2e$/TJ	Calculated by Promethium Carbon
Stationary Combustion of Diesel	3	$kgCO_2$/TJ	South African Methodological Guidelines-2022 Annexure A
Stationary Combustion of Diesel	0.6	$kgCH_4$/TJ	South African Methodological Guidelines-2022 Annexure A
Stationary Combustion of Diesel	74 638	kgN_2O/TJ	South African Methodological Guidelines-2022 Annexure A
Mobile Combustion of Diesel	4.15	$kgCO_2$/TJ	South African Methodological Guidelines-2022 Annexure A
Mobile Combustion of Diesel	28.6	$kgCH_4$/TJ	South African Methodological Guidelines-2022 Annexure A
Mobile Combustion of Diesel	56 190	kgN_2O/TJ	South African Methodological Guidelines-2022 Annexure A
Stationary Combustion Natural Gas	56 100	$kgCO_2e$/TJ	Calculated by Promethium Carbon
Stationary Combustion Natural Gas	1	$kgCO_2$/TJ	South African Methodological Guidelines-2022 Annexure A

Activity	Value	Unit	Source
Stationary Combustion Natural Gas	0.1	$kgCH_4/TJ$	South African Methodological Guidelines-2022 Annexure A
Stationary Combustion Natural Gas	0.00266	kgN_2O/TJ	South African Methodological Guidelines-2022 Annexure A
SCOPE 2 - EMISSION FACTORS			
Grid emission factor	0.945	tCO_2e/MWh	Calculated by Promethium Carbon
SCOPE 3 - EMISSION FACTORS			
3.1 Purchased Goods and Services			
Purchased water	0.0012	tCO_2e/Million Litre	DESNZ 2024 - "Water Supply" tab
Annual water production	1 739 225	Ml/annum	Randwater Annual Report 2024
Water tariff rate	1.95	R/kWh	Eskom Tariff-booklet Megaflex 2024
Annual Electricity cost for production of water	4 394 013	R	Randwater annual report 2024 (assumed all energy is from electricity)
Energy Consumed per ML Water Produced	0.0013	MWh/Ml	Assumed by calculation
South Africa Electricity Grid	0.9447	tCO_2e/MWh	Calculated by Promethium
Cement	0.8380	tCO_2e/tonne	PPC Cement Emissions Intensity
Steel	1.9100	tCO_2e/tonne	World Steel Association (global average) - https://worldsteel.org/sustainability/sustainability-indicators-2023-report/
3.3 FUEL AND ENERGY RELATED ACTIVITIES			
WTT – Diesel	0.0006	tCO_2e/Litre	DESNZ 2025 - "WTT - Fuels" tab: Liquid fuels, Diesel (100% mineral diesel), litres
Eskom Transmission & Distribution Losses	0.1052	tCO_2e/MWh	Calculated by Promethium Carbon in accordance with the GHG Protocol
South Africa T&D losses	0.124	%	Calculated by Promethium
3.4 UPSTREAM TRASNPORTATION & DISTRIBUTION			
Sea Freight - LNG Tanker	0.000014	tCO_2e/tonne.km	DESNZ 2025; Average LNG Tanker (WTT +Combustion)
3.7 EMPLOYEE COMMUTING			
Bus	0.0002	tCO_2e/ passenger.km	DESNZ 2025- Local bus (not London)
Average car	0.0002	tCO_2e/ passenger.km	DESNZ 2025- Average Car-Petrol
Minibus taxi	0.00002	tCO_2e/ passenger.km	Toyota Quantum specifications
Construction Phase			
Bus	50%	%	Assumption

Activity	Value	Unit	Source
Average car	10%	%	Assumption
Minibus taxi	40%	%	Assumption
Operation and Maintenance Phase			
Bus	15%	%	Assumption
Average car	75%	%	Assumption
Minibus taxi	10%	%	Assumption
CONVERSION FACTORS AND ASSUMPTIONS			
Densities			
Density of Diesel	0.826	kg/l	SA Methodological Guidelines Annexure D
Density of Petrol	0.741	kg/l	SA Methodological Guidelines Annexure D
Density of Water	1 000	l/m³	https://sengpielaudio.com/ConvDensi.htm
Density of Liquified Natural Gas	0.56	kg/l	SA Methodological Guidelines Annexure D
Emissions per unit energy	0.056	tCO_2e/GJ	Calculated by Promethium
Emissions per unit mass	2.712	$tCO_2e/tLNG$	Calculated by Promethium
Density of Steel	7 850	kg/m³	https://kg-m3.com/material/steel
Density of Cement	1 200	kg/m³	https://www.afrisam.co.za/wp-content/uploads/2021/10/2010277-AfriSam-Technical-Ref-Guide-update-2021.pdf
Calorific Values			
Diesel NCV	35.5	MJ/l	SA Methodological Guidelines Annexure D
Natural Gas NCV	48.3	MJ/kg	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Global Warming Potentials			
CO_2 - 20 Year GWP	1	$kgCO_2/kgCO_2$	South African Methodological Guidelines - Annexture G
CH_4 - 20 Year GWP	62	$kgCO_2/kgCH_4$	South African Methodological Guidelines - Annexture G
N_2O - 20 Year GWP	275	$kgCO_2/kgN_2O$	South African Methodological Guidelines - Annexture G
CO_2 - 100 Year GWP	1	$kgCO_2/kgCO_2$	South African Methodological Guidelines - Annexture G
CH_4 - 100 Year GWP	23	$kgCO_2/kgCH_4$	South African Methodological Guidelines - Annexture G
N_2O - 100 Year GWP	296	$kgCO_2/kgN_2O$	South African Methodological Guidelines - Annexture G
Days			
Average workdays per year	365	days	Provided by client
Average workdays per month	30	days	Provided by client
Average weeks worked	52	weeks	Provided by client
Other Assumptions			
Total hours in a year	8 760	hours	Calculated by Promethium

Activity	Value	Unit	Source
Seconds in a year	31 536 000	s	Calculated by Promethium
Total workhours per year	8760	hours	Calculated: 8760hours/year-((365days-336 workdays) *24hours/day
Gas Consumption	2 311	tonne/day	Calculated by Promethium
Gas Consumption	843 354	tonne/year	Calculated by Promethium
Gas Consumption	21 083 851	tonne/25 years	Calculated by Promethium
Shipping Distance: USA to Richard's Bay	18 300	km	Estimation (~18100-18500 km)
Shipping Distance: Angola to Richard's Bay	3 600	km	Estimation (~3500-3700 km)
Fugitive Emissions		Gg per 10^6 m3 of marketable gas	"2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Chapter 4, Table 4.2.5: Methane emission factor for fugitive emissions from gas operations - Gas Transmission & Storage (transmission, fugitives) for Developing country and country with economy in transition (pg 4.57).
Gas Transmission Velocity	15	m/s	Used the average of 0.000166 - 0.0011 Gg per 106 m3 of marketable gas"
Pipeline Diameter	0.6	m	https://www.atmosi.com/en/news-events/blogs/the-atmos-book-of-pipeline-simulation-chapter-five/
Pipeline Flow Area	0.28	m^2	Calculated by Promethium
Gas flow rate	4.24	m^3/s	Calculated by Promethium
Pipeline Pressure	7 000	kPa	https://www.kellasmidstream.com/assets/images/Typical-gas-entry-product-specifications.pdf pg 4
Pstandard	101.33	kPa	https://www.engineeringtoolbox.com/stp-standard-ntp-normal-air-d_772.html
Tstandard	288	K	https://www.engineeringtoolbox.com/stp-standard-ntp-normal-air-d_772.html
Tpipeline	288	K	https://www.engineeringtoolbox.com/stp-standard-ntp-normal-air-d_772.html
Z (Compression factor)	0.85		https://www.pipeflow.co.uk/public/documents/PipeFlowExpertCompressibleResultsVerification.pdf
Glas flow rate @STP	249.05	m^3/s	Calculated by Promethium
Annual gas throughput	7 853 994 656	m^3/annum	Calculated by Promethium
Annual gas throughput	7.85	billion m^3/annum	Calculated by Promethium
Cement/concrete mix	350	kg cement/ m^3 concrete	https://civilsynergy.wordpress.com/2020/07/28/mix-design-calculation-for-m30-grade-concrete/
Pipeline wall thickness	0.012	m	https://epcmholdings.com/gas-pipeline-design-focus-on-wall-thickness-calculation/
Inside diameter	0.58	m	Calculated by Promethium
Construction Time of Pipeline	60	days	Assumption: 2 months of construction

Activity	Value	Unit	Source
Amount of cement	10	m^3/km	Assumption: 10 cubic meters of concrete per km for supports, anchor blocks, and special structures.
Life Cycle Emissions for Natural Gas			
100 Year GWP			
United States of America			
Natural Gas Extraction	0.0027	tCO_2e/GJ	https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Natural Gas Gathering &Boosting	0.0063	tCO_2e/GJ	https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Natural Gas Processing	0.0023	tCO_2e/GJ	https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Domestic Pipeline Transport	0.0079	tCO_2e/GJ	https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Liquefaction	0.0049	tCO_2e/GJ	https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Tanker Berthing & Deberthing	0.0002	tCO_2e/GJ	https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
LNG Regasification	0.0005	tCO_2e/GJ	https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Angola			
Natural Gas Extraction	0.0085	tCO_2e/GJ	Used Algeria's emission intensities as a proxy for gas being imported from Angola https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Natural Gas Gathering &Boosting	0.0062	tCO_2e/GJ	Used Algeria's emission intensities as a proxy for gas being imported from Angola https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Natural Gas Processing	0.0023	tCO_2e/GJ	Used Algeria's emission intensities as a proxy for gas being imported from Angola https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Domestic Pipeline Transport	0.0079	tCO_2e/GJ	Used Algeria's emission intensities as a proxy for gas being imported from Angola https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Liquefaction	0.0050	tCO_2e/GJ	Used Algeria's emission intensities as a proxy for gas being imported from Angola

Activity	Value	Unit	Source
			https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Tanker Berthing & Deberthing	0.0002	tCO_2e/GJ	Used Algeria's emission intensities as a proxy for gas being imported from Angola https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
LNG Regasification	0.0005	tCO_2e/GJ	Used Algeria's emission intensities as a proxy for gas being imported from Angola https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
20 Year GWP			
United States of America			
Natural Gas Extraction	0.0040	tCO_2e/GJ	https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Natural Gas Gathering &Boosting	0.0093	tCO_2e/GJ	https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Natural Gas Processing	0.0032	tCO_2e/GJ	https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Domestic Pipeline Transport	0.0107	tCO_2e/GJ	https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Liquefaction	0.0068	tCO_2e/GJ	https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Tanker Berthing & Deberthing	0.0002	tCO_2e/GJ	https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
LNG Regasification	0.0006	tCO_2e/GJ	https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Angola			
Natural Gas Extraction	0.019	tCO_2e/GJ	Used Algeria's emission intensities as a proxy for gas being imported from Angola https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Natural Gas Gathering &Boosting	0.010	tCO_2e/GJ	Used Algeria's emission intensities as a proxy for gas being imported from Angola https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Natural Gas Processing	0.003	tCO_2e/GJ	Used Algeria's emission intensities as a proxy for gas being imported from Angola https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf

Activity	Value	Unit	Source
Domestic Pipeline Transport	0.011	tCO_2e/GJ	Used Algeria's emission intensities as a proxy for gas being imported from Angola https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Liquefaction	0.005	tCO_2e/GJ	Used Algeria's emission intensities as a proxy for gas being imported from Angola https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
Tanker Berthing & Deberthing	0.000	tCO_2e/GJ	Used Algeria's emission intensities as a proxy for gas being imported from Angola https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf
LNG Regasification	0.001	tCO_2e/GJ	Used Algeria's emission intensities as a proxy for gas being imported from Angola https://www.energy.gov/sites/prod/files/2019/09/f66/2019%20NETL%20LCA-GHG%20Report.pdf