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Analysing Policy and Regulatory Frameworks for Addressing Climate Change in South Africa's Oil and Gas Industry

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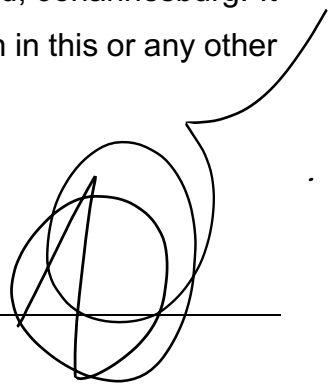
DECLARATION

I, **Tshegofatso Robin Maja-Ohonba**, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Management in **Energy Leadership** at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Name: Tshegofatso Robin Maja-Ohonba Signature:



Signed at Newlands, Cape Town

On the 25th day of February 2025

DEDICATION

This work is humbly dedicated to God Almighty, my grandmother, my husband.

To God Almighty, whose infinite grace, wisdom, and guidance have been the foundation of my journey. Your presence has provided me with strength, clarity, and resilience, enabling me to pursue this work with purpose and determination. I am profoundly grateful for Your countless blessings.

To my grandmother Mrs. Elizabeth Maja, whose unwavering strength, resilience, and wisdom have profoundly shaped my values and character. Your life is a testament to perseverance and love, and your belief in the transformative power of education has inspired me every step of the way. This research stands as a tribute to your enduring legacy and the countless lessons you have imparted.

To my husband, Dr. Efosa Ohonba, whose endless love, encouragement, and steadfast support have been my greatest source of strength. You have been my anchor throughout this journey, standing beside me through every challenge and celebrating every achievement. Your faith in me has made this endeavour possible, and I am eternally grateful for your patience and understanding.

I hope that this work contributes to the advancement of the upstream oil and gas sector in South Africa by fostering a deeper understanding of the policy and regulatory frameworks needed to effectively address climate change.

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This research paper was written with the assistance of AI tools, including Microsoft Word Editor, Copilot, QuillBot, Grammarly and Scribbr. These tools were used to refine language, improve clarity, enhance readability, and check for grammar and style consistency. Additionally, I used Cite This For Me for generating references for the reference list below. However, all intellectual contributions, critical analysis, and conclusions remain my own. The insights, interpretations, and final presentation of this research reflect my understanding and perspective on the topic. While these tools have assisted in the writing process, the underlying ideas and arguments developed in this paper are solely attributable to my own research and analytical efforts.

ABSTRACT

South Africa's upstream oil and gas industry currently has a negligible impact on the country's overall greenhouse gas (GHG) emissions due to its limited production activities which are primarily from Renergen's Virgina gas operation. Historical emissions were mainly from PetroSA's Gas Fields (FA; E-M, South Coast Gas and F-O) and Oil Fields (Oribi, Oryx and Sable) all in Block 9 off the South Coast, about 100km from Mossel Bay. Production from these fields ceased in 2020 which further reduced emissions in the sector.

The objective of this study was to assess whether the climate change policy framework of South Africa provides sufficiently for the mitigation of carbon dioxide emissions from the upstream petroleum sector while advancing energy security of supply. The study further evaluated carbon dioxide mitigation strategies that are employed by the upstream petroleum industry globally. A qualitative research approach was applied utilising in-depth semi-structured interviews with industry representatives in the oil and gas industry and energy related sectors. A thematic analysis was conducted using Atlas.ti to identify the key trends. In addition, comparative studies from international markets particularly Canada and Norway were analysed to highlight best practices applied in emission reduction within the sector.

This study finds that while the upstream petroleum sector has insignificant carbon dioxide emissions, given the current discoveries off the south coast and onshore and the number of active exploration rights currently which are expected to be converted to production rights upon discoveries of oil or gas, the sector could become a significant contributor to the country's carbon dioxide emissions.

The research findings indicate that currently there is a lack of stringent policy and regulatory frameworks, clear emissions reduction targets, and robust carbon pricing mechanisms. As a result, the potential growth of South Africa's upstream oil and gas activities may conflict with the national climate commitments. Therefore, the integration of international best practices, investment of clean emission reduction strategies and the strengthening of policy and regulatory

frameworks can potentially develop the current upstream oil and gas industry to ensure that it aligns with both global sustainability and the domestic energy security objectives required. The research findings highlight the importance of a balanced approach that prioritises emissions transparency, regulatory stability, and long-term climate resilience in shaping the future of South Africa's oil and gas sector.

Keywords: Climate change, greenhouse gas (GHG) emissions, oil and gas industry, energy policy and regulation, exploration and production (E&P), Just Energy Transition, carbon capture, utilisation and storage (CCUS), renewable energy integration, energy security and sustainable development.

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LIST OF ABBREVIATIONS

AI	Artificial Intelligence
BCM	Billion Cubic Meters
BEE	Black Economic Empowerment
BOE	Barrel of Oil Equivalent
BOE/Y	Barrels of Oil Equivalent by year
CBM	Coal Bed Methane
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilisation, and Storage
CDR	Carbon Dioxide Removal
CET	Carbon Emission Targets
CSP	Concentrated Solar Power
DED	Department of Economic Development
DFFE	Department of Forestry, Fisheries and Environment

DFI	Development Finance Institutions
DNT	Department of National Treasury
DMRE	Department of Mineral Resources and Energy
DWS	Department of Water and Sanitation
E&P	Exploration and Production
EPA	Environmental Protection Agency
EMPs	Environmental Management Plans
EOR	Enhanced Oil Recovery
EIA	Environmental Impact Assessments
EWE	Extreme Weather Events
ERA	Environmental Risk Assessment
ESG	Environment, Social and Governance
GDP	Gross Domestic Product
GEF	Global Environment Facility

GHG	Greenhouse Gas Emissions
Gt	Gigatons
Gt CO2-eq	Gigatonnes of CO2 equivalent
GTL	Gas-to-Liquids
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
IDC	Industrial Development Corporation
IOC	International Oil Companies
IRP	Integrated Resource Plan
ITAC	International Trade Administration Commission
JET	Just Energy Transition
JETIP	Just Energy Transition and Industrialisation Plan
JT	Just Transition
LNG	Liquefied Natural Gas
LTS	Long-Term Strategies

LTMS	Long-Term Mitigation Scenario
M&A's	Mergers and Acquisitions
MAC	Marginal Abatement Cost
MILLION BOE/Y	Million Barrels of Oil Equivalent by Year
MPA	Mandatory Performance Agreements
MPRDA	Mineral and Petroleum Resources Development Act No 28 of 2002
MPTRO	Mineral and Petroleum Titles Registration Office
MRV	Monitoring Reporting and Verification
Mt	Megatons
MTRA	Mining Titles Registration Act
NCCRWP	National Climate Change Response White Paper
NCCAS	National Climate Change Adaptation Strategy
NCCRP	National Climate Change Response Policy

NDC	National Determined Contributions
NDP	National Development Plans
NEMA	National Environmental Management Act
NERSA	National Energy Regulator of South Africa
NIOC	National Iranian Oil Company
NOC	National Oil Companies
NT	National Treasury
NZE	Net Zero Emissions
OECD	Organisation for Economic Co-operation and Development
PASA	Petroleum Agency of South Africa
PCC	Presidential Climate Commission
PETROSA	Petroleum Oil and Gas Corporation of South Africa SOC Ltd
PPP	Pollution Prevention Plans
PV	Photovoltaic

REI4P	Renewable Energy Independent Power Producer Procurement Programme
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
RES	Renewable Energy Sources
RDM	Robust Decision Making
RSA	Republic of South Africa
SD	Sustainable Development
SAMSA	South African Maritime Safety Authority
SAOGA	South African Oil & Gas Alliance
SAPIA	South African Petroleum Industry Association
SANPC	South African National Petroleum Company
SAPVIA	South African Photovoltaic Industry Association
SATMAR	South African Torbanite Mining and Refining Company
SET	Sector Emission Targets

SFF	Strategic Fuel Fund
STEPS	Stated Policies Scenario
SOEKOR	Southern Oil Exploration Corporation
TCF	Trillion Cubic Feet
TCP	Technical Cooperation Permits
UNFCCC	United Nations Framework Convention on Climate Change
UPRD	Upstream Petroleum Resources Development Act 23 of 2024

CHAPTER 1: INTRODUCTION

Climate change presents a significant global challenge, profoundly affecting the environment, economy, and society. The oil and gas industry is a major contributor to GHG emissions, primarily due to the extraction, production, and consumption of fossil fuels (Ewim et al., 2023). Consequently, this sector holds substantial responsibility in mitigating climate change impacts (Nordhaus, 2019).

Climate change refers to prolonged changes in temperature, precipitation, and other atmospheric conditions caused by human activities, particularly the combustion of fossil fuels (Kountriasova, 2022). The oil and gas industry plays a significant role in this phenomenon by emitting substantial amounts of greenhouse gases, including carbon dioxide (CO2) and methane (CH4), throughout extraction, processing, and burning stages (Ekemezie and Digitemie, 2024). These emissions enhance the greenhouse effect, driving global warming and climate change (Adamo, Al-Ansari & Sissakian, 2024).

The oil and gas industry faces the implications from climate change which include risks to infrastructure, operations, and supply chains due to rising global temperatures, changing weather patterns, and sea-level (Ekemezie and Digitemie, 2024). The climate change related concerns are rising leading to regulatory pressures, market uncertainties, and reputational risks for companies within the sector (Katopodis & Sfetsos, 2019).

Policy frameworks to mitigate climate change within South Africa's oil and gas industry employ a multifaceted approach aimed at reducing emissions, protecting the environment, and promoting sustainable development (Kountriasova, 2022). Specifically, the recently enacted Climate Change Act of 2024 provides the overarching legal framework for mitigation and adaptation, setting binding emission-reduction targets, mandating carbon budgets for high emitters, and aligning sectoral policies with national climate goals. These strategies include carbon pricing mechanisms, integrating renewable energy sources, conducting comprehensive Environmental Impact Assessments (EIAs), fostering stakeholder

engagement, and encouraging technological innovation (Katopodis & Sfetsos, 2019).

According to Engel-Cox, Ericson, & Arent (2021), due to the energy-intensive nature of upstream oil and gas operations, there are significant associated Scope 1 emissions and environmental impacts that are expected. Further, integrating renewable energy technologies can mitigate fossil fuel dependency, reduce costs, and lower emissions. Promoting renewable energy sources such as wind and solar power in oil and gas operations has the potential to mitigate GHG emissions and enhance energy security and resilience. Nonetheless, integration of renewables into upstream oil and gas faces challenges, including intermittency of supply, grid connectivity constraints, high capital costs, and policy uncertainty regarding incentives and subsidies. These practical hurdles limit the pace of adoption in South Africa’s oil and gas operations

The primary drivers of South Africa's emission reduction efforts in the upstream oil and gas sector are anticipated to be the implementation of the carbon tax and enhanced regulatory measures targeted at exploration and production activities. These measures, alongside proposed investments in renewable energy as outlined in the Integrated Resource Plan 2019 (IRP, 2024), are expected to significantly influence the industry's approach to mitigating climate change (Nemavhidi & Jegede, 2023). The carbon tax aims to incentivise reductions in GHG emissions from exploration and production processes, while stricter environmental regulations ensure compliance with sustainability goals (Nemavhidi & Jegede, 2023). This commitment, reinforced by the proposed trajectory of the carbon tax in South Africa’s 2022 budget, signifies a strong dedication to achieving climate objectives. However, Potter, Oloyede, & Klaus (2023) emphasises that the crucial aspect lies in the successful implementation of these policies.

Technological progress plays a crucial role in decreasing GHG emissions within the oil and gas industry. Innovations such as advanced drilling methods and carbon capture, utilisation, and storage (CCUS) technologies offer substantial

potential to decrease the industry's environmental impact (Wenlong et al., 2023). According to Lyons et al., (2020). Horizontal drilling enables multiple extraction points from a single wellbore, improves production efficiency and minimises environmental disturbances by reducing surface impact and habitat fragmentation. Although hydraulic fracturing (the technology used to extract natural gas from shales or tight geological formations) raises concerns about water contamination and seismic activity, it increases natural gas production, which emits less CO2 compared to coal, thus contributing to lower emissions in the energy sector (Jew et al., 2022).

CCUS technologies work by capturing CO2 emissions from industrial processes before they enter the atmosphere. The captured CO2 can either stored underground or repurposed for use in various industrial applications (Johnson et al., 2023). Carbon utilisation involves converting captured CO2 into valuable products such as fuels, chemicals, and construction materials, which adds economic benefits to emission reduction efforts. On the other hand, carbon storage means injecting CO2 deep underground for long-term sequestration, thus preventing its release into the atmosphere (Kelemen et al., 2019). However, in South Africa, CCUS faces challenges such as high upfront costs, lack of large-scale storage infrastructure, limited technical expertise, and uncertainty over long-term liability for stored carbon. These barriers complicate its deployment despite its mitigation potential. By investing in and effectively applying these technologies, the oil and gas industry can lower its GHG emissions and contribute significantly to the shift towards a low-carbon economy.

Grasso (2019) argues that mitigating GHG emissions is crucial for the oil and gas industry to address climate change and its associated risks. Reducing emissions can minimise environmental impact, ensure compliance with regulations, and demonstrate a commitment to sustainability. Furthermore, emission reduction can result in cost savings, improved operational efficiency, and enhanced competitiveness in the evolving energy landscape.

This research aims to assess whether South Africa's climate change policy framework effectively mitigates GHG emissions associated with upstream oil and gas exploration and production. Furthermore, the research evaluates the effectiveness of the Climate Change Act of 2024 in shaping emission-reduction obligations, addressing implementation challenges, and ensuring that the upstream oil and gas sector contributes to South Africa's just transition. Climate change stands as a critical socioeconomic and environmental issue in South Africa, necessitating an urgent and nuanced policy approach. By analysing the effectiveness of these policies, the study seeks to identify areas for improvement, contributing to the ongoing dialogue on climate change mitigation in the oil and gas industry and informing future efforts in this critical area. Furthermore, this study seeks to inform future policy efforts, contributing to the development of effective climate adaptation strategies tailored to South Africa's complex challenges posed by climate change, and provide valuable insights and recommendations.

1.1 Purpose of the study

The purpose of this exploratory study is to analyse the adequacy of South Africa's current climate change policy and regulatory framework particularly the Climate Change Act of 2024, in addressing climate change concerns within the upstream sector of the oil and gas industry. The study seeks to provide insights to improve the climate change policy framework thereby supporting the South Africa's transition to a low-carbon economy and promotion of sustainable development

1.2 Aim of the study

Through this analysis, the study aims to offer insights and recommendations to enhance policy coherence, improve regulatory efficiency, and advance industry practices that align more effectively with climate change mitigation and adaptation.

1.3 Context of the study

The context of the study is situated within the broader global discourse on climate change and sustainable development. South Africa possesses approximately 27 billion barrels of oil and 60 trillion cubic feet (tcf) of prospective natural gas resources in its southern, eastern, and western coastlines, according to estimations by PASA (Human, 2023). These potential resources offer a substantial investment opportunity and hold promise for enhancing the country's energy security objectives, thereby facilitating vital economic growth and developmental trajectories (DMRE, 2023)

South Africa is a signatory to the Paris Agreement and remains committed to reducing its GHG emissions and shifting towards a low-carbon economy.

This commitment is operationalised through domestic policies, most notably the Climate Change Act of 2024, which establishes a legal framework for emission reduction targets, carbon budgets, and adaptation measures. In addition, the Carbon Tax Act (No. 15 of 2019, with amendments in 2022) incentivises emission reductions by pricing carbon, while the Integrated Resource Plan (IRP 2019) outlines South Africa’s energy transition pathway, including the gradual integration of renewable energy sources and the phasedown of coal. Together, these policies form the backbone of South Africa’s climate response, providing sector-specific direction for the upstream oil and gas industry.

However, South Africa faces the dual challenge of ensuring reliable energy security, given its dependence on coal and growing demand, while simultaneously mitigating the impacts of climate change. Therefore, to achieve its climate-related goals, the oil and gas industry must adopt industrial practices consistent with the country’s policy and regulatory framework, which emphasises emission reduction, sustainable energy transition, and long-term resilience (IMF, 2023).

According to Averchenkova, Gannon, & Curran (2019), South Africa has established a climate governance framework, which is notably advanced

compared to other developing and emerging economies. There are several domestic challenges that hinder the climate change objective. These challenges include limited human and technical resources, ambiguous roles and responsibility assignments, lack of ownership and accountability for implementation plans, lack of effective communication and coordination between various government departments.

Substantial strides have been achieved in establishing the climate governance framework however, according Leck & Simon (2018) the process of implementation is frequently hindered by insufficient coordination and sector-specific planning. Kamarck (2019) identifies weak institutional frameworks within both public and private sectors as primary factors contributing to the inadequate implementation of climate initiatives in South Africa.

There is an urgent need to improve the effectiveness of climate change policies. The consistent implementation of energy sector reforms is crucial to reduce regulatory challenges and encourage a more responsive approach to fossil fuel usage (IMF, 2023). Giordano, Hall, Gilder, & Parramon (2011) argues that to effectively integrate both adaptation and mitigation strategies, all government departments, and administrative levels, including decentralised entities and state-owned enterprises (SOEs), need incorporate climate change objectives into their policies and actions. While these perspectives were developed before the enactment of the Climate Change Act of 2024, the new Act provides a stronger institutional and legal framework by mandating carbon budgets for large emitters, requiring sectoral adaptation plans, and enhancing coordination across government levels. The Act therefore addresses some of the gaps previously identified in the literature, although its effectiveness will ultimately depend on consistent enforcement and institutional capacity.

This study recognises the importance for South Africa to address climate change and the need to transition towards cleaner, alternative sources of energy to meet international climate objectives. The study acknowledges the challenges and uncertainties associated with climate change adaptation and mitigation efforts.

The study also examines the socio-economic impacts of climate policies and highlights the importance of a just energy transition (JET). In doing so, the research contributes to the broader objective of advancing sustainable development with the objective of addressing climate change both globally and in South Africa.

1.4 Research Problem

This research aims to investigate whether South Africa's policy framework particularly the Climate Change Act of 2024 is adequate to mitigate GHG emissions, particularly carbon dioxide and methane, from South Africa's upstream oil and gas exploration and production activities. These emissions have the potential to significantly contribute to global GHG emissions, hindering efforts to limit global warming to 1.5°C or well below 2°C if they are not well managed. The research examines whether the existing frameworks can be enhanced to better mitigate climate change while ensuring environmental integrity, energy security, and economic growth. Furthermore, by conducting a detailed analysis of these frameworks, the study aims to identify both strengths and areas for improvement, ultimately informing policy decisions that balance environmental protection with economic and energy considerations.

1.5 Research Questions

- How could potential future oil and gas exploration and production in South Africa contribute to greenhouse gas (GHG) emissions and climate change?
- What are the current policy and regulatory gaps in South Africa that hinder effective climate change mitigation by the oil and gas industry?

1.6 Significance of the study

This study is significant as it has the potential to address policy and regulatory challenges in South Africa's oil and gas industry. Therefore, it seeks to thoroughly analyse and evaluate the current policy and regulatory frameworks governing the sector, highlighting the gaps that potentially prevent effective GHG emission reduction methods and the effects on climate change.

Secondly, the findings will provide insights for policymakers, stakeholders, and environmental advocates, informing the need for the development of clearer and more robust policies that are well aligned with international agreements.

1.7 Delimitations of the study

According to Miles and Scott (2017), delimitations of a study define the scope of an investigation by establishing both its boundaries and criteria, acknowledging that findings may not be generalisable to the entire population. This is supported by Coker (2022) who emphasises that these boundaries reflect the researcher's intentional focus and choices in shaping the study.

This study focuses exclusively on how potential future oil and gas exploration and production in South Africa may contribute to increasing GHG emissions and climate change. The study emphasises policy and regulatory analysis as the research aims to provide a comprehensive assessment of the gaps in the South African policy and regulatory framework for mitigating climate change and promoting sustainable practices within the industry. The study further applied a qualitative, exploratory approach and gathered insights through virtual interviews with industry experts conducted on Zoom and Microsoft Teams. The selected participants had relevant industry experience. The scope is confined to the South African context.

1.8 Definition of terms

Climate Change	Refers to long-term changes in temperature, precipitation patterns, and other climate variables caused by both natural processes and human activities, especially the emission of greenhouse gases (Abbass et al., 2022).
Just Energy Transition	The shift towards a sustainable energy system that ensures fairness and equity for all stakeholders, particularly those affected by economic and environmental changes (Wang & Lo, 2021).
Policy and Regulatory Framework	A set of rules, laws, and guidelines established by governments to regulate various aspects of society, including industries such as energy, to achieve specific policy objectives (Lakhno, 2023).
Utilitarianism	An ethical theory that advocates actions that maximise overall happiness or well-being (utility) and minimise suffering, emphasizing outcomes that benefit the greatest number of people (Beekun et al., 2010).
Environmental Ethics	Refers to the moral principles and guidelines that govern human interactions with the natural world, emphasizing the responsibility to protect and conserve the environment for current and future generations (Attfield, 2012).

Environmental Justice	Focuses on fair treatment and equitable distribution of environmental benefits and burdens among all people, particularly addressing disparities and injustices faced by marginalised communities in environmental policies and practices (Attfield, 2012).

1.9 Assumptions

According to (Simon, 2011; Simon & Goes, 2013) assumptions in research are the underlying beliefs or premises that are accepted as true without requiring proof. They serve as foundational principles guiding the research process, influencing decisions on methodology, data interpretation, and conclusions.

This study assumes that participants have the relevant knowledge and expertise regarding South Africa's oil and gas industry and its impact on GHG emissions.

The interviewees voluntarily participated in this research without any expectation of compensation, offering insights based on their lived experiences and observations.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction:

Climate change is an important global issue that presents significant challenges to ecosystems, economies, and societies around the world (Amusan & Olutola, 2016). In South Africa, the oil and gas industry has the potential to significantly improve energy security and drive economic growth. Ferreira & Pedersen (2022) affirm that the oil and gas industry has a crucial role of in the country's economy and energy landscape. According to Nkomo (2009), the industry's response to environmental challenges is largely influenced by policy and regulatory frameworks. The process of diversifying energy supply sources and implementing demand-side measures are important strategies for improving energy security however, it has been determined that their success depends on effective policy implementation and enforcement. Nonetheless, the industry's contribution to GHG emissions although negligible in South Africa, its impact on climate change is growing concerns. Grasso (2019) highlights that there is a need for clear, robust regulatory frameworks to mitigate emissions and limit the industry's effect on climate change. This highlights the urgency of effective policy implementation within the sector.

In response to the pressing need to tackle climate change, the South African government has pledged to support global initiatives to reduce global warming (UNFCCC,2016). Khavhagali et al., (2024) notes that the introduction of the National Climate Change Adaptation Strategy (NCCAS) in 2020 marked a significant step in South Africa's climate policy objectives aiming to build a climate-resilient economy and society across various sectors and levels of government.

Furthermore, according to (Soria-Lara et al., 2020), comprehensive Environmental Impact Assessments (EIAs) are essential for evaluating the potential environmental impacts associated with industrial activities and implementing measures to mitigate adverse effects on marine ecosystems and

biodiversity. These assessments are valuable in ensuring that environmental considerations are integrated and applied into project planning and implementation processes.

Therefore, addressing these challenges is crucial and requires concerted efforts to streamline regulatory processes and strengthen institutional capacity. The South African government intends to maintain legislative stability, simplify the licensing process, conduct emergency response drills, activate the International Oil Pollution and Compensation Fund, and capitalise on research opportunities in oil and gas exploration to encourage industry investment (DPME, 2014).

2.1.1 Overview of the Oil and Gas Industry

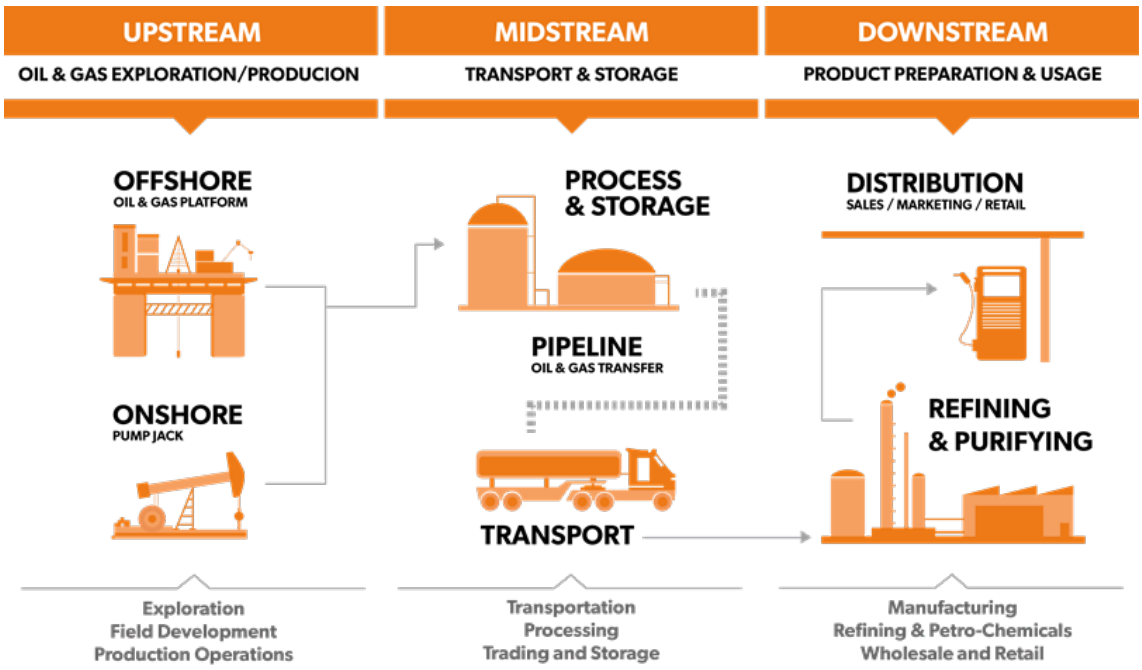

Figure 1: Overview of the Oil and Gas Industry: Upstream, Midstream, and Downstream (Eland Cables, 2024)

The oil and gas industry is divided into three main categories: upstream, midstream, and downstream as illustrated above in Figure 1. According to Ewing, Malik, and Payne (2024), these sectors serve crucial and distinct functions within the energy supply chain.

The upstream sector encompasses both exploration and production (E&P) activities and is the foundation of the oil and gas supply. This includes land acquisition, drilling, and hydrocarbon extraction. This sector is highly capital-intensive and is sensitive to fluctuations in oil and gas prices. This is due to the inherent challenges of resource depletion and the high capital investment required for the geological extraction process of finding and developing reserves resulting in high investment risks- thus affecting long-term industry sustainability. This sector primarily generates scope 1 emissions (direct emissions). This sector is important as domestic production reduces the reliance on imports thus stabilising the pricing and supply for national energy needs. (Ewing et al., 2024).

The midstream sector enables market access as it is mainly responsible for the transportation, storage, and initial processing of crude oil and natural gas. It relies on extensive infrastructure, including pipelines, pump stations, and storage facilities. This sector has an environmental impact that contributes to GHG emissions but plays an important geopolitical and economic role influencing global energy security and pricing. Further, the sector incurs high fixed costs but relatively low variable costs once operational. Furthermore, the stream is said to typically secure long-term contracts with upstream producers which often ensures revenue stability through transportation tariffs and volume-based agreements (Adams & Mueller-Hirth, 2021).

The downstream sector mainly focuses on the refining crude oil into marketable petroleum products, such as petrochemicals, and distributing these products to end use consumers. This sector determines the availability of fuel and the affordability to end-user customers. However, the downstream operations often vary in structure, with some companies functioning as fully integrated entities while others specialise in refining, petrochemicals, or fuel distribution. According to Wari, Zhu, & Lim (2023), the downstream sector plays an important role in supplying energy products to industrial and retail markets.

2.1.2 Global Oil and Gas industry overview

In the context of the global oil and gas industry, South Africa's sector remains relatively small and largely overshadowed by more dominant producers, which include the United States, Russia, Iran, Saudi Arabia, and Russia who are high producers. As a result, South Africa's oil and gas industry is often perceived as negligible in comparison to these major players as seen in Figure 2 below by Global Energy Monitor (2025). This figure displays the oil and gas production by country in million barrels of oil equivalent by year (million boe/y) and the results for South Africa remain as 0 million boe/y.

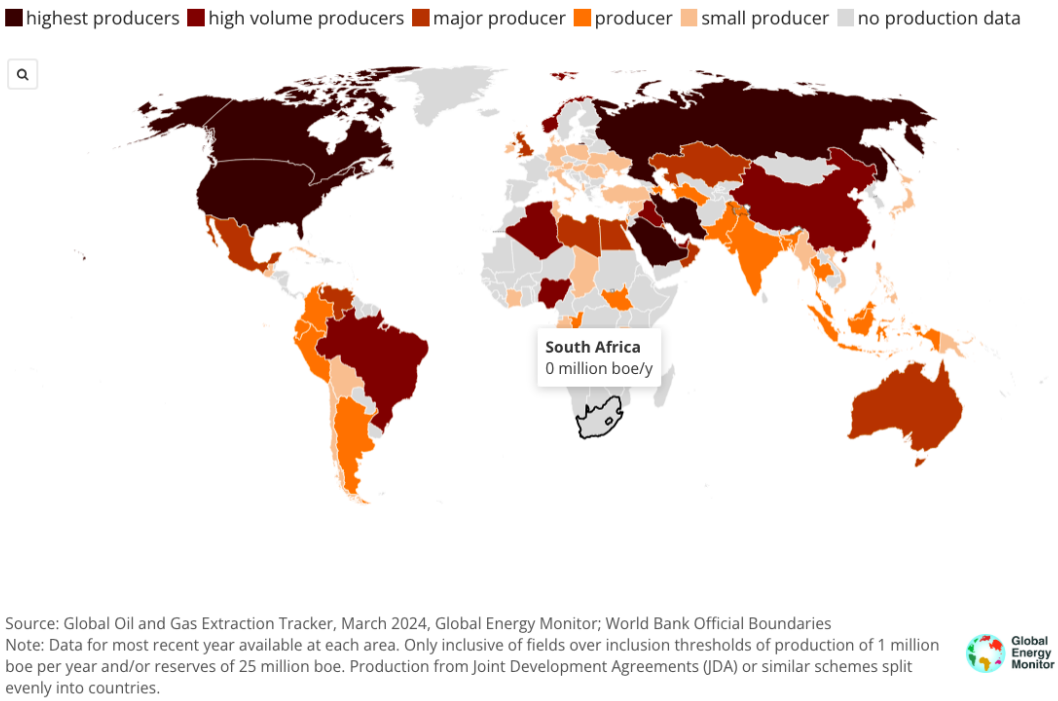

Figure 2: Oil and Gas Production by Country (Global Energy Monitor, 2025).

These dominant players have the benefit from the available and extensive reserves, advanced extraction technologies that they have adopted, and well-established market positions, which has certainly created a highly competitive environment for South Africa. The International Energy Agency (IEA) forecasts that there will be a global demand for both oil and gas which will peak by 2030 (IEA, 2023).

Wang et al., (2023) note that the COVID-19 pandemic, which began in 2020, caused significant disruptions to the global economy and had a significant impact on the oil and gas industry. However, according to Zhang et al., (2024) the crisis regarding the Russia-Ukraine war in 2022 introduced further complexities to the industry's development, taking place against a backdrop of global interconnected events as well as rapid transformative changes. Notwithstanding this, the oil and gas industry remain a crucial driver of the global economy and will likely remain so for the foreseeable future. This id due to the increasing global demand for fossil fuels despite the complex investment challenges (Sadeghi Mojarad, Atashbari, & Tantau, 2018).

According to IEA (2023), in 2022, global consumption reached approximately 97 million barrels per day (mb/d) of oil and 4,150 billion cubic meters (bcm) of natural gas, leading to over 18 gigatons (Gt) of CO2 emissions. Although recent advancements in clean energy technologies indicate that oil and gas demand may peak before 2030 under the Stated Policies Scenario, the subsequent declines in demand remain insufficient to meet global climate targets. This indicates that while there is progress in clean energy adoption, the projected demand decline for fossil fuels is not aggressive enough to align with necessary climate action.

To effectively combat climate change, it is not sufficient to focus only on reducing oil and gas consumption beyond 2030; equal attention must be given to upstream activities, which contribute significantly to overall sectoral emissions globally. Further, globally, upstream operations through exploration, drilling, processing, and flaring account for approximately 15 to 20% of total oil and gas GHG emissions, primarily in the form of methane and carbon dioxide leaks (IEA,2023). Therefore, understanding and mitigating these upstream emissions is therefore critical for South Africa, given the expansion of offshore exploration and the need to align with its Climate Change Act of 2024 commitments.

Bekun (2024) argues that increasing renewable energy adoption plays a crucial role in reducing CO2 emissions and promoting long-term sustainability in South

Africa. The process of expanding and adopting green technologies can further reduce emissions. To support this transition, Bekun (2024) recommends implementing carbon taxes to reduce emissions, increasing investment in renewable energy particularly through private sector participation and exploring CCS technologies to reduce emissions. Overall, South Africa's path to carbon neutrality also relies on integrating renewable energy.

This is supported by Feng (2022) who suggested that an increase in the share of renewable energy in the overall energy consumption will lead to a decrease in carbon dioxide emissions, resulting in a higher intensity of renewable energy usage.

Furthermore, the process of implementing Artificial Intelligence (AI) technologies in monitoring and supervising exploration and production activities and operations has the potential to enhance risk management and incident control in the oil and gas industry. The industry should continue to leverage and optimise AI in the business operations and decision-making processes. According to Olawade et al., (2024) key applications include seismic data analysis for resource identification, predictive maintenance to minimise downtime, drilling optimisation for efficiency, demand forecasting for supply chain management, and emissions tracking for environmental compliance, enhancing overall efficiency and sustainability.

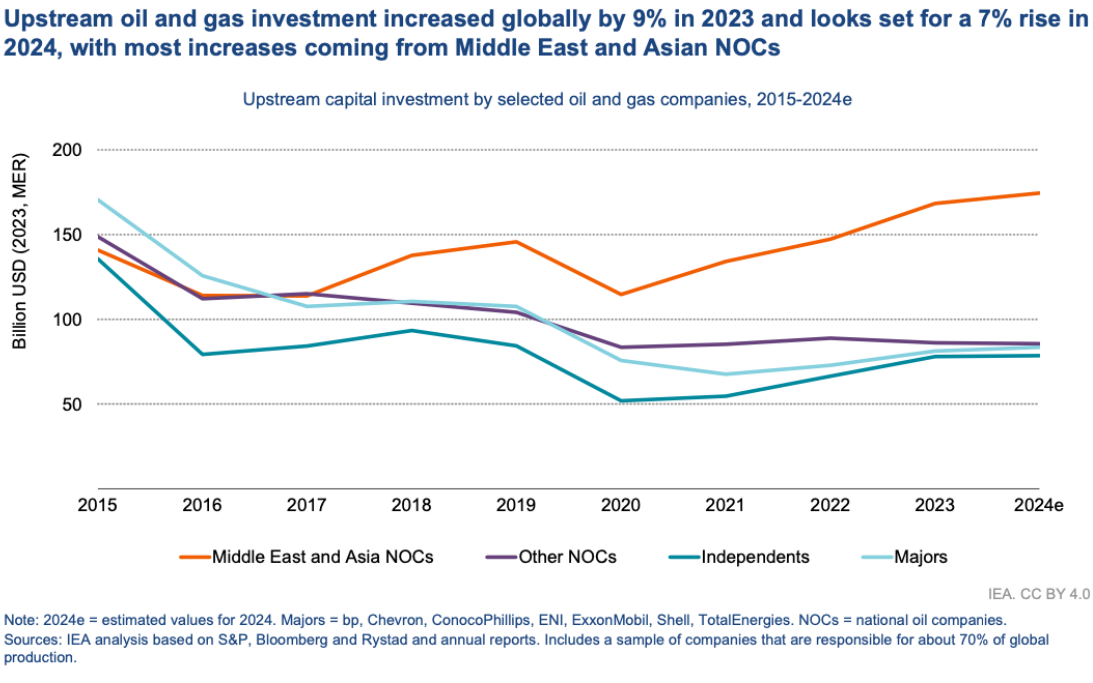

Figure 3: Graph illustrates the increase in upstream oil and gas investment globally from 2015 (IEA,2024).

According to the IEA (2024) the upstream oil and gas industry investment is forecasted to increase by 7% in 2024, reaching $570 billion, following a 9% increase in 2023. This growth is can largely be attributed to national oil companies (NOCs) in the Middle East and Asia, which have increased their investments by over 50% since 2017(as seen in Figure 3 above). Additionally, liquefied natural gas (LNG) investment is set to grow with project approvals expected to enhance supply capacity by 250 billion cubic meters (bcm) by 2030. Over the past decade, oil and gas capital investment has accounted for about 40% of total upstream spending, with exploration investments projected to increase by 15% in 2024, particularly in China and North America.

As seen in Figure 4 below, in 2023 oil and gas companies invested $28 billion in clean energy which is substantial and this is a 30% increase from 2022, although this was lower than the previous 65% growth between 2021 and 2022 due to inflation and supply chain issues (IEA,2024). Mergers and Acquisitions (M&As) represented nearly half of this investment, with notable deals including

ExxonMobil's $4.9 billion acquisition of Denbury's carbon capture network (Valle & Kumar, 2023) and TotalEnergies' over $1.5 billion purchase of Eren Re (Rajgor, 2023). Therefore, over 40% of clean energy spending was focused mainly on solar and wind projects, while national oil companies contributed $1.5 billion, primarily targeting Solar Photovoltaic (PV) and low-emissions hydrogen (IEA,2024).

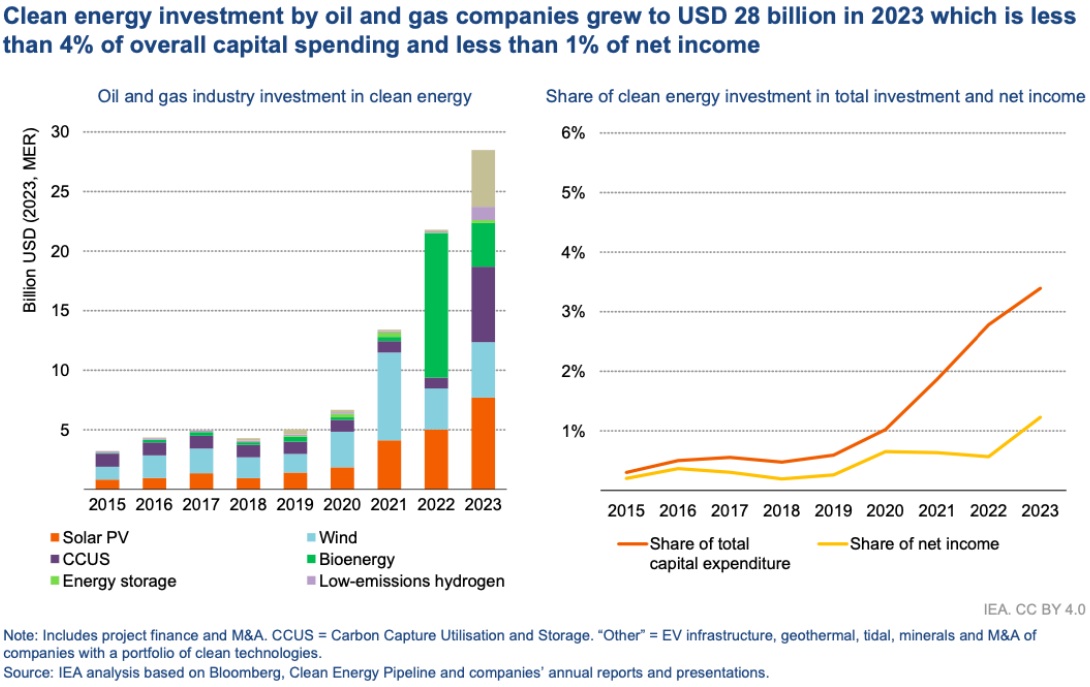

Figure 4: Graph illustrates clean energy investment from 2015 to 2023(IEA,2024).

The investment landscape for 'low-emissions hydrogen' as seen above in Figure 4, continues to remain uncertain and this due to variable demand and consumer price sensitivity. Furthermore, as noted by IEA (2024), due to NOCs increasing their clean energy investments to over $1.5 billion this has accounted for approximately 5% of the oil and gas sector's total clean energy spending (IEA,2024).

Upon further observation, it remains clear that the oil and gas industry continues to mainly focus on fossil fuel investments. This suggests that while there is sufficient and clear evidence that the industry needs to transition towards cleaner alternative sources of energy, the pace of transitioning remains rather low and

slow. As observed, the slight increase in the overall share of clean energy investment from 2022 above, suggests that despite the increasing interest and growth in clean energy investments, there are several factors such as economic pressures and market uncertainties that remain which may possibly be affecting and limiting the industry's willingness to shift its investments toward cleaner alternative energy sources.

Furthermore, Africa faces a significant funding gap for clean energy projects, needing over $200 billion annually by 2030 to meet both energy and climate goals. There are existing high debt challenges and limited investment capacity. Further, it has been noted that only 2% of global clean energy investments are allocated to the continent. This highlights that there is an urgent need for concessional support which is necessary for sustainable development of the continent (IEA,2024).

According to the IEA (2024) report, clean energy projects, especially in sub-Saharan countries, rely heavily on concessional funding from development finance institutions (DFIs). However, according to AfDB (2020) current investment levels are insufficient for a sustainable energy transition. Increasing funding and attracting private investors is therefore essential, along with enhanced commitments from donors and DFIs to scale up clean energy investments, particularly with energy access initiatives.

2.1.3 Overview of the South African Oil and Gas industry

Oil and gas exploration in South Africa began in the 1960s, this certainly reflects the industry’s long-standing presence. Although South Africa's oil and gas sector is often considered negligible on a global scale, there have been over 300 wells drilled and more than 10 seismic acquisitions conducted in the past five years, this highlights its potential. Notably, despite this extensive activity, no catastrophic events impacting the environment or marine life have been recorded, with Mossel Bay being a prime example of this safety record (Sayidini, 2022).

South Africa’s oil and gas industry is relatively small, characterised by negligible production levels and limited exploration activities. Despite possessing significant untapped resources of approximately 27 billion barrels of oil and 60 trillion cubic feet of natural gas (PASA, 2023), South Africa has struggled to translate these proven reserves into meaningful output. However, recent developments indicate a cautious approach from major players, with Total abandoning significant exploration projects like the Brulpadda and Luiperd fields due to uncertainties surrounding commercial viability and regulatory frameworks (Human, 2023). South Africa's geographic and political location makes it an ideal hub for supporting oil and gas projects in sub-Saharan Africa. Situated at the southern tip of the continent, it offers convenient sea and air access to both eastern and western regions of Africa (South African Oil & Gas Alliance [SAOGA], 2025)

2.1.4 Historical Context of South Africa's Oil and Gas industry

Prior to the development of adequate domestic refining capacity, South Africa was entirely dependent on imported refined petroleum products. The country's first refinery, a synthetic fuel facility, was established in the 1930s. This refinery, operated by the South African Torbanite Mining and Refining Company (SATMAR) in Boksburg, utilised shale oil as a feedstock for fuel production (SAPIA, 2014). According to (Miller & van Meelis, 2005), the development of South Africa’s oil industry has been significantly influenced by the country’s historical context. Initially driven by the energy demands of the mining and agricultural sectors, the industry's expansion was largely facilitated by the government's import substitution industrialisation policy.

During the apartheid era, the state's emphasis on self-sufficiency in liquid fuels, coupled with military strategic considerations, played a critical role in shaping the industry's trajectory (Rustomjee et al., 2007). Following the rise to power of the apartheid nationalist party in 1948, the import substitution policy was further intensified. This led to the establishment of Sasol in 1950, which, by 1955, began producing petrol from coal using Fischer-Tropsch technology, an innovation acquired from Germany by Anglovaal (Verhoef, 2017).

Furthermore, according to SAPVIA (2014) until 1954, South Africa primarily relied on imported petroleum products to meet its fuel demands. That year, the country's first crude oil refinery was commissioned in Durban by Mobil (now Engen Petroleum). In an effort to reduce dependence on imports in 1950, the government established the South African Coal, Oil, and Gas Corporation (now Sasol) (Glebova, 2013).

By the late 1960s, South Africa and Iran shared key foreign policy alignments, particularly their anti-communist stance and concerns over Soviet expansion (Chehabi,2016). Both nations were engaged in conflicts against Soviet-backed insurgencies. The 1973 Arab oil embargo and rising oil prices further strengthened their cooperation, particularly in the energy sector. This partnership, which included France, extended into nuclear collaboration from 1974. In 1969, the National Iranian Oil Company (NIOC) partnered with Sasol and the French firm Elf Aquitaine (later Total) to develop the Natref refinery in Sasolburg. Within this agreement, NIOC committed to supplying crude oil to the refinery for 20 years upon its completion (Rustomjee et al., 2007).

The initial land exploration for oil began in Beaufort West, Western Cape in 1965, resulting in the discovery of small oil accumulations however, these were deemed non-commercial. Geopolitical and economic events in the 1970s and 1980s, including the fall of the Shah of Iran, rising oil prices, the 1977 UN arms embargo, and disinvestment campaigns, significantly influenced South Africa's liquid fuels and chemical industries (Chehabi,2016).

Iran had been the country's primary oil supplier, but growing military and strategic concerns under the apartheid regime, particularly in the 1980s, led to increased investment in synthetic fuel production. Sasol's expansion played a key role in developing the downstream chemical sector (Cooper, 2008).

South Africa's oil and gas industry has undergone substantial evolution, driven by a complex interplay of political and economic factors. The establishment of Soekor, a state-owned enterprise, in 1965 marked a pivotal moment in the industry (PASA, 2024). During this period, Esterhuyse (2023) stated that when

major international oil companies were increasingly focusing on more profitable markets abroad, Soekor emerged as a key player in South Africa's exploration efforts (SAPIA,2014).

The Superior Group conducted the first offshore drilling, resulting in the discovery of natural gas deposits within the continental shelf complex off the Southern Cape coast (Beckman, 2014). According to (Zangqa et al., 2024) there were significant discoveries in the Bredasdorp Basin, notably the F-A and E-M gas fields in Block 9, between 1980 and 1983 (Beckman, 2014). These discoveries were instrumental in setting the groundwork for future exploration and development in the region (Rustomjee,2023).

The 1980s brought a renewed focus on achieving domestic fuel self-sufficiency. This era saw the launch of the Mossgas project, which had the objective to leverage South Africa’s natural gas resources to reduce reliance on imported fuels. During this time, various consortia also sought to enter the market, driven by the potential of the country's untapped resources (Rustomjee,2023). These efforts often faced substantial hurdles due to the prevailing political and economic challenges, which included regulatory constraints and market volatility. Despite these obstacles, the groundwork laid in this period was crucial for the development and prospects of South Africa’s oil and gas sector.

In 1987, the government launched the Mossgas project to produce petrol from offshore natural gas, addressing diesel shortages critical to military operations. The oil industry remained highly secretive, with key facilities designated as National Key Points under the 1980 Act, limiting access and trade union activities (Rustomjee et al., 2007).

Lacking significant crude oil reserves, South Africa has relied on imports. In 1995, 68% of its crude oil came from Iran and by 2003, this decreased to 33%, with Saudi Arabia becoming the primary supplier at 45% (Chehabi,2016).

In the early 2000s, the government consolidated state-owned oil assets under PetroSA, integrating exploration, extraction, and processing. Despite these

efforts, the sector remains concentrated, with upstream operations controlled by multinational companies and the state (Rustomjee,2023).

South Africa's National Oil Company was named the Petroleum, Oil and Gas Corporation of South Africa SOCLtd (PetroSA). PetroSA was established in January 2002 through the merger of three entities: Mossgas (Pty) Limited, Soekor (Pty) Limited, and portions of the Strategic Fuel Fund [SFF] (SAPIA, 2014).

2.1.5 Current state of the industry

According to Meissner (2025), the South African government's "Operation Phakisa" policy prioritises the development of the oil and gas industry as part of its strategy to expand the ocean economy across various sectors. The implementation of the Operation Phakisa oil and gas lab aligns with South Africa's commitment to the Paris Agreement on Climate Change (Grimett, 2024).

Furthermore, the recent global shift towards renewable energy and stringent climate commitments has intensified scrutiny of South Africa's reliance on fossil fuels (Bekun, 2024). The global emphasis on reducing carbon emissions and transitioning to cleaner energy sources presents a considerable challenge for South Africa as it seeks to balance economic growth with environmental targets.

The latest draft of South Africa's 2024 Integrated Resource Plan (IRP) does not specifically reference crude oil in the country's future energy strategy (DMRE, 2024). Instead, it emphasises the continued role of coal with carbon capture, utilisation and storage, gas, and nuclear energy, alongside renewable sources like solar PV, wind, Concentrated Solar Power (CSP), hydropower, and energy storage. These renewable technologies are seen as key to diversifying the energy mix. The IRP does place natural gas as an important element in the transition, serving to support and enhance renewable energy sources (DMRE, 2024).

South Africa relies on fossil fuels for over 80% of its primary energy, with coal making up roughly over 70% of this mix as seen in Figure 5 below. This

dependence places the country among Africa's top three carbon emitters Ritchie, Roser, & Rosado, 2022).

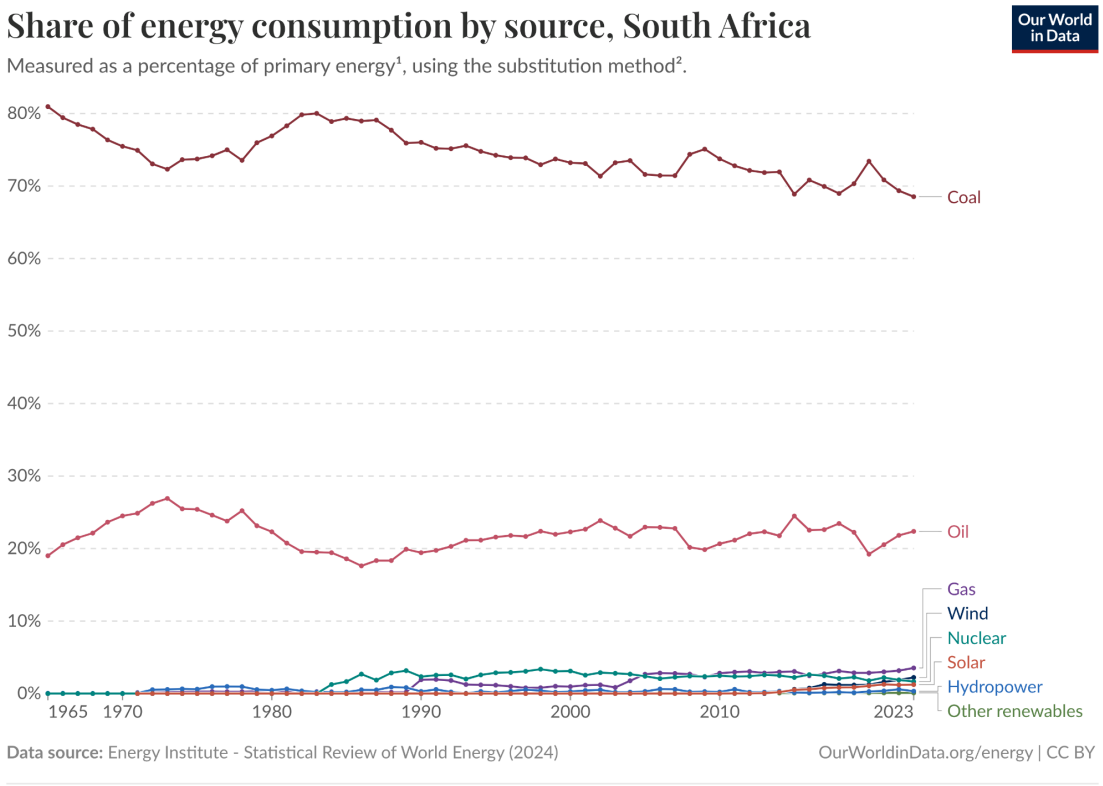

Figure 5: Graph illustrates South Africa's share of energy consumption by source from 1965 to 2023 (Ritchie, Roser, & Rosado, 2022).

2.1.6 Current and future prospects

The South African oil and gas sector is navigating a landscape marked by both significant challenges and promising opportunities. According to Steyn (2022), at the forefront are advanced offshore projects like Brulpadda and Luiperd, which represent significant investments in the industry (Ayuk, 2023). These projects are crucial for the sector's future and require seamless integration with existing infrastructure to realise their commercial potential.

TotalEnergies ceased exploration in Block 11B/12B in 2019 and 2020 respectively (as seen in Figure 6 below). According to Creamer (2024), the company allocated $400 million in 2019 to explore Brulpadda, estimating a

potential of 1 billion barrels of light liquid hydrocarbons. Further exploration in 2020 resulted in the discovery of the Luiperd field (Rodgers, Carstens, & Allen, 2021). Despite these promising findings, TotalEnergies, in partnership with CNR International, decided to withdraw from the block due to economic and commercial challenges associated with developing and monetising the gas resources for the South African market (Fraser, 2024).

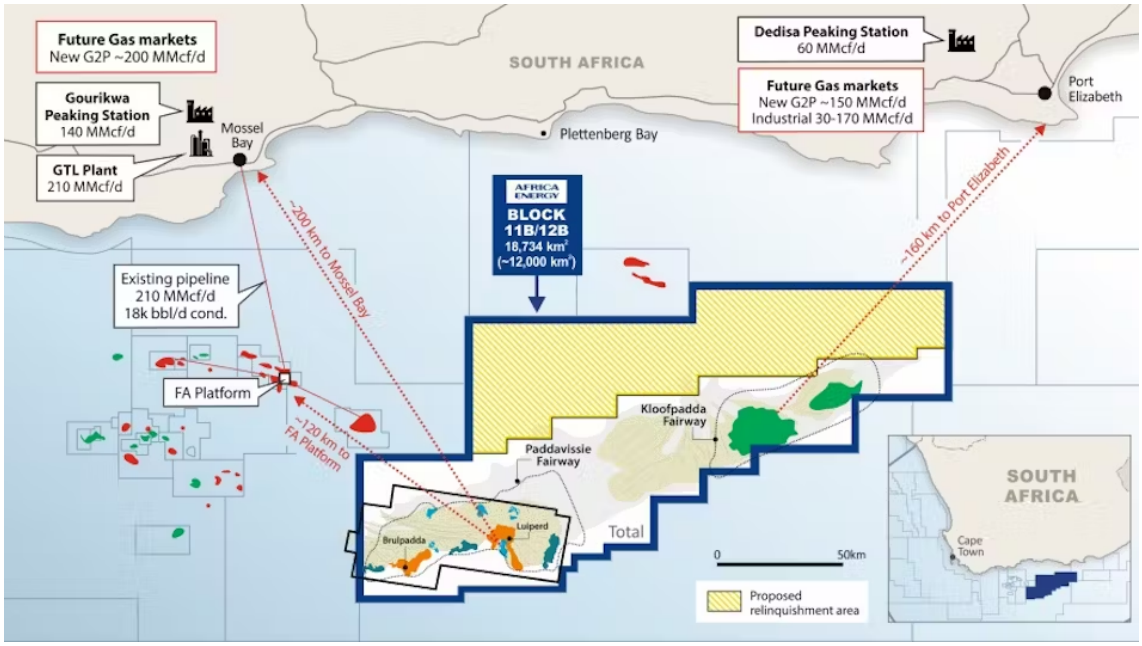

Figure 6: Illustrating Block 11B/12B Development (Africa Energy Corp., 2024).

Following this decision, TotalEnergies has shifted its focus to the Orange Basin along South Africa's Atlantic coast, an area proximate to the oil discoveries in Namibia (Africa Energy Corp., 2024). The Brulpadda and Luiperd discoveries were initially expected to contribute to reducing South Africa's reliance on coal and provide feedstock. According to Ashraf (2023), PetroSA had partnered with Gazprombank Africa, a Russian financial institution, to facilitate the reactivation of its dormant gas-to-liquid (GTL) refinery in Mossel Bay. The Mossel Bay GTL plant, with a capacity of 45,000 barrels per day, has remained inactive for several years under care and maintenance due to the depletion of offshore gas reserves. According to Comrie (2025), nearly a year after the South African Cabinet designated Gazprombank Africa as PetroSA's investment partner, the bank failed

to deliver the promised $200 million investment or fund a feasibility study, resulting in PetroSA incurring over R500 million in annual maintenance costs. Disputes over ownership rights and feasibility study delays further hindered progress. Consequently, PetroSA is now seeking a new investment partner to revive the refinery.

Although the oil and gas industry in South Africa is relatively negligible compared to global standards, it cannot be considered entirely insignificant. Figure 7 (below) presents Section 10 Notices and Provincial Gazettes, which include applications that have been received and accepted but are currently being evaluated for compliance with the legislative requirements of the relevant permits and rights (PASA, 2025).

SECTION 10 NOTICES & PROVINCIAL GAZETTES

25 entries per page

Search:

Applicant	Type of application	Date received	Date accepted	Comments
Motuoane Energy (Pty) Ltd ...pdf	Exploration Right 386	8-October-24	22-October-24	Gazette
Motuoane Energy (Pty) Ltd pdf	Exploration Right 315	19-July-24	19-August-24 (granted)	Renewal
Legacy Box Holdings (Pty) Ltd. pdf	Exploration Right 385	28-June-24	12-July-24	
Consulting Evolution Mining (Pty) Ltd. pdf	Exploration Right 384	28-June-24	12-July-24	
Afro Energy (Pty) Ltd	Exploration Right	10-Apr-24	24-Apr-24	
Plateau Helium SA (Pty) Ltd	Exploration Right	19-Feb-24	4-Mar-24	
Plateau Helium SA (Pty) Ltd	Exploration Right	19-Feb-24	4-Mar-24	
Rhino Oil and Gas Exploration SA (Pty) Ltd	Exploration Right	5-Jul-23	19-Jul-23	
Rhino Oil and Gas Exploration SA (Pty) Ltd	Exploration Right	5-Jul-23	19-Jul-23	
Rhino Oil and Gas Exploration SA (Pty) Ltd	Exploration Right	5-Jul-23	19-Jul-23	
Panoro 2B Energy	Exploration Right	7-Jun-23	21-Jun-23	
Bastion Oil & Gas South Africa (Pty) Ltd	Exploration Right	23-Jun-22	9-Jul-22	
Bastion Oil & Gas South Africa (Pty) Ltd	Exploration Right	23-Jun-22	9-Jul-22	
Bastion Oil & Gas South Africa (Pty) Ltd	Exploration Right	23-Jun-22	9-Jul-22	
TotalEnergies, Mainstreet, CNR, Qatar	Production Right	5-Sep-22	19-Sep-22	
Tosaco Energy (Pty) Ltd	Exploration Right	5-May-20	16-Jul-20	
Rhino Oil and Gas Exploration SA (Pty) Ltd	Exploration Right	03-Jan-2019	23-Jan-19	
Motuoane Energy (Pty) Ltd	Exploration Right	14-Jan-18	28-Feb-28	
Sungu Sungu (Pty) Ltd	Exploration Right	14-Sep-16	19-Sep-16	
Shell Exploration South Africa B.V	Exploration Right	21-Jan-22	28-Jan-22	Application withdrawn
Shell Exploration South Africa B.V	Exploration Right	21-Jan-22	28-Jan-22	Application withdrawn
Shell Exploration South Africa B.V	Exploration Right	21-Jan-22	28-Jan-22	Application withdrawn
Bundu Oil and Gas (Pty) Ltd	Exploration Right	31-Aug-10	7-Sep-10	
Falcon Oil and Gas (Pty) Ltd	Exploration Right	19-May-10	2-Jun-10	

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Figure 7: Section 10 Notices and Provincial Gazettes (PASA,2025).

The continued issuance of active exploration and production permits and licences by PASA as the regulatory authority, provides clear evidence that the industry is operational and engaged in ongoing activities. These permits, as seen below in Figure 8, reflect active interest from companies in exploring and potentially developing resources within the country (PASA,2025). The number of applications received and granting of such rights also signals that the government and industry stakeholders recognise the potential strategic and economic value of these resources, even within a context where the industry contributes minimally to South Africa's overall energy mix. This activity emphasises the relevance of this sector in the country’s energy strategy and highlights the potential for further development.

ACTIVE EXPLORATION & PRODUCTION PERMITS/RIGHTS

25 entries per page

Search:

File no.	Holder	Area / Province	Date issued	Date commenced	Term	Expires	Period
12/3/027	Tetra4 (Pty) Ltd	Evander, MP	2007.05.08	2007.05.08	3 years	2010.05.07	Application for renewal granted but not yet executed, pending appeal.
12/3/031	Tetra4 (Pty) Ltd	Evander, FS	2007.05.08	2007.05.08	3 years	2010.05.08	Applied for renewal. Granted but not yet executed, pending appeal.
12/3/032	Tetra4 (Pty) Ltd	Virginia , FS	2022.11.21	2022.08.23	2 years	2024.08.22	third renewal period
12/3/034	Tetra4 (Pty) Ltd	Virginia, FS	2007.05.08	2007.05.08	3 years	2010.05.07	Applied for first renewal, pending appeal
12/3/094	Tetra4 (Pty) Ltd	Virginia, FS	2022.11.21	2022.08.23	2 years	2024.08.22	third renewal period
12/3/315	Motuoane Energy	ONSHORE, Free State	2023.07.10	2022.03.15	2 years	2024.03.14	applied for second renewal
12/03/002	Thungela Operations (Pty) Ltd	Waterberg,LP	2024.02.23	2024.01.22	2 years	2026.01.21	third renewal period
12/3/262	Booi Brothers	Mutale & Malamulele, Limpopo Province	2021.02.24	2021.12.03	2 years	2023.12.02	applied for third renewal
12/3/214	Gold One Africa (Pty) Ltd	Various Farms, FS Province	2019.11.15	2019.08.28	3 years	2022.08.27	applied for renewal
12/3/270	Afro Energy (Proprietary) Ltd	Various Farms, in FS, MP & KZN Provinces	2023.06.28	2023.06.12	2 years	2025.06.11	1st renewal period
12/3/271	Afro Energy (Proprietary) Ltd	Various Farms,Amersfoort, in MP Province	2023.06.28	2023.02.20	2 years	2025.02.19	1st renewal period
12/3/272	Afro Energy (Proprietary) Ltd	Various Farms, in MP Province	2023.06.28	2023.02.14	2 years	2025.02.13	1st renewal period
12/3/294	Rhino Oil	Various Farms, FS Province	2021.10.29	2019.01.23	3 years	2022.01.22	applied for first renewal. Pending EA Appeals
12/3/318	Rhino Oil	Various Farms, FS Province	2021.10.29	2019.01.23	3 years	2022.01.22	applied for first renewal. Pending EA Appeals
12/3/288	twala Mnyamande	onshore Mpumalanga	2022.06.23	2021.09.01	3 years	2024.08.31	Initial Period
12/3/364	Gondwana Energy (Pty) Ltd	Onshore, Eastern Cape	2022.09.28	2022.07.06	3 years	2025.07.05	Initial Period
12/3/365	Gondwana Energy (Pty) Ltd	Onshore, Eastern Cape	2022.09.28	2022.07.06	3 years	2025.07.05	Initial Period
12/3/373	Imbokodo (Pty) Ltd	onshore, Mpumalanga	2024.01.19	2023.09.04	3 years	2026.09.03	Initial Period
12/3/374	Imbokodo (Pty) Ltd	Onshore, Free State	2024.01.19	2023.09.04	3 years	2026.09.03	Initial Period
12/3/370	karabelo Energy Solution (Pty) ltd	ONSHORE, Free State	2024.05.22	2024.03.15	3 years	2027.03.14	initial Period

Showing 1 to 20 of 20 entries

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Figure 8: Illustration of Active Exploration & Production Permits/Rights (PASA, 2025)

a) Renergen's role in South Africa's Gas industry

Renergen is South Africa's first onshore natural gas explorer and producer of liquefied helium (LHe) and liquefied natural gas (LNG), based in the Virginia Gas Project which is located in the province of Free State (as seen in Figure 9 below). This project involves liquefying natural gas, separating helium, and producing almost a 100% pure liquid helium.



Figure 9: The Virginia Gas Project in Free State, South Africa (Renergen, 2025).

Renergen holds Africa's first onshore petroleum production right, spanning 187,000 hectares in Welkom, Virginia, and Theunissen. Tetra4, was established in 2005 and obtained its Exploration Right in 2007 and transitioned to an Onshore Petroleum Production Right in 2012 (Neethling, 2024). Renergen successfully achieved helium production in 2024. They aim to lead in LNG and helium markets, supporting South Africa's energy transition while benefiting from carbon tax exemptions (Renergen, 2025).

Renergen aims to meet South Africa's helium demand while exporting the surplus and supplying the country's first commercial LNG. Phase 1 targets helium production of 350 kg/day, with Phase 2, expected in 2026, significantly expanding output to 7.6 billion cubic feet over 19 years (Renergen,2025). LNG production will start at 50 tons/day, increasing by 34,400 GJ/day in Phase 2. The project is expected to generate 360 temporary jobs during construction and 160 permanent jobs upon full development (Barradas, 2025). Renergen operates as a lower-cost producer due to its use of shallow wells which are approximately 1,000 to 1,500 ft deep. This allows gas to flow naturally minimising both extraction costs and environmental impact (Lewis, 2024).

b) Kinetiko's role in South Africa's gas industry

The Kinetiko Amersfoort Development spans the provinces of Mpumalanga and KwaZulu-Natal in South Africa (Claasen, 2024).

Kinetiko Energy's gas resources in South Africa are recognised with a contingent resource estimated at 6 trillion cubic feet (tcf) and a prospective resource of 5.8 tcf (Kinetiko Energy LTD, 2024). The company achieved its first gas reserve certification in late 2023, assessing 6.4 billion cubic feet (BCF) over a pilot production area supported by a Joint Venture with the Industrial Development Corporation (IDC). Notably, all 44 wells drilled have successfully encountered gas. (Kinetiko Energy LTD, 2025). The anticipated resource growth is expected to follow a flow testing program and the granting of additional exploration rights (ER383), which encompasses 2,383 km² extending the project's life and value (Kinetiko Energy LTD, 2024).

Kinetiko's operations do not require hydraulic fracturing, as the asset consists of shallow conventional gas reserves situated in sandstone layers above coal deposits, sealed and compartmentalised by dolerite sills and dykes. The gas quality is said to be high, with measured methane content ranging from 96% to 98% with minimal CO2 levels (Kinetiko Energy LTD, 2024). According to de Bruyn (2024) Kinetiko has already demonstrated the gas-to-power capability, confirming

the quality of the gas in May 2024, which requires minimal refining and allows for quick revenue generation upon obtaining production rights.

Furthermore, each production test well is strategically located near critical infrastructure, such as gas pipelines and transmission lines, enhancing Kinetiko's potential to become a significant supplier to South Africa's power grid (Evans, 2024). This is well illustrated in Figure 10 below.

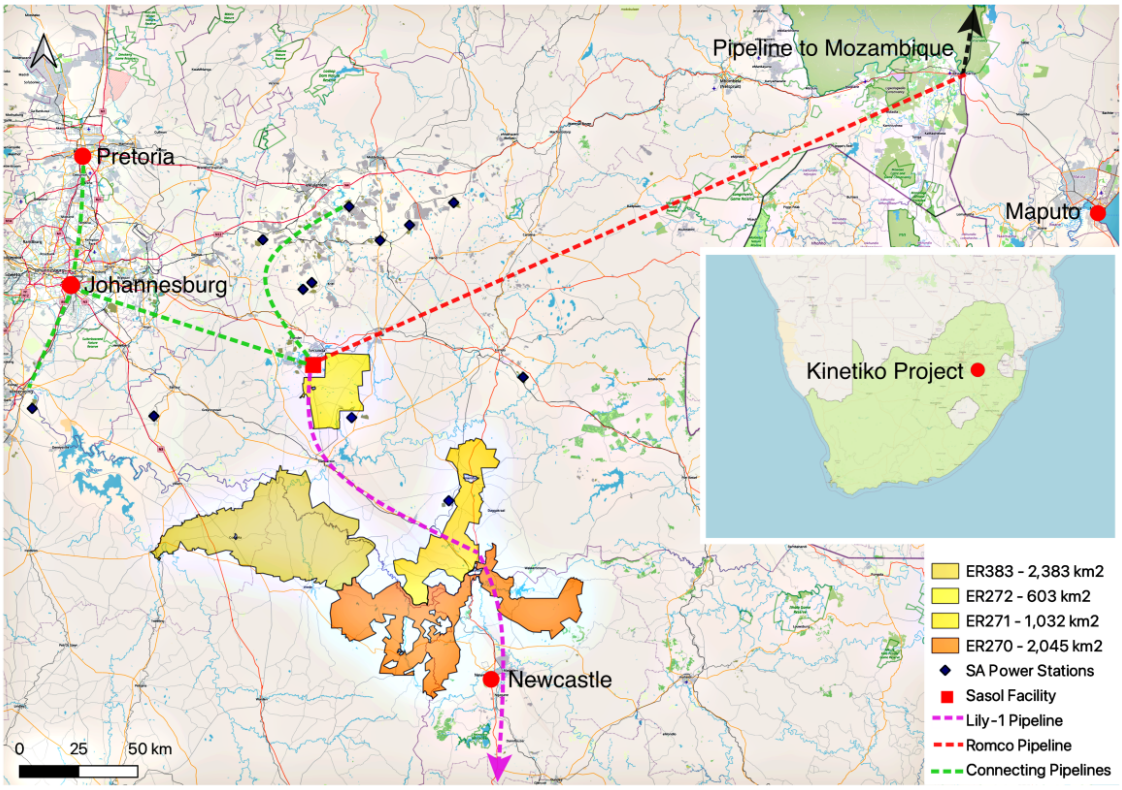

Figure 10: The Kinetiko project location (Kinetiko Energy LTD, 2025)

Kinetiko's significant discovery stems from approximately 13 years of drilling in proximity to established gas infrastructure, such as Eskom's Majuba Plant, Sasol's Secunda GTL Refinery, and the Lily-1 Pipeline, alongside nearby roads and transmission lines (Engel, 2023). This strategic emphasis on areas adjacent to existing gas pipelines has facilitated Kinetikos ability to access proven resource zones, thereby increasing the potential for successful gas production and its integration into the broader energy network.

Table 1: Detailed information for the key projects in South Africa:

Project	Location	Size/ Capacity	Ownership	Potential	Technology	Challenges	Status
Brulpadda and Luiperd Fields	Offshore South Africa	Estimated reserves: ~1 billion barrels of oil equivalent	Total (45%), Qatar Petroleum (25%), Canadian Natural Resources (20%), Africa Energy (10%)	Gas-to-liquid production	Advanced drilling and exploration techniques	Commercial viability, regulatory frameworks	Advanced exploration stages
Karoo Shale Gas	Karoo Basin	Estimated reserves: ~209 trillion cubic feet of gas	Various stakeholders	Estimated reserves of 209 trillion cubic feet	Hydraulic fracturing, directional drilling	Environmental opposition, regulatory clarity	Development hindered by strong opposition-Moratorium
PetroSA offshore southern cape fields	Mossel Bay	Resource estimate? (1tcf)	PetroSA	Critical for energy production	Gas-to-liquid technology	Shut down due to gas supply instability	Currently shut down since November 2020
East Coast / Projects	East Coast of South Africa	Various fields, estimated reserves not fully defined	Sasol, ENI	Oil and gas development	Conventional exploration	Environmental opposition	Interest exists, but facing significant barriers
Renergen's Virginia Gas Project	Free State	Estimated reserves: ~1.4 trillion	Renergen (100%)	Helium and methane production	Advanced extraction techniques	Regulatory and environmental challenges	Currently in production phase, helium

		cubic feet of gas					production expected in 2024
Total's Outeniqua Basin Exploration	Offshore Southern Cape	Potential reserves yet to be quantified	Total (Operator)	Potential oil and gas reserves	Advanced offshore drilling techniques	Uncertainty in regulatory frameworks	Exploration ongoing, with recent discoveries adding potential
Kinetico's Coal Bed Methane Project	Various locations	Potential reserves: data not fully disclosed	Kinetico (100%)	Coal bed methane production	Hydraulic fracturing	Environmental opposition	Exploration and feasibility studies ongoing
Shell's Exploration Activities in the Outeniqua Basin	Offshore Southern Cape	Potential reserves yet to be quantified	Shell (Operator)	Oil and gas reserves potential	Advanced offshore exploration techniques	Regulatory challenges	Exploration ongoing, facing regulatory challenges
Sasol's Natural Gas Pipeline	Various	Capacity: supports ~200 million cubic feet of gas per day	Sasol (100%)	Gas distribution	Pipeline infrastructure	Aging infrastructure	Ongoing operations and maintenance
TotalEnergies' Exploration in the Orange Basin	Offshore	Potential reserves yet to be quantified	TotalEnergies	Significant oil reserves	Advanced offshore drilling techniques	Commercial viability concerns	Ongoing exploration, assessing viability

(Authors own)

These oil and gas activities highlight the sector's potential for expansion and diversification. If harnessed effectively, these resources could reduce the country’s trade deficit and contribute to GDP growth. Successful integration of

new projects and technologies will be key to unlocking the full potential of South Africa's oil and gas industry and achieving long-term growth and sustainability (Zakizadeh & Zand, 2024).

c) Comparative analysis with neighbouring regions

South Africa’s oil and gas industry is advancing at a slower pace compared to neighbouring countries like Namibia and Mozambique which have experienced significant growth and investment in recent years. Namibia’s discoveries in the Orange Basin according to Coffee (2024) and Mozambique’s natural gas developments in the Rovuma Basin African Energy according to Chamber (2025) both highlight the potential for Southern Africa to become a major player in the global energy market. These successes emphasise the need for South Africa to create a more investor-friendly environment by addressing policy and regulatory bottlenecks. As supported by Mosquera Valderrama (2024) highlights the importance of regional cooperation and connecting regional integration with economic development and the 2030 Sustainable Development Agenda.

d) Government incentives and support

The South African government has attempted to incentivise investment in the oil and gas sector through initiatives such as tax breaks, favourable licensing terms, and partnerships with state-owned entities (SOEs). According to the IMF (2023), the carbon tax, introduced in June 2019, serves as a key tool in the country's mitigation strategy. This is based on the polluter-pays principle as it is levied on fuel inputs according to emission factors and procedures established by the Intergovernmental Panel on Climate Change. However, the effectiveness of these measures has been undermined by inconsistent policy implementation and bureaucratic inefficiencies. To attract investors, the government should aim to prioritise creating a stable and transparent regulatory environment while addressing governance and corruption concerns that are incredibly prevalent. Further, expanding public-private partnerships (PPPs) and investing in research and development (R&D) could further improve the sector’s appeal. Qadir et al.,

(2021) states that there is a need for a robust incentive framework which is essential for unlocking the full potential of South Africa's resources.

2.1.7 Methane emissions

According to IEA (2023) oil and gas exploration and production contribute around 15% of global energy-related emissions, equating to 5.1 billion tonnes of CO2-equivalent in 2022. The climate implications of such activities are significant and necessitate significant reductions to meet global climate ambitions.

As seen in Figure 11 below, Methane accounts for approximately 30% of the global temperature rise since the Industrial Revolution. The oil and gas sector emits about 80 Mt of methane, equivalent to 2.4 Gt CO2 equivalent. Further, to achieve emission reduction objectives by 2030 as stipulated in the NZE Scenario, methane emissions must decrease by over 60 Megatons (Mt).

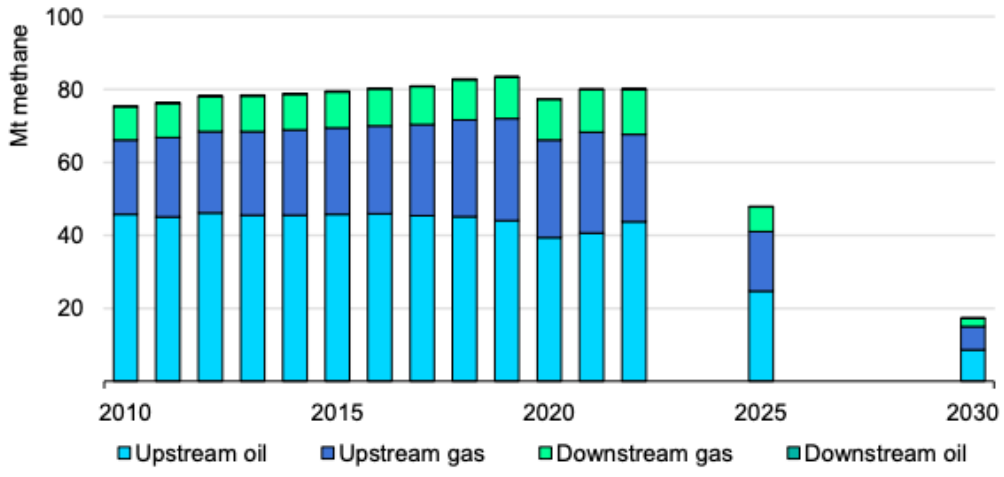

Figure 11: Methane Emissions from Oil and Gas in the NZE Scenario from 2010-2030 (IEA, 2023)

Within the South African policy landscape, the regulation of methane emissions is gaining increasing prominence. The Climate Change Act of 2024 establishes binding carbon budgets for major emitters, an initiative that implicitly extends its coverage to include methane emissions stemming from upstream oil and gas operations. Furthermore, South Africa's Greenhouse Gas Emissions Reporting

Regulations (2017, amended 2020) impose a mandatory requirement for corporations to monitor and report methane leaks. In tandem with this, the Carbon Tax Act introduces an economic price signal on fugitive emissions, inclusive of methane.

Despite the implementation of these measures, limitations persist in terms of enforcement and monitoring capacity, while policy instruments exhibit a greater focus on CO2 than on methane. A more robust policy framework, incorporating methane-specific regulations such as mandatory leak detection and repair (LDAR) and clearer restrictions on routine flaring and venting would serve to harmonise South Africa's approach with international best practice. Such measures would also substantially enhance the effectiveness of the nation's broader climate change policy framework

2.1.8 Advancements and shortcomings in emissions reduction

CO2 emissions have surged past pre-pandemic levels, this is primarily due to the increased use of coal, reaching a record 36.8Gigatonnes (Gt) in 2022, with a further projected rise for 2023. Emerging economies, notably China, India, and Indonesia, have driven this increase quite significantly. Oil and gas emissions remained stable between 2019 and 2023. Oil demand decreased by 12% in 2020 but rebounded by 10% through 2022, with increases driven by mature economies and regions like Africa and the Middle East. The natural gas demand initially fell but further decreased again due to the energy crisis following the Russian invasion of Ukraine, with Europe, Asia, and Latin America contributing to the decrease. The consumption of coal is rising in emerging economies but declining in developed economies, while oil consumption in mature economies has surpassed 2019 levels as seen in Figure 12 below.

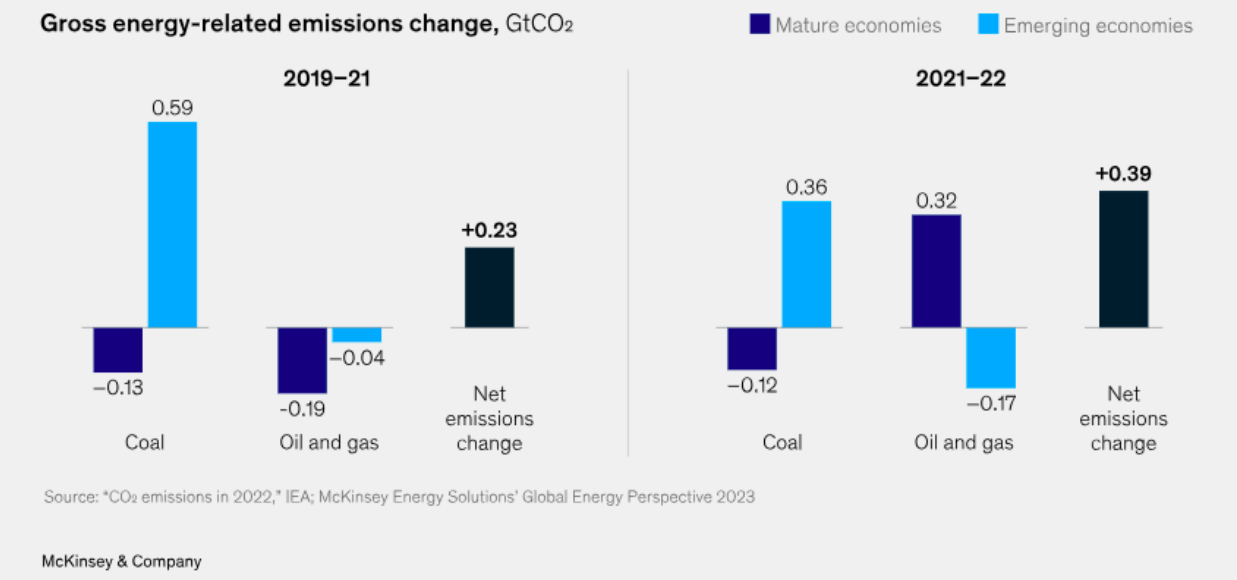

Figure 12: illustration of energy source emission changes between mature economies and emerging economies from 2019 (McKinsey, 2024).

The upstream oil and gas sector has achieved a 12% reduction in emissions per barrel of oil equivalent (boe) since 2017, this is largely due to efforts such as reduced flaring, improved methane leak detection, electrification, and carbon capture, utilisation, and storage (CCUS) (McKay & Pollard, 2024). However, despite this progress, overall emissions remain high and are tied closely to production levels.

Reducing emissions from South Africa's upstream oil and gas sector requires a coordinated package of policy and regulatory interventions. The Climate Change Act (2024) provides a legal basis for sectoral carbon budgets and strengthened enforcement, while the Carbon Tax Act and GHG Reporting Regulations already cover fugitive methane emissions. However, more upstream-specific measures are needed, including stricter methane leak detection and repair (LDAR) requirements, a ban on routine flaring, enhanced monitoring and verification, and targeted incentives for electrification and carbon capture, utilisation and storage (CCUS). By sequencing short, medium and long-term actions, South Africa can reduce upstream emissions while safeguarding energy security and supporting a just transition.

2.1.9 The impact of International Climate Agreements on the Oil and Gas industry

Although South Africa's emissions are relatively negligible compared to larger oil producers, the developed international climate commitments continue to drive national policy changes and regulatory frameworks affecting the upstream sector (McKay & Pollard, 2024).

The Paris Agreement, with its flexible NDCs, allows countries to set their own emission reduction targets (Paris Agreement, 2015). For South Africa, these targets, while not legally binding, guide national climate policies and impact the oil and gas sector's operations (UNFCCC, 1992). However, despite the lack of enforceable targets, the expectations set by these agreements influence the regulatory environment and operational practices within the sector.

International agreements primarily target emissions reductions from fossil fuel consumption instead of production. This creates a gap in regulatory coverage (Shapovalova, 2020). According to McKay & Pollard (2024), this limitation means that while South Africa faces pressure to reduce emissions from production activities, there are less direct regulations impacting upstream operations. For South Africa, this translates into increased pressure on the upstream oil and gas industry to adopt advanced technologies that reduce emissions, such as carbon capture and storage and to enhance overall environmental performance (McKay & Pollard, 2024).

a) Political dynamics in South Africa's Oil and Gas industry

In South Africa's oil and gas sector, a significant political conflict exists between Minister Gwede Mantashe of the Department of Mineral Resources and Energy (DMRE) and former Minister Barbara Creecy of the Department of Forestry, Fisheries, and the Environment (DFFE). According to Van Diemen & Engel (2023), Mantashe advocates for the expansion of fossil fuel exploration and production, positioning it as essential for economic growth, energy security, and job creation. Minister Mantashe argues that a diversified energy mix, including oil

and gas, is vital for addressing energy shortages and attracting foreign investment.

Conversely, Creecy emphasises environmental sustainability and the necessity of mitigating climate change impacts (Dawood, 2021). The DFFE, under her leadership, prioritised stringent environmental regulations and assessments for energy projects, often causing delays for fossil fuel initiatives. Creecy's approach aligns with South Africa's commitments to global climate agreements, advocating for a transition to renewable energy sources.

This dichotomy reflects a broader struggle within the South African government regarding energy policy direction, resulting in policy paralysis where fossil fuel initiatives experience significant regulatory challenges. The outcomes of this conflict will significantly influence the country’s energy future, necessitating a delicate balance between economic development and environmental preservation to achieve long-term sustainability and energy security.

2.2 Definition of the topic

"Analysing Policy and Regulatory Frameworks for Addressing Climate Change in South Africa's Oil and Gas Industry" refers to the process of examining and evaluating and examining the Climate Change Act (2024), the Carbon Tax Act, the GHG Emissions Reporting Regulations, and policy frameworks such as the National Climate Change Response Policy (2011) and the Integrated Resource Plan (2019**)**, which collectively guide South Africa’s approach to mitigating climate change impacts in the oil and gas sector. This analysis involves assessing the effectiveness, coherence, and alignment of these frameworks with national and international climate mitigation objectives. The topic aims to identify strengths, developmental areas, gaps, and opportunities within the regulatory landscape to enhance environmental protection, promote sustainable development, and reduce associated GHG emissions in South Africa’s oil and gas activities.

2.3 Research Question 1: How could potential future oil and gas exploration and production in South Africa contribute to greenhouse gas (GHG) emissions and climate change?

2.3.1 Importance of addressing climate change in South Africa's Oil and Gas industry

South Africa plays a significant role in global GHG emissions, this is predominantly due to its significant dependence on coal for electricity generation (Cohen & Winkler, 2014). Additionally, according to PASA (2023), the country's oil and gas industry is expected to grow, further contributing to its carbon footprint and environmental impact. However, the country's oil and gas industry has faced recent setbacks, including Total's abandonment of key projects and Shell's ongoing legal challenges, raising questions about its growth potential. Despite these challenges, there are expectations for future potential development driven by substantial untapped reserves and ongoing interest from various companies. This anticipated growth in the oil and gas sector could further exacerbate the country's carbon footprint and environmental impact, particularly as production levels remain low and the industry grapples with increasing scrutiny in a global context shifting towards sustainability (Ritchie, Roser, & Rosado, 2020).

As seen in Figure 13 below, the oil and gas industry is responsible for a less considerable share of the country's CO2 emissions compared to coal, which contribute to global climate change (Ritchie, Roser, & Rosado, 2020). As climate change intensifies, this transition is crucial for meeting the country's Nationally Determined Contributions (NDCs) under the Paris Agreement, aligning with domestic policy objectives and national development goals, and mitigating the adverse impacts such as pollution (Hanto et al., 2022).

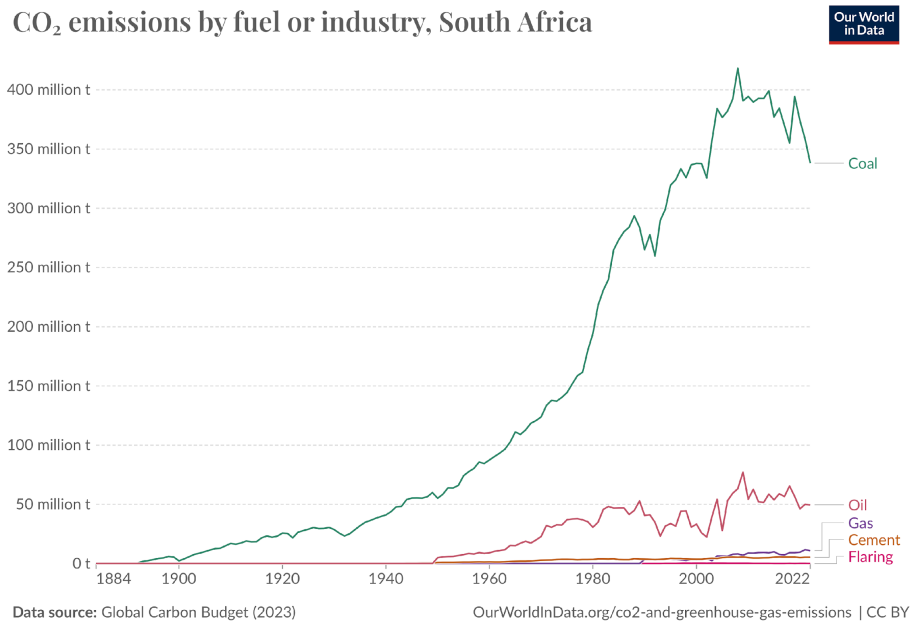

Figure 13: CO2 Emissions by fuel or industry in South Africa (OurWorldInData, 2023)

In this context, as argued by Hanto et al. (2022), addressing climate change within South Africa's oil and gas industry is crucial. Like coal, the oil and gas sector are a major contributor to global GHG emissions (Shapovalova, 2023). Nonetheless, natural gas plays a key role in South Africa's transition to net-zero carbon emissions, serving as a transitional fuel that reduces dependence on coal while facilitating the integration of renewable energy sources. Thus, advancing to cleaner and more sustainable energy options within the oil and gas industry is vital for mitigating climate change impacts (Sayidini, 2022).

However, as illustrated in Figure 14 below, global progress requires collective action, with significant contributions from top emitters such as China, the USA, and the EU, which together all account for over half of global emissions (OurWorldInData, 2023). South Africa's contribution to global CO2 emissions is less than 1.1%, highlighting its relatively minor impact on the global emissions profile.

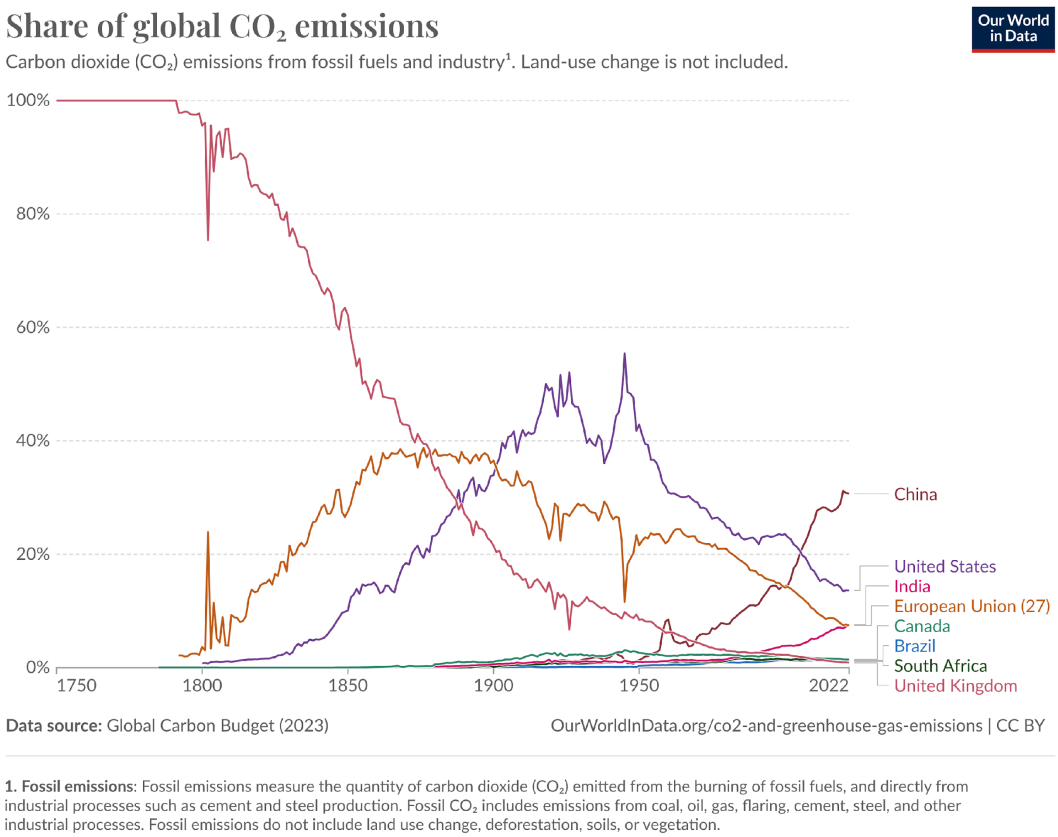

Figure 14: Share of global CO2 emissions from fossil fuels (OurWorldInData, 2023)

Globally, fossil fuel consumption has worsened environmental degradation and elevated CO2 emissions. Despite these challenges, South Africa's global CO2 emissions remain negligible in the oil and gas industry as seen in Figure 15 below, particularly when compared to many developed and emerging economies such as Canada, Norway and Guyana (OurWorldInData, 2023).

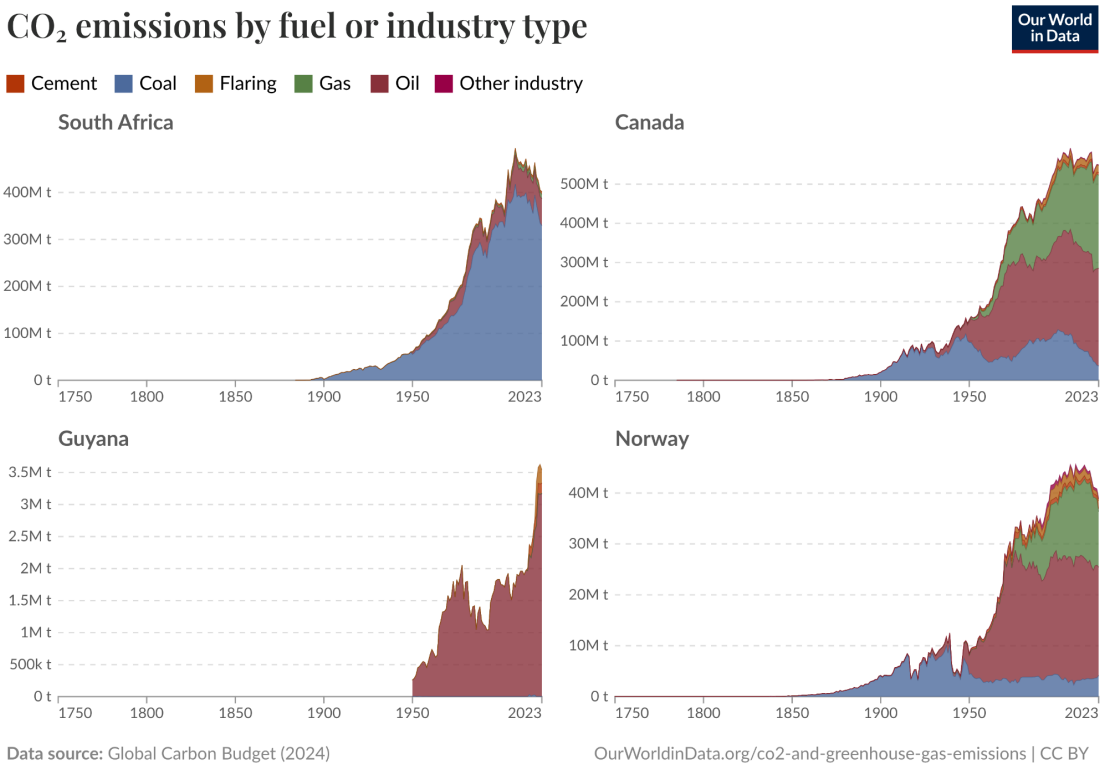

Figure 15: Comparison of CO2 emissions by fuel or industry-South Africa, Canada, Guyana and Norway (OurWorldInData, 2023)

However, as of 2024, Norway stands as Europe's leading oil and gas producer while maintaining one of the lowest carbon emissions intensities worldwide. It also has the lowest average upstream emissions intensity, meaning it releases fewer emissions per barrel of oil and gas produced compared to other major suppliers (Gillespie & Forbes-Cable, 2024). This is primarily due to its stringent environmental policies, widespread electrification of offshore oil and gas production platforms, and strict carbon pricing mechanisms (Herrera Anchustegui & Tscherning, 2024).

According to NS Energy Business (2022) the Eldfisk North Project, has a peak production capacity of 15,000 barrels of oil equivalent per day (boed), with an emissions intensity of 7kg of CO2 per barrel of oil equivalent.

To determine the annual production, we multiply(x) the daily production by the number of days in a year:

Annual Production=15,000 boed x 365 days=5,475,000boe/year.

To calculate the total annual emissions by multiplying the annual production by the emissions intensity:

Total Annual Emissions= 5,475,000boe/year x 7kg CO2/boe=38,325,000kg CO2

Converting this value to tonnes (since 1 tonne = 1,000 kg), it is found that the total annual emissions for the Eldfisk North Project are:

Total Annual Emissions= 38,325,000kg CO2 / 1,000 = 38,325tonnes CO2

In contrast, According to Oil Climate Index (2025) Nigeria Obagi project in Southern Nigeria has high levels GHG emissions that is poorly managed. The current production barrels per day of 9,910 and 637kg CO2 per barrel of crude and an estimated GHG emission rate of 2million metric tons of CO2 eq. per year

The emission intensity is: 637kg Co2 per barrel

The total GHG emissions: 2 million metric tons of CO2 eq per barrel

Converting the metric since 1 tonne = 1,000 kg

Therefore 1 metric ton= 1000kg

The total emissions in kg CO2 = 2, 000 000 x 1000

= 2 000 000 000kgCO2

The Nigeria Obagi project has significantly higher emissions thus contributing to overall GHG output. Unlike Norway, which has invested in low-emission energy solutions for its oil and gas sector. This analysis demonstrates that from an emissions perspective the Obagi project has a considerably higher carbon footprint than the Eldfisk North Project. If Nigeria adopts these technologies, it

can lower the emissions intensity and remain competitive in the decarbonisation journey.

According to Statista (2024), in 2022 Norway's oil and gas operations produced approximately 36kg of CO2 per barrel of oil equivalent (as seen below in Figure 16), significantly lower than the global average. Norway has implemented measures such as banning routine flaring, reducing methane leakage, and integrating renewable energy into offshore extraction, all of which contribute to its low emissions footprint (Herrera Anchustegui & Tscherning, 2024).

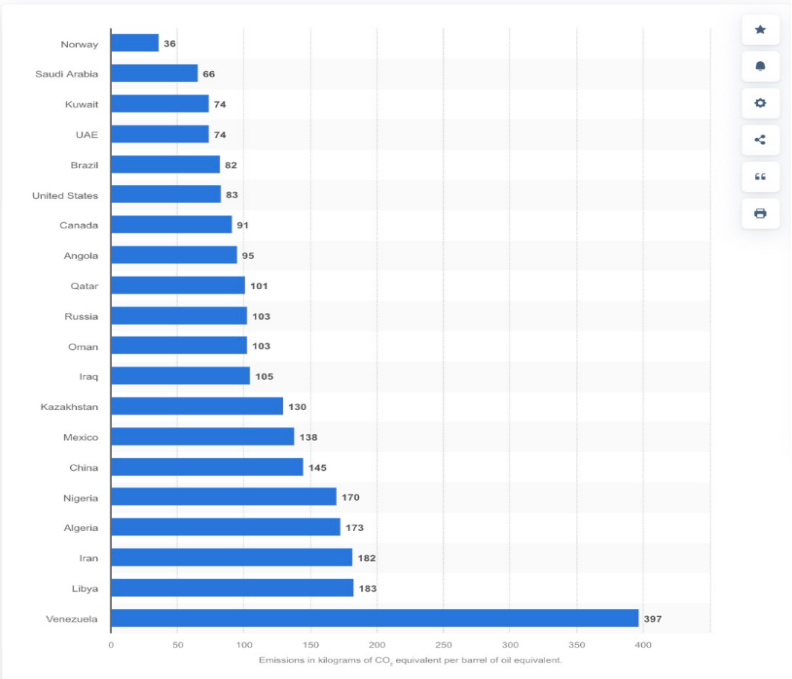

Figure 16: illustrates the average CO2 emissions from oil production in 2022 by country in kilograms (kg) of CO2 equivalent per barrel of oil produced (Statista, 2024).

To reduce its carbon footprint in future operations, South Africa could potentially follow Norway's example by adopting stricter emission regulations, investing in carbon pricing mechanisms, and accelerating the integration of renewable energy into its power generation sector. The process of transitioning to cleaner energy sources and enhancing efficiency in fossil fuel operations could significantly lower emissions while ensuring long-term energy security and sustainability (IEA, 2023).

a) Sustainability pressures and regulatory challenges for Oil and Gas

South Africa’s upstream oil and gas sector is facing significant legal challenges that highlight the sector's complexities. Notably, environmental justice groups, including the Green Connection and Natural Justice, have contested TotalEnergies' offshore drilling plans in court, arguing that the environmental authorization from the DMRE and DFFE lacks sufficient Environmental Impact Assessments (EIAs) and community consultation. They claim the drilling could potentially harm marine ecosystems and local livelihoods (Engel, 2024).

Additionally, a recent court ruling revoked Shell’s seismic exploration rights of the Wild Coast, marking a major victory for environmental and local community groups. These disputes highlight the ongoing conflicts between economic development and environmental and social justice in South Africa’s oil and gas industry (Tsotetsi, 2022). These legal disputes reflect the ongoing tension between economic development, environmental protection, and social justice in South Africa's oil and gas sector. The ongoing potential for legal disputes may deter investment in an already complex sector, impeding the growth of the upstream petroleum industry. Therefore, such hindrances could lead to far-reaching consequences, putting energy security, local economic expansion, skill enhancement, and employment prospects at risk.

As societal norms shift towards sustainability, companies face increased scrutiny over their sustainability practices and climate impact. Recent South African court rulings uphold ESG principles, emphasising the importance of balancing ESG concerns with economic considerations. Therefore, prioritising ESG is essential in effectively navigating disputes to ensure compliance and mitigate risks (Kennedy, Rapson, & Serongoane, 2021)

2.3.2 Role of policy and regulatory frameworks

In South Africa, several key regulatory bodies oversee upstream oil and gas operations, including the Department of Mineral Resources and Energy (DMRE),

the Petroleum Agency South Africa (PASA), and the Mineral and Petroleum Titles Registration Office (MPTRO). The regulatory framework also involves the Department of Environment, Forestry and Fisheries, the National Energy Regulator of South Africa (NERSA), the International Trade Administration Commission (ITAC), and the South African Maritime Safety Authority (SAMSA), each addressing areas such as environmental compliance, pricing regulation, trade, and safety (Strong, 2022).

The National Environmental Management Act (NEMA) 107 of 1998 is a fundamental piece of legislation governing environmental standards in South Africa. It mandates Environmental Impact Assessments (EIAs), environmental authorizations, and management plans, emphasising the "*polluter pays"* principle and public involvement (Ridl & Couzens, 2010; RSA, 1998). NEMA ensures that oil and gas activities adhere to environmental standards through detailed EIAs and regulatory oversight (McLean & Carrick, 2007). The Mineral and Petroleum Resources Development Act (MPRDA) 28 of 2002 regulates the exploration and exploitation of mineral and petroleum resources, with the state as the custodian. It aims to ensure equitable access and promote sustainable development, though it has faced criticism for prioritising financial gains over community benefits (van der Vyver, 2012; Hermanus et al., 2015). The Upstream Petroleum Resources Development (UPRD) Act 23 of 2024 seeks to create a framework for upstream operations that balances economic growth with environmental responsibility but has experienced delays affecting investment (SANEA, 2024; Parliament of South Africa, 2021). The Draft South African National Petroleum Company (SANPC)Bill of 2024 proposes the creation of a state-owned entity to unify energy sector management, improve transparency, and reduce political interference, although governance concerns remain (Koranteng, 2023). These regulations provide oversight and guidelines for the oil and gas sector in South Africa.

A significant development in environmental regulation occurred in 2014 with the transfer of environmental oversight from the MPRDA to NEMA by the DMRE and the Department of Water and Sanitation, establishing the "One Environmental System" (Department of Water and Sanitation (DWS, 2023).

This analysis supports the view that policy and regulatory frameworks are vital in guiding the transition to a sustainable and low-carbon future (Todd & McCauley, 2021). Falcone (2023) emphasises that effective policies and regulations play a crucial role in promoting the adoption of cleaner technologies and improving energy efficiency.

2.4 Research Question 2: What are the current policy and regulatory gaps in South Africa that hinder effective climate change mitigation by the oil and gas industry?

2.4.1 Policy and regulatory frameworks in South Africa's Oil and Gas industry related to climate change

Policy and regulatory frameworks play a crucial role in shaping the direction and pace of this transition and need to be critically evaluated and aligned with climate mitigation objectives to ensure a sustainable and low-carbon future for the oil and gas industry in South Africa (SAPVIA, 2022). South Africa has made significant strides in developing policy and regulatory frameworks to address climate change and promote sustainable development in its oil and gas industry.

In the context of the transition to sustainable energy, the role of policy and regulatory frameworks is paramount. These frameworks are essential for guiding the industry towards sustainable energy sources, ensuring environmental protection, fostering social equity by facilitating equal access to energy resources, and promoting economic growth through the cultivation of a sustainable energy sector (Drago & Gatto, 2022).

2.4.2 National Climate Change Response Policy White Paper (NCCRP)

The NCCRP outlines guiding principles for climate action, prioritises adaptation and mitigation efforts, and defines the necessary legal, regulatory, and governance frameworks (DWS, 2017). It specifies the roles of stakeholders and

coordination mechanisms for effective climate action, aligning with South Africa's Vision 2030. This vision recognises climate change as a significant challenge and includes strategies for institutional development, enhanced coordination at all levels, and capacity building for local governments and decision-makers (CoJ, 2015).

The NCCRP is a comprehensive, evidence-based framework that integrates climate planning and action across various government levels (Lukey, 2020). It lays the groundwork for a climate-resilient, low-carbon economy and society (Garland, 2014). The policy aims to enhance climate governance by addressing both mitigation and adaptation to reduce greenhouse gas (GHG) emissions (Zipplies & van Schalkwyk, 2008). Its main goals include managing the impacts of unavoidable climate change by strengthening social, economic, and environmental resilience and emergency response, and contributing equitably to global efforts to stabilize atmospheric GHG concentrations (Popoola et al., 2020).

The National Department of Environment, Forestry and Fisheries (DEFF) leads and coordinates climate change-related activities, including mitigation, adaptation, monitoring, and evaluation programs (Leck & Simon, 2018; Ortega-Cisneros et al., 2021). The DEFF also plays a key role in policymaking, ensuring that environmental conservation and protection efforts align with international climate obligations (Lukey, 2020).

To address climate change within the oil and gas industry, a policy framework is needed that promotes sustainable practices, reduces GHG emissions, and supports the transition to cleaner energy sources. The NCCRP emphasises energy policy and the shift towards renewable energy (Lukey, 2020).

The NCCRP exemplifies a collaborative, evidence-based approach to policy development involving government departments, scientists, and the public. This process could serve as a model for creating targeted policy and regulatory frameworks to effectively address climate change challenges in the upstream oil and gas industry.

2.4.3 Climate Change (Act of 2024)

The Climate Change Act of 2024 in South Africa provides a legal framework for addressing climate change by promoting a transition to a low-carbon, climate-resilient economy. Victor and Van Wyk (2024) emphasise that the Act is essential for provincial and municipal authorities, as well as enterprises operating within South Africa, in facilitating the nation’s objective of attaining Net Zero emissions. It establishes the National Climate Change Adaptation Strategy, which guides government efforts in mitigating GHG emissions and enhancing resilience to climate impacts. The act includes provisions for developing regulations, standards, and reporting mechanisms to monitor progress while emphasising stakeholder engagement from local governments, businesses, and civil society. It aligns with South Africa's international commitments, including the Paris Agreement, and aims to balance economic growth with environmental sustainability in the face of climate change challenges (South African Government, 2024).

However, the literature identifies several gaps in the Act’s implementation. There are concerns around the capacity of provincial and municipal authorities to enforce new requirements, the uncertainty around sectoral carbon budgets and how they will be allocated, and the lack of clear incentives for industries such as oil and gas to adopt CCUS or methane abatement technologies (Metzger, 2022).These gaps suggest that while the Act provides a strong legal foundation, its effectiveness will depend on institutional capacity, regulatory clarity, and industry cooperation this supported Motebang (2021).

2.4.4 National Climate Change Adaptation Strategy (NCCAS)

The National Climate Change Adaptation Strategy (NCCAS) is South Africa's main framework for climate change adaptation, aligning sustainable environmental management with national development goals (Averchenkova, Gannon, & Curran, 2019). It offers detailed guidance across different government levels and sectors, ensuring compliance with international commitments under

the Paris Agreement while addressing vulnerabilities and maximizing adaptation opportunities (DEA, 2011). However, the strategy does not outline specific adaptation measures for the oil and gas industry, indicating a need for targeted policies and regulations to bolster climate resilience within this sector (DFFE, 2020).

The NCCAS emphasises the importance of incorporating climate considerations into national development frameworks, highlighting the need for thorough vulnerability assessments and coordinated adaptation efforts across various sectors (DEA, 2011; DFFE, 2020). This suggests that the oil and gas industry should align its practices with national adaptation goals to meet both domestic and international climate commitments.

Similarly, the National Climate Change Response Policy (NCCRP) highlights South Africa's dedication to creating a climate-resilient economy and society, though it does not specifically address the oil and gas sector. The policy emphasises the need for adaptable and locally informed responses across different sectors.

As South Africa's regulatory framework evolves, there is growing pressure on the oil and gas industry to adjust its operations to manage climate risks and support broader national climate change mitigation and adaptation goals (DEA, 2011; DFFE, 2020).

2.4.5 Difficulties associated with the implementation of climate change mitigation policy in the context of South Africa’s Oil and Gas industry.

Implementing climate change mitigation policies in South Africa's oil and gas industry faces numerous challenges and complexities, as highlighted by recent research and expert analysis. Trollip & Boulle (2017) highlight that despite the presence of core mitigation policies outlined in the National Climate Change Response White Paper (NCCRWP) such as reporting regulations, carbon

budgets, pollution prevention plans, and the carbon tax, full implementation remains elusive. This is exacerbated by ongoing challenges in the empirical basis of quantitative emissions analysis, particularly concerning Pollution Prevention Plans (PPP) and Mandatory Performance Agreements (MPA), which are critical for effective policy implementation. These hurdles necessitate transparent peer-reviewed analysis and improved accessibility of official data to inform policy decisions (Trollip & Boulle, 2017).

Furthermore, the delay in promoting GHG emissions reporting regulations and data systems, as noted by Bogmans, Pescatori, & Prifti (2023), exacerbates the implementation gap and undermines the efficacy of mitigation strategies. The complexity of policies within the NCCRWP presents significant technical challenges for the Department of Environmental Affairs (DEA), exacerbated by inadequate coordination among various governmental departments involved in mitigation policy implementation (Trollip & Boulle, 2017).

Therefore, addressing these challenges requires strengthening technical capacity within the DEA and across sectors, as emphasised by Awuni et al. (2023). The learning-by-doing approach adopted by the DEA, while potentially beneficial for capacity building, raises concerns about conflicts of interest and highlights the need for robust governance frameworks. Additionally, the unrealistic time frames outlined in the NCCRWP for policy implementation highlight the intricate nature of climate change policy execution (Awuni et al., 2023).

Moreover, the absence of specific regulations tailored to the oil and gas sector, unlike those governing renewable energy initiatives such as the REIPPPP and the Carbon Tax Act, poses a significant challenge. This regulatory gap impedes effective GHG emissions reduction and sustainable practices within the industry (Bogmans, Pescatori, & Prifti, 2023). Further, fragmented governance across governmental levels and sectors further compounds the challenge, leading to inconsistent policy implementation and enforcement, alongside regulatory uncertainties.

2.5 Conclusion of literature review

The literature review highlights the historical evolution, current dynamics, and prospects of South Africa's onshore and offshore oil and gas industry. The oil and gas industry remains relatively negligible compared to global producers, it is still active, with ongoing exploration and development efforts. Offshore discoveries, particularly in the Orange Basin, present opportunities for future growth, while onshore prospects, including shale gas in the Karoo, remain uncertain due to environmental concerns and regulatory challenges. Despite these opportunities, investment in the sector has been constrained by policy uncertainty, infrastructure limitations, and the global energy transition.

In addition, the literature review highlights the complexities of implementing climate change mitigation policies in South Africa. While frameworks such as the National Climate Change Response White Paper (NCCRWP) exist, full implementation remains hindered by regulatory delays, insufficient sector-specific policies, and institutional capacity constraints. The lack of clear emissions reduction regulations for the oil and gas sector, in contrast to structured renewable energy programs, presents a significant challenge. The process of strengthening governance, improving technical capacity, and aligning domestic policies with international climate commitments are critical to balancing energy security with sustainability.

Despite these challenges, South Africa's oil and gas industry holds untapped potential. These resources could support domestic energy security and economic growth. Addressing regulatory and institutional gaps, fostering investment, and ensuring a coordinated transition to a low-carbon economy will be essential for shaping the industry's future within the broader climate policy landscape.

2.6 Conceptual or theoretical framework

Theory is fundamental in qualitative research, guiding methodology and shaping inquiry (Collins & Stockton, 2018). This study uses environmental ethics and

justice to assess policy and regulatory frameworks in South Africa's oil and gas industry. Environmental ethics, a branch of applied ethics, explores normative principles guiding human interactions with nature, emphasising sustainability, biodiversity conservation, and climate obligations (Attfield, 2012). Environmental justice assesses the fair distribution of environmental benefits and burdens, ensuring inclusivity in policymaking (Makoul, 2022).

Utilitarian ethics, rooted in consequentialism, supports decisions that maximise societal welfare while minimising environmental harm (Schminke et al., 2003; Stavrova, 2020). This framework integrates ethical theories to evaluate policy effectiveness, emphasising fairness, sustainability, and social welfare in mitigating fossil fuel impacts. By applying these principles, the study critically examines regulatory approaches, ensuring climate policies promote equitable environmental benefits while addressing systemic disparities in South Africa's transition to a low-carbon economy.

CHAPTER 3. RESEARCH METHODOLOGY

This chapter describes the research methodology used to examine the policy and regulatory frameworks related to climate change in South Africa's oil and gas industry. It further outlines the research approach and design, the data collection methods, sampling strategy, and research population, and explains the data analysis techniques that were applied. This methodology aims to ensure the study's quality, reliability, and validity.

3.1 Research approach

This study employed a qualitative research approach to investigate the policy and regulatory frameworks for climate change mitigation in South Africa's oil and gas industry. Qualitative research is particularly effective for examining these complex frameworks, providing nuanced insights and a deeper contextual understanding (Moser & Korstjens, 2017). It prioritises trustworthiness and rigour, revealing the socio-environmental dynamics that shape policy decisions and regulations (Tierney & Clemens, 2011).

This method captures diverse stakeholder perspectives ensuring that the voices of affected communities, policymakers, and industry representatives are heard. Ashby (2011) highlights that qualitative research amplifies participants' voices, facilitating inclusive exploration of policy impacts, while Chandler, Anstey, and Ross (2015) emphasise its role in enhancing the credibility of analysis through critical self-reflection.

Qualitative research is valuable for understanding the social, economic, and environmental implications of oil and gas activities. It uncovers varied viewpoints and organisational complexities, informing comprehensive policy strategies (Tierney & Clemens, 2011). The iterative nature of qualitative research allows for in-depth exploration of key themes, making it effective for identifying implementation challenges and evaluating policy effectiveness (Ford & Goger,

2021). The focus on contextualisation is crucial for analysing regulatory frameworks.

3.2 Research design

The research design for this study adopted an exploratory approach to examine the policy and regulatory frameworks related to climate change in South Africa's oil and gas industry. This design provided a foundational framework, guiding the data collection and analysis processes. The process of selecting an appropriate research approach is essential, as this directly impacts the gathering of relevant information however, research design encompasses a series of interconnected choices that shape the study's direction and methodological rigour (Sileyew, 2019).

This study employed an exploratory qualitative design, primarily utilising semi-structured interviews for data collection (Saunders, Lewis, & Thornhill, 2015). This method facilitated direct engagement with participants, fostering rapport and collaboration, which enriched the data and offered deeper insights (Antwi & Hamza, 2015). Exploratory research is particularly effective for investigating emerging issues, allowing researchers to ask open-ended questions that reveal underlying dynamics and provide nuanced understandings (Saunders et al., 2015). Additionally, the flexibility inherent in exploratory research enables adjustments to the approach during data collection, incorporating new insights as they arise (Ngulube, 2015).

Qualitative research, especially interview-based designs, is vital for generating knowledge, as it allows researchers to critically assess existing theoretical assumptions and engage in inductive theory development (Sandberg & Alvesson, 2011). Compared to quantitative methods, qualitative research facilitates in-depth exploration of novel topics and complex phenomena, making it especially valuable for understanding dynamic, context-specific issues (Wilhelmy & Köhler, 2021).

3.3 Data collection methods

Moser and Korstjens (2018) highlight that qualitative research utilises various data collection methods, including in-depth interviews, participant observation, and focus groups. In this study, semi-structured interviews were conducted with key stakeholders in the oil and gas sector and related sectors. These interviews enabled a thorough exploration of participants' perspectives, experiences, and insights regarding climate change mitigation policies and regulations. The semi-structured format allowed for flexibility in probing and asking follow-up questions while ensuring that key topics are consistently covered during the interviews.

3.4 Population and sample

The population sample for this study consisted of various stakeholders involved in South Africa's oil and gas industry. Participants included government officials, such as policymakers and regulators, as well as industry experts from oil and gas companies, executives, retired professionals and consultants who provided insights into industry practices and challenges related to climate change mitigation. Experts had varying levels of experience, ranging from 5 to over 36 years. According to Tierney & Clemens (2011) diversity among participants enhances the richness of observations and reduces the risk of generalising findings from individual responses.

3.4.1 Sampling method

Given the diversity of all the participants a purposive sampling method was deemed suitable for this study, enabling the intentional selection of participants with relevant experiences to provide in-depth insights into South Africa's climate change policy and regulatory frameworks in the oil and gas sector. This method had the objective to capture a wide range of perspectives, thereby enhancing the study's rigour (Palinkas et al., 2015).

The goal was to interview at least 20 participants who met the established criteria, using personal networks as and when needed. However, only 14 participants were interviewed. To recruit additional participants, referral sampling was employed, seeking referrals from those already interviewed and from other potential participants who could not or chose not to participate. This strategy aimed to achieve theoretical saturation, assuming a relatively homogeneous population, with interviews designed to reach saturation if the participants shared similar characteristics.

3.5 The research instrument

In this study, one-on-one semi-structured interviews were conducted using a customised interview guide (see Appendix A) aligned with the research questions. According to Adams (2015), the quality of the interview guide is crucial, as it significantly affects research outcomes. The questions were formulated based on the literature review findings. Furthermore, the Interview guide ensures thorough topic coverage, provides a structured framework, and enhance clarity for interviewers. This can all influence research results (Stuckey, 2013). Open-ended questions allowed for participants to articulate their experiences freely, which enabled the fostering of honesty and individuality in their responses (Albudaiwi, 2017). This approach facilitated the collection of in-depth information, aiming to provide a comprehensive understanding of the challenges and opportunities in mitigating climate change impacts within South Africa's oil and gas sector.

3.6 Procedure for data collection

All the participants were first contacted through email to introduce the research study and invite them to participate voluntarily. They all received detailed information about the study's aims and content, and formal consent was obtained at the beginning, allowing them to withdraw at any time. The semi-structured

interviews lasted around 60 minutes on average and were conducted and recorded using Zoom and Microsoft Teams.

The process of recording interviews is beneficial as it helps maintain focused interactions (Rutakumwa et al., 2020). Additionally, transcription is a lengthy and often tedious process according to Al-Yateem (2012), making verbatim records essential for unbiased and accurate documentation. Verbatim transcription was crucial for this qualitative research as it intends to capture every aspect of participants' speech, including pauses, and emotional nuances, which are important for thorough analysis.

However, transcription can be prone to errors due to misinterpretation, cultural differences, or language barriers. Keeping the original audio recordings allowed for the process of verifying and correcting transcripts as needed. This approach ensured that the transcription reflected the interviewee's intended message while capturing relevant non-verbal cues, such as interruptions and overlapping dialogue which are vital for understanding context (McMullin, 2023).

3.7 Data analysis and interpretation

This research applied a qualitative methodology to delve into the nuanced perspectives, experiences, and perceptions of all stakeholders. A thematic analysis is used to discover patterns within the qualitative data according to Naeem et al., (2023) therefore providing insights into climate change policies. In addition, content analysis was conducted to analyse policy documents for significant themes and as a result, enhances the understanding of the regulatory frameworks governing the sector. According to Busetto et al., (2020), comparative analysis facilitates the examination of stakeholder perspectives, and this enabled the identification of shared challenges and opportunities.

The research further incorporated Atlas.ti software, which supported the systematic coding and organisation of the attained qualitative data. This tool facilitated the categorisation of interview transcripts based on emerging themes

and allowed for the visualisation of relationships between codes, thereby enhancing the understanding of the data. The findings were interpreted in relation to existing literature that was analysed to assess the strengths and weaknesses of the relevant policies this was to ensure trustworthiness and rigor through established qualitative research criteria as supported by Busetto et al., (2020).

According to Ahmed (2024), high-quality qualitative research is grounded in four key criteria namely: credibility, which is attained through extensive engagement, ongoing observation, triangulation and transferability. This is achieved by providing thorough and detailed descriptions dependability. This was ensured through meticulous documentation and an established audit trail as well as confirmability.

This methodological approach contributed to a deeper understanding of the complexities associated with climate change policies which ultimately provided valuable insights to inform mitigation strategies in South Africa's oil and gas sector.

3.8 Limitations of the study

While this study provides valuable insights into the perspectives of stakeholders regarding climate change policies in South Africa's oil and gas sector, it is not without limitations. According to Galdas (2017), it is important to identify and understand research bias, as this is crucial for evaluating the significance of study findings and plays a key role in evidence-based decision-making. One significant limitation that exists is the potential for participant bias, as participants may have personal interests or affiliations that could influence their responses. This bias may affect the authenticity of the data collected as participants might tailor or alter their answers to align with perceived expectations or norms. According to Turner (2015) the awareness of the potential effects of response bias on data validity is essential. Therefore, applying strategies such as building rapport, using open-ended questions, and applying multiple triangulation methods was vital to

mitigate its impact and obtain a more accurate representation of participants' perspectives and experiences for this study.

(Polit & Beck, 2010) argues that qualitative research can yield generalisable insights. This study's qualitative nature means that the findings may not be generalisable to the broader population. The insights gained are specific to the participants involved in this research and may not fully represent the views of all individuals within the oil and gas industry or related sectors. Consequently, the applicability of the findings to other contexts or regions may be limited.

Further, another limitation is the reliance on semi-structured interviews, which, although they are beneficial for obtaining in-depth information, it can also lead to variability in the data collected (Albudaiwi,2017). The differences in participants' communication styles and the interviewer's guiding questions may result in inconsistent data complicating the comparative analysis of participant perspectives.

Furthermore, while the use of Atlas.ti facilitated systematic data analysis, the software's effectiveness relies on the researcher's skill in coding and interpreting the data. Any inconsistencies or errors in this process could impact the reliability of the findings.

Lastly, the research was conducted within a specific timeframe which may have restricted the depth of exploration into some issues. Future studies could potentially benefit from a longitudinal approach allowing for a more comprehensive understanding of how stakeholder perceptions and policy frameworks evolve over time in response to climate change challenges.

3.9 Validity and trustworthiness

Polit & Beck (2010) emphasises the importance of validity and trustworthiness as key considerations for enabling meaningful generalisation from qualitative research. To ensure the trustworthiness of qualitative research methods is crucial this is because this method offers a deep understanding of complex issues by

exploring the perspectives, experiences, and motivations of those involved. This approach was particularly useful for this study, as it provided insights into decision-making processes, participant interactions and the contextual factors influencing policy implementation (Maher et al., 2018).

Therefore, by focusing on enhancing transferability, credibility, dependability, and confirmability this study had the objective to provide valuable and actionable insights for the oil and gas sector. These insights will have implications for future policy development, decision-making, and future research efforts (Maher et al., 2018).

3.9.1 Transferability

The study's transferability was enhanced by its comprehensive approach to data collection, diverse sampling strategy, and detailed descriptions of the research context (Maher et al., 2018). Polit & Beck (2010) argues that transferability is an important model of generalisation in qualitative research as it provides guidance on how researchers can support transferability through detailed contextual descriptions and conceptual framing

Therefore, by providing insights into the policy and regulatory frameworks for addressing climate change in the oil and gas industry, the study offered valuable lessons and implications that may potentially be relevant to similar industries and or contexts facing similar challenges globally (Maher et al., 2018).

3.9.2 Credibility

Turner (2015) highlights triangulation as an effective strategy for minimising bias and enhancing the validity and reliability of research findings. This approach involves using multiple methods or perspectives to gather data, which corroborates results and provides a more comprehensive understanding of the research topic. By integrating various approaches, triangulation addresses the limitations of any single method which leads to more robust and credible results.

In this study, the interviews were audio-recorded and transcribed verbatim to capture participants' responses accurately. Clear data descriptions were provided and during data analysis credibility was ensured through several strategies, including the triangulation of data sources, which involved cross-referencing findings from different interviews and documents. Furthermore, as the researcher, reflexivity was practised by reflecting on the potential biases and influences throughout the research process, which further enhanced the credibility of the findings (Maher et al., 2018).

3.9.3 Dependability

Dependability in qualitative research relates to the consistency and stability of findings over time and across various contexts. It requires thorough documentation of the research process and the establishment of an audit trail, enabling other researchers to trace the steps taken and verify the results, thereby ensuring that the findings are reliable and trustworthy which enhances the overall credibility of the research (Ahmed, 2024).

This study-maintained dependability through systematic data collection and analysis procedures. By applying structured methods for data collection and analysis, the study ensured the reliability and consistency of its findings which then led to facilitating replication and validation by other researchers (Maher et al., 2018). The transcripts were reviewed for errors to minimise the risk of potential misinterpretation.

3.9.4 Confirmability

Confirmability in qualitative research refers to the degree to which the findings can be confirmed or corroborated by others ensuring that the results are shaped by the participants' experiences rather than the researchers' biases or preconceptions (Maher et al., 2018). This study ensured confirmability through several rigorous strategies. Diligent record keeping was utilised and applied.

3.10 Ethical considerations

Ensuring that research is ethical involves several key considerations and actions throughout the research process.

Here's a detailed description of how ethical standards were upheld based on the responses provided in the WBS ethics form:

3.10.1 Data collection

Data collection in the study was conducted through semi-structured interviews, allowing for in-depth exploration of participants' perspectives within the oil and gas sector or related fields. Participants were asked about their industry involvement, with a focus on their roles and years of experience. The interviews were conducted online to accommodate participants' schedules and ensure accessibility. The personal identifying information such as names, gender, and specific age details was excluded to ensure anonymity and protect participants' privacy. This approach enabled a comprehensive understanding of the participants' experiences while maintaining and ensuring confidentiality and anonymity.

3.10.2 Minimisation of risk to participants

The study involved minimal risk categorisation. Prior to the process of data collecting, the study adhered to the ethical clearance process set by the Wits Business School (WBS). This was to ensure that the principles of non-maleficence and beneficence were upheld. This research was designed to avoid causing any harm or risk to participants. This approach effectively reduced any potential risks related to all the respective participants involvement in the study.

3.10.3 Anonymity and confidentiality

Anonymity and confidentiality in the study were ensured through various measures. As indicated, anonymity was assured by removing participants' names and identifying information from all collected data, with pseudonyms assigned to protect their identities. Prior to data collection, consent was obtained from all the participants, who were also asked to provide verbal consent before the interview began. For this study, none of the participants were remunerated for their involvement in the study in any way. The data was stored on a password-protected computer and cloud platform with access restricted to the researcher. The data will be stored for a period not exceeding five (5) years and remain anonymised.

In addition, confidentiality agreements were established with any third parties involved in data storage or analysis to prevent unauthorised disclosure. Interview transcripts had all identifying details of the participants redacted. These steps were applied and collectively maintained to ensure and protect participants' anonymity and confidentiality throughout the research process.

Table 2: Consistency Table: research questions, hypotheses, data collection methods, and data analysis techniques

Research Question	**Prop/ Hyp. No.**	**State Proposition**	**Data Collection Detail/ approach**	**Data Analysis Method**
How could potential future oil and gas exploration and production in South Africa contribute to greenhouse gas (GHG) emissions and climate change?	1	Oil and gas exploration and production in South Africa has the potential to contribute to GHG emissions and climate change.	Semi-structured interviews with industry experts. Questions 15-21	Thematic analysis, content analysis, comparative analysis, interpretation, and synthesis of qualitative data (Busetto et al., 2020).
What are the current policy and regulatory gaps in South Africa that hinder effective climate change mitigation by the oil and gas industry?	2	The current policy and regulatory frameworks in South Africa's oil and gas industry are not effective in regulating and	Semi-structured interviews with industry experts. Questions 3-14	Thematic analysis, content analysis, comparative analysis, interpretation, and synthesis of qualitative data (Busetto et al., 2020).

		reducing GHG emissions.		

CHAPTER 4. FINDINGS AND DISCUSSIONS

4.1 Introduction

Chapter 4 consolidates and discusses the qualitative data gathered from fourteen (14) semi-structured online interviews with participants across various roles in the oil and gas industry. The data gathered during these interviews were analysed using Atlas.ti, version 25, a computer-aided qualitative analysis software.

The results submitted underwent a process of coding and code grouping into themes in alignment with addressing the research objectives. The findings are presented in an unbiased manner that is free from subjective interpretation or partiality.

The key insights were drawn from participants' contributions with verbatim quotes included to ensure depth and clarity.

The findings address the following research questions:

1. How could potential future oil and gas exploration and production in South Africa contribute to greenhouse gas (GHG) emissions and climate change?

2. What are the current policy and regulatory gaps in South Africa that hinder effective climate change mitigation by the oil and gas industry?

The themes and sub-themes identified provide a comprehensive framework for understanding these challenges. The first set of themes focuses on the environmental and operational impacts of oil and gas activities which included emissions reduction strategies, technological advancements or developments, and political, operational or financial barriers or constraints.

The second set highlights regulatory gaps or shortcomings and existing policy misalignment addressing issues such as sector-specific emission targets (SETs),

incentives, international pressures and the risk of greenwashing. Altogether, these themes provide insight into the complexities of balancing energy security with climate commitments in South Africa's evolving policy landscape.

Table 3: Details of participants

PARTICIPANT (PSEUDONYM CODE)	**INDUSTRY EXPERIENCE(YEARS)**	**INDUSTRY/SPECIALITY**
Participant 1	34 years	Energy sector: Downstream oil and gas.
Participant 2	24 years	Energy sector: Oil and gas.
Participant 3	14 years	Energy: manufacturing, and industrial applications
Participant 4	36 years	Energy and finance
Participant 5	10 years	Energy: Upstream oil and gas
Participant 6	25 years	Energy and finance
Participant 7	21 years	Energy and consulting
Participant 8	21 years	Energy: Upstream oil and gas
Participant 9	26 years	Energy: Upstream oil and gas

Participant 10	20 years	Environmental Specialist (Air Quality Management and Climate Change)
Participant 11	5 years	Environmental Consultant
Participant 12	16 years	Environmental Specialist (ESG and Sustainability)
Participant 13	11 years	Energy: Upstream oil and gas
Participant 14	30 years	Energy: Petrochemicals

4.2 Participant demographics overview

To maintain the confidentiality and privacy of the participants, their names and affiliations have been omitted from the analysis and discussion. This approach aims to ensure that the focus remains on the content of their insights while protecting their respective identities. The participants come from diverse professional backgrounds and possess varying levels of experience, ranging from five (5) to thirty-six (36) years in the energy sector and related fields with a focus on oil and gas and some participants were retired at the time.

4.3 Findings and Discussion related to RQ 1: how could potential future Oil and Gas exploration and production in South Africa contribute to greenhouse gas (GHG) emissions and climate change?

4.3.1 Theme 1: Exploration and production impacts on climate change

The discussions highlighted a strong consensus among participants that oil and gas exploration and production significantly contribute to global GHG emissions across various stages of upstream operations. These emissions arise from exploration, extraction, and production processes, presenting a considerable challenge in balancing energy security with global climate related objectives.

Participant 12 articulated the fundamental nature of the oil and gas sector, stating,

"*The product they sell is a fossil fuel product... The oil and gas sector feeds into these two value streams: energy and petrochemical."*

This statement highlights the dual role of fossil fuels, not only as a primary energy source but also as a crucial feedstock for petrochemical industries, which produce essential goods such as plastics, fertilisers, and chemicals (Kapsalyamova & Paltsev, 2020). This interconnectedness complicates emission reduction efforts, as demand for fossil fuel-derived products remains high across multiple sectors across the world.

A key issue that was raised during the discussions was the inherent tension between economic viability and environmental sustainability. Historically, the oil and gas sector had prioritised economic returns and energy production, often at the expense of environmental considerations. This dynamic has hindered the adoption of cleaner technologies and practices (Cohen, 2020). As Participant 4 observed,

"Without effective regulation, the industry prioritises economic returns over sustainable practices."

This perspective aligns with broader literature suggesting that inadequate or poor regulatory frameworks allows for the industry to prioritise profits before purpose instead of driving towards environmental sustainability objectives. In the absence of stringent policies, the sector's profit-driven model tends to impede the necessary transitions to low-carbon alternatives that result in reduced harm to the environment.

Further, methane emissions emerged as a critical concern, particularly in upstream operations. Participant 9 highlighted this issue by stating,

"The upstream sector is a significant contributor to emissions, especially considering methane leaks during extraction and transportation."

As research has proven, methane is a potent GHG with a significantly higher global warming potential than carbon dioxide over a 20-year period. Therefore, addressing methane emissions is an essential component of any objective that is driven for mitigating the climate impact of oil and gas operations as supported by Lavoie et al., (2017). However, the sector faces substantial challenges in effectively detecting and addressing these emissions due to aging infrastructure, inadequate maintenance, and gaps in monitoring and reporting systems.

Moreover, as developing economies pursue GDP growth and industrialisation, they are increasingly relying on fossil fuels which inevitably leads to an increase in CO2 emissions. Recent research indicates that emerging markets and developing countries account for more than two-thirds of global CO2 emissions as supported by Gielen et al., (2019). This highlights the urgency and need for addressing emissions not only from the upstream sector but also from the broader economic activities in these regions where is has been noted that the potential for methane and CO2 emissions is significant. Therefore, comprehensive emission reduction strategies must encompass both operational practices in the upstream sector and the developmental pathways of these growing economies.

Participants emphasised the importance of improved monitoring and regulation within the upstream sector to effectively address these emissions. For example, Participant 2 explained,

“Streamlining their exploration and production activities and building in these additional measures does require looking at what type of support is needed.”

Therefore, study findings align with the literature regarding the urgent need for the upstream oil and gas industry to reconcile operational practices with the importance of environmental sustainability. Unfortunately, without significant changes the potential future contributions of exploration and production activities to GHG emissions and climate change could remain considerable and have continued negative consequences to the climate.

The potential for technological innovation to mitigate these emissions was a focal and key point of the discussions. Participant 2 emphasised the necessity of institutional and financial support for integrating advanced detection technologies, stating,

"Building in additional emissions reduction measures requires the right support."

Modern leak detection systems such as infrared cameras, drone surveillance, and AI-driven monitoring offer promising solutions for identifying and addressing methane leaks in real time (Daugela et al., 2020; Frish, 2020; Shi et al., 2020). The application of drone-based methane detection systems as highlighted by Tassielli et al. (2024), allows for rapid data acquisition and the monitoring of large geographical areas thus improving response times and efficiency in emissions management.

However, financial constraints remain a significant barrier to the widespread adoption of such technologies. Participant 13 highlighted this challenge, stating,

"International funders are increasingly reluctant to finance fossil fuel projects,"

which complicates efforts to transition toward more sustainable practices. The reluctance of investors to support fossil fuel-based ventures is most likely driven by growing environmental, social, and governance (ESG) considerations as well as the increasing global momentum toward decarbonisation.

Overall, the discussions by the participants highlighted the urgent need for a comprehensive approach to emissions reduction in the oil and gas sector. The discussions emphasised the need for a paradigm shift within the industry, where climate change considerations become integral to decision-making processes.

As global climate agreements, such as the Paris Agreement impose stringent emissions reduction targets, the upstream oil and gas sector must adapt to the ever-evolving regulatory landscapes and integrate sustainability considerations into its operational and financial decision-making processes.

a) Industry perspectives on Scope 1 emission reductions

The discussion surrounding Scope 1 emission reductions within the oil and gas industry reveals a complex interplay among corporate commitments, technological advancements, and economic pressures. While a significant number of companies publicly pledge to reduce their respective Scope 1 emissions, the sincerity and depth of these commitments are variable and often contingent upon external pressures and incentives.

As highlighted by Participant 12,

"Oil and gas companies are stating their commitments or their pledges in terms of reducing their Scope 1 emissions, and some of them really are taking actions to address low-hanging fruit."

This observation indicates that some companies are implementing practical measures to mitigate emissions such as improving maintenance routines and minimising intermittent flaring. However, such actions, observed in countries like Canada, reflect a recognition of the need for substantial efforts to address emissions, corroborated by Sharaf-Addin (2024). However, the effectiveness and

impact of these initiatives vary significantly across the industry and from country to country.

This variability aligns with the findings of Onolemhemhen and Bello (2024), who discussed the impact of carbon pricing on energy efficiency across Canadian provinces, highlighting both its potential and limitations. While carbon pricing aims to reduce emissions by increasing the cost of fossil fuel use, the observations made by Onolemhemhen and Bello (2024) study indicates that its effectiveness is influenced by regional disparities and economic impacts. Canada's carbon pricing system which includes both a fuel charge and an output-based pricing mechanism, has led to increased industrial costs and potential declines in economic growth and employment. However, it has been emphasised that aligning carbon pricing with broader energy efficiency strategies such as optimising production inputs and reducing flaring can enhance its effectiveness in achieving climate targets as seen in Canada’s case.

Despite these initiatives, challenges persist in achieving meaningful progress in Scope 1 emissions reductions. As Participant 11 cautioned,

"...the peer pressure among companies to be seen as leaders in emissions reduction is real. But it also leads to superficial actions that don’t address the root problem."

This highlights a critical concern regarding the distinction between genuine emissions reduction efforts and those driven by public relations. The need for robust industry-specific guidelines, such as the GHG Protocol, is highlighted to ensure consistent and reliable practices in Scope 1 emissions accounting as emphasised by Sharaf-Addin (2024). As such, these guidelines can help mitigate the risk of superficial compliance measures that do not substantially contribute to emissions reductions.

Further, the economic context plays a pivotal role in shaping the industry’s approach to emissions reductions. Participant 7 emphasised the disincentives facing companies, stating,

"The industry is being disincentivised from further investing and growing. The upstream oil and gas industry is probably one of the most expensive investments. We still need more incentives for investments into oil and gas in South Africa."

This sentiment was echoed by Participant 8, who remarked,

"These oil companies are not willing to spend our money trying to decarbonise if there's not going to be an incentive. I don't think current policies have been effective in reducing Scope 1 emissions."

Both these statements reflect a pervasive concern that without the appropriate incentives and supportive policies, companies are often reluctant to invest in emissions reduction technologies and initiatives. This is an unfortunate reality.

Moreover, Participant 5 noted,

"South Africa is in the early stages of exploration and production, and we must ensure future projects are designed with emissions reductions in mind."

This perspective emphasises the importance of integrating emissions reduction strategies into the foundational design of oil and gas projects. Participant 5 further stated,

"Companies must take responsibility for incorporating low-carbon solutions from the outset rather than treating emissions reduction as an afterthought."

This calls for a paradigm shift within the industry, where emissions considerations are embedded from the initial stages such as project planning and operational strategies.

Participant 13 added a significant dimension to the discussion, stating,

"I think I would suggest that the focus moves from pure mitigation to reduction strategies... We need to move the focus from a heavier fossil fuel consideration and what the net positive impact is by moving that onto a lower burn, a lower emitting fossil fuel, for instance, natural gas."

This perspective aligns with Filonchyk et al. (2024) argument, which emphasises the importance of transitioning towards more sustainable energy sources within the fossil fuel sector and advocates for a balanced approach that prioritises lower-emission alternatives.

Participant 2's viewpoint reflects an optimistic stance regarding the feasibility of achieving emissions reduction targets, asserting,

"I don't take a view that they are unable to achieve them. I do think that they would be able to achieve them. I'm of the view that the goals need to be structured and set such that they are also alive to the balance or the harmonisation of the different objectives that countries and the continent need to satisfy."

This perspective highlights the importance and great need for clear emissions reduction goals to be tailored to specific economic and developmental contexts, recognising that achieving sustainability objectives must align with broader national and regional priorities.

Both technological and economic challenges remain significant barriers to reconciling high production levels with net zero Scope 1 emissions. Participant 7 noted that

"White papers and thinking show around alignment to overall global climate commitments."

However, it was also expressed that there are concerns about the implications for project progression, stating,

"…So that kind of hinders the progress of projects means you have to pilot a lot. It means you have to work with manufacturers to be able to understand how we progress, the technology, how we scale the technology. The demand on technology is also another challenge, just as finance is the issue."

This statement highlights the importance of collaboration between companies and technology providers to facilitate the development and scaling up of innovative solutions that can effectively reduce emissions and be well adopted.

According to McLaughlin et al. (2023), the lack of both financial support and an enabling regulatory environment will lead to the deployment of carbon capture and storage (CCS) technologies to remain limited, unfortunately. Innovative solutions, such as electrified rigs and CCS technologies, are essential in bridging this gap as emphasised by Sharaf-Addin (2024). However, the integration of these technologies is often contingent on financial viability and regulatory support. Therefore, a multifaceted approach that combines stringent regulatory frameworks, targeted financial incentives and the promotion of technological innovation is crucial for driving effective Scope 1 emissions reductions in the oil and gas industry.

Therefore, while there is a consensus on the need for Scope 1 emissions reductions within the oil and gas sector- achieving meaningful progress requires overcoming quite a few challenges. The industry must navigate the complexities of corporate commitments, tough economic realities, and technological limitations, all while aligning efforts with broader sustainability objectives. As the discourse around emissions reduction evolves, it will be most likely be essential for industry stakeholders to collaborate and advocate for a regulatory environment that supports both emissions reductions and the sustainable growth of the oil and gas sector- which is a great necessity.

b) Addressing emissions reduction and regulatory challenges

The South African government has increasingly demonstrated a commitment to environmental sustainability and climate action through strategic policies such as the National Development Plan (NDP), the Integrated Resource Plan (IRP) for electricity, the National Climate Change Response Policy, and the Climate Change Act of 2024, which collectively guide the country’s transition to a low-carbon, climate-resilient economy. These frameworks emphasise the

significance of transitioning to a low-carbon economy while ensuring energy security (Montmasson-Clair & Ryan, 2014). However, the implementation of specific guidance regarding emerging technologies, particularly carbon capture and storage (CCS), remains notably limited. This lack of clarity prevents the oil and has sector's capacity to effectively reduce Scope 1 emissions which are direct emissions from owned or controlled sources.

Despite its recognition as a flagship mitigation technology in South Africa's National Climate Change Response White Paper, the implementation of carbon capture and storage (CCS) faces significant challenges. These include the absence of a comprehensive regulatory framework, limited financial incentives, and insufficient pilot projects. For instance, the World Bank's Technical Assistance Project aimed at developing CCS in South Africa has made modest progress, World Bank (2023) notes that with key milestones such as the Front-End Engineering Design (FEED) for a pilot project remaining incomplete Word Bank. This highlights the need for more robust policy support and investment to advance CCS deployment

Participant 12 emphasises a critical aspect of the current regulatory framework within the upstream oil and gas sector, stating,

"If you look at an exploration site so far upstream of oil and gas, the emissions generated from that exploration site itself is not necessarily that much compared to the use of the product that they are actually producing."

This observation reflects the reality that emissions associated with exploration activities are often less in comparison to those generated during the product's consumption phase. Consequently, from a project-specific perspective the lack of compelling emissions reduction mandates complicates the approval process for environmental impact assessments (EIAs).

This is supported by the literature of this study that reveal that despite the existence of regulatory frameworks in the industry, enforcement remains inconsistent, resulting in significant environmental degradation and adverse

health effects in affected communities. Audu and Umana (2024) highlight the challenges faced by the industry remain in balancing economic interests with environmental responsibilities, particularly regarding emissions associated with exploration activities which is a tough balance to find.

Further, the industry's recognition of environmental compliance as a strategic necessity and of great importance indicates that there is an awareness of the importance of reducing carbon emissions. However, the absence of compelling emissions reduction mandates complicates the approval process for EIAs. This then is further exacerbated by the fact that emissions generated during the consumption phase of a product often overshadow those associated with exploration activities resulting in a decreased focus on reducing scope 1 related emissions.

Additionally, the analysis highlights that there is a need for enhanced institutional capacity, clearer regulatory guidelines, and improved inter-agency coordination to ensure effective enforcement of environmental standards. Therefore, strengthening these areas is crucial for facilitating more robust environmental oversight and addressing the complexities of emissions reduction which ultimately will lead to more effective EIA approvals and better environmental outcomes.

Participant 12 further highlights that

"The only thing that might make it difficult to get approval is if a company was not dealing with things like leaks, for instance, from a pipeline."

Therefore, asserting that the existing regulatory landscape do not provide sufficient motivation for upstream companies to proactively mitigate their emissions leading to a situation where project approvals can take place with minimal accountability for their environmental impacts.

This regulatory deficiency is echoed by Participant 7, who asserts that

"Funders and financiers have a clear view that they want to limit their exposure to hydrocarbon projects."

This sentiment reflects a broader trend among investors who are increasingly wary of the associated risks involved with hydrocarbon business opportunities, especially considering growing climate change concerns. Moreover, Participant 5 highlights the delicate balance between environmental compliance and economic viability, noting,

"Environmental compliance is necessary, but excessive regulation can stifle project development and discourage investment."

(Tang et al.,)2024 demonstrates that increased uncertainty in oil prices leads firms delaying investments. Since 2017, the escalation of geopolitical conflicts and the global economic recession triggered by the covid 19 pandemic have heightened the overall associated investment risks in the oil and gas sector. In contrast, countries such as Qatar and the UAE benefit from stable political environments and an excellent business environment.

Ahmadi, Manera, and Sadeghzadeh (2019) analyse the link between investment and uncertainty in the oil and gas industry. Their findings suggest that the impact of oil market uncertainty on investment largely depends on the specific factors causing the uncertainty. To foster investment and economic growth, governments should aim to prioritise monitoring demand fluctuations. This perspective is vital for investors when determining whether to allocate resources to the oil and sector or diversify into non-oil related industries and renewable energy adoption.

The challenge lies in reconciling these competing interests, as Participant 5 further states,

"Balancing environmental goals with economic viability remains a significant challenge."

Regulatory uncertainty exacerbates this dynamic, with Participant 5 stating,

"It’s not just environmental restrictions; investors are more concerned about South Africa’s petroleum laws and regulatory uncertainty."

This highlights the necessity for a stable and transparent regulatory framework that fosters investment while ensuring environmental protection.

Audu and Umana (2024) highlighted the importance of strengthening institutional capacity, establishing clearer regulatory guidelines, and improving inter-agency coordination to achieve effective enforcement of environmental standards.

Participant 3 discusses the importance of aligning regulatory frameworks with economic growth and inclusivity, emphasising,

"The way in which that is incorporated into the upstream regulation and into the climate policies needs to be able to directly propel that agenda of economic growth and inclusivity."

This highlights the existing and inherent tension between regulatory frameworks and the objectives of achieving environmental sustainability and fostering economic development.

Further, some industry participants advocate for regulatory frameworks that support sustainable development without imposing excessive burdens on investment. They recognise that South Africa's licensing process already incorporates principles of environmental prudence. As stated by Participant 3,

"The commitment already in terms of how the licensing is pursued integrates environmental prudence. The South African environmental authorities have become quite alive to the need to talk to a holistic approach in terms of climate mitigation and climate change considerations in projects."

To bridge this gap, collaboration among stakeholders is essential. Therefore, by engaging with government departments, industry participants can advocate for policies that facilitate the adoption of CCS and other low-carbon technologies. As demonstrated in other countries such as Norway and Canada, such collaborative

efforts, supported by literature Ahmadi, Manera, & Sadeghzadeh, (2019); McLaughlin et al., (2023), have proven effective in creating clear regulatory pathways and incentivising investment in emissions reduction strategies. This can create a more conducive regulatory environment. This environment would enable companies to implement emissions reduction strategies with greater confidence and effectiveness. Furthermore, stakeholders can provide critical feedback to regulators, ensuring that policies are practical and aligned with industry needs.

Okeke (2021) highlights how European companies align their reporting with global sustainability frameworks, leading to more transparent and comprehensive emissions disclosures. This aligns with the notion that collaborative efforts such as industry partnerships can drive improved transparency and accountability in emissions reporting by encouraging standardised, rigorous disclosure practices.

Collaborative initiatives have the potential to pave the way for standardised metrics and verification processes for CCS projects, therefore improving trust among stakeholders and demonstrating progress in emissions reduction efforts. By aligning their strategies and sharing best practices, industry players can collectively address concerns about greenwashing and improve the credibility of their climate initiatives.

Considering these collaborative efforts, South Africa has the potential to position itself as a leader in the transition to a low-carbon economy, ultimately benefiting both environmental sustainability and economic growth. However, as Participant 5 notes regarding the carbon tax,

"When I think of, like the carbon tax, for example, it was implemented, but they're not really… it's not as stringent as it could be."

This observation highlights the need for more robust and enforceable measures that would drive meaningful emissions reductions and encourage the adoption of innovative technologies such as CCS.

South Africa's existing policy frameworks reflect a commitment to environmental sustainability and the current regulatory landscape presents significant challenges in facilitating the effective implementation of emissions reduction strategies. However, addressing these challenges will require collaborative efforts among stakeholders a re-evaluation of regulatory frameworks, and a clear commitment to fostering an investment-friendly environment that prioritises both economic growth and environmental protection in the country.

c) Operational inefficiencies

Operational inefficiencies within South Africa's oil and gas industry significantly hinder efforts to reduce GHG emissions and achieve climate goals. These inefficiencies arise from outdated infrastructure, less than optimal extraction and refining technologies, and a continued reliance on fossil fuel-intensive processes. The persistence of such inefficiencies not only contributes to elevated emissions but also leads to increased operational costs and reduced competitiveness in an evolving global energy landscape.

Participant 12 highlights a critical aspect of operational inefficiencies related to pipeline management, stating,

"The only thing that might make it difficult to get approval is if a company was not dealing with things like leaks, for instance, from a pipeline, if it's a methane pipeline."

This comment highlights the importance of addressing operational inefficiencies, particularly regarding methane emissions from pipelines. If companies do not effectively manage these emissions, they face challenges in obtaining project approvals and ensuring compliance with Environmental Management Plans (EMPs). This scenario indicates a crucial need for improved operational practices to minimise emissions and enhance regulatory compliance within the industry.

Moreover, the financial landscape has been shaped by increasing shareholder activism and political pressure on financial institutions. Participant 7 notes that

“Financial institutions have succumbed to political and financial shareholder pressure, a lot of shareholder activism and funders pushing for change.”

This dynamic reflects a growing awareness among investors regarding the environmental implications of fossil fuel investments, which leads to the pressuring companies to adopt more sustainable practices. However, Participant 5 points out that

“We are not exploring as aggressively as other countries, which puts us at a disadvantage,”

highlighting that the lack of robust exploration efforts constrains the sector's ability to compete globally. This restraint can exacerbate inefficiencies and as a result, creating uncertainty that deters investment. Participant 5 further emphasises that

“There is a misalignment between policy intent and operational execution, which slows down progress,”

highlighting the critical need for policy frameworks to align effectively with operational realities.

Zang et al. (2023) reinforces this by stressing the need for both policy and financial support to accelerate the deployment and adoption of technologies such as renewable energy, CCUS, and hydrogen. This highlights the necessity for well-aligned and actionable policies that effectively drive industry transformation.

The integration of emissions reduction measures into existing operations poses significant financial and logistical challenges, as articulated by Participant 3

“From an operational constraints perspective, perhaps you're right that in a number of these areas, we might be working with brownfield developments, and the additional cost of integrating mitigations may really impact the feasibility of advancing production.”

This statement highlights the significant challenges associated with retrofitting emissions-reduction technologies into old and outdated infrastructure where financial considerations often complicate decision-making processes.

Participant 3 also acknowledges that the industry is grappling with delays in infrastructure development and regulatory approvals, further exacerbating operational inefficiencies. They express concern over the increasing amount of time spent in legal disputes, stating,

“I think we are spending a lot more time in and out of courts, and really to the detriment of us seeing what is possible the potential around the upstream of the oil and gas industry.”

This sentiment reflects the frustration within the industry regarding the slow pace of progress, as prolonged legal battles and regulatory hurdles divert resources and attention away from productive activities. Consequently, these challenges hinder the industry's ability to fully explore and capitalise on the potential opportunities in the upstream sector. This discussion emphasises the critical need for clear and streamlined regulatory processes and improved infrastructure development to foster a more efficient and responsive oil and gas industry in South Africa.

However, the transition to cleaner and more efficient technologies necessitates substantial capital investment, which remains a considerable challenge for many industry players. As participant 9 notes,

“The transition to cleaner and more efficient technologies requires substantial capital investment, which remains a challenge for many industry players.”

Financial constraints, combined with regulatory uncertainty, have decelerated the adoption of advanced technologies. The process leading to addressing these challenges, targeted incentives and funding mechanisms are of great importance as it encourages companies to modernise their operations for the greater good. Canada’s advancements in CCS provide valuable insights for South Africa as it

seeks to grow and develop its upstream oil and gas industry sustainably. Like Canada, South Africa contends with complex regulatory frameworks and significant emissions challenges. Bhavsar et al. (2023) argue that high capital and operational costs remain significant challenges for widespread adoption of CCS which is unfortunately compounded with weak government regulations and the lack of strong market incentives for CO2 emissions.

Therefore, to facilitate the adoption of CCS, South Africa could potentially benefit from implementing a carbon pricing mechanism like what is being done in Alberta, Canada. This would offer financial incentives for oil and gas companies to invest in emissions reduction technologies. This framework could potentially enhance and improve the cost-competitiveness of CCS projects but also provide a strong need and requirement for their adoption in the industry. Should South Africa follow and adopt Canada's model the industry could potentially foster collaboration among industry stakeholders, government bodies and environmental organisations. This would be a collective effort that could advocate for more supportive policies that address the unique challenges faced in the South African context, which would ultimately lead to more effective emissions reduction initiatives (Zhang, Lau, & Chen, 2022).

Additionally, successful CCS projects as seen with the Canada's Quest Project, can help build confidence in the viability of existing technologies within the South African context. There is need for more engagement in the industry to pilot projects can potentially demonstrate the feasibility of CCS while addressing the economic and environmental concerns that are specific to South Africa's oil and gas sector.

The Renewable Energy Independent Power Producer Programme (REIPPP) is a key policy framework that could support technological upgrades in the sector. It was initially designed to promote renewable energy generation however the, REIPPP has created a pathway for integrating cleaner energy sources into South Africa's broader energy system. Expanding on this initiative to include the oil and

gas industry could potentially incentivise the use of renewables for operational energy needs in the sector thus reducing overall carbon intensity.

The inclusion of oil and gas companies in the REIPPP could facilitate collaborations between fossil fuel producers and renewable energy developers, driving a more integrated and sustainable energy transition. Moreover, regulatory mechanisms could be strengthened to mandate or encourage the gradual incorporation of renewables in oil and gas operations, ensuring alignment with South Africa's broader climate commitments.

Therefore, addressing operational inefficiencies through technological advancements is crucial for reducing emissions in South Africa's oil and gas industry. In addition, the strengthening of policy incentives and ensuring regulatory clarity will be essential in driving this transition while maintaining energy security and economic stability. This will be achieved by learning from the experiences of other countries and fostering collaborative efforts among all industry related stakeholders. This will lead to South Africa contributing meaningfully to global emissions reduction efforts.

4.3.2 Theme 2: Climate change mitigation measures in the Oil and Gas sector

The oil and gas sector faces increasing scrutiny over its role in climate change, necessitating a multifaceted approach to emission reduction. The participants emphasised the critical role of carbon dioxide removal (CDR) technologies and renewable energy in mitigating emissions from upstream oil and gas activities.

Participant 12 articulated a forward-looking vision for the sector, asserting that the integration of CDR technologies is essential for the industry's survival. Participant 12 stated,

"The only way they're going to carve out a future for themselves is through targeted and aggressive use of carbon dioxide removal technologies, whether it's CCS or complementing their own electricity generation with renewables."

Participant 12's perspective highlights the necessity of adopting innovative solutions that not only decrease emissions but also enhance the operational resilience of oil and gas companies in a rapidly changing energy landscape.

This participant acknowledged that traditional oil and gas operations must certainly evolve to include renewable energy. Participant 12 further advocated for this transition, declaring,

"I honestly don't believe that you should have any exploration sites that are not also coupled with either solar panels or wind, or some form of renewable energy."

The participant stressed that future exploration projects in South Africa should be designed with a renewable energy foundation, reinforcing the argument that all oil and gas infrastructure from the upstream, midstream and downstream must integrate renewable energy sources. This approach aligns with global trends towards decarbonisation and demonstrates an intentional commitment to more sustainable practices within the sector.

Despite the clear benefits of incorporating renewable energy, challenges remain. Participant 3 highlighted the financial implications of adopting advanced technologies, noting,

"The technology, for example, is expensive to implement to reduce greenhouse gas emissions. So, the carbon capture and storage technology is too expensive to be implemented in the sense that it incurs a lot of financial burden."

Furthermore, the high costs associated with CDR technologies such as carbon capture and storage (CCS), present significant challenges for many companies within the oil and gas sector. These financial burdens have the potential to deter investment which could result in the slower the pace of emissions reductions.

However, as noted by Wang et al. (2023), oil and natural gas will play a significant role in the transition to carbon neutrality due to the unpredictability and developmental challenges associated with renewable and sustainable energy sources. This highlights that there is need to explore the potential for producing

and utilising low-carbon oil and gas instead of solely focusing on replacing or reducing these fossil fuel resources.

The integration of renewable energy sources into oil and gas operations, although essential for reducing emissions does require careful consideration of financial feasibility and operational capacity. It is important that as companies explore hybrid energy solutions to integrate, it is essential for them to also navigate the complexities of regulatory frameworks and market dynamics. Encouragingly, the potential for collaboration between fossil fuel producers and renewable energy developers does exists and has been proven. This then provides for increased opportunities for innovative partnerships that can drive the sector towards a more sustainable future which is essential.

Additionally, to facilitate this transition, industry stakeholders, policymakers, and financial institutions must collaborate to create supportive frameworks that incentivise the adoption of CDR technologies and renewable energy integration as mentioned. Participant 12 and Participant 3 remarks indicate, overcoming the financial and operational barriers to implementing these technologies will be critical in enabling the oil and gas sector to meet its climate goals.

The discourse surrounding climate change mitigation measures in the oil and gas sector highlights that there is a pressing need for integrated solutions that combine CDR technologies and renewable energy sources. Therefore, by embracing these strategies, the industry can potentially enhance its sustainability objectives while continuing to play a vital role in the global energy landscape. As such, the successful implementation of these measures will most likely require increased concerted efforts from all stakeholders involved to foster innovation, promote investment, and ensure regulatory clarity in the pursuit of a low-carbon future.

a) Carbon capture utilisation and storage and renewable energy integration

The integration of carbon capture, utilisation, and storage (CCUS) technologies with renewable energy sources has emerged as a pivotal strategy for mitigating GHG emissions in the upstream oil and gas sector from the participants. According to Bhavsar et al. (2023), CCUS enables companies to capture CO2 emissions from their operations and store it underground, thereby allowing them to continue energy production while significantly reducing their carbon footprint.

Similarly, renewable energy technologies such as solar and wind can be deployed to power extraction and processing operations, reducing reliance on fossil-fuel-based energy and lowering the overall carbon intensity of production. However, both approaches present notable challenges. CCUS implementation is capital-intensive, energy-demanding, and requires robust monitoring to prevent CO2 leakage, while renewable energy integration faces intermittency issues, high upfront costs, and potential technical incompatibilities with existing infrastructure.

CCUS has the potential to decrease the levels of GHG emissions in the oil and gas sector. This hybrid approach not only reduces emissions but also diversifies energy portfolios which results in enhancing resilience against fluctuations in fossil fuel prices. As highlighted in the discussions, integrating renewable energy into fossil fuel operations presents multiple benefits particularly in terms of sustainability and long-term viability.

Participant 4 and Participant 11 highlighted the potential for electrifying fossil fuel operations through renewable energy, with Participant 4 noting,

"There are opportunities to electrify operations using renewable energy, but the initial investment costs remain a barrier for many companies."

This statement reflects a crucial challenge in the transition toward cleaner energy practices. Even though, electrification has the potential to significantly reduce emissions from fossil fuel operations, the high upfront costs associated with

implementing renewable technologies often deter companies from making such investments. The existing literature corroborates these findings, indicating that although electrification offers substantial environmental benefits, financial barriers frequently result in a much slower progress for the oil and gas sector.

Participant 7 emphasised that

"Carbon capture, utilisation, and storage is not a new concept or a fundamentally new technology. It has existed for some time, but it has a lot of costs associated with it. For it to work, it has to be economically viable."

This observation highlights the longstanding nature of CCS technology, alongside the financial challenges that limit its widespread adoption. As such, the successful implementation of CCS requires both technological advancements as well as economic viability through supportive policies and market mechanisms.

Bhavsar et al. (2023) highlight that the high capital and operating costs associated with CCUS technologies are a massive challenge. The high expenses of CCUS have certainly proven that it has impacted its adoption as it needs to be economically viable and competitive with alternative solutions, with cost-effectiveness being a critical factor in the selection of innovative CCUS technologies. The technology serves as an important solution for the energy transition, contributing to a more sustainable energy future as part of the broader basket of interventions (Xu et al., 2021; Kang et al., 2021).

Additionally, Bhavsar et al. (2023) points out that the lack of market incentives and weak government regulations represent non-technical barriers that prevent the large-scale adoption of implementing the use of CCUS technologies. Overall, addressing these substantial challenges through policy support, and market-based incentives is needed for the promotion of broader CCUS adoption.

As Participant 7 stated,

"Every single oil and gas business has a decarbonisation strategy."

This highlights the industry’s recognition of the need for structured approaches to reduce carbon emissions.

This sentiment was echoed by Participant 5, who suggested,

"Future projects should integrate carbon capture and renewable energy where feasible,"

The participants are asserting the importance of aligning new infrastructure developments with climate commitments. This perspective highlights that there is a shift in industry priorities recognising that future operations must consider environmental impacts and adhere to increasingly stringent climate targets.

Participant 3 addressed the necessity of financial and policy support to incentivise developers and investors, stating,

"Building in these additional measures does require us to look at what type of support is then availed to some of these developers, investors, to ensure that they are attracted and incentivised to proceed with the activities."

This highlights the critical role of supportive frameworks in facilitating the adoption of mitigation technologies, ensuring that industry participants are motivated to engage in emissions reduction efforts.

To encourage the adoption of CCS and enhanced oil recovery (EOR) for example, the U.S. Environmental Protection Agency (EPA) has implemented regulations under the Clean Air Act that mandate the incorporation of CCS technology in new power plants to mitigate carbon emissions. Similarly, the European Union's Emissions Trading System requires large emitters to either reduce their emissions or purchase emission credits as highlighted by Perona (2017).

Moreover, Participant 3 emphasised the need for increased investment in CCS and renewable energy integration to mitigate the environmental impacts of fossil fuel production. Participant 3noted,

"As the confidence grows and we see the level of activity increasing, there is a stronger case to build in more of the mitigation interventions."

This statement suggests that as technological advancements progress and operational confidence improves, the case for adopting additional mitigation strategies becomes increasingly compelling.

Participant 1 contributed to the discussion by emphasising the relationship between renewable energy generation and fossil fuel dependency, stating,

"Renewable energy is obviously going to have an impact in the sense that the more we generate through renewable energy, the less we're going to need fossil fuel generation."

This observation reinforces the idea that increased reliance on renewable sources can facilitate a reduced phase-out of fossil fuel dependency which will ultimately contribute to reduced emissions.

Participant 6 added that financial considerations often influence decisions regarding carbon capture implementation, remarking,

"They may not want to spend as much, say, on carbon capture. Say, you've got to go and put additional equipment in in order to reduce emissions."

This highlights the existing reality that economic factors often influence companies' willingness to invest in emission reduction technologies quite significantly which can limit the progress in achieving climate change related goals.

Participant 10 emphasised the crucial role of technological advancements in addressing climate change, stating,

"And certainly, the technology is improving, and I think it's core to improving how we manage climate change."

This perspective highlights two critical aspects: first being that the continuous technological improvements and the critical role in climate change management. As mentioned, and highlighted, technological innovations such renewable energy, CCS, energy efficiency and digital monitoring systems are increasingly driving, leading and shaping the way industries reduce emissions and sustainably transition. Advancements in artificial intelligence (AI) and data analytics further enhance climate modelling, allowing for more precise predictions and informed decision-making. This is supported by Shobanke, Bhatt, & Shittu (2025) who argues that the continued fast paced advancements and the implementation of AI to reduce climate change impacts has led to the increase in promotion and adoption of renewable energy- has provided great insights on the potential for energy systems optimisations and advancements which will be valuable for the oil and gas industry.

Moreover, this literatures viewpoint aligns with broader global trends where governments and industries are investing heavily R&D to accelerate the adoption of cleaner technologies. This is supported by Grafström et al., (2020), who argues that the challenges posed by climate change require the global adoption of renewable energy innovations. However, challenges related to scalability, cost, scalability as well as policy support remain key factors in determining the effectiveness of these technological solutions.

Overall, Participant 10's insight further emphasises the importance of continued investment in and adoption of innovative technologies as a key pillar in the fight against climate change.

Finally, Participant 13 acknowledged the important role of carbon capture, stating,

"I think carbon capture plays an important role in facilitating the transition. Obviously, the technological advancements, provided they come in with cost reductions, will certainly be advantageous."

This statement reinforces the notion that even though CCS has challenges, there are ongoing technological improvements and cost reductions that have the potential to enhance its feasibility and effectiveness in contributing to climate mitigation efforts.

As a result, the integration of carbon capture and renewable energy within the oil and gas sector represents a very important pathway for reducing GHG emissions and key to ensuring that operations align with global climate commitments while maintaining energy security which is essential.

b) Policy challenges for effective climate action

The process of the oil and gas sector transitioning more towards sustainable operations is filled with significant financial and operational challenges, as participants acknowledged during the discussion. Participant 11 succinctly summarised this challenge, stating,

"The path forward is clear, but we need to address the financial and operational hurdles that stand in our way."

This statement encapsulates the clear consensus that while there are viable pathways to reduce emissions there is a great need for concerted efforts that are required to navigate the challenges that hinder and slow down the progress of climate change. Another key element is the need for clear and unified government support, incentives, and financing mechanisms to encourage investment in sustainable technologies as supported by Qadir et al., (2021).

Participants identified a primary concern that involved policy misalignment, particularly the lack of cohesion within the regulatory framework governing the oil and gas sector. Participant 12 and Participant 14 highlighted that the fragmented nature of South Africa’s existing energy policies and they both emphasised that there is a significant disconnect between the Integrated Resource Plan (IRP) and the Nationally Determined Contributions (NDC). Participant 14 articulated the consequences of this challenge, noting,

"Without a unified policy direction, companies are left to interpret regulations in ways that suit their operations, undermining collective climate action."

As a result, such regulatory inconsistency unfortunately creates an environment of uncertainty of which consequently slows down the adoption of effective emissions reduction strategies.

The competitive landscape for funding emerged as another critical barrier that was asserted by Participant 7 stated,

"Funding is available for cleaner energy projects. But it's highly competitive. When you have the whole world trying to transition at the same time, funding will go to where the risk is the lowest and the returns are the highest."

This statement highlights the reality that while financing for sustainable projects exists, it is limited and often directed towards the least risky and most lucrative opportunities. Participant 9 also echoed this sentiment by discussing and emphasising that some financial institutions have committed to reducing climate change, however, Participant 12 indicated that

There is a necessity for clear targets and accessible financing for effective climate action, stating,

“…people who want to implement the right thing, but they need to know what the target is. We need to know that the financing for these things is going to be available. I think that the international political conversation has come in that the flow of climate finance into developing nations is making that finance available at reduced rates because it is the ethical and the obligation thing to do.”

This statement highlights the importance of well-defined goals to guide climate action as well as the critical role of climate finance in enabling sustainable initiatives, particularly in developing nations. Further, the lack of clear targets, policymakers, businesses, and other stakeholders may struggle to implement effective strategies. There are certain elements such as well-structured clear

policies that are supported by scientific data and long-term planning play a huge role driving meaningful change.

The insights gathered from the various participants reveal critical theme that relayed to the intersection of governmental coordination, industrial development, and environmental sustainability in South Africa. Furthermore, there was a primary theme that continues to emerge which is governmental coordination and policy integration, particularly the disconnect between the Department of Environmental Affairs (DFFE) and the Department of Mineral Resources and Energy (DMRE). Participant 12 highlights this disconnect, stating that

"There is a disconnect between these two bodies of government."

This fragmentation between various government departments and their leaders such as ministers can lead to inconsistencies in policy implementation and create confusion among stakeholders which ultimately continues to undermine South Africa's reputation globally.

The great necessity and importance for collaborative policy development is emphasised by Participant 11, who advocates for the two departments (DMRE and DFFE) to

"co-produce frameworks and policies that would speak to emission reductions."

This recommendation by this participant, highlights the importance for leaders to foster a collaborative relationship between environmental and energy sectors to create coherent strategies that balance economic growth with sustainability goals. The lack of such collaboration and policies has the potential to inadvertently limit the progress in both environmental protection and industrial development.

Another critical theme that was identified is the tension between industrial development and environmental sustainability. Participant 12's comments about aligning with *"the developed world"* on climate commitments while adhering to an

"African narrative" raise concerns about the feasibility of reconciling these opposing perspectives. Participant 12 highlighted that,

“From a climate commitment perspective, it seems that we are aligning ourselves with the developed world. But then, from an industry perspective. It seems that we are aligning ourselves with an African narrative, and I have a problem with the fact that these 2 are being put as opposites.”

This significant and challenging dichotomy highlights the complexity of developing policies that support economic growth, particularly in resource extraction, without compromising environmental integrity.

Participant 7 reinforces and supports this point by stating the need for clear guidelines around emissions and highlighted that

“To allow an industry to develop we would have to establish clear guidelines around emissions if we want to regulate”

This highlights the importance of capacity building and clear guidelines to prevent implementation challenges. Participant 4's insistence that there is a need for enough time to me made to build efficient. Further, internal capacity with the objective to meet international commitments which reflects a significant barrier that developing countries often face.

“International obligations should not be imposed… and we should be afforded adequate time to build internal capacity… because what it means for the country is an afterthought”

Therefore, the increasing calls for the need for enough time to develop these capacities emphasises the need for a realistic approach to policy implementation that considers the unique challenges of the South African context.

This is supported by (Klinsky & Sagar) 2022 who emphasises the importance of inclusive capacity building that engages a variety of stakeholders more especially

individuals from marginalised communities are required. This approach ensures awareness of and responsiveness.

Furthermore, Participant 3's suggested that

“The government should demystify these policies and what they mean individually and in conjunction what they imply”

This highlights the necessity for clear communication and understanding among all industry stakeholders to ensure that all parties are aware of the implications of policy decisions.

For South Africa to effectively navigate the complexities of environmental sustainability and industrial development, it is imperative to enhance coordination between governmental bodies, establish clear regulatory frameworks, and invest in capacity building. These steps are crucial for fostering a balanced approach that supports both economic growth and environmental stewardship, ensuring that South Africa can fulfil its commitments while addressing the needs of its industry and citizens.

Furthermore, Participant 12’s emphasis on climate finance reflects ongoing global discussions about equitable funding mechanisms. Developing nations often face financial barriers in transitioning to low-carbon economies, making access to affordable financing a crucial factor (Bynoe & Moonsammy, 2023). The recognition that climate finance should be made available at reduced rates aligns with ethical and political commitments under international agreements such as the Paris Agreement.

According to Bynoe & Moonsammy (2023), Guyana's experience with its growing oil and gas industry highlights a proactive approach to energy transition, as the country-initiated investments in renewable energy infrastructure even before the industry's growth. This foresight has positioned Guyana favourably, allowing the growing industry to provide the capital needed to further develop and enhance these renewable energy initiatives. Therefore, by leveraging the financial

resources generated from oil and gas, Guyana can build upon its initial efforts, creating a more sustainable energy landscape for the future.

Overall, this perspective highlights the interconnected nature of clear climate policies and accessible funding. Ensuring that both elements are in place is essential for meaningful progress in addressing climate change, particularly in regions that require external support to implement sustainable solutions.

However, the financial burden is not only on investors but also on consumers. Participant 13 remarked,

"Customers aren't willing to pay that extra premium to absorb that cost,"

indicating a reluctance among consumers to bear the higher costs associated with transitioning to cleaner energy sources. This consumer sentiment further restricts the adoption of sustainable energy solutions, as the market remains predominantly competitive against traditional fossil fuel technologies. Participant 5 also noted,

"High capital investment requirements remain one of the biggest hurdles,"

a sentiment that highlights the daunting financial challenges companies face in pursuing low-carbon transitions.

Participant 3 raised a significant point regarding the disparity between developed and emerging economies in achieving emissions targets, stating,

"There is a global target that is said to be applicable to a first-world country. I do believe that it is a far stretch to expect an emerging country to address those imperatives with the same rigour when it still needs to overcome developmental objectives."

This comment highlights the financial and policy constraints faced by developing nations, which struggle to align with global climate goals while addressing local developmental needs.

Regulatory uncertainty and financial constraints were further emphasised as crucial barriers to implementing large-scale climate mitigation projects. Participant 3 remarked,

"We do need to place onerous requirements on investors, but we must be cautious not to create barriers to investment."

The absence of sector-specific emissions reduction targets presents an additional challenge, as Participant 12 pointed out:

"There is no clear reduction pathway for the sector." Without clearly defined targets, oil and gas companies face difficulties aligning their operations with evolving climate policies, complicating long-term planning for decarbonisation efforts. Financial constraints further complicate the transition to low-carbon technologies.

Participant 4 also noted that

"Initial investment costs remain a barrier,"

making it challenging for companies to justify the upfront expenses associated with carbon capture and storage (CCS), electrification, and other green technologies. Although these technologies offer significant long-term benefits, the lack of immediate financial returns discourages firms from making necessary investments.

To mitigate these challenges, Participant 4 advocated for fiscal incentives, including tax credits and subsidies, to stimulate investment in renewable energy, electrification, and CCS. By reducing high initial costs, these financial mechanisms could accelerate the industry's transition towards cleaner technologies and a low-carbon economy (Zhou et al., 2024).

The importance of transparency and accountability in emissions reporting was also emphasised. Participant 3 stressed the necessity for robust third-party

verification processes and mandatory public disclosure of emissions data, stating,

"Transparency would address the risks of greenwashing and build trust among stakeholders."

Accurate and reliable emissions reporting is essential for maintaining credibility and driving substantive progress in emissions reduction efforts. Without proper oversight, companies risk overstating their sustainability achievements while failing to implement meaningful changes. Sharaf-Addin (2024) emphasises that emissions reporting plays a critical role in ensuring that there is clear accountability, enhanced transparency, and improving environmental sustainability.

Participants highlighted collaboration and innovation as critical strategies for overcoming the challenges faced by the industry. Participant 1 and Participant 10 both emphasised the value of partnerships among industry stakeholders, government bodies, and academic institutions. They suggested that shared infrastructure for CCS and other emerging technologies could significantly lower costs and expedite development.

"Collaboration could accelerate innovation and reduce costs,"

they argued, reinforcing the notion that collective action is vital for meaningful progress.

Participant 10 raised a critical point about the challenges of implementing legislation in South Africa, stating,

“When we put our legislation together, we adopt what works internationally, and therein lies the challenge to implement it because it's not always fit for purpose. And I think South Africa has got a lot to learn, and just having the sheer resources to implement what they write into legislation.”

This statement highlights a common issue in policy development which is that the adoption of international frameworks that may not always align with local contexts. While drawing from global best practices can provide valuable guidance, these policies often require adaptation to suit a country's unique economic, social, and infrastructural realities. In South Africa, the challenge lies in ensuring that internationally inspired legislation is effectively tailored to the nation's specific needs and constraints.

Another key issue raised is the resource gap in implementation. Even when policies are well-crafted, the lack of financial, technical, and institutional capacity can hinder their execution. This is particularly relevant in sectors such as energy and environmental regulation, where ambitious goals often require significant investment and skilled personnel.

Participant 10's perspective highlights the need for a more pragmatic approach to policy formulation, one that balances global best practices with practical feasibility. Ensuring adequate funding, capacity-building, and stakeholder engagement is crucial for translating legislation into tangible outcomes. South Africa's experience in this regard highlights broader global lessons about the importance of contextualizing international policies to fit national realities.

Finally, with a decline in international funding for fossil fuel projects, participants discussed alternative financing mechanisms to support transitional projects. Participant 12 proposed leveraging domestic climate financing, including carbon markets, to secure the necessary capital for low-carbon solutions. By tapping into these financial resources, companies could sustain their sustainability initiatives without relying exclusively on foreign investment.

Addressing these barriers necessitates a multifaceted approach that includes regulatory alignment, financial incentives, transparency, collaboration, and innovative financing solutions. Only through coordinated efforts across industry and government can the oil and gas sector effectively reduce emissions and transition towards a more sustainable future.

Participants collectively acknowledged that a transition toward sustainability is not only necessary but also achievable with the right policy frameworks and financial support. The oil and gas sector must align with evolving climate policies, embrace technological advancements, and leverage available funding mechanisms to implement effective emissions reduction strategies.

As Participant 11 stated,

"The path forward is clear, but we need to address the financial and operational hurdles that stand in our way."

This collective understanding highlights the importance of a synergistic approach that combines regulatory clarity, financial incentives, and industry collaboration to facilitate the sector's meaningful contributions to global climate objectives while ensuring energy security and economic viability.

c) Greenwashing risks

Greenwashing presents a significant challenge within South Africa’s oil and gas sector, where companies may potentially mislead stakeholders about the sustainability of their environmental practices. Greenwashing refers to the practice of presenting misleading or exaggerated claims about an organisation's environmental initiatives, practices, or impacts to create a false impression of environmental responsibility. As global and domestic pressures to reduce carbon emissions intensify, some industry players may engage in superficial sustainability initiatives rather than implementing substantive measures to lower GHG emissions. This deceptive approach not only undermines genuine climate action but also distorts market competition and erodes public trust in the industry's commitment to sustainability.

Participants in the discussion raised concerns about the gap between corporate sustainability pledges and actual implementation. As Participant 5 noted,

"There is always the risk that companies will commit to emissions reductions on paper but fail to follow through."

This is supported by Nemes et al., (2022) who indicated that this approach is often employed to enhance the organisation's public image while diverting attention from less sustainable practices or policies.

This sentiment was also echoed by other participants, who emphasised that without rigorous monitoring and verification processes, greenwashing may continue to persist unchecked.

Participant 3 further highlighted the limitations of voluntary commitments, stating,

"Voluntary commitments are great, but there is always the risk that they are not followed through in a meaningful way."

This observation highlights concerns regarding the credibility of corporate climate pledges, suggesting that some companies may prioritise reputation management over tangible emissions reductions. Expanding on this point, Participant 3 asserted,

"Voluntary commitments are good, but they must translate into tangible mitigation actions. Otherwise, they risk being perceived as greenwashing."

Latapí Agudelo, Jóhannsdóttir, and Davídsdóttir (2019) noted a marked rise in corporate pledges for emission reductions after the 2015 Paris Agreement, raising concerns about greenwashing in net-zero claims (Condon, 2023). These formalised commitments are said to prompt the demands for mandatory and verified disclosures due to widespread greenwashing in environmental, social, and governance (ESG) areas.

Researchers caution that net-zero goals may serve as a delay tactic in climate initiatives. As regulatory frameworks evolve to combat misleading practices, their effectiveness is still under scrutiny. Consequently, governments are updating regulations to address these deceptive claims.

Participant 4 reinforced these concerns, pointing to the lack of transparency in renewable energy investments within the sector:

"Many companies claim advancements in renewable energy, but in reality, it constitutes only a small fraction of their overall business."

This lack of transparency contributes to growing scepticism regarding the sincerity of corporate sustainability initiatives.

Similarly, Participant 12 criticised the failure of companies to clearly articulate their implementation strategies:

"They talk a nice talk, but when the rubber hits the road, how are they actually going to do it? That is then not articulated. So, I think the risk for greenwashing in the sector is tremendous."

Indicators of greenwashing have become critical in evaluating corporate sustainability claims. However, selective disclosure is a common tactic where companies emphasise positive environmental practices while concealing negative impacts, creating a misleading impression of their overall sustainability efforts (de Freitas Netto et al., 2023). This practice can often lead to a misalignment between claims and actions, as organizations may publicly commit to sustainability while continuing investments in fossil fuels. Furthermore, inadequate reporting on environmental performance can obscure the true extent of a company's sustainability initiatives, making it challenging for stakeholders to assess their genuine impact. Additionally, some companies engage in practices

that prioritise political influence over meaningful environmental action using their sustainability claims to enhance their public image while resisting regulatory changes that promote genuine sustainability as seen with the Pathways Alliance Campaign in Canada (Greenpeace Canada, 2023). Collectively, these indicators highlight the need for greater transparency and accountability in corporate sustainability efforts which supports Participant 4’s sentiments.

To effectively combat greenwashing, participants highlighted the importance of strengthening monitoring, reporting, and verification (MRV) systems. Robust MRV frameworks are essential for ensuring that emissions data and sustainability claims are accurate, transparent, and aligned with South Africa's climate policies. Therefore, enhanced enforcement mechanisms could mandate that oil and gas companies adhere to standardised methodologies for emissions reporting, undergo third-party audits, and provide greater transparency in disclosing their environmental performance. By establishing clear reporting structures and implementing stringent verification protocols, regulators can deter greenwashing practices and promote accountability across the sector.

As a result, according to Aronczyk, McCurdy, & Russill (2024) countries have implemented regulatory measures to combat fraud and deception. For instance, the European Union's Green Claims Directive, provisionally agreed upon in September 2023, aims to prevent misleading environmental claims in commercial practices. It prohibits false or deceptive green claims and enforces legal consequences, including penalties for non-compliance. This directive strengthens consumer protection and enhances corporate accountability in sustainability efforts.

Greenwashing poses a significant challenge that undermines the credibility of South Africa's energy transition and impedes progress toward meaningful emissions reductions. By strengthening Monitoring, Reporting and Verification (MRV) enforcement and aligning it with the EIA regulatory framework, policymakers can ensure that sustainability claims are verifiable, transparent, and indicative of genuine climate action. Holding companies accountable for their

environmental commitments not only promotes authentic decarbonisation efforts but also safeguards public trust in the industry’s role in South Africa's transition to a low-carbon future. As discussed, a collective commitment to transparency and accountability will be essential in overcoming the risks associated with greenwashing, ultimately fostering a more credible and effective response to the pressing challenges of climate change.

4.4 Findings and discussion related to RQ 2: what are the current policy and regulatory gaps in South Africa’s Oil and Gas industry that hinder effective climate change mitigation?

4.4.1 Theme 1: Policy and regulatory gaps

The discussion surrounding policy and regulatory gaps within South Africa's energy sector highlights significant barriers that impede progress toward sustainable energy development. Participant 12 pointed out a critical issue, stating,

"The enabling environment is not really there from a regulatory perspective... there isn't a goal yet... a goal for the industry has not been set, and that will come with the Carbon Emission Targets (CETs), I imagine."

This observation highlights the absence of a clear regulatory framework that outlines specific goals for the industry, which is essential for guiding stakeholders toward a more sustainable energy future.

Participant 13 further elaborated on this gap by advocating for a greater emphasis on a substitution model rather than solely focusing on green or renewable energy approaches. Participant 13 noted,

"I think there needs to be a greater focus on that substitution model versus a complete approach to green or renewable energy-focused approaches."

This perspective indicates a recognition of the complexities involved in transitioning to sustainable energy sources and the need for diverse strategies that can address the specific contexts and constraints faced by various sectors, including oil and gas.

Participant 13 also identified technological and operational constraints as key barriers that affect not only the oil and gas industry but all sectors within the energy landscape. Participant 13 remarked,

"The barriers stem from the same area, technological or operational constraints impact across all sectors, not only oil and gas."

This observation highlights the interconnected nature of the challenges faced by different sectors and the need for comprehensive policies that address these systemic issues.

The regulatory framework in place was described by participants as overly complex, which hampers effective implementation of sustainable practices. Participant 12 stated,

"It's a little bit too cumbersome as an overarching policy framework that the government has put in place. And that's where the streamlining needs to take place."

This sentiment reflects a consensus among participants that a more streamlined and coherent policy framework is necessary to facilitate the transition to sustainable energy practices. Reducing bureaucratic obstacles can potentially enhance the agility of the industry in adapting to changing environmental and market conditions.

Participant 10 highlighted a critical challenge in South Africa’s regulatory landscape, emphasising that while the country has well-structured legislation, its effectiveness is undermined by inadequate enforcement. They stated,

“The legislation we have is good. It's the enforcement of it. I think that's falling short.”

This observation highlights the gap between policy formulation and practical implementation, suggesting that regulatory frameworks alone are insufficient without strong oversight and compliance mechanisms.

This emphasises that weak enforcement diminishes regulatory credibility and allows industry players to bypass sustainability commitments. Without stringent oversight, companies may fail to adhere to environmental and industry standards, exacerbating issues such as environmental degradation as well as greenwashing. Therefore, strengthening enforcement mechanisms and implementation through improved monitoring, increased regulatory capacity, and stricter penalties for non-compliance was identified as a crucial step in ensuring that legislation translates into tangible action.

Therefore, by addressing these enforcement shortcomings, policymakers can ensure that existing legislation drives responsible practices within the oil and gas sector. As participants noted, effective enforcement not only promotes industry accountability but also reinforces South Africa’s broader climate and sustainability objectives.

Participant 3 contributed to the discussion by emphasising the necessity for clearer policies and sector-specific emission targets to guide sustainable energy development. Participant 3 noted,

"The ethos of environmental sustainability and responsibility is incorporated in regulatory approaches, but without specific targets, progress remains uncertain."

This highlights a fundamental flaw in the current regulatory landscape. This indicates that while there may be a commitment to environmental sustainability, the lack of clear and explicit targets leads to ambiguity and hinders accountability. Clear and measurable goals are essential for driving progress and ensuring that all stakeholders are aligned in their efforts to achieve sustainable outcomes.

The dialogue surrounding policy and regulatory gaps in South Africa's energy sector reveals critical areas for improvement. The absence of a clear regulatory framework with specific goals, along with the need for a more streamlined approach, highlights the challenges that stakeholders face in transitioning to sustainable energy practices. Furthermore, addressing technological and operational constraints will be crucial in overcoming barriers that affect the entire energy landscape. The establishment of clearer policies and sector-specific emission targets, policymakers can foster and enable a more conducive environment for sustainable energy development, ensuring that progress is measurable and accountable. Ultimately, a concerted effort to refine the regulatory framework and set explicit targets will be essential for driving meaningful change in South Africa's energy sector.

a) Policy misalignment and lack of cohesion

A prominent theme in the discussion among participants was the misalignment between national policies governing South Africa's energy sector and the disconnect between the Integrated Resource Plan (IRP) and the Nationally Determined Contributions (NDC). This disconnect represents a significant challenge for both regulatory agencies and industry stakeholders creating uncertainty and inefficiencies in implementing effective climate action strategies. As Participant 12 highlighted,

"There is a disconnect between the IRP and the NDC. Agencies like PASA [Petroleum Agency of South Africa] are caught in the middle, navigating two policy instruments that are at odds with each other."

The IRP outlines South Africa's long-term energy supply strategy, primarily focusing on energy security and economic considerations (Turner & Fane, 2023), whereas the NDC, which is part of the country's commitment under the Paris Agreement, sets emissions reduction targets aimed at mitigating climate change (Laudari, Aryal, Bhusal, & Maraseni, 2021). This results in the lack of alignment

between these two frameworks which creates conflicting priorities where some policies promote fossil fuel development while others seek to reduce emissions.

This inconsistency complicates the ability of regulatory agencies such as PASA to develop clear guidelines for the industry, as they must balance economic objectives with climate commitments.

Participant 12 further asserted,

“I think that the environment really needs to be created by dialogue between the different stakeholders. So, you've got Environmental Affairs, you've got the GTI, you've got the Department of Energy, you've got the Department of Minerals, and they need to have dialogue in terms of setting specific goals and objectives. And the goals that they set have to be mutually exclusive, and they should not be in conflict with each other. They should meet each other in the middle.”

This statement emphasises the need for collaborative governance where the relevant departments coordinate their efforts to establish coherent and mutually reinforcing and beneficial policy goals.

Participant 11 echoed this sentiment by stating,

“The DFFE and the DMRE need to find a way of working together and co-producing policies and frameworks that they would both be able to use in terms of regulating the sector. Because if the DFFE and the DMRE speak different languages, it makes complying with whatever policies or frameworks these two departments establish difficult.”

This observation highlights the challenges created by misalignment between regulatory bodies, where differing approaches and communication gaps between the Department of Forestry, Fisheries and the Environment (DFFE) and the Department of Mineral Resources and Energy (DMRE) complicate compliance within the energy sector.

Participants emphasised that greater coordination between these departments which is crucial for the process of developing cohesive policies that provide clear and consistent regulatory guidance. This will ultimately foster a more streamlined and effective approach to sector governance.

Participants also noted that while South Africa drafts strong policies, the implementation is often inconsistent. Participant 5 stated,

“South Africa drafts strong policies, but implementation is inconsistent,”

and further commented that

“Overly stringent regulations can slow down progress while still failing to meet environmental objectives.”

This inconsistency highlights a very crucial aspect of policy effectiveness. The gap between policy formulation and its execution. Therefore, without robust mechanisms for implementation, even well-designed policies may fail to achieve their intended outcomes.

Participant 3 remarked on the broader implications of policy misalignment, stating,

“A misalignment between climate policies and economic growth strategies hinders effective implementation of sustainability initiatives.”

Participant 3 further stressed that

“*...the climate change agenda should not counter development but rather support inclusive growth and participation.”*

This perspective emphasises that sustainable energy policies must be integrated with broader economic and social objectives to be effective and equitable.

Participant 14 reinforced the concern regarding the lack of a unified policy direction, asserting that

“Without a unified policy direction, companies are left to interpret regulations in ways that suit their operations, which undermines the collective effort to reduce emissions.”

This lack of cohesion means that companies may selectively comply with policies that align with their business interests while disregarding others that impose stricter environmental controls. This sort of behaviour not only creates regulatory loopholes and gaps but also weakens the overall impact of emissions reduction initiatives.

The process of enhancing information-sharing platforms and improving the quality and accessibility of information provided by government departments can strengthen trust, commitment, and communication among stakeholders. These factors are so crucial for fostering effective relational governance which in turn, contributes to stakeholders' perception of greater public value (Pooe & Munyanyi, 2022).

The discussion highlighted the urgent need for greater policy coherence to ensure that energy and climate policies work in tandem rather than at cross-purposes. Therefore, an integrated approach would provide clear and consistent guidelines for industry players, thereby reducing uncertainty and fostering a more predictable investment environment (as supported by participant contributions and the literature).

Participant 6 articulated the necessity of evaluating current policies to identify existing gaps, stating,

“I aim to sort of evaluate the current policies to see what are the gaps that are existing. How can we enhance the effectiveness to sort of balance that environmental preservation and the energy security part with the economic growth side of things”

Moreover, participants Participant 6, Participant 7, and Participant 13 suggested that strengthening inter-agency coordination and streamlining policy objectives could help bridge the existing gaps.

Ultimately, addressing policy misalignment requires proactive government intervention, clear regulatory guidance and stakeholder collaboration. Without a unified policy direction, efforts to decarbonise the sector will continue to face significant barriers which will inevitably cause the delaying of progress toward a more sustainable energy future.

Torres and Clegg (2014), supports this statement and argues that policymaking in developed countries often takes place in a highly political and contested environment, influenced by debates and formalised through government decisions and legislation. Since policies address complex social issues and competing values, transparency and full disclosure are crucial to ensure meaningful stakeholder participation and informed evaluation.

Participant 4 summarised the prevailing sentiment by stating,

"*They're going to put energy security above climate when push comes to shove."*

Participant 13 added,

"I think our policies align with the international market, and I don't think we have a lack of policy. I just think it's our ability to implement, manage, and whether our sector is at a stage where it's advanced enough to accept and implement those policies effectively. I think what you've seen in other oil-producing economies is that they've had the ability to transition over time. This is very new for us."

This final observation encapsulates the complexities of navigating policy alignment in a rapidly evolving energy landscape. This then highlights the need for the continuous adaptation and collaborative governance to achieve sustainable energy outcomes.

b): Lack of sector-specific emission targets

A critical issue identified during the discussions was the absence of specific mitigation targets for the oil and gas industry in South Africa. This is a gap that significantly limits the country's efforts to reduce emissions and transition toward a low-carbon economy. Unlike other sectors that have established clear emissions reduction targets, the oil and gas industry currently operate without a structured framework, creating substantial uncertainty for companies striving to align their operations with South Africa's broader climate commitments.

Participants highlighted the pressing need for the establishment of sector-specific emission targets (SETs) as a prerequisite for meaningful climate action. As Participant 12 noted,

"A goal for the industry has not been set... the goals that they set have to be mutually exclusive, and they should not be in conflict with each other."

This observation highlights the critical challenge of defining specific emission reduction pathways for the sector. The absence of such goals leaves companies without a regulatory mandate to reduce emissions, making it challenging to implement structured and measurable climate action plans. In the current climate, many industry players are left without clear expectations, leading to a situation where operational efficiency often takes precedence over environmental sustainability.

The delay in establishing SETs exacerbates this issue, resulting in a lack of direction for industry players regarding decarbonisation efforts. Participant 7 emphasised the importance of having explicit targets, stating,

"Clear targets would not only guide companies but also provide a benchmark for measuring progress. Right now, it's like shooting in the dark."

This lack of sector-specific benchmarks creates difficulties in assessing progress, comparing industry performance, and holding companies accountable for their emissions reduction efforts. The absence of clarity complicates the ability of

regulators and stakeholders to track whether the oil and gas industry is making meaningful strides toward emissions reduction or merely adopting superficial measures.

Filonchyk et al., (2024) highlights the need for stringent government regulations, standards and incentives to ensure compliance and promote the implementation of effective strategies. It calls for urgent global collaboration and coordinated efforts to tackle climate change and the urgency for clear sector-specific emission targets for the oil and gas industry.

Moreover, the discussions revealed a consensus among participants regarding the urgency of establishing a structured framework for industry-specific decarbonisation strategies. Participant 5 remarked,

“We do not have clear emissions reduction targets for the oil and gas sector, which makes planning difficult,”

further highlighting the critical nature of this gap in policy. The need for targets tailored to specific industries rather than relying on general climate policies was echoed by Participant 3, who stated,

"If we're saying there’s a global target, we need to make sure that it is aligned with our local realities."

This highlights the necessity of aligning emissions targets with the unique challenges and opportunities presented by the oil and gas sector.

Participant 12

“I think, in developing those sector targets. You are going to have political resistance, and you must expect some resistance from industry. However, I also see that there is a lot of goodwill from people who want to implement the right thing, but they need to know what the target is”

Setting sector-specific targets is essential for fostering accountability and driving meaningful emissions reductions within the oil and gas industry. Participants

argued that the introduction of SETs could provide a structured approach that helps companies plan their transition strategies in alignment with both national and international climate goals. Furthermore, well-defined targets would create a level playing field thus ensuring that all industry players are subject to the same emissions reduction expectations. This would prevent certain companies from gaining an unfair advantage by delaying their climate commitments.

The absence of sector-specific emissions targets that are a realistic reflection of our local reality, this will constitute a significant gap in South Africa's climate policy landscape. Addressing this issue will require urgent action from policymakers to define clear, science-based reduction pathways for the oil and gas sector. Until such targets are in place, the industry remains without a definitive roadmap for decarbonisation, thereby undermining the country’s overall efforts to meet its climate commitments and transition toward a more sustainable energy future.

South Africa does not have sector-specific emissions targets for its upstream oil and gas sector due to several factors. The country's energy policy has historically prioritised energy security and economic growth over stringent environmental regulations thus resulting in a lack of clear frameworks for enforcing specific emissions targets. Additionally, South Africa's heavy reliance on fossil fuels such as coal, complicates the transition to stricter regulations in the already negligible oil and gas sector. Furthermore, the absence of comprehensive data on emissions and production levels hinders the establishment and monitoring of specific targets, contributing to the lack of targeted emissions reduction strategies in this industry.

c) Insufficient incentives and penalties

A significant issue identified in the discussion was the lack of sufficient incentives and penalties aimed at driving emissions reductions within South Africa's oil and gas sector. While the country has established a climate change legal framework, participants argued that this framework is inadequate in encouraging companies to actively reduce their emissions. The current regulatory environment lacks

targeted financial incentives designed to support investments in low-carbon technologies, while simultaneously failing to impose meaningful penalties on companies that continue to operate with high emissions intensity. Governments often defend the use of tax incentives to address market failures driven by external pressures, such as competition for limited foreign investment (Bird & Zolt, 2008).

Participant 12 articulated this gap by stating,

"Our ERA [Environmental Risk Assessment] legislation requires companies to look at construction and production emissions, but there are no penalties or incentives specifically addressing Scope 1 emissions in the upstream oil and gas sector."

This observation highlights a critical flaw or gap in the regulatory landscape while companies are mandated to assess their environmental impact, there are no direct consequences for failing to mitigate emissions from their operations. Scope 1 emissions remain largely unregulated regarding financial penalties which then diminishes the urgency for companies to adopt cleaner technologies.

Participant 2 echoed this sentiment, emphasising the need for stronger financial mechanisms by stating,

"*The government needs to introduce fiscal measures, such as tax credits or subsidies, for companies investing in green technologies. Without these, progress will be slow."*

Participants recognised that, despite the acknowledgment of the importance of emissions reduction among many companies, the high upfront costs associated with carbon capture and storage (CCS), electrification of operations, and the integration of renewables into production processes act as significant deterrents. Without adequate financial support, smaller companies find it challenging to justify the investment necessary for a transition toward lower-carbon operations. Participant 8 expressed this frustration, noting,

"These oil companies are not willing to spend our money trying to decarbonise if there's not going to be an incentive."

Further contributions from Participant 13 highlighted the potential for more robust incentives from the government to benefit both consumers and producers. Participant 13 stated,

"I think there can be far more done on incentives from the government for the consumer or for the producers to promote and support those investments in order to reduce those impacts."

Participant 5 added,

“Companies will comply with strict regulations if there are clear incentives and penalties,” indicating that a well-structured policy framework is crucial.

Participant 5 further asserted, “*Without a well-structured policy framework, businesses will either delay investment or avoid South Africa altogether.*”

Participant 3 emphasised the importance of financial mechanisms, stating,

"Support and incentives for investors must be structured in a way that makes it attractive for them to integrate emissions reduction technologies."

This assertion highlights the necessity for both positive incentives and regulatory penalties to effectively drive industry compliance. Participant 3 also pointed out that

"*The absence of strong incentives for cleaner energy investments and penalties for excessive emissions weakens industry commitments to sustainability."*

This observation reinforces the argument that robust mitigation interventions must be supported by policies that balance economic and environmental goals.

Tax incentives and fiscal policies play a very crucial role in shaping investment decisions in the petroleum sector. Historically countries have introduced various fiscal instruments to attract foreign direct investment (FDI) while ensuring

revenue generation for host governments. Australia's Petroleum Resource Rent Tax (PRRT) (Holden and De Cruz, 2017) was designed to tax above-normal profits from oil and gas projects only after they became profitable, thereby maintaining investment attractiveness while securing fiscal revenues (Kraal, 2019). Australia also has relatively fewer tax incentives compared to other high-income countries (Kraal, 2019). Similarly, Malaysia has introduced targeted incentives for marginal petroleum fields, though FDI in the sector has nonetheless experienced declines (Goh & Effendi, 2017). Conversely, Indonesia's petroleum fiscal regime has struggled due to legal uncertainties and economic nationalism, highlighting the complexities of designing effective fiscal policies (Kraal, 2019).

Participant 4 emphasised the need for well-structured financial incentives to facilitate the transition toward cleaner energy solutions, stating,

"Robust financial incentives can accelerate the shift to cleaner energy while ensuring companies meet environmental standards."

This perspective aligns with broader academic findings that highlight the importance of aligning fiscal policies with sustainability objectives to encourage industry-wide emissions reductions. Effective regulatory frameworks and targeted fiscal measures are essential for bridging the gap between profitability and sustainability, fostering an industry-wide shift towards low-carbon operations.

Participants noted a critical disparity in the treatment of different industries regarding financial incentives. While sectors such as renewable energy and manufacturing benefit from structured financial support, the oil and gas sector remain largely unsupported in its decarbonisation efforts. This lack of targeted assistance creates a challenge where fossil fuel companies are expected to transition but are not provided with the necessary financial tools to do so effectively.

The consensus established during the discussion indicates that without the introduction of fiscal measures designed to reward emissions reductions and penalise high-emission activities, the transition to a lower-carbon oil and gas

sector will remain slow and sluggish. Policy reforms that integrate both incentives for green investments and stricter penalties for emissions could pave the way for a regulatory landscape that actively supports and accelerates decarbonisation efforts within the industry. Ultimately, creating a comprehensive framework that balances encouragement for low-carbon innovation with accountability for high emissions will be crucial in steering the oil and gas sector toward a more sustainable future. However, imposing stricter regulations on a small but growing oil and gas sector such as in South Africa has the potential to stifle its development before it even has a chance to succeed.

4.4.2 Theme 2: Financial and international pressures

a) International and financial pressures/ withdrawal of international funding

The oil and gas sector in South Africa is increasingly facing challenges related to the withdrawal of international funding which has been significantly influenced by global climate commitments, shifting investor priorities, and increasing pressures from environmental groups and regulatory bodies. Participants in this discussion highlighted the profound impact of the divestment movement, which has gained traction over the past decade, leading to a notable retreat of banks, pension funds, and institutional investors from financing fossil fuel projects, particularly those involving new developments.

As articulated by Participant 12,

“Many international funders won’t touch new coal or gas production. The pressure from this end is only going to grow.”

This sentiment reflects a broader trend where financial institutions are aligning their investment strategies with the goals outlined in the Paris Agreement. A growing number of major financial institutions have established explicitly clear policies that restrict or entirely prohibit investments in fossil fuel expansion projects. This is further compounded by the perception that any investment in

fossil fuels, including gas-fired power generation or carbon capture initiatives, is misaligned with long-term climate objectives. Such a shift presents a significant barrier for companies seeking financing for transitional projects that could bridge the gap between fossil fuels and renewable energy.

The geopolitical implications of this funding withdrawal cannot be overlooked. As Participant 11 noted, the relationship between energy security and national sovereignty is a critical concern.

“If you are secure in terms of oil and gas, it means to some extent, you are independent from external influences.”

The withdrawal of international funding will not only threaten the energy security in South Africa but also limit the government's ability to implement necessary reforms and improvements within the sector. Therefore, without sufficient political will and funding for the sector, there is a risk of stagnation, further complicating the path toward a sustainable energy transition.

Participants also highlighted the impact of policy uncertainty and regulatory hurdles on attracting international investors. As Participant 5 stated,

“International investors are hesitant to commit due to policy uncertainty and regulatory hurdles.”

This situation has led many companies to redirect their funds to countries with clearer investment frameworks, further exacerbating the funding challenges in South Africa. Participants pointed out the financial constraints facing this sector, indicating an urgent need to demonstrate value to potential investors to encourage further exploration and investment.

The dual nature of the funding withdrawal presents a double-edged sword. While it compels companies to explore greener alternatives it also simultaneously limits the capital available for transitional projects. Participant 13 remarked,

“This withdrawal is a double-edged sword. While it pushes companies to consider greener alternatives, it also limits capital for transitional projects.”

The decline in fossil fuel financing necessitates a reassessment of business models within the industry, prompting a shift toward investments in renewable energy sources such as wind, solar, and green hydrogen.

However, while there is a notable shift toward greener practices, the rapid withdrawal of international funding creates significant financial gaps, particularly for transitional projects. For instance, natural gas has often been considered a potential transitional fuel as it offers lower emissions compared to coal and oil. However, reducing the access to international financing poses a significant challenge for these projects, especially in developing countries such as South Africa, where energy security concerns remain very prevalent up to this day.

Furthermore, the discussion revealed that while international funders are withdrawing from fossil fuels, alternative sources of financing, particularly domestic and regional investors, have yet to fill the gap adequately. The growing green finance mechanisms, including sustainability-linked bonds, climate funds, and carbon markets are said to be insufficient to meet the funding needs of companies striving to decarbonise their operations while maintaining energy security.

The economic and geopolitical implications of this funding withdrawal are significant. As international lenders no longer invest in fossil fuel investments, there are growing concerns that some projects may seek alternative capital sources, including state-backed financing from countries that do not prioritise climate-aligned investment strategies. This shift could undermine and negatively affect global climate efforts especially if the financing lacks stringent environmental conditions and transparency standards.

Herzog-Hawelka and Gupta (2023) explores the transition strategies of multinational oil and gas (O&G) companies in the context of the climate crisis and the necessity of leaving fossil fuels underground. It outlines that these companies

are diversifying their operations by investing in renewable energy sources, improving energy efficiency, and expanding into petrochemicals. However, this diversification does not inherently result in a decrease in fossil fuel production. Furthermore, O&G companies need to employ corporate social responsibility (CSR) narratives to enhance their public image and maintain legitimacy yet, this strategy often faces intense accusations of greenwashing as many firms do not fulfil their transition claims. Additionally, the companies actively engage in lobbying to influence policymaking, advocating for voluntary reporting and emission targets that allow them to continue their 'business-as-usual' practices.

Furthermore, Herzog-Hawelka and Gupta (2023) emphasises the interplay of both endogenous factors, such as corporate governance and shareholder interests, and exogenous factors, including policy, law, competition, and activism, that affect these transition strategies. Herzog-Hawelka and Gupta (2023) ultimately argues that the barriers to effective transition are more significant than the motivating drivers, resulting in O&G companies often falling short of their climate commitments and resorting to greenwashing.

b) Leveraging domestic climate financing

The withdrawal of international funding from fossil fuel projects presents significant challenges for the energy sector, particularly in countries like South Africa, which rely on these investments for economic stability and energy security. In response to this growing concern, participants in the discussion highlighted the urgent need to explore and enhance domestic financing mechanisms to mitigate the impacts of capital shortfall. A prominent strategy identified was the development and expansion of domestic carbon markets, which hold the potential to provide companies with alternative funding sources for emissions reduction projects and broader climate initiatives.

Carbon markets function by assigning a monetary value to GHG emissions, thereby creating a financial incentive for companies to reduce their carbon footprints. In compliance-based carbon markets, companies operating within

regulated sectors are required to either reduce their emissions to remain within allocated carbon limits or purchase carbon credits from entities that have achieved greater emissions reductions. Conversely, voluntary carbon markets enable businesses and investors to buy credits from projects dedicated to actively removing or reducing emissions, such as reforestation, renewable energy generation, or carbon capture and storage (CCS) initiatives.

Participants highlighted that South Africa is uniquely positioned to leverage carbon markets as a financing tool. With the introduction of the country's carbon tax and ongoing discussions and debates surrounding carbon trading schemes, there exists a significant opportunity to channel revenues generated from these mechanisms into transitional energy projects. This strategic channelling would empower companies struggling to secure international funding to access domestic financial resources, facilitating investments in cleaner technologies while maintaining their economic viability. As Participant 12 articulated,

"If international funders are pulling out, we need to develop domestic solutions that incentivise emissions reductions and make it easier for companies to transition."

The establishment of a well-structured carbon market would allow high-emitting industries such as the oil and gas sector to slowly but surely decarbonise while still attracting investment. A framework as such ensures that funding is directed toward projects contributing to South Africa's climate objectives while simultaneously upholding economic stability. By leveraging carbon markets and other domestic financial tools, businesses have the potential to secure the essential capital required to sustain operations and implement emissions reduction strategies.

Moreover, participants recognised the critical role of collaboration between government and the private sector in driving investment in sustainable solutions. As Participant 5 noted,

“South Africa must develop domestic financing mechanisms to support low-carbon oil and gas projects.”

This sentiment reflects the consensus that without robust domestic financing structures, many companies in South Africa’s energy sector might face the untenable choice of either stopping new investments altogether or continuing with fossil fuel reliance without clear pathways to decarbonisation.

The discussion also revealed that integrating carbon markets into South Africa's broader financial landscape could significantly bridge funding gaps and create a more sustainable funding model for transitional projects. As participant 14 remarked,

“*Without alternative sources of funding, many companies in South Africa’s energy sector face a difficult choice: either halt new investments altogether or continue relying on fossil fuels without clear pathways to decarbonisation.”*

This highlights the necessity of innovative financing solutions to support the transition to a more sustainable energy future.

In addition to carbon markets, other domestic financing mechanisms, such as green bonds, sustainability-linked loans, and government-backed climate funds, were also identified as vital tools in supporting the energy transition. These financing instruments, when paired with a strong regulatory framework and clear policy direction, could help mitigate the risks associated with the withdrawal of international funding while ensuring that companies maintain competitiveness in an evolving global energy landscape.

As Participant 3 emphasised,

“*We need to ensure energy security while unlocking value from our resources. Leveraging domestic climate finance can help bridge the gap.”*

The discussions clearly illustrate and support Herzog-Hawelka and Gupta (2023) argument that while the withdrawal of international funding presents significant

challenges, it also opens avenues for innovative domestic financing strategies. Therefore, by prioritising the development of carbon markets and other financial mechanisms, South Africa can build a more resilient and sustainable energy sector and energy future that can navigate the complexities of the global transition toward a low-carbon future.

c) International pressures

The South African oil and gas industry is increasingly confronted with international pressures to align with global climate commitments and transition towards a low-carbon economy. These pressures originate from a complex interplay of multilateral agreements, trade policies, and shifts in financial markets that are reshaping the investment landscape. As countries globally enhance their decarbonisation efforts, fossil fuel-dependent economies such as South Africa, face the risk of losing access to key markets and funding if they fail to demonstrate tangible progress toward climate objectives.

As noted by participant 5,

“Global trends toward stricter climate policies and carbon pricing are shaping investment decisions.”

This sentiment encapsulates the growing realisation that the trajectory of investment in fossil fuels is being altered by an increasingly stringent regulatory environment aimed at combating climate change. Additionally, Participant 5 further emphasised,

“South Africa is under pressure to align its regulatory framework with international climate commitments,”

highlighting the urgency for South Africa to adapt its policies to meet global standards.

Participant 11 articulated a crucial point regarding the implications of policy direction on investor attractiveness, stating,

“The direction that we take as a country is either going to be attractive or not attractive to investors. So yeah, like you've said, the more stringent the policies are, the less likely we are going to have a booming economy, and the more flexible and accommodative they are.”

This observation highlights the delicate balance between regulatory stringency and economic growth within South Africa's energy sector. Participants highlighted that overly stringent policies may deter potential investors, thereby hindering economic expansion and innovation. Therefore, flexible and accommodative policies could foster a more favourable investment climate, attracting both local and foreign capital.

This emphasises the need for policymakers to consider the economic ramifications of their regulatory frameworks while striving for environmental sustainability.

Usman et al. (2024) emphasises that policymakers in polluted economies should prioritise a balanced approach that integrates both economic and environmental objectives when implementing Environmental Policy Stringency (EPS). Additionally, Usman et al. (2024) advocates for fostering international collaboration on environmental regulations to mitigate carbon leakage and promote sustainable trade. This dual focus is essential for achieving effective environmental policies while maintaining economic stability and competitiveness in global markets.

Therefore, striking an appropriate balance between stringent regulations and investor-friendly policies is essential for promoting a thriving economy while addressing climate change challenges. This approach could enhance South Africa's competitiveness in the global energy market and support the transition towards a sustainable energy future.

To navigate these international pressures effectively, South Africa must prioritise the development of comprehensive transition plans that balance energy security, economic development, and climate action. A well-structured transition plan

would serve as a clear roadmap for gradually reducing the country's reliance on fossil fuels while ensuring a just and equitable shift for the industries and workers affected by this transition. Key components of an effective transition plan could include:

International pressures are significantly reshaping the future of South Africa's oil and gas industry, necessitating proactive policy responses. Developing structured transition plans and aligning with global climate commitments, such as the Paris Agreement and the CBAM, will be critical for maintaining economic competitiveness and securing access to international markets and finance. This is why it is essential to ensure that the process of embracing a managed energy transition will enable South Africa to safeguard its industrial base while actively contributing to climate action efforts in a positive manner.

4.4.3 Theme 3: Industry adaptation and future pathways

As the global climate landscape continues to evolve, the South African oil and gas industry faces significant challenges and opportunities in its adaptation strategies. Participant 3 articulated a crucial perspective, emphasising that

"The sector must embrace innovation and collaboration to adapt to evolving climate policies and market dynamics."

This statement highlights the imperative for the industry to not only respond to regulatory changes but also to proactively shape its future through innovative practices and cooperative efforts among stakeholders.

In navigating the complex transition to a low-carbon economy, an integrated energy philosophy emerges as a vital framework for the industry. Participant 3 further noted,

"*An integrated energy philosophy is critical for navigating the transition while maintaining economic stability."*

This philosophy advocates for a holistic approach to energy management that aligns various energy sources and technologies to meet both current and future demands. Therefore, by integrating renewable energy sources, such as wind and solar, with traditional fossil fuel operations as successfully seen in Norway's Eldfisk project. The industry can then potentially create a more resilient and flexible energy system

Innovation is central to the adaptation of the oil and gas sector. The implementation of advanced technologies such as digitalisation, AI, and data analytics, can optimise production processes, enhance efficiency, and reduce environmental impacts. For example, companies can leverage predictive analytics to anticipate maintenance needs and optimise supply chains, ultimately lowering operational costs and minimising emissions. Furthermore, the development and deployment of carbon capture and storage (CCS) technologies present a promising pathway for reducing GHG emissions from fossil fuel operations.

Investment in research and development (R&D) is essential to drive technological advancements and foster a culture of innovation within the sector. In addition, there is a need for continued collaboration with academic institutions, technology providers, and government departments which can accelerate the development of novel solutions tailored to the unique challenges faced by South Africa's oil and gas and energy landscape.

Collaboration among various stakeholders is equally crucial for effective adaptation. Thus, by fostering partnerships between government, industry players, and civil society, the oil and gas sector can navigate regulatory frameworks more effectively and ensure that the voices of all stakeholders are considered in decision-making processes. This kind of collaboration can facilitate knowledge sharing, drive consensus on best practices and enhance public trust in the industry's commitment to sustainability.

Moreover, aligning with local communities is of absolute importance for addressing social and environmental concerns associated with fossil fuel

production. The process of engaging stakeholders in meaningful dialogue and incorporating their feedback into project planning can lead to more socially responsible practices that prioritise community well-being and environmental protection.

Looking ahead, the future pathways for South Africa's oil and gas industry certainly rely on the successful integration of sustainability into business models. This type of transition requires a strategic shift towards investing in low-carbon technologies and diversifying energy portfolios. The sector must explore opportunities in renewable energy generation, hydrogen production, and energy storage solutions, which can complement traditional fossil fuel operations while contributing to national climate goals.

The adaptation of South Africa's oil and gas industry to evolving climate policies and market dynamics requires a multifaceted approach that emphasises innovation, collaboration and strategic planning. Therefore, by embracing an integrated energy philosophy, fostering partnerships, and investing in low-carbon technologies the industry can navigate the transition toward a sustainable future while ensuring economic stability and resilience. The proactive measures taken today will be instrumental in shaping the industry's trajectory, its future and its role in both enabling and securing its role in a low-carbon energy landscape.

a) Encouraging collaboration and innovation

In addressing the urgent challenge of climate change, one of the significant mitigation measures identified during discussions was the necessity of fostering partnerships among industry players, government bodies, and academic institutions. This multi-stakeholder approach is crucial for collaboratively developing South Africa's upstream oil and gas industry. The effectiveness and efficiency of emissions reduction efforts within the sector hinge on this collaborative framework, which can streamline operations and facilitate the advancement of sustainable practices.

As highlighted by participant 5,

“Companies must work together to develop industry-wide solutions for emissions reductions.”

This sentiment by Participant 5, highlights the importance of collective action in tackling emissions and suggests that individual efforts may be insufficient in the face of the complexities posed by climate change. Public-private partnerships (PPPs) are particularly pivotal in this regard, as they can mobilise resources and expertise from both sectors to accelerate low-carbon innovation. Participant 3 emphasised this need for industry-wide collaboration, stating,

“The developments we are embarking on have environmental responsibility built into them.”

This assertion indicates that sustainability principles should be integrated into ongoing projects from their inception are therefore enhancing their overall impact.

Cross-sector collaboration is vital for achieving emission reduction targets, as evidenced by participant 3’s further comment:

“There is a pragmatic view around how climate considerations are integrated with growth imperatives. We must continue fostering collaboration to drive sustainable solutions.”

Such collaborative efforts not only address environmental goals but also align with the economic growth objectives of the industry, creating a balanced approach to energy production and consumption.

The complexity and cost associated with implementing CCS technology can be overwhelming for individual companies, as noted by participant 14:

“The challenges in deploying CCS are significant, and many companies lack the necessary resources to implement these technologies independently.”

This highlights that establishing partnerships allows for the pooling of resources, knowledge, and expertise, which can lead to more effective implementation of these technologies. The process if collaboration, companies can then possibly

share the financial burdens associated with developing infrastructure, conducting research and development, and executing large-scale projects that might otherwise be unfeasible on a standalone basis. This cooperative strategy has been observed in countries such as Canada where literature supports the effectiveness of collaborative approaches in advancing CCS initiatives. This was supported by Rock et al., (2017) who stated that the Quest Carbon Capture and Storage (CCS) Project which was operated by Shell in Alberta, Canada had the project successfully sequesters over 1 million tonnes of CO2 annually which prevented these emissions from entering the atmosphere. It was also indicated that what made this project so successful was that there continuous and on-going engagement with stakeholders in an effort to embrace collaboration.

Participant 12 pointed out that

“Collaborative efforts in CCS development can significantly reduce the financial risks for companies while advancing the technology more rapidly.”

Moreover, partnerships with academic institutions can significantly enhance research and development efforts. Universities and research centres often possess access to cutting-edge technology and the capability to conduct valuable studies that inform industry practices and policies. This synergy can lead to breakthroughs in CCS technology, making it more effective and accessible for companies seeking to reduce their emissions. As highlighted, the collaborative efforts between industry and academia have been instrumental in developing innovative solutions. According to Mkoko (2024) in 2024 Minister Gwede Mantashe launched the first Carbon Capture, Utilisation, and Storage (CCUS) research site in Leandra, in the province of Mpumalanga. Furthermore, this initiative is led by the Council for Geoscience (CGS) and has the objective to effectively mitigate carbon emissions in Mpumalanga which is a province renowned for its intense coal-fired power stations and industrial activities. Thungela Resources which is a mining company in South Africa has also partnered with the CGS to advance emissions research which further highlights and emphasises the importance of collaborative efforts

Participant 13 remarked,

“I think carbon capture plays an important role in facilitating the transition.”

His observation reflects the growing recognition of CCS as a critical component in the shift towards a more sustainable energy landscape. Furthermore, Participant 13 noted,

“I think there is a growing appetite for investment in the sector in South Africa,”

indicating a positive trend towards financing low-carbon initiatives. Participant 13 elaborated,

“As I mentioned, we're in a year now where we believe fully in the substitution of heavier fossil fuels with cleaner burning fossil fuels.”

This sentiment reinforces the idea that as the industry evolves, there is an increasing recognition of the need for cleaner energy alternatives, further emphasising the importance of collaborative frameworks in driving innovation and adaptation.

Participant 4 indicated that

“International obligations should not be imposed… and we should be afforded adequate time to build internal capacity… because what it means for the country is an afterthought

This emphasises that there is a need to improve internal capacity and to encourage continuous collaboration and innovation among industry players, government departments, and academic institutions is of absolute importance for advancing South Africa’s oil and gas sector. Therefore, by fostering partnerships, pooling resources, and embracing a multi-stakeholder approach, the industry can enhance its capacity to meet emission reduction targets while maintaining economic stability. The collective commitment to innovation and sustainability will not only support the transition to a low-carbon economy but also ensure that the sector remains competitive in an increasingly regulated global landscape.

b) Voluntary commitments

In recent years, the oil and gas industry has witnessed a growing trend of voluntary commitments from companies aiming to reduce GHG emissions. Even though such pledges are often celebrated as steps towards sustainability there is a notable scepticism regarding their actual effectiveness and the sincerity of these commitments. Participant 12 in the discussion highlighted critical concerns about the tangible impact of these voluntary initiatives and the potential for greenwashing.

Participant 12 noted that

“Oil and gas companies are stating their commitments or pledges in terms of reducing their Scope 1 emissions.”

This is reference to Scope 1 emissions direct emissions from owned or controlled sources indicates that companies are focusing on their operational impacts. However, Participant 12 further remarked that

Participant 4 echoed these concerns by emphasising the risks associated with greenwashing, stating,

“There’s a risk of companies making ambitious pledges without substantive action. Directors face a daily challenge to be honest about what’s achievable.”

This observation highlights the tension between corporate aspirations and objectives versus the realities of implementing effective emission reduction strategies. The potential for greenwashing where companies promote an exaggerated or misleading image of their environmental efforts poses significant challenges for stakeholders attempting to assess the credibility of these voluntary commitments. It also raises questions about the motivations behind such pledges as to whether they are genuinely aimed at reducing emissions or are they merely designed to enhance corporate reputations without delivering substantive results.

Participant 3 further cautioned against placing excessive reliance on voluntary industry commitments, stating,

"There needs to be consistent monitoring, reporting, and verification of emissions to build public confidence."

This call for transparency and accountability highlights a crucial element in addressing scepticism regarding voluntary commitments. The establishment of robust monitoring and verification systems is essential to ensure that the commitments made by companies translate into real, quantifiable emissions reductions. The lack of such mechanisms in place can potentially lead to an increased level of risk that voluntary initiatives may serve more as public relations tools than as effective climate action strategies- which would be unfortunate.

Moreover, Participant 3 emphasised that

“Voluntary sustainability commitments must be backed by verifiable actions to avoid greenwashing accusations.”

This assertion points to the need for companies to go beyond mere rhetoric and demonstrate tangible results in their sustainability efforts. By implementing transparent reporting practices and establishing measurable impacts, companies can enhance their respective credibility and build trust with stakeholders, including investors, customers, and regulatory bodies. Participant 3 further stated,

"Confidence in industry efforts will grow if voluntary commitments are accompanied by transparent reporting and measurable impacts,"

highlighting that accountability is integral to the effectiveness of these initiatives.

Therefore, while voluntary commitments from oil and gas companies to reduce emissions represent a positive trend, there remains a critical need for scepticism and scrutiny regarding their implementation and impact. The discussions highlighted the importance of transparency, monitoring, and verification in

ensuring that these commitments produce meaningful results instead of serving as mere symbolic gestures. As the industry navigates the complexities of climate action, the establishment of credible frameworks for accountability will be essential in fostering public confidence and advancing genuine progress towards emissions reduction targets. Ultimately, for voluntary commitments to contribute effectively to the global climate change agenda it must be noted that there must be well substantiated through verifiable actions that align with the urgent need for significant reductions in GHG emissions.

c) First-mover risks

The theme of first-mover risks emerged prominently in discussions about emissions reduction strategies within the oil and gas industry. Participant 12 expressed concerns regarding the financial and operational challenges that companies may face when they choose to lead in setting ambitious emissions reduction targets. Participant 12 articulated a common apprehension, stating,

“There’s a risk to companies to be a first mover, to set the most ambitious targets and then outprice themselves out of the market. That race to the bottom is real.”

This observation highlights the tension that arises when companies attempt to pioneer sustainable practices in an environment where cost competitiveness often takes precedence over environmental responsibility.

Participant 2 echoed this sentiment, noting that

“First movers in setting ambitious targets face risks of being priced out of the market.”

The phrase *"race to the bottom"* describes the competitive pressures that can lead companies to prioritise short-term profitability over long-term sustainability. This perspective highlights the challenges faced by companies attempting to balance economic viability with the imperative of making meaningful progress toward emissions reductions. The reluctance to lead in emissions reductions thus illustrates a broader systemic issue within the industry, where superficial

commitments to sustainability may be favoured over substantive actions that might jeopardise immediate financial performance.

Moreover, Participant 5 pointed out that

“Companies that adopt emissions reduction strategies early face financial and operational risks.”

This assertion is particularly significant in the context of an industry that has traditionally relied on fossil fuels and may not yet have established a robust market for low-carbon technologies. The potential for early adopters to incur higher costs without immediate returns poses a higher barrier to the widespread implementation of emissions reduction strategies. Furthermore, without appropriate policy incentives to support these early actions, as noted by Participant 5,

“First movers may be at a disadvantage compared to late adopters.”

This scenario creates a disincentive for companies to take proactive measures, thereby stalling progress in the transition to a low-carbon economy.

Participant 3 acknowledged the multifaceted risks faced by companies that take early action, stating,

“Those who move first often bear the highest costs, and we need to ensure that they are supported through appropriate incentives.”

This commentary emphasises the necessity for government and financial support systems that can alleviate the burdens placed on early movers. Therefore, by providing targeted incentives, such as tax breaks or subsidies for low-carbon technology investments, policymakers can help level the playing field for companies that choose to prioritise sustainability, thereby encouraging broader industry participation in emissions reduction efforts.

Additionally, Participant 3 elaborated on the competitive disadvantages faced by early adopters, asserting that

“Companies that adopt early climate action strategies may face competitive disadvantages unless regulatory frameworks provide adequate support.”

This observation highlights the critical role of regulatory environments in shaping the behaviours of industry players. Supportive policies not only enhance the viability of early emissions reduction initiatives but also signal to the market that sustainability is a legitimate and essential business consideration. Participant 3 further argued,

“Investing in cleaner technologies is essential, but without supportive policies, early movers’ risk financial strain compared to those who delay compliance.”

This assertion highlights the importance of a cohesive policy framework that aligns economic incentives with environmental goals, ensuring that companies are not penalised for taking proactive steps toward sustainability hence it is important for companies to invest in cleaner technologies as the lack of supportive regulations puts a huge financial strain.

The discussion surrounding first-mover risks reveals significant barriers to the adoption of ambitious emissions reduction strategies in the oil and gas industry. The tension between cost competitiveness and sustainability highlights the need for robust regulatory frameworks and financial support systems that can mitigate the risks faced by early adopters. By fostering an environment conducive to innovation and investment in low-carbon technologies, policymakers can encourage more companies to take the lead in emissions reductions, ultimately driving meaningful progress toward global climate goals. Without such measures, the industry may continue to struggle with superficial commitments and missed opportunities for substantial emissions reductions.

Overall, this chapter detailed the key findings from participants, highlighting the oil and gas sector's significant contributions to GHG emissions, the policy and regulatory gaps that hinder effective mitigation, and the pressures from international funders and stakeholders. Participants provided critical insights into the challenges and opportunities for aligning the sector with South Africa’s climate

change commitments. Chapter 5 below will present recommendations and conclusions based on these findings.

4.5 Conclusion for RQ1: The impact of future Oil and Gas exploration and production on greenhouse gas (GHG) emissions and climate change

The impact of future oil and gas exploration and production on greenhouse gas (GHG) emissions and climate change is a significant concern, particularly in the context of South Africa's ongoing reliance on fossil fuels. As South Africa continues to expand its oil and gas exploration activities there is an expectation that there will most likely be a substantial increase in emissions associated with this. However, it has been noted that unfortunately, this trajectory is inconsistent with international climate commitments. The findings suggest that the continued development of new oil and gas operations, the lack of stringent regulatory controls as well as technological improvements will exacerbate and further increase the country's overall carbon footprint, making it increasingly difficult to transition toward a low-carbon economy.

The challenge of balancing energy security with climate commitments is a recurring theme in the discussion with the participants regarding the oil and gas industry. On the one hand, South Africa's need for reliable and affordable energy supply requires for the continued investment in fossil fuel infrastructure. However, on the other hand, the long-term climate risks associated with increased emissions as well as rising temperatures, extreme weather events, and environmental harm highlight the need for a strong, clear and decisive shift toward cleaner alternative sources of energy. The findings indicate that without targeted mitigation efforts, including the implementation of best practices in emissions management the oil and gas sector will continue to remain a huge contributor towards national and global emissions.

The analysis further highlights that there is a significant gap in the industry's approach to emissions reduction particularly concerning Scope 1 emissions.

Industry participants suggest that while some companies have adopted voluntary commitments to reduce emissions, these measures are often insufficient and lack implementation capabilities. Additionally, operational inefficiencies involved in the operations continue to contribute to local and global emissions. Hence there is a great need for addressing these inefficiencies would require both technological advancements and stronger regulatory oversight to be applied by the South Africa government and industry to ensure that companies adhere to best practices for emissions management.

From a global perspective, these findings align with existing literature that emphasise and confirm the impact of the oil and gas sector has on climate change. Previous studies indicate that without an accelerated transition away from fossil fuels, emissions from the sector will continue to increase which unfortunately goes against the global efforts to achieve net-zero emissions. The Intergovernmental Panel on Climate Change (IPCC) as well as the International Energy Agency (IEA) have both emphasised that new oil and gas developments are certainly not compatible with a 1.5°C warming scenario as these developments will contribute to GHG emissions unless they operations are supported with aggressive emissions reductions methods and technologies which have been proven to be successful in some operations globally however, the challenge remains the high costs involved that may hinder investors and companies from adopting such as it may potentially harm their profits to a larger extent. The results of this study further support the idea that South Africa's future exploration and production activities must be well aligned and have clearly defined emissions reduction pathway to effectively mitigate climate impacts effectively and successfully.

Main Findings

The study's findings demonstrate that future oil and gas exploration and production in South Africa will potentially contribute significantly to GHG emissions, and this is primarily due to the expansion of extraction activities and the absence of robust mitigation policies. The projected increase in emissions is

driven by both direct operational processes, such as drilling and refining, and indirect activities, including transportation and distribution. The research indicates that operational inefficiencies remain a major concern, as many companies continue to use outdated technologies that result in higher emissions levels as seen in countries such as Nigeria which is a developing economy with strong oil and gas reserves. This inefficiency is compounded by the lack of stringent regulatory enforcement and implementation mechanism which allow for continued high-emission practices.

The study further reveals that there is a misalignment between industry commitments and actual emissions reduction outcomes. Unfortunately, while some oil and gas companies have announced voluntary emissions reduction targets these measures are often not legally binding and are implemented inconsistently across the sector which needs to be addressed. Additionally, financial constraints and regulatory uncertainty discourage investment in cleaner technologies, further limiting the sector's ability to reduce its overall carbon footprint. The findings suggest that a more comprehensive and enforceable and implementable regulatory framework is what is required to ensure that emissions reduction commitments translate into tangible and reliable outcomes that have a positive contribution to the climate.

The research also highlights that there are broader implications of the potential for increased oil and gas exploration and production on South Africa’s climate resilience. The potential continued expansion of oil and gas projects is likely to delay the South Africa’s transition to cleaner alternative sources of energy, which unfortunately will prolong and extend the dependence on high-emission energy production. This delay will cause long-term risks to both environmental and economic stability as the global financial markets continue to shift away from fossil fuel investments. The findings emphasise there is a great need for a proactive policy approach that integrates climate considerations into energy planning to ensure a sustainable transition away from carbon-intensive energy sources.

The study's conclusions align with global literature on oil and gas emissions, reinforcing the argument that the expansion of fossil fuel production without corresponding mitigation measures is incompatible with long-term climate goals. The findings provide further empirical evidence and support for policy interventions that are clear and prioritise emissions reductions, encourage technological innovation and clear regulatory implementation to address the sector's climate impact effectively.

4.6 Conclusion for RQ 2: Existing policy and regulatory gaps hindering effective climate mitigation

The analysis of South Africa's policy and regulatory framework for climate mitigation in the oil and gas sector reveals that there are significant gaps that prohibit or limit effective emissions reductions. The existing literature emphasises that while South Africa has developed several climate policies such as the Climate Change Act of 2024 and sectoral guidelines for energy regulation these frameworks often lack integration and alignment with energy sector planning (Khavhagali, 2024).. The research findings indicate that existing policies that have been developed unfortunately do not sufficiently integrate climate change considerations into energy sector planning which inevitably leads to the highly disjointed and fragmented as well as conflicting regulatory frameworks and regulatory environment in South Africa. This lack of cohesion prevents the effective implementation of emissions reduction strategies and slows down the journey to effectively and sustainably transition to a low-carbon economy.

The lack of clear and binding sector-specific emissions reduction targets is a huge critical regulatory gap identified in the study (Centre for Environmental Rights, 2025). While South Africa has committed to reducing its overall emissions under the Nationally Determined Contributions (NDCs) framework, there are no enforceable mandates requiring the oil and gas industry to achieve specific reduction goals. This regulatory gap allows companies to continue operating with minimal accountability for their emissions which then continues to undermine

local and international climate commitments that have been established. The findings suggest that without legally binding emissions limits, voluntary corporate initiatives are unlikely to deliver meaningful reductions measures and results, unfortunately.

The study also highlights that there are financial and policy barriers that limit the effectiveness of climate mitigation efforts. The lack of sufficient incentives for emissions reductions such as subsidies for renewable energy integration or penalties for excessive emissions, discourages companies from investing in cleaner technologies. Additionally, international financial pressures, including the withdrawal of foreign direct investments in fossil fuel projects create uncertainty for industry stakeholders. Further, the findings indicate that leveraging domestic climate financing mechanisms could potentially provide an alternative pathway for funding sustainable energy transitions. However, due to the lack of clear policy direction the oil and gas industry will remain hesitant to adopting long-term climate change emission mitigation strategies.

The regulatory gaps identified in this study align with broader literature that was analysed on existing climate governance challenges in fossil fuel-dependent economies. Further, research highlights that there are indeed difficulties regarding implementing stringent and clear emissions controls in contexts where fossil fuels play a dominant role in economic and energy security. The findings reinforce the argument that effective climate mitigation requires an integrated regulatory approach that aligns emissions reduction policies with energy sector development plans. This is crucial for South African market as well. Additionally, international best practices suggest that introducing sector-specific carbon pricing mechanisms and strengthening regulatory oversight has the potential to enhance the effectiveness of emissions reduction efforts.

While the South African government develops climate policies and regulatory frameworks, effective implementation cannot rely solely on government agencies. Key stakeholders including upstream oil and gas companies, provincial authorities, civil society organisations, and research institutions are required to

participate in ensuring compliance, adopting decarbonisation measures, and monitoring progress. Mechanisms such as multi-stakeholder task forces or public–private partnerships can facilitate coordination and accountability. For instance, the Presidential Climate Commission provides a platform to align government, industry, and civil society in overseeing the country's climate mitigation strategies, illustrating

Main Findings

The research findings indicate that the lack of a cohesive, clear and enforceable policy frameworks is a crucial and key barrier to effective climate mitigation in South Africa's oil and gas industry. This clear misalignment between energy policies and climate objectives results in regulatory inconsistencies that limit the sector's ability to reduce emissions. The study also finds that the clear lack of legally binding sector-specific emissions targets allows for continued high-emission practices without consequences as companies face minimal regulatory pressure to adopt cleaner technologies.

The financial constraints associated with emissions reduction initiatives further hinder and limit the intensity and consistency of mitigation efforts. The research highlights the need for stronger financial incentives, including tax breaks and subsidies for renewable energy integration, to encourage industry-wide adoption of low-carbon technologies. This is supported by the emphasis made by participants. Additionally, the findings suggest that international financial pressures such as the withdrawal of funding for fossil fuel projects are said to be reshaping the investment landscape making it more and more important for South Africa to develop domestic climate financing mechanisms that are clear.

The study's findings are consistent with global research in the literature review. The literature also suggests that effective climate mitigation in the oil and gas sector requires an integrated approach that combines binding regulatory mandates with market-based incentives. The findings further support the suggestion that policy coherence and regulatory enforcement and

implementation are crucial to ensuring that emissions reduction commitments translate into tangible outcomes.

The research highlights the urgency of addressing these regulatory gaps to align South Africa's oil and gas industry with global climate goals. Further, with decisive policy action, the oil and gas industry it will not limit its global and national emissions as it will enable the transition to a sustainable energy system and increasing climate-related risks.

4.7 Comparison of Literature Review and Findings

Table 4: The comparison of the literature review, findings from the study & perspectives and findings that were consistent with the literature

Proposition Based on Literature Review	**Response to Research Question**	**Findings from this study**	**Perspectives & Findings Consistent with Literature**
Future oil and gas exploration and production contribute significantly to global greenhouse gas (GHG) emissions, exacerbating climate change.	Future exploration and production activities in South Africa will likely increase emissions, making climate mitigation more challenging.	The study confirms that operational inefficiencies, including flaring, venting, and outdated extraction technologies, significantly increase emissions. Without stringent mitigation policies, the sector will remain a major	Studies show that oil and gas exploration is a leading contributor to emissions, particularly through methane leaks and flaring. Similar challenges are observed in other fossil fuel-dependent countries where

		contributor to GHG emissions.	mitigation efforts remain weak.
Countries with high fossil fuel dependence struggle to balance energy security with climate goals.	South Africa faces difficulties in transitioning away from fossil fuels due to economic and energy security concerns.	Findings highlight the country's reliance on fossil fuels, where expansion of oil and gas operations is seen as an economic necessity, despite climate risks. There is a lack of incentives for companies to transition to cleaner energy alternatives.	Literature emphasises that energy security concerns often delay decarbonisation efforts, as seen in countries with similar energy structures, such as Nigeria and Indonesia.
The lack of stringent sector-specific regulatory frameworks hinders emissions reduction efforts.	Policy and regulatory gaps prevent effective emissions reduction strategies in the oil and gas industry.	The study identifies a major disconnect between South Africa’s energy policies and climate objectives. There are no binding emissions reduction targets for the oil and gas sector, leading to inconsistent implementation of mitigation	Research on climate governance highlights that weak regulatory enforcement and vague commitments contribute to continued fossil fuel expansion. Similar trends exist in many developing economies.

		measures.	
Voluntary corporate climate commitments are often insufficient and do not align with national and global climate goals.	Many industry actors rely on voluntary commitments rather than mandatory regulations to manage emissions.	Findings show that while some companies have set emissions reduction targets, these are often non-binding and inconsistently applied. There is little regulatory oversight to ensure compliance.	Literature suggests that voluntary climate commitments often serve as greenwashing mechanisms, with companies setting targets but failing to achieve them due to the lack of enforcement.
International financial and regulatory pressures influence domestic oil and gas policies.	Global financial institutions are withdrawing from fossil fuel investments, affecting South Africa's energy sector.	The study confirms that international financial pressures are reshaping investment trends, making it harder for South Africa to secure funding for fossil fuel projects. However, domestic climate financing mechanisms remain underdeveloped.	Global financial divestment from fossil fuels is accelerating, as seen in other regions where banks and investors are shifting toward renewables. South Africa faces similar trends but lacks a strong local financing framework for transition efforts.

Carbon capture, renewable energy integration, and technological improvements can mitigate emissions but require strong policy support.	There is potential for emissions reductions through cleaner technologies, but policy and financial barriers remain.	Findings suggest that South Africa lacks sufficient incentives for renewable energy integration and carbon capture technology adoption. Policy misalignment hinders large-scale deployment of these solutions.	Studies highlight that carbon capture remains underfunded globally, with implementation challenges linked to high costs and uncertain long-term viability. South Africa faces these same issues.
Climate mitigation policies are more effective when they include penalties for high emissions and financial incentives for low-carbon investments.	The absence of sector-specific carbon pricing and penalties weakens climate mitigation efforts.	The study finds that weak enforcement and implementation mechanisms allow continued high-emission activities. South Africa has yet to implement effective financial penalties or incentives for emissions reduction.	Countries with strong climate policies, such as the EU nations, have successfully used carbon taxes and cap-and-trade mechanisms to drive emission reductions. A great example is in Norway. South Africa's lack of such measures is a key barrier.
Political will and interdepartment	The misalignment between	Findings reveal that South Africa's	Similar governance issues are

al coordination are crucial for effective climate action in the oil and gas sector.	departments (DMRE and DFFE) and conflicting policy priorities hinder implementation.	climate policies are fragmented across multiple government departments, leading to delays and inefficiencies in implementation. Political reluctance to challenge the fossil fuel industry further weakens policy enforcement.	observed in fossil fuel-dependent nations, where ministries responsible for energy and economic growth often resist aggressive climate policies.
Implementation of climate policies often faces structural and administrative challenges.	Even well-designed policies struggle to be implemented due to weak governance, resource constraints, and lack of accountability.	The study finds that South Africa has several strong climate policies on paper, but enforcement remains weak due to a lack of capacity, regulatory duplication, and industry resistance.	Research shows that climate policies are often delayed or weakened in implementation due to lobbying pressures, resource limitations, and administrative inefficiencies. South Africa's experience is consistent with these broader trends.

4.8 Conclusion

This chapter has provided an in-depth analysis of two key research questions. The findings highlight that the continued oil and gas project development will significantly contribute to national and global emissions which will cause a challenge to South Africa's ability to meet its climate commitments. Even though there are clear advancements in emission reduction technologies, unfortunately, operational inefficiencies and reliance on outdated extraction methods remain prevalent which further increases and exacerbates the sector's carbon footprint. The persistence of these inefficiencies highlights the limitations of voluntary industry-led initiatives and highlights the need for stronger regulatory interventions to drive meaningful emissions reductions.

Regarding the first research question, the study confirms that without clear and stringent emission mitigation measures the future oil and gas activities in South Africa will contribute to the increased carbon emissions. This will inevitably undermine and slow down South Africa's decarbonisation objectives that have been set. This finding also aligns well with broader literature that was analysed and that identified that indeed, oil and gas production is a primary driver of climate change and has negative climate change related impacts. Further, emphasising that Scope 1 emissions from oil and gas operations remain substantial, particularly in regions with poor and weak regulatory oversight and transparency. The study further finds that the economic prioritisation of domestic energy security over climate commitments creates policy contradictions even though South Africa is on a journey seeking to grow its oil and gas exploration despite its pledges to reduce emissions to achieve climate change objectives.

Additionally, international divestment from fossil fuels related projects by investors has certainly placed great financial pressure on the industry but domestic policies have yet to fully respond by incentivising cleaner alternatives at a scale that can drive and increase sufficient adoption of cleaner technologies that can help reduce the impacts of climate change. The analysis also highlights that while some companies have adopted emissions reduction strategies, these

efforts are often constrained by financial limitations or lack of willingness by investors to make financial investments, technological developments as well the lack of implementable sector-wide emissions reduction objectives.

Addressing the second research question, the study finds that South Africa's policy and regulatory frameworks for climate mitigation in the oil and gas sector remain fragmented, disjointed and inconsistent. Even though there are national policies such as the National Climate Change Response Policy (NCCRP) and the Carbon Tax Act which both have the objective to regulate emissions, their enforcement or implementation ability is challenged by weak implementation mechanisms that exist, the lack of interdepartmental coordination between Ministers(i.e. Minister Mantashe and Minister Creecy as discussed in the literature review., and political resistance from key industry stakeholders. This aligns with existing literature, which highlights that there is a big policy misalignment challenge that exists in many developing economies where unfortunately there are competing national priorities often weaken climate governance.

The study also reveals that the absence of sector-specific emissions reduction targets creates ambiguity which has allowed and enabled oil and gas companies to continue operations without clear accountability measures which will have devastating consequences in the near future and highlights the lack of industry accountability that is prevalent. Further adding to this issue at hand is that there is a lack of strong financial incentives and penalties to encourage industry-wide compliance, and this is a result of existing carbon pricing mechanisms that remain too weak to drive significant behavioural change.

In addition, another critical barrier identified is the lack of political will and the challenges associated with interdepartmental coordination. Even though South Africa has developed several progressive climate policies compared to many developing economies, their implementation is often undermined by the existing bureaucratic inefficiencies and conflicting mandates between government departments and leaders who are responsible for energy, environmental

protection, and economic development. The study also finds that these challenges create regulatory uncertainty, which inevitably discouraging investment in cleaner technologies and delaying meaningful policy action. This is consistent with global research findings on climate policy implementation that indicate and highlights the great importance of cohesive governance structures in ensuring effective climate action. Moreover, the study identified a clear disconnect between international climate finance trends and domestic policy adaptation. As international financial institutions withdraw funding from fossil fuel projects, South Africa has yet to develop robust domestic financing mechanisms to support the transition to low-carbon energy alternatives. This gap in climate finance further constrains South Africa's ability to implement large-scale mitigation strategies within the oil and gas sector.

The findings of this chapter also highlight the urgent need for regulatory reform to close the existing policy gaps and align South Africa's climate policies with its economic and energy priorities. Strengthening implementation and enforcement mechanisms followed by introducing clear and implementable emissions reduction goals and improving interdepartmental coordination will be essential in enhancing and supporting the effectiveness of climate mitigation efforts that have been taking place. Additionally, increasing financial incentives for emission reductions and establishing sector-specific carbon pricing mechanisms could encourage greater industry compliance. The absence or lack of these structural and policy reforms, South Africa faces the risk of failing to meet its climate commitments while continuing to face long-term economic and environmental challenges that are associated with fossil fuel dependency.

As this chapter has demonstrated, the journey and process towards mitigating the impact of oil and gas production on climate change requires a holistic approach that integrates policy, financial, and institutional reforms. The next chapter will build on these findings by exploring potential policy recommendations and strategies to strengthen South Africa's climate response while ensuring a just, equitable and sustainable transition for the energy sector.

CHAPTER 5. CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the key conclusions drawn from the research specifically addressing the two research questions that guided the overall study. The study analysed the impact of continued oil and gas exploration and production on GHG emissions and climate change, as well as the policy and regulatory gaps that hinder effective climate mitigation in South Africa's oil and gas sector. Additionally, the findings were critically analysed in relation to the existing literature which allowed for a detailed comprehensive understanding of the challenges and opportunities in climate governance within this industry. Furthermore, this chapter intends to highlight the key contributions to knowledge by comparing initial hypotheses that were derived from the literature review with the study's own findings. The intention is to demonstrate areas of consistency and the key differences and gaps that influence the contribution to knowledge.

5.2 Conclusion for RQ 1: The impact of future Oil and Gas exploration and production on GHG emissions and climate change

The research findings indicate that the continued expansion of oil and gas exploration and production in South Africa will contribute to increased GHG emissions. The study confirms that despite growing international commitments to reduce and phase out the use of fossil fuels, South Africa remains heavily invested in hydrocarbon development due to economic and energy security concerns that remain prevalent. This dual approach presents a policy contradiction that do not support the national and international decarbonisation efforts. According to (IEA, 2021; IPCC, 2022), the literature supports this view, as it has emphasised and warned that continued use of and exploration of fossil fuel resources will remain incompatible with the drive to achieving the global temperature targets that have been set and outlined in the Paris Agreement.

Further, regarding South Africa, this depicts a broader that is challenge faced by many developing and emerging economies that are needing to ensure that they seek and balance industrial growth with climate responsibilities and energy security.

In addition, there has been another finding in this study which is that operational inefficiencies which include high methane emissions and outdated infrastructure significantly contribute to global emissions. These existing operational inefficiencies that have been noted align with the global observations that oil and gas operations are said to approximately account for 15% of total energy-related emissions as supported by the (IEA, 2021).

The study also finds that voluntary industry measures that are targeted at reducing these notable emissions have had minimal impact. Lazarus & van Asselt (2018) supports this, arguing that voluntary initiatives lack enforceability often serve as corporate greenwashing rather than effective mitigation strategies.

Furthermore, while carbon capture, utilisation, and storage (CCUS) technologies have been widely discussed as a potential solution for emissions reduction, the study reveals that their implementation in South Africa faces significant financial and policy barriers. The lack of targeted incentives and the lack of a clear regulatory framework hinder large-scale deployment. This aligns with literature findings which indicate that without government subsidies and a stable investment environment the adoption of CCUS will continue to remain limited.

Another key finding is that South Africa's continued reliance on fossil fuel production may potentially lead to and result in challenging economic and trade risks and this is due to major international financial institutions continue to withdraw funding from carbon-intensive projects. Sovacool et al., (2021) has highlighted how international climate finance trends increasingly favour low-carbon energy investments which inevitably results in fossil fuel-dependent economies to be in a vulnerable difficult position. The study finds that while South Africa acknowledges these risks, the country lacks sufficient domestic climate finance mechanisms to replace declining international support. This emphasises

the need for an urgent policy shift to align national energy planning with global climate trends.

5.3 Conclusion for RQ 2: the existing policy and regulatory gaps that hinder effective climate mitigation

The study finds that while South Africa has developed several climate-related policies, including the National Climate Change Response Policy (NCCRP) and the Carbon Tax Act as mentioned. Their respective implementation has been determined to be inconsistent and weak due to the existing fragmented governance and a lack of interdepartmental coordination. The literature strongly supports this, as (Burton et al., 2018) highlight the structural inefficiencies in South Africa's policy landscape hinder effective climate action. The lack of sector-specific emissions reduction targets for the oil and gas industry further exacerbates these challenges which inevitably creates regulatory ambiguity and reduces accountability which is of great importance.

Further, policy misalignment between energy and climate policies is another critical issue identified in the research. While South Africa's climate policies advocate for emissions reductions, the existing energy policies continue to promote hydrocarbon development as emphasised by industry leaders such as Minister Gwede Mantashe leading to contradictory objectives that hinder effective implementation. Furthermore, policy fragmentation and lack of coherency is a considered a big issue in developing and emerging economies where economic growth priorities often clash with environmental commitments. This misalignment has led to further deeper political resistance from both industry stakeholders and government departments that view stringent climate regulations as a threat to economic growth and job creation.

The study also identifies weak implementation mechanisms as a major barrier to climate mitigation. Further, the existing penalties for non-compliance with emissions reduction requirements are minimal, and regulatory agencies lack the capacity to monitor and enforce strict environmental standards. Literature echoes

this concern too, arguing that without significant penalties and active government intervention the industries are more unlikely to adopt meaningful emissions reduction measures.

Additionally, financial disincentives play a crucial role in delaying the transition to a low-carbon economy. South Africa has introduced carbon pricing through the Carbon Tax Act, the study finds that its impact has been limited due to low pricing levels and generous exemptions granted to industries. Based on the literature one can deduce that the carbon pricing should be supported by regulatory implementation and complementary financial incentives to drive real change.

Finally, the study also highlights the importance and need for political will in overcoming these policy and regulatory challenges. The findings indicate that while there is some recognition within government circles for the need to strengthen climate governance, bureaucratic inefficiencies and competing priorities have stalled meaningful progress. Therefore, this emphasises that successful climate policy implementation requires strong leadership, intergovernmental collaboration, and stakeholder engagement.

5.4 Consistency table

Table 5: The literature-based propositions, conclusions based on own research, key differences & contribution to knowledge and the gaps/ unconfirmed aspects

Research Question	Literature-Based Propositions	Conclusions Based on Own Research	Key Differences and Contribution to Knowledge	Gaps or Unconfirmed Aspects
RQ1: The impact of future oil and gas exploration and production on GHG emissions and climate change	**1. Continued fossil fuel production will lead to increased emissions and hinder climate targets.** Literature argues that new oil and gas projects are incompatible with Paris Agreement targets.	**Confirmed.** The study finds that South Africa's ongoing hydrocarbon expansion has the potential to contribute significantly to GHG emissions and conflicts with its climate commitments. There is a disconnect between policy rhetoric and implementation	**Contribution:** The research provides specific evidence of South Africa's fossil fuel expansion plans conflicting with international decarbonisation goals. It highlights the country's policy contradictions in greater detail than previous	**Gap:** While the study confirms rising emissions, it does not comprehensively quantify potential future emissions from planned projects under different policy scenarios. More modelling is needed.

			studies.	
	2. Industry self-regulation is insufficient for meaningful emissions reductions. Research suggests voluntary corporate actions lack enforceability and are often greenwashing efforts.	**Confirmed.** The study finds that industry-led voluntary commitments have had minimal impact due to a lack of oversight and regulatory enforcement. Companies focus on symbolic actions rather than substantive emissions reductions.	**Contribution:** The research builds on existing literature by demonstrating how weak enforcement in South Africa allows voluntary initiatives to serve as corporate PR rather than effective climate mitigation tools.	**Gap:** The study does not measure whether voluntary commitments lead to marginal improvements in emissions reductions compared to complete non-compliance. A comparative analysis is needed.
	3. Technological solutions like CCUS face financial and policy constraints. Literature emphasises that CCUS adoption requires significant	**Confirmed.** The study finds that while CCUS is discussed as a mitigation solution, there are no significant incentives or regulatory	**Contribution:** The research identifies South Africa-specific barriers, such as a lack of policy coherence and limited	**Gap:** The study does not evaluate the feasibility of CCUS in specific oil and gas fields or the potential cost-effectiveness

	government support, which is often lacking.	frameworks supporting its deployment in South Africa. Financial and technical barriers remain major obstacles.	domestic funding mechanisms, which exacerbate CCUS implementation challenges.	of pilot projects.
	4. International financing will shift away from fossil fuels, pressuring economies reliant on them. Studies highlight the risk of stranded assets and declining fossil fuel investments.	**Confirmed.** The study finds that major financial institutions are reducing their support for fossil fuel projects, increasing economic risks for South Africa. However, the country lacks sufficient domestic climate finance to compensate for this shift.	**Contribution:** The research provides empirical evidence of South Africa's growing vulnerability due to international funding withdrawal and emphasises the urgent need to develop domestic climate finance solutions.	**Gap:** The long-term implications for energy security and economic stability remain uncertain. More data on potential domestic financing solutions and their viability is required.

RQ2: The existing policy and regulatory gaps that hinder effective climate mitigation	**1. Policy misalignment, lack of enforcement, and weak financial incentives hinder emissions reductions.** Literature notes that conflicting policies and poor governance prevent effective climate action.	**Confirmed.** The study finds that South Africa's energy and climate policies often contradict each other, making emissions reductions difficult to achieve. There is a lack of coordination between government departments.	**Contribution:** The research provides a more granular analysis of policy contradictions, highlighting specific instances of misalignment (e.g., continued investment in gas while committing to net zero).	**Gap:** It remains unclear whether policy alignment efforts are underway or if future legislation may address these contradictions.
	2. Sector-specific targets are necessary for accountability. Research Literature argues that emissions reduction efforts must be tailored to different industries for better enforcement.	**Confirmed.** The study finds that South Africa lacks clear sector-specific emission reduction targets for oil and gas, reducing accountability and regulatory clarity.	**Contribution:** The research highlights how the absence of sectoral targets creates regulatory ambiguity, discouraging industry investment in emissions reduction.	**Gap:** The study does not explore industry perspectives on potential sector-specific regulations. More engagement with industry stakeholders is needed.

	3. Political resistance will slow policy reform. Studies suggest that fossil fuel industries and government entities often resist stringent climate policies.	**Confirmed.** The study finds that political opposition from industry stakeholders and some government departments delays the adoption of more stringent climate policies. Economic concerns often outweigh environmental priorities.	**Contribution:** The research provides an in-depth exploration of how political will (or lack thereof) shapes climate governance in South Africa and how vested interests influence policy stagnation.	**Gap:** Future research could investigate whether international pressure (e.g., trade policies, carbon border taxes) could overcome domestic political resistance.
	4. Bureaucratic inefficiencies and interdepartmental conflicts weaken climate policy implementation. Literature points to governance fragmentation as a barrier to policy effectiveness.	**Confirmed.** The study finds that overlapping mandates and poor interdepartmental collaboration result in delayed and inconsistent implementation of climate policies.	**Contribution:** The research highlights specific governance challenges in South Africa, such as conflicts between the Department of Mineral Resources	**Gap:** The study does not assess whether new governance structures (e.g., interdepartmental task forces) could improve coordination. Further

			and Energy (DMRE) and the Department of Environment, Forestry and Fisheries (DEFF).	institutional analysis is required.
	5. Weak enforcement mechanisms and insufficient penalties allow non-compliance. Research suggests that penalties must be substantial enough to drive compliance.	**Confirmed.** The study finds that regulatory agencies in South Africa have limited capacity to monitor and enforce emissions reduction measures. Penalties for non-compliance remain too low to incentivise change.	**Contribution:** The research provides specific examples of enforcement failures, illustrating how regulatory agencies are underfunded and lack the authority to impose stringent penalties.	**Gap:** The study does not quantify the financial impact of stricter penalties or explore potential funding sources for better enforcement mechanisms.
	6. Many fossil fuel companies engage in greenwashing, presenting climate-	**Confirmed**: The research found that while some companies have	**Contribution**: This study confirms that greenwashing	**Gap**: Further research is needed on how regulatory

	friendly commitments that lack enforceability and transparency (e.g., through voluntary carbon offset programs).	adopted climate commitments, these often lack independent verification, and some firms continue high-emission practices while publicly claiming sustainability efforts.	is a significant barrier to genuine emissions reductions in South Africa's oil and gas sector. The absence of strict reporting standards allows misleading sustainability claims to persist, undermining public trust and regulatory efforts.	mechanisms can counteract greenwashing, such as mandatory third-party emissions verification.
	6. Financial disincentives and policy uncertainty delay the transition to a low-carbon economy. Literature argues that carbon pricing and green incentives must be	**Confirmed.** The study finds that while South Africa has introduced carbon pricing, it remains too low to be effective. Policy uncertainty	**Contribution:** The research emphasises how inconsistent carbon pricing and frequent policy shifts create uncertainty, undermining	**Gap:** The study does not analyse potential pathways for strengthening carbon pricing mechanisms or alternative fiscal incentives.

	more aggressive to drive change.	discourages long-term industry investment in low-carbon alternatives.	investor confidence in low-carbon transitions.	

5.5 Key findings

The study has revealed several key findings regarding the relationship between South Africa's oil and gas industry and climate change mitigation efforts. Firstly, continued exploration and production (E&P) activities in the sector contribute to GHG emissions, which in turn affect the country's ability to meet its Paris Agreement commitments. The research further highlights the absence of stringent sector-specific emissions targets and the weak enforcement of existing regulatory mechanisms, both of which have resulted in minimal reductions in operational emissions. Moreover, while some oil and gas companies have voluntarily adopted climate commitments, these efforts remain inconsistent and lack robust accountability measures, thereby limiting their overall effectiveness.

Another finding is that South Africa's policy framework lacks coherence, with conflicting priorities between economic growth, energy security, and emissions reduction. The study found that while the South African government has introduced various climate-related policies, such as the Carbon Tax Act (2019) and the Climate Change Act (2024), their effectiveness in mitigating emissions from the oil and gas sector remains limited. The Carbon Tax Act, designed to place a price on GHG emissions, has faced criticism for its relatively low tax rate, generous allowances, and phased implementation, which dilute its impact on major emitters, including those in the energy sector. Similarly, the Climate Change Act of 2024 provides an overarching framework for sectoral carbon

budgets and mitigation targets, yet its integration with energy policy has been weak. A key challenge lies in the misalignment between the Department of Mineral Resources and Energy (DMRE), which continues to prioritise oil and gas exploration, and the Department of Forestry, Fisheries and the Environment (DFFE), tasked with enforcing climate commitments. This interdepartmental disconnect, coupled with limited institutional capacity and weak enforcement mechanisms, has hindered effective implementation (Averchenkova et al., 2019). Moreover, the absence of strong political will to restrict fossil fuel development driven by concerns over energy security and economic growth undermines the credibility of these policies. As a result, while the legislative framework exists on paper, the oil and gas industry continues to operate without meaningful constraints on its upstream emissions, which remain negligible compared to global producers but still significant in the context of South Africa's Paris Agreement commitments.A further significant discovery was the inadequate or lack of financial incentives for emissions reduction initiatives. This further makes it challenging for the industry to invest in low-carbon technologies and carbon capture solutions.

While carbon capture and storage (CCS) is briefly noted in the literature and acknowledged by participants as a potential mitigation measure, its integration into South Africa's policy and regulatory framework remains limited. Key instruments such as the National Climate Change Response White Paper (2011), and the Upstream Petroleum Resources Development Bill (UPRD Act 23 of 2024**)** focus on long-term decarbonisation or resource governance, yet they provide little explicit guidance on CCS deployment. Similarly, the Climate Change Act and the Integrated Resource Plan make no substantive provision for incentives, compliance mechanisms, or monitoring standards specific to CCS. In contrast, jurisdictions such as the United States have developed more detailed frameworks, including tax credits (for example the Section 45Q of the Internal Revenue Code) and federal guidelines for storage site monitoring, which provide clearer pathways for investment and implementation. South Africa could draw on such international examples to strengthen its policy environment, positioning

CCS as a viable complement to renewable energy and energy efficiency measures in meeting long-term mitigation targets.

5.5.1 Unexpected findings

While the study largely confirmed the anticipated policy and regulatory shortcomings or gaps, several unexpected findings were prevalent. One notable revelation was that the extent of international financial pressures on South Africa's oil and gas sector. The withdrawal of funding from major international investors due to climate concerns has placed additional strain on the industry which further accelerated the need for domestic financing mechanisms. Additionally, the research uncovered a distinct and clear disconnect between national climate commitments and the actual implementation process at the industry level. Even though South Africa's has declared and committed to climate related commitments to achieving net-zero emissions there is a lack of implementation and enforcement mechanisms to ensure compliance by fossil fuel producers.

Additionally, another unexpected finding was the hesitance of industry stakeholders to engage in collaborative climate mitigation efforts, driven by concerns regarding economic viability and competitive disadvantages. Quite a few of the stakeholders expressed apprehension about the potential costs associated with adopting new technologies and practices. This is due to the perception that such changes could potentially negatively impact their profit margins and overall competitiveness in the market. This scepticism was particularly evident in the low participation rates in voluntary emissions reduction programs, as many industry players were reluctant to commit resources to initiatives that they perceived as uncertain or potentially disadvantageous.

5.6 Recommendations and implications of the research

5.6.1 Policy recommendations

Given the findings, several policy recommendations are proposed to enhance climate governance in South Africa's oil and gas sector. Firstly, there is an urgent need to establish clear, legally binding sector-specific emissions targets (set's) that align with national and international climate commitments. The process of strengthening regulatory implementation and enforcement mechanisms, as well as increasing penalties for non-compliance and ensuring independent monitoring of emissions, is essential to improving accountability. Furthermore, policy coherence should be prioritised by streamlining regulations and removing any sort of contradictions between fossil fuel development and decarbonisation strategies.

A critical policy recommendation is to maintain South Africa's carbon pricing mechanisms while ensuring that the tax rates are set at levels that do not discourage investment in the already negligible oil and gas industry. While it is essential to uphold a carbon tax to promote emissions reductions, imposing excessively high rates could potentially hinder the growth of this sector and deter both domestic and foreign investments. Therefore, a balanced approach is necessary, allowing the industry the opportunity to develop and expand without being overburdened by taxation. Qu, Suphachalasai, Thube, and Walker (2023) argue that South Africa's carbon tax has so far had a limited impact due to generous allowances and exemptions, which reduce the effective tax rate for high-emitting sectors. The report recommends gradually increasing the carbon tax and reducing exemptions, while implementing complementary measures such as support for renewable energy and stronger enforcement, to ensure the tax effectively incentivises emissions reductions without undermining investment in key industries like oil and gas.

Moreover, rather than reallocating carbon tax revenues, the focus should be on establishing an enabling environment for the oil and gas sector to flourish and

succeed. By allowing the oil and gas sector to mature, the South African government can foster a more resilient energy landscape that is better positioned to integrate sustainable practices over time. This will potentially enable the objective to find the right balance that promotes growth within the oil and gas industry while still encourage embrace both environmentally friendly and responsible practices.

To address the challenge of greenwashing and ensure genuine emissions reductions in the oil and gas sector, stricter climate disclosure regulations need to be introduced. Oil and gas companies need to be legally obligated to report verified emissions data and this is to ensure that their sustainability commitments align with independently and fairly with audited reduction targets. Therefore, it is important for the establishment of penalties for misleading environmental claims is essential to prevent organisations from over-exaggerating their climate efforts without implementing meaningful change. Additionally, standardised sustainability reporting frameworks should be introduced to create consistency and transparency in corporate disclosures. Transparency must also be strengthened by mandating companies to publicly disclose detailed breakdowns of their climate actions, ensuring that all reported reductions reflect true and actual emission cuts instead of the reliance on offsets or strategic public relations efforts. These policy interventions will enhance regulatory oversight, improve public trust in corporate climate commitments which has reduced over the years, and drive the oil and gas industry toward genuine decarbonisation- which is essential.

5.6.2 Industry Recommendations

The oil and gas industry must take a more proactive role in addressing its emissions footprint. Companies should adopt best practices for reducing operational emissions, including methane abatement strategies, electrification of upstream operations, and phasing out routine flaring and venting. Integrating renewable energy sources into fossil fuel operations, such as hybrid models

combining gas-fired power with solar or wind energy, can contribute to lowering emissions while maintaining energy security.

Moreover, oil and gas companies should commit to greater transparency by publicly disclosing their emissions data and setting clear, science-based reduction targets. Participation in voluntary carbon offset programs and industry-led climate initiatives should be expanded, with independent oversight ensuring that these commitments translate into measurable outcomes.

5.6.3 Social and economic implications

The transition away from fossil fuels has significant socio-economic implications, particularly for communities dependent on the oil and gas sector. A just energy transition framework must be developed to ensure that affected workers and regions are adequately supported, and this includes the process of reskilling programs and investment in alternative industries. This has been seen in the coal industry too as certain coal fired-power stations cease operating. Additionally, balancing emissions reduction efforts with energy security remains a priority, requiring strategic planning to maintain reliable and affordable energy access during the transition.

Stakeholder engagement plays a pivotal role in effective climate governance, as it ensures that diverse perspectives and expertise are integrated into the development of climate strategies. Policymakers, industry leaders, and civil society organisations need to actively collaborate to create practical and inclusive approaches that consider the unique socio-economic realities of the country.

First, involving various stakeholders in the decision-making process fosters a sense of ownership and accountability. This includes by engaging communities, businesses, and non-governmental organisations, policymakers can gather valuable insights that reflect local needs and priorities. This participatory approach can lead to more robust climate policies that are better aligned with the realities faced by different groups within society.

Second, collaboration among stakeholders can facilitate knowledge sharing and capacity building. Industry leaders possess technical expertise and practical experience in implementing sustainable practices, while civil society organizations often have a deep understanding of community dynamics and environmental concerns. Further, working and collaborating, these groups can identify innovative solutions and best practices that can be adapted to the local context.

Moreover, effective stakeholder engagement can help address potential conflicts and build consensus around climate initiatives. Open dialogue and transparent communication allow stakeholders to express their concerns and aspirations, leading to more equitable and just outcomes. By acknowledging and addressing the interests of various groups, policymakers can enhance the legitimacy of climate policies and increase public support.

Finally, inclusive stakeholder engagement can improve the resilience and adaptability of climate strategies. By incorporating diverse perspectives, policymakers can identify potential risks and opportunities related to climate change, ensuring that strategies are flexible enough to respond to evolving challenges. This adaptability is crucial in a rapidly changing climate landscape, where the impacts of climate change can be unpredictable.

5.7 Contributions to knowledge

This research makes several contributions to the field of knowledge related to climate governance and energy policy in South Africa. Firstly, it provides an empirical assessment of the emissions impact of the oil and gas sector, filling a gap in the literature where data on sector-specific contributions to climate change have been limited. Secondly, the study critically evaluates policy and regulatory shortcomings, highlighting areas where existing frameworks fail to support meaningful emissions reductions.

Another significant contribution is the analysis of industry perspectives on emissions reduction strategies. The findings demonstrate that while some oil and gas companies acknowledge climate risks, financial and regulatory barriers hinder widespread adoption of mitigation technologies. This insight challenges assumptions in the literature that voluntary corporate climate commitments are sufficient to drive emissions reductions, reinforcing the need for stronger regulatory oversight.

Moreover, the research extends beyond South Africa by offering broader lessons for other developed and developing economies facing similar challenges in balancing fossil fuel dependence with climate obligations. The study highlights the role of international financial pressures in shaping domestic energy policies, providing insights into the evolving landscape of climate finance and investment trends.

5.8 Suggestions for further research

While this study provides critical insights, several areas require further research. A longitudinal study assessing the effectiveness of South Africa's climate policies over time would be valuable in determining whether recent regulatory changes yield measurable emissions reductions. Additionally, comparative research examining South Africa's approach alongside other resource-rich developing nations would provide useful policy lessons and best practices.

Further research into alternative energy solutions such as green hydrogen is also recommended to explore their feasibility in transitioning away from fossil fuel reliance. Another potential area of study is the social and political dimensions of climate policy implementation, including public perceptions and industry lobbying influences on climate legislation.

5.9 Conclusion

This research finds that South Africa's oil and gas sector currently has a negligible impact on GHG emissions and climate change, largely due to the limited production activities in South Africa. The analysis considered historical emissions, potential future developments, and the regulatory landscape influencing upstream emissions.

The upstream petroleum sector in South Africa currently emits negligible greenhouse gases (GHGs) due to limited production. The only operational gas field is Renergen's Virginia Gas Project in the Free State, which produces on a small scale. As a result, the sector's contribution to national emissions is minimal compared to other industries such as coal-fired power generation and transport.

Historically, upstream GHG emissions in South Africa were primarily driven by PetroSA's operations in the FA-EM and surrounding gas fields in the Southern Western Cape. These fields supplied gas to the Mossel Bay Gas-to-Liquids (GTL) refinery, but production ceased in 2020 due to gas depletion, eliminating their contribution to upstream emissions.

Additionally, South Africa previously had active offshore oil production from the Oribi, Oryx, and Sable fields, which were operational between 1997 and 2013. Even though these fields contributed to upstream GHG emissions through extraction, processing, and associated flaring. The clear and precise emissions volumes were not able to be quantified in available research. However, their closure further reduced the sector's overall emissions profile.

There is growing potential for future upstream emissions due to recent gas discoveries at Brulpadda (2019) and Luiperd (2020) respectively in the Outeniqua Basin. If these fields proceed to full-scale production within the next five years it has been determined that this could potentially affect the emissions landscape of South Africa's upstream petroleum sector.

Further, should gas from Brulpadda and Luiperd be developed to supply the Mossel Bay GTL refinery the upstream emissions would increase due to increased extraction, processing, and associated flaring or venting of natural gas. The extent of these emissions would depend on the operational efficiency of the actual production facilities, the adoption of low-emission technologies, as well as the regulatory oversight of methane leaks and routine flaring.

Despite the potential for growth, the South African upstream oil and gas sector remains in a low-emission phase, and this is primarily due to delays in developing offshore resources. Additionally, regulatory uncertainty, fiscal instability, and environmental concerns have all contributed to the slow pace of new developments.

A significant issue within South Africa’s upstream petroleum industry is the lack of publicly available emissions data. For example, Renergen has yet to disclose the carbon emissions from its Virginia Gas Project, making it difficult to assess the project's environmental impact accurately.

This highlights the need for South Africa's upstream petroleum industry to attain a comprehensive understanding of its emissions levels. This is because such clarity is essential for formulating effective mitigation strategies and ensuring adherence to environmental regulations.

This lack of transparency hinders the ability of policymakers and industry stakeholders to formulate effective emissions mitigation strategies. Thus, establishing clearer reporting mechanisms would provide greater insight into emissions levels and enable more effective environmental management.

Enhanced transparency regarding emissions is crucial for the following reasons:

- ➔ Ensuring compliance with national and international climate commitments,
- ➔ Identifying areas for emissions reduction within the sector and
- ➔ Building investor and public confidence in the industry’s environmental responsibility.

Further, South Africa does not currently produce crude oil which means that most petroleum-related emissions occur in the downstream operations which is during the process for refining, fuel distribution, and end-use.

The decline of domestic upstream activities along with the closure of local oil refineries, has led to reduced direct emissions from petroleum production. However, this shift has also resulted in increased reliance on imported refined products which carry their own emissions footprint from overseas production and transportation.

If South Africa proceeds with large-scale upstream natural gas production, potential emissions risks include:

- ➔ Methane leakage during extraction, processing, and transport, which could significantly contribute to GHG emissions. Methane is more potent than CO2.
- ➔ Increased emissions from gas-to-power projects, as gas is often marketed as a ‘transition fuel’ but can still contribute to climate change.
- ➔ Infrastructure emissions, including the construction and operation of pipelines, processing facilities, and power plants.

If not properly regulated these factors could undermine the perceived climate benefits of natural gas as a lower-carbon alternative to coal.

Research has determined that there are several measures could help limit emissions from future upstream petroleum developments, including:

- ◊ CCUS technologies have the potential to mitigate emissions from gas extraction and processing. However, their feasibility remains uncertain due to high costs, technological challenges, and limited large-scale deployment.
- ◊ South Africa will need to enforce and implement robust policies to limit unnecessary emissions from new oil and gas projects.

- ◊ Using advanced leak detection and repair (LDAR) programs can assist to significantly reduce methane emissions from production facilities.

The revival of offshore oil and gas production in the industry will require a clear and comprehensive emissions management strategy, ensuring that production aligns with national climate policies and environmental commitments.

South Africa has set a net-zero target for 2050, which will necessitate stringent emissions controls on any future upstream oil and gas developments. The ability to meet this target will depend on:

- ➔ The pace of renewable energy adoption, which may reduce long-term demand for domestic gas.
- ➔ International climate policies, which could impose stricter emissions regulations on fossil fuel-producing nations thus affecting project viability.
- ➔ The willingness of investors to fund fossil fuel projects, given the shift towards sustainable energy investments.

The future of South Africa's upstream petroleum industry will be shaped by:

1. Regulatory clarity: A clear and stable policy framework is essential to attract investment while ensuring environmental compliance.
2. Investor confidence: Major oil and gas companies are re-evaluating their portfolios in response to climate policies and shifting global energy demand.
3. Market conditions: The viability of future projects will depend on the long-term price of natural gas and oil, as well as competition from renewable energy sources.

A key challenge for South Africa will be balancing the development of domestic oil and gas resources with the need to mitigate GHG emissions. The country faces critical decisions on:

- ◊ Whether to prioritise energy security through domestic fossil fuel production or accelerate the transition to renewable energy sources.

- ◊ How to manage emissions responsibly if new oil and gas projects are developed.
- ◊ Aligning upstream petroleum sector activities with South Africa's commitments under the Paris Agreement and other climate frameworks.

The upstream petroleum sector in South Africa currently contributes negligible emissions, but future gas developments could alter this landscape. While there is potential for increased production, strong regulatory oversight, transparency in emissions reporting as well as climate related and aligned policies will be essential to managing environmental impacts. The country's long-term energy strategy will need to balance economic growth, energy security, and climate action, ensuring that any future upstream petroleum projects align with global decarbonisation efforts.

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APPENDIX A: PARTICIPANT INFORMATION SHEET

Participant Information Sheet

Wits Business School: African Energy Leadership Centre

Dear Participant

My name is Tshegofatso Maja, and I am currently pursuing a Master of Management degree at the Wits Business School's African Energy Leadership Centre in Johannesburg, South Africa. As part of my academic program, I am conducting an in-depth research project focused on the topic of "Analysing Policy and Regulatory Frameworks for Addressing Climate Change in South Africa's Oil and Gas Industry." This research is supervised by Dr. Bongani Sayidini.

The objective of my study is to evaluate the existing policies and regulatory measures that govern the oil and gas sector in South Africa, particularly in the context of their effectiveness in mitigating climate change. Through this research, I aim to identify gaps, challenges, and opportunities within the current frameworks and propose recommendations for enhancing their alignment with national and global climate mitigation goals.

The findings from this research will not only contribute to the academic discourse on this critical topic but also provide valuable insights that can inform policymakers, industry stakeholders, and the broader community about the effectiveness of current regulations and potential areas for improvement. By shedding light on these aspects, the study seeks to support the development of more robust and sustainable policies that address the environmental impacts of the oil and gas industry in South Africa.

Due to your extensive knowledge, skills, and experience as a leader in South Africa's energy sector, I would like to invite you to participate in my study and to allow me to interview you for approximately one hour. If you decide to participate,

your involvement in this research study will last about one hour. The interview will take place virtually on [this date] at [time].

With your permission, I would like to audio record the interview. This data will be stored securely in an encrypted digital format for five years. After this period, the data will be permanently deleted. Only I, as the researcher, will have access to the data.

During the interview, I will ask for some personal information about you, including:

- Your name
- Professional background
- Experience in the oil and gas industry

The interview will be confidential and anonymous. When I share the results of the research study, I will not include your name, organisation or any information that could identify you. With your permission, other researchers may use the data collected from this research study for future research, but your name and any personal information will not be used or passed on to them.

If you decide to take part in the research study, it should be because you want to volunteer. Participation is entirely voluntary. You can stop being in the study at any time, and you do not have to answer any questions that you do not want to. You will not receive any direct benefits from participating in this study. You will not lose any services, benefits, or rights you would normally have if you decided not to participate. Taking part in the research study will not cost you anything. You will not be paid for participating in this research study.

The risks associated with this research study are minimal and are no more than what happens in everyday life.

I appreciate your consideration and am grateful for your willingness to contribute to this important research. Thank you for your time and consideration.

This research study will be written up as a research report. The report will be available on the university library website. If you would like a summary of the findings or access to the full report, I would be happy to share it with you. For this purpose, I would need some contact information from you, provided you are comfortable sharing it.

If you have any questions during or afterwards about this research study, feel free to contact me or my supervisor on the details listed below. If you have any concerns or complaints about the ethical procedures of this research study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za.

Yours sincerely,

Tshegofatso Maja

1362268@students.wits.ac.za, 0716148817

Supervisor:

Dr. Bongani Sayidini, email, sayidinib@petroleumagencysa.com, phone number, 0832878079

APPENDIX B: INTERVIEW GUIDE

Context setting and general questions.

- **Opening Remarks**: Good [morning/afternoon/evening and thank you for taking the time to speak with me today.
- **Self-Introduction**: My name is Tshegofatso Maja, and I am conducting research on the policy and regulatory frameworks addressing climate change in South Africa's oil and gas industry.
- **Purpose Explanation**: The aim of this interview is to gather insights into the effectiveness of current policies and regulations, understand the challenges faced, and explore potential improvements to align with climate mitigation objectives.
- **Confidentiality Assurance**: Your responses will be kept confidential and used solely for academic purposes. With your consent, I would like to record this interview to ensure accuracy. Is that acceptable to you?

Standard demographic questions

- **Sector of involvement:**
- **Number of years in energy/ oil and gas sector:**

Background Information

1. Could you please provide a brief introduction of yourself and outline your roles and responsibilities within the oil and gas industry or related sectors? In other words, how do you contribute to and engage within this field?

2. Have you been involved in any projects specifically related to climate change mitigation (in other words projects that are aimed at reducing or limiting GHG emissions) and or GHG emissions reductions in the oil and gas sector – This could be through technological solutions such as Carbon Capture & Storage, policy measures to encourage low emission practices etc.

Policy and Regulatory Frameworks

3. In your view, how well do these policies (such as the National Climate Change Response Policy White Paper, National Climate Change Adaptation Strategy and the Climate Change Act 22 of 2024) align with South Africa's national climate goals and international obligations such as the Paris Agreement?

Policy & Regulatory Gaps and Challenges

4. Do you think there are key policy and regulatory gaps specifically in South Africa's upstream oil and gas industry that hinder proactive effective climate change mitigation- if so, what are they?

5. In your view, what are the main barriers/ challenges that prevent the oil and gas industry from achieving the climate change mitigation goals?

6. In your opinion, how do financial, technological, or operational constraints impact the implementation of climate change mitigation measures in the oil and gas sector?

7. Do you think the current climate change legal framework adequately provides for penalties or incentives related to reducing scope 1 emissions in the upstream oil and gas operations? The scope 1 emissions would be the direct GHG emissions from the source

Effectiveness of Current Policies

8. Based on your experience, how effective have current policies been in proactively reducing scope 1 emissions in South Africa's upstream oil and gas industry?

9. Are you aware of any metrics or frameworks that are used to assess effectiveness (or lack thereof) of policies aimed at reducing scope 1 emissions in upstream oil and gas activities?

Transition to Sustainable Practices

10. In your opinion, how can South Africa's oil and gas industry transition to more sustainable practices while meeting the country's energy demands?

11. In your view, what role does technological innovation (e.g., carbon capture, renewable energy) play in facilitating this transition?

Best Practices and Global Comparisons and Lessons Learnt

12. What is your view on how South Africa's climate change policies in the oil and gas sector compared to those of other countries with significant oil and gas exploration?

13. From your perspective, are there any successful initiatives from other regions/countries that South Africa can adopt to enhance its own frameworks?

14. Based on your insights, are there examples of countries where Scope 1 emissions regulations in upstream oil and gas have been effective in curbing emissions? What lessons can South Africa learn from these cases?

Future Oil and Gas Exploration and GHG Emissions

15. Do you believe there is ongoing interest in upstream oil and gas exploration in South Africa despite global decarbonization trends? If so (or not), how do you see this affecting South Africa's commitment to proactively reducing scope 1 emissions in this sector?

Barriers to Regulatory Reform:

16. In your view, what are the main obstacles to implementing scope 1 emission reduction climate change policies in South Africa's oil and gas sector? (are these barriers primarily economic, political, or rooted in industry resistance?)

Prospects and Solutions: Energy Transition Planning:

17. How do you think South Africa can balance its energy security needs with the increasing urgency to reduce scope 1 emissions, particularly in the context of the upstream oil and gas sector?

Industry Response

18. In your opinion, how is the upstream oil and gas industry responding to increasing calls for climate action? Are companies voluntarily adopting scope 1 emissions reduction measures? If yes or no, what are the reasons behind this?

International Pressure and Investment:

19. How do you see international climate policies or pressure from foreign investors shaping the future of oil and gas exploration and production in South Africa?

Recommendations for Improvement

20. In your view, what specific changes or enhancements would you recommend improving the alignment of South Africa's upstream oil and gas regulatory frameworks with the emission reduction goals, to more effectively achieve climate change mitigation objectives?

21. Lastly, from your perspective, what role should the government and industry play in implementing these changes, and how can they effectively communicate them to gain support from the public?

Final Ask to participants: Are there any additional insights, perspectives, or specific information that you believe would be valuable for me to consider in the context of my research? I would appreciate any suggestions, data points, or recommendations that could enhance the depth and breadth of my study and help me better address my research objectives.

Closing: Final Thoughts

- Is there anything else you would like to add that we have not covered?
- Do you have any further questions for me regarding this research?

Thanks, and Next Steps

- “Thank you again for your time and valuable insights.”
- “The information gathered will be analysed and included in my research findings. We will share the results with you once the study is complete. If you have any further questions or need to follow up, please feel free to contact me.”

APPENDIX C: PARTICIPANT CONSENT FORM

Participant consent form.

Title of project: "*Analysing Policy and Regulatory Frameworks for Addressing Climate Change in South Africa's Oil and Gas Industry.*"

Name of researcher Tshegofatso Maja

I, ……., agree to participate in this research project.

I agree to the following:

(Please circle the relevant options below)

The research study was explained to me. I understand what this study is about.	YES	NO
I understand that I can volunteer to take part in the study and that I can withdraw at any time without penalty.	YES	NO
I agree that the interview may be audio recorded.	YES	NO
I agree that direct quotations from my interview may be used by the researcher in their research report.	YES	NO
I agree that my participation will remain anonymous (my name or other identifying data will not be used by the researcher in their research report	YES	NO
I agree that I participate in an interview expected to last approximately one (1) hour.	YES	NO

I agree and acknowledge that I have the right to refuse to answer any question and to withdraw from the study at any time without consequences	YES	NO
I agree that the study adheres to ethical guidelines, including informed consent and confidentiality.	YES	NO
I agree and consent that the study has the potential use of my anonymized data in future research or by other researchers.	YES	NO

…… (signature)

…… (name of participant)

…… (date)

…… (signature)

…… (Tshegofatso Maja)

…… (date)

ETHICS CLEARANCE CERTIFICATE

Graduate School of Business Administration
University of the Witwatersrand, Johannesburg

Wits Business School Ethics Committee
Constituted under the University Human Research Ethics Committee (Non-Medical)

Ethics Clearance Certificate

Ethics protocol number: WBS/EL1362268/858
This certificate is only valid with a legitimate ethics protocol number and signed by the Researcher (below).

This certificate is only valid if accompanied by formal permission from the relevant stakeholder(s).

Project title	Analysing policy and regulatory frameworks for addressing climate chang South Africa's oil and gas industry
Investigator / Researcher	Mrs Tshegofatso Maja-Ohonba
Nature of Project	MM (Energy Leadership)
Decision of the Committee	Approved, provided stakeholders and participants are guaranteed confidentialty.
Issue Date of Certificate	07/10/2024
Expiry date	Date of submission of the project / research report
Chairperson	Dr Ayanda Magida ☎ +27 11 717 3953 ✉ ayanda.magida@wits.ac.za

Declaration by Researcher

One copy must be signed by the Researcher and returned to the Chairperson of the Wits Business School Eth Committee.

I fully understand the conditions under which I am authorized to carry out the abovementioned research an guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I undertake to resubmit the protocol to the Committee.

Signature

Date: