



Evaluating the effect of the suggested carbon
budgeting system on the hard-to-abate
industry

**M de Oliveira Ramos
Furlan**

orcid.org



0000-0002-4059-4216

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Supervisor: Mr JC Coetzee

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ABSTRACT

Background:

Carbon pricing mechanisms are considered powerful instruments to reduce greenhouse gas (GHG) emissions in a global effort to respond to climate change. In South Africa, a carbon tax has been implemented, and a proposed carbon tax rate of R640 per tonne of CO₂eq will be charged as a penalty for emissions exceeding the carbon budget allocation. Hard-to-abate industries, including iron and steel, cement and chemical manufacturing, contribute significantly to the GHG emissions in the country but are hard-to-abate because they lack available low-carbon technologies at industrial scale and will require significant investment to decarbonise fully. There is a need to explore the effectiveness and feasibility of both carbon pricing mechanisms on the hard-to-abate industries while the industry cannot make the transition to ensure a sustainable, feasible transition to a low-carbon economy.

Objective:

The study aims to determine the effect of the suggested R640 per tonne of CO₂eq carbon tax penalty as part of the carbon budget system over and above the carbon tax on the hard-to-abate industry in South Africa. It will explore potential opportunities, challenges, and implications for the industry and civil society.

Method:

This study followed an interpretivism paradigm associated with an inductive research approach, originating from an empirical investigation applying qualitative data collection and constructing theory throughout the research process. A pragmatic philosophy was followed as well as a non-probability interview strategy. A cross-sectional time horizon, data collection based on information from interviews applied in a single period and to a restricted number of participants. Correlation with theory, legislation, and other information already in the public domain regarding carbon pricing mechanisms implemented in South Africa was also considered.

Results:

The study determined that the suggested R640 per tonne of CO₂eq carbon tax penalty as part of the carbon budget system over and above the carbon tax would

significantly affect the hard-to-abate industry in South Africa. The study identified the challenges experienced by the hard-to-abate sector to fully decarbonise, opportunities, and negative implications. The study presents recommendations to possibly support the hard-to-abate industry in transitioning to a just and equitable low-carbon economy.

Keywords:

Effect, challenges, carbon tax, carbon budget, penalisation, hard-to-abate, industry, just transition, South Africa

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LIST OF ABBREVIATIONS

CBAM	Carbon Border Adjustment Mechanism
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilization and Storage
CDH	Cliffe Dekker Hofmeyr
CDM	Clean Development Mechanism
CER	Centre for Environmental Rights
COP	Conference of the Parties
CO _{2eq}	Carbon Dioxide equivalent
DACC	Direct Air Carbon Capture
DFFE	Department of Forestry, Fisheries, and the Environment
DMRE	Department of Mineral Resources
DTIC	Department of Trade, Industry and Competition
EIUG	Energy Intensive Users Group of Southern Africa
ETS	Emissions Trading Systems
FOLU	Forestry and Other Land Use
H ₂	Hydrogen
GHG	Greenhouse gas
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IRA	Inflation Reduction Act of 2022
Kg	kilogram
MW	Megawatt
NASA	National Aeronautics and Space Administration
NBI	National Business Initiative
NCCR	National Climate Change Response
NDC	Nationally Determined Contribution
NGOs	Non-Government Organizations
NOAA	National Oceanic and Atmospheric Administration
NT	National Treasury
NZ	Net-Zero
POPIA	Protection of Personal Information Act of 2013
RE	Renewable Energy

RD&D	Research, Development, and Demonstration
ROMPCO	Republic of Mozambique Pipeline Investments Company
SAISI	South African Iron and Steel Institute
SAR GWP	Second Assessment Report Global Warming Potential
SARS	South African Revenue Service
SDGs	Sustainable Development Goals
SOE	State-Owned Enterprises
tCO _{2eq}	tons of Carbon Dioxide equivalent
TIPS	Trade & Industrial Policy Strategies
TLAB	Taxation Laws Amendment Act
UNFCCC	United Nations Framework Convention on Climate Change
US\$	United States dollar
USEPA	United States Environmental Protection Agency
VCS	Verified Carbon Standard
WEF	World Economic Forum

CHAPTER 1: NATURE AND SCOPE OF STUDY

1.1 Introduction

Climate change is a real threat to ecosystems and humankind, and the change in weather patterns can potentially disrupt nature, society, and the economy (NOAA, 2021). It is estimated that the greenhouse gas (GHG) emissions originating from the combustion of fossil fuels (oil, coal, gas, and derivatives) are the most significant contributor to climate change (United Nations, s.a.(a)). “GHG” herein referred to as carbon dioxide equivalent “CO_{2eq}” interchangeably as carbon dioxide, is the main portion of GHG emitted by anthropogenic activity (USEPA, 2022).

Fuel combustion emissions, which mostly originate from energy-intensive sectors, account for more than 90.00% of CO_{2eq} emissions worldwide and represent 75.00% of all global GHG emissions (United Nations, s.a.(a)). Therefore, the industry must lead the transformation towards a lower/neutral carbon economy (de Bruyn *et al.*, 2020:11).

To provide some perspective, in 2021, the global annual CO_{2eq} emissions were 37.12 billion metric tons (Statista, 2023). In the same year, South Africa emitted approximately 0.44 billion tonnes of CO_{2eq} (Statista, 2023), and although this figure only represents 1.18% of global emissions, South Africa occupies the 14th position of the largest CO_{2eq} emitters in the world ranking (Statista, 2023). This position can be attributed mainly to the high coal dependency for energy in South Africa (Climate Transparency, 2019).

A hundred and ten direct carbon pricing mechanisms have been implemented in different jurisdictions around the world, of which 39 are in the form of carbon taxes, 36 Emissions Trading Systems (ETS), and 35 governmental crediting mechanisms with the primary objective of reducing GHG emissions (World Bank Group, 2024). These mechanisms differ in format and prices and are implemented under different dynamics in each jurisdiction; hence, defining the most appropriate and effective mechanism to meet climate goals can lead to very complex discussions on this subject (Amsen, 2022).

In South Africa, there is only one carbon pricing mechanism, the carbon tax, which the National Treasury (NT) has implemented since 2019 (NT, 2021). In parallel, the Department of Forestry, Fisheries, and the Environment (DFFE) implemented the Carbon Budget system, which allocates a specific amount of CO₂eq emissions at the sectoral and company levels (DFFE, 2021).

The NT has proposed that once the Climate Change Act (SA, 2024) comes into effect and regulations about carbon budgets and GHG mitigation plans are gazetted by the DFFE, a significantly more elevated carbon tax rate of R640 per tonne of CO₂eq emissions exceeding the allocated carbon budget (CDH, 2022) will be imposed on top of the carbon tax already implemented. During this study, the Climate Change Bill was signed by the South African Presidency on the 23rd of July of 2024; however, it was still not operational, pending the future presidential proclamation of the date on which it will come into effect (CER, 2024).

Hard-to-abate sectors are energy-intensive, including iron and steel, cement, aluminium, and industrial chemicals. These industries depend highly on fossil fuels as an energy source and often as a reductant in their processes. The lack of mitigation technologies and prohibitive implementation costs for such technologies to make the transition define them as hard to abate (Lombard, 2021).

While the National Treasury and the DFFE state that the alignment and integration of both a carbon tax and carbon budget instruments will not imply a double penalty (DFFE, 2021), controversy is found as in the 2022 budget speech was indicated that a higher carbon tax rate will apply to GHG exceeding the carbon budget (National Treasury, 2022:48). The carbon tax discussion paper on phase two of the carbon tax published for public comments on the 13th of November 2024 confirms the proposed higher tax to be imposed from 1 January 2026 (NT, 2024).

If enacted, this proposal implies that companies subject to both instruments will have their GHG emissions capped and pay a carbon tax on their total direct emissions, which include those within the allocated budget. If the carbon budget allocation is

exceeded, a higher carbon tax rate will also apply as a penalty for emissions above the carbon budget (ENS Africa, 2021).

This research aimed to collect data from the hard-to-abate industries in South Africa to investigate the negative effects of both carbon pricing mechanisms being imposed. The study provided a better understanding of the effect of double taxation on the hard-to-abate industry and the perceived readiness for the industry to effect the transition to a lower carbon economy in order to minimise carbon tax liability.

This research included, among other things, a literature review focusing on the carbon pricing mechanisms in South Africa, the problem statement, the primary and secondary objectives of the research, the scope of study and delimitations, research design and methods, data collection and analysis, ethical considerations, the importance of the study, limitations, conclusion, and recommendations. In addition, a layout of the study and a timeframe were provided.

This study was approached from the industry's perspective and aimed to explore the possible impacts of the double taxation system on the hard-to-abate industry in South Africa. Especially considering the carbon budget at a rate of more than three times the current carbon tax rate per tCO₂eq (CDH, 2022), it has the potential to negatively impact business competitiveness, job retention, and the cost to civil society in South Africa.

1.2 Background to the Study

In recent decades, relevant research has been conducted under the climate change umbrella, including but not limited to studies exploring the socio-economic impacts of GHG mitigation instruments and carbon pricing in South Africa. However, limited studies concentrate on the impacts of a possible double carbon taxation on the energy-intensive and hard-to-abate industry, as this is a very actual and specific topic in the climate change arena in South Africa.

The alignment of the carbon tax and the carbon budget (with a potential penalty attached to it), both used as carbon pricing mechanisms, is a serious topic of concern

as the various stakeholders involved, be it the government, industry, NGOs, civil society, and other interested parties, consider different interests, risks, and opportunities. The alignment of policies in the climate change response must ensure a resilient economy and society on the path to a low-carbon transition (DFFE, 2022:4).

It is critical to ensure that climate change-related policies will be cost-effective by minimising additional costs to society while reducing GHG emissions. It must be ensured that consumers and producers will internalise environmental and social costs as per the polluter pays principle, and competitiveness issues and equitable treatment must be considered (The World Bank, 2017).

This study aimed to address gaps between past research and present developments and to provide an opportunity to better understand the impacts, challenges, and opportunities arising from the hard-to-abate industry's perception of possibly facing a double carbon taxation.

1.3 Preliminary Literature Review

The discovery of climate change began early in the 19th century (Carbon Brief, 2016). Over the years, the scientific community has reached a consensus on the direct relation between global temperature rise and the increase in GHG concentration in the atmosphere caused by humans, also known as anthropogenic activity (NASA, 2023). Since then, international mobilisation has been taken to stabilise, minimise, and reduce GHG emissions in the atmosphere.

One of the most relevant initiatives took place in 2015 when the Paris Agreement (2015) was adopted in the Conference of the Parties (COP 21) with the main objective of committing countries to reduce GHG emissions, to limit the global average temperature rise to well below 2°C above pre-industrial levels by 2100 (UNFCCC, s.a.). More recently, countries have taken a step further and committed to more ambitious efforts to limit warming to 1.5°C (UNFCCC, s.a.) and thus avoid possible catastrophic climate change effects scientists predict. This translates to

more demand and pressure on signatory countries and their industries to achieve their respective targets.

Climate Action is highlighted as one of the seventeen global Sustainable Development Goals (SDGs) determined by the United Nations (United Nations, s.a.(b)). This is another indicator that the world needs to act with urgency to mitigate the effects of climate change to save lives and livelihoods and to create a better horizon for humanity (WEF, 2022). In the same breath, it is crucial to ensure that the transition to a low-carbon economy will be just and that it will leave no one behind (United Nations, 2023).

Given the urgent call for global action, countries have developed and submitted to the United Nations Framework Convention on Climate Change (UNFCCC) their Nationally Determined Contribution (NDC) plans, which embody efforts to reduce GHG emissions at a country level and adapt to the impacts of climate change. NDCs may also include set reduction targets and provide a vision of the pathway towards lower carbon or Net-Zero (NZ) economies. Furthermore, numerous instruments, mitigation policies, and carbon pricing mechanisms are under development or have been adopted in different countries to constrain GHG emissions and promote behavioural change by creating price signals.

Carbon pricing mechanisms can be efficient instruments to reduce GHG emissions and provide incentives for new and more efficient technologies (IMF, 2021). This study focused on the proposed carbon pricing mechanisms in South Africa, namely the carbon tax and the carbon budget penalty.

Carbon Tax:

According to the South African Revenue Service (SARS) (2021), the carbon tax is a tax collected from GHG emitters with the main purpose of reducing GHG emissions in a manner that will be sustainable, cost-effective, and affordable (SARS, 2021). Further, SARS indicates that the carbon tax assists in influencing the emitter's future decisions related to production, consumption, and investments by considering the cost of negative climate change (SARS, 2021).

In South Africa, the carbon tax was developed by the National Treasury and enacted in May 2019. The carbon tax rate started at R120.00 per tCO_{2eq} with an annual increase of inflation plus 2% until 2022 (SARS, 2021). According to the NT (2021), the policy rationale for the implementation of the carbon tax is to provide a price signal to provoke changes in the behaviour of producers and consumers and resolve the challenges related to climate change while enabling economic growth in a sustainable manner (Carbon Tax Act 15 of 2019).

In January 2023, as part of the Taxation Laws Amendment Act (TLAB) gazetted by the National Treasury (2023), section 5 of the Carbon Tax Act 15 of 2019 was amended to indicate the carbon tax rate increases that will be applied until 2030 at a much more accelerated pace than initially based on the inflation plus 2% annually. The indication is that carbon tax rates will increase as follows:

- R159.00 for tax periods from 1 January 2023 until 31 December 2023;
- R190.00 for tax periods from 1 January 2024 until 31 December 2024;
- R236.00 for tax periods from 1 January 2025 until 31 December 2025.
- R308.00 for tax periods from 1 January 2026 until 31 December 2026.
- R347.00 for tax periods from 1 January 2027 until 31 December 2027;
- R385.00 for tax periods from 1 January 2028 until 31 December 2028;
- R424.00 for tax periods from 1 January 2029 until 31 December 2029.
- R462.00 for tax periods from 1 January 2030 until 31 December 2030.

Post-2030 carbon tax rates will be increased by the amount announced by the Minister (National Treasury, 2023).

Since the carbon tax implementation, carbon taxpayers have been relying on a percentage of tax-free allowances that can go from 60.00% up to 95.00% (Engineering News, 2018) depending on the sector and the category of its GHG emissions, which have had a cushion effect to enable the industry to pay its carbon tax liability and to prepare for the low-carbon transition. As the budget speech (2022) states, tax-free allowances will gradually decline from 2026 onwards. This is a significant concern as tax-free allowances have been instrumental in supporting the

energy-intensive and hard-to-abate sectors when paying the carbon tax liability. The carbon tax discussion paper on phase two of the carbon tax published for public comments (2024) reflects the proposed reduction of tax-free allowances for GHG emissions (NT, 2024).

Furthermore, verifying the effective carbon tax rate paid in other jurisdictions where carbon pricing mechanisms have been adopted is important, significant tax-free allocations are considered to continue beyond 2030 (Eurometal, 2022), and incentives have been provided to hard-to-abate sectors. In some countries, the hard-to-abate sector is exempted from tax liability, recognising the relevance of such sectors for the economy.

Without tax-free allowances, one can infer that this rapid increase in the carbon tax rate could significantly, or totally, erode companies' annual revenues, threatening their sustainability and competitiveness.

Carbon Budgets:

Carbon budgets are defined as an assigned amount of direct GHG emissions in tCO₂eq allocated to a person conducting and controlling a listed activity generating GHG emissions over a defined period (DFFE, 2021).

The carbon budget was implemented in South Africa in 2016 as part of the voluntary phase of the carbon budget system and is another important instrument to cap and reduce GHG emissions under the Department of Forestry, Fisheries and the Environment (DFFE) mandate. According to DFFE (2021), the carbon budget cycle has been divided into three phases: voluntary Phase 1 (from January 2016 to December 2020), a Transition period (from January 2021 to December 2022), and a mandatory Phase II (from January 2023 to December 2027) (DFFE, 2021).

Currently, carbon budgets have been implemented with no implied price but with a limit on GHG emissions at the company level. The mandatory phase of the carbon budget to be enacted as part of the Climate Change Act will imply a price of R640.00 per tonne of CO₂eq for emissions exceeding the allocated carbon budget (CDH,

2022). This translates to more than three times the R190.00 carbon tax rate imposed for 2024, as indicated above under the carbon tax section.

Furthermore, the carbon budget allocation methodology is still under development between relevant stakeholders such as DFFE, third-party experts, companies across sectors, and non-governmental organisations (NGOs), and public engagement is also involved. The carbon budget system will be legislated once the Climate Change Act signed in 2024 has its date to come into operation proclaimed by the Presidency and carbon budget regulations have been finalised (SA, 2024).

1.4 Problem Statement

Industries in the hard-to-abate sector in South Africa, including iron and steel, cement, and chemical manufacturing, contribute significantly to the country's greenhouse gas emissions. Carbon pricing mechanisms such as the implemented carbon tax and the proposed carbon budget at a price are considered powerful instruments to change polluters' behaviour and curb GHG emissions in the mission against climate change.

At this stage, the perception is that tax-free allowances that companies currently receive should be phased out and that the full amount should be paid to the fiscus. This deep jump from one level of taxation to another gives rise to an extremely high penalty that few or no persons or companies can afford.

See an illustrative example in Table 1 below, assuming an organisation emitting 10 million tCO₂eq per year, at 95.00% tax-free allowances, for the 2024 calendar year at R190/tCO₂eq. Such a company would be liable for something in the region of R95 million. Should the company keep the same level of production, generating 10 million tCO₂eq in 2030 with 0.00% tax-free allowances, that company would pay something in the region of R4.62 billion at a rate of R462/tCO₂eq.

On that, we have another tax (double taxation) at R640/tCO₂eq, and although the allocation is defined by the DFFE, the National Treasury has proposed a higher tax. Considering that the same company has a carbon budget of 7 million tonnes CO₂eq

per year allocated by DFFE and emits 10 million tonnes CO₂eq, that company would pay R1.92 billion as a penalty over and above the carbon tax.

Another scenario that could be considered is if the sector is expecting market growth and, for instance, increases production and emits 12 million tonnes of CO₂eq (that means 5 million tonnes of CO₂eq above the allocated carbon budget), that company would pay a penalisation fee of R3.2 billion on top of the carbon tax.

Clearly, this would be detrimental to the operation and survival of the hard-to-abate industry until a feasible, affordable, and suitable solution is implemented, whether it includes technology, alternative materials, or new methodology.

Different scenarios of Carbon Tax Liability - Assuming a company emitting 10 million tons of CO ₂ e per year *				
Year	Carbon Tax Rate (R/tCO ₂ e)	Carbon Tax Liability considering different levels of Tax-Free Allowances **		
		95% ***	60%	0% ****
2023	159	ZAR 79,500,000.00	ZAR 954,000,000.00	ZAR 1,590,000,000.00
2024	190	ZAR 95,000,000.00	ZAR 1,140,000,000.00	ZAR 1,900,000,000.00
2025	236	ZAR 118,000,000.00	ZAR 1,416,000,000.00	ZAR 2,360,000,000.00
2026	308	ZAR 154,000,000.00	ZAR 1,848,000,000.00	ZAR 3,080,000,000.00
2027	347	ZAR 173,500,000.00	ZAR 2,082,000,000.00	ZAR 3,470,000,000.00
2028	385	ZAR 192,500,000.00	ZAR 2,310,000,000.00	ZAR 3,850,000,000.00
2029	424	ZAR 212,000,000.00	ZAR 2,544,000,000.00	ZAR 4,240,000,000.00
2030	462	ZAR 231,000,000.00	ZAR 2,772,000,000.00	ZAR 4,620,000,000.00
* No specific company is reflected in this example. This is purely a generic and simplistic example to illustrate the potential effect of the Carbon Tax on a company with relatively high emissions. ** The Carbon Tax formula takes into consideration different tax-free allowances applicable to different categories of emissions. This is merely an illustrative manner to consider an overall level of tax-free allowance applicable. Carbon Tax calculation requires a much more level of detail. Average allowance considered for this exercise. Not taking into consideration the different allowances per emission category may lead to an estimated error of < 5%. *** The current Carbon Tax system allows companies to have up to 95% tax-free allowances. Some sectors are exempted of Carbon Tax. In this example we are assuming a company that pays the Carbon Tax. **** Illustrates what would be the Carbon Tax liability if there were no tax-free allowances. National Treasury has indicated the intention to rapidly phase out the tax-free allowances from 2026 onwards until 2030. However, there is no clarity when exactly will the tax-free allowances reach 0%.				
Example of Calculation of a possible Carbon Budget Penalisation. The following assumptions were considered: - The company above was allocated a carbon budget of 7 million tons of CO₂e per year by DFFE; - The company above is part of the hard-to-abate sector, not able to shift to low carbon technologies due to unavailable technologies or prohibiting costs. - The company above keeps its production capacity or faces growth in demand, resulting in an exceedance of the 7 million tons of CO₂e. Different scenarios are illustrated on exceedances from 1 MtCO₂eq to 5MtCO₂eq per year. - Carbon Budget system imposes a Carbon price rate where exceedances will be penalised at R640/tCO₂eq.				
CO ₂ e emissions exceedance (tCO ₂ e)	Carbon Tax liability to be paid as penalisation (ZAR)	R640/tCO ₂ e		
1,000,000	ZAR 640,000,000.00			
2,000,000	ZAR 1,280,000,000.00			
3,000,000	ZAR 1,920,000,000.00			
4,000,000	ZAR 2,560,000,000.00			
5,000,000	ZAR 3,200,000,000.00			

Figure 1 An illustrative example of the carbon pricing taxation on a company emitting 10 million tonnes of CO₂eq at different tax-free allowances levels.

Therefore, the effectiveness and feasibility of such carbon pricing mechanisms in South Africa remain unclear, especially for the hard-to-abate industries. There is a need to explore and assess the effect of carbon pricing mechanisms on hard-to-abate industries in South Africa, including their potential benefits and challenges, in order to inform policy decisions and facilitate a sustainable, feasible and just transition low-carbon economy.

Carbon pricing mechanisms are important instruments in the global effort against climate change, promoting behaviour change and reducing GHG emissions (Neste, 2022). However, it is important to ensure that the hard-to-abate sector in South Africa will make the transition to a low-carbon economy in a just and sustainable manner and will not be left behind.

Apart from research and development investment in new viable technologies, numerous other enablers are required for the low-carbon transition, including public policies and regulatory framework, financial and capital funding, as well as reliable, abundant, and feasible renewable energy (RE) to support greener technologies in the transition (Edie, 2022). The latter is a challenge on its own due to the energy crisis faced currently in South Africa (The Conversation, 2023). Furthermore, it is estimated that by 2050, greener technologies will demand more than 10-fold the amount of energy required today (Reuters, 2021), and the time required to build such scale of RE infrastructure and capacity in the country should not be underestimated.

In addition, enabling policies and incentives are vital to promoting investments and avoiding carbon leakage to address competitive issues. In other jurisdictions like Canada, European countries, and the US, governments provide funding, especially to hard-to-abate industries, to facilitate the transition to a low-carbon economy. For example, the Inflation Reduction Act (IRA) of 2022 will provide the US with \$ 369 billion for green technologies to curb climate change (PIIE, 2023). In South Africa, there is no clarity about intensive funding from the government; in contrast, the revenue from the carbon tax is not ringfenced to climate change-related projects (Mail & Guardian, 2019).

Whilst more clarity is awaited about the alignment between the carbon tax and the carbon budgets, this study aims to evaluate the effect of the suggested carbon budgeting system on the hard-to-abate industry. This may lead to a double penalisation and an unsustainable tax burden, resulting in a detrimental socio-economic impact on the economy, especially on the hard-to-abate industry in South Africa and to the communities in which they operate.

1.5 Research Objectives

1.5.1 Primary Objective

The primary objective of this research was to evaluate the effect of the suggested carbon budgeting system on the hard-to-abate industry in South Africa.

1.5.2 Secondary Objectives

To achieve the primary objective of this study as mentioned above, the following secondary objectives were set:

1. To investigate the potential implications of both carbon pricing mechanisms on the business competitiveness of the hard-to-abate industry in South Africa.
2. To investigate the challenges faced by the hard-to-abate industry in South Africa in reducing greenhouse gas emissions and minimising the imposed carbon pricing liability.
3. To investigate the effect of double carbon taxation (tax liability compared to investment in GHG mitigation technologies).
4. To investigate the negative social impacts on the employees of the hard-to-abate industry in South Africa resulting from the shift of technologies to reduce greenhouse gas emissions and carbon pricing liability.
5. To make recommendations on the appropriate actions for the hard-to-abate industry to follow.

1.6 Research Methodology

1.6.1 Literature and Theoretical Review

The research design of the study was based on two parts. In the first part, existing legislation and climate change-related information were used for the literature review. In this phase, information was given to set the context of the study, introduce and emphasise the importance of carbon pricing mechanisms, and introduce the already implemented carbon tax and the carbon budget mechanisms as proposed in South Africa.

In the second part, the researcher correlated the information from the legislation with primary data obtained from interviews. Data was also collected from annual reports and other publicly available documents related to carbon pricing and GHG emission

reduction. Findings from information already available were analysed and correlated with the primary data obtained.

Methods that were utilised include the collection of data sourced from government legislation, business associations, and other carbon pricing or climate change-related sources, including libraries and the Internet. Interviews were conducted with knowledgeable professionals working in, but not limited to, the climate change, sustainability, and/or environmental management area, acting directly or indirectly in the energy-intensive sector and hard-to-abate industry in South Africa.

1.6.2 Empirical research

Empirical research is defined as research whose outcome can be demonstrated and supported by evidence collected through quantitative or qualitative research methods (Question Pro, 2023). When interpretivism is followed, emphasis is given to individuals' experiences of cultural objects and their interpretations (Saunders et al., 2019:160).

To achieve this study's primary and secondary objectives, empirical research was conducted by collecting real data through human participation as part of its foundation.

1.6.2.1 Study population

The study was conducted primarily by interviewing knowledgeable professionals working in, but not limited to, Climate Change, Sustainability, and/or Environmental management, acting directly or indirectly with the energy-intensive sector and hard-to-abate industry in South Africa.

Focusing on the hard-to-abate sectors, participants typically participated in environmental-related forums, representing companies, sectors, chambers, or business associations. Targeted representatives or professionals were part of the following organisations or companies (not limited to the list below):

- SAISI (South African Iron and Steel Institute);
- EIUG (Energy Intensive User Group of Southern Africa);
- BUSA (Business Unity South Africa);

- Iron and Steel Industry;
- Cement and/or concrete industry;
- Oil and Gas industry;
- Mining: coal, gold, PMGs and others;
- Researchers.

It is important to mention that due to the technical and financial nature of carbon pricing mechanisms, organisations may attribute the responsibility to a wide range of professionals in the technical area, process, environmental, accounting, financial, legal, and others. Therefore, this research was open to considering knowledgeable professionals in the carbon pricing arena acting directly or indirectly within the hard-to-abate sectors in South Africa, that can add relevant information to the study.

1.6.2.2 Criteria of the participants

The questions and objectives of a research are critical when assessing the relevance of the data collected. To evaluate such relevance, it was ideal to elaborate on pre-set inclusion and exclusion criteria before assessing the literature (Saunders *et al.*, 2019:106). For this research, the following criteria have been defined:

i. Inclusion criteria:

- Participants must be knowledgeable professionals in the carbon pricing arena;
- Participants that are performing or have performed directly or indirectly within the hard-to-abate or energy-intensive industry in South Africa;
- Participants must provide information related to companies paying or that will pay the carbon tax;
- Participants must provide information related to companies that are subject to carbon budgets;
- Participants that are or have been part, directly or indirectly of the energy-intensive industry.

ii. Exclusion criteria:

- Persons without knowledge in the carbon pricing area;
- Companies or representatives of companies that do not pay or will not pay the carbon tax;
- Information provided that seems inaccurate, illogical, or not relevant data to the research.

1.6.2.3 Gathering and analysis of data

Data was collected through twelve interviews conducted with knowledgeable professionals working in, but not limited to, climate change, sustainability, and/or environmental management, acting directly or indirectly with the energy-intensive sector and hard-to-abate industry in South Africa.

The interviewees were formally invited to explain the study's drive and background. The interviews were conducted face-to-face and online via Teams. The information was analysed before the study's conclusion.

1.6.3 Sources

As part of the study, integrated annual reports of hard-to-abate publicly traded organisations (private businesses) were perused. International information was sourced from the World Bank website, and reports about carbon pricing were available. Further climate change-related information was also considered. The library and the Internet were also sources of information to correlate with the data collected from the interviews.

In terms of data for the literature review and correlation with the collected data via interviews, the South African Carbon Tax Act 15 of 2019 and the sections of the Climate Change Bill (2021) related to Carbon Budgets and other relevant information related to the study were considered.

Regarding sampling size, textbooks focusing on research advise collecting qualitative data through interviews until data saturation is achieved. This means that the collected data provides a minimum or does not add new information or themes (Saunders et al., 2019:297). The researcher followed this guide and conducted interviews until data saturation was reached.

1.6.4 Time horizon

Research can have a cross-sectional or longitudinal time horizon. Cross-sectional research studies a certain subject or phenomenon at a specific time, whereas longitudinal research focuses more on change and development over a longer period (Saunders et al., 2019:200).

The time horizon selected for this study was cross-sectional as the study was done in a short period (conclusion in November 2024) and done at one point in time and not in multiple observation times in a long period. Data collection was mainly based on information from interviews applied in a single period and to a restricted number of participants (twelve in total). For correlation with theory, legislation, and other information already in the public domain regarding carbon pricing mechanisms implemented in South Africa was also considered.

1.6.5 Research

The nature of this research called for an inductive approach originating from qualitative data collection and the construction of theory throughout the research process. Pragmatic philosophy was followed, as it was believed that the answer to the question driving the research would be encountered in the practical consequences after the implementation of carbon budgets as a carbon pricing mechanism in addition to the carbon tax in South Africa.

An interpretivism method was associated with an inductive research approach, depicting a profile of small samples, analysing qualitative methods, and deep investigation from the interpretation of data (Saunders *et al.*, 2019:145).

Ethical principles guided the researcher while conducting the interviews. These principles include integrity and objectivity from the researcher, avoidance of any harm to the interviewee, demonstrating respect for the participants, protecting their privacy, respecting their willingness to participate in the research, and withdrawing if desired. Interviews were also conducted on a voluntary basis.

1.7 Layout of the Study

To provide an overview of the expected flow of this mini-dissertation, an intended layout of the study is presented in 4 chapters as follows:

- Chapter 1 – Nature and scope of study: this section discusses the problem statement, enlightening the main purpose of the study, the question and objectives that need to be answered through the research and intended outcomes thereof, and the scope of the study.
- Chapter 2 – Literature review: This chapter focuses on the literature review of the carbon tax and carbon budget system designs and application to the hard-to-abate industry in South Africa. Dates of implementation, amendments, advantages and disadvantages of implementation thereof, possible advancements achieved in terms of GHG emission reduction, identified gaps in new technologies, policies and frameworks, financial and funding incentives, and specific gaps in resources in South Africa, among others.
- Chapter 3 – Empirical study: This chapter presents the research methodology and details regarding the philosophies and assumptions adopted, the approach of the study, and the data analysis methods used. It also provides information regarding the qualitative data obtained through the interviews, with the collected data analysed, interpreted, discussed, and presented to the reader.
- Chapter 4 – Conclusions and recommendations: This chapter presents the conclusion and suggested improvements in both carbon mechanisms by emphasising the study's outcomes based on literature review and empirical investigation.
- References
- Appendix

1.8 Conclusion

The problem stated in this proposal and the presented supporting arguments based on literature elucidates the need for more extensive research on this topic as it is not clear what will be the real impact on the hard-to-abate sector in South Africa if the carbon budget system enforces a penalisation at a price on top of the already implemented carbon tax. The lack of clarity and certainty can have detrimental effects not only on the hard-to-abate sector but on the communities in which they operate, in the South African economy and on civil society, which, in the end, in one way or another, will pay the price. This study contributes to the enlightenment of the implications of both carbon pricing mechanisms being enforced, including technological, financial, environmental, and socio-economic challenges and opportunities. The proposal includes an intensive qualitative data collection process following ethical procedures aiming to obtain high-quality and valuable research as an outcome.

1.9 Chapter Summary

Based on the literature, whether the reader believes in climate change or not, the scientific community has reached a consensus on the direct relation between the rise in global temperature and the concentration of CO₂eq emissions in the atmosphere and the reason behind that rise is anthropogenic (human) activity. Countries around the globe have committed to reducing their CO₂eq emissions, and carbon pricing mechanisms are considered to be powerful and effective tools for achieving their reduction targets.

South Africa implemented the carbon tax in 2019 with the main objective of reducing GHG emissions in a sustainable, cost-effective, and affordable manner and influencing future business strategies to reduce emissions. Carbon Tax liability can be softened by the application of allowances that reduce such liability, but these allowances will gradually decline from 2026 onwards, and this is already a concern given the lack of available technologies at scale and affordable cost enabling the industry to make the transition to a low-carbon economy.

In addition, the carbon budget system in South Africa already stipulates a cap on the permitted volume of GHG emissions that can be emitted at a company level. This

might result in production limitations or cessation of operations to comply with such limits until greener technologies are implemented. On top of that, the NT has indicated the intention to include a penalisation with a much higher Carbon tax rate attached to it from 2026 onwards to be applied to GHG emissions exceeding the carbon budget as allocated by the DFFE (NT, 2024). This could imply a double penalty to industries subject to both carbon pricing mechanisms, resulting in a detrimental socio-economic impact, especially to the hard-to-abate industry in South Africa and to the communities in which they operate.

There are numerous benefits associated with the implementation of carbon pricing mechanisms, as companies will certainly be committed to prioritising the reduction of their emissions, but it is also certain that enablers must be available to allow the change. To make the transition to a low-carbon economy, investment is necessary to research and develop greener technologies at an affordable cost; financial solutions must be provided, funding and subsidies, as well as abundant, affordable, and reliable renewable energy, which is also key to making the transition possible and sustainable.

CHAPTER 2: LITERATURE STUDY

Given the importance of climate change, nations worldwide are uniting forces to fairly stabilise atmospheric concentrations of greenhouse gases (GHG) in a common endeavour to prevent and mitigate human interference with the climate system and mitigate the negative impacts of climate change on the people and the planet.

South Africa has set the foundation for its National Climate Change Response Policy (NCCRP) (DFFE, 2011) to coordinate national policies and measures and steer the country towards a low-carbon emission and more sustainable future. Some of the mechanisms chosen to reduce GHG emissions and change production and consumption behaviour are the carbon tax and the Carbon Budget system.

The Carbon Budget system was implemented in 2016 to allocate a certain quantity of CO₂ equivalent emissions at the sectoral and corporate levels, and the carbon tax was implemented in 2019 as a pricing mechanism imposing a mandatory financial charge on a taxpayer levied on GHG emissions. It has been suggested that in addition to the carbon tax already imposed, a higher rate of carbon taxation should be applied to CO₂e emissions exceeding the allocated carbon budget to industries. With this, industries are expected to choose lower carbon technologies, emit less GHG and reduce their carbon tax liability, but are all industries able to choose cleaner technologies?

Energy-intensive industries that rely heavily on fossil fuels from thermal and stoichiometric perspectives for their processes are considered hard-to-abate. What makes it difficult for them to address GHG emission reduction is the lack of alternative technologies at the industrial scale and/or prohibitive implementation costs required for such technologies to make the transition. This is a challenge as hard-to-abate sectors are practically unable to reduce emissions while being compelled to comply with robust climate policies and measures in a sustainable manner.

The aim of this chapter is to provide an introduction to the carbon tax and to the Carbon Budget system in South Africa. Explore the concepts, purposes, and implementation of them. Assess the theoretical perspective of what are the intended effects of the proposed higher tax rate of R640/tCO_{2eq} on emissions exceeding the allocated carbon budgets to industry, potential implications on the hard-to-abate competitiveness, what are the challenges faced by these industries, affordability to invest in decarbonisation and possible social impacts on people more specifically on employees. This will provide a comprehensive view of what is expected in theory and how climate change policies and measures should enable the transition to a low-carbon economy in a sustainable manner for the South African economy.

2.1 Introduction to the Carbon Tax

2.1.1 Definition

A carbon tax is a financial charge imposed by a governmental organisation on a person who conducts and controls an activity that generates carbon dioxide equivalent (CO_{2e}) emissions to benefit public spending and/or control or minimise negative externalities. In the case of the South African carbon tax, the act indicates that the revenue collected is for the benefit of the National Revenue Fund (NT, 2019).

Originated by the economist Arthur Cecil Pigou, environmental taxation should account for the environmental externalities brought on by the good or service's production and usage, leading to the price increase of a specific good or service by adding environmental taxes (NT, 2010:26).

The principle behind Pigou's concept is that cost increases are typically transferred to the final customer. In theory, when prices rise, consumers respond by decreasing their demand, thus changing behaviour. However, there are controversies as consumer responses are unpredictable and rely on available alternatives as well as price perception. In the South African context, the question goes beyond available alternatives to hard-to-abate industries and consumer perceptions, but would civil society be able to afford higher prices in reality?

According to Benjamin Görlach, there is high complexity and uncertainty in analysing the cost-effectiveness of climate policies and whether the costs justify the benefits of climate change avoidance. Görlach recognises that technical solutions are still to be developed and solutions in the organisational and social areas. He further emphasises the importance of ensuring that targets are achieved at the lowest cost to society and monitoring all the constraints involved in the decarbonisation process, including social hardships, public acceptance and legal requirements (Görlach, 2013).

Carbon tax and emissions trading programs are the two market-based instruments in the primary economic policy for pricing carbon and reducing GHG emissions. The main difference between both instruments is that carbon taxes intend to reduce GHG emissions by imposing a direct price on emissions, while emission trading schemes target limiting GHG emission levels by enabling allowance trading (NT, 2010:3).

Although it is not the focus of this research, it is important to mention that, in South Africa, the National Treasury introduced environmental excise taxes and tax incentives on diesel, petrol, and electricity in July 2009, initiating a carbon pricing regime to promote the transition to a lower-carbon economy (NT, 2011:52). In addition, the carbon tax was implemented in 2019.

An interesting fact is that according to the World Bank Group map reflecting the GHG emissions coverage by pricing mechanisms in 2024, in terms of volume of emissions, the South African carbon pricing mechanism has the second highest GHG emissions coverage in the world, covering 82.00% of the country's emissions and ranking only behind Korea which covers 89.00% of the country's emissions. The European ETS performs way behind, covering 38.00% of the European GHG emissions (World Bank Group. 2024). This depicts South Africa's strong commitment to carbon pricing coverage and GHG emissions mitigation.

2.1.2 The purpose of the Carbon Tax

The primary reasons and intent of the carbon tax, as introduced in the Carbon Tax Act (2019), indicate that given the scientific correlation between increasing

anthropogenic GHG emissions and global climate change, there is a need to control and minimise the impacts thereof. The act emphasises that an urgent climate change response is required by implementing measures that will position South Africa in a more resilient and sustainable state from a social, economic and environmental perspective (NT, 2019). Furthermore, the importance of contributing to the global endeavour to stabilise GHG concentrations in the atmosphere at a pace that promotes socio-economic and environmental development and ensures the transition sustainably is also highlighted. The purpose of the carbon tax includes the following:

- **Climate Change Impact Management:** by imposing a financial cost on GHG emissions, the aim is to reduce such emissions in South Africa, incentivising a change in behaviour from the person conducting and controlling an activity generating a GHG emission and the consumer paying for that good or service. Human intervention in weather patterns is expected to be minimised by reducing GHG emissions and contributing to controlling GHG concentration in the atmosphere. In promoting change and sustainable practices, research and development will be key towards the transformation of the low-carbon economy. Especially where the uptake and penetration of new low-carbon technologies are expected, and the development of new technologies and solutions is required. The dynamics of this transformation are expected to prepare the country for adaptation and to minimise climate change-related damages.
- **GHG emission reduction and fair contribution to the global effort:** by reducing GHG emissions in South Africa, the country will be better positioned to minimise GHG concentrations in the atmosphere and achieve the climate change commitments specified in the Nationally Determined Contribution (NDC) submitted under the Paris Agreement. Effective from November 2016, the global Paris Agreement firmed the aim of “holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial

levels, recognising that this would significantly reduce the risks and impacts of climate change.” (Paris Agreement, 2015).

- **Provide a price signal:** by imposing a monetary tax on GHG emissions, a financial incentive is created for businesses to invest in cost-effective solutions to reduce their carbon footprint. Tax incentives are expected to promote energy efficiency in the country, leading to less combustion of fossil-fuel energy sources and thus less GHG emissions while steering the economy more sustainably. The price signal imposed by the carbon tax is underpinned by the polluter pays principle, which attributes the responsibility of pollution, as well as any harm caused to people and the environment, to the person that pollutes and compensates for the damage caused (Gaur *et al.*, 2022).
- **Policies and Measures Development and Implementation:** the government intends to develop and implement a combination of different mitigation approaches to achieve the national climate goals (DFFE, 2011). Economic tools as the carbon tax and incentives are part of the national climate change response to steer and promote mitigation action across sectors.
- **Revenue Generation:** Although the main intention of the carbon tax is not explicitly associated with revenue generation, the Carbon Tax Act 15 of 2019 specifies that the tax will be levied and collected for the National Revenue Fund. According to the World Bank Group (2024), in 2023, revenues from carbon taxes and emission trading systems (ETS) worldwide reached a record of USD 104 billion.

2.1.3 Application of the Carbon Tax

Not all persons conducting and controlling activities that emit greenhouse gas emissions in South Africa will be subject to the carbon tax. That is mostly the case for civil society and small businesses. To better understand the application of the carbon tax, the following key provisions must be considered.

2.1.3.1 Phased Approach

- Phase 1: initially intended to last from 2019 to 2022.
- Phase 2: initially intended to be implemented from 2023 to 2027 (pending the implementation of the carbon budget commitment period).

The abovementioned duration periods for both Phase 1 and Phase 2 were affected by the delay in enacting the Climate Change Act (SA, 2024) and regulations pertaining to the carbon tax and carbon budgets, which are under development and expected to be published within two years of the date the Climate Change Act comes into operation.

2.1.3.2 Threshold

Schedule 2 of the Carbon Tax Act 15 of 2019 specifies a list of activities/sectors generating GHG emissions and their respective codes aligned with the Intergovernmental Panel of Climate Change (IPCC). For each IPCC code, a specified threshold will determine whether the person responsible for that activity will be liable to pay the carbon tax.

2.1.3.3 Tax Rate

The carbon tax rate was initially set at R120 per ton of CO₂eq (carbon dioxide equivalent) emissions. The rate was subject to annual increases in line with inflation plus 2.00% until 2022. In January 2023, under the Taxation Laws Amendment Act (TLAB) gazetted by the National Treasury (2023), the gradual increase of the carbon tax rate until 2030 was clearly specified. For the 2024 calendar year, the carbon tax rate is at R190 / tCO₂eq.

2.1.3.4 Tax-free Allowances

In order to ease the transition and minimise the socioeconomic impacts of the implementation of the carbon tax, a provision for tax-free allowances (that work basically as discounts) is made in Schedule 2 of the Carbon Tax Act 15 of 2019. The maximum possible allowances that can be applicable per activity/sector emitting

GHG emissions are specified and these tax-free allowances can significantly reduce the effective carbon tax liability. Tax-free allowances considered in the Carbon Tax Act 15 of 2019 are listed below:

- Basic tax-free allowance for fossil fuel combustion emissions;
- Basic tax-free allowance for process emissions;
- Fugitive emissions;
- Trade exposure allowance;
- Performance allowance;
- Carbon Budget allowance and;
- Offsets allowance.

Both basic tax-free allowances for fossil fuel combustion emissions and process emissions, as well as the fugitive emissions allowance, are afforded to all taxpayers when applicable for the corresponding activity as per Schedule 2 of the Carbon Tax Act 15 of 2019. In general, the maximum total tax-free allowances that can apply to a specific activity vary between 90.00% to 100.00%. However, that does not mean that all taxpayers can apply the maximum tax-free allowances, as that will depend on meeting the eligibility criteria underlying the rules for each tax-free allowance. Trading vulnerability for certain products due to high imports into the country, performance on GHG emission intensity (tCO_{2e} per unit of product), and participation in the carbon budget voluntary system will also determine further relief on carbon tax liability.

Although the legislation specifies a tax-free allowance, the Offset allowance represents a narrowed potential from the financial point of view. The ability to use carbon offsets to reduce carbon tax liability is constrained. Greenhouse gas emissions that can be offset have been limited to between 5.00% and 10.00% of total GHG emissions.

Furthermore, the eligibility criteria for offset projects to qualify include that they must be undertaken in the country, must be approved in respect of CDM, VCS, Gold Standard, or local standard (meaning costly projects and crossing the additional

hurdle), and must be a project whose activity is not subject to the carbon tax. The threshold for eligible renewable energy projects as offset allowance should not exceed an installed capacity of 30 MW at a specified maximum cost.

Therefore, the current offset market in the country is limited and often dominated by companies with high economic capacity. These companies can pay more for offsets than for the carbon tax, as typically, the cost of an offset is higher than the carbon tax rate. Thus, the offset alternative is unattractive to the industry.

It is expected that the National Treasury, the DFFE and the Department of Mineral Resources and Energy (DMRE) will finalise the framework for approving domestic carbon offset standards in 2024. Consideration to include a new mechanism that will replace CDM as an eligible carbon offset standard is expected to reduce the cost burden on carbon offset project developers for the registration and approval processes, which will, in turn, make offsets more affordable.

Tax-free allowances will gradually be phased down/out at a pace that is still uncertain as per current legislation. According to the carbon tax discussion paper: phase two of the carbon tax (2024), 10% points will reduce the basic tax-free allowance in 2026 and 2.5% annually from 2027 until 2030. Simultaneously, carbon offset allowances will increase by 15% points in 2026, and a performance allowance for combustion emissions will increase by 5% points increase in 2026. Post-2031, the basic tax-free allowance is proposed to be reduced by at least 2.5% points annually from 2031 (NT, 2024). This proposal has been submitted for public comment. Reducing a basic allowance implies that companies will have increased carbon tax liabilities. The increase in offset allowances is debatable as the price of an offset often does not justify the investment versus paying the tax. In addition, carbon offset in South Africa is very limited.

2.1.3.5 Carbon Tax Formula

To calculate the carbon tax liability, a taxpayer must be able to calculate the respective GHG emissions generated from its activities, including energy, process,

and fugitive emissions, using a reporting methodology approved by the DFFE. In October 2022, the Minister of Forestry, Fisheries and the Environment published the Methodological Guidelines for Quantification of Greenhouse Gas Emissions, often known as the “technical guidelines.” The technical guidelines describe the reporting methodologies and guidance on how to calculate the GHG emissions per activity/sector.

Different methodologies from those stipulated in the technical guidelines to calculate GHG emissions and monitoring results available at point sources may also be utilised to determine total GHG emissions subject to the approval of the DFFE.

Once the direct emissions (known as scope 1 emissions) are determined then the carbon tax formula must be applied to know what is the amount of carbon tax payable. This study will not focus on the details of the formula elements to calculate the liability but to illustrate and provide an idea, in a very simplistic manner, of what are the elements involved in the carbon tax liability, in respect of a tax period, the amount of carbon tax payable can be calculated by applying the formula below:

$$X = \{[(E-S) \times (1-C)] - [D \times (1-M)]\} + \{P \times (1-J)\} + \{F \times (1-K)\} \times R$$

X = the amount of carbon tax liability to be paid (Rand);

E = total energy-related GHG emissions (tCO_{2e});

S = total sequestered GHG emissions (tCO_{2e});

C = total sum of tax-free allowances applicable to energy emissions (%);

D = total Petrol and diesel combustion-related GHG emissions (tCO_{2e});

M = Total sum of tax-free allowances applicable to Diesel and petrol GHG emissions (%);

P = total process-related GHG emissions (tCO_{2e});

J = total sum of tax-free allowances applicable to process emissions (%);

F = total fugitive-related GHG emissions (tCO_{2e});

K = total sum of tax-free allowances applicable to fugitive emissions (%);

R = rate of carbon tax prescribed in legislation for the calendar year in which GHG emissions were generated (Rand).

Once the calculation of the carbon tax liability is concluded, taxpayers have the information at hand to complete their tax returns through the South African Revenue Service (SARS) 's e-filing system. Submission of supporting documentation and payment of the carbon tax liability to SARS must take effect annually in July no later than the penultimate working day of that month (South African Reserve Bank, 2019).

2.2 Introduction to the Carbon Budget System

2.2.1 Definition

Under the definitions provided in the Carbon Tax Act 15 of 2019, a Carbon Budget is a maximum specified amount of GHG emissions, expressed in tCO_{2e}, permitted for a certain period of time to a person conducting an activity that generates GHG emissions (NT, 2019).

2.2.2 Purpose

The allocation of carbon budgets is one of the key elements in the overall national approach to mitigating climate change, and its allocation will be done at the company level by the DFFE (NCCR, 2011). In South Africa, the carbon budget system complements the Carbon Tax Act 15 of 2019 by providing a clear framework for reducing emissions and ensuring that national climate targets are met. From a global perspective, the carbon budget must be aligned with scientific-based requirements to ensure tolerable levels of climate change and global warming (WWF, 2014).

2.2.3 Application of the Carbon Budget System

As proposed, only persons conducting and controlling activities that emit GHG emissions exceeding the maximum specified amount of GHG emissions will be subject to paying the carbon budget penalty of R640 per tonne of CO_{2e}. According to

the carbon tax discussion paper, phase two of the carbon tax (2024), the penalty will be implemented after the finalisation of both the mitigation plan and carbon budget regulations by the DFFE. After that, the NT will publish the necessary amendments to the Carbon Tax Act through the Taxation Laws Amendment Bill, either in 2025 or 2026 (NT, 2024).

2.2.4 Phased Approach

2.2.4.1 Phase I – The voluntary phase

In 2015 the DFFE conducted extensive engagements with relevant businesses regarding GHG emissions taking place in the voluntary phase of the carbon budget system. In this phase, carbon budget-relevant companies were invited by the DFFE to submit a carbon budget for the review and approval of the department and, in turn, as an incentive, would be eligible for the tax-free carbon budget allowance of 5.00% to reduce their carbon tax liability (DFFE, 2021). This initial phase of the carbon budget system, Phase I, was from 1 January 2016 to 31 December 2020.

The carbon budget system covered 89.00% of GHG emissions considering carbon budget-relevant sectors. Forty-five of fifty-eight companies that had initially applied for a carbon budget were successfully allocated a carbon budget for Phase I, and the remaining number of companies did not finalise the process (DFFE, 2021).

The allocation of carbon budgets considers appropriate approaches for different businesses and historical, actual, and future data projections on production and GHG emission reduction goals. In Phase I, companies participating in the voluntary phase of carbon budgets were permitted to use a 5.00% carbon budget tax-free allowance, reducing their carbon tax liability.

2.2.4.2 Extended Phase

Although the allowed period to make carbon budget submissions was finalised on 31 December 2020, on 22 October 2020, the Minister gazetted a Transition Period from January 2021 to December 2022. This period, following Phase I, aimed at extending

Phase I for voluntary carbon budget submissions and to enable the DFFE to engage further, develop and prepare for the mandatory Phase II of the carbon budgets. During the transition period, the DFFE will assess the most appropriate methodology to allocate carbon budgets per company by engaging with industry, mining, and interested stakeholders (DFFE, 2021).

The end of the Transition period in December 2021 and the beginning of the 5-year mandatory carbon budget allocation was expected to commence in January 2022.

The DFFE's intention was and still remains to start with the mandatory phase of the carbon budget pending the promulgation of the Climate Change Act (SA, 2024) and the finalisation of carbon budget regulations. However, that did not happen by January 2022 as the President signed the Climate Change Act on 23 July 2024, and at the time this study was written, the Act was still pending proclamation of a date to come into operation.

During the Transition period, companies permitted to use the 5.00% carbon budget tax-free allowance can still do so. However, a recent amendment of the Carbon Tax Act 15 of 2019 has reflected that such a carbon budget allowance can be used until December 2024.

2.2.4.3 Phase 2 – The mandatory phase

Once the Climate Change Act comes into operation, climate change-related regulations will be updated and published including the rules pertaining to the carbon budget system. According to the Climate Change Act (DFFE, 2024), the Minister is responsible for allocating a carbon budget to a person conducting GHG emission activity. The process of allocating a carbon budget must consider the socio-economic impacts caused by the carbon budget, the best available science-based technology, and solutions to reduce GHG emissions, amongst others. With the national GHG emissions trajectory at the core, there must be an alignment between the allocation of carbon budgets and the aimed reduction trajectory.

At the time this study was written, indications were that the DFFE had completed the carbon budget draft regulations and the DFFE was busy finalising the guidelines accompanying those regulations. Pending an internal commenting period among the governmental departments and relevant authorities, documents should be published for public comment, which is expected to be between Q4 2024 and Q1 2025. In parallel, the DFFE was still working on allocating the mandatory budgets, which should be finalised mid-2025.

2.2.5 Duration period

Carbon Budgets will have a duration of no less than 3 successive 5-year periods with a defined maximum amount of GHG emissions that can be emitted during the first period of 5 years. After the first 5-year period or upon request, the Minister must review the carbon budget allocated, which will then be subject to a revision, amendment, transfer or cancellation, pending the circumstances and status of national and international commitments and obligations (DFFE, 2004: pag 42:51)

2.2.6 Methodology

Different methodologies can be considered for carbon budget allocation, and the DFFE makes this decision through an extensive engagement process between the government, third-party experts, and companies across sectors (DFFE, 2021). In South Africa, the methodologies vary per sector and follow the principles of fixed reduction target, mitigation potential and benchmarking approach (DFFE, 2021).

Having a close look into the hard-to-abate sector, the carbon budget allocation for the Iron and Steel industry will follow a product benchmark ($\text{tCO}_2\text{e} / \text{tCrude Steel}$), the cement sector a technology-based benchmark ($\text{tCO}_2\text{e} / \text{t clinker}$) and the petroleum refining sector a Solomons methodology: South Africa Complexity Weighted Tonne (SA-CWT) ($\text{kgCO}_2\text{e} / \text{SA-CWT}$) approach. The DFFE is still defining the best approach to other sectors (DFFE, 2021).

2.2.7 Mitigation plan and reporting requirements

According to the Climate Change Act 22 of 2024, a person responsible for GHG emissions who has received a carbon budget allocation must submit a mitigation plan to the Minister describing measures to reduce GHG emissions for his/her approval. A person receiving a carbon budget allocation must implement the approved mitigation plan, monitor, manage and submit an annual report to the DFFE (SA, 2024:36).

Reporting requirements include GHG emission quantification based on prescribed methodology and demonstrating progress. In case the report indicates failure or potential failure to comply with the allocated carbon budget, a justification must be presented with the required measures that will be implemented to become or remain compliant with the carbon budget allocation. Developments in available technologies, scientific advances, evidence, and other information must be considered when revising the carbon budgets President of the Republic of South Africa, 2024:38).

2.2.8 Management and Enforcement

The DFFE must develop regulations that cover the management of climate change response, including the determination, alteration, compliance, and enforcement of carbon budgets, as well as the implementation and operation of GHG emission mitigation plans and all matters related to them (President of the Republic of South Africa, 2024:42).

It is stated in the Climate Change Act 22 of 2024 that a regulation may make provision for offences and penalties contemplated in section 49B(2) of the National Environmental Management Act if any person is found convicted for contravening or failing to comply with a provision of the Act. According to this section, a person convicted of an offence in terms of a certain section is liable to a fine of a maximum of R5 million and/or to imprisonment for a maximum of 5 years for a first-time conviction. For a subsequent conviction, the fine can go up to R10 million and an imprisonment period of up to 10 years (President of the Republic of South Africa, 2024:46).

From the hard-to-abate industry perspective, this might be a concern pending the level of carbon budget allocation and the pace of development, as well as the availability and affordability of low-carbon technologies to enable the reduction of GHG emissions aligned with the carbon budget demands. Therefore, it is important to engage with the DFFE with transparent information and progress on mitigation plans and to request a review, alteration, or cancellation of an allocated carbon budget within the timeframe prescribed by law in case of an inability to meet the target. Otherwise, the hard-to-abate representative can be subject to fines and/or imprisonment in case of non-compliance with the Climate Change Act.

2.2.9 Penalisation for exceedance of carbon budget

To ensure alignment between the carbon tax and the carbon budget, the DFFE and the National Treasury work together to assess the potential implications and choose one of the two integration options that are considered.

One option implied partial or total replacement of the basic tax-free allocation of 60.00% to the carbon budget allowance. For example, by reducing the basic tax-free allocation (which is given to all sectors) from 60.00% to 20.00% and transferring the 40.00% difference to the carbon budget allowance increasing the weight of the carbon budget allowance (DFFE, 2021, slide 35:42). In case of a carbon budget being exceeded this would equate to an administrative-related penalty imposed by the DFFE and it would forfeit the carbon budget allowance increasing thus the carbon tax liability leading to higher financial implications.

The other option is a penalty mechanism that aims to charge CO_{2e} emissions exceeding the carbon budget allocation at a higher rate. In this case, exceeding the carbon budget would imply charging a tax rate of above R600 per tonne of CO_{2e} above the carbon budget allocation (DFFE, 2021, slide 35:42). This is on top of charging the carbon tax to CO_{2e} emissions within the carbon budget allocation at a normal rate already specified in the Carbon Tax Act 15 of 2019 as per Taxation Laws Amendment Bill (2023, page 25-26:32).

In the 2022 Budget review, the National Treasury reflected its intention to choose the latter option by imposing a penalty mechanism for CO_{2e} emissions exceeding the carbon budget allocation by taxing such emissions in exceedance at R640/tonne CO_{2e} (NT, 2024) and that intention was again reflected in the 2024 Budget Review (2024).

The amendments to the law about the R640/tonne CO_{2e} penalty as an integration option are expected to happen once the Climate Change Act comes into operation and after the relevant regulations are gazetted. Pending the finalisation of those

regulations, the carbon budget penalty will be applied from the 1st of January of the calendar year after the legislation is finalised (EY, 2024). Most recently, in the carbon tax discussion paper on phase two of the carbon tax (2024), NT has proposed the penalty implementation from 1 January 2026 (NT, 2024).

Additionally, the 5.00% tax-free carbon budget allowance provided to taxpayers participating in the voluntary Phase 1 of the Carbon Budget system is expected to fall away at Phase 2 (mandatory phase) coming into effect 2024 Budget Review (2024).

2.3 Challenges and Considerations

Numerous benefits are associated with implementing the carbon pricing and budget system as part of the policies and mechanisms promoting the reduction of GHG emissions. Apart from mitigating anthropogenic interference with weather patterns, other co-benefits related to the environment, health, innovation, and positive socio-economic developments are expected. On the other hand, some challenges and considerations might have negative impacts, especially on those industries that are energy-intensive and depend on non-existent low-carbon technologies to make the transition. Some challenges and considerations are stated below:

2.3.1 Technical Challenges

A report from the Technology Executive Committee of the UNFCCC (2023) mapped low and near-zero emission initiatives in hard-to-abate sectors. According to the report, commercial application of various low-carbon technologies is not ready yet; additional capacity of existing traditional technologies may be needed in the upcoming years. Therefore, decarbonising these sectors is not an easy task, and hurdles will have to be overcome to achieve climate goals (UNFCCC, 2023).

Most of the challenges identified are faced across all the three industries considered hard-to-abate: cement, steel and chemicals. Common barriers are highlighted below:

- Low-carbon technologies maturity levels.

- Lengthy lifetimes of industrial facilities of approximately 20 to 50 years, increasing the complexity and risks towards the transition due to the difficulty of replacing existing assets.
- Alternative materials/energy sources availability, sustainable supply thereof and technical challenges related to their use.
- Energy Prices.
- Carbon Capture and Storage- (CCS) as well as Carbon Capture, Utilization and Storage- (CCUS) related challenges:
 - Lack of financial support for Research, Development and Demonstration (RD&D) of technologies that will reduce GHG emissions.
 - Potential negative environmental impacts including groundwater contamination, technical uncertainty, seismicity activity, public acceptance and possible liabilities (The Nature Conservancy, 2024).
- There is a lack of renewable energy infrastructure, availability, and investment to ensure electricity supply to meet the increasing demand in the low-carbon transition and the deployment of other technologies, such as green hydrogen production.

Having outlined the general and common technical challenges above for the hard-to-abate industry, it is crucial to delve deeper into the specific challenges encountered within the main sectors of this study. To provide a comprehensive analysis of the sector-specific challenges and to better understand the complexities and dynamics that influence each sector's ability to decarbonise, further details are given below per sector.

2.3.1.1 Technical Challenges of the Cement Sector

The following technical challenges have been identified particularly to the cement and/or concrete sector:

- Lack of availability of alternative raw materials able to substitute clinker.
- Technical challenges and limitations associated with using alternative clinker substitutes in the process. The replacement of clinker for other materials can lead to an increase of volatile organic compounds in the process and high

concentrations of incompatible elements like sulphur, magnesium and others. Therefore, clinker substitution rates in large proportions are challenging.

- The addition of low-carbon cement to concrete can delay the application process, and extra labour might be required to ensure good finishing results. These alterations in concrete can also affect construction processes by delaying early-stage strength development.
- The deployment of electrification for cement kilns is limited due to the high-temperature requirements and significant infrastructure investment required to achieve the high-intensive power demand that it requires.
- Market acceptance of new products with different designs and compositions can be a problem, as reducing the clinker ratio in cement can cause customers to perceive that safety will be compromised. Changing the composition of the material will also generate alterations in the procurement, design, and construction processes, which can cause difficulties in the construction sector.

2.3.1.2 Technical Challenges of the Iron and Steel Sector

The following technical challenges have been identified, particularly to the Iron and Steel sector:

- The iron ore electrolysis requires the discovery of an affordable, corrosive-resistant and carbon-free inert anode to become feasible and possible at an industrial scale. To play a significant role in decarbonisation, this technology would require an upscaling in volume of approximately 8 orders of magnitude from developments currently made (Worldsteel Association, 2021). However, this technology is expected to jeopardise the use of slag as a by-product of the steel sector in the construction sector due to the high content of free lime.
- Scrap in electric arc furnaces (EAF) is considered the most straightforward technology for reducing CO₂ emissions in steelmaking. However, there is no sufficient scrap collected in the world to make a complete conversion to EAF steelmaking. There is already a scarce market for scrap, and projections indicate that the demand for scrap will only increase in the future (Grigorenko, 2023).

In the South African context, the scrap market has further negative implications. As stated by the DTIC (2022), the resale of scrap in the country causes economic damage of more than R47 billion per year (DTIC, 2022).

- Natural gas is an important transition fuel for the steel sector. Some technologies, such as the Direct Reduced Iron (DRI) technology, rely on natural gas to reduce CO₂ emissions. In the future, coupled with CCUS technologies and renewable energy, natural gas could assist in achieving the near-zero CO₂ emissions pathway. This can be feasible for countries with natural gas abundance, which is not the case for South Africa.

Sasol initiated the supply of synthetic fuel in South Africa in the 1950's and in Secunda in 1980. The first natural gas supply was provided by PetroSA in 1992 (Putter, 2018). Since 2004, natural gas has been supplied in the country via Sasol through a joint venture with the government of Mozambique and the government of South Africa. Natural gas is sourced from the Pande and Temane gas fields in Mozambique and flows via the Republic of Mozambique Pipeline Investments Company (ROMPCO) pipeline (Putter, 2018).

- However, an energy crisis is looming as Sasol has announced that natural gas supply will run out in the country in mid-2026 (Webster, 2024). This could lead to a 'day zero' to the manufacturing sector in South Africa leading to disturbing consequences to the industry including job losses (South African Government News Agency, 2024). The situation can lead to supply shortage across various sectors, goods and services directly or indirectly depending on natural gas and increase in prices (Groenendaal, 2024). This would add to the technical constraints on the hard-to-abate sector to decarbonise and it could in fact, increase CO₂ emissions as industries would have to increase reliance on fossil fuels to replace natural gas.
- Technical feasibility challenges for Green Hydrogen production, water demand in the process with a ratio of approximately 9t of water to 1t of Hydrogen produced (UNFCCC, 2023), further issues related due to extremely low density of hydrogen and costly transport infrastructure;

2.3.1.3 Technical Challenges of the Energy and Chemical Sectors

The Chemical sector encounters the following specific technical challenges:

- The synfuels and downstream chemicals value chain will rely on implementing disruptive technologies and sustainably sourced alternative feedstock. The main requirements include renewable energy, efficiency improvements, green hydrogen, sustainable sources of carbon and gas, and CCUS and Direct Air Carbon Capture (DACC) (NBI, 2021).
- The International Fertiliser Association, cited by UNFCCC (2023), estimates that in 2020, the average age of ammonia plants worldwide was around 24 years. Considering that heavy capital has already been invested in equipment to produce ammonia, sacrificing existing technologies and replacing them before their end of life is a challenge (UNFCCC, 2023).
- Sustainably sourced biomass is one of the lower-carbon alternatives that the industry will rely on to replace fossil-fuel carbon. However, there are technological and economic challenges related to the availability and application of biomass use a sustainable solution. Some of the challenges include the elevated thermodynamic stability and kinetic inertness of CO₂. (UNFCCC, 2023).
- The utilisation of CO₂ as a feedstock to produce value-added products is subject to ongoing research and development. Difficulties presented due to the CO₂ properties pose a challenge in chemical synthesis. As an unintended consequence, if green ammonia production is adopted at 100.00%, urea output will require another innovative source of CO₂ (UNFCCC, 2023). These are some of the interdependencies that currently underpin the circular economy and might be lost by transforming some processes into lower-carbon technologies. It is also true that with further research and development, time and investment new innovative opportunities will arise.
- According to a report from the NBI (2021), the South African petrochemical and chemical sectors have the potential to become leaders in green synthetic

fuels and green chemicals production, such as e-ammonia (ammonia produced with renewable energy) and Sustainable Aviation Fuel (SAF) (NBI, 2021). The report also indicates that full decarbonisation of these sectors will heavily depend on green H₂ being developed at scale and a price below US\$2/kg. This is a problem when taking into consideration the forecasted South Africa's price evolution for green H₂ production in the region of US\$3.82/kg in 2025, increasing to the highest at US\$4.12/kg in 2030 and reaching US\$1.47-1.76/kg in 2040 (DTIC, 2022).

2.4 Economic Impact

In addition to business-as-usual expenditures significant investment will be required from businesses into research and development, implementation of new low-carbon technologies, infrastructure, resources and building intellectual capacity to enable a process transformation. Industries like the Iron and Steel sector, for example, are some of the most challenging industries to decarbonise due to their high heat and energy requirements in their processes, coal dependency and at the same time generate low profit margins and high capital intensity demands (Kim et al., 2022:2).

Industries in such distressed economic situations must pay carbon tax as an extra cost. If the proposed penalty for exceeding the carbon budget is implemented, another extra cost will be incurred exponentially. The analysis made by McKinsey & Company (2022) suggests that hard-to-abate industries like cement and steel could increase their production costs by roughly 45.00% and 30.00%, respectively, by 2050 due to the needed implementation of lower carbon technologies, opex, capex, and depreciation (Krishnan *et al.*, 2022:85).

Energy-intensive businesses will be more impacted than businesses with fewer energy requirements to operate. If low-carbon technologies are available and affordable, industries will be able to reduce their carbon emission intensity and carbon tax liability. However, that will not be possible for industries that cannot afford to upgrade to newer technologies. In general, carbon pricing (carbon tax and carbon budget penalty) will reduce profitability as it will increase production costs.

Alternatively, sectors that are not enabled to improve energy efficiencies and implement low-carbon technologies at the required pace of policies and legislation in South Africa could reduce CO₂e emissions at the cost of cutting production to remain within the carbon budget allocation. This could lead to a significant negative socio-economic impact on the South African manufacturing economy.

2.4.1 Practical example

To provide a simplistic and illustrative example, the carbon budget's application period will be considered one year to be aligned with the carbon tax application period. Further, although the carbon tax rate increases annually and tax-free allowances will be phased down with time, the 2024 carbon tax rate will be used for practical purposes.

Assuming a hard-to-abate business that has not significantly changed its process due to a lack of technology availability, this business has been allocated a carbon budget of 1 million tonnes of CO₂e (per annum), but with favourable market demand and a high production rate, it generated 2 million tonnes of CO₂e emissions in that specific year. Carbon tax liability and carbon budget penalty would be roughly applied as follows.

If 1 million tonnes of CO₂e were taxed at the carbon tax rate of R190/tCO₂e, the taxpayer would pay R190 million if no tax-free allowances were applicable. Considering a tax-free allowance of 80.00%, the carbon tax liability would be roughly R38 million, which is already considerable.

The same amount of 1 million tonnes of CO₂e emissions that exceeded the carbon budget would equate to a further penalty of R640 million to be paid on top of the R38 million for the carbon tax. Carbon pricing in total would be between R678 million and R830 million. It is important to emphasise that carbon tax rates are expected to

increase up to R464/tCO₂e in 2030. The same calculation would equate to a total between R732.8 million to R1.104 billion using the same parameters in 2030.

To provide some perspective in terms of CO₂e emissions generated annually in South Africa and the potential for carbon tax revenues, figures obtained from the National GHG inventory report for South Africa for the 2000 to 2020 period (excluding Forestry and other land use (FOLU) and using SAR GWP estimates) are as follows:

Total GHG emissions in South Africa were 457,83 million tCO₂e in 2000 and 458,07 million tCO₂e in 2020 (DFFE, 2023).

- The energy sector generated 371,34 million tCO₂e in 2000 and 379,50 million tCO₂e in 2020 (81.00% and 83.00% of the total GHG emissions in the country, respectively). Some of the main GHG sources of emissions part of the energy sector are as follows:
 - Electricity and heat production: 186,08 million tCO₂e (2000) and 205,62 million tCO₂e (2020).
 - Manufacture of solid fuels: 30,58 million tCO₂e (2000) and 28,63 million tCO₂e (2020).
 - Manufacturing industries and construction: 28,93 million tCO₂e (2000) and 33,34 million tCO₂e (2020).
 - Road transport: 37,10 million tCO₂e (2000) and 44,96million tCO₂e (2020).
- Industrial Processes and Product Use (IPPU): 32,96 million tCO₂e (2000) and 25,49 million tCO₂e (2020) (7.00% and 6.00% of the total GHG emissions in the country respectively). Some of the main GHG sources of emissions part of the IPPU sector are as follows:
 - Cement Production: 3,87 million tCO₂e (2000) and 3,80 million tCO₂e (2020).
 - Chemical industry: 2,77 million tCO₂e (2000) and 2,26 million tCO₂e (2020).

- Iron and Steel: 15,33 million tCO₂e (2000) and 3,85 million tCO₂e (2020).
- Ferroalloy Production: 8,08 million tCO₂e (2000) and 6,98 million tCO₂e (2020).
- Aluminium Production 2,07 million tCO₂e (2000) and 1,25 million tCO₂e (2020).

The energy sector figure includes GHG emissions from electricity generation, petroleum refining, manufacture of solid fuels and other energy industries, manufacturing industries, construction, and transport, among others. The IPPU sector includes industries in mineral, chemical, metal, and non-energy products, among others. However, GHG emissions derived from the combustion of fuels will also be categorised under the energy sector emissions.

By estimating the possible carbon pricing liability from both mechanisms reflected in the example above and the total GHG emissions per sector, one can infer the significant financial impact on the hard-to-abate industries that form part of both sectors specified above and the significance of possible taxation.

2.5 Equity concerns

Disproportionate application of the carbon tax and carbon budget system through businesses due to the nature of their production processes may exacerbate socio-economic impacts on the companies, employees and surrounding communities. Furthermore, it is essential to ensure that low-income households will not be disproportionately affected.

2.6 Administrative Capacity

To ensure compliance with the carbon tax and carbon budget systems' legal requirements, specialised resources are needed to adequately quantify and verify GHG emissions, be it in the private sector as well as in the public sector, from a management and enforcement point of view. In order to quantify GHG emissions, carbon analysis from all carbon-bearing inputs and outputs taking part in a process is needed to ensure a proper mass balance of GHG emissions. In the case of GHG

emission measurements at point sources, investment in monitoring equipment is required alongside administrative capacity to manage such emission quantification.

2.7 Competitiveness

Implementation of the carbon tax and carbon budget penalization might create a positive image from an international point of view, demonstrating serious commitment to the global goal of reducing GHG emissions and attracting investment. However, on the other hand, peer industries in other jurisdictions without carbon pricing will have no incentive to reduce their emissions and will incur less costs when compared to South Africa. This could lead to higher imports into South Africa competing with products at a lower price, dominating local market share and ultimately leading to the South African de-industrialisation. Other negative implications can include foreign exchange risk, supply chain vulnerability and job losses.

Although this study did not focus on the effect of international carbon pricing on the hard-to-abate sector in South Africa, it is relevant to mention that Europe has implemented a Carbon Border Adjustment Mechanism (CBAM) starting from October 2023 until December 2025 with its transitional phase. In this phase reporting declarants are obliged to report direct and indirect embedded emissions of products listed under the scope of CBAM. In January 2026, the definitive phase will start imposing carbon pricing applied to the CO₂e-embedded emissions in products being exported to the EU. According to a report from the Trade & Industrial Policy Strategies (TIPS), based on 2022 South African exports, data sourced from Trade Map (2023) and, considering the current CBAM regulations, it is estimated that approximately R52.40 billion of South African exports are at risk (Maimele, 2023). This is a clear reflection of carbon pricing adding exponentially to South African products, and it will undoubtedly have a detrimental effect on the competitiveness of South African producers, especially those in the hard-to-abate sector. The United Kingdom has also announced the implementation of CBAM in 2027, and similar mechanisms are expected to materialise globally.

The South African Steel and Metal Fabrication Master Plan 1.0 by the DTIC (2021) indicates the importance of the local industry to be competitive, with the effective support of State-Owned Enterprises (SOEs), municipalities and the prevention of illicit- and below-standard imports. The report indicates that for every 200 000 tonnes of final products imported, the equivalent of 800 new direct jobs (multiplier of 4 jobs per 1000 tons sold into the manufacturing sector) and approximately R7bn revenue per annum are threatened in the South African industry (The DTIC, 2021).

According to Chronux Research, cited by Global Cement News (2024), nearly 20.00% of cement imports into South Africa were experienced in 2023 (an increase of 18.00% from 2022). The report also associates plant closures and job losses with the gradual increase year-on-year of cheaper products imports into the country, affecting the local cement industry (Global Cement News, 2024). It is further indicated that despite a cement production capacity of 20 million tonnes per year, only 12 million tonnes are produced in the country. This is a clear reflection of local manufacturing displacement by imports. Another research by PPC Cement and the Gordon Institute of Business Science (2023) emphasises the underutilisation of the local cement industry operating at two-thirds of capacity and difficulties related to job losses, low market demand and government revenue collection (Global Cement News (2024).

The South African Iron and Steel Institute (SAISI) has confirmed that although South Africa was historically a steel exporter, it became a net importer of primary steel in 2020. Record volumes were reached in 2021 at 1.7 million tonnes of primary steel imported, representing one-third of the steel used in South Africa (Creamer, 2022). Other challenges experienced in the sector include the Chinese global over-supply of steel, illicit trade into the country, reduced competitiveness, and increased production and service costs. According to SAISI, underutilisation can lead to closure of plants and job losses (Creamer, 2022).

2.8 Potential for Overlapping Regulations

There is a risk of regulatory overlap, where businesses might face conflicting requirements or duplicative reporting obligations between the carbon tax, carbon budgets and other climate change-related regulations.

2.9 Social Impact

Unemployment in South Africa remains a significant challenge on its own. The official unemployment rate in the country in Q2 2024 was 33,50% (Stats SA, 2024); this high rate affects various sectors of the economy. Despite efforts to create jobs and stimulate growth, many South Africans continue to struggle without jobs and associated socio-economic impacts. Therefore, it is important to ensure the sustainability of local industry and preserve existent jobs also in the hard-to-abate sector.

2.9.1 Job losses

Determining the real social impact in detail in terms of job losses and impact on the community is challenging as not all job-related data is publicly available per industry (Wright, 2022). In addition, the social impacts of a direct job extend far beyond the individual employed but influence a network of multiple indirect jobs and dependents. An employment chain enhances economic stability and growth within the community, empowering individuals to purchase goods and services, to access education, healthcare, and other essential services. Consequently, uplifting the socio-economic status of a broader community, fostering overall development and well-being.

A general perception is that decarbonisation will promote investments and innovation and generate new job opportunities. An NBI report (2023) indicates that decarbonising and diversifying the heavy manufacturing sector, including the production of metals, transport equipment, and machinery, has the potential to create approximately 740,000 new jobs (NBI, 2023).

On the other hand, it is also recognised that decarbonising activities that depend heavily on coal will pose significant social implications on the coal mining sector due

to a decline in demand, affecting approximately 2 to 4 million people and their livelihoods in South Africa. This is considering that the coal mining sector and coal value chain support nearly 400,000 jobs and that one mine worker typically supports 5 to 10 dependents (NBI, 2021).

Between 2018 and 2020, the South African cement and iron and steel industries contributed, on average, approximately 7,000 and 40,000 direct jobs, respectively (NBI, 2023). By applying a six-fold employment multiplier and a ratio between 7 to 10 people depending on every formal job in the iron and steel sector, negative implications on employment can lead to a severe social and economic catastrophe (SEIFSA, 2024).

It is estimated that the petrochemicals and chemicals sector in South Africa supports approximately 14,000 direct jobs, sustaining local industrialisation and exporting opportunities (NBI, 2021). The management and mitigation of socio-economic impacts associated with the potential displacement of these employees in the sector is of great concern, so accelerating the decarbonisation across sectors is important (NBI, 2021).

2.9.2 Job Insecurity

Companies facing financial uncertainty may increasingly rely on short-term or temporary contracts, leading to job insecurity for employees. Potential layoffs can also create a stressful work environment, negatively impacting employee morale, mental health, workplace safety, and productivity.

2.9.3 Decreased Wages and Remuneration

To manage carbon pricing and higher tax burdens, companies may implement cost-cutting measures that could include wage freezes, reductions in employee benefits, and cuts to bonuses and incentives. Financial constraints may prevent companies from offering competitive wages, affecting the living standards of employees and the companies' competitiveness.

2.9.4 Reduced Training and Development Opportunities

While the low-carbon transition will require workers to reskill and upskill to enable a functioning working environment operating new low-carbon technologies and maintaining employability, financial constraints may lead to reduced investment in human capital associated with training and career development programmes. This could limit opportunities for employees and hinder career progression and adaptability to new technologies and a new job market.

It is important to emphasise that a significant portion of the jobs provided in the coal value chain are associated with unskilled labour (NBI, 2021). This is a concern as in cases where labour is not reskilled or upskilled at the required level, a significant portion of the workforce may face difficulties in finding alternative jobs. Further, in the coal value chain, coal miners, for example, get well paid relative to their qualifications (Makgetla et al., 2019). Displacement of the unskilled workforce could lead to an increased unemployment rate, lower purchasing power and more poverty in the country.

2.9.5 Community Impacts

Job losses, reduced remuneration, and less investment in human capital among employees would affect communities heavily dependent on hard-to-abate industries and have a ripple effect on the local economy. Furthermore, increased unemployment rates have the potential to strain social services and public welfare systems.

Carbon pricing and penalties on carbon budget exceedance can incentivise industries to stay within their carbon budgets and reduce GHG emissions. However, overly severe penalties may be counterproductive if they lead to significant economic hardship, as companies can be forced to cut back on investments and infrastructure, scale down operations and close plants. Unable to decarbonise and reduce carbon tax liability within the timeframe dictated by climate policies could lead to profound

social impacts on employees and surrounding communities to the hard-to-abate sectors. Considering that companies face increased financial strain due to the high investment required, reduced free cash flow, low market demand and lower profits, the likelihood of job losses rises significantly.

Other negative social impacts mentioned above are particularly severe in South Africa, where economic disparities and high unemployment rates already pose significant challenges. Comprehensive social protection measures, targeted support for affected workers, and investments in retraining and community development to mitigate these negative impacts will ensure a just transition to a low-carbon economy.

2.10 Key factors for effectiveness

Identifying and addressing key factors for the effectiveness of carbon taxes and budgets is crucial for their success. These mechanisms to achieve climate goals require that policies be practical and fair and consider minimising negative economic impacts. Some of the key elements for effectiveness are explored below.

2.10.1 Carbon Tax Rate

Higher tax rates are expected to have a greater impact on GHG emission reduction and industry uptake of lower-carbon technologies. However, it is important to recognise that the tax should be high enough to create a behaviour change but not too high to threaten the industry's sustainability. It is crucial to maintain the balance between environmental goals and socio-economic sustainability.

2.10.2 Ring-fencing of the carbon tax revenue

Recycling revenues originated from carbon pricing mechanisms to fund low-carbon technologies and more climate-sustainable solutions have shown positive effects in other jurisdictions worldwide, while industries become more efficient in terms of GHG emissions. In fact, models followed by Europe, Canada, and the USA have accelerated their implementation of decarbonisation solutions.

In South Africa, the revenue for a carbon tax is not ring-fenced to lower-carbon projects in the private sector but mainly recycled into a) tax incentives for energy efficiency savings, b) credit for the renewable energy premium included in the electricity pricing against Eskom's carbon tax liability (to avoid further impact on electricity prices in phase 1, c) electricity levy, d) solar water geysers installation and improved free basic electricity for low-income households, e) public transport & freight from road to rail improvements. (DFFE, 2021, slide 33 of 42)

2.10.3 Complementary Policies

Carbon pricing mechanisms should be supported by the development and implementation of complementary policies that contribute to the acceleration of climate change response and the effectiveness of the tax. Such complementary policies include those coordinating the legal and institutional framework, providing subsidies for renewable energy, and regulations underpinning financial, technological, and innovation support.

2.10.4 Public Acceptance

Stakeholder awareness, support, and willingness to comply with carbon pricing are fundamental to its successful implementation.

2.10.5 Low-carbon electricity grid and required infrastructure

Although indirect GHG emissions are not covered by the carbon tax, in some instances, it is possible to reduce direct GHG emissions by replacing thermal technology with electrification. In addition, decarbonisation solutions tend to increase electricity requirements, and uptake of such technologies will only make sense with greener electricity and required infrastructure being available. A profound infrastructure transformation for more renewable energy would enable other sectors to reduce their carbon tax liability pending significant public investment and long-term implementation timeframe.

According to the South African National GHG Inventory Report 2000-2020 (DFFE, 2022), GHG emissions from public electricity producers account for 86.00% of the energy industry's emissions, which in turn represent more than 80.00% of the country's total GHG emissions. This reflects the country's high reliance on coal power stations. The decarbonisation of the national electricity grid is crucial to significantly reducing GHG emissions in the country and enabling other sectors to reduce their carbon footprint.

2.10.6 Socio-Economic Context of South Africa

It is important to consider the socio-economic reality faced in South Africa to ensure the effectiveness of the carbon pricing mechanisms. The nation must absorb the impacts of carbon pricing while remaining sustainable and resilient.

As part of the South African climate change response, the carbon tax and the carbon budget system play important roles in promoting the reduction of GHG emissions and changing producers' and consumers' behaviours in relation to the environment. The effectiveness of both mechanisms' design and implementation has potential for improvement in order to accelerate decarbonisation and minimise socio-economic disruptions and de-industrialisation.

Hard-to-abate industries in South Africa face many challenges in reducing greenhouse gas emissions, including technological, economic, infrastructural, regulatory and social barriers. Addressing these challenges requires a coordinated approach involving government policies, financial incentives, technological innovation, and stakeholder engagement.

The implementation of the penalty for exceeding the carbon budget allocation presents significant challenges and risks to industries in economic distress, especially to the hard-to-abate sector. Careful design and implementation are essential to address administrative complexity, potential regulatory overlap, and socio-economic impacts. Learning from international experiences and adapting best

practices to the South African context can help optimise the alignment process and achieve the country's climate goals.

2.11 Chapter Summary

Chapter 2 delves into the literature surrounding carbon tax and the carbon budget system. It begins with an introduction to the carbon tax, defining its purpose, application, and the phased approach to its implementation, including an explanation on the threshold, tax rates, and tax-free allowances. The chapter explores the carbon budget system, detailing its definition, purpose, application, and the phases of its implementation. It also addresses the technical challenges the hard-to-abate sector faces, the economic impact of these mechanisms, equity concerns, administrative capacity, and competitiveness. Additionally, the chapter highlights the potential for overlapping regulations and the social impacts, such as job losses and community effects. Key factors for the effectiveness of these systems, including the carbon tax rate, ring-fencing of revenue, complementary policies, public acceptance, and the socio-economic context of South Africa, are also discussed.

This chapter emphasised the importance of reducing GHG emissions and stabilising atmospheric concentrations of GHG to prevent and mitigate the negative impacts of climate change. It introduced both a carbon tax and a carbon budget system, focusing on the purpose of each mechanism, timelines of implementation, methodologies followed, key elements of the respective applications, and management and enforcement thereof.

Research suggests that numerous benefits and opportunities can be associated with the transition towards a lower-carbon economy and that carbon pricing mechanism are powerful instruments to change polluters' behaviour and curb GHG emissions. However, significant challenges and considerations prevent the hard-to-abate industries from decarbonising rapidly. These industries face potential negative impacts as they require alternative materials and low-carbon technologies, which are yet to be developed at an industrial scale, to facilitate the transition.

The chapter alludes to the significant investment required in decarbonisation technologies, research and development infrastructure, resources, and human capital to enable the process transformation. In addition, it brings some realism with illustrative examples of what could be the carbon pricing burden on a hard-to-abate industry while enabling the reduction of GHG emissions. This reflects exponential carbon liabilities to be paid. Additional potential impacts on competitiveness and socio-economic factors in the South African context were also emphasised.

CHAPTER 3: EMPIRICAL STUDY

3.1 Introduction

Chapter three provides a comprehensive overview of the empirical study, detailing the study's research strategy, methodology, and paradigm. It outlines the research instruments and data collection methods, including the recruitment of participants and interview strategy. The chapter also reflects the study population demographics, accessibility, interview size, and the relationship between the researcher and participants. It emphasises the credibility and validity of the study, followed by a thorough statistical and data analysis. The results of the qualitative analysis are presented through thematic analysis from ATLAS.ti., covering the predominant themes of the interviews such as technical, economic impacts, socio-economic impacts, policy and regulations and transition. Ethical considerations, including informed consent, are also addressed, concluding with a summary of the chapter's key points.

3.2 Research Strategy

The strategy of this research was based on twelve interviews with open-ended questions to collect data from knowledgeable professionals working in, but not limited to, the areas of climate Change, Sustainability, and/or Environmental management area, acting directly or indirectly with the energy-intensive sector and hard-to-abate industry in South Africa.

The interviews included representatives mostly of large companies, sectoral institutes or representatives of the relevant businesses in South Africa and the researcher community. Complementary theory was obtained through publicly available information: laws, scientific articles, integrated annual reports, and data collected by trusted institutions in the field.

The study determined the perceptions of the impact that carbon pricing mechanisms will have on the hard-to-abate industry, considering implications for business competitiveness, future challenges, and negative social impact on employees.

3.3 Research Methodology

Using interviews as a data-collection strategy in quantitative and qualitative research is possible. Some main types of interviews are structured, semi-structured, and unstructured. The researcher must conduct a loyal transcription, coding, and analysis of collected data (Bryman & Bell, 2014:215).

Quantitative and qualitative research approaches can be adopted. Researchers using qualitative research will emphasise words more when collecting and analysing data instead of focusing on numbers and measurements, as quantitative research requires (Bryman & Bell, 2014:30).

In this study, the researcher followed a mono-method qualitative approach to gain a deeper understanding of the matter, collecting and analysing data using the answers obtained from the participants. The intention was to focus on an inductive approach correlating the theory based on publicly available information, literature, and research. The approach was to understand participants' perceptions given a constantly changing and emerging social reality (Bryman & Bell, 2014:31).

3.4 Research paradigm

The adopted paradigm or philosophy underpins any study by determining the set of beliefs built upon by the researcher (Saunders et al., 2019:159). While developing research, scholars encounter a series of beliefs and assumptions, and how they are

considered will define the research philosophy of that specific research. Assumptions can mainly be ontological (based on reality), epistemological (based on human knowledge), and axiological (based on the extent and manner in which researchers' values influence the research) (Saunders et al., 2019:130).

According to Saunders (2019), there are five main philosophies in research related to business and management: positivism, critical realism, interpretivism, postmodernism, and pragmatism (Saunders et al., 2019:144).

Of all five main philosophies mentioned above, the researcher adopted interpretivism for this research, which emphasises the meaning created by individuals and the understanding that humans are different from physical (Saunders et al., 2019:148). In order to explore the different meanings from participants, qualitative data was collected through open-ended questions and interviews determining the perceptions on the impact caused by carbon pricing mechanisms on the hard-to-abate industry.

Furthermore, interpretivism provided different perspectives and obtained a deeper understanding of the reality that the hard-to-abate industry in South Africa may face. The correlation between legislation intents and the challenges faced by industry, together with internal and external dynamics around decarbonisation, may result in a different outcome from the one intended by policymakers.

In terms of the individual research philosophy, the researcher adopted subjectivism as an ontological position. Implementing subjectivism affirms that participants' assumptions, perceptions, and actions form part of the social reality (Saunders *et al.*, 2019:137).

Businesses in South Africa face multiple perceptions and realities regarding carbon pricing. This study focused on hard-to-abate industries that are expected to experience carbon pricing differently than other industries that do not depend on carbon as a reductant to manufacture their products and for which technologies are available and affordable to reduce their emissions.

3.5 Research instruments

Qualitative unstructured interviews can be conducted using different approaches depending on the nature of the research questions and the preferred design. Two main types of unstructured interviews are namely: unstructured (when the researcher uses limited questions and allows the interviewee to answer freely) or semi-structured (when the researcher is prepared with a wider number of questions and the interviewee has the freedom to respond) (Bryman & Bell, 2014:225). This study used a semi-structured design where a more comprehensive list of questions was prepared, and participants were allowed time to answer freely. This approach ensured the richness of the answers but, at the same time, kept a clear focus on the objective of the interview and the study.

In preparing the interview, the researcher created a list of open-ended questions in a logical order and easy to understand to ensure that the questions and objectives of the study were met while avoiding being too specific in the questions to allow the necessary freedom and creativity to the interviewee. The language applied was as simple as possible and aligned with the terms typically used in the subject of the study. Communication was clear and objective, and interviewees were also asked if they had any questions regarding the research, interview, or the process. Although the interviews were handled gently, a level of steering and criticism was required to deal with inconsistencies in answers given by interviewees. The researcher adhered to balance and ethical behaviour at all times.

Devices allowing digital recordings, such as smartphones or computers, via Microsoft Teams, were used to facilitate the transcript of the interviews, ensuring the quality of analysis. Interviews took place in quiet places to promote high levels of attention and concentration. The researcher took additional notes that enhanced the context of the study.

3.6 Data collection method and recruitment of participants

The researcher's first step was to draft a list of targeted participants who were members of the organisations/associations listed under section 1.6.2.1 of this study. Permission from a gatekeeper/entity/organisation for access to the participants was not required because the targeted participants were experts in climate change,

Greenhouse gas emissions, and carbon tax-related legislation influencing policy-makers.

The researcher contacted targeted participants directly by email and telephone. The email included an introduction of the researcher and the study, an invitation to participate in the interview, and a consent letter from NWU Business School.

The researcher ensured that the recipients understood that their participation was voluntary and that they were free to refuse to participate in the study without any negative consequences to the parties involved. Participants were also informed that even when accepting the invitation to participate, they were entirely free to withdraw from the study at any time.

Some targeted participants representing the hard-to-abate industries in South Africa were members of Business Unity South Africa (BUSA). The researcher also invited participants from other institutions, such as SAISI, EIUG, and CAIA, as indicated in section 1.6.2.1. Similarly, knowledgeable professionals from the Cement and/or concrete, mining, and electricity sectors and independent researchers with experience in the area were also invited to participate. Unfortunately, three persons did not respond to the invite, and five persons responded that they were unable to participate due to time constraints.

In terms of interview arrangements, a proper and convenient schedule was arranged between the researcher and the interviewee, which increased the probability of participation and did not cause inconveniences to the participants.

The researcher assured the participants that the Protection of Personal Information Act of 2013 (POPIA) of South Africa would be adhered to at all times. The researcher also ensured that participants understood what to expect before the interview, in terms of the context of the interview, the required time, and possible benefits from the outcome of the study to motivate voluntary participation.

The interviews were conducted by the researcher in person, and in cases where it was not possible to do so, online platforms were utilised. The communication and

connection between researcher and participant were established to incentivise honesty and willingness from the participant, ensuring a high-quality interview and research.

The qualitative data collection process involved recording and transcribing the interviews using smartphones, computers, and online resources.

The interviews were considered to focus on the following questions:

1. Would both the carbon tax and the carbon budget system apply to the company/sector you represent, and how would they apply?
2. In your opinion, will the company/sector you represent be ready for the lower-carbon transition before 2026 when the tax-free allowances for the carbon tax will significantly decline?
3. What will the financial implications be if the carbon budget system enforces a carbon tax rate of R640 per tCO₂eq, exceeding emissions over and above the already implemented carbon tax?
4. How could both carbon pricing mechanisms possibly affect the competitiveness of the company/sector that you are representing?
5. What are the potential challenges in terms of greener technologies experienced by the hard-to-abate industries?
6. How will both carbon pricing mechanisms affect the investment in decarbonisation technologies and the reduction of emissions (carbon tax liability vs investment in greener technologies)?
7. How could the South African government and financial institutions possibly support the hard-to-abate industries to access capital to finance the transition to low-carbon technologies?

8. What could be the potential negative social effect resulting from the transition to lower-carbon technologies? (Job opportunities/job losses/upskilling/community)
9. Will the transition towards lower-emission technologies result in higher costs to companies, and if so, how will these costs affect civil society?
10. How could the government, industry, and other stakeholders ensure that the transition towards low-carbon technologies is just and equitable for the hard-to-abate industry and its employees?
11. How could regulatory frameworks and policies assist the hard-to-abate sector in the transition to lower-carbon emissions?
12. What would be your recommendations to address the appropriate approach to align both carbon pricing mechanisms in South Africa?
13. Is there any additional information that you would like to share regarding the potential effect of both carbon pricing mechanisms in South Africa?

To ensure that the interviews would collect the necessary data for this research, a matrix was created to align the interview questionnaire with primary and secondary objectives.

Interview questions 1, 3, 4, 6, 8, and 9 were related to the primary objective of this study, to evaluate the effect of the suggested carbon budgeting system on the hard-to-abate industry in South Africa by assessing the potential financial implication, possibly impact on the competitiveness of the company, required investment in decarbonisation technologies, negative social effect and higher costs to companies. These questions also confirmed the answers to secondary objectives.

		Research Objectives					
		Primary Objective The primary objective of this research was to evaluate the effect of the suggested carbon budgeting system on the hard-to-abate industry in South Africa.	Secondary Objective 1 To investigate potential implications of both carbon pricing mechanisms on the business competitiveness of the hard-to-abate industry in	Secondary Objective 2 To investigate what are the challenges faced by the hard-to-abate industry in South Africa to reduce greenhouse gas emissions and minimize the imposed carbon pricing liability.	Secondary Objective 3 To investigate the effect of double carbon taxation (tax liability compared to investment in GHG mitigation technologies).	Secondary Objective 4 To investigate the negative social impacts on the employees of the hard-to-abate industry in South Africa resulting from the shift of technologies to reduce greenhouse gas emissions and carbon pricing liability.	Secondary Objective 5 To make recommendations on the appropriate actions to hard-to-abate industry to follow.
Interview questions	1. Would both the carbon tax and the carbon budget system apply to the company/sector that you are representing and how would they apply?	✓					
	2. In your opinion, will the company/sector that you are representing be ready for the lower-carbon transition before 2026 when the tax-free allowances for the carbon tax will significantly start to decline?		✓	✓			
	3. What will be the financial implications if the carbon budget system enforces a carbon tax rate of R640 per tCO ₂ e exceeding emissions over and above the already implemented carbon tax?	✓	✓		✓		
	4. How could both carbon pricing mechanisms possibly affect the competitiveness of the company/sector that you are representing?	✓	✓				
	5. What are the potential challenges in terms of greener technologies experienced by the hard-to-abate industries?			✓			
	6. How will both carbon pricing mechanisms affect the investment in decarbonisation technologies and the reduction of emissions (carbon tax liability vs investment in greener technologies)?	✓			✓		
	7. How could the South African government and financial institutions possibly support the hard-to-abate industries to access capital to finance the transition to low-carbon technologies?						✓
	8. What could be the potential negative social effect resulting from the transition to lower-carbon technologies? (job opportunities/job losses/upskilling/community)	✓				✓	
	9. Will the transition towards lower-emission technologies result in higher costs to companies, and if so, how will these costs affect civil society?	✓	✓			✓	
	10. How could the government, industry, and other stakeholders ensure that the transition towards low-carbon technologies is just and equitable for the hard-to-abate industry and its employees?					✓	✓
	11. How could regulatory frameworks and policies assist the hard-to-abate sector in the transition to lower-carbon emissions?						✓
	12. What would be your recommendations to address the appropriate approach to align both carbon pricing mechanisms in South Africa?						✓
	13. Is there any additional information that you would like to share regarding the potential effect of both carbon pricing mechanisms in South Africa?	✓					

Table 1 Matrix with interview questionnaire vs study objectives

Regarding the literature review, information collected for the proposed study relied mostly on the available legislation and regulations, literature, studies, articles and other climate change-related information in the public domain. The intention was to explore the Carbon Tax Act 15 of 2019 and the carbon budget system in South

Africa, considering the proposal for a penalty for exceeding emissions. The national GHG inventory report (2000 to 2020) also obtained vast information on GHG emissions in South Africa. Information related to carbon pricing mechanisms adopted worldwide also contributed to the study.

3.7 Interview strategy

To contribute to theory in qualitative research, it was crucial to study participants' perceptions and the relationship between those meanings by using data collection and analysis techniques. Unstructured interviews in the data collection process led to a natural and interactive process. The success of the research can be attributed to building a connection with the participant and gaining access to data by showing sensitivity (Saunders *et al.*, 2019:168).

Available sampling techniques can be identified in two types, namely probability and non-probability sampling (Saunders *et al.*, 2019:275). Probability sampling involves the selection of a sample within a wider population to answer the questions of the research (Saunders *et al.*, 2019:276). The non-probability sampling involves the participation of a non-random population, and the research question and objectives require a detailed and in-depth study focusing on a small number of cases or populations to construct a theory (Saunders *et al.*, 2019:297).

The researcher of this study followed a non-probability interview strategy to facilitate the effectiveness and objectivity of answering the very specific questions and objectives of the study. This ensured more quality data for the study, lower cost, and accessibility to relevant participants.

3.7.1 Demographics of the study population

This study counted on participants acting directly or indirectly within the hard-to-abate and energy-intensive industries in South Africa as the population. No other classification of participants was defined in this study, meaning that the participants providing the information had different job titles, levels, ages, gender, and other demographic aspects.

Demographic category	Variables	Frequency of Interviewee's Responses
Business establishment	Less than 5 years ago	1
	5-10 years ago	0
	10-20 years ago	1
	More than 20 years ago	9
	N/A	1
Legal form of the business	Sole proprietor	0
	Partnership	0
	Close corporation	0
	Private company	10
	Other	2
Business manufactured products	Aluminium	0
	Cement and/or Concrete	2
	Chemicals	0
	Iron and Steel	5
	Oil/gas	0
	Other	5
	If other, please specify:	Chemical and Energy. Chemical and Oil and gas. Mining: coal. Mining: Gold, PGMs and others products. N/A.
Size of the business	Micro	0
	Small	0
	Medium	0
	Large	10
	Other	2
	If other, please specify:	N/A. Medium to Large.
Number of full-time employees	Fewer than 500 employees	0
	Between 500 and 1000 employees	1
	More than 1000 employees	10
	N/A	1
Estimated annual turnover	Between R0 and R100 million	0
	Between R100 million and R500 million	0
	Between R500 million and R1 billion	0
	More than R1 billion	11
	N/A	1
Major objective for the business in the next three years	To reduce in size	0
	To stay the same	2
	To grow	8
	Other	2
	If other, please specify:	Stabilize and then grow. N/A.

Table 2 Demographics of the study population

3.7.1.1 Accessibility of study population

For this study, the targeted population were participants representing the hard-to-abate sector in South Africa. The main business associations, institutes, and representatives of the largest GHG emitters in South Africa were mostly based in Gauteng, which facilitated access to the participants interviewed.

3.7.1.2 Interview size

The most affected hard-to-abate industries in South Africa is a small group of industries that led to a relatively small number of interviews, but considering the short period of the study, accessibility, and cost constraints, a smaller population counted in favour of the completion of the research. Twelve interviews were completed with open-ended questions conducted for the study, considering the in-depth information obtained and the saturation achieved.

3.7.1.3 Relationship between researcher and participants

The researcher of this study is a professional acting in a company considered part of the hard-to-abate industry in South Africa, affected by the Carbon Tax and the carbon budget system. All participants, especially those acting on behalf of competitors of this company, were advised not to share any competitively sensitive information, including but not limited to company-specific strategic information, company-specific costs or pricing information, division of markets, or tendering, as it is prohibited and it would be a contravention of the Competition Act, No. 89 (1998). The interviewer and participants respected, agreed, and complied with the act.

Although some participants of the hard-to-abate industry could fall within the competition companies, the conflict of interest between the researcher and the participants was minimal to non-existent. The sector should raise commonly identified challenges that will potentially impact the industry in South Africa not as competitors but as a united voice for the business's survival.

Other participants were totally out of any area of conflict of interest.

3.7.1.4 Credibility and Validity

Participants in the interviews were selected from reliable organisations representing the hard-to-abate industry in debates with the government and other forums, and the same confidence was applied to the legislation that will be assessed. However, in case of amendments made to the Carbon Tax Act 15 of 2019 and to the Climate Change Act 22 of 2024 (the Presidency has signed the latter and is still pending proclamation for the date of its commencement), the researcher kept abreast of such changes and updated the study accordingly. Variations in allowances as part of the carbon tax, carbon pricing, public policies, climate financing, related funding, and international policies may also influence the South African industry.

Numerous textbooks advise collecting qualitative data until data saturation is reached (Saunders et al., 2019:297) to ensure validity. This study followed this approach.

3.8 Statistical/data analysis

The researcher used the qualitative data obtained from the interviews. Data was obtained and reviewed through the recordings, and notes were made accordingly. Collected data was coded into relevant categories, correlating the data to theory. Additionally, a software called ATLAS.ti. was used for data analysis. This software assisted by addressing the entire analytical process to answer the questions and objectives of the present study.

The interpretivism method was associated with an inductive research approach. Therefore, as part of the data analysis, the researcher had to assess the outcome of the interviews and identify codes and themes. By using Atlas.ti., it was possible to create a practical and visual data interpretation, ensuring the research objectives had been met.

3.9 Results of the Qualitative Analysis

Most interviewees represented companies subject to both carbon tax and carbon budget systems. The carbon tax is applied to their direct emissions, and the DFFE allocates a carbon budget.

The impact varies for each company, depending on the nature of the business, the original choice of technology and the ratio between direct and indirect emissions, as the latter is not subject to a carbon tax. Therefore, while some companies face minimal financial impact in the initial phase of the carbon tax and carbon budget system, others are already experiencing significant carbon tax liability. All representatives indicated that the companies are preparing for lower carbon transitions. However, they will not be ready for the reduction of tax-free allowances.

3.9.1 Concepts

An ATLAS.ti Concepts Cloud was generated for the combination of all interviews as below.

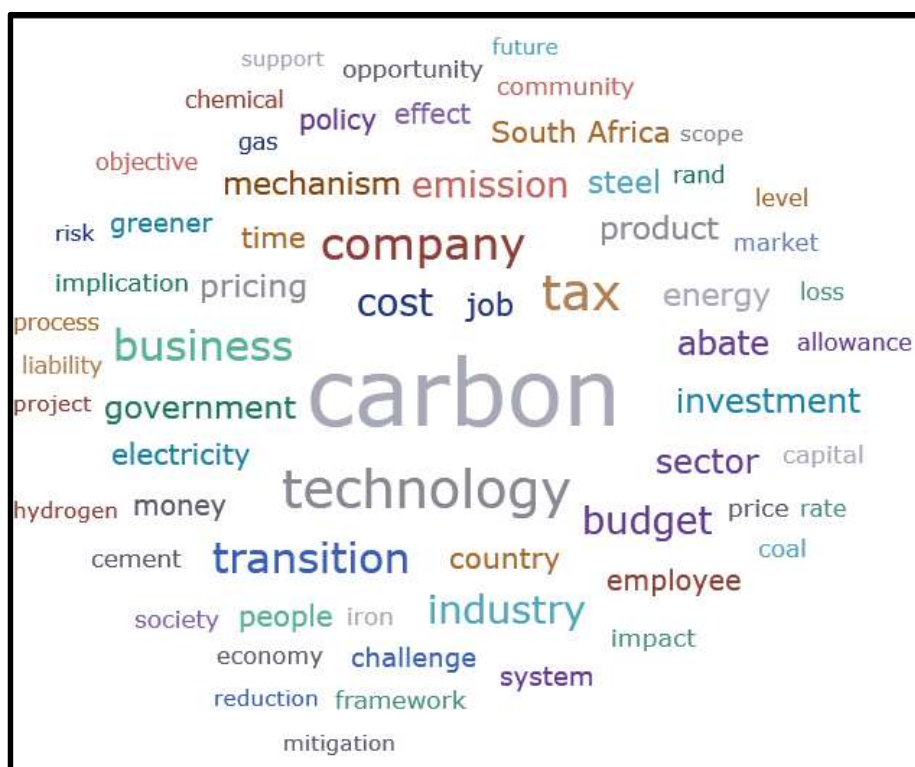


Figure 2 Concepts Cloud

The themes and subthemes presented under section 3.9.2 will further discuss these concepts.

3.9.2 Thematic Analysis

To facilitate the assessment and interpretation of the data, ATLAS.ti was used to analyse the outcome of all twelve interviews. Many codes associated with a specific

theme were merged to ensure appropriate analysis and discussions on key subthemes.

The assessment result will be presented in 5 themes with 13 subthemes.

- Theme 1: Technological
 - o Uncertainties, challenges and constraint
 - o Innovation & transition
- Theme 2: Economic Impacts
 - o Economic concern
 - o Policies and Framework
 - o Economic viability
- Theme 3: Industry and Socio-economic impacts
 - o Socio-economic and effects
 - o Industry and trade implications
- Theme 4: Policy and Regulations
 - o Policy integration
 - o Policy making and implementation
 - o Policy and Regulation analysis
- Theme 5: Transition
 - o Economic Transition
 - o Industry and cost transition
 - o Transition planning and support

Codings were associated with quotes, indicating the perspectives and opinions of the interviewees in relation to the literature review compiled for this study, also from ATLAS.ti a network was created per theme. Many of the themes were interrelated; however they were discussed individually in the study.

3.9.2.1 Theme 1: Technological

This theme is comprised of two main codes:

- Uncertainties, challenges and constraint
- Innovation & transition

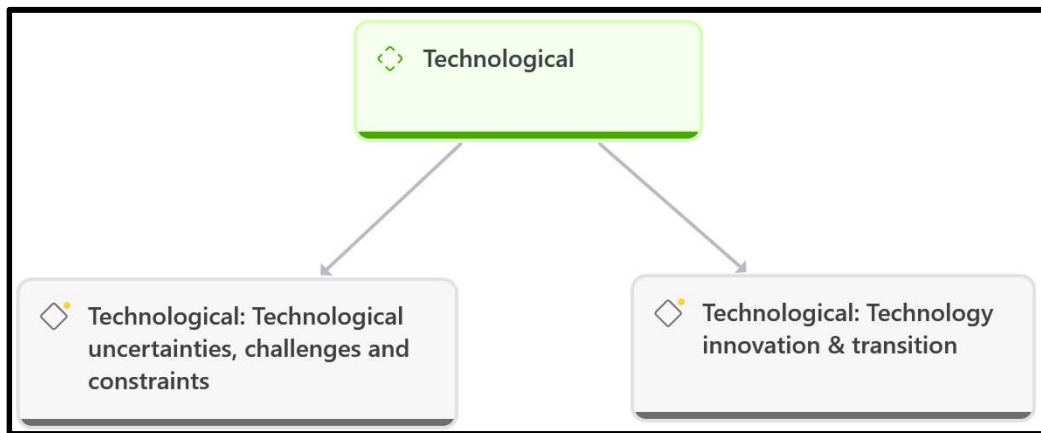


Figure 3 ATLAS.ti Category Code Network: Technological

3.9.2.1.1 Technological uncertainties, challenges and constraint

The challenges also are, for example, the technologies are new, and the technologies are normal technology adoption in developing countries. It takes years, and then now we are required to adopt them in a very shorter time frame. So that is the challenge by itself for developing countries because we don't have the finances to make sure that we scale them up that quickly.

The potential challenges faced by hard-to-abate industries in adopting newer and better technologies include high capital investments, a lack of proven and industrialised technologies, and the limited availability and high cost of green energy sources.

First of all, it has not been proven yet. Some of the technologies are still in the development phase. If you, for example, look at green hydrogen, the biggest green hydrogen plant being constructed today is not even enough for only one of our business units as a hydrogen facility that would need. So the scale is just enormous, even for the carbon capture.

There are challenges in obtaining green electricity through power purchase agreements, the need for a massive scale of implementation of new technologies like green hydrogen and carbon capture, constraints in transitioning from fossil fuels to low-carbon energy due to feedstock availability and supply chain issues, and limited

time and resources for testing and implementing new technologies while balancing economic viability and sustainability.

Until the government sees the hard-to-abate private sectors as affected by this, nothing will be done because currently, wherever you go, it is more like the private sector to donate money to ensure this happens. We are expected to give the money we don't have as hard-to-abate because our industry requires a lot. I mean, just the name of hard-to-abate means it is hard in terms of technology, resources, and raw material; whatever it is, it is going to be harder. But our government is looking at the private sector; everybody is looking at the private sector's need to contribute money towards the transition, but we are saying we don't have the money towards the transition; can the government also look into our hard-to-abate and say how we can help? How can we incentivise you so that you transition more quickly? So until the government sees us not as donors but also as acceptors of cash, then, unfortunately, we will always crumble throughout this process.

These challenges are further exacerbated by the slow technology adoption rates in developing countries and the lack of government support through collaboration and finance.

I know that doesn't directly affect our carbon tax locally, but it does affect overall emissions reporting at the international level. So, in sourcing green electricity, the local market in South Africa still has to mature a lot of the availability, and the process of obtaining a PPA (Power Purchase Agreement) supply is still a challenge at this point. So, two challenges that technology constrains are the availability of green energy.

The challenges faced by hard-to-abate industries in adopting greener technologies include high cost structures, a lack of proven financial feasibility, the need to develop efficiencies and technologies, and the substantial investments required.

3.9.2.1.2 Technology innovation & transition

What you're actually sitting with is that you'll have a far bigger carbon tax liability, eroding the money available for us to invest in technology development or even the cost reduction of technologies. And so what you sit with is then an inability to actually transition because that capital is now being paid over into the fiscus as opposed to rather being utilised to find opportunities to transition or potentially even invest in new businesses to be able to sustain the economy. And this is a bit of a challenge because it becomes a vicious cycle where business is shut down, de-industrialization, loss of jobs. So, it has huge implications. It's not just about the technology itself. You're just taking away the money needed to transition because that goes into the carbon tax.

Being the first to invest in these technologies can lock companies into high cost structures, making them less competitive when others invest later. Industries may not have the margins to be early investors for the greater good of humanity, so government support through funding, subsidies and incentives is crucial for driving technology development.

Yeah, so, like I said, we will not be in the market; we will not be able to be a player. it is just not attainable. So the cost will throw us out completely because your product is more expensive than the others. And also considering companies that are so many years old, the technology is not that new. So we have all less efficient technology. If you put up a new plant today and they compared to what some of the plants have your energy use obviously will be much lower and the newer one than the old one. So it is just gonna throw you out of the market completely.

Companies often lack the financial resources to accelerate the decarbonisation process, which may result in a slower transition to greener practices. While renewable technologies are easier to implement and provide quick wins, they may only impact a small percentage of the industry's CO₂ emissions profile. The more

significant portion requires costly, greener technologies, which can be challenging to implement given the competitive market environment. The transition to green energy solutions will take time and may not be achieved by 2026.

I think it's to implement supportive policies and legislation, supportive and also very not tedious requirements that will make companies demotivated to uptake. I think it should be collaborative, it should be facilitated, it should be a kind of an easier-to-adopt process than what we have currently.

The transition to lower carbon emissions in hard-to-abate sectors can be facilitated through supportive, collaborative, and easy-to-adopt policies and regulations. Training and reskilling programs are crucial for employees, and policies should ensure a fair carbon allocation and budget. Governments should ring-fence carbon tax funds for industry transition, provide enabling policies, and ensure a just transition for employees. Collaboration between government, industry, and stakeholders is essential to ensure equitable access and participation in the transition to low-carbon technologies.

3.9.2.2 Theme 2:Economic impacts

This theme is comprised of three main codes:

- Economic concern
- Policies and Framework
- Economic viability

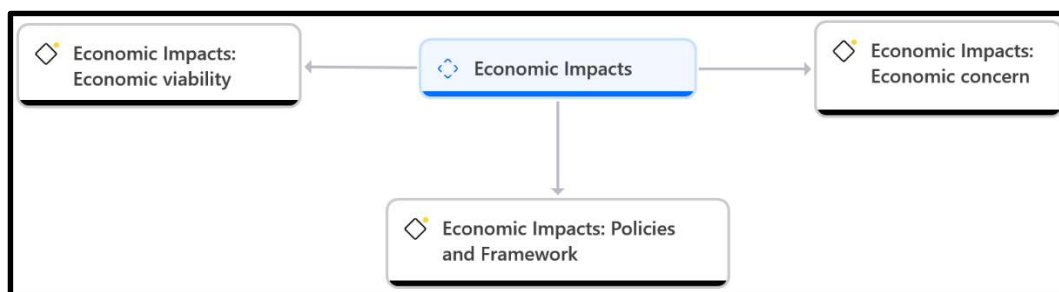


Figure 4 ATLAS.ti Category Code Network: Economic impacts.

3.9.2.2.1 Economic concern

The government can pick and choose, but companies on their own with their own balance sheets are not going to be able to afford this.

Many interviewees expressed that carbon pricing mechanisms could negatively affect a company's competitiveness by impeding its ability to adopt new technologies at the required pace, limiting its ability to compete with peers in developed countries with more resources to scale up new technologies quickly.

This extra expense can eat into margins needed for investments in technology, plants, and efficiencies, potentially leading to job losses, a slow decline in the company's performance, and the country's de-industrialisation.

3.9.2.2.2 Policies and Framework

I think today, South Africa doesn't have any protection on carbon pricing, meaning that products that come over the fence let's say they come via Africa Overland or are imported through the harbours, whereas we, as producers, need to pay a carbon tax. So that is already in effect on our product because our price includes carbon pricing, which the others do not necessarily have. If the allowances fall away, the financial effect of a burden on our product would be significant if the playing field worldwide is not equal. We are always depending on our local competitiveness about imports.

Regulatory frameworks and policies can assist the hard-to-abate sector in transitioning to lower carbon emissions by providing incentives for a quicker transition. Policymakers should provide supportive frameworks alongside carbon pricing to lessen the financial burden on industries.

I think policies and frameworks, first of all, need to be supportive going forward. It's one thing to say, for instance, the polluter pays principle applies, but from a financial impact, what does that mean? And for some industries it

may be quite a significant financial burden, for others, maybe a lesser burden. And so I think from a policy and framework perspective, it's very important that government considers supportive frameworks as well. Implementing carbon pricing is one thing, but what support is being offered? And I think in the US example is very important where there is support being offered and it's less of a punitive measure, less punitive measures are implemented and support is being offered from the onset obviously if you plan to implement decarbonisation projects going forward.

The greener technology that we are talking about requires some stronger links and engagements with government, because we will use things like certain waste streams, biomass, and the sustainability of supply of that is fundamental to make those projects viable. So yes, it will help for sure in terms of offsetting the carbon tax, but there is still a bigger risk on the supply side of the technology, specifically for our industry.

Regulators must understand the context of developing countries and support the private sector in transitioning towards lower carbon emissions.

Regulatory frameworks should consider socio-economic implications and realistic mitigation plans for hard-to-abate sectors. Reinvestment of carbon tax, streamlined permit processes, financial incentives, and supportive policies for transitioning industries are crucial.

3.9.2.2.3 Economic viability

When it comes to the technologies of renewable or whatever energy, to really transition from the fossil fuel to low carbon energy, it's like we are looking at a lot of technologies, especially maybe for our operations and our processes, whereby you might need a different feedstock and you find that that feedstock is not available or is very far to source it to do all the supply chain, it is going to be expensive and sometimes economically not viable. So those things need to be tested first so that you can be able to make a choice that will enable us to not have as much impact on the job level, but also be a company that can

produce or make profits and also still add on the GDP. So some of these challenges with the technologies is that they are very new to us and to test them at the very short period of time is going to take time and it's going to take the know-how and sometimes even the capabilities within our countries are not there and then we have to source them out.

The challenges faced by hard-to-abate industries in adopting cleaner technologies include the need to quickly adopt new technologies, which can be difficult for developing countries due to financial constraints. Some challenges include sourcing new feedstock, high costs, and lack of local capabilities. The pressure to comply with regulations and market demands adds to the challenge of adopting new technologies faster than what may be feasible.

It's very important to allow the private sector to construct transmission lines, making sure that there is no unnecessary cost on transmitting electricity, that's absolutely key. So making it easier to get permits and licenses and making it easier to construct sites, whether they're renewable electricity or other sites. And then, as I mentioned, of course, other incentives to make the cost of generating electricity or to make the cost of producing a green product cheaper will absolutely help.

The transition to lower carbon emissions in hard-to-abate sectors can be facilitated through supportive, collaborative, and easy-to-adopt policies and regulations. Policies should ensure a fair carbon allocation and budget. Governments should ring-fence carbon tax funds for industry to ensure a just transition.

Carbon taxpayers have been relying on a percentage of tax-free allowances. These allowances may not start to decline from 2026 to preserve the South African economy, and the increase in the carbon tax rate will significantly erode the annual revenues of companies, threatening their business sustainability.

3.9.2.3 Theme 3: Industry and Socio-economic impacts

This theme is comprised of two main codes:

- Socio-economic and effects
- Industry and trade implications

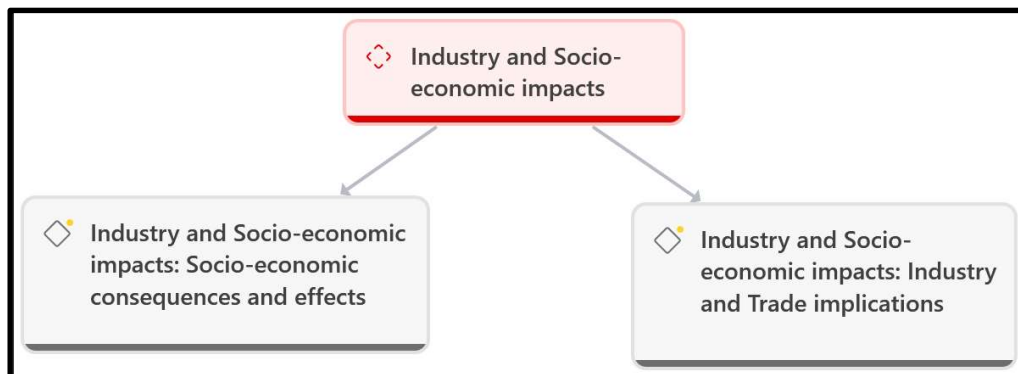


Figure 5 ATLAS.ti Category Code Network: Industry and Socio-economic impacts

3.9.2.3.1 Socio-economic and effects

*I don't think that the socio-economic environment would be negatively affected
I think the socio-economic environment could be positively affected because
new jobs will develop under the decarbonization policies which will maybe
replace some of the older type of jobs.*

*Because you can have job losses, but you can also have an absorption of
those jobs into other sectors that will require that.*

*In our direct organisation, I don't really see negative social effects, but looking
a little bit wider at communities in the heartland of coal mining and coal-fired
power generation, I think there we definitely are looking at potential for job
losses. A need for upskilling or reskilling but if the timing of that is not on time,
in time to have people ready for the transition, definitely I see a risk of job loss,
specifically in our wider community.*

*I would say it would impact where we source our primary fuels from, in this
case coal. Obviously, it will reduce demand and then impact job within that
value chain.*

Some participants have a neutral or positive view on socio-economic effects in terms of job opportunities within the low-carbon transition. However, reskilling and upskilling will be crucial to minimise the impact on job losses, especially if the hard-to-abate sector is not ready to decarbonise at the pace regulators expect. Although not all organisations might experience a negative effect, it will certainly affect jobs and communities in the coal value chain. Such associated job losses will increase the cost burden on the South African state and potentially increase poverty.

Job losses are envisaged because we'll just not be able to keep up.

All I can say is don't do it. Please don't do it. I realise the government is looking at this as another source of revenue and it's interesting because they've got quite a long list of socio-economic endeavors that they want to fund. It's got a real risk of putting companies out of business, putting people on the street, making them more dependent on the state for care, because there's just no jobs. I don't know if that is the right society that we want to be in. Dependent on the state. I don't think that is a sustainable society. I don't think so.

We may find in extreme cases closures of business with knock-on effects to job creation, etc., etc. And also, I think supporting local communities may be challenged just in terms of shortage of funds. So I think there are socio-economic consequences.

The honest truth is it's very hard to replace all the coal-related jobs with jobs within a post-carbon society or in a low-carbon economy. To be quite frankly, I think it's close to impossible to convert all those jobs into other jobs that form part of a low carbon economy.

But if that tax rate is going to be that high to operate at this level, it might mean like our business has to downgrade and downgrading means job cutting, job cutting means making like the lives or the country as itself be worse where it is currently today. You can leave the country worse where it is today. That's what it means for us.

This transition may lead to negative social effects such as job losses in industries reliant on carbon-intensive technologies, challenges in upskilling workers for new roles in a low-carbon economy, and potential economic impacts on communities dependent on industries like coal mining.

Transitioning to greener technologies could also impact job opportunities in sectors related to primary fuel production. South Africa is already facing challenges in adapting to new energy technologies due to a lack of technical capabilities and reliance on external service providers.

I think the just transition and the loss of jobs. To be quite honest, my personal opinion is that not enough is being done.

The transition to lower carbon technologies may lead to a shift in job opportunities, requiring upskilling for new roles. However, some industries are likely to adapt rather than experience significant job losses. Workers may need training to operate new technologies, creating different job opportunities in the future.

This whole thing has got the real risk that companies are going to go out of business. That is our social effect. And no matter of upskilling is going to save people from this. These companies closed down because of all of this. The economic social hardships that we are creating is going to be far greater than any upliftment will ever solve. Really. It's important that the businesses remain viable and find a way to transition so that jobs are available during this transition. People have work. Upscaling is not going to solve the problem. It's not that people don't have skills. It's not that you need different skills because you're now a green industry. If you want to upskill people, upskill them anyway. Don't do it because you are now going to go green.

Although the Climate Change Act is highlighted as the legal framework for addressing mitigation and adaptation, considering the complexity of the transition process, demonstrating the importance of learning and collaboration in navigating these changes. Co-creation between government, industry and society are essential

for a successful transition. It will be critical to define the balance in transitioning to more sustainable practices while considering socio-economic impacts.

3.9.2.3.2 Industry and trade implications

Well, the implications can be quite severe because somebody will have to pay for that. So industry will be levy the tax and obviously in some way it will be passed on to the end consumer. So it will actually influence your competitiveness in the end of the day.

Where we may not or where we will definitively feel the shock is if the electricity supplier passes on its carbon costs to us as well. And it all depends on, first of all, how will ESKOM manage down its grid emission factor and will it pass on its carbon costs. But I think that's the most important aspect is that pass on effect, that is our biggest fear.

The shift towards lower emission technologies may increase consumer prices due to companies passing on carbon costs. In the present carbon tax framework, Eskom's carbon tax liability amounts to zero because it is offset by the deductions from the electricity levy and the renewable energy premium (NT, 2024). The government incentivised this to avoid higher electricity costs passed onto industries and society. However, there is no clarity on when Eskom will start paying the carbon tax and passing the cost to customers, leading to an additional cost burden for all electricity users. The need for sustainable investments and assessing impacts on affordability is vital, therefore finding the balance to ensure the viability of the business.

I think the more we try and want to copy European Union standards on the one side, the more we need to be open to also copy those similar standards on the industry side. And again, I'm going to use an example of waste where within the European context, players get paid a disposal fee. But within the South African context, you have to negotiate, and in most cases, there is no disposal fee for the use of this waste. And that is a key barrier, a key challenge that needs to be overcome. And it can only be overcome with the

help of government. Industry alone cannot fix that. Yeah, I think that would be the main one that I would say that would impact our sector.

In some countries, incentives and policies are in place to help mitigate these increased consumer costs. However, affordability becomes a significant concern in places like South Africa, where such support may be limited. The government should identify sectors affected by the transition, assess upskilling needs and job losses, and support the sector to minimise impact during this period.

These are sectors that are hard-to-abate that are quite big contributors to the South African economy. These are sectors that contribute significantly to employment in the country and particularly in a country right now where economic growth has been stagnating for quite a while and poverty is at an all-time high, you want to be able to sustain and maintain the sectors that are still contributing positively to the economy. So the moment you start implementing these very high taxes, the business has no flexibility and what they will end up doing is look for the measures to help save costs. And if you can't avoid the carbon tax, what you're actually sitting with then is to cut costs elsewhere. And that is where job loss then becomes, you know, a very real reality. Downsizing, rightsizing businesses, cutting back on production, which impacts the economy from a GDP perspective. You'll also see like hard-to-abate sectors, product supply, there'll be product shortages, there might be impact on the balance of payments for the country, because a lot of this would need to be imported, all the products that are produced in country will need to be then brought in externally. These impact trade balances in the country, so there's huge implications and all of this has a dire impact on the economy.

The cost will be higher. Absolutely. In the next 10 to 15 years, the price will still be higher if we are to transition. If you look at, it really depends on the application. So vehicles, anything between 3% to 5% more expensive. If you look at the fact that the price of steel will be between 20% and 25% more expensive. If you look at housing, informal housing specifically, there's a much more dramatic impact there. Pipes and tubes for appliances and products. It would have to be taken on a case-by-case basis exactly what the impact

would be. I think from a construction perspective, it would be a cost. Your house would be more expensive. Your appliances will be more expensive. Your water piping will be more expensive. Your roofing will be more expensive.

Prices potentially increase the cost of vehicles, steel, informal housing, and materials like pipes and tubes, which will impact the overall cost of housing, appliances, and other products. It's expected that there may be impacts on people's affordability of goods.

Transitioning to lower-carbon technologies could lead to financial hardships for businesses. This transition period over the next years may be economically tough, with risks of companies shutting down due to the high costs of compliance with new technologies. Businesses must find ways to remain viable during this transition to ensure job opportunities for people.

3.9.2.4 Theme 4: Policy and Regulations

This theme is comprised of three main codes:

- Policy integration
- Policy making and implementation
- Policy and Regulation analysis

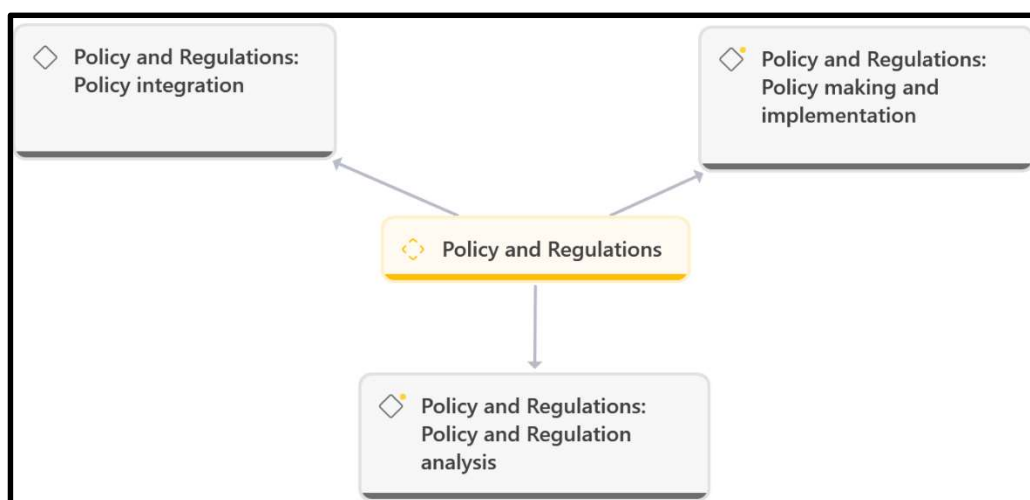


Figure 6 ATLAS.ti Category Code Network: Policy and Regulations.

3.9.2.4.1 Policy integration

To me, it appears unnecessarily complex to have this double pricing system.

Dual pricing mechanism or duplicate pricing mechanism just does not make sense. The question also could be asked, you've got two state departments trying to implement carbon pricing should there be a level of integration and I think we have to acknowledge that the one carbon pricing mechanism being the tax has now won the race and carbon budgets should not be considered going forward. You cannot have two pricing mechanisms in place.

One could completely avoid the carbon tax if you do the right things and your budget is set in the correct, fair, transparent way. But we are going to sit with a carbon tax that's standalone of all your emissions, and I think the way to maintain that so that it's not going to be penalizing is to make sure that all the allowances are in play to at least 2040 and beyond.

The carbon tax and carbon budget system would apply to the hard-to-abate sector represented by most interviewees. If the company exceeds its carbon budget allocation, an additional tax will be imposed on top of the already active carbon tax. The relationship between carbon tax and carbon budget must be clear to ensure business viability sustainably; the application of double taxation will negatively impact business competitiveness in South Africa.

Okay, first of all, with the two instruments that we have with the budgets and we have the tax, those two are not linked currently.

We are very poor and then we can't exacerbate that because of our egos. We need to talk and be vulnerable and open about it and help each other. We need something to really fall flat before we can say, how can we help? But it's within us and the leadership of this country and our organization to say, how can we help? They did it with load shedding. It's more than like 100 days

without load-shedding. They did it. They can do this. But we need the leaders that can actually drive that with the servant leaders saying how can I help?

Then I would make sure that the targets and the budgets for each sector also matches the complexity of the specific sector. Because at the end of the day it must be just, meaning that our own industry, local industry should not disappear because of carbon taxation. It should happen in a way that still protects our own industry, but allows them to flourish in the new economy.

The alignment and integration of both carbon tax and carbon budget instruments by the National Treasury and the DFFE must be further developed to not imply a double penalty as it currently does. Although both governmental departments, the NT and the DFFE, constantly indicate that they are working together on the alignment of both instruments and engaging with the industry, participants perceive that the industry's needs have not been heard. Participants indicated that there should be simply one carbon pricing and not two. Most participants indicated the need for the government to improve engagements with the industry more collaboratively and transparently, focusing on the needs of the industry and taking an approach of servant leadership to assist the industry in the transition. It also emphasised the importance of creating more awareness, partnerships, capacity building and ensuring that municipalities and communities are also moving swiftly.

3.9.2.4.2 Policy making and implementation

Currently the taxes that are being paid are not being ring-fenced. So from that perspective, one of the biggest concerns is that the carbon pricing and the carbon taxes that are being levied, that they are not necessarily being plough back into decarbonisation initiatives.

There is not enough money to go around to pay taxes and invest in these technologies. There is not enough. In fact, there is not enough to do any one of them properly.

Carbon taxes, it needs to be ring-fenced and it needs to come back to industry to expedite and to help industry to decarbonise. I think that is what government needs to do. So they are basically generating the funds, via the taxes and those taxes need to be ring-fenced to industry to invest and to help funding the transition to the green economy.

This is probably where carbon pricing becomes debatable, because where does the money end? I think some jurisdictions have got a fairly well-defined carbon pricing or carbon tax collection system in place where some of those funds can be re-ploughed into decarbonisation developments like in the EU for instance. In the US, for instance, they're moving in a totally different direction away from carbon pricing. And if you look at the Inflation Reduction Act, that is more a support mechanism to support industries from the onset with decarbonisation efforts.

Suppose the collected carbon tax funds are not reinvested in decarbonisation projects. In that case, the effort to transform into a green economy will be weakened and will potentially create several negative effects on the South African economy. In the long term, potential trade barriers will be implemented, and it will reduce the industry's global competitiveness; therefore, to achieve the reduction in carbon emissions as part of the Paris Agreement, the allocation of funds on decarbonisation projects will be required to meet its climate targets.

Carbon tax already applies and carbon budget, we have been participating in the voluntary phase of the carbon budget and we will be included in the mandatory phase.

The hard-to-abate sector is committed to reducing carbon emissions; however, enablers must be available to allow the change. To make the transition to a low-carbon economy, investment is necessary to research and develop greener technologies at an affordable cost; financial solutions, funding and subsidies must be provided, as well as abundant, affordable, and reliable renewable energy, which is also key to making the transition possible and sustainable.

3.9.2.4.3 Policy and Regulation analysis

I think we need to have the right policies and the right frameworks set up that is in pace with the transition goals of hard-to-abate segment. So there is a clear path to follow and there's development work that needs to be done. And those transition and policy frameworks and regulatory frameworks needs to support that. That we go with the same pace.

The products originated by the hard-to-abate sector are key to the country's development and the implementation of lower-carbon technologies and solutions. Hence, protecting the local industry is crucial to remaining sustainable and resilient. It is of utmost importance to develop supporting policies and regulations rather than punitive and demanding ones.

As initially stated in the background of this study, it is critical to ensure that climate change-related policies will be cost-effective by minimising additional costs to society while reducing GHG emissions. It must be ensured that consumers and producers will internalise environmental and social costs as per the polluter pays principle, and competitiveness issues and equitable treatment must be considered (The World Bank, 2017).

Policies and Framework are further discussed under the theme Economic impact
3.9.2.3.2

3.9.2.5 Theme 5: Transition

This theme is comprised of three main codes:

- Economic Transition
- Industry and cost transition
- Transition planning and support

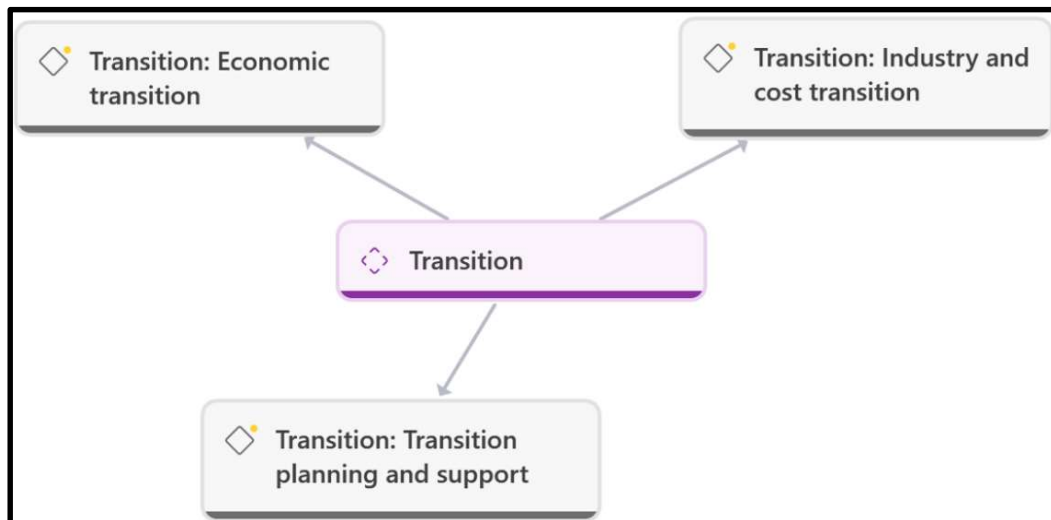


Figure 7 ATLAS.ti Category Code Network: Transition.

3.9.2.5.1 Economic Transition

And they need to be all around support from government in terms of the carbon tax, dispensations, allowances being maintained for as long as possible. All of these things need to be a suite of measures that just help in transitioning the economy, but at the same time protecting the sectors that need protection until a certain point in time.

The transition to lower carbon emissions should be protected and supported through incentives and policies that facilitate the transition for hard-to-abate industries. Protecting the local market from cheap imports will motivate local industries to invest in low-carbon technologies.

The government must protect the local economy by keeping allowances during the transition phase. Currently, the focus is on the private sector providing finance for the transition, but hard-to-abate industries will require a lot of resources and capital, bringing additional challenges to the availability of funds to finance these changes. The government needs to see these industries as needing support and incentivise their transition rather than just expecting them to contribute financially.

Well, I think if one talks about the carbon taxes, it needs to be ring-fenced and it needs to come back to industry to expedite and to help industry to decarbonise. I think that is what government needs to do. So they are basically generating the funds, via the taxes and those taxes need to be ring-fenced to industry to invest and to help funding the transition to the green economy.

Carbon budgets should be allocated to accommodate the transition, and incentives should be put in place, such as reinvesting carbon tax revenue into industry's decarbonisation. Incentives can help lower lending costs and encourage re-industrialization into low-carbon sectors, creating opportunities for transitioning businesses into new models like green hydrogen production or renewable energy. The government can use carbon tax collections or other financial means to support decarbonisation projects and offer green funding in the form of grants at the country level to facilitate the transition to low-carbon technologies.

3.9.2.5.2 Industry and cost transition

A lot of studies that need to be done on the various processes will be, let's say, feasibility studies. And a lot of them, or a large percentage of the technologies that you investigate will not necessarily be feasible. So there's a cost to all of these industries to transition, so there's a need for this developmental funding, which is key.

The South African government and financial institutions need to support the hard-to-abate industries in implementing the proposed decarbonisation roadmaps by providing access to capital for transition to low-carbon technologies. In addition, local governments can support hard-to-abate industries by providing subsidies, grants, low-cost debt, and financial instruments like investments and loans during all phases of the transition requirements.

It doesn't help the frameworks and the policy accelerate too fast and the industry cannot keep up. And the policies and the frameworks also need to

take into consideration about the investments that need to be done, the difficulty that it will need to transition.

Most of the interviewees indicated that companies/sectors they represented will not be ready for the lower carbon transition before 2026 due to the technology being expensive and not fully developed and available for implementation, the lack of capital for fast-tracking the transition, and the identification of unready opportunities by that time.

These companies, as part of the hard-to-abate sector, are committed to this transition, but it was indicated during the interviews that they will not be ready by 2026 due to the new technologies not being fully implemented. Therefore, the decline in tax-free allowances for a carbon tax will negatively impact their operations and, consequently, their ability to reduce emissions.

3.9.2.5.3 Transition planning and support

I think what governments firstly need to do is to make sure that the hard-to-abate industry in South Africa is a sustainable industry. When new policy and new legislation come on board, make sure it remains sustainable for the companies. Otherwise, there's not a just transition mindset towards the company itself. So I think that's very important. And then also towards the people. I mean, if it's all about carbon and shutting down the facilities, it's not fair for the company, it's not fair for the employees.

It is essential to find a balance between the costs of implementing low-carbon technologies and the long-term benefits linked to the sustainability of the industries. Investments should focus on ensuring feasible outcomes that are viable in the long run. The transition to lower emission technologies is projected to be more expensive for companies, which could lead to higher costs for society; therefore, this could impact employment and make basic necessities more expensive to households.

3.10 Ethical Considerations

3.10.1 Ethical Issues

Ethical principles were followed, and the researcher was guided while conducting the study. These principles include integrity and objectivity from the researcher, avoidance of any harm to the interviewee, demonstrating respect for the participants, protecting their privacy, respecting their willingness to participate in the research and to withdraw if desired. As the main objective was to explore qualitative data collected via interviews and pieces of legislation that were publicly available, the researcher ensured the naturalness of the data.

When hard-to-abate representatives were interviewed, considerations were made at the best of the researcher's capacity to avoid harm to participants (not to invade their privacy, provided an informed consent was signed, and remained ethical and honest throughout the process).

Identifications were preserved to keep the confidentiality of participants, organisations, and institutions. Data management was conducted under the principles of the Protection of Personal Information Act of 2013 (POPIA) of South Africa at all times. However, the researcher reserved her right to use information that is already in the public domain.

The informed consent letter clearly specified any possible ethical issues implied by this study. The present research proposal was subjected to the ethical clearance process of the Faculty of Economic and Management Sciences Ethics Committee.

3.10.2 Informed Consent

Informed consent was obtained from all participants before the interviews being conducted. The intention was to inform the participants about the study's objectives, making them feel comfortable participating or denying participation according to their will without any pressure.

Content obtained through the interviews was responsibly used and protected until data destruction occurred.

3.11 Conclusion

Only a few participants indicated that companies will be partially ready before 2026, but most indicated that the hard-to-abate sector will not be ready for the lower carbon transition before 2026 due to technology limitations, high costs of transitioning, and reliance on energy-intensive processes. The shift to renewable energy sources like wind and solar is deemed insufficient and expensive for the industries requiring high energy intensity. The transition to lower carbon emissions in hard-to-abate sectors can be facilitated through supportive, collaborative, and easy-to-adopt policies and regulations in order to promote a low carbon environment with economic growth in the country.

Additionally, job losses and decreased competitiveness in industries are anticipated if carbon taxes increase significantly. The carbon tax rate of R640 per ton of CO₂ equivalent will have significant financial implications on companies, potentially leading to hindered technology adoption, operational shutdowns, job cuts, economic impact, and loss of competitiveness. The additional tax burden could result in increased costs, reduced investments, and difficulties in staying compliant with carbon emission limits.

The challenges faced by hard-to-abate industries in adopting greener technologies include issues with legislation requirements for alternative fuels and resources, difficulties in obtaining alternative materials, including waste, and the potential impact of carbon pricing mechanisms on competitiveness. Additionally, exporting decarbonised products to jurisdictions without carbon taxation may put companies at a disadvantage. Carbon taxes could lead to increased costs, reduced competitiveness, slower adoption of new technologies, and potentially, the company's inability to operate.

Companies may struggle to pass on carbon costs to customers, face competition from cheaper imports from countries without carbon taxes, and see negative impacts on profitability and share prices. South Africa's lack of global carbon pricing parity could affect local competitiveness and increase the financial burden on products.

Regulatory frameworks and policies should include clear criteria for treating these sectors, incentives for low-carbon sectors, government agency involvement, and support such as carbon taxes, dispensations, and allowances.

3.12 Chapter Summary

This chapter provides a comprehensive overview of the empirical study, its structure and results obtained from the interviews. The research explored the predominant challenges, effects and implications of both carbon tax and the suggested carbon budget system as a pricing mechanism for the hard-to-abate industry in South Africa. The study's primary outcomes are reflected in five themes: technological, economic impacts, industry and socio-economic impacts, policy and regulations, and transition. Thirteen subthemes were also identified and discussed accordingly in this chapter.

The research explored the technological challenges of the hard-to-abate industries in adopting newer and lower-carbon technologies, which will require substantial investments. Challenges include a lack of proven technologies, the need for a large scale of implementation, limited feedstock availability of alternative materials and related supply chain issues, new technologies such as green hydrogen and carbon capture technologies, limited time and resources for testing and implementing new technologies while balancing economic viability and sustainability.

Findings indicate that industries lack the necessary financial resources to accelerate the decarbonisation process, which may result in a slower transition to greener practices; therefore, government support through funding, subsidies, and incentives is crucial for driving technology development. The transition to green energy solutions will take time and will not be achieved by 2026. This indicates that carbon pricing is at a faster pace than what may be feasible. In other words, the pace of regulations is not aligned with Industry readiness and technology advancements.

The research explored the economic impacts of both carbon pricing mechanisms, and findings indicate that carbon pricing as proposed could negatively affect the competitiveness of the hard-to-abate industry by impeding their ability to adopt new

technologies at the required pace, limiting their ability to compete with peers in developed countries that have more resources to scale up new technologies at a faster pace. Carbon taxes can eat into profit margins that are needed for investments in technology, plants, and efficiencies, potentially leading to job losses and a slow decline in the company's performance and the country's de-industrialisation. Carbon taxpayers have been relying on a percentage of tax-free allowances. These allowances may not start to decline from 2026 in order to preserve the South African economy, and the increase in the carbon tax rate will significantly erode the annual revenues of companies, threatening business sustainability.

The socio-economic impacts explored in the study include the effects of both carbon mechanisms in terms of job opportunities, upskilling and communities. Findings indicate that upskilling and reskilling will be crucial to minimise the impact on job losses, especially if the hard-to-abate sector is not ready to decarbonise at the pace expected by regulators. Although not all organisations might experience a negative effect, it will undoubtedly affect jobs and communities in the coal value chain. Such associated job losses will increase the cost burden on the South African state and potentially increase poverty.

This transition may lead to negative social effects such as job losses in industries reliant on carbon-intensive technologies, challenges in upskilling workers for new roles in a low-carbon economy, and potential economic impacts on communities dependent on industries like coal mining. Co-creation between government, industry and society is essential for a successful transition. It will be critical to define the balance in transitioning to more sustainable practices while considering socio-economic impacts.

In the global context where carbon pricing has been implemented, incentives and policies are in place to assist the hard-to-abate sector to decarbonise and mitigate increased costs for consumers. However, in South Africa where such support may be limited, and affordability becomes a significant concern. The transition to lower carbon technologies could lead to financial hardships for businesses. This transition period over the next years may be economically tough, with risks of companies shutting down due to the high costs of compliance with new technologies. It is crucial

for businesses to find ways to remain viable during this transition to ensure job opportunities for people.

In terms of policy and regulations, the chapter highlights the need for transparency and alignment between both carbon mechanisms to be further developed in a way that will not imply a double penalty, as currently does. Although both governmental departments, the NT and the DFFE, constantly indicate that they are working together on the alignment of both instruments and engaging with the industry, the perception is that the industry's needs have not been heard. Industry indicates that there should be simply one carbon pricing and not two.

The government needs to improve engagements with industry more collaboratively and transparently, focusing on industry needs and taking an approach of servant leadership to assist industry in the transition. The chapter emphasises the importance of creating more awareness, partnerships, capacity building, and ensuring that municipalities and communities are also moving swiftly. It is of utmost importance to develop supporting policies and regulations rather than punitive and demanding ones for the hard-to-abate industry.

The last theme to be explored in this chapter is the transition of the hard-to-abate industry. The government must protect the local economy by keeping allowances during the transition phase. Carbon budgets should be allocated in order to accommodate the transition, and incentives should be put in place, such as reinvesting carbon tax revenue into the industry's decarbonisation. The South African government and financial institutions must support the hard-to-abate industries in implementing the proposed decarbonisation roadmaps by providing access to capital, subsidies, grants, low-cost debt, and financial instruments like investments and loans during all transition phases.

Findings indicate that companies/sectors will not be ready for the lower carbon transition before 2026 due to the technology being expensive and not fully developed. Therefore, the decline in tax-free allowances for a carbon tax will negatively impact their operations and the sustainability of these industries in South Africa. The transition to lower-emission technologies is projected to be more

expensive for companies, which could lead to higher costs for society. Therefore, this could impact employment and increase the cost to civil society.

In conclusion the study suggests that hard-to-abate industries are technically and financially unable to make the transition to a lower-carbon economy in a fast pace aligned with carbon pricing legislation. The carbon tax rate increase combined with the tax-free allowances phase down/out approach as proposed by the National Treasury (2024) for phase two of the carbon tax will be alone unaffordable to certain industries, especially those with reduced profit margins.

In addition, allocating a carbon budget with applicable penalties on top of the carbon tax will be unreasonable to some industries and will cause dire socio-economic effects not only to those companies, employees and surrounding communities but to the country as a whole. The study recommends urgent intervention from the government to protect and support the hard-to-abate industry by keeping tax-free allowances until enablers allow decarbonisation, providing funding in the form of grants, facilitating green finance at affordable rates, and creating incentives and subsidies to accelerate decarbonisation. Protective measures to minimise imports and avoid further de-industrialisation in South Africa are crucial to ensure a just transition that will not leave the hard-to-abate sector behind and will include the industry in the country's future.

CHAPTER 4: CONCLUSION AND RECOMMENDATIONS

4.1 Introduction

The primary objective of this study was to evaluate the effect of the suggested carbon budgeting system on the hard-to-abate industry in South Africa; the problem was better described in Chapter 1, where different scenarios were specified considering the carbon tax and the proposed carbon budget. The literature review conducted in Chapter 2 focused on the purpose, application and implementation timeline of the carbon tax and carbon budget, explaining Climate Change Impact Management, GHG emission reduction, policies and Measures in different sectors of the hard-to-abate industries.

Chapter 3 discussed the research methodology, empirical study, and data analysis regarding the qualitative data obtained through the interviews used for this study. The objective of Chapter 4 is to conclude the study based on a literature review, empirical investigation, and results reached from data analysis on the conducted interviews. Challenges and opportunities of the carbon budgeting system in the hard-to-abate industry in South Africa were also discussed, as well as a critical evaluation of the study and recommendation.

4.2 Results

This study aimed to explore the effect of the suggested carbon budget penalty as a carbon pricing mechanism on top of the already implemented carbon tax on the hard-to-abate industry in South Africa. It was important to determine the perceived readiness of the hard-to-abate industries to evaluate the possible effect of such a double penalty on companies that are not ready for the low-carbon transition. The study findings indicate that it is not a matter of choice but that without the necessary enablers, the hard-to-abate industries cannot make the transition overnight and will not be ready either by 2026, when the tax-free allowances of the carbon tax are expected to decline. Decarbonising will require time, developing technologies, innovation, alternative materials, and significant investment.

Although it was not one of the chosen themes, it was also found through the interviews that not all the companies will experience the same impact as it will depend on profit margins and affordability of the company, ratio between direct and indirect emissions generated, on the nature of the process and technology required in each industry among other factors. This reflects that the impact of carbon pricing will not necessarily be equally and justly applied to all industries be it in the hard-to-abate sector or even within the same sector. This already undermines competitiveness and equitable treatment.

Although literature suggests that aligning policies in the climate change response must ensure a resilient economy and society on the path to a low-carbon transition (DFFE, 2022:4), results indicate that unaffordable levels of carbon pricing in South Africa can result in dire socio-economic impacts threatening the sustainability and resilience of the country's economy and society.

The study aimed to provide a better understanding of the impacts, challenges and opportunities associated with carbon pricing on the hard-to-abate sector. Literature suggests that the low-carbon economy will promote numerous opportunities in research and development, innovation, new job creation, upskilling and reskilling. The research indicates that companies are committed to decarbonisation roadmaps that will bring development opportunities, and some companies envisage a neutral or positive effect in terms of direct jobs and human capital. However, this study indicates that the adverse effects of excessive carbon taxes implemented while the industry cannot develop new technologies and reduce carbon tax liability can lead to plant closures, downsize operations, job losses, aggravating unemployment, inequality and poverty in South Africa. It is also recognised that the transition to lower-carbon technologies will negatively affect those directly or indirectly in the coal value chain.

The literature indicates that carbon pricing can efficiently reduce GHG emissions and provide incentives for more efficient technologies. The study shows that the carbon tax in South Africa has already sent a price signal, provoking management change and leading to the creation of decarbonisation roadmaps and the setting of targets and commitments by the industry as intended. However, carbon tax rate increases

coupled with the phase down of tax-free allowances at a more rapid pace than what the hard-to-abate can afford will go beyond the reduction of GHG emissions in fact, the country's GHG emissions will be curbed but due to de-industrialisation and not due to practical and more efficient low-carbon technologies being implemented.

Literature suggests that it is critical to ensure climate change-related policies will be cost-effective and minimise additional costs to society while reducing GHG emissions. Further, it implies that it will internalise environmental and social costs as per the polluter pays principle and that competitiveness issues and equitable treatment must be considered (The World Bank, 2017). This study voices the hard-to-abate industry, saying that the carbon pricing in South Africa is not affordable and will add costs to society. Although it internalises environmental costs, it affects competitiveness and does not provide equitable treatment.

According to the NT (2021), the policy rationale for the implementation of the carbon tax is to provide a price signal to provoke changes in the behaviour of producers and consumers and resolve the challenges related to climate change while enabling economic growth in a sustainable manner (Carbon Tax Act 15 of 2019). While in the long term, once technologies are available at an industrial scale and affordable, investment will increase and economic growth might be positively affected, the study shows that in the short to middle term, there is no balance between the current carbon pricing signal and economic growth in a sustainable manner. The hard-to-abate industry indicates that implications of both carbon pricing mechanisms will potentially cause downsizing and/or closure of operations, affect competitiveness, and lead to job cuts. Findings indicate that significant job cuts will create an additional burden on the state to support those affected by unemployment, reflecting the opposite of a sustainable and resilient economy.

According to Benjamin Görlach, there is high complexity and uncertainty in analysing the cost-effectiveness of climate policies and whether the costs justify the benefits of climate change avoidance. He further emphasises the importance of ensuring that targets are achieved at the lowest cost to society and monitoring all the constraints involved in the decarbonisation process, including social hardships, public acceptance and legal requirements (Görlach, B., 2013). The study suggests that

decarbonisation targets will not be achieved at the lowest cost to society. Prices will tend to increase, especially prices of products originating from the hard-to-abate industries requiring significant investment in new technologies and solutions. This can potentially cause social hardship and resistance from public acceptance or further hinder sustainable development goals for the country as an unintended consequence.

The Carbon Tax Act (2019) emphasises that an urgent climate change response is required by implementing measures to position South Africa in a more resilient and sustainable state from a social, economic and environmental perspective (NT, 2019). Although that could be ideally expected in the long term considering a successful just transition where no one will be left behind, the research shows that in the hard-to-abate perspective, until decarbonisation is not possible, the industry will struggle to remain sustainable without the necessary protection and support from government to enable the transition. Unaffordable carbon pricing will worsen the industry's position, negatively affecting socio-economic factors, communities and GDP contribution to the country.

4.3 Recommendations

It is recommended that a balanced approach between the carbon tax rate and applicable tax-free allowances is followed, especially for industries that are technically unable to decarbonise and cannot afford the significant investment required. This will ensure a just and equitable approach considering the hard-to-abate sector. Otherwise, although not responsible for the majority of the GHG emissions in the country, certain industries will be the most penalised. All tax-free allowances are suggested to remain applicable until low-carbon technologies are developed and affordable. Further studies are recommended to assess the realistic timeline for when these technologies will be proven at an industrial scale and become feasible and affordable. Tax-free allowances are suggested to apply to hard-to-abate industries beyond 2035/2040.

It is also recommended that carbon pricing and carbon budgets not be implemented through a blanket approach applying the same rules for all industries but rather

consider the technicalities, challenges, and financial constraints for specific companies to ensure the appropriate approach is followed. Target and carbon budgets for each sector should be aligned with the complexity of the specific industry.

The allocation of the carbon budgets must be made transparently, scientifically soundly, and collaboratively. GHG emission allocation must be reasonable, considering the pace at which the industry can decarbonise. It must also protect the industry, ensuring development and growth will not be suffocated.

Co-creation and engagement between the hard-to-abate industry and governmental departments such as the National Treasury and the DFFE should happen more collaboratively, ensuring that leaders in all spheres take a more servant leadership approach with the intent of helping each other with the available resources and working together to achieve the common climate goals. Industry must do everything possible to implement available technologies, research new technical solutions, improve energy efficiencies, create awareness, and upskill and reskill employees and surrounding communities. At the same time, the government must do everything in their power to develop and implement supporting and enabling policies and regulations. Financial support in the form of grants from the government to the hard-to-abate industry is needed to accelerate decarbonisation, the creation of subsidies and incentives that will not add costs to the industry in the transition to a low-carbon economy but will rather facilitate the implementation of such technologies is also crucial.

It is recommended that the government assesses and implements protection against carbon-intensive products being imported from countries with less onerous carbon policies in their jurisdictions. Protection of local manufacturing is needed, minimising plant closures and de-industrialisation in the country. Economy stimulation is necessary to promote product demand and alleviate the economic hardship some hard-to-abate industries are experiencing in the current scenario. That will ameliorate local industry and promote sustainable development and affordability of newer technologies.

Carbon pricing revenues should be ring-fenced to be ploughed back into industry decarbonisation, including research and development, investment, and implementation of low-carbon solutions. Government and financial institutions must assist in paying for the capital required in the transition, reducing the cost of loans, and making the transition possible and more affordable.

It is recommended that only one carbon pricing mechanism be considered in South Africa. Although there is no consensus on which of both mechanisms would be ideal, it is clear that only one carbon pricing should be applied and not two, as suggested by the government. Similarly, only one mechanism should set the amount of GHG emissions that can be emitted in alignment with the NDC, but duplication of both carbon pricing and carbon budget allocations should be avoided. Simplistic and facilitated approaches are needed.

It is suggested that the government intervene to implement less bureaucratic legislation to accelerate creative innovation and implement low-carbon solutions. Incentives and subsidies from this perspective are also recommended to expedite the transition sustainably and resiliently. This is the case for the implementation of renewable energy, exploration of nuclear energy implementation, adoption to facilitate the use of waste materials as alternative materials, carbon capture storage and use and other low-carbon technologies in general.

4.4 Limitations of the current study and suggestions for future research

This study was concluded considering the available public information and latest considerations on the Carbon Tax Act (2019), Climate Change Act (2024), discussion paper on phase two of the carbon tax (2024 and other applicable legislation until the date of submission of this study, therefore future changes in legislation will create new opportunities for further studies and researches on carbon budgeting system on the hard-to-abate industry in South Africa

Future research may include the potential impact of the allocated carbon budgets in different industries in South Africa and also the total impact on the South African

economy post-implementation of carbon budgeting at a company and sectoral level. The effects of carbon border adjustment mechanisms (CBAM) as additional carbon pricing to South African products being exported, the challenges, impacts and trade dynamics affecting the South African industry should also be explored.

4.4.1 No control over changes in legislation

The President signed the Climate Change Act on 23 July 2024, and when this study was written, the Act was still pending a proclamation of the date to come into operation. The carbon tax discussion paper on phase two of the carbon tax was published for public comments on the 13th of November 2024, confirming the proposed higher tax to be imposed from 1 January 2026 (NT, 2024). Stakeholders have been invited to submit written comments on the draft proposal until the close of business on the 13th of December, 2024. Following public consultation, the draft proposals will be revised to consider public comments and announcements made in the 2025 Budget. Therefore, the document is subject to changes as it involves public participation. However, no significant changes were envisaged at the moment of this study, and the researcher kept abreast of any amendments that arose, keeping the study relevant and valuable, especially from the hard-to-abate industry's perspective.

4.4.2 Complexity of data

No major limitations were identified when exploring and providing an overview of carbon pricing mechanisms, the carbon tax, and the Carbon Budgets. However, limitations were encountered when assessing the possible impacts on the South African Industry due to the diversification of sectors and the number of variables playing a role in this sphere. Some examples of these variables were:

- Different allowances granted per sector in terms of the carbon tax configuration altering the effective tax paid per sector;
- Financial and technical position of an organisation as well as the relative relevance of the carbon liability (cost) implied;
- Available technologies in each sector enabling the reduction of GHG emissions and their liability;
- National Public policies and legislation;

- Access to climate funding/finance for the implementation of lower carbon technologies;
- Availability, feasibility, and reliability of renewable energy in the country;
- International factors and policies that also influence the South African policies for Climate Change.

4.4.3 No control over data quality and availability

Climate change and financial implications may be considered sensitive information and this compromised company-specific data availability in published annual reports. Sectors' representatives had limitations in sharing financial information. In addition, possible data that a company has collected without external verification also represents a limitation in terms of quality assurance.

4.5 Meeting of research objectives

At the beginning of this study, the primary and secondary objectives were formulated, to further understand the potential impact of Carbon Budgeting on the hard-to-abate industry in South Africa when implementing the research methodology as well as data analysis specified in Chapter 3 with the results discussed and presented in Chapter 4, these research objectives were met. The results of the primary objective are summarised below.

Research objective	Outcome
Primary Objective The primary objective of this research was to evaluate the effect of the suggested carbon budgeting system on the hard-to-abate industry in South Africa.	The effect of the suggested carbon budgeting system on the hard-to-abate industry in South Africa was clearly discussed and if implemented as has been proposed will pose significant challenges for the hard-to-abate industries in South Africa. The interviewed participants highlighted concerns specially related to financial implication (loss of revenue), socio-economic impacts, affordability to invest in decarbonisation and mitigation technologies (prohibitive implementation costs), threatening their sustainability and competitiveness. The company/sector assessed in the interviews will not be ready (best case scenario partially ready) for the lower-carbon transition before 2026 when the tax-free allowances for the carbon tax will significantly start to decline.

The results of the secondary objectives were summarised below:

Research objective	Outcome
Secondary Objective 1 To investigate potential implications of both carbon pricing mechanisms on the business competitiveness of the hard-to-abate industry in South Africa.	South African hard-to-abate industry competitiveness will be significantly impacted when both carbon pricing mechanisms are fully implemented, especially considering that the tax-free allowances will phased down with time. Most industries will not be able to absorb these costs without transferring it onto the consumers, leading to a negative business impact resulting in reduced competitiveness against international markets without carbon pricing legislations.
Secondary Objective 2 To investigate what are the challenges faced by the hard-to-abate industry in South Africa to reduce greenhouse gas emissions and minimize the imposed carbon pricing liability.	The main challenges faced by the hard-to-abate sector to reduce greenhouse gas emissions and minimize the imposed carbon pricing liability are related to the availability of funds, untested new emerging technologies (not fully developed in order to be implemented at a large scale, and at high cost), and the proposed implementation timeline to complete to low-carbon transition. These 3 concerns were raised by most of the interviewed. The high energy intensity of the process was also highlighted as a constraint for the transition, due to unavailability of large scale greener energy and lack of government support and incentives.
Secondary Objective 3 To investigate the effect of double carbon taxation (tax liability compared to investment in GHG mitigation technologies).	The double taxation system on the hard-to-abate industry will create an unsustainable tax burden resulting in less available capital to invest in GHG mitigation technologies. The double taxation has the potential to erode the annual revenues of companies creating a negative impact to competitiveness and profitability threatening the business sustainability in South Africa.
Secondary Objective 4 To investigate the negative social impacts on the employees of the hard-to-abate industry in South Africa resulting from the shift of technologies to reduce greenhouse gas emissions and carbon pricing liability.	The study examines the socio-economic impacts of both carbon mechanisms, focusing on job opportunities, upskilling, and community effects. The findings highlight that upskilling and reskilling are essential to mitigate job losses, particularly if the hard-to-abate sector cannot decarbonize at the expected pace. While not all organizations may experience negative effects directly, jobs and communities within the coal value chain will certainly be impacted. These job losses will increase the financial burden on the South African state and potentially elevate poverty levels. The transition could lead to adverse social effects, such as job losses in carbon-intensive industries, difficulties in upskilling workers for new roles in a low-carbon economy, and economic challenges for communities dependent on coal mining. Successful transition requires collaboration between government, industry, and society. It is crucial to balance the shift to sustainable practices with socio-economic considerations.
Secondary Objective 5 To make recommendations on the appropriate actions to hard-to-abate industry to follow.	The study formulates a set of recommendations that emphasize the need for a balanced approach to carbon tax rates and tax-free allowances, particularly for industries that cannot easily decarbonize due to technical and financial constraints. This approach aims to ensure fairness and prevent undue penalties on certain sectors. It is suggested that all tax-free allowances remain applicable until low-carbon technologies are affordable and proven at an industrial scale, with further studies recommended to determine realistic timelines. Additionally, carbon pricing and budgets should be tailored to the specific challenges and complexities of each industry, rather than applying a uniform approach. The recommendations also call for transparent and collaborative allocation of carbon budgets, considering the industry's decarbonization pace to avoid halting growth. Collaboration between government, industry, and society is crucial, with a focus on servant leadership to achieve common climate goals. Financial support, including grants, subsidies, and incentives, is essential to facilitate the transition to a low-carbon economy. Protection against imports of carbon-intensive products and measures to stimulate the local economy are also recommended. Simplifying carbon pricing mechanisms and reducing bureaucratic hurdles will accelerate innovation and the implementation of low-carbon solutions.

4.6 Final conclusion

This study aimed to explore the effect of the suggested carbon budget penalty as a carbon pricing mechanism on top of the already implemented carbon tax on the hard-to-abate industry in South Africa. The study determines that it is not a matter of choice but that without the necessary enablers, the hard-to-abate industries cannot make the transition overnight and will not be ready either by 2026, when the tax-free allowances of the carbon tax are expected to decline. Decarbonising will require time, developing technologies, innovation, alternative materials, and significant investment. The study points out that not all companies will experience the same impact as it will depend on profit margins and affordability of the company, the ratio between direct and indirect emissions generated, and the nature of the process and technology required in each industry, among other factors. This reflects that the impact of carbon pricing will not necessarily be equally and justly applied to all industries, be it in the hard-to-abate sector or even within the same sector. This already undermines competitiveness and equitable treatment.

The research indicates that unaffordable levels of carbon pricing in South Africa can result in dire socio-economic impacts threatening the sustainability and resilience of the country's economy and society. The study provided a better understanding of the impacts, challenges, and opportunities associated with carbon pricing in the hard-to-abate sector.

The research suggests that hard-to-abate companies are committed to decarbonising roadmaps that will bring development opportunities. Some companies envisaged a neutral or positive effect regarding direct jobs and human capital. However, this study indicates that the negative effects of excessive carbon taxes implemented while the industry is unable to develop new technologies and reduce carbon tax liability can lead to plant closures, downsizing of operations, job losses and aggravate unemployment, inequality and poverty in the country. It is also recognised that the transition to lower-carbon technologies will negatively affect those directly or indirectly in the coal value chain.

The study shows that the carbon tax in South Africa has already sent a price signal, provoking management change, leading to the creation of decarbonisation roadmaps and the setting of targets and commitments by industry as intended. However, carbon tax rate increases coupled with the phase down of tax-free allowances at a more rapid pace than what the hard-to-abate can afford will go beyond the reduction of GHG emissions in fact, the country's GHG emissions will be curbed but due to de-industrialisation and not due to effective and more efficient low-carbon technologies being implemented.

This study voices the hard-to-abate industry, saying that the carbon pricing in South Africa is not affordable and will add costs to society. Although it internalises environmental costs, it affects competitiveness and does not provide equitable treatment. While in the long term, once technologies are available at an industrial scale and affordable, investment will increase and economic growth might be positively affected, the study shows that in the short to middle term, there is no balance between the current carbon pricing signal and economic growth in a sustainable manner. The hard-to-abate industry indicates that implications of both carbon pricing mechanisms will potentially cause downsizing and closure of operations, affect competitiveness, and lead to job cuts. Findings indicate that significant job cuts will create an additional burden on the state to support those affected by unemployment, reflecting the opposite of a sustainable and resilient economy.

The study suggests that decarbonisation targets will not be achieved at the lowest cost to society. Prices will tend to increase, especially prices of products originating from the hard-to-abate industries requiring significant investment in new technologies and solutions. This can potentially cause social hardship and resistance from public acceptance or further hinder sustainable development goals for the country as an unintended consequence. Although an urgent climate change response is required, and ideally, a successful transition where no one will be left behind is expected, the research shows that in the hard-to-abate perspective, until decarbonisation is not possible, the industry will struggle to remain sustainable without the necessary protection and support from government to enable the transition. Unaffordable

carbon pricing will worsen the industry's position, negatively affecting socio-economic factors, communities, and GDP contributions to the country.

The study formulates a comprehensive set of recommendations under 4.2 that emphasises the need for a balanced approach to carbon tax rates and tax-free allowances, particularly for industries that cannot easily decarbonise due to technical and financial constraints. This approach aims to ensure fairness and prevent undue penalties on particular sectors. All tax-free allowances are suggested to remain applicable until low-carbon technologies are affordable and proven at an industrial scale, with further studies recommended to determine realistic timelines. Carbon pricing and budgets should be tailored to each industry's challenges and complexities rather than applying a uniform approach.

The recommendations also call for transparent and collaborative allocation of carbon budgets, considering the industry's decarbonisation pace to avoid halting growth. Collaboration between government, industry, and society is crucial, focusing on servant leadership to achieve common climate goals. Financial support, including grants, subsidies, and incentives, is essential to facilitate the transition to a low-carbon economy. Protection against imports of carbon-intensive products and measures to stimulate the local economy are also recommended. Simplifying carbon pricing mechanisms and reducing bureaucratic hurdles will accelerate innovation and the implementation of low-carbon solutions.

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APPENDIX A – Interview Questionnaire

INTERVIEW QUESTIONS

Title of study:

Evaluating the effect of the suggested Carbon Budgeting system on the “hard-to-abate” industry.

Please note:

Interviews will be conducted with knowledgeable professionals working in but not limited to the Climate Change, Sustainability, and/or Environmental management area, acting directly or indirectly with the energy-intensive sector and hard-to-abate industry in South Africa.

All information obtained through this interview will be kept **confidential** and will only be used for academic purposes only.

Section A

Company demographic information

B1: When was the business established?

Less than 5 years ago	1
5-10 years ago,	2
10-20 years ago,	3
More than 20 years ago	4

B2: What is the legal form of the business?

Sole proprietor	1
Partnership	2
Close corporation	3
Private company	4
Other	5

B3: As part of the hard-to-abate and/or energy-intensive industry which product does the business manufacture?

Aluminium	1
Cement and/or Concrete	2
Chemicals	3
Iron and Steel	4
Oil/gas	5
Other	6
If other, please specify:	

B4: How would you classify the size of the business?

Micro	1
Small	2
Medium	3
Large	4

B5: What is the number of full-time employees in the business?

Fewer than 500 employees	1
Between 500 and 1000 employees	2
More than 1000 employees	3

B6: What is the estimated annual turnover for the business?

Between R0 and R100 million	1
Between R100 million and R500 million	2
Between R500 million and R1 billion	3
More than R1 billion	4

B6: Which of the following would be a major objective for the business in the next three years?

To reduce in size	1
To stay the same	2
To grow	3

Section C

1. Would both the carbon tax and the carbon budget system apply to the company/sector that you are representing and how would they apply?
2. In your opinion, will the company/sector that you are representing be ready for the lower-carbon transition before 2026 when the tax-free allowances for the carbon tax will significantly start to decline?
3. What will be the financial implications if the carbon budget system enforces a carbon tax rate of R640 per tCO₂eq exceeding emissions over and above the already implemented carbon tax?
4. How could both carbon pricing mechanisms possibly affect the competitiveness of the company/sector that you are representing?
5. What are the potential challenges in terms of greener technologies experienced by the hard-to-abate industries?
6. How will both carbon pricing mechanisms affect the investment in decarbonisation technologies and the reduction of emissions (carbon tax liability vs investment in greener technologies)?
7. How could the South African government and financial institutions possibly support the hard-to-abate industries to access capital to finance the transition to low-carbon technologies?
8. What could be the potential negative social effect resulting from the transition to lower-carbon technologies? (job opportunities/job losses/upskilling/community)

9. Will the transition towards lower-emission technologies result in higher costs to companies, and if so, how will these costs affect civil society?
10. How could the government, industry, and other stakeholders ensure that the transition towards low-carbon technologies is just and equitable for the hard-to-abate industry and its employees?
11. How could regulatory frameworks and policies assist the hard-to-abate sector in the transition to lower-carbon emissions?
12. What would be your recommendations to address the appropriate approach to align both carbon pricing mechanisms in South Africa?
13. Is there any additional information that you would like to share regarding the potential effect of both carbon pricing mechanisms in South Africa?

APPENDIX B – Consent Form

Consent form

Dear participant,

You have been identified as a knowledgeable professional working in but not limited to the Climate Change, Sustainability and/or Environmental management area acting directly or indirectly with the energy intensive sector and hard-to-abate industry in South Africa.

You are invited to participate in this research study titled: Evaluating the effect of the suggested Carbon Budgeting system on the “hard-to-abate” industry, as part of my Master of Business Administration research project through the North-West University Business School.

The information will be collected through the enclosed interview presented by this research and will assist to exploring the impact of carbon pricing in South Africa, especially a possible double penalization if a price is linked to the carbon budgets system over and above the carbon tax already implemented.

Participation in this research is completely voluntary and participation can be withdrawn from the study at any time without any negative consequences to the parties involved.

Identifications will be preserved to keep the confidentiality of participants, organizations, and/or institutions. Data management will be conducted under the principles of the Protection of Personal Information Act of 2013 (POPIA) of South Africa at all times. However, the researcher reserves her right to make use of information that is already in the public domain.

The responses obtained will only be used for this research project and will remain confidential. None of the interview question's responses can be cross-referenced back to the participant nor will they be shared with any third party. Any information obtained will be protected until destruction will take place. There will not be any type of incentives involving any party involved in this research except for being able to get access to the final research paper.

Upon agreeing to participate in this research project, the interview should take approximately 50 minutes to complete.

If there are any questions regarding this project, please feel free to contact my study leader Johannes Coetzee at Johannes.coetzee@nwu.ac.za / 082 821 7177.

Thank you for your participation.

Kind regards,

Márcia de Oliveira Ramos Furlan

Date

I hereby willingly participate in this interview and understand the contents of this letter.

Signature: Participant

Date

APPENDIX C - NWU Checklist for Ethics Review



Private Bag X1290, Potchefstroom
South Africa 2520

Tel: 018 299-1111/2222
Fax: 018 299-4910
Web: <http://www.nwu.ac.za>

Senate Committee for Research Ethics
Tel: 018 299-484
Feziwe.Mseleni@nwu.ac.za

03 September 2024

ETHICS APPROVAL LETTER OF STUDY

Based on approval by the Economic and Management Sciences Research Ethics Committee (EMS-REC) on, 03/09/2024 the Economic and Management Sciences Research Ethics Committee hereby approves your study as indicated below. This implies that the North-West University Senate Committee for Research Ethics (NWU-REC) grants its permission that, provided the special conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title: Evaluating the effect of the suggested Carbon Budgeting system on the "hard-to-abate" industry

Study Leader/Supervisor (Principal Investigator)/Researcher: Mr. J.C. Coetzee
Student: M. De Oliveira Ramos Furlan (44710216)

N	W	U	-	0	0	7	4	8	-	2	4	-	A	4
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Institution Study Number Year Status
Status: S = Submission; R = Re-Submission; P = Provisional
Authorisation; A = Authorisation

Application Type:

Commencement date: 03/09/2024

Risk:

Minimal

Expiry date: 03/09/2025

Approval of the study is initially provided for a year, after which continuation of the study is dependent on receipt and review of the annual (or as otherwise stipulated) monitoring report and the concomitant issuing of a letter of continuation.

Special in process conditions of the research for approval (if applicable):

•

General conditions:

While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, the following general terms and conditions will apply:

- The study leader/supervisor (principle investigator)/researcher must report in the prescribed format to the EMS-REC:
 - annually (or as otherwise requested) on the monitoring of the study, whereby a letter of continuation will be provided, and upon completion of the study; and
 - without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study.
 - The approval applies strictly to the proposal as stipulated in the application form. Should any amendments to the proposal be deemed necessary during the course of the study, the study leader/researcher must apply for approval of these amendments at the EMS-REC, prior to implementation. Should there be any deviations from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited.
 - Annually a number of studies may be randomly selected for an external audit.
 - The date of approval indicates the first date that the study may be started.
- In the interest of ethical responsibility, the NWU-SCRE and EMS-REC reserves the right to:*
- request access to any information or data at any time during the course or after completion of the study;
 - to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process;
 - withdraw or postpone approval if:
 - any unethical principles or practices of the study are revealed or suspected;
 - it becomes apparent that any relevant information was withheld from the EMS-REC or that information has been false or misrepresented;
 - submission of the annual (or otherwise stipulated) monitoring report, the required amendments, or reporting of adverse events or incidents was not done in a timely manner and accurately; and / or
 - new institutional rules, national legislation or international conventions deem it necessary.

The EMS-REC would like to remain at your service as scientist and researcher, and wishes you well with your study. Please do not hesitate to contact the EMS-REC or the NWU-SCRE for any further enquiries or requests for assistance.

Yours sincerely,



Prof Diana Viljoen-Bezuidenhout

Chairperson: NWU Economic and Management Sciences Research Ethics Committee

APPENDIX D - Declaration of Language Editor



Dynamic Language &
Translation Specialists

1 Kgaka street no. 5
Potchefstroom
Tel: 018 293 3046
Cell: 082 878 5183
Language@dlts.co.za
CC No: 1995/017794/23

Tuesday, 19 November 2024

To whom it may concern

Re: Confirmation of language edit, typography and technical precision

The MBA dissertation "**Evaluating the effect of the suggested Carbon Budgeting system on the "hard-to-abate" industry**" by M de Oliveira Ramos Furlan (44710216) was edited for language and technical precision. Referencing and sources were checked to comply with the Harvard guidelines specified by the NWU Reference Guide.

Final, last-minute corrections remain the responsibility of the author.

Antoinette Bisschoff

BA Languages (UPE – now NMU); MBA (PU for CHE – now NWU); Translation and Linguistic Studies (NWU)

Officially approved language editor of the NWU since 1998
Member of SA Translators Institute (no. 100181)

Precision ... to the last letter

APPENDIX E - Declaration By Researcher



NWU Business School
North-West University
Private Bag x6001
Potchefstroom, 2520
<http://commerce.nwu.ac.za/business-school>

SOLEMN DECLARATION – INDIVIDUAL ASSIGNMENT

Solemn Declaration by the student

Module: Mini- Dissertation
Module Code: MBAC 873
Assignment No: Mini Dissertation
Assignment due date: 27 November 2024

I; Márcia de Oliveira Ramos Furlan, hereby declare that the thesis entitled " Evaluating the effect of the suggested Carbon Budgeting system on the "hard-to-abate" industry " is my own original work and that I have not previously, in its entirety or in part submitted it at any university for a qualification.

Signature of Student

Student Number: 44710216

Student initial and surname: M De Oliveira Ramos Furlan

Data signed: 17/11/2024

