UNIVERSITY OF KWAZULU-NATAL ™

INYUVESI YAKWAZULU-NATALI

Fleet decarbonisation for sustainable transport initiative: A case of V-Polizza

by

Thandiswa Nkosingithandile Ndawonde

217001491

A dissertation submitted in fulfilment of the requirements for the degree

Master of Commerce – Supply Chain Management

COLLEGE OF LAW AND MANAGEMENT STUDIES

SCHOOL OF MANAGEMENT, IT & GOVERNANCE

Supervisor: Dr T.P. Mbhele

2022

Declaration

I, Thandiswa Nkosingithandile Ndawonde declare that

(i) The research reported in this dissertation, except where otherwise indicated, is my original contribution.

(ii) This dissertation has not been submitted for any degree or examination at any other university.

(iii) This dissertation does not contain other persons' data, pictures, graphs or other

information, unless specifically acknowledged as being sourced from other persons.

(iv) This dissertation does not contain other persons' writing, unless specifically acknowledged as being sourced from other researchers. Where other written sources have been quoted, then:

a) their words have been re-written, but the general information attributed to them has been referenced:

b) where their exact words have been used, their writing has been placed inside quotation marks, and referenced.

(v) This dissertation does not contain text, graphics or tables copied and pasted from the Internet, unless specifically acknowledged, and the source being detailed in the dissertation and in the References sections.

Signature: [redacted] Date: 08 February 2023

Acknowledgements

I acknowledge the support of the V-Polizza for my studies. The Deputy Provincial Commissioner: Support Services in KwaZulu-Natal played a huge role in ensuring I had the information I needed and making the participants available. I am grateful for all that he did. I also extend my thanks to the participants who were interviewed, my V-Polizza mentor and the V-Polizza research department.

I would also like to express my immense gratitude to my supervisor, Dr. Thokozani Mbhele, who read my numerous revisions and helped make some sense of the confusion, for his patience, guidance and support, and for providing invaluable feedback on my analysis and framing. I benefited greatly from his wealth of knowledge and meticulous editing.

Thank you to my mother, Sheilla Zondo, for your endless support. You have always stood by me, and this was no exception. Mom, thank you for fielding a ridiculous number of phone calls, calming me down, and for always reminding me of the end goal.

Most importantly, I am grateful for my family and friends' unconditional, unequivocal, and loving support.

Last but not least, I praise and thank God, the Almighty, who has granted me countless blessings, knowledge, and opportunities. It is because of Him that I am who and where I am today.

ABSTRACT

Decarbonisation refers to the measures adopted by a business sector or entity to reduce its carbon footprint, primarily its greenhouse gas emissions to ameliorate its impact on the climate. The focus on sustainability is mainly motivated by climate change. There can be no doubt that the number of significant climate events is increasing and that greenhouse gas emissions are rising at an alarming rate. Reducing transportation-related greenhouse gas emissions through deep decarbonisation is this an important strategy in the race against climate change. This study examined how V-Polizza's fleet contributes to carbon emissions, the benefits of optimising fleet decarbonisation and going green for the environment and society, and how technology can promote sustainable optimisation of V-Polizza's transportation. The Technology Organisational and Environmental conceptual framework that underpinned the study is an organisation-level theory that posits that three different elements of a firm's context influence adoption, namely, the technological, organisational, and environmental contexts. A qualitative exploratory case study approach was adopted, with data collected by means of semi-structured interviews with open-ended questions and the data was analysed using thematic analysis. Non-probability, purposive sampling was used to select two senior managers in the Supply Chain Management department and two fleet managers as well as two managers responsible for decision making within the province. The study found that V-Polizza has not been pursuing a sustainable fleet or reduced carbon emissions. While it is vital for it to do so, the importance of fleet decarbonisation goes beyond reducing direct emissions. The findings also showed that decarbonisation makes a significant contribution to people's well-being by enabling access to goods, services and social networks that support a good quality of life. The study recommends improved vehicle efficiency at V-Polizza and that the organisation should launch campaigns and demonstrate interest in the environmental sector, as well as collaborate with firms and non-profit organisations engaged with these issues.

Key words: Decarbonisation, sustainability, climate change, environment

Table of Contents

List of Tables

List of Figures

Acronyms

SCM – Supply Chain Management

SAPIA – South African Petroleum Industry Association

$C0_2$ – Carbon Dioxide

GHG – Greenhouse Gas

TBL – Triple Bottom Line

TOE – Technology – Organisation – Environment

SAPS - South African Police Service

KZN – KwaZulu-Natal

PRASA – Passenger Rail Agency of South Africa

WTO – World Trade Organisation

SCP – Supply chain planning

ERP – Enterprise resource planning

EDI – Electronic Data Interchange

IoT – Internet of Things

SC – Supply Chain

NCSFA – National Conference of State Fleet Administrators

GSCM – Green Supply Chain Management

SSCM – Sustainable Supply Chain Management

CSCMP – Council of Supply Chain Management Professionals

CSR – Corporate Social Responsibility

EV – Electric Vehicles

GDP – Gross Domestic Product

IPCC – The Intergovernmental Panel on Climate Change

PFMA – Public Finance Management Act

SDIP – Service Delivery Improvement Programme

IT – Information Technology

CSIR – Council for Scientific and Industrial Research

GTS – Green Transport Strategy

SDGs – Sustainable Development Goals

KPI – Key Performance Indicator

CBD – Central Business District

CHAPTER ONE

INTRODUCTION TO THE STUDY

1.1 Introduction

Sustainability is being promoted across entire supply chains, and transportation makes a substantial contribution to unsustainability in the supply chain. This study investigated the sustainability of a governmental organisation's fleet. The term sustainability has been expressed as "never harvesting more than what the forest yields" (Singh, 2021:237). This simply means the use of current resources in such a way that it will not jeopardise their use in the future. The United Nations (2020) defines sustainability of the environment as the use of clean processes throughout the lifecycle of products or services.

This research focused on the ways in which a government organisation can minimise gas and air pollution produced by vehicles, which will create a cleaner, quieter, and healthier environment. It focused on the ways in which employees can do things differently to reduce their impact on climate change and create a green and safe environment. A qualitative exploratory case study approach was adopted to identify initiatives that could be launched to optimise sustainability with regard to carbonisation, pollution and damage to the fleet.

The research also sought to identify the decarbonisation challenges confronting V-Polizza, how the organisation can implement green transportation initiatives and the benefits that will accrue. The pseudonym, V-Polizza, was used to protect the image and reputation of the organisation.

1.2 Background of the study

Following South Africa's first democratic election, the government committed itself to service excellence in the public sector. This initiative was brought to life in 1997 with the White Paper on Transforming Public Service Delivery known as the Batho Pele document (The Constitution of South Africa, 1996). These principles are based on the premise that transforming public service delivery requires a focus on client satisfaction where the public sector is attuned to clients' needs and expectations. The South African Police Force was founded in 1913 with the dual goal of the preservation of internal security and the maintenance of law and order. 'Service' was not part of the agenda (SAPS, 2022). The SAPS was born out of the constitutional reform South Africa has been undergoing since 1990 (SAPS, 2022).

Police Service is one government department which has been affected by industrial revolution. The industrial revolution brought about new technologies with immense power and resulted in

new manufacturing processes in Europe and the United States in the period from 1760 to 1840 (Pratt and Clinker, 2021). It was followed by on-going industrialisation and further technological advancements in developed countries around the world. The impact of this technology on the environment has included misuse and damage to the planet (Gumbo et al., 2022). These technologies have damaged the world in two main ways; pollution and the depletion of natural resources. Air pollution occurs when harmful or excessive quantities of gases such as CO_2, carbon monoxide, sulphur dioxide, nitric oxide and methane are introduced into the earth's atmosphere (Henderson, 2019). The main sources all relate to technologies which emerged following the industrial revolution such as the burning of fossil fuels, factories, power stations, mass agriculture and vehicles. The consequences of air pollution include negative health impacts for humans and animals and global warming, where increased Green House Gas (GHG) in the air traps thermal energy in the earth's atmosphere and cause a global rise in temperature (Rojas-Rueda, 2020).

Environmental technology is also known as 'green' or 'clean' technology and refers to the development of new technologies which aim to conserve, monitor or reduce the negative impact of technology on the environment and the consumption of resources (Nieuwenhuijsen and Khreis, 2020). Increased global concern about climate change has led to the development of new environmental technology that aims to address some of the biggest environmental concerns through a shift towards a more sustainable, low-carbon economy (Cooper et al., 2014). Renewable energy, also known as 'clean energy', is energy that is collected from renewable resources which are naturally replenished such as sunlight, wind, rain, the tides, waves, and geothermal heat (Jarvis, 2020). Modern environmental technology has enabled this naturally occurring energy to be captured and converted into electricity or useful heat through devices such as solar panels, wind and water turbines. This reflects the highly positive impact that technology can have on the environment (Bellamy, 2020).

Having overtaken coal in 2015 to become the second largest generator of electricity, renewable sources currently produce more than 20% of the United Kingdom's electricity, and EU targets mean that this is likely to increase to 30% by 2020 (Keay and Robinson, 2017). While many renewable energy projects are large-scale, renewable technologies are also suited to remote areas and developing countries, where energy is often crucial to human development. The cost of renewable energy technologies such as solar panels and wind turbines is falling and government investment is on the rise (Bellamy, 2020). This contributed to the number of

rooftop solar installations in Australia growing from approximately 4,600 households to more than 1.6 million between 2007 and 2017 (Ritchie, 2020).

Smart home technology uses devices such as linking sensors and other appliances connected to the Internet of Things (IoT) that can be remotely monitored and programmed in order to be as energy efficient as possible and to respond to users' needs. The IoT is a network of Internet-connected objects that are able to collect and exchange data using embedded sensor technologies enabling devices in the network to autonomously 'make decisions' based on real-time information (Shackelford, 2020). For example, intelligent lighting systems only illuminate areas that require it and a smart thermostat keeps homes at certain temperatures during certain times of day, therefore reducing wastage (Chaudhuri, 2018). This environmental technology has been enabled by increased connectivity to the Internet as a result of the increased availability of Wi-Fi, Bluetooth and smart sensors in buildings and cities (Bellamy, 2020). Experts predict that the cities of the future will be places where every car, phone, air conditioner, light and more are interconnected, bringing about energy efficient 'smart cities' (Jarvis, 2020).

Although technology's negative impact on the environment due to industrialisation cannot be reversed, many believe that new technology, such as renewable energy combined with smart logistics and electric transport, has the potential to bring about the rapid decarbonisation of economies and prevent further damage (Henderson, 2019). This study focused on road transportation in the public sector, which is referred to as fleet transport. Fleet vehicles comprise all the vehicles owned by a company, government agency or other business. These are sometimes leased to transport companies to transport goods to customers (Sowerby, 2021).

V-Polizza has developed a set of urban planning and design principles, with targets set for each to promote sustainability practices. They aim to promote sustainable environments and encourage living within the planet's capacity without compromising the needs of future generations. The eight principles, which resonate with the systems approach, promote efficient energy; sustainable water; sustainable transport; green landscaping; going local; zero waste; a healthy environment and feasibility (Cronje, 2021). V-Polizza is responsible for combating crime in South Africa. It has 1,138 stations in KwaZulu-Natal (KZN), all of which have vehicles that help police perform their duties and protect and serve society (AmaShabalala, 2021). These vehicles are on the road on a daily basis, resulting in emissions which damage the environment and contribute to air and noise pollution.

In response to climate change, organisations and companies have embraced sustainable initiatives that aim to satisfy their current needs without undermining future ones (Farrington, 2012). Climate change measures the average weather in a particular location over many years and refers to a shift in such conditions (Wang and Zhang, 2022). Rapid climate change is caused by the use of oil, gas and coal in homes and factories, as well as transportation. When these fossil fuels burn, they release greenhouse gas (GHG) that damages the environment (Van Zanten, and van Tulder, 2021). Although V-Polizza has committed to sustainability, it has not paid much attention to decarbonisation and the environmental damage its fleet has caused. It is against this background that this study examined the impact and contributions V-Polizza's fleet makes to environmental and climate change. Its findings offer insight into initiatives that could be adopted to promote a more sustainable fleet and produce fewer vehicle emissions.

1.3 Research Problem

Given the importance of enhancing public safety, most police officers do not consider the environmental impact of their operations (Ricciardelli, Carleton, and Cramm, 2020). However, the environmental costs of policing are real as police cruisers burn fuel and release pollution (Legodi, 2021). V-Polizza's vehicles consume a large amount of fuel, with the cost per kilometre travelled higher than the market rates published by the South African Petroleum Industry Association (Parker, 2022). Obviously, this increases spending on fleet services. While air pollution is the most well-known and discussed environmental impact of operating automobiles, it is not the only one. Traffic noise is significant, especially in and around cities, with such noise emissions including hooting, engine noise, tire friction, screeching brakes and grinding gears that all contribute to the urban din (Noro, 2022). Sustainable transportation initiatives and mobility are central to sustainable development (Caprari, 2022). Given that V-Polizza's fleet makes a significant contribution to carbon emissions, there is a need for the organisation to reduce such emissions for the benefit of the environment and society and ultimately to mitigate climate change. Few studies have been conducted on sustainable transportation initiatives in South Africa. There is limited knowledge on governmental fleet decarbonisation and its contribution to climate change. Against this background, this study aimed to offer insight into how V-Polizza's fleet contributes to carbon emissions, the opportunities and benefits of optimising fleet decarbonisation for the environment and society, the potential impact of V-Polizza going green on the environment and society and how technology can influence sustainable optimisation of the organisation's transportation, as well

as the benefits that will accrue. Efforts to reduce supply chain carbon intensity are gaining traction worldwide and governmental organisations can play a significant role in this regard, both in their operations and through broader supply chain optimisation. The direct benefits include reduced costs, management of risks, and business growth and efficiency (Elavarasan, 2020).

1.4 Research Questions

The study aimed to answer the following questions:

1. What is the role of fleet decarbonisation in influencing sustainable fleet management initiatives at V-Polizza?

2. What are the opportunities and benefits of optimising fleet decarbonisation at V-Polizza for the environment and society?

3. How does the advent of transport technologies at V-Polizza impact efficient decarbonisation responsiveness to mitigate climate change?

1.5 Research Objectives

The study's objectives were:

1. To assess the role of fleet decarbonisation in sustainable management initiatives at V-Polizza

2. To establish the opportunities and benefits at V-Polizza of optimising fleet decarbonisation for the environment and society.

3. To examine the advent of transport technologies at V-Polizza impact on efficient decarbonisation responsiveness to climate change.

1.6. Preliminary Literature Review

This section introduce the preliminary literature that formed the foundation for this study. A literature review involves the collection and review of current data and scholarly arguments relating to the research topic (Lane, 2022). Lane (2022), explains that a complete analysis and evaluation of the body of work that has been done on a particular subject is known as a literature review. The literature review offers a condensed summary of previous research and published writings that are relevant to the subject of the present investigation. It also establishes a point of reference for the reader (Kraus, Mahto, and Walsh, 2023). Importantly, it provides an update on the state of the most recent research. Furthermore it determine the most suitable

methodologies, instruments, and processes for data analysis (Kraus e t al, 2023). In addition to this, it provides the researcher with assistance in the conceptual and operational characterization of essential words, assumptions, and constraints, as well as the articulation of research questions and hypotheses/proposition pertaining to the new research topic (Mendoza-Silva, 2021). It is therefore necessary for the reader to have an understanding of how previous studies helped guide and inform the current investigation.

1.6.1 Supply Chain Management

Supply chain management is the active management of supply chain activities to maximise customer value and achieve a sustainable competitive advantage. It represents a conscious effort by the firms or organisations in the supply chain to develop and run such chains in the most effective and efficient ways (Handfield, 2021). Zekhnini, Cherrafi, Bouhaddou, Benghabrit and Garza-Reyes (2020) define a supply chain as a network of entities that support the flow of production and delivery of goods and services. A supply chain thus starts with suppliers and ends with customers. Supply chain management is considered a vehicle for service delivery since it incorporates forecasting and controlling all undertakings embodied in out-sourcing, purchasing, transportation, and logistics administration (Handfield, 2021). As the departmental role players charged with ensuring that the supply chain fulfils its mission, SCM managers should identify potential clients and end-users to enhance the flow of the process, thus eliminating variability of demand and activities that do not add value to the organisation. Performance management reports must be produced to measure the opportunity, cost, value for money and the financial impact on the organisation (Habib, Bao, Nabi, Dulal, Asha, and Islam, 2021).

Mirroring developments in the business world, SCM is constantly evolving, with supply chain 4.0 the most recent trend (Fenton, 2021). Effective SCM processes are essential across South Africa's three spheres of government given increasing demand for public services amidst a scarcity of resources (Kolenko, 2021). Green supply chain management is based on integrating SCM and environmental management and controlling the environmental effects of products in their lifecycle by sharing information and coordination (Habib e t al., 2021).

1.6.2 Sustainability

Sustainability is defined as the "means of transforming our way of living to maximise the chances that environmental and social conditions will indefinitely support human security, wellbeing and health" (Sachs, Kroll, Lafortune, Fuller, and Woelm, 2022). It thus aims to ensure a healthy future community and generation. Stefanakis, Calheiros, and Nikolaou (2021) asserts that extensive, comprehensive knowledge is required to grasp and understand the relationship between the social, economic and environmental systems involved in sustainability. Sustainability studies emerged during the 1990s and are evolving on an on-going basis. Sustainability is a subject of investigation in a variety of different disciplines across the natural and social sciences (Stefanakis e t al, 2021). Sach e t al (2022), identify four main reasons why sustainability is important and requires urgent attention, namely, regulations, community relations, cost and revenue imperatives and societal and moral obligations. Decarbonisation should be part of a movement towards sustainability, at least for the moment.

1.6.3 Decarbonisation

The key to supply-chain-wide decarbonisation is an understanding of CO_2 emissions across the system. Corporate-level reporting, guided by the widely-used Greenhouse Gas Protocol, is gaining traction (Mytton, 2020). Product level foot printing is an important step towards supply chain carbon rationalisation. Significant movement is expected towards reduced supply chain carbon intensity. This create both opportunities and risks for logistics and transport firms, with changes in supply and demand driven by regulation of carbon emissions, higher and more volatile fuel prices, and evolving consumer and client demands (Hayes, 2022). The supply chain sector can play an influential role in decarbonisation, both in its operations and through broader supply chain optimisation. This offers direct benefits in the form of reduced costs, management of risks and business growth (Ivanova and Sanders, 2021). Greenhouse gas emissions are a serious concern for human civilization, with recent climatic change having had widespread impacts on human and natural systems. The central aim of the multinational climate agreement signed in Paris in 2015 was to restrict the rise in the global temperature to well below 2°C above pre-industrial levels while pursuing efforts to limit the increase to 1.5°C (Scheepmaker, 2021).

1.7 Theoretical Framework

The research hinges on Triple bottom line and Technological, Organisational and Environmental models as a theoretical frameworks. Triple bottom line (TBL) is an accounting framework that goes beyond traditional measures of profits, return on investment, and shareholder value to include environmental and social dimensions. The term was coined by John Elkington some 25 years ago as a challenge to business leaders to rethink capitalism (Elkington, 2018).

The Technology-Organisation-Environment (TOE) framework developed by Tornatzky and Fleischer is a useful theoretical lens to understand technology adoption within organisations (Kulkarni, and Patil, 2020). The TOE framework not only offers a framework that explains the decision to adopt a technological innovation based on technological considerations, but also in terms of the organisational and environmental contexts. The TOE is a classical framework that proposes a generic set of factors that explain and predict the likelihood of innovation/technology adoption (Jana, and Kaushik, 2022).

By focusing on comprehensive investment results such as performance along the interrelated dimensions of profit, people and the planet, Triple Bottom Line reporting can be an important tool to support sustainability goals (Liute, and De Giacomo, 2022). The Triple Bottom Line captures the essence of sustainability by measuring the impact of an organisation's activities on the world including both its profitability and shareholder value and its social, human and environmental capital (Edeigba, and Arasanmi, 2022). It can be used by businesses and local government agencies to gauge the level of environmental sustainability achieved by, for example, reducing the amount of solid waste that goes into landfills. In order to do away with the weakness of TBL conceptual model the Technological, Organisational and Environmental (TOE) is a classical framework that proposes a generic set of factors that explain and predict the likelihood of innovation/technology adoption. It posits that three enterprise contexts influence the adoption and/or implementation of innovations, namely, technology development (Ergado et al., 2021); organisational conditions or organisational reconfiguration and the industry environment (Kulkarni, and Patil, 2020). Technological innovation can occur internal or external to the organisation. In terms of the organisation, the measures relate to the structure and framework of resources, the size of the organisation and the scope of administrative work. The environment is made up of competing organisations and industry, as well as government regulations (Jere and Ngidi, 2020).

The overall goal of both these sustainable business strategic frameworks is to positively impact the environment, society, or both, while also benefiting shareholders. Business leaders are increasingly realising the power of sustainable business strategies in not only addressing the world's most pressing challenges but driving their firms' success. These frameworks that underpinned this study focus on the different strategies that lead to a sustainable fleet. The TOE and TBL were therefore used as theoretical lens to guide this study.

1.8 Significance of the study

Few studies have been conducted on sustainable transportation initiatives in South Africa, especially among government organisations. Therefore, it is envisaged that this study's findings and recommendations will contribute to the existing body of knowledge by identifying areas in which sustainable initiatives can be adopted and improved in the country's transport fleets. There is limited knowledge on governmental fleet decarbonisation and its contribution to climate change. The deterioration of the environment is becoming an important issue for society and business (Xie, and Sun, 2021) due to the adverse effects of global warming and the scarcity of natural resources (Yu, Lyu, Chen, and Choguill, 2021). Decarbonisation aims to reduce businesses' carbon footprint through various upward and downstream initiatives (Yu e t al, 2021). Since many factors affect climate change, businesses need to identify these, as they are critical for sustainability. These issues informed this study that analysed whether the organisation under the spotlight is sustainable and has identified appropriate initiatives to render its fleet more sustainable. The study is also significant as it assesses the impact fleet emissions have on citizens' well-being and identifies best practices that will not only benefit government institutions, but ultimately the communities they serve.

1.9. Research Methodology

1.9.1 Research Design

Research designs refers to the types of inquiry that include quantitative, qualitative and mixed methods approaches. A research design sets out the specific directions that a research will take, and is thus sometimes referred to as "strategy of research" (Creswell, 2020). Levitt et al. (2018:41) identify three common purposes of research, namely, exploration, description and explanatory. The methods used to conduct exploratory research include a literature review, interviews with experts on the subject and focus group interviews, while descriptive research calls for observation, case studies and survey methods.

This study adopted an exploratory case study design. Sekaran and Bougie (2019) define an exploratory design as a study where little information or knowledge is available on the phenomenon under investigation or when a new area of a topic is being investigated (Boolani, Allen, Barrios, and Sames, 2022). An exploratory design was appropriate for this study because sustainable fleet initiatives and the impact of decarbonisation is not a widely explored phenomenon and very little literature is available on this topic. Durrheim, Terre-Blanche and Painter (2018) state that exploratory studies are used to perform preliminary investigations into relatively unknown areas of research. This study was exploratory in the sense that it set out to identify sustainable initiatives, the benefits derived and the challenges the organisation faces in adopting sustainable logistics. A case study design is a method of investigating a contemporary phenomenon in a real life context. It allows the researcher to closely examine the phenomenon of interest within the context in which it occurs (Yin, 2019). Several researchers have used case study designs to examine real-life scenarios to provide a foundation for the application of ideas. A single-case or a multiple-case design may be adopted depending on the phenomenon that is explored (Sekaran and Bougie, 2019).

A case study approach was adopted to provide insight into the decarbonisation challenges V-Polizza faces; describe how the organisation can implement green transportation and identify the benefits that it will derive from decarbonisation. Secondary data was gathered to provide a perspective on the transport and logistics industry, and the concept of decarbonisation, and to identify best practices for a sustainable fleet for V-Polizza. As this research employed a qualitative approach, the researcher applied an inductive method to collect data in order to build a theory as opposed to testing an existing one through a deductive study (Bonner, Tuckerman, Kaufman, Costa, Durrheim, Trevena, Thomas, and Danchin, 2021). An inductive method is a strategy to derive generalisations from particular instances. Therefore, an interpretivist philosophy was adopted, which aligned with understanding the complexities associated with the individual interviewees.

1.9.2 Research Approach

A research approach is a plan and procedure based on broad assumptions that sets out detailed methods for data collection, analysis, and interpretation. It is, therefore, based on the nature of the research problem addressed. The research approach concerns more than just the type of data used; it focuses on the overall direction of the research and the types of conclusions that

will be drawn (Winchet, 2019). The three main research approaches are quantitative, qualitative and mixed-methods.

A quantitative approach is used to address a problem by gathering numerical data or data that can be transformed into useable statistics. This type of research uses measurable data to uncover facts and reveal patterns (Teherani, 2017). The qualitative approach leans towards exploratory research. It provides in-depth information on the problem which helps the researcher to develop ideas or propositions (Timans, 2019). Lastly, a mixed-methods approach is a combination of quantitative and qualitative research. This study adopted a qualitative approach to gain understanding of the research problem.

Schoonenboom (2017) defines qualitative research as research about exploring issues, understanding phenomena, and answering questions by analysing and making sense of unstructured data. This can be done by means of focus groups or in-depth interviews, as this type of research aims to acquire in-depth data. Semi-structured interviews were conducted to gather rich information from purposively selected participants in the organisation. A qualitative approach is most appropriate where little is known about a problem or when previous research only partially covered the research questions (Shorten, 2017). Given the lack of published research on this topic, it was deemed necessary to use a qualitative instrument to gain an initial understanding of the local context for efficiency improvements to police vehicles.

An interpretivist philosophy was adopted for this study. Interpretivism is a research methodology that focuses on individuals' beliefs and motivations to gain an understanding of social phenomena and culture. The researcher relied on the views of the interviewees, based on their experiences (Mackenzie and Knipe, 2016). Interpretivism requires researchers to interpret elements of the study and thus integrates human interest. Accordingly, interpretive researchers assume that access to reality (given or socially constructed) occurs only through social constructions such as language, consciousness, shared meanings, and instruments (Collins, 2018). This philosophy seeks to interpret social reality through the subjective viewpoints of the participants embedded within the context where the reality is situated.

1.9.3 Study Site

A research site is the place where research is conduced to obtain the required information; it is the physical location used to conduct primary research (Burke, 2020). The study took place in the KZN province in one of the Durban district police stations that was selected due to its ease of accessibility and the fact that it had a sufficient complement of departmental sections. Furthermore, it is representative of all V-Polizza stations in KZN.

1.9.4 Population

A population is generally a large collection of individuals or objects that is the main focus of a scientific inquiry (Shukla, 2020). The total population is 138595 police officer working for SAPS occupying different posts starting form constable to the commissioner of police (Mona, Chimbari, and Hongoro, 2019). A study's target population refers to the entire group of people who are of interest to the researcher (Sekaran and Bougie, 2016). In this study, the target population were personnel in various departments at the V-Polizza, provincial office. The targeted population constitute six hundred and seventy-three (673) employees, working at the provincial office.

1.9.5 Sampling Method

The method one applies to select participants is known as the sampling method. It is representative of the entire population to which the outcomes of the research can be applied (Alvin, 2021). Probability sampling and non-probability sampling are two types of sampling methods. In probability sampling, the known population is represented in the sample (Shukla, 2020). This means that each person has an equal probability of being chosen. Turner (2020) defined non-probability sampling as a sampling technique where the likelihood of any individual being selected cannot be calculated (Khalifa, 2020). This study used non-probability sampling that allowed the researcher to select participants with the most relevant information on climate change and decarbonisation initiatives, so as to gain an in-depth understanding of the phenomenon under investigation. This study aimed to identify the challenges experienced in relation to V-Polizza vehicles and the impact that implementing green transportation would have on state vehicles. A managerial-level perspective was required to explore this phenomenon from a strategic point of view.

Purposive sampling, also referred to as selective or subjective sampling, is virtually synonymous with qualitative research and was thus used in this study. The researcher selects a

sample of experts and subjects according to the topic and their skills in relation to it (Turner, 2020) based on their expertise and familiarity with the problem that is the subject of the research (Sekaran and Bougie, 2018).

Smith and Noble (2015) define bias as concentration on, or an interest in, one particular party or subject. Bias can be mitigated by using multiple people to code the data collected and by reviewing the findings with peers and checking for alternative explanations (Mishra, 2021).

1.9.6 Sample Size

The sample size defines the number of individuals included in a research study to represent a population. The sample size for this study was, six, namely, two senior managers in the supply chain management department, two personnel under fleet management and two of the senior management directly involved in decision making. The composition of the sample was congruent with the nature of the phenomenon under investigation (decarbonisation initiatives and green transportation). The sample size of six was reasonable as the intention was to also collect data using document analysis.

1.9.7 Data Collection Methods

Semi-structured interviews, which fit well with a qualitative research design, were conducted with expert participants to gather primary data. A semi-structured interview guide was formulated to guide the interviews. The recorded interviews were transcribed and thematic analysis was used to identify themes and patterns. Secondary data was collected by reviewing academic journals, textbooks, dissertations, theses and articles. Secondary sources like academic journals provide credible backup because they are peer-reviewed. Therefore, there was an in-depth understanding of the literature relating to the ground-breaking aspects of the study (Leedy and Ormrod, 2019).

1.9.8 Data quality control

According to Mast and Kemper (2009), data quality control measures the credibility and trustworthiness of the data. It establishes if a research measures what it is supposed to measure and ensures that it is measured in a consistent manner (Nowell, 2017). In this study, credibility was ensured by reviewing the transcribed text data and analysis before writing up the report (Shen, 2019). Conformability was promoted by keeping a journal, documentation and interview recordings (Scruggs, 2018). Lincoln and Guba (1985:107) note that, while it is “not the researcher’s task to provide an index of transferability, however, it is his or her

responsibility to provide the database that makes transferability judgments possible on the part of other researchers." In this study, transferability was ensured by thick descriptions in the form of a detailed account of the researcher's experiences during data collection. Lastly, credibility was ensured by recording the interviews and appreciating each participant's point of view.

1.9.9 Data analysis

Data analysis aims to obtain information that is practical and applicable. According to Nassaji (2015:132), it is "the art or science of examining raw data to draw conclusions about that information. It is imperative to understand the meaning of data, and data and information should not be confused. While these terms are often used simultaneously, their purposes are very different. According to Calzon (2022), data represents all available statistics, opinions, facts and predictions. Information represents interpreted, formatted and organised data, which is usable for decision-making (Cant and Van Heerden, 2017).

The primary data was analysed using thematic analysis. The raw data was categorised into themes, patterns, trends and relationships (Nowell, 2017). Data reduction was employed to analyse the data and convert it into meaningful, usable information. This enabled the researcher to ascertain which data was relevant to the research questions and achieve the objectives. Coding is an early step in the data analysis process that is defined by Calzon (2022), as the process of categorising and sorting data. Coding is used for content analysis by deriving keywords to identify patterns and interpret the meanings of the word patterns (Maguire and Delahunt, 2017). This was followed by data display, with the identified patterns depicted using both text and visual aids where necessary (Mortensen, 2021) before drawing and describing conclusions.

1.10 Ethical Considerations

Ethics refers to rules or standards that govern a relationship so that all those concerned benefit, with shared respect for the needs and wants of all the individuals involved (Calzon, 2022). The ethical principles that guide research include respect for people, beneficence and justice. These principles were upheld during the process of conducting the study to ensure that the participants were respected and protected from harm and that the study was conducted in a fair manner (Bhandari, 2022). The researcher applied for ethical clearance from the ethics committee at the University of KwaZulu-Natal before any form of primary research was undertaken. Before the interviews were conducted, participants signed an informed consent form that noted that they

would participate of their own free will. Before approaching prospective participants, gatekeeper permission was applied for, granting the researcher permission to collect data from the participants. Information obtained during the course of the study remained confidential and the participants were assured of anonymity. The secondary data collected for this study was referenced using the Harvard Referencing System as required by the University.

1.11 Conclusion

This chapter introduced and justified the study. It presented the research problem, which was the impact of fleet emissions, and also discussed the study's aim, the research questions and the rationale for the study. The research methodology employed to conduct the study was briefly discussed, as well as the study's significance.

1.13 Summary of chapters

The chapters are organised as follows:

Chapter One	**Introduction and Background** This chapter introduced and outlined the study. It presented the background to the study, defined relevant terms and concepts, and set out the research problem, theoretical framework, and research questions and objectives. The chapter also discussed the study's significance, preliminary research methods, ethical considerations, the limitations of the study and the structure of the dissertation.
Chapter Two	**Literature Review** Chapter two chapter presents a literature review on concepts relating to the study, including different perspectives on these concepts. It also presents the conceptual framework that underpinned the study.
Chapter Three	**Research Methodology** This chapter focuses on the research methodology used to achieve the study's objectives. It includes the research design, research approach/paradigm, study site, sampling design, target population, data collection methods, data analysis, data quality control, ethical considerations and the study's limitations.

Chapter Four	**Analysis, presentation and discussion of the findings** Chapter four presents and analyses the data collected from the participants. The data is interpreted in relation to the research objectives.
Chapter Five	**Discussion of results** This chapter discusses the findings from the literature review and the main study.
Chapter Six	**Recommendations and conclusions** Chapter six summarises the study and outlines the main findings with regard to the research objectives. It closes by offering recommendations.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter reviews the literature relevant to this study to provide insight into the benefits and challenges of decarbonisation and how sustainability through transportation can be achieved. Labaree (2009) describes a literature review as a comprehensive summary of previous research on a topic. It surveys scholarly articles, books, and other sources relevant to a particular area of research and combines a summary and synthesis. This review focuses on key concepts of decarbonisation relating to climate change mitigation, including the reduction of CO_2 and efforts towards net-zero emission by (1) examining progress in the literature over time, (2) identifying the literature's geographical locus and sectorial focus, and (3) determining the interrelationships between the key concepts. The literature review highlights key cost-effective options for decarbonisation of the transport sector and identifies knowledge gaps.

2.2 Background of the review

Globally, governments are investigating transport solutions that not only reduce national emissions but also decrease their reliance on energy imports and increase clean air in cities and towns (Caetano, Merven, Hartley, and Ahjum, 2017). A transition in the transport sector is seemingly inevitable considering these priorities. Technology and behaviour change has been a focus of the international literature on transport options to mitigate climate change (Baumeister, 2020). Options that use electricity and hydrogen fuel cells have the potential to play a major role in decarbonising the transport sector (Oshiro, and Fujimori, 2022). Mitigation scenarios for cities and at the national and regional level emphasise the importance of behaviour change.

Emissions from the transport sector account for 10.8% of South Africa's total GHG emissions, with road transport responsible for 91.2% (Lalendle, Goedhals-Gerber, and van Eeden, 2021). Should these trends continue, in the absence of policies and measures, the transport sector is projected to emit a total of 136 Gg CO_2 by the year 2050 (Olojede, 2021). Decarbonising transport is a significant challenge, as it is one of the major sectors where emissions are well above their 1990 levels, and increased by about 33% over the same period (Di Silvestre, Favuzza, Sanseverino, and Zizzo, 2018). However, they have started to fall recently due to high oil prices and improved vehicle efficiency. More than two-thirds of transport-related GHG

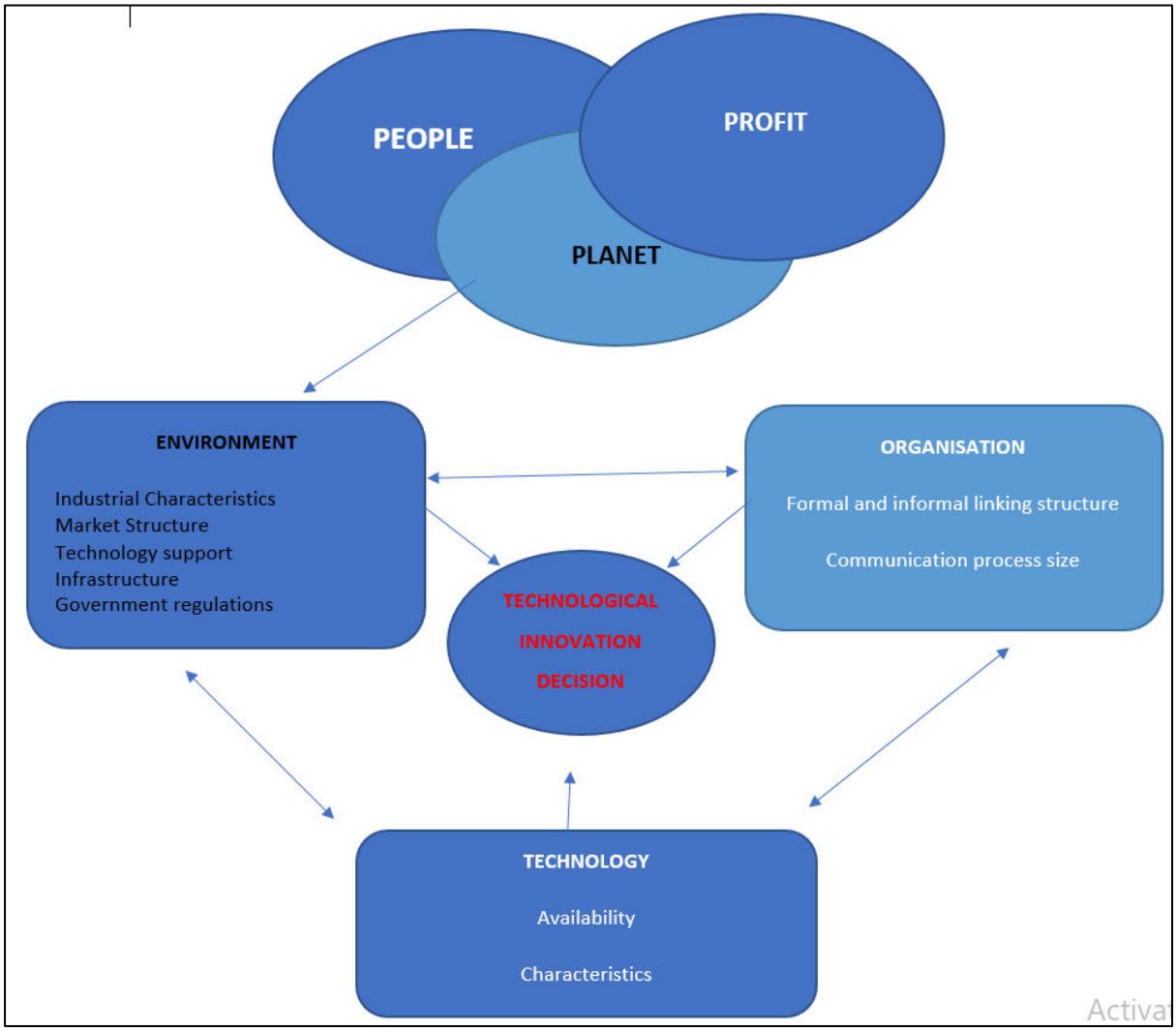
emissions are from road transport. This places the transport sector second only to the energy sector in terms of emissions volume. These figures represent direct emissions, principally consisting of tailpipe emissions. If indirect GHG emissions associated with the transport sector were to be included, such as those associated with fuel refineries and electricity generation for transport, they would be substantially higher (Crippa, Solazzo, Guizzardi, Monforti-Ferrario, Tubiello, and Leip, 2021).

Companies seek to improve their image and reputation by embracing sustainable initiatives. Sustainability aims to satisfy the company's current needs without compromising future availability (Bartolacci, Caputo, and Soverchia, 2020). Sustainability efforts are mainly triggered by climate change, which refers to the average weather conditions in a location over many years. A shift in such conditions indicates climate change (Wang and Zhang, 2022). Rapid climate change is caused by people using oil, gas and coal for their homes, factories and transport. When these fossil fuels burn, they release GHG that harm the environment (Shen, Huang, Chen, Song, Zeng, and Zhang, 2020). While V-Polizza has been pursuing sustainable practices such as supporting crime prevention through environmental design initiatives it has not focused on decarbonisation and the damage its fleet does to the environment; hence, the importance of this study.

2.3 Theoretical Framework

In the mid-1990s, John Elkington developed a new framework to measure sustainability performance in corporate America. This accounting framework, called the Triple Bottom Line (TBL), goes beyond traditional measures of profit, return on investment, and shareholder value to include environmental and social dimensions (Slaper, 2011). On the other hand, the Technology-Organization-Environment (TOE) model hinges on proper technology, organizational, and environmental factors. The study presents a theoretical framework where Triple Bottom Line is incorporated within the TOE. As such, Figure 2.1 shows the link between the Triple Bottom Line and Technological, Organisational and Environmental model that guided this study.

Figure 2-1: Triple Bottom Line incorporated with the TOE



The figure 2.1 shows that by focusing on comprehensive investment results such as performance along the interrelated dimensions of profit, people and the planet, Triple Bottom Line reporting can be an important tool to support sustainability goals (Liute, and De Giacomo, 2022). The Triple Bottom Line captures the essence of sustainability by measuring the impact of an organisation's activities on the world including both its profitability and shareholder value and its social, human and environmental capital (Edeigba, and Arasanmi, 2022). It can be used by businesses and local government agencies to gauge the level of environmental sustainability achieved by, for example, reducing the amount of solid waste that goes into landfills. However, a local mass transit company might measure success in terms of passenger miles, while a for-profit bus company would measure it in terms of earnings per share (Choi, and Chen, 2022). The TBL can accommodate these differences. It is a business concept that posits that firms should commit to measuring their social and environmental impact. The environmental

variables should represent measurements of natural resources and reflect potential influences on their viability. They could incorporate air and water quality, energy consumption, natural resources, solid and toxic waste, and land use (Fernandes, 2022). Determining long-range trends for each of the environmental variables would help organisations to identify the impacts a project or policy would have on the area. The main weakness of the TBL is that it does not provide specific guidelines; thus, businesses that may decide to adopt it have no idea where to start and how to track their progress. This raises the risk of businesses pay lip-service to sustainability while doing little by way of concrete action. In short, the TBL by itself lacks both accountability and practicality.

In order to do away with the weakness of TBL conceptual model the Technological, Organisational and Environmental (TOE) is a classical framework that proposes a generic set of factors that explain and predict the likelihood of innovation/technology adoption. It posits that three enterprise contexts influence the adoption and/or implementation of innovations, namely, technology development (Ergado et al., 2021); organisational conditions or organisational reconfiguration and the industry environment (Kulkarni, and Patil, 2020). Technological innovation can occur internal or external to the organisation. In terms of the organisation, the measures relate to the structure and framework of resources, the size of the organisation and the scope of administrative work. The environment is made up of competing organisations and industry, as well as government regulations (Jere and Ngidi, 2020).

The overall goal of both these sustainable business strategic frameworks is to positively impact the environment, society, or both, while also benefiting shareholders. Business leaders are increasingly realising the power of sustainable business strategies in not only addressing the world's most pressing challenges but driving their firms' success. However, defining what sustainability means, setting clear, attainable goals, and formulating a strategy to achieve those goals can be daunting. These frameworks that underpinned this study focus on the different strategies that lead to a sustainable fleet. The TOE and TBL were therefore used as theoretical lens to guide this study.

2.4 Supply Chain Management

Over the past decade, traditional purchasing and logistics functions have evolved into a broader strategic approach to materials and distribution management known as SCM. The lack of a universal definition of SCM is in part due to the way in which the concept of the supply chain has evolved as it has been considered from different points of view in different studies

(Müßigmann, von der Gracht, and Hartmann, 2020). Its multidisciplinary origins make it difficult to come up with a universal definition of SCM.

A supply chain is defined as a set of three or more entities directly involved in the upstream and downstream flow of products, services, finances, and information from a source to the customer (Yunani, and Supriadi, 2020), while SCM is the systematic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purpose of improving long-term performance of the individual companies and the supply chain as a whole (Yunani, and Supriadi, 2020). These definitions show that a supply chain is based on two core concepts and that the organisations that constitute it are linked together through physical and information flows. Physical flows involve the transformation, movement, and storage of goods and materials that are the most visible elements of the supply chain. However, information flows are just as important as they enable the various supply chain partners to coordinate their long-term plans, and to control the day-to-day flow of goods and materials up and down the supply chain (Müßigmann et al, 2020).

The most recent definitions of SCM include most components in commerce. Langley (2018:17) states that it is "the science and art of integrating marketing, production, logistics and financials throughout the entire chain, from the supplier's supplier to the customer". According to Min, Zacharia, and Smith (2019:45), SCM is "the systematic, strategic coordination of the traditional business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole." It enables organisations to collaborate to achieve efficiencies and a successful flow of products throughout the supply chain. Through collaboration, they are able to collectively gain a better understanding of future demand and plan how to best satisfy such demand (Bentaher and Rajaa, 2022). Müßigmann et al (2020), suggests that, from an integrative philosophical perspective, SCM directs supply chain members to focus on developing innovative solutions to create unique, individualised sources of customer value.

Some authors have divided the evolution of SCM into stages (Shen, Hu, Günay, and Kremer, 2020). Shen e t al (2020) identified three stages. In the creation era (1980s), the buyer-supplier understood the benefits that a cooperative relationship offers. This is when SCM was first encountered. During the integration era, IT systems (Enterprise resource planning, Electronic

Data Interchange, etc.,) were introduced. These systems focus on managing not only the resources of the individual firm but also those of the integrated supply chain. The globalisation era started with the adoption of trade liberalisation policies and the establishment of international institutions such as World Trade Organisation (WTO) and others that deal with global/regional trade policies. Due to the fact that previous conceptions of SCM are not sufficiently efficient and competitive in the new environment, new concepts and management strategies are emerging. The evolution of SCM points to significant changes in the way firms operate in the supply chain. It should be noted that, linkages between the factors have influenced the evolution of SCM and the factors that impact supply chain performance because with the evolution of SCM, supply chains' performance has been enhanced (Durach, Kembro and Wieland, 2017).

Although scholars view SCM from different perspectives, its main purpose is to provide a strategic tool to build and enhance sustainable competitive advantage by reducing costs without compromising customer satisfaction (Ghisolfi, 2022). Moreover, understanding the environmental pressures that drive SCM, noting the barriers and devising solutions enables a supply chain to maintain competitive advantage (Dai, Xie, and Chu, 2021). The main goal of a supply chain is leveraging the expertise, experience, skills and capabilities of the partners that comprise this competitive network (Ghisolfi, 2022). The latest trend in the evolution of SCM is supplier relations that transcend national boundaries and extend to other continents (Handfield, 2021). Green SCM (GSCM) is the latest concept in the literature on SCM. Firms are much bigger than they used to be and have achieved economies of scale. With the advent of trade liberalisation policies they are internationalising their businesses to identify the most cost-effective inputs and grow the markets to sell their products (Tseng, 2019). Traditional conceptions of SCM are not sufficient in these new circumstances, leading to the emergence of new strategies such as GSCM. An integrated supply chain offers considerable competitive advantage to the individual actors participating in it and developed economies are thus witnessing a shift from firm-firm competition to chain-chain competition (Shen e t al, 2020; Dai e t al., 2021).

Well-planned and executed logistics services are required to effectively manage a supply chain. Logistics is a crucial element of SCM as it involves shipping the goods throughout the supply chain. It manages a network of activities with the main aim of creating an uninterrupted flow of inventory within a logistics channel and enabling organisations to meet their customers' needs (Yunani and Supriadi, 2020).

2.5 Evolution of Logistics

Logistics was first examined from an academic perspective between the late 1960s and the early 1970s. According to Fisher-Holloway (2022)., logistics is a business concept that is related to various areas, including production/operations, marketing and quality. For Rodrigue, (2020). logistics involves the study of how management can provide the best distribution services to customers and consumers through planning, organisation and effective control of supply, storage, handling and distribution activities which control the flow of material from suppliers to end users (Rodrigue, 2020). Thus, logistics refer to strategic management of movement, storage and information relating to material, parts and finished goods in a supply chain through the stages of procurement, work in progress and final distribution (Fisher-Holloway, 2022).

Pérez (2019) adds that the concept of logistics emerged when the post-war economy came to be dictated to by the market and customer issues became more visible. During this period, logistics functions were considered as support operations, with no interface or coordination with other business functions (marketing, finance, and human resources, among others), generating duplication of work and wastage (Rodrigue, 2020). Prior to the 1950s, logistics was thought of in military terms as it had to do with procurement, maintenance, and transportation of military facilities, material, and personnel (Feng and Ye, 2021). According to Rodrigue (2020), historically, the academic and business worlds referred to logistics using various terms, such as physical distribution, materials management, distribution, logistics management of materials, or engineering of distribution. All of these terms concerned management of the flow of material or goods from the point of origin to the point of consumption.

Thus, logistics involves information integration, transportation, inventory level, warehousing, material handling and packaging (Feng and Ye, 2021). The challenge is to coordinate individual task-specific knowledge into an integrated competency focused on customer service (Pérez, 2019). Collaboration is an essential element in integration, as strategic collaboration is required to enable communication of cross-functional logistics activities and joint efforts between business partners (Rodrigue, 2020). Wudhikarn (2018) adds that, in general, logistics is increasingly focused on the efficiency and effectiveness of the performance of logistics activities and, as a result, on organisational performance. Therefore, logistics is the part of the supply chain process that efficiently and effectively plans, schedules, and controls the shipment, reverse flow, and storage of goods and services, as well as related information flow, between the point of origin and that of consumption, in order to meet the needs and/or wishes

of customers ((Feng and Ye, 2021).). However, Akbari (2018) notes that companies should focus on their core business and can outsource logistics activities.

Organisations tirelessly seek to secure their position in the market and sound logistics management can assist in this regard. Logistics is a link between the market and the company and between the company and its suppliers. The better logistics management is, the faster the company's response to the market will be (Feng and Ye, 2021).

Furthermore, companies are constantly seeking to reduce costs with regard to production (manufacturing), distribution (transportation), and consumption (retail) to improve their margin and competitiveness, and increase their market share. This is commonly done by opting for specific locations and types of facilities (Albertone, 2018).

Production is the responsibility of an institutional unit that uses inputs of labour, capital, and goods and services to produce outputs of goods or services (Pérez, 2019). Outsourced logistics promotes the effectiveness of individual systems, and safely and reliably undertakes tasks in compliance with agreed, defined work schedules. Logistics collaboration has been defined as a business process whereby two or more supply chain partners work together towards common goals and mutual benefits (Akbari, 2018). Many businesses around the world have been practicing supply chain collaboration for many years for improved business performance such as reduced costs and increased profit. The major objective of supply chain collaboration is to create synergies for competitive advantage among supply chain partners through sharing information (Albertone, 2018).

Physical distribution is the facet of business management that is responsible for the movement of raw materials and finished products, and development of a system to do so. The study and practice of physical distribution and logistics emerged at a later stage. The main functions of physical distribution include customer service, order processing, inventory control, transportation, and logistics and packaging (Richards, 2018). It is capable of creating a competitive advantage for organisations. Effective distribution is so crucial that practices such as just in time inventory have become an integral part of supply chain and inventory management. Overall, successful distribution involves many moving parts and methods, calling for a strong distribution management strategy fuelled by real-time information. Distribution includes activities and processes such as consumer or commercial packaging, order fulfilment and order shipping (Champion, 2022). Distribution management is first and

foremost about organising everything involved in getting goods to the buyer in a timely fashion with the least amount of wastage. Therefore, it has a direct impact on profits (Silva, 2020).

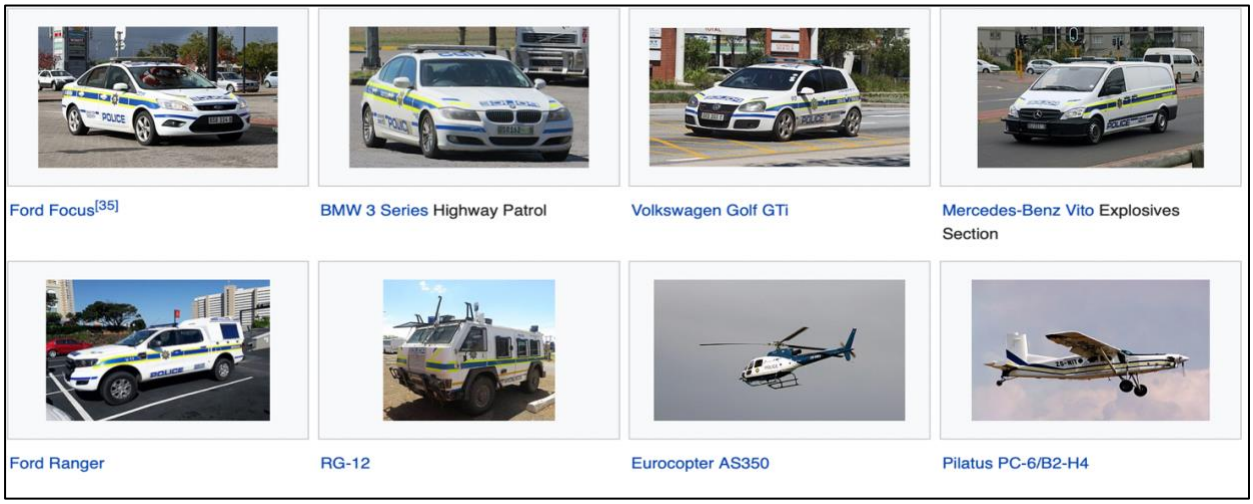
The Council of Logistics Management (2017), a trade organisation based in the United States, describes logistics as the aspect of SCM that plans, implements and controls the efficient and economical flow and storage of raw materials, inputs, semi-finished work or work in progress and finished products, from the point of origin to the point of consumption, in order to meet customer requirements. While it was first associated with the military, this definition limits such activities to business enterprises (Wood, 2019). Logistics thus implies coordination of a number of separate activities.

In the military, logistics involves preparation for war through the transfer of the nation's potential to its armed forces in time of peace as in times of war (Denman, 2020). It is thus not the act of waging war but channelling, distributing, and maintaining the supplies required in the event of one. First adopted to guarantee a supply line in war, logistics now pervades political and economic life (Chersich, 2019). The logistics of police power involves the movement of weapons, supplies, and practices between the military and the police. This exchange involves circulating objects and overlapping geographies that persist in the present (Denman, 2020).

Law enforcement presents unique challenges to logistics managers, such as equipping patrol vehicles with power-intensive equipment; managing dynamic driving behaviour; and catering for the needs of patrol personnel. Hard working police and security officers need hard working, modified vehicles to help keep the community safe and secure (Shange, 2017).

With challenges like attending accident scenes, getting to a crime scene as fast as possible, dealing with reckless and negligent driving, patrolling, and managing public gatherings and demonstrations, the police have their work cut out for them. A reliable and safe vehicle is thus of the utmost importance. The following modes of transportation are used for the logistics of the organisation:

Figure 2-2: Modes of transportation used for the logistics of the organisation



Source: (SAPS, 2019)

The use of these vehicles causes harm to the environment. Sustainable logistics management aims to ameliorate such harm (Denman, 2020). It should promote efficient driving and reduce unnecessary idling, minimise a fleet's carbon footprint, optimise routes, practice proactive vehicle maintenance and work to integrate electric vehicles (EVs) into logistics operations (Mthabini, 2020).

Logistics sustainability refers to activities centred around reducing the environmental, economic and social impact of fleet vehicles, including strategies such as asset tracking, fuel-efficient driving, reduction of idling and carbon emissions, adoption of low- or zero-emission vehicles, right-sizing to meet fleet needs, vehicle pooling or car sharing, reducing total trips, and considering alternative modes of transportation (Mthabini, 2020). Sustainable logistics management is the practice of operating a fleet with a specific focus on the long-term viability of profit, the planet, and people – otherwise known as the TBL. The TBL seeks to gauge an organisation's level of commitment to social responsibility and its impact on the environment (Denman, 2020). Keeping tabs on financial, environmental, and social performance over time enables the organisation to account for the full cost of doing business. It also enables business challenges to be balanced for the best possible monetary and ethical outcomes (Shange, 2017). After all, the goal is to meet current consumers' needs, while ensuring that future generations will be able to meet theirs.

Developing a sustainable logistics management strategy can reduce operational costs and create greener fleets. The less fuel and resources vehicles use to complete routes, the less it costs in fuel spend, vehicle downtime, wear and tear, and repairs. Reducing fuel consumption is the most effective way of safeguarding valuable resources and protecting the environment (Mthabini, 2020). Reducing CO_2 and NOx emissions decreases an organisation's carbon footprint and helps it achieve its green goals. In the race to profitability, fleet operators have tended to put sustainability on the back burner. However, as part of government-driven sustainability policies, the transport and logistics sector has come under pressure to meet sustainability targets or face the consequences (Albertone, 2018).

2.6 Global Perspective of Logistics

Langley, Novack, Gibson, and Coyle (2020) notes that the globalised market has given rise to technological innovations, shorter product life cycles and constant changes in consumer profiles and behaviour, which affect the overall business environment. Business processes have become more specialised, with some activities outside the business domain being developed by partners. These changes also influence the operations of logistics companies as companies need to focus on their core competencies, and many outsource their logistics activities to specialised entities (Katiyar, 2018). Arvianto, Sopha, Asih, and Imron (2020) observe that there has been an increase in supply chain complexity because the best supplier may be on the other side of the world and customer expectations, needs or wants are often scattered. Arvianto e t al (2020) points out that in this context, competitive advantage can be gained by an organisation differentiating itself from its competitors in terms of customer perceptions and the ability to operate at low cost with higher profit in different processes and activities that add value to the products and/or services available to the final consumer (Langley e t al., 2020).

Langley e t al., (2020), observes that global economic developments have resulted in fields that previously worked differently such as procurement, logistics, and operations management converging in SCM. This supports Ralston, Schwieterman, Bell, and Ellram (2023) assertion that supply chain competition overlaps with competition between individual companies, and that only when the supply chain achieves high levels of competitiveness can the company envision its long-term sustainability in the market. In this environment marked by the complexity of logistics services, coupled with the need to reduce costs and improve the level of customer service, logistics has become an area capable of streamlining organisational resources and optimising companies' production processes (Ralston e t al, 2023). This new

environment led to the growth of logistics outsourcing, giving rise to logistics operators that specialise in carrying out logistics activities and have the necessary knowledge to make the best use of available tools, enabling companies to focus on their core activities (Langley e t al.,2020).

Sustainability has become a topical issue and logistics can play a major role in sustainable operations and a sustainable supply chain. Logistics plays an important role in sustainable operations management (Müßigmann et al., 2020). Most of the cited articles on sustainable development are related to logistics and sustainable supply chains (Wichaisri and Sopadang, 2018). Differentiation between logistics management and management of supply chains has been the focus of the literature (Katiyar, 2018). A further issue is the difference between the terms 'green' and 'sustainable'. While sustainability is a more comprehensive concept that involves the integration of social, economic and environmental dimensions 'green' refers specifically to the environmental dimension (Abdalla, 2016).

However, the concept of sustainable logistics remains under-researched and there is no systematic definition of this concept. Decarbonisation is part of this concept, especially to address the least studied dimension of sustainability, the social one.

2.7 Climate Change

Climate change is a change in the usual weather in a particular place. It could be a change in the level of rainfall in a year or in the usual temperature for a month or season (May, 2017). Climate change describes a change in the average conditions — such as temperature and rainfall — in a region over a long period of time (NASA, 2022). It is expected to have significant implications for the global economy and, more broadly, for many areas of human activity. Estimating the impacts of climate change is key to any discussion of mitigation or adaptation policies (Rosen, 2021). In order to decide whether or not action is needed, and to select a target, policymakers need be aware of the cost of inaction and how the cost of mitigation policies weighs against the benefits of acting.

However, numerous uncertainties surround the impacts of climate change. There are at least five sources of uncertainty: GHG emissions projections; the accumulation of emissions in the atmosphere and how the resulting concentration will affect the average global temperature; the physical impacts of a given increase in temperature, particularly in terms of non-market impacts, such as on health; valuation of physical impacts in terms of gross domestic product

(GDP); and the risk of abrupt climate change that would trigger irreversible impacts (Chersich, 2019).

These uncertainties are not fully reflected in existing monetary estimates of global impacts. First, most do not consider the risk that a given level of GHG concentration may lead to exceptionally high increases in temperatures. Second, existing global estimates do not consider the whole range of possible impacts and the uncertainty surrounding them (Thompson, 2016), particularly the risk of severe impacts. In theory, adaptation constitutes a downward risk to estimates of the impact of climate change. However, since treatment of adaptation varies across studies, the extent of this downward risk is unclear. In any case, it is unlikely that a downward risk could offset the upward risk stemming from the incompleteness of the estimated impacts. Despite these uncertainties, the literature suggests that the impacts of climate change could be severe. Moreover, although GHG concentration can be reversed by reducing emissions, at least over a sufficiently long period of time, some of the impacts of climate change will be irreversible (Thompson, 2016).

Climate change involves not only global warming but other physical changes such as precipitation, the intensity and frequency of storms and the occurrence of droughts and floods. A report by the Intergovernmental Panel on Climate Change (IPCC, 2017) based on the most recent research attributes most of the observed increase in global average temperatures since the mid-20th century to anthropogenic causes with a probability of more than 90%. It also identifies a range of already observed impacts of climate change. A relatively large number of studies have attempted to estimate the impact of climate change in specific areas using various methodologies. The typical approach of early studies was a climate model that projects climate change for a given level of CO_2 concentration (generally, a doubling from the pre-industrial level) (Balendran, 2021). These studies estimate the static and physical impacts of climate change on 'today's world', mainly relating to modest increases in temperatures, and cover a limited number of regions, often only the United States (Song,2021).

The growing impact of climate change and increased public awareness of environmental issues have become important drivers of political and social change. Cities are vulnerable to climate change, but they are also uniquely positioned to lead the way in both mitigating and adapting to it. While there is no single solution to climate change, cities have a responsibility to transition towards a more sustainable future (Carson, 2020). Although many regions, both rural and urban, are experiencing warming trends, localised effects from urbanisation and the urban heat

island effect will increase thermal stress and vulnerability considerably more in urban areas than in rural areas. It is thus crucial for cities to measure the impacts of both large-scale and local drivers of climate change in their environments, recognising that these effects should not be treated independently (Balendran, 2021).

In addition to increases in global temperature and the additional heat in cities resulting from the urban heat island effect, more extreme winter temperatures and storms are expected, increasing energy demand for heating and cooling. Given higher energy consumption in cities, they are the source of as much as 80% of global GHG emissions (Song,2021). Climate change will affect urban energy production and delivery and rising sea levels and storm surges associated with climate change will increase the vulnerability of power plants along coastlines (Harper, Cunsolo, Babujee, Coggins, Aguilar, and Wright, 2021).

The public transportation sector is a development priority for cities (Carson, 2020). While there are considerable variations in urban design and development practices for this sector around the world, in recent decades, climate change has sparked efforts to find ways to minimise dependence on the automobile in urban areas (Balendran, 2021). Although there are many advantages of using public transportation, research tends to focus on its ability to reduce GHG emissions. "By reducing the growth in vehicle miles of travel, easing congestion and supporting more efficient land use patterns, public transportation can reduce harmful CO_2 emissions by 37 million metric tons annually. These savings represent the beginning of public transportation's potential contribution to national efforts to reduce greenhouse gas emissions and promote energy conservation" (Kumar and Alok, 2020). Those who use public transportation not only reduce their carbon footprint through conserving energy and reduced GHG emissions, but create benefits for those around them (Song, 2021). The result is fewer kilometres travelled in personal vehicles, reduced emissions, less time spent in traffic jams, and greater fuel efficiency from less congested roads (Balendran, 2021). Improvements to public health are another benefit of supporting alternative transportation options such as walking or cycling. Access to alternative transportation not only improves public health, but can also address air pollution, increase housing values, contribute to a sense of place and community, promote economic development in an area, and save households money (Fitchett, 2021).

While the current portrayal of climate change is linked to increased release of atmospheric GHG and uncertainty in relation to environmental change, its potential effect in South Africa is of increasing concern. Globally, climate change leads to an increase in CO_2 as well as other

gases, which ultimately allows sunlight to reach the surface of the earth, but creates a barrier that prevents infrared or heat radiation from escaping to space. The increase in CO_2 will lead to an equilibrium earth warming of about 2°C to 4°C. Climate change will cause sea levels to rise and extreme climatic events, and winters will become warmer. It will have a significant impact on key sectors in South Africa such as water, agriculture, and biodiversity (Balendran, 2021). Annual temperatures in the country have increased by at least 1.5 times, and globally, by 0.65°C over the past five decades. This will negatively impact water resources, food security, health, infrastructure and the environment, including biodiversity and ecosystems. The anticipated impacts of climate change in the key sectors are as follows (Fitchett, 2021):

- Biodiversity: The grassland biome could face considerable infringement by woody vegetation due to the increase in temperature as well as the increase in CO_2.

- Agriculture: Climate change will increase demand for irrigation. Crops may be negatively influenced since rainfall levels may change during summer and winter.

- Water: The likelihood of floods and droughts will increase, negatively impacting health and the economy.

As climate change moves up the global agenda, fleet companies are taking a closer look at their CO_2 emissions. Many businesses are being proactive and changing their practices - a smart move for multiple reasons (Song, 2021).

2.8 Sustainability

Sustainability has become a subject of increasing concern to academics and practitioners in recent years. Increasing demand for environmentally and socially responsible products and services and concerns pertaining to climate change have encouraged supply chains to focus on sustainability. The importance of sustainability has been widely recognised by researchers and practitioners (Comin, 2019) and 95% of the 250 largest companies in the world (G250 companies) now report on their sustainability activities, with 62% of them offering sustainable products (KPMG, 2021). While an increased number of studies have examined sustainability, Sustainable Supply Chain Management (SSCM) is a fairly new concept.

The table below traces the different meanings of sustainability over the years.

Table 2-1: Meanings of sustainability

Reference	Sustainability Definition	Rationale
Brundtland (1987)	"Meeting the needs of the present without compromising the ability of future generations to meet their own needs."	Three different areas of sustainability are normally distinguished: the environmental, the social, and the economic. Several terms are used for this concept in the literature: authors may speak of three pillars, dimensions, components, aspects, perspectives, factors, or goals, but all mean the same thing in this context.
Costanza, Daly, and Bartholomew (1991:8), cited in Gladwin et al.	"Sustainability is a relationship between dynamic human economic systems and larger dynamic, but normally slower-changing ecological systems, in which (a) human life can continue indefinitely, (b) human individuals can flourish, and (c) human cultures can develop; but in which effects of human activities remain within bounds, so as not to destroy the diversity, complexity."	Functional systems view; maintaining ecological life support systems; no socio-economic systems without eco-systems.
Dyllick and Hockerts (2002: 131)	Corporate sustainability is "defined as meeting the needs of a firm's direct and indirect stakeholders (such as shareholders, employees, clients, pressure groups, communities etc.), without compromising its ability to meet the needs of future stakeholders as well."	Grow corporate economic, social and environmental capital base; understand organisational success as the 'triple bottom line' (Elkington, 1994).
Boudreau and Ramstad (2005: 129)	"Achieving success today without compromising the needs of the future."	Grow human capital; understand organisational success beyond the financial bottom line.

The most commonly accepted definition of sustainability is: “meeting the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland 1987). According to the Council of Supply Chain Management Professionals (2016: 191), corporate sustainability refers to the efforts a company makes to conduct business in a socially and environmentally responsible manner. It includes elements such as sustainable development, corporate social responsibility (CSR), stakeholder concerns, and corporate accountability. Many of the definitions are derived from the TBL (Elkington 1997) which is the most prevalent concept in the literature that considers sustainability as at the intersection of a firm’s economic, social, and environmental goals. There are various definitions of SSCM. Seuring and Muller (2008: 1700) describe it as “the management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, economic, environmental and social, into account which are derived from customer and stakeholder requirements”. Carter and Rogers (2008: 368) offer a similar definition of SSCM: “the strategic, transparent integration and achievement of an organisation’s social, environmental, and economic goals in the systemic coordination of key interorganisational business processes for improving the long-term economic performance of the individual company and its supply chains”. Pagell and Wu (2009: 38) state that a sustainable supply chain is “one that performs well on both traditional measures of profit and loss as well as on an expanded conceptualization of performance that includes social and natural dimensions”. The common theme in these definitions is that they embrace a TBL perspective.

Sustainability programmes are playing an increasingly important role in planning and management within companies and across supply chains. Linton et al. (2007) notes the increasing attention paid to sustainability in supply chains. Guest’s (2022) review of the literature on GSCM highlights the importance of this new concept. Mohammad-Hosseinpour and Molina’s (2022) meta-analysis of more than 20 years of research on environmentally friendly supply chain practices found a positive and significant relationship between these practices and firm performance. The development of sustainable products and services requires a joint effort by all members of the supply chain (Vasileiou and Morris, 2006). Therefore, sustainability is more of a supply chain issue than an organisational matter (Konchou, Koholé, Tchuen, and Tchinda, 2022). Although SCM focuses on cost, quality, delivery, flexibility and innovation as main sources of competitive advantage (Krause, 2001), social and environmental sustainability are becoming additional drivers of competitiveness (Pullman, 2009; Ashby,

2012). It has been recognised that promoting sustainability is a key differentiator in the supply chain versus supply chain competition (Tracey, 2004).

Adoption and development of sustainability has moved from specific organisations to the entire supply chain (Tracey, 2004; Linton, 2007) and sustainability is playing an increasingly crucial role in designing and managing such chains (Kleindorfer, 2005; Srivastava, 2007; Golicic and Smith, 2013). Considerable research has been conducted on sustainability issues in the supply chain context. Early studies focused on socially responsible buying and environmentally friendly purchasing. Drumwright (1994) explored why socially responsible buying behaviour with respect to the environment takes place in organisations. Min and Galle (1997) examined the effect of environmental partnerships in supplier selection decisions. Later research investigated barriers to and triggers of sustainability and proposed a framework for SSCM.

Bansal and Roth (2000) investigated the motivation and contextual factors that induce environmental sustainability in firms. Bansal (2002) highlighted the challenges confronting companies in implement sustainability practices, while Dyllick and Hockerts (2002) examined the three facets of sustainability (environmental, social, and economic) and discussed how a company can achieve sustainability. Linton (2007) notes the increasing role of sustainability in supply chains. Carter and Rogers (2008) introduced a framework for SSCM that expands the concept of sustainability from the company to the supply chain level. Seuring and Muller (2008) offered a literature review on SSCM and outlined major lines of research in the field. Similarly, Carter and Easton (2011) reviewed the SSCM literature and identified the trends in the field. The most recent studies focus on the effects of consumers on SSCM. Bask (2013) identified consumer preferences for sustainability and their impact on SCM, while Wolf (2014) examined the relationship among SSCM, stakeholder pressure and corporate sustainability performance. Sigala (2014) explored consumers' role in managing sustainability throughout a supply chain.

In short, environmentally sustainable companies preserve natural resources, minimise waste, and reduce emissions (Krause, 2009). Environmental sustainability issues in supply chains have been extensively studied, with a focus on energy consumption (Van Hoek and Johnson, 2010; Ingarao, 2012); water usage issues within supply chains (Reich-Weiser and Dornfeld, 2009; Aviso, 2011); green product development and innovation (Tracey, 2004; D'angelico and Pujari, 2010; Isaksson, 2010; Chen and Chang, 2013); environmental and reverse supply chain management (Erol, 2010; Eng-Larsson and Kohn, 2012; Kim and Lee, 2012); material usage

and selection (Mayyas, 2013; Lindahl, 2014); and green supply chain practices (Sarkis, 2012; Perotti, 2012; Morali and Searcy, 2013; Gimenez and Sierra, 2013).

However, most previous research examined environmental sustainability practices, with the social dimension of sustainability receiving little attention (Pagell and Wu, 2009; Pfeffer, 2010; Wolf and Seuring, 2010). Many authors call for future research to examine social sustainability (Pullman, 2019; Sarkis, 2013). While environmental sustainability emphasises management of environmental effects, social sustainability is concerned with management of social effects, including employees' working conditions, relationships with communities and social values (Sarkis, 2013).

A growing number of companies are taking action to become more sustainable, and most logistics companies are looking into decarbonising, reducing emissions and embracing this as an opportunity to drive innovation, increase competitiveness, and stimulate resilient growth.

2.9 Decarbonisation

Decarbonisation refers to the process of reducing carbon dioxide (CO_2) emissions resulting from human activity (Engie, 2021). The current (and optimistic) objective of decarbonisation is to, eventually, eliminate CO_2 emissions. To achieve deep decarbonisation, organisations need to rethink how they produce and consume energy and undergo a radical shift to renewables and low carbon energy sources (Bank, 2022).

There is strong consensus in the literature that reaching near-zero emissions is much more challenging — and may require a very different mix of resources — than comparatively modest emissions reductions (50-70% or less) (Zachman, 2022). Planning and policy measures should therefore focus on long-term objectives (near-zero emissions) in order to avoid costly lock-in of suboptimal resources. In addition, there is strong agreement that a diversified mix of low-CO_2 generation resources offers the best chance of affordably achieving deep decarbonisation (Zachmann, 2022). Many studies conclude that a reduction of power sector CO_2 emissions by a half to two-thirds can be achieved with a mix of commercially available technologies—namely, by replacing existing coal-fired generation with natural gas combined cycle power plants, increasing the share of wind and solar energy, and maintaining existing nuclear and hydropower capacity (Caetano, Merven, Hartley and Ahjum, 2017). Despite a series of transport decarbonisation initiatives, transport carbon emissions have grown in both absolute and relative terms since 1990, and this is contributing to climate change (Ziegler and Abdelkafi, 2022).

Electric mobility, or electromobility, could be a global strategy to spearhead transport decarbonisation and mitigate climate change. Compared to traditional 'avoid' and 'shift' strategies, electric mobility not only has higher carbon reduction potential (Qiao, 2019; Wu, 2019) but is also more feasible with potentially greater co-benefits, including increased energy security. Improved cost-effectiveness (Santos and Hanak, 2022), and higher levels of economic growth are among the benefits accruing from less air pollution and improved public health (Damert and Rudolph, 2018. Although the actual benefits and co-benefits are context-specific, electric mobility can act as an impetus to promote comprehensive sustainability (social, economic and environmental) and pave the way for long-term decarbonisation and carbon neutrality (Wimbadi and Djalante, 2020).

Electric mobility has become an important field in sustainable transport research. However, there are two major research gaps. Firstly, there is insufficient research on actual reductions in road transport carbon emissions in regions with rapid EV development over the past decade. In general, it is recognised that EV can reduce well-to-wheel carbon emissions when the electricity mix is sufficiently clean (Queiroz, 2019). Some studies have analysed trends in transport decarbonisation in different countries by applying aggregated data on transport CO_2 at a national level with an analytical timeframe of more than 20 years. Overall, these global studies indicate that progress towards transport decarbonisation has been slow and uneven in the past three decades (Tapio, 2007). Electric mobility policies were associated with periods of decoupling of transport carbon emissions in selected countries (Loo, 2020; Tsoi, 2021).

2.10. Complex Challenges of Decarbonisation

While there is a growing literature on the role of government policies in promoting electric mobility (Hardman, 2019; Sperling, 2018; Wu, 2021), regional policies are overlooked. Decarbonisation is not necessarily about stopping people from doing things, but rather about doing the same things differently. The COVID-19 pandemic meant that some change is happening faster than expected. Working from home altered changed traditional commuter and shopping trips, probably for ever. Videoconferencing has changed business travel. These developments will save thousands of tonnes of carbon, but also create new challenges, such as a further rise in already proliferating delivery vehicles on the roads (Olojede, 2021).

The world simply cannot rely on the electrification of road transport, or believe that zero emission cars and lorries will solve all problems, particularly in meeting medium-term carbon reduction targets. Achieving ambitious reductions in GHG is particularly challenging for

transportation due to the technical limitations of replacing oil-based fuels (Tyler, 2021). Studies show that wholesale replacement of oil-fuelled individual vehicles by electric ones alone cannot deliver GHG reductions consistent with climate stabilisation and could result in a scarcity of key minerals, such as lithium and magnesium (Perez-Dominguez et al., 2016). In addition, energy-economy feedbacks within an economic system create a rebound effect that counters the benefits of substitution (Loo, 2020; Tsoi, 2021). One strategy that could achieve the objectives at a global level follows the Degrowth paradigm, combining a quick and radical shift to lighter EV and non-motorised modes with a drastic reduction in total transportation demand (Camarasa, 2022). The Degrowth paradigm primarily concerns the abolition of economic growth as a social objective. This implies a new direction in which societies will use fewer natural resources and will organise themselves and live differently from the way they do today (Buch-Hansen, 2018).

The transition to a non-carbon society is a major source of concern among researchers interested in achieving sustainable societies. Decarbonisation efforts are motivated by the need to reduce GHG and avoid worst-case climate change scenarios, as well as anticipate the depletion of fossil fuels (Fay, 2015). In this context, transportation is routinely identified as one of the most difficult sectors to decarbonise. This is due to current cultural mobility patterns, the fact that transport is the least diversified energy end-use sector, continuous growth in global demand for mobility, and technical limitations in replacing oil-based fuels (Pesch, 2018). Emissions increased by 2.5% annually between 2010 and 2015, and over the past half century the sector has witnessed faster emissions growth than any other (Zenghelis, 2019).

The challenges in relation to decarbonised transportation include environmental sustainability, security of the energy supply, economic stability and social aspects (Papadis, 2020). A global carbon tax is the most promising instrument to accelerate the process of decarbonisation. Nevertheless, this process will be very challenging due to high capital requirements, competition among energy sectors for decarbonisation options, inconsistent environmental policies and public acceptance of changes in energy use (Gross, 2021).

Policymakers and government bodies are pivotal in creating a greater sense of urgency by committing to and setting clear expectations for the transition path of the accommodation sector. This could be achieved by setting sectoral emission reduction targets in consultation with stakeholders (Scott, 2020). Likewise, destinations could create transition strategies and roadmaps that break down national targets to the local level. There is also a need for clear

communication about what a country's/destination's transition path means for businesses (expected increase in energy costs over a certain timeframe) (Droege and Fischer, 2019).

Knowledge gaps and a lack of access to relevant information are important barriers for about a third (30%) of the remaining measures (Gross, 2021). A large number of accommodation establishments are open to adopting more ambitious plans to reduce GHG emissions. They have already implemented many measures, but lack relevant information to go further. This includes a lack of data about the sustainability impact of specific measures, the financial implications, and practical considerations (for example the impact on the guest experience during implementation) (Papadis, 2020). Providing accommodation establishments with tailored information and support can unlock this potential. A lack of financial resources or access to capital are hindering progress on the remaining measures. While many emission reduction measures are generally profitable over a 15-year investment horizon, they might require significant upfront investment (Scott, 2020). Some measures are also not profitable at all and thus require a larger commitment. Financial incentives are thus an important trigger to unlock this reduction potential, with the majority of accommodation establishments (78%) indicating that subsidies are more important than loans (Droege and Fischer, 2020).

Many governments already provide a wealth of information on sustainability and decarbonisation measures as well as government assistance for such (Sperling, 2018). There will be a gradual breakaway from the older core values of security, reliability, and robustness which existing energy systems were built on, to new values of sustainability, flexibility, and affordability, enabled by a completely new way of producing, delivering, and consuming energy (Scott, 2020). This does not necessarily mean that the older frame of values will become obsolete or irrelevant anytime soon, but the weight is definitely being rebalanced. However, on the input side, socio-economic activities cannot be entirely decarbonised because biomass is indispensable in producing food and feed, and the carbon content of dry matter biomass amounts to 45-50% (Papadis, 2020). There is therefore a dual challenge of emissions from the energy sector but also other sectors like agriculture (dairy, meat).

Pursuit of maximum efficiency calls for zero wastage of resources. This highlights the need to reuse or repurpose existing infrastructure. The transition will depend heavily on infrastructure that is adaptable, reliable and affordable (Beumelburg, 2021). Looking to the future, it must be borne in mind that existing energy infrastructure was built around conventional resources over

many decades with trillions of dollars invested. It would be a missed opportunity to not plan for the role of existing infrastructure in future energy systems.

2.11. The Role of Legislation and Emission Laws

The South African government is of the view that imposing a tax on GHG emissions and concomitant measures such as tax incentives to reward efficient use of energy will provide appropriate price signals to nudge the economy towards a more sustainable growth path. It has also become necessary to make a contribution to the global effort to stabilise GHG concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system within a timeframe that enables economic, social and environmental development to proceed in a sustainable manner (Government Gazette, 2020). It has consequently become necessary to manage the inevitable climate change impact through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity. The Carbon Tax Act, No. 15 of 2019 was promulgated to provide for the imposition of a tax on the CO_2 equivalent of GHG emissions; and to provide for matters connected therewith.

Ad valorem CO_2 emissions taxes on new passenger cars were introduced in the 2009 Budget. The original tax proposal was, however, later changed to a flat rate CO_2 emissions tax, commencing on 1 September 2010 (Government Gazette, 2020). Once CO_2 limits for passenger cars are finalised, the emissions fee will be extended to commercial vehicles. For each g/km over 120 g/km, new passenger vehicles will be taxed at a rate of ZAR75 (USD6.77) per g/km. The existing ad valorem luxury tax on new cars was supplemented by this emissions charge (Government Gazette, 2020).

Over two-thirds of GHG emissions that contribute to climate change emanate from transport. With per capita emissions nearly twice the global average, South Africa ranks 13th globally in relation to GHG emissions with road transport directly and indirectly accounting for 91.2% of total transport GHG emissions (Hémous, 2012). It is projected that by the year 2100, the country's average temperature will increase by 100% more than average rise in the 20th century (Mann, 2022). This has far-reaching implications. To decarbonise its transport sector, South Africa committed to reducing GHG emissions by 34% by 2020 and 42% by 2025 through

targeted strategies and policies (Chaumontet, 2021). However, efficient implementation of the proposed measures and sufficient funding remain daunting challenges (Vigotti, 2021).

Active transport is indispensable to South Africa's achievement of its transport decarbonisation goals, especially given that the steps taken hitherto seem ineffective. There is thus a need to inculcate the right attitudes, and adopt regulatory instruments, and policy initiatives to promote active transport (Vigotti, 2021). Transport accounts for about a quarter of global energy-related carbon emissions, and this contribution is rising faster than for any other energy end-use sector. If current trends continue, direct transport carbon emissions could double by 2050 (Chaumontet, 2021). Transport relies overwhelmingly on oil, with more than 53% of global primary oil consumption in 2010 used to meet 94% of transport energy demand (Kharas, 2022). This makes the transport sector a key area for energy security concerns and a major source of air pollutants such as ozone, nitrous oxides and particulates, as well as CO_2 (Burger, 2021).

According to the South African Department of Transport, there is overwhelming consensus among the scientific community that climate change in the form of global warming is real and driven by GHG emissions caused by human activity. The single most important GHG is CO_2, which is also the single most problematic source of GHG, mainly resulting from the production and consumption of fossil fuels (Chaumontet, 2021). More than two-thirds of transport-related GHG emissions are from road transport. Therefore, motorised transport emissions have become a significant contributor to the global problem of GHG emissions that lead to climate change (Haonan, 2022). In 2009, transport was responsible for 23% of global GHG emissions compared with 41% for energy (Lindsey, 2022). By 2035, it is expected to become the single largest GHG emitter accounting for as much as 46% of global emissions, and it is set to reach 80% by 2050 (Vigotti, 2021).

It is clear that climate change is real, and that human activities, particularly transport-related emissions, are a major cause. Changes in the climate are being observed in all geographical regions of the globe: the atmosphere and oceans are warming, the extent and volume of snow and ice are diminishing, sea levels are rising, and weather patterns are changing (Lindsey, 2022). Anthropologic GHG emissions from transport are a key contributor to global climate change, with CO_2 representing the largest proportion of such emissions. Over the past three decades, CO_2 emissions from transport have risen faster than those from all other sectors and are projected to rise even more rapidly (Kharas, 2022). Industrialised countries are currently the main sources of transport emissions (Burger, 2021); however, the proportion of emissions

produced in developing countries is increasing rapidly. The majority of transport fuel emissions (76%) are from road transport, including four-wheel vehicles and personal pickup trucks. Air travel produces around 12% of transport CO_2 emissions, and its share is also growing at a fast rate (Lindsey, 2022).

However, there are externalities associated with this tendency, particularly in environmental terms. Emissions from the transport sector in South Africa account for 13% of the country's total GHG emissions, of which 86% is from the combustion of liquid fossil fuels (Vigotti, 2021). In addition to these direct emissions, indirect emissions arise from the production, refining and transport of transport fuels (Chaumontet, 2021). South Africans pay dearly for their auto-dependency predilection, largely in the form of traffic congestion, especially during peak hours. This increases trip times and restricts mobility, with far-reaching psychological, economic and environmental ramifications (Ahjum, 2020). Overall productivity is adversely affected. Transport is the primary consumer of liquid fuels in South Africa (Vigotti, 2021). Demand for energy in this sector is forecast to grow to 24-37% of total energy demand by 2050, possibly representing the largest sectoral demand for energy in the country (Hanto, 2021).

The Department of Transport's draft Green Transport Strategy (GTS) (SDG, 2019) is guided by the National Climate Change Response White Paper and National Development Plan, which outlines South Africa's commitment to climate change interventions in line with the 2015 United Nations Climate Change Conference (COP 21) and affordable transport systems (Ahjum, 2020). It aims to reduce harmful emissions and the negative environmental impacts associated with transport systems and has become the primary reference for policy interventions. The interventions identified in South Africa's multi-sector energy-economic modelling framework, otherwise known as the South African TIMES Model (SATIM) are (Ahjum, Merven and Stone, 2020):

- 30% shift in freight transport from road to rail by 2022,
- 20% shift in passenger transport from private cars to public transport and non-motorised transport by 2022,
- 20% of the public sector fleet and 10% of the national fleet comprising electric or hybrid vehicles by 2022,
- All (metro) public and quasi-public (minibus) transport vehicles to move to a natural gas and petrol dual-fuel system within 10 years,

- 10% of the urban bus fleet to be converted to gas-only vehicles per year,
- 10% of Metrobus fleets to be converted to gas-only vehicles per year,
- Fuel levy relief (50% exemption for biodiesel and 100% exemption for bioethanol),
- Fiscal policies such as the imposition of a carbon tax.

Moreover, with additional growth expected in road transport demand, emissions are expected to increase over coming decades. Therefore, South Africa faces the need to modernise and expand its transport infrastructure while simultaneously significantly reducing transport-related emissions (Burger, 2021). The country recently adopted several climate strategies and policies in the transport sector, which have been implemented to various degrees. Recent studies focus on making active transport an easy choice through sound urban design, restrictions on car use and land-use planning that enables services to be accessed without motorised transport (Lindsey, 2022). Only a few studies directly relate the promotion of active transport to carbon reduction and climate change.

2.12. Paradigm Shift to Decarbonised Transport

The government aims to make public transport a viable alternative to driving. In order to achieve this, it is encouraging public transport operators to make things as easy as possible for travellers (Aropet, 2017). Police officials should be looking at alternative modes of transport such as walking or cycling where convenient and for patrolling their area and using alternative fuel vehicles (AFV) that run on fuel other than petroleum. Compressed natural gas (CNG) is one such alternative fuel that produces less pollution and GHG. Renewable fuels include ethanol, which is derived from plant materials, and biodiesel, which is made from vegetable oils and animal fats (Ryneveld, 2018).

Walking and cycling constitute the ultimate zero carbon and environment-friendly solution for personal transport (Ohlund, 2021). However, both have declined significantly in recent years (Kharas, 2022). Empirical evidence shows that this is due to the growth and affordability of the motor car and psychological and sociological factors that range from a generally poor level of fitness as well as safety and security issues to unfavourable weather and physical factors (Fay, 2015). Nevertheless, the South African Department of Transport has identified a modal shift from private car usage to public transport (particularly rail) and non-motorised transport as essential to reduce energy consumption and GHG emissions (Vigotti, 2021). This implies that South Africa is unlikely to achieve carbon decarbonisation without recourse to active transport.

Research undertaken on behalf of the South African government indicates, among other things, the imperative of implementing measures to reduce carbon emissions (Dyrhauge, 2021). It was found that given that the road transport sub-sector is responsible for 91.2% of direct emissions from transport, shifting passengers to public transport and freight to rail is a necessity (Vigotti, 2021). Several sustainable transport instruments that double as decarbonised transport tools have been identified. This highlights the need for land use planning that prioritises non-motorised modes (walking and cycling) as well as planning for public transport modes, including bus, rail, light rail, and metro and underground systems (Ryneveld, 2018).

Emphasising the importance of policy interventions to promote active transport, Farrag-Thibault (2020) argues that the transition required to dramatically reduce GHG emissions calls for system-wide strategies that combine, among other things, modal change, stringent sustainable transport strategies, and profound behaviour change (Sung and Monschauer, 2021). Chapman (2018) concurs that stabilisation of GHG emissions from transport will require behavioural change brought about by policy. Therefore, the drive to reduce GHG emissions from transport should not be limited to alternative fuels, energy sources or technology as typically emphasised in South Africa, but should also include a change in travel behaviour and modes. Technology improvements are often most effective when implemented in conjunction with other instruments within a larger strategy (Fitchett, 2021).

2.13 Fleet Management

Fleet management is the management of commercial vehicle operations at scale (Redmer, 2020). Any company that uses a fleet of vehicles as part of its business model can be said to be engaged in some form of fleet management. Fleet management is about keeping costs reasonable, maximising profitability, and minimising risk (Redmer, 2020). Technically, a ‘fleet’ can consist of at least two or more vehicles. The principles of fleet management become more valuable at scale, when there is a need to efficiently and economically manage many vehicles. Vehicles in a fleet need not be owned; rented vehicles are also considered fleet vehicles. Trucks, vans, cars, drones, industrial and construction equipment, and boats are typically associated with fleet management (Weerawansa, 2016).

Statistics show that the vast majority of fleet management companies do not lease their vehicles, and many of those that do only lease a small portion. It can thus be deduced that most of these companies are utilising their fleets to perform mainly transport and logistics-related services. The purpose of fleet management is to keep track of vehicles’ performance and

maintenance in order to ensure that the system runs smoothly, and identify ways to improve efficiency (Redmer, 2020). Fleet management is about optimisation and process improvement. Fleet managers are responsible for activities such as maintenance and repair of vehicles, resource management (fuel, parts, vehicles, and even drivers themselves), driver training, behaviour and safety, compliance, asset utilisation, risk management, route planning, waste management, and overseeing and improving the fleet's productivity (Ali, 2018). A good fleet manager will help a company to get the most value out of the vehicles in its fleet (Orošnjak, 2020).

Fleet safety is very important, not just for fleet operators, but as a strategic approach to improve the safety of the entire fleet. Corporate purchasers of vehicles and transport services can specify high safety standards and thus create an economic imperative for providers of vehicles and transport services to meet these standards. Fleet management at V-Polizza comprises all the activities required to maintain and operate equipment throughout its life cycle from acquisition to the final stage of asset disposal. This includes maintenance and repair, inventory control, training, and safety issues (Orošnjak, 2020). Two methods are employed to evaluate a company's fleet management process. The Haddon matrix revolves around organisational safety and is concerned with driver assessment, monitoring and improvement. It provides an all-encompassing pre-crash, at scene and post-crash systems-based framework for fleet safety. The network influence method is a risk management method (Weerawansa, 2016).

In recent years, more tools have been developed for fleet management optimisation, resulting in changes in this field. The projected growth of the fleet management industry to around $30 billion by 2022 is largely driven by advances in technology and the rate at which fleet management companies adopt this technology will impact the growth rate (Dickson, 2021). The National Conference of State Fleet Administrators' (NCSFA) 2018 survey of 44 state and university fleet managers recommended that fleet management companies begin implementing "robust fleet management policies and procedures" as well as "accelerating the implementation of technology to measure the efficiency and effectiveness of fleet management practices". The survey found that 38% of repairs and 39% of preventative maintenance work was insourced, in addition to routine in-house activities that form part of fleet management (Van Niekerk, 2021). The primary concerns expressed by the fleet managers were training needs and advanced technology. Business process management aims to keep track of all processes and identify strategies to optimise and improve them.

Measurable metrics are an integral part of managing a fleet. However, managing vehicle data and translating it into meaningful insights can be difficult for a manager who is balancing various other job responsibilities. Dispersed data sources add to the challenges, and the more sources there are the more complicated processing becomes (Peterson, 2021). Once the data is understood and there is a general idea of what improvements need to be made, fleet managers, with their multiple hats, need to receive approval from multiple departments. This can be time-consuming and it makes it difficult to balance immediate needs (driver safety, fuel spend) against plans for the future (vehicle acquisitions, technology updates). The IoT has created more connected, safer vehicles through the use of engine sensors, automation, and new tools designed to streamline operations. The benefits include cost savings, and improved safety and compliance. However, as more vehicles are added to fleets and regulations continue to change, the abundance of data increases, calling for more administrative attention from fleet managers (Van Niekerk, 2022).

Acquisition, utilisation, maintenance and disposal of fleets in most government departments is governed by a set of policy frameworks and legislation. The primary ones include the Public Finance Management Act (PFMA) (1999), Treasury Regulations, Transversal Contracts, and the Preferential Procurement Policy Framework Act (No. 5 of 2000). These set out the processes to be followed when managing government resources. All fleet management processes within V-Polizza need to comply with the principles of fairness (equity), as well as effective and efficient resource utilisation. The organisation also needs to ensure that proper supply chain processes are followed when issuing tenders for auctioning and disposing of its vehicles. This also applies to transversal arrangements for vehicles, fuel/diesel and tyres and tubes. The organisation vehicle fleet programme has a range of stakeholders that have a direct and indirect impact on provision, utilisation and management of the department's vehicles. These stakeholders also have significant influence and interests in the department's vehicle fleet processes (Posada, 2017).

2.14 Conclusion

This chapter reviewed the existing literature on decarbonisation. It began by defining key terms and presented a general overview on SCM and logistics. The benefits of decarbonisation and its effect on climate change was also reviewed. This chapter highlighted that the road transport sub-sector is responsible for 91.2% of direct emissions from transport. The review concluded by assessing how climate change will impact the key sectors in South Africa.

The following chapter presents the research methodology employed to conduct this study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Research is the methodological gathering and objective evaluation of data with the aim of achieving a specific objective (Phillippi and Lauderdale, 2018:388). A variety of methodologies are used to analyse a problem or subject. The methods used to collect and analyse data are referred to as the research techniques that are designed to promote the quality and dependability of knowledge acquisition. The research approach enables data to be gathered about a particular topic in a logical and intentional manner (Kumar, 2017:35). Research paradigms incorporate fundamental philosophical notions and goals about the nature of reality and the pursuit of knowledge in science (Park, Konge and Artino, 2020: 694). Positivism and phenomenology are two schools of thought in this regard.

This chapter sets out the study's research methodology and discusses the rationale for its adoption. It begins by restating the study's objectives, defines qualitative research, and outlines the research strategy. The principles of a qualitative case study method are explained. The chapter also describes the study's target population, sample, research tools, and data collection techniques. It discusses the data analysis process and the issues of reliability and validity. The chapter ends with a summary of the chapter.

3.2 Research Objectives and Questions

3.2.1 Objectives

The study's objectives were:

1. To assess the role of fleet decarbonisation in sustainable management initiatives at V-Polizza

2. To establish the opportunities and benefits at V-Polizza of optimising fleet decarbonisation for the environment and society.

3. To examine the advent of transport technologies at V-Polizza impact on efficient decarbonisation responsiveness to climate change.

3.2.2 Research questions

The study aimed to answer the following questions:

1. What is the role of fleet decarbonisation in influencing sustainable fleet management initiatives at V-Polizza?

2. What are the opportunities and benefits of optimising fleet decarbonisation at V-Polizza for the environment and society?

3. How does the advent of transport technologies at V-Polizza impact efficient decarbonisation responsiveness to mitigate climate change?

3.3 Research design

According to Sekaran and Bougie (2013), a research design is a guide for data collection, measurement, and analysis based on the study's research questions. Abbott and McKinney (2013) define a research design as a strategy to integrate several study components using a set of techniques and procedures. It is therefore a strategy for how the study will be carried out. Panke (2018: 4) describes the research design as the strategy to link relevant empirical research and theoretical issues.

There are various purposes for carrying out a study. Levitt et al. (2018:41) identify three common purposes, namely, exploration, description and explanation. The methods used to conduct exploratory research include a literature review, interviews with experts on the subject and focus group interviews. Observation, case studies and surveys are employed to undertake descriptive research.

An exploratory case study design was used for this research project. A case study focuses " in-depth research of a particular individual, organisation, or event" (Tetnowski, 2015: 39-45). Case studies can be explanatory or descriptive. The case study approach is particularly useful when the researcher seeks to comprehend a subject, event, or phenomenon in its context. According to Yin (2009), case studies are carried out when the researcher wants to answer "how" and "why" questions. When the lines between a phenomenon and its context are hazy and the researcher has limited control over the phenomenon and context, a case study makes it possible to investigate a current occurrence in a real-world environment (Yin, 2009). The researcher can examine a specific example in the context of its surroundings to identify similarities and distinctions that are important in exploring the observed phenomenon (Yin,

2009). In other words, case study research is appropriate when a contemporary phenomenon is researched in a natural environment (Patnaik and Pandey, 2019).

An exploratory design conducts a complete exploration of a phenomenon in order to clarify concepts, establish priorities, enhance the study design, and provide operational definitions (Patten and Newhart, 2017). This approach was pertinent to this study because decarbonisation and sustainable fleet initiatives are not a well-researched phenomenon, with scant literature on the subject. According to Durrheim, Terre-Blanche, and Painter (2018), exploratory studies are utilised to conduct initial research into comparatively unexplored areas of study. This study was exploratory in that it aimed to learn about decarbonisation initiatives, the advantages associated with them, and the difficulties organisations encounter in delivering sustainable logistics.

3.4 Research approach

A research approach is a strategy and process that specifies in-depth procedures for data gathering, analysis, and interpretation based on general hypotheses/proposition and specific research objectives. Therefore, it is determined by the type of research problem being addressed. The research approach focuses on the overall direction of the study, and conclusions that will be reached, rather than just the kinds of data that are employed (Winchet, 2019). The most common research approaches are quantitative, qualitative, and mixed methods.

A quantitative approach measures variables using a numerical system, analyses these measurements using a variety of statistical models, and reports relationships and associations among variables (Teherani, 2017). A qualitative approach produces descriptive (non-numerical) data, such as observations of behaviour or personal accounts of experiences. The goal of gathering qualitative data is to examine how individuals perceive the world from different perspective. A variety of techniques are subsumed under qualitative research, including content analysis of narratives, in-depth interviews, focus groups, participant observation, and case studies, often conducted in natural settings (Timans, 2019). Lastly, a mixed methods approach is a combination of quantitative and qualitative research. This study adopted a qualitative research approach to gain an understanding of the research problem of addressing the challenges of climate change through decarbonisation in relation to the case of V-Polizza.

Schoonenboom (2017:15) observes that, in analysing and making sense of unstructured data, qualitative research is "about investigating topics, explaining phenomena, and answering questions." Focus groups or in-depth interviews can be used since this kind of research seeks to gather comprehensive data. Semi-structured interviews were used to collect rich, open-ended data from carefully chosen subjects. Where little is known about a topic or where a prior study only partially addressed the research questions, a qualitative technique is most appropriate (Shorten, 2017). Given the lack of published information in the South African context, it was deemed necessary to use a qualitative instrument to gain an initial understanding of the local context for efficiency improvements to police vehicles in terms of sustainable fleet management.

3.5 Research philosophy

The research philosophy refers to the source, nature and development of knowledge from a broader perspective. In simple terms, it is a belief about the ways in which data on a phenomenon should be collected, analysed and used (Shorten, 2017). The research philosophy deals with the specific way of developing knowledge in an empirical narrative. This matter needs to be addressed because researchers may have different assumptions about the nature of truth, knowledge and philosophy, which serve as the base for the research strategy. Different disciplines favour different research philosophies, with the four main ones being pragmatism, positivism, realism, and interpretivism.

This research adopted an interpretivist philosophy. Interpretivism places strong emphasis on people's beliefs and motivations and is thus appropriate to comprehend social phenomena and culture (Mackenzie and Knipe, 2016). The researcher relies on the perspectives of the participants, based on their experiences. Interpretivism thus incorporates a study's human interest. Interpretive scholars "believe that access to reality (given or socially built) occurs solely through social constructions such as language, consciousness, shared meanings, and instruments" (Collins, 2018:12). In the context in which reality is situated, this philosophy seeks to interpret social reality using the varying perspectives of individuals.

3.6 Sampling technique

Sampling is a technique to select individual members or a subset of the population to make inferences and estimate the characteristics of the whole population. Different sampling

methods are used by researchers so that they do not need to research the entire population to gain actionable insights.

Probability sampling is a sampling technique where a researcher sets a few selection criteria and randomly chooses members of a population. All the members have an equal opportunity of being part of the sample. In non-probability sampling, the researcher chooses participants. Non-probability sampling method is not a fixed or predefined selection process and all the elements of a population thus do not have an equal opportunity of being included in a sample (Mackenzie and Knipe, 2016).

Non-probability sampling was used in this study to enable the researcher to select participants with the most pertinent data in order to gain a comprehensive grasp of the phenomenon under investigation. The purpose of this study was to determine the difficulties confronting V-Polizza in using vehicles and the effects that implementing green transportation would have.

The participants in this study were chosen using a purposeful non-probability sampling method. Qualitative research is almost always associated with purposeful sampling, often known as selective or subjective sampling, although it does not allow for generalisation of the study's results. The researcher assesses the participants' expertise in relation to the phenomenon under study and chooses a sample of experts and subjects (Turner, 2020). Researchers are able to draw on a wide range of qualitative research designs when they employ purposive sampling. Achieving the goals of these designs often requires a different type of sampling strategy and technique to gather the necessary data to draw conclusions. The various techniques that are possible through the purposive approach allow the research design to be more adaptive, allowing for specific techniques to be applied to work towards the end result (Saunders et al., 2016). Judgmental or purposive sampling is applied at the discretion of the researcher. The researcher considers the purpose of the study, alongside an understanding of the target audience. He/she chooses volunteers based on their knowledge of and familiarity with the research problem (Sekaran and Bougie, 2018).

3.7 Study time horizon and site

A research site is the physical location utilised for conducting primary research to obtain the necessary information (Burke, 2020). Due to its accessibility, the study was conducted in a police station in Durban. Furthermore, this station provides information and covers all police stations in the province. The study was subjected to a cross-sectional time horizon as the

researcher measured the outcomes and was exposed to the study participants at the same time. In such a research design, data is collected from different individuals at a single point in time.

3.8 Target population

The overall group of individuals that the researcher is interested in studying is referred to as the target population (Sekaran and Bougie, 2016). A research population is typically a sizable group of people or things that serve as the main subject of a scientific investigation (Shukla, 2020). The sample should be representative of the population to ensure that the findings can be generalised to the population as a whole. Staff members in various departments at the V-Polizza station were the study's target population. Six hundred and seventy-three employees work in the departments that were selected. The population of police at the district police station was comprised of individuals from the entire police station population, excluding eThekwini.

3.9 Sample Size

The sample size is a research term that refers to the number of individuals included in a study to represent a population (Saunders e t al, 2016). A sample is a fragment selected from a population and the sample size is the total number of units in the sample (Leedy and Ormrod, 2019). The sample is thus the group of people that participate in the research. Some individuals who could have participated might decide not to do so, and thus do not compromise part of the sample (Soetewey, 2020). The sample size for this study comprised of two senior managers in the supply chain management department, two in fleet management and two senior managers involved directly in the organization's decision making within the province. These individuals were chosen because, as a result of their job responsibilities, they are aware of the carbonisation, pollution, and damage that their fleet causes; as a result, they were able to provide insight into transport decarbonisation. The sample was selected based on Martinez-Mesa et al. (2016:326) who said that one to thirty informants are adequate to ensure the validity of a qualitative investigation. The sample size was also selected based on Elfil and Negida (2017:22) who argue that the number of informants is determined by the information requirements of the investigation, which will ensure adequate responses to research questions. This is reinforced by saturation theory, which implies that no new data will be gathered after a specified sample size has been exceeded (Yin, 2016). In line with saturation theory, the researcher deemed it appropriate to conduct six interviews with open-ended questions on the nature, scope, and role of fleet decarbonisation in influencing sustainable fleet management initiatives.

3.10 Rank structure and overview of interviewees

The current SAPS ranking system was adopted in April 2010. The change caused some controversy as the new ranks like 'general' and 'colonel' have military connotations. The new rank system mirrors the system used by the South African Police during the apartheid era. In 2009, Deputy Minister of Police Fikile Mbalula spoke of making the police a paramilitary force by changing the ranking system so that it would closely mirror the military one. This created controversy among those critical of what they called the 'militarisation' of the police.' The ranking system was amended in 2016. The role of regional police commissioner was introduced, with the rank of lieutenant general. The major and lieutenant ranks were eliminated, with lieutenants assuming the rank of captain and majors that of lieutenant colonel (SAPS, 2021).

The 1,154 police stations in South Africa are divided according to the provincial borders, and a Provincial Commissioner is appointed in each province. The nine Provincial Commissioners report directly to the National Commissioner. As the leader of the organisation, the Minister is supported by the National Commissioner who is known as General, with Lieutenant Generals serving under him/her, namely, the divisional commissioner, regional commissioner, provincial commissioner, deputy national commissioner, and acting national commissioner. These are followed by major generals who serve as deputies to the lieutenant generals and may also serve as district commissioners (SAPS, 2022).

Brigadiers are the head of every component at provincial level; they also serve the districts as section commanders and station commanders in large stations within the province. Colonels and lieutenant colonels are of a lower rank than brigadiers and support the brigadiers in big stations; they also serve as sub-section commanders at provincial and district level, and station commanders in smaller stations within the province. Table 3-1 below illustrates the police ranks for commissioned officers under senior management and junior management and ranks for non-commissioned officers for other ranks.

Table 3-1: Police ranks in South Africa: Commissioned Officers under Senior Management

Group	**Senior Management**			
Rank	General (Gen)	Lieutenant General (Lt Gen)	Major General (Maj General)	Brigadier

Role	Designation of National commissioner	Actg. National Commissioner. Deputy National Commissioner Regional Commissioner Provincial Commissioner Divisional Commissioner		
Insignia				

Table 3-2: Police ranks in South Africa: Commissioned Officers under Junior Management

Group	Junior Management		
Rank	**Colonel (Col)**	**Lieutenant Colonel (Lt Col)**	**Captain**
Insignia			

Source: (SAPS, 2022)

Table 3-3: Police ranks in South Africa: Non-Commissioned Officers under other ranks

Group	Other Ranks		
Rank	**Warrant Officer (WO)**	**Sergeant (Sgt)**	**Constable (Const)**
Insignia			

Source: (SAPS, 2022)

Table 3-4: Profile of participants

Rank	Position	Age group	Highest qualification	Time in SAPS
Major General	**Senior Management**	**50+**	**PhD in Criminology**	**30+ years**
Brigadier	**Senior Management**	**50+**	**Bachelor of Business Management**	**30+ years**

Brigadier	**Senior Management**	**50+**	**Advanced Diploma in Public Management**	**28 years**
Lieutenant Colonel	**Junior Management**	**40-49**	**Diploma in Labour Law**	**20+ years**
Warrant Officer	**Other ranks**	**40-49**	**Bachelor of Social Science**	**14 years**
Sergeant	**Other ranks**	**30-39**	**National Diploma in Policing**	**7 years**

Source –Researcher (2022)

3.11 Data collection

Data collection is the methodological gathering of information from various sources to obtain a precise and comprehensive picture of a topic (Bilsborrow, 2016:156). Interviews were used to gather data for this study. An interview is a conversation between an interviewer and interviewee with the goal of gathering information (Makady et al., 2017:865). Interviews offer several advantages, including the ability to elicit comprehensive information on ideas, attitudes, and personal sentiments, the ability to ask more thorough questions, a high response rate, and the ability to explain ambiguities (Makady et al., 2017:858). It is for this reason that purposive sampling was used to select experts and individuals with knowledge of the concept of decarbonisation within the case under investigation.

Based on the characteristics of the qualitative study design, primary data were gathered through semi-structured interviews with subject-matter specialists in the field. A semi-structured interview guide was used to conduct the interviews. The recorded interviews were transcribed and thematic analysis was used to identify themes and patterns.

Secondary data was also gathered by reviewing academic journals, V-Polizza reports, textbooks, dissertations, theses and articles. “Secondary sources like academic journals provide credible backup because they are peer-reviewed. Therefore, there is an in-depth understanding of the literature relating to the ground-breaking aspects of the researcher’s study” (Coldwell and Herbst, 2014:7).

3.12 Data analysis

McCombes (2019:1) defines data analysis as the act of condensing gathered data into a more manageable size while the researcher searches for patterns, employs statistical methods, and

summarises the data. Frequency distribution may be used to acquire sufficient readable data. Castleberry and Nolen (2018) state that, in the qualitative method, data presentation is a procedure used to convert, modify and review particular information to arrive at certain conclusions in relation to a certain condition or problem. Various software programmes can be used to produce charts, tables, and graphs to present data. This enables the researcher to reach conclusions and answer the research questions.

Thematic data analysis was used to analyse the primary data. The raw data was sorted into categories such as relationships, themes, patterns, and trends (Nowell, 2017). Data reduction was utilised to identify information pertinent to the research questions and objectives in order to analyse the data and transform it into meaningful, useable information. This was followed by coding. Calzon (2022) describes this initial stage of data analysis as "the process of categorizing and sorting data." By deriving keywords, identifying patterns in the keywords, and understanding the meaning of these word patterns, coding is utilised for content analysis (Maguire and Delahunt, 2017). Following data display, recognised patterns were represented using text and visual aids where appropriate.

According to Castleberry and Nolen (2018:17), thematic analysis is a data analysis strategy that is a commonly used across qualitative approaches for “identifying, analysing, and reporting patterns (themes) within data”. It is a descriptive method that reduces the data in a flexible way that dovetails with other data analysis methods and is commonly used because of the wide variety of research questions and topics it can address (Castleberry and Nolen, 2018). Inductive analysis involves coding the data without attempting to fit it into a predetermined coding framework or the researcher's analytic ideas. This kind of thematic analysis is thus data-driven (Castleberry and Nolen, 2018). The steps in thematic analysis used in the study includes:

Step 1: Familiarization

Step 2: Coding

Step 3: Generating themes

Step 4: Reviewing themes

Step 5: Defining and naming themes

Step 6: Writing up

3.12.1 Computer aided Qualitative Analysis

According to Creswell (2014), qualitative analysis centres on descriptive analysis of interviews or any text data. The data analysis was based on the interviews with six participants. All the questions are used in presenting the results which provide answers to the research questions. The analysis was performed in Nvivo 12 which help the researcher to explore the data and gain insights. Nvivo 12 offered a flexible approach to explore the responses. The researcher exported pictures from the software to obtain a sense of what the interviewees were saying. This enabled detailed analysis for a more focused perspective. Querying in Nvivo specifies words or those that occur most frequently (QSR, 2021). This allowed the researcher to ask questions, identify patterns based on coding and check for coding consistency among the interviews. The themes considered included sustainability initiatives and activities to curb climate change, organisational support for a sustainable fleet and decarbonisation of the fleet, the benefits of decarbonisation and the use of transport technologies for efficient decarbonisation.

Text query searching was conducted to find all occurrences of a word, phrase, or concept. According to QSR (2019), there are three basic reasons for text querying. First, it enables one to explore the use, context and meaning of word(s). Second, it allows automatic coding of words or phrases. Third, the search for concepts enables the identification of similar words. As a result, text querying finds and analyses all occurrences of a certain thing to enable determination of the content of the words during thematic analysis. Using this tool, the analysis offered insights into sustainability initiatives and activities to curb climate change, organisational support in sustainable fleet and decarbonisation of the fleet, and the benefits of decarbonisation and transport technologies in efficient decarbonisation.

3.13 Data Quality Control

Data quality control refers to strategies and policies to ensure that data integrity, quality, and reliability are maintained at every stage of the project. This includes strategies to prevent errors from entering the datasets, taking precautions before data is collected, and establishing procedures while data is used (Nowell, 2017). Data quality control was specifically maintained as the following were maintained:

Dependability means that similar outcomes are attained if equivalent techniques are applied in the same situation and under the same conditions (Alaoui and Gahi, 2019:810). The research procedures were sufficiently comprehensive for other researchers to repeat them in related

studies, and the researcher describe the numerous stages to establish the study and the methodology's dependability.

Credibility is achieved by ensuring that the research accurately assesses or evaluates the hypotheses that it was designed to assess and evaluating how closely the outcomes correspond to reality (Serret, Deguines, Jang, Lois and Julliard, 2019:22). The emphasis is consequently on ensuring that the research methods retain the quality of the data and that it accurately represents the topic under study. Credibility was ensured in this study by means of the researcher's assessment of the data and analysis from the transcribed text before it was written up (Shen, 2019; Scruggs, 2018).The credibility of this study was emphasised throughout the research process and the in-depth interview sessions.

Transferability examines whether a study's findings can be applied to other pertinent situations. Transferability has been noted as a challenge in qualitative research since the results of a qualitative inquiry are context-specific, making it challenging to demonstrate their applicability to other settings (Alaoui, Gahi, 2019:803). In this study, transferability was ensured by providing thick descriptions, i.e., a detailed account of the researcher's experiences during data collection. The findings and information from this study needed to be transferable in order to achieve its objectives.

3.14 Conclusion

This chapter described the study's research design, methods, and data quality control. The research methodology sets out why the study is being conducted as well as how it the research was carried out. It thus describes the study's principal goals, its thesis, and the research challenges. Given that this study sought to explain a particular phenomenon, a non-probability, purposive sampling technique was used to select units or individuals. The research tools, data collection techniques, data analysis, and issues relating to reliability were also covered in detail in this chapter.

The following chapter presents the data analysis, interpretation of results, and the findings using thematic analysis.

CHAPTER FOUR

PRESENTATION OF RESULTS

4.1 Introduction

This study aimed to assess fleet decarbonisation for sustainable transport initiative. The first specific purpose was to assess the role of fleet decarbonisation for sustainable management initiatives in V-Polizza. The second was to establish the opportunities and benefits of optimising fleet decarbonisation for the environment and society. The third purpose was to examine the impact of the advent of transport technologies on efficient decarbonisation responsiveness to climate change.

The interview transcripts were analysed based on the following themes:

1. Sustainability initiatives and activities to curb climate change.
2. Organisational support for a sustainable fleet and decarbonisation of the fleet.
3. Benefits of decarbonising.

Transport technologies in efficient decarbonisation. The following section analyses each main theme while also coming up with sub-themes.

4.2 Theme One: Sustainability initiatives and activities to curb climate change

Six themes were created under sustainable initiatives to curb climate change. These can be depicted as follows.

Figure 4-1: Sustainability Initiatives

Sustainability in any industry is mostly motivated by climate change, which measures the average weather in a particular place over many years (Wang and Zhang, 2022). This main theme was derived from the responses to the question on the organisation's sustainability initiatives and activities to curb climate change, as well as other forms of transportation. The intention was to the obtain views of V-Polizza personnel on the organisation's sustainability initiatives and policing activities to curb climate change. The responses from the six participants were analysed to identify key words relating to sustainable initiatives and policing that supports decarbonisation. The sub-themes or child nodes which were derived from this are shown in the following table as well as the number of times they occurred in the narratives.

Table 4-1: Sustainable initiatives to support decarbonisation

Sub-theme	Files	References/narrative instances
Nothing	1	6
Horses	1	3
Motorcycles	1	2
Foot patrols	1	2

Helicopters	1	1
Cutting unnecessary transportation	1	1
Bicycles	0	0

The table shows that Nothing, Horses, Motorcycles, Foot patrols, Helicopters and Cutting unnecessary transportation were the six most referenced sub-themes. Given that "Nothing" was the most dominant sub-theme, the following figure summarises references that employ the word 'nothing'.

Figure 4-2:Don't/Not/Nothing/Little References

6 References Coded (2.43% coverage)

Reference 1 - 0.05% Coverage

We don't do foot patrols anymore

Reference 2 – 0.67% Coverage

Nothing, nothing whatsoever. Even the employees in their own personal interest don't participate or care much about it.

Reference 3 – 0.67% Coverage

The organisation does not really dwell on decarbonisation of its fleets or anything to reduce its carbon footprint. It ensures sustainable fleet by ensuring vehicle maintenance.

Reference 4 – 0.37% Coverage

Organisation does much to promote a sustainable fleet either from advocating excellent driving and fitness.

Reference 5 – 0.55% Coverage

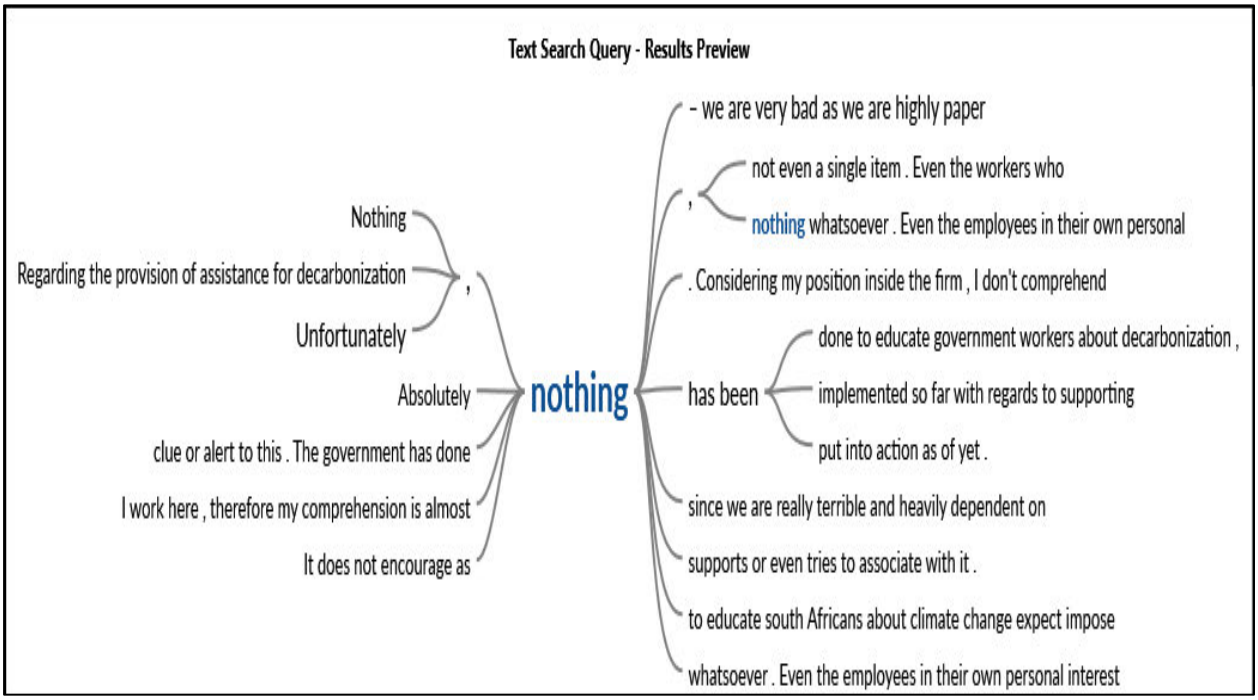
Does little to encourage a sustainable fleet other than to promote safe driving habits and physical fitness so that employees may walk short distances when needed.

Reference 6 – 0.13% Coverage

For the motor vehicles and all the generators we purchase diesel.

Figure 4.2 shows that the participants were somewhat negative about the implementation of sustainable initiatives to support decarbonisation at V-Polizza. The Nvivo output produced a word tree on narratives that show that little or nothing was or is currently pursued by V-Polizza as a decarbonisation initiative.

Figure 4-3:Don't/Not/Nothing/Little Word tree



This figure shows that the participants used the word 'nothing' in many instances to show that V-Polizza is not engaging in sustainability initiatives to curb climate change. For example:
Participant 1 said, *''Unfortunately, nothing – we are very bad as we are highly paper based. Every meeting is contact meeting because the organisation doesn't enforce that, there's no awareness of climate change. We do not recycle, reuse. We print everything. We buy diesel for the generators and all the motor vehicles".*
Participant 3 concurred: "*As far as I know the organisation does not have a policy for fleet sustainability or sustainable in general; the organisation is not really involved in anything that involves climate change directly".*
Participant 5 commented: "*As far as I'm aware, the organisation does not really engage in anything that directly addresses climate change, and neither does it have a policy for fleet sustainability or sustainable practices in general".*

In terms of basic greening initiatives, participant 6 categorically stated that:

"We're terrible since we rely so heavily on paper. Due to the organisation's lack of enforcement, every meeting is a contact meeting, and there is no understanding of climate change. We do not recycle, reuse. We print all materials. We purchase diesel for the generators and all cars."

These responses point to a lack of sustainability initiatives and activities at V-Polizza to combat climate change.

The responses also show that horses as a sustainability initiative and alternative policing activity were being used to curb climate change at V-Polizza. Foot patrol and motorcycles would equally be considered as carbon free modes of transport. The least used sustainable initiatives were helicopters, and cutting unnecessary transportation, with none of the participants saying that bicycles were used. These results shows that alternative forms of policing such as foot patrols and motor cycles are implicitly considered as decarbonisation activities. Once again, they highlight that V-Polizza has not made serious efforts to promote sustainable initiatives and activities to curb climate change. Environmental degradation is an important issue confronting society and businesses and V-Polizza should play its part by reducing its carbon footprint.

Therefore, in terms of the study's first objective, which was to assess the role of fleet decarbonisation for sustainable management initiatives in V-Polizza, the results show that the organisation is doing very little or nothing. Hence, more work needs to be done in this regard.

4.3 Theme two: Opportunities and Benefits of Fleet Decarbonisation

The ultimate objective of decarbonisation is to achieve carbon neutrality, which entails a return to the CO_2 levels in the atmosphere before human interference (Canales-Bustos, 2017). The participants were asked to list the benefits of decarbonisation. This resulted in the emergence of the following six themes under Opportunities and Benefits of Fleet Decarbonisation:

Figure 4-4: Opportunities and benefits of decarbonisation

The participants presented their views on the benefits of decarbonising for the organisation as well as the community. A text search query on the organisational context shows that the words: Ecosystem, environment, save money, less carbon dioxide, community health, reducing global warming, postpone climate change, lessen floods and droughts, clean air and reduction of traffic jams were used most frequently. The sub-theme that emerged most frequently was environmental or ecosystem. The extent of the use of these words is summarised as follows.

Table 4-2: Benefits of Fleet Decarbonisation

Name	**Files**	References/narrative instances
Environment/ Ecosystem	1	8
Save Money	1	6
Less Carbon dioxide	1	5
Community Health	1	5
Reducing Global warming	1	3

Postpone Climate Change	1	3
Lessen Floods and Droughts	1	2
Clean Air	1	2
Reduce Traffic Jams	1	1

In terms of the benefits and opportunities of fleet decarbonisation, table 4.6 shows that the most referenced sub-themes were Environment and Save Money. Reducing carbon dioxide and maintaining community health were in third position, with reduction in global warming and postponement of climate change fourth. The least quoted sub-theme and benefit was reduction of traffic jams. The results also show that all the benefits the participants highlighted related to the 'environment'. As shown below, this word was mentioned in eight instances:

Table 4-3: Narrative Instances of Environmental benefits of fleet decarbonisation

8 References Coded (1.06% coverage)
Reference 1 - 0.10% Coverage
Contribute to environmental sustainability
Reference 2 – 0.18% Coverage
Less oil emissions in the environment
Reference 3 – 0.14% Coverage
Reduce carbon dioxide that pollutes the air and harms the environment
Reference 4 – 0.29% Coverage
More environmentally friendly fleet under SAPS
Reference 5 – 0.12% Coverage
Minimising environmental effect
Reference 6 – 0.11% Coverage
Emissions that harm the environment
Reference 7 - 0.03% Coverage
Accommodate electric vehicle for environmental sustainability
Reference 8 – 0.09% Coverage
Promote environmental sustainability

The participants responded as follows.

Participant 6: "…*as a result of emissions that harm the environment and pollute the air, I often see signs and television commercials about issues related to climate change*."

Participant 3: "*decarbonisation can help the organisation to reduce its costs and minimise its environmental impact. Also, contribute positively to the community issues such as health issues."*

Participant 2: "*Through the Emission Development Strategy 2050, Centre of Environmental Rights Climate Bill in parliament, South Africa is guaranteed [a] low environmental emissions development strategy*…"

Participant 1 summarised the benefits of decarbonisation: "*Cleaner air, reduction of negative impacts of carbon emission, less global warming, less consequences of global warming such as floods and droughts, postpone climate change, healthier. Then in terms of organisation it will save on money – contribute to environmental sustainability*".

Figure 4.7 and the verbatim responses above show that the participants were firmly of the view that decarbonisation would benefit the environment in which everyone operates, including V-Polizza. They felt that fleet decarbonisation would contribute to environmental sustainability, reduce emissions in the environment, reduce harm to the ecosystem, and ensure a more environmentally friendly fleet.

Based on figure 4.7, the participants mentioned the word environmental in eight instances in the context of the benefits of decarbonisation for the organisation as well as the community. In response to the question, "what benefits do you think decarbonising would have on the organisation and community?", they stated that *"the benefits of decarbonisation on the organisation and community include environmental sustainability"*- that is the environment benefiting the current generation without depriving future generations. In terms of the opportunities and benefits of optimising fleet decarbonisation for the environment, they noted that *"decarbonisation will bring environmental sustainability which in turn is an advantage/benefit to the organisation and the community at large".* Decarbonisation is thus assumed to promote a sustainable environment.

The participants characterised fleet decarbonisation as *"a way to reduce carbon dioxide so as to reduce the negative impact of pollution emission … when the gas is released".*

4.4 Theme three: Transport technologies in efficient decarbonisation

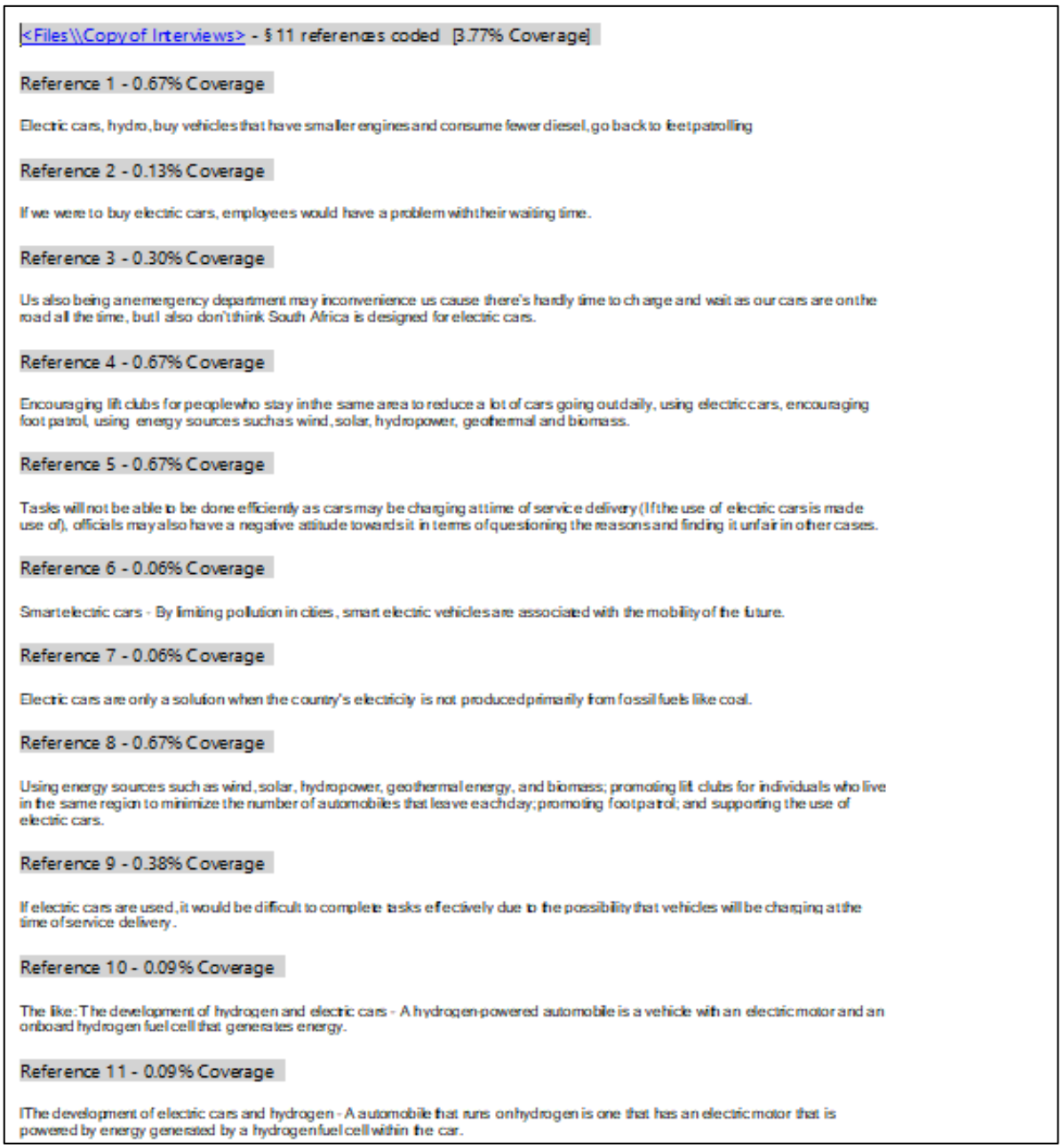
The participants were also asked to share their views on the use of transport technologies for efficient decarbonisation and how changes in the transportation industry brought about by the fourth industrial revolution impact the organisation's efforts to promote decarbonisation.

Keywords were gleaned from the six participants' responses. A text search query on transport technology shows that the words 'electric' 'hydrogen' and 'technology' were the most frequently used.

Subtheme 1: Hydrogen and Electric

Narrative instances of the use of the words 'hydrogen' and 'electric' can be summarised as follows.

Figure 4-5: Hydrogen and Electric Cars as Transport technologies in efficient decarbonisation



<Files\\Copy of Interviews> - § 11 references coded [3.77% Coverage]

Reference 1 - 0.67% Coverage

Electric cars, hydro, buy vehicles that have smaller engines and consume fewer diesel, go back to foot patrolling

Reference 2 - 0.13% Coverage

If we were to buy electric cars, employees would have a problem with their waiting time.

Reference 3 - 0.30% Coverage

Us also being an emergency department may inconvenience us cause there's hardly time to charge and wait as our cars are on the road all the time, but I also don't think South Africa is designed for electric cars.

Reference 4 - 0.67% Coverage

Encouraging lift clubs for people who stay in the same area to reduce a lot of cars going out daily, using electric cars, encouraging foot patrol, using energy sources such as wind, solar, hydropower, geothermal and biomass.

Reference 5 - 0.67% Coverage

Tasks will not be able to be done efficiently as cars may be charging at time of service delivery (If the use of electric cars is made use of), officials may also have a negative attitude towards it in terms of questioning the reasons and finding it unfair in other cases.

Reference 6 - 0.06% Coverage

Smart electric cars - By limiting pollution in cities, smart electric vehicles are associated with the mobility of the future.

Reference 7 - 0.06% Coverage

Electric cars are only a solution when the country's electricity is not produced primarily from fossil fuels like coal.

Reference 8 - 0.67% Coverage

Using energy sources such as wind, solar, hydropower, geothermal energy, and biomass; promoting lift clubs for individuals who live in the same region to minimize the number of automobiles that leave each day; promoting foot patrol; and supporting the use of electric cars.

Reference 9 - 0.38% Coverage

If electric cars are used, it would be difficult to complete tasks effectively due to the possibility that vehicles will be charging at the time of service delivery.

Reference 10 - 0.09% Coverage

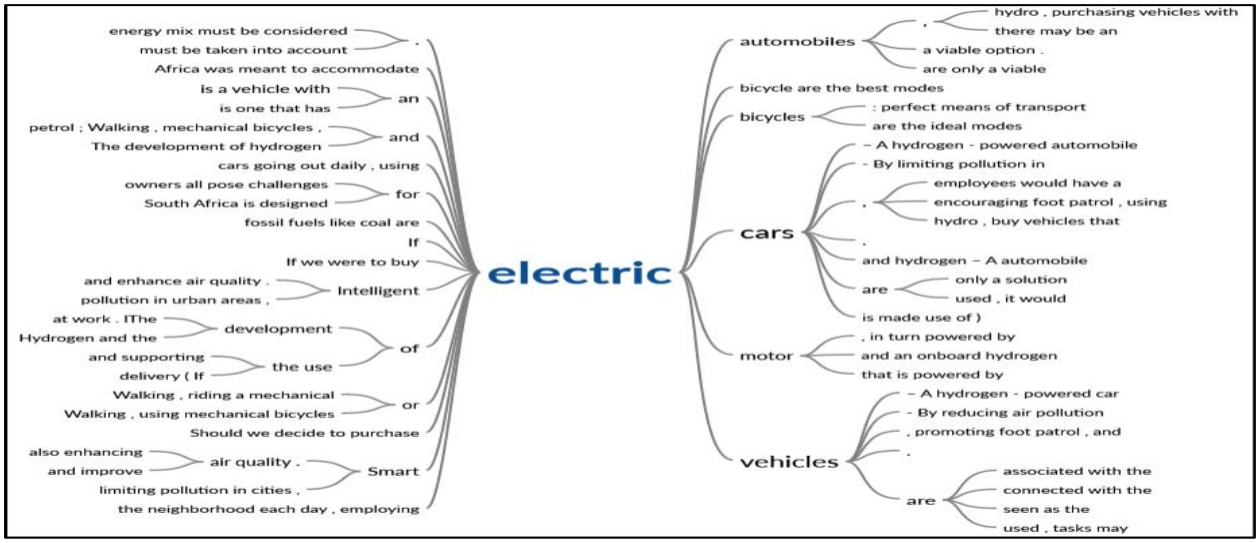
The like: The development of hydrogen and electric cars - A hydrogen-powered automobile is a vehicle with an electric motor and an onboard hydrogen fuel cell that generates energy.

Reference 11 - 0.09% Coverage

IThe development of electric cars and hydrogen - A automobile that runs on hydrogen is one that has an electric motor that is powered by energy generated by a hydrogen fuel cell within the car.

Figure 4.5 shows that the participants felt that electric and hydrogen cars offer more advantages than disadvantages, as electric cars generally have a smaller engine than a diesel or petrol engine. However, participant 1 expressed concern about the time required to charge electric cars and expressed a negative attitude towards this technology. Asked how changes brought about by the fourth industrial revolution will impact the transportation industry and the organisation's decarbonisation efforts, participant 1 noted that *"carmakers and automotive-tech companies are already working on ways to transform cars and the driving experience in a new, greener world. …[A] hydrogen-powered car is a vehicle with an electric motor, in turn powered by electricity produced on board by a hydrogen fuel cell".* The participant added that in the cell, hydrogen comes into contact with oxygen in the air to produce water. This chemical reaction produces heat and electricity, which allows the car to move forward. Participant 4 said that the *"hydrogen car has the advantage of not making any noise and not producing any polluting or toxic emissions".* Participant 5 was aware that a hydroelectric car would improve air quality. While smart electric cars are associated with the mobility of the future and it is likely that people would adapt to addressing environmental concerns, participant 2 observed that *"electric cars are only a solution when the country's electricity is not produced primarily from fossil fuels like coal".* As shown below, the text querying produced similar results.

Figure 4-6: Querying Electric Cars



The figure shows that the participants regarded electric and hydrogen cars as an advantage in pursuing decarbonisation.

Subtheme 2: Technology/tech

The word "technology/tech" came up the most frequently. The participants responded as follows:

Participant 1 suggested that: *"The country isn't even really involved or trying to adjust to the fourth industrial revolution, while some countries are moving towards the sixth industrial revolution – the country is very behind in terms of technology so expecting a department within the country to adjust to industrial revolutions while the country is struggling to do so or just keep up is practically impossible. We need updated technology and infrastructure, suppliers and manufacturers and all sort of things to keep up with the changes in the rest of the world"***.**

Participant 2 said that: *"It requires that we work through technology; therefore, movement of people will decrease because most will work from home, transportation with regards to public transportation will decrease, allocation of work vehicles in organisation will decrease, employment."*

Participant 3 commented: *"Carmakers and automotive-tech companies are already working on ways to transform cars and the driving experience in a new, greener world."*

Participant 4 observed: *"Automobile manufacturers and automotive technology businesses are already working on methods to improve automobiles and the driving experience for a greener future."*

Participant 5 said that: *"It necessitates that we work through technology; as a result, the majority of people will work from home, reducing the need for public transit and the allocation of company vehicles, as well as reducing employment."*

Participant 6 remarked: *"... South Africa is lagging behind in terms of technology, so expecting a department within the country to adapt to industrial revolutions while the country is struggling to do so or just keep up is nearly impossible. To stay up with the developments in the rest of the globe, we require modernised technology and infrastructure, as well as suppliers and manufacturers."*

These excerpts show that the participants were well aware that the technological changes in the transportation industry brought about by the fourth industrial revolution would impact the organisation's decarbonisation initiatives.

4.4 Theme four: Strategies to improve fleet's overall efficiency

Strategies to improve a fleet's overall efficiency is one of the most efficient methods to establish a sustainable fleet and reduce emissions (Cronje, 2021). The participants were asked what strategies they thought the organisation could adopt to ensure a sustainable fleet.

In relation to the sub-themes participant 1 commented on decarbonisation policy and the need to: "… *[Take] things easily and slowly at a time and getting … each … properly … implemented before jumping on to another project. Having a policy within the organisation regarding climate change or sustainability to at least have certain steps to follow or an idea of the objectives that we want to reach within the organisation and how to reach them with first implementing small, tiny steps that could possibly positively influence the community to also adjust. Running campaigns and showing interest or some sort of initiatives within the environmental department, even working with certain companies or NPOs that deal with that, that could hold us accountable for certain actions and matters taken against sustainability*."

Participant number 2 noted the need for training: "*the organisation should minimise outsourcing of vehicles and guarantee sufficient training for incoming vehicles. Increase of workshop primary power, providing advanced driving instruction to drivers to guarantee that they are adequately trained*."

Participant 5 recommended the purchase of fuel efficient cars: "*Buying the proper car: energy usage and CO_2 emissions are proportional. That's why you should consider your needs and pick a fuel-efficient car. Each vehicle comes with a maintenance manual with guidelines for proper maintenance. Walking, mechanical, or electric bikes are great for short journeys and exercise. Public transportation is cleaner than driving, especially for work commutes. Trains are energy-efficient and reduce air pollution."*

The verbatim responses show that decarbonisation policy, training and campaigns were highly recommended. Other proposals included minimising outsourcing of vehicles, demonstrating interest in the environmental sector, training opportunities for drivers, implementation of equitable policies within the organisation, and buying fuel-efficient cars.

4.5 Summary and Conclusion

Qualitative analysis was employed to identify all instances of words in the data, with sub-themes developed for each primary theme. In terms of sustainability initiatives and activities

to curb climate change used by the organisation, the words ‘not’ and ‘cost-saving’ were the most frequently used. This suggests that the majority of the participants were of the view that V-Polizza had no sustainability initiatives and activities to curb climate change.

Do not/Does not was also identified as a theme in evaluating how the organisation supports a sustainable fleet and promotes decarbonisation of its fleet. The majority of the participants noted that the organisation does not support a sustainable fleet and decarbonisation.

Turning to the benefits of decarbonisation for the environment, the participants were in agreement that decarbonisation has a major effect on environmental sustainability. Finally, the participants believed that the use of technology in the transport industry will promote decarbonisation. They suggested strategies that V-Polizza should adopt, including environmental policies, training, and workshops and campaigns to promote decarbonisation.

In conclusion, the qualitative analysis identified flaws in V-Polizza’s efforts to promote a sustainable environment and encourage living within the planet’s capacity. The participants’ responses suggest that, in essence, V-Polizza is failing to implement sustainability practices.

CHAPTER FIVE

DISCUSSION OF RESULTS

5.1 Introduction

This chapter summarizes the findings from the literature review and the main study, and discusses saturation and data quality control. The purpose of this study was to establish the impact of V-Polizza's fleet on the environment and climate change and to identify initiatives that could be launched to promote a more sustainable fleet and produce less vehicle emissions. This chapter discusses the results set out in chapter four against the conceptual framework, guided by the study's objectives as outlined in chapter one.

Decarbonisation is a critical pillar of the larger journey toward net-zero emissions, where the total amount of GHG (including CO_2) emitted equals the amount absorbed or otherwise removed from the atmosphere (Wimbadi and Djalante, 2020). To date, more than 130 countries have committed to, or are considering, a net-zero target by the middle of this century (Parra et al., 2019). Based on the empirical findings this study makes a positive contribution to future research and to promoting V-Polizza's efforts to promote a sustainable environment and encourage living within the planet's capacity.

The responses from the police personnel revealed mixed perceptions but nonetheless confirmed that the organisation does not focus sufficiently on environmental and climate change issues and that further knowledge and/or education could improve the situation. This study adopted a qualitative approach since it tapped into subjective views that captured the actual experiences of staff through interviews. Further research could investigate implementation of the suggested measures and develop a value stream map of environmental sustainability processes.

Research Question One

What is the role of fleet decarbonisation in influencing sustainable fleet management initiatives in V-Polizza?

In today's world, almost every organisation operates vehicle fleets to fulfil business requirements. Irrespective of the size of their vehicles or fleet, these companies require some form of fleet management. Fleet management entails a transition to a more sustainable model that encompasses economic, environmental, and social dimensions. While the economic dimension of sustainability has resulted in the emergence of a new model known as Technology Corporate Management (TCM), the environmental dimension constructs a road map to greener fleets and delivers quick wins that companies can easily implement (Bentley and Hodge, 2020). Fleet vehicles are responsible for close to two-thirds of global emissions from road transport. It is thus vital to reduce their emissions; however, the importance of fleet decarbonisation goes beyond direct emissions reductions. Electrifying fleets can accelerate road transport's overall transition and has significant social benefits. Fleets make up 20% of light and heavy-duty vehicles on the roads, but cause half of the emissions from road transport. V-Polizza's vehicles tend to be larger and are driven for longer distances than private vehicles.

The study participants had mixed feelings regarding V-Polizza's implementation of a sustainable project to promote decarbonisation. The results suggest that the organisation has done close to nothing to adopt sustainable fleet management initiatives, except for cutting unnecessarily transportation, combination of trips and good maintenance of vehicles. Nonetheless, fleet decarbonisation is acknowledged as a way to reduce carbon dioxide and the negative impact of pollution when the gas is released. Environmentally focused fleet management starts with the adoption of an environmentally-centric fleet policy. This provides a baseline for setting environmental goals, targets and key performance indicators (KPIs) that are regularly reviewed and implemented. Effective policy implementation calls for top management's commitment to ongoing improvement in line with changes in legal and tax regulations and market requirements. The policy should be a long-term, written one that is communicated to all employees and also be made available to the public to enhance the organisation's image (Wong and Fryxell, 2004).

Managing V-Polizza's fleet in terms of the three pillars of sustainability is imperative. Environmental sustainability can be achieved by gradual reduction of emissions, adopting EVs, vehicle optimisation, smart rooting, driver training, etc. All strategies should be scalable and should be backed by sound analysis of what is required in terms of support. Acceptance of the policy by all stakeholders is crucial to its success.

Research Question Two

What are the opportunities and benefits of optimising fleet decarbonisation for the environment and society?

Significant misalignment exists between incomes and climate change contributions made by individuals and countries. Those that contribute the least to climate change are those with the fewest economic opportunities and suffer most from its impacts (Crawford-Brown, 2016). Transport is inextricably linked to the critical issues of our time. It contributes considerably to people's well-being by enabling access to goods, services and social networks and supports a good quality of life. At the same time, the negative externalities of transport, notably CO_2 emissions, are a growing concern for climate change.

The participants acknowledged that optimising fleet decarbonisation will provide the following benefits and opportunities for society and the environment:

Less Pollution and Clearer Skies

Every vehicle on the road releases an average of one pound of CO_2 per mile driven. Compared with driving alone, using public transportation or other alternatives reduces CO_2 emissions by 45%, decreasing pollution in the atmosphere and improving air quality (Matak et al., 2022). The participants identified fleet decarbonisation as a way to reduce carbon dioxide and pollution when the gas is released.

Healthier Communities

Improved air quality in a community benefits the health of those who live there. This can result in fewer cases of respiratory ailments such as asthma and even cancer. People are also more prone to exercise when the air quality is better. The participants noted that decarbonisation, which aims to enhance the environment in which everyone operates, including V-Polizza's employees would ensure a more environmentally friendly fleet while reducing emissions into the environment and harm to the ecosystem.

Noise Is Also Pollution

One rarely thinks of noise pollution when it comes to cars, unless one lives on a busy street. Less driving will make neighbourhoods quieter, to everyone's benefit. While this factor was not mentioned by many participants, transportation's impact in the form of noise pollution was

acknowledged. Emissions and noise from transport affect people's health and environmental ecosystems, highlighting the need to reduce noise pollution by all modes of transport.

Public health

Fleet decarbonisation will have tangible public health benefits. Using forward-thinking technologies to monitor and reduce the number of contaminants emitted into the air will not only counteract climate change, but it will also boost air quality. Air pollution is responsible for some seven million premature deaths worldwide, with a serious public health impact. The participants were of the view that decarbonisation will benefit the organisation and the community by supporting environmental sustainability, encourage living within the planet's limits, reducing energy costs, and promoting energy conservation.

Economic consequences

The health consequences of a carbon-heavy world are not only measured in lost lives and hospitalisation statistics, but by the attendant impact on the public purse. This takes many different forms, from reduced spending on health services to improved employee productivity and enhanced energy efficiency. The participants observed that decarbonisation will save the organisation money by reducing expenditure on health issues.

Future proofing and self-sustainability

Phasing out the use of fossil fuels – which are both finite and concentrated in the hands of select resource-rich nations – in favour of renewable sources of power generation such as solar, wind and wave, will future proof societies against the resource scarcity that will ultimately arrive, even if not for centuries or more. Having the means to power homes and businesses on our own soil means that importing energy from other nations could become a thing of the past, thus reducing reliance on others and enhancing self-sustainability. The participants acknowledged that smart EV are the mobility of the future and that people would adapt to this lifestyle while meeting new environmental needs. However, they noted that this is only a solution when the country's electricity is not produced primarily from fossil fuels like coal.

Research Question Three

How does the advent of transport technologies impact efficient decarbonisation responsiveness to mitigate climate change?

Road transport presents particular challenges for emissions reduction and requires a steep change in behaviour and technology. The scale of the challenge means that incremental improvements using existing technologies are not sufficient to meet the targets. Taking passenger cars as an example (Aziz, 2017), beyond 2045, all vehicles must emit less CO_2 than a best-in-class fossil-fuelled ice hybrid, which means that the majority of vehicles should be either evs/PHevs with an almost completely (75-100%) decarbonised electricity grid and/or substantial roll-out of sustainable biofuels (again, perhaps a 75-100% blend) (Beaudet, 2010). Such radical changes will require the availability of innovative technological options, consistent political support and policies focused on the long term across multiple sectors (vehicles, fuels and electricity supply).

The intentional focus is on priority technological developments to address climate change that will generate large transition risks for the South African economy. The V-Polizza participants agreed that the application of technology in the transportation sector will move the organisation closer to decarbonisation. They noted that automakers have been hinting at future technology through new modes of transportation. However, the participants expressed concerned that South Africa is not keeping pace with the fourth industrial revolution. Sutherland (2019) concurs and notes that South Africa has a significant skills shortage due to failings in its education system, limiting the supply of managers, researchers and workers required for the fourth industrial revolution. Further problems include poor quality infrastructure, reflecting weak governance and state capture. The country has a poor record when it comes to policy formulation and implementation, especially across departments, with notable delays in cybersecurity and data protection.

All six participants mentioned technology/tech in some way when discussing how the changes brought about by the fourth industrial revolution in the transportation industry would impact the organisation's decarbonisation efforts. This implies that they felt that such use of technology would move V-Polizza towards decarbonisation. This addresses the third objective, which was to examine how the advent of transport technologies would impact efficient decarbonisation responsiveness to mitigate climate change. For example, participant 4 alluded to the new technologies embraced by automobile manufactures which will *"…improve the driving experience for greener future."* This implies that there will be

decarbonisation which will promote a sustainable environment. Shi and Li (2022) assert that reductions could be achieved globally in the transportation sector as a result of advancements in technological efficiency, the electrification of vehicles, extensive decarbonisation of the grid, and the utilisation of low-carbon fuels. This is also in line with the theoretical framework underpinning this study, the TOE (Tornatzky and Fleischer, 1990) that posits that the decision to adopt a technological innovation is based on technological considerations, but also on the organisational and environmental contexts. In this study this framework reveals the benefits of adoption of new technologies in the automotive industry on an organisational and environmental context. According to Kowath and Choon (2001), technology is a crucial instrument for the automotive industry's transformation towards energy efficiency and fewer carbon emissions because automobiles are responsible for a substantial portion of urban air pollution and the combustion of fossil fuels which creates severe environmental dangers that threaten human health.

Significant reduction in the current average CO_2 emissions produced by V-Polizza's fleet could be achieved at relatively low cost with established technologies such as engine downsizing, light-weighting and the use of smaller vehicles. Deep decarbonisation is the most aggressive way to transform the current fossil-fuel-reliant energy system to one powered solely from renewable and low-carbon energy sources (Sheldon and Dua, 2020). Finding solutions to significantly reduce human-made, atmospheric heat-trapping GHGs, also known as carbon dioxide emissions, is imperative to meet emission reduction targets, achieve climate policy goals, and halting the mounting effects of climate change.

Policy on decarbonisation, training for incoming vehicles and campaigns were among the participants' recommendations, with suggested solutions including minimising outsourcing of vehicles, demonstrating interest in the environmental sector, training opportunities for drivers, implementation of equitable policies within the organisation, and buying fuel-efficient cars.

According to Shi and Li (2022), the importance of campaigns and policies in the battle against climate change cannot be overstated. The results also corroborate Wu et al.'s (2022) assertion that the objective of campaigns and policies is to strike a balance between environmental protection and the conservation of natural resources and other policy objectives, such as affordable energy and economic growth and employment. Therefore, organisations that run campaigns and implement environmental policies are more likely to triumph in decarbonisation.

In the context of South Africa's NDC (Nationally Determined Contributor), an EV fleet with zero tail-pipe emissions will potentially enable more equitable decarbonisation of the power sector by allowing extended operation of existing coal plants in the near term. The increase in emissions from the power sector will be balanced in the long term (2040-2050) by a zero GHG emissions road fleet (O'Reilly, 2022).

5.2 Significance of the study's findings.

This study investigated the role of fleet decarbonisation in influencing sustainable fleet management initiatives in V-Polizza, the opportunities and benefits of optimising fleet decarbonisation for the environment and society and the impact of the advent of transport technologies on efficient decarbonisation responsiveness to mitigate climate change. Its findings have practical implications for the industry and the environment by shedding light on the suitability of fleet decarbonisation in influencing sustainable fleet management. The results are of relevance to those involved in SCM and the transport sector because they will help reduce their carbon footprint. The findings also contribute to the body of knowledge on transport decarbonisation in a public organisation in developing countries, current modelling practice, and policy planning to decarbonise the transport sector.

5.3 Summary of chapter and conclusion

The chapter analysed and discussed the results set out in chapter four, focusing on the aim of this research which was to identify the opportunities and benefits of optimising fleet decarbonisation for the environment and society, and the impact V-Polizza going green would have on the environment and society. It also aimed to determine how technology could influence sustainable optimisation of V-Polizza's transportation, and the benefits that will accrue. V-Polizza lacks sustainability programmes that aim to address climate change. A sustainable fleet that benefits the environment or leads to a decrease in carbon emissions has thus not been achieved by the organisation. Moving to a more sustainable fleet management model is necessary to take into account social, environmental, and economic factors. Fleet vehicles are responsible for almost two-thirds of global emissions from road transportation. This study highlights the need to reduce fleet emissions; however, the importance of decarbonising fleets goes beyond these immediate benefits. With the exception of cutting down on pointless travel, consolidating trips, and maintaining vehicles well, V-Polizza has implemented very few sustainable fleet management activities. However, it acknowledges fleet

decarbonisation as a way to reduce carbon dioxide emissions and minimise the harm that these emissions cause to the environment.

Based on the analysis and results obtained, chapter six presents conclusions and recommendations emanating from the findings.

CHAPTER SIX

RECOMMENDATIONS AND CONCLUSIONS

6.1 Introduction

This final chapter concludes the study and provides recommendations. The purpose of this study was to investigate the impact of V-Polizza's fleet on the environment and climate change. It aimed to provide insight into initiatives that could be adopted to ensure a more sustainable fleet and less vehicle emissions. This chapter sets out the study's findings, recommendations, limitations and delimitations and a conclusion guided by the research objectives.

6.2 Summary of findings from the Literature Review

Researchers such as Ellen MacArthur (2019) highlight that switching to renewable energy will only cut GHG emissions by 55%, as the remaining 45% emanate from production and consumption of products and how food is produced.

Understanding the carbon footprint across an entire organisation enables identification of the primary sources of energy usage, production intensity, transportation needs, and the waste generated across processes (Elimi and Stoffberg, 2022). This information can be used to identify key opportunities to save costs and reduce carbon output. For many organisations, going beyond their own operations to Scope 3 emissions in supply chains will result in even bigger opportunities for carbon and cost reductions (Zipperer et al., 2017).

The global energy mix is shifting from fossil fuels to renewables. There are abundant examples of both public and private organisations that are working hard to decarbonise the economy. As this energy transformation or 'Green Deal' gains momentum, new ecosystems are forming and new technologies are emerging (Gibson, 2022). These developments are helping to grow renewables, develop new energy carriers, improve energy efficiency, reduce emissions and create new markets for carbon and other by-products as part of an increasingly circular economy. At the same time, many of these decarbonisation strategies, such as increased electrification, wide-scale use of renewable energy and intensified energy efficiency measures pose unique challenges.

The prevailing literature shows that the South African energy transition is influenced by technical and economic as well as social and political factors (Baker et al., 2014).

6.3 Summary of findings from the main study

The participants used the words ‘not’ and ‘cost-saving’ in relation to V-Polizza’s adoption of sustainability initiatives and activities to combat climate change. Indeed, many participants claimed that V-Polizza lacked any sustainability programmes and strategies to address climate change. The use of ‘Do not’/ ‘Does not’ was also noted as a theme in the responses to the questions used to assess how the organisation supports a sustainable fleet and fleet decarbonisation, with most participants using these terms. Thus, the findings show that V-Polizza has not committed to a sustainable fleet or reduced carbon emissions.

The participants agreed that decarbonisation has a significant impact on environmental sustainability and that harnessing technological innovations in the transportation sector will promote decarbonisation. They suggested that V-Polizza should implement environmental policies, offer workshops and training, and launch decarbonisation initiatives.

6.4 Synthesis and Summary of the Study

The energy transition in South Africa is influenced by technological, economic, social, and political considerations. The study found that V-Polizza lacks strategies to address climate change. The organisation has not taken steps to promote a sustainable fleet or reduced carbon emissions. Fleet management should shift to a more sustainable model that incorporates economic, environmental, and social concerns. Almost two-thirds of the global emissions from road transportation are caused by fleet vehicles. However, decarbonising fleets extends beyond direct emission reductions. Electrification of fleets can accelerate the overall transition of the road transportation system and has major societal benefits. Twenty percent of light and heavy-duty vehicles on the road are part of fleets, but they account for 50% of all road transport emissions. V-Polizza's vehicles are often larger and are driven over longer distances than private vehicles.

The study’s results illustrate that, with the exception of reducing unnecessary transportation, combining trips, and maintaining vehicles, V-Polizza has not made a substantial investment in sustainable fleet management. However, there would appear to be acknowledgement that fleet decarbonisation would reduce carbon dioxide emissions that negatively impact the environment. Environmentally conscious fleet management should begin with the adoption of an eco-friendly fleet policy that sets goals, targets, and KPIs that are routinely reviewed and implemented. An effective policy calls for commitment from senior management, as well as continuous improvements in line with changes in the legal and tax landscape and market

requirements. The policy should be scalable and should be based on sound understanding of what is required to support the environmental policy. Furthermore, all stakeholders should endorse the policy.

Transport is intrinsically intertwined with the most pressing concerns of the day. It facilitates access to commodities, services, and social networks that promote a high quality of life and thus significantly enhances the well-being of its users. However, the negative externalities of transportation, including CO_2 emissions, are a major issue in relation to climate change. The benefits of decarbonisation include less pollution and clearer skies, healthier communities, less noise pollution, improved public health, future proofing and self-sufficiency, and economic benefits. Changes in the transport business will necessitate novel technology choices, as well as long-term, constant political backing and sector-spanning regulations (vehicles, fuels, and electricity supply). All the study participants agreed that the deployment of technology in relation to transportation will bring V-Polizza closer to decarbonisation. However, an emphasis on technology advances to combat climate change will create significant transition risks for the South African economy.

6.5 Recommendations

Decarbonisation is a complex task, and there are a number of levers available to organisations to adopt this strategy, including changes in enterprise guidance, electrification, energy efficiency, sourcing cleaner energy, and direct carbon management of a company's infrastructure portfolio (O'Reilly, 2022). Reducing Scope 3 emissions which result from activities or assets not owned by the organisation but which indirectly impact its value chain, would entail encouraging suppliers to decarbonise or changing suppliers. Offsets are an option for those emissions that cannot be easily reduced (Chersich, 2019).

Achieving deep decarbonisation calls for a rethink of how we produce and consume energy and a radical switch to renewables and low carbon energy sources (Ndung'u and Signé, 2020). Getting to zero net emissions requires switching to clean energy sources and shifting from fossil fuels to electricity. Different sectors will follow different pathways based on their mitigation potential, and each organisation will need to complete a detailed analysis of its operations to identify appropriate methods to achieve its objectives (Nhede et al., 2022). Companies are increasingly implementing internal carbon pricing, which assigns a monetary value to emissions to reflect the real cost to both the business and society, in order to

inform risk mitigation, investment and operational decision-making (Chersich and Wright, 2019).

The following recommendations are made to promote the decarbonisation of V-Polizza's fleet and address practices that have negative climate impacts:

- The organisation should adopt policy on climate change and sustainability that outlines the objectives and how they will be achieved step by step.
- Improved vehicle efficiency. Significant CO_2 reductions of perhaps 30% of the current fleet average could be achieved at relatively low cost using established technologies such as engine downsizing, light-weighting and selection of smaller vehicles.
- V-Polizza should run campaigns and demonstrate interest in the environmental sector, as well as collaborate with specific firms and non-profit organisations that address these issues and could hold the organisation liable for activities that undermine sustainability.
- Improved efficiency of vehicle use. Behavioural measures such as 'eco-driving' can reduce fuel consumption by around 10-15% at low cost, but require ongoing training and speed limit enforcement. While such reduction could cut emissions quickly, there is mixed evidence on their cost and acceptability.
- Decarbonisation Training initiatives should be provided on the use of incoming vehicles. The key objective of this training should be to promote fuel efficient driving habits, which will result in fuel savings, as well as reduction in harmful vehicle emissions and an improvement in urban air quality.
- Drivers should receive advanced driving instruction to ensure that they are properly trained on fleet decarbonisation. This will help result in substantial fuel savings and reduced emissions, Eco-driving can assist in effectively reducing fuel consumption thereby reducing harmful vehicle emissions and pollutants such as CO which is one of the greenhouse gases that contributing to climate change. Motor vehicle usage has a significant impact on the atmosphere by releasing pollutants that contribute to the slow, but steady increase in average world temperature, commonly known as global warming (Drumheller et al., 2001).
- V-Polizza should make use of fuel-efficient cars such as those that has fuel consumption of 6-litres/100km. a small city hatchback should be able to achieve an average fuel consumption of around six to seven litres per 100km, a mid-sized SUV will be closer to

eight or nine litres per 100km and a full-sized family SUV will use closer to 10 litres per 100km in the real world (Oastler , 2023).

6.6 Limitations of the study

The first limitation of this study is that V-Polizza employees, especially senior management, were always very busy, leaving little time to engage in interviews. More time should thus have been allocated to data collection. The researcher also had to travel to access the interviewees. Some questions were not answered during the interviews due to a lack of understanding or interest in the subject at hand. Security is tight at V-Polizza and gaining access to the participants was a further limitation. Lastly, load shedding, which worsened as the study progressed, meant that the researcher did not have access to the network in her area for hours at a time, hampering completion of the study.

6.7 Conclusion

This chapter outlined the study's findings, conclusions, recommendations and limitations. The research objectives were achieved and the research questions were answered. Strategies suggested by the study participants to promote sustainable initiatives in V-Polizza were also outlined. Energy is often the largest driver of emissions and deploying renewable energy is a major lever to reduce them. Switching to renewable energy procurement and investing in process redesign can help reduce emissions, as can asset electrification, upgrading existing systems (such as heating and cooling) to run on low- or no-carbon energy sources rather than fossil fuels.

List of References

Abbasi, M. and Nilsson, F., 2012. Themes and challenges in making supply chains environmentally sustainable. *International Journal of Supply Chain Management*, Iss. 5, pp 517 – 530.

Adwok, J., 2015. Probability Sampling – A Guideline for Quantitative Health Care Research. *Journal of The Annals of African Surgery*, Issue 2, pp 95 – 99.

Agility. 2019. *Best Practices for Green Supply Chain and Sustainability | Agility*. [online] Available at: <https://www.agility.com/en/blog/what-are-green-supply-chain-practices-your-guide-to-supply-chain-sustainability/> [Accessed 20 July 2022].

Akbari, M., 2018. Logistics outsourcing: a structured literature review. *Benchmarking: An International Journal*, 25(5), pp.1548-1580.

Alberus, Rene W., 2019. "Translating a Digital Strategy for South Africa's Police Services". CONF-IRM 2019 Proceedings. 41 (online) Available at: https://aisel.aisnet.org/confirm2019/41 {Accessed 22 March 2022}

Alex Scott., 2019. "European chemical makers plan 'cracker of the future,'" *Chemical and Engineering News* 97, no. 35 available at : https://cen.acs.org/business/petrochemicals/European-chemical-makers- plan-cracker/97/i35. (Accessed : 28 September 2022)

Arvianto, A., Sopha, B., Asih, A. and Imron, M., 2020. Literature review of city logistics: Classification of studies and dominant factors in developing countries. *The 5th international conference on industrial, mechanical, electrical, and chemical engineering 2019 (icimece 2019)*.

Azarabadi, H. and Lackner, K.S., 2020. "Post-combustion capture or direct air capture in decarbonizing US Natural Gas Power?" Available at: https://doi.org/10.26434/chemrxiv.11678013.

Aziz, M., 2017. "Advanced charging system for plug-in Hybrid Electric Vehicles and battery electric vehicles," *Hybrid Electric Vehicles* [Preprint]. Available at: https://doi.org/10.5772/intechopen.68287.

Baltutis, J. (2010). Benefits of Eco-driving, UNEP: Division of Technology, Industry and Economics. Available online from www.unep.org/transport/PDFs/Ecodriving/ Ecodriving_pwpt.pdf [Accessed on 18 April 2023].

Bank, W., 2022. *Decarbonizing Development*. [Online] Openknowledge.worldbank.org. Available at: <https://openknowledge.worldbank.org/handle/10986/21887?show=full> [Accessed 26 July 2022].

Beaudet, A., 2010. "Competing pathways for the decarbonisation of road transport: A comparative analysis of electric and Hydrogen Vehicles," *SSRN Electronic Journal* [Preprint]. Available at: https://doi.org/10.2139/ssrn.1707426.

Bellamy, R., 2020. "Negative Emissions Technologies," *International Encyclopedia of Geography*, pp. 1–6. Available at: https://doi.org/10.1002/9781118786352.wbieg2008.

Bentaher, C. and Rajaa, M., 2022. Supply Chain Management 4.0: A Literature Review and Research Framework. *European Journal of Business and Management Research*, 7(1), pp.117-127.

Bentley, J. and Hodge, C., 2020. "Federal best practices: Core principles of sustainable fleet management." Available at: https://doi.org/10.2172/1707747.

Bernard, H.R. and Ryan, G., 2010. *Qualitative Data Analysis: Systematic Approaches. Thousand Oaks*: Sage Publications

Beumelburg , C., 2020. *Heidelbergcement takes the next step towards CO2 Capture and storage (CCS) in Brevik, Norway*, *Heidelberg Materials*. Available at: https://www.heidelbergmaterials.com/en/pr-17-06-2020 (Accessed: October 2, 2022).

Brinken, J., Pabsch, C. and Behrendt, F., 2022. *Decarbonisation Potential of Logistic 4.0 Technologies in Apple Supply Chains*. Procedia Computer Science, 200, pp.461-470.

Bryman, A., 2006. Integrating Quantitative and Qualitative Research: How Is It Done? *Qualitative Research*, 6(1), 97-113.

Buch-Hansen, H., 2018. “The prerequisites for a degrowth paradigm shift: Insights from Critical Political Economy,” *Ecological Economics*, 146, pp. 157–163. Available at: https://doi.org/10.1016/j.ecolecon.2017.10.021.

Burgess, K., Singh, P. and Koroglu, R., 2006. Supply chain management: a structured literature review and implications for future research. *International Journal of Operations andamp; Production Management*, 26(7), pp.703-729.

BusinessTech., 2021. Shocking number of SA police cars are out of service (online) Available at: https://businesstech.co.za/news/government/166321/shocking-number-of-sa-police-cars-are-out-of-service/ {Accessed 29 March 2022}

Caetano, T., Merven, B., Hartley, F. and Ahjum, F., 2017. Decarbonisation and the transport sector: A socio-economic analysis of transport sector futures in South Africa. Journal of Energy in Southern Africa, 28(4).

Champion, A., 2022. *What is physical distribution in supply chain management?*, *Flowspace*. Available at: https://flow.space/blog/physical-distribution/ (Accessed: November 9, 2022).

Chaudhuri, A., 2018. “Internet of things and regulations,” *Internet of Things, for Things, and by Things*, pp. 181–196. Available at: https://doi.org/10.1201/9781315200644-10.

Chersich, M.F. and Wright, C.Y. ., 2019. “Climate change adaptation in South Africa: A case study on the role of the Health Sector,” *Globalization and Health*, 15(1). Available at: https://doi.org/10.1186/s12992-019-0466-x.

Chiang, W.-yu K., 2012. “Supply Chain Dynamics and channel efficiency in durable product pricing and distribution,” *SSRN Electronic Journal* [Preprint]. Available at: https://doi.org/10.2139/ssrn.1958114.

Claire O’reilly., 2022. *Sa’s aggressive decarbonisation strategy to start - engineering news*. Available at: https://www.engineeringnews.co.za/article/sas-aggressive-decarbonisation-strategy-to-start-2022-01-05 (Accessed: December 04, 2022).

Coldwell, D. and Herbst, F.J., 2014. *Business research*. Cape Town: Juta Academic.

Collins, H., 2018. "*Creative Research: The Theory and Practice of Research for the Creative Industries"* AVA Publications

Cooper, J., Stamford, L. and Azapagic, A., 2014. "Environmental impacts of shale gas in the UK: Current situation and future scenarios," *Energy Technology*, 2(12), pp. 1012–1026. Available at: https://doi.org/10.1002/ente.201402097.

Covary, N. (2010). The 2010 Fuel Efficiency Campaign for City of Cape Town. Available online from http://www.capetown.gov.za/en/Pages/ GreenGoal2010puts20certifiedecodriventaxisontheroad.aspx

Crawford-Brown, D., 2016. "Analysis of the co-benefits of climate change mitigation," *Handbook of Climate Change Mitigation and Adaptation*, pp. 477–488. Available at: https://doi.org/10.1007/978-3-319-14409-2_59.

Creswell, J.W. and Guetterman, T.C., 2019. *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. 6th ed. New York: Pearson.

Damert, M., and Rudolph, F., 2018. Policy options for a decarbonisation of passenger cars in the EU: recommendations based on a literature review.

Denton, T., 2020. "Electric Vehicle Technology," *Electric and Hybrid Vehicles*, pp. 63–98. Available at: https://doi.org/10.1201/9780429296109-4.

Denzin, N., 2010. On Elephants and Gold Standards. *Journal of Qualitative Research*, Issue. 3, pp 269 – 272.

Dolati Neghabadi, P., Evrard Samuel, K. and Espinouse, M., 2018. Systematic literature review on city logistics: overview, classification and analysis. *International Journal of Production Research*, 57(3), pp.865-887.

Drumheller, B., Quaid, A., Wyman M., Liljenwall J. and Young A. (2001). Sustainable transportation option for protecting the climate: a guide for local government. Available online from http://www.iclei.org/documents/Global/Progams/CCP/ Sust_Trans_Options.pdf [Accessed on 12 October 2022].

Durach, C., Kembro, J. and Wieland, A., 2017. A New Paradigm for Systematic Literature Reviews in Supply Chain Management. *Journal of Supply Chain Management*, 53(4), pp.67-85.

Dyrhauge, H., 2021. Discourses about EU Transport Decarbonisation: Towards a Paradigm Shift?. The International Spectator, 56(3), pp.71-86.

Elfil, M., and Negida, A., 2017. Sampling methods in clinical research; an educational review. *Emergency*, *5*(1).

Eltayeb, T.K., Zailani, S. and Ramayah, T. (2010). *Green supply chain initiatives among certified companies in Malaysia and environmental sustainability: Investigating the outcome. Journal of Resources, Conservation and Recycling*, pp 1 – 12.

Epstein, M.J. and Buhovac, A.R., 2014. *Making Sustainability Work: Best Practices in Managing and Measuring Corporate Social, Environmental and Economic Impacts*. 2nd Ed. San Francisco: Berrett-koehler Publishers, Inc.

European Commission, 2010. What is the EU doing on climate change? [Online]. Available: http://europa.eu/pol/env/index_en.html [Accessed 12 March 2022].

European Commission, 2016. Greenhouse gas emissions statistics. [Online]. Available: http://ec.europa.eu/eurostat/statisticsexplained/index.php/Greenhouse_gas_emission_statistics [Accessed 13 March 2022].

European Commission, 2017. Reducing emissions from transport: A European Strategy for low-emission mobility. [Online]. Available: https://ec.europa.eu/clima/policies/transport_en [Accessed 12 March 2022].

Feng, B. and Ye, Q., 2021. Operations management of smart logistics: A literature review and future research. *Frontiers of Engineering Management*, 8(3), pp.344-355.

Fisher-Holloway, B. and Mokhele, M., 2022. "The deployment of theory in Logistics Research: A systematic literature review," *Journal of Transport and Supply Chain Management*, 16. Available at: https://doi.org/10.4102/jtscm.v16i0.716.

Flick, U., 2014. *An Introduction to Qualitative Research*. Thousand Oaks, CA: Sage.

Frederico, G., 2021. From Supply Chain 4.0 to Supply Chain 5.0: Findings from a Systematic Literature Review and Research Directions. *Logistics*, 5(3), p.49.

Gattiker, J., 2021. "Direct air capture of CO2 (DAC) [Tech Snapshot]," pp. 3–7. Available at: https://doi.org/10.2172/1782623.

Gattiker, J., 2021. "Direct air capture of CO2 (DAC) [Tech Snapshot]," pp. 3–7. Available at: https://doi.org/10.2172/1782623.

GE Capital Solution. (2011). Your guide to Eco-driving essential driver support. Available online from www.gecapital.co.uk/en/docs/ecodriving_guide.pdf [Accessed on 18 April 2023].

Gibson, C.W., 2022. "Cities and the green new deal," *Routledge Handbook on the Green New Deal*, pp. 353–371. Available at: https://doi.org/10.4324/9781003110880-23.

Gross, S., 2022. *The challenge of decarbonizing heavy industry*, *Brookings*. Brookings. Available at: https://www.brookings.edu/research/the-challenge-of-decarbonizing-heavy-industry/ (Accessed: August 10, 2022).

Guest, S., 2022. *SAP BrandVoice: Sustainable Supply Chain: 3 Businesses Making A Difference*. [online] Forbes. Available at: <https://www.forbes.com/sites/sap/2021/11/03/sustainable-supply-chain-3-businesses-making-a-difference/?sh=3ec71b864460> [Accessed 24 May 2022].

Guo, L., 2009. "Quality disclosure formats in a distribution channel," *Management Science*, 55(9), pp. 1513–1526. Available at: https://doi.org/10.1287/mnsc.1090.1035.

Harper, S., Cunsolo, A., Babujee, A., Coggins, S., Aguilar, M. and Wright, C., 2021. Climate change and health in North America: literature review protocol. *Systematic Reviews*, 10(1).

He, M., Shen, J., Wu, X. and Luo, J., 2018. Logistics Space: A Literature Review from the Sustainability Perspective. *Sustainability*, 10(8), p.2815.

Heizer, J.H. and Render, B., 2014. *Operations management: sustainability and supply chain management.* Boston: Prentice Hall.

Herrmann, F. and Rothfuss, F., 2015. “Introduction to hybrid electric vehicles, battery electric vehicles, and off-road electric vehicles,” *Advances in Battery Technologies for Electric Vehicles*, pp. 3–16. Available at: https://doi.org/10.1016/b978-1-78242-377-5.00001-7.

Hossein Nassaji., 2015. *Qualitative and descriptive research: Data type versus data analysis:* Sage publications

Ivanova, O., 2021. “The economics of reducing carbon emissions from air and Road Transport,” *International Encyclopedia of Transportation*, pp. 457–463. Available at: https://doi.org/10.1016/b978-0-08-102671-7.10085-5.

Jab?o?ski, M., 2019. Sustainability of Young Companies-Contemporary Trends and Challenges. [Place of publication not identified]: MDPI - Multidisciplinary Digital Publishing Institute.

Jamaluddin, F. and Saibani, N., 2021. Systematic Literature Review of Supply Chain Relationship Approaches amongst Business-to-Business Partners. *Sustainability*, 13(21), p.11935.

Jamet, S., 2009. Assessing the Impacts of Climate Change. *OECD Economics Department Working Papers*,.

Jarvis, P., 2020. “Environmental Technology for the Sustainable Development Goals (sdgs),” *Environmental Technology*, 41(17), pp. 2155–2156. Available at: https://doi.org/10.1080/09593330.2020.1772547.

Kathawala, Y. and Abdou, K., 2003. “Supply Chain Evaluation in the Service Industry: A Framework Development compared to manufacturing,” *Managerial Auditing Journal*, 18(2), pp. 140–149. Available at: https://doi.org/10.1108/02686900310455137.

Keay, M. and Robinson, D., 2017. “Managing electricity decarbonisation.” Available at: https://doi.org/10.26889/9781784670801.

Konchou, F., Koholé, Y., Tchuen, G. and Tchinda, R., 2022. Energy, exergy and sustainability assessment of Cameroon residential sector. *Environment, Development and Sustainability*,.

Kovacs, G. and Kot, S., 2016. "New Logistics and production trends as the effectof global economy changes," *Polish Journal of Management Studies*, 14(2), pp. 115–126. Available at: https://doi.org/10.17512/pjms.2016.14.2.11.

Krejcie, R. V., and Morgan, D. W., 2003. Systems Research. Proceedings of the 11th Annual Midwest United States Association for Information Systems (MWAIS) [online] Available at: https://aisel.aisnet.org/mwais2016/26 Determining Sample Size for Research {Accessed 12 March 2022}.

Kuklina, M., Savvinova, A., Filippova, V., Krasnoshtanova, N., Bogdanov, V., Fedorova, A., Kobylkin, D., Trufanov, A. and Dashdorj, Z., 2022. Sustainability and Resilience of Indigenous Siberian Communities under the Impact of Transportation Infrastructure Transformation. *Sustainability*, 14(10), p.6253. doi:10.3390/su14106253.

Kumar, R. and Alok, K., 2020. Adoption of electric vehicle: A literature review and prospects for sustainability. *Journal of Cleaner Production*, 253, p.119911.

Kumar, R., 2019. *Research methodology: a step-by-step guide for beginners.* 5th ed. Los Angeles [U.A.] Sage.

Lane, R., 2018. "Decarbonisation." Available at: https://doi.org/10.31235/osf.io/y2u7s.

Liao, F., Molin, E. and van Wee, B., 2016. Consumer preferences for electric vehicles: a literature review. *Transport Reviews*, 37(3), pp.252-275.

Littlejohn, S.W. and Foss, K.A., 2009. "*Encyclopedia of Communication Theory*", SAGE Publication

Loza, A. and Fidélis, T., 2021. 'Literature review on the analysis of climate change risks in the environmental impact assessment of dams'. *Impact Assessment and Project Appraisal*, 39(4), pp.277-289.

Mabasa, H.M. and Olutola, A.A., 2021. "The structure of South African police: Towards a single police service," *Cogent Social Sciences*, 7(1). Available at: https://doi.org/10.1080/23311886.2021.1959974.

Mann, M. E. (2022, November 15). *Greenhouse gas* . Encyclopædia Britannica, inc. Available at: https://www.britannica.com/science/greenhouse-gas (Accessed: December 16, 2022).

Mark Oastler (2023) What is average fuel consumption?, CarsGuide. Available at: https://www.carsguide.com.au/car-advice/what-is-average-fuel-consumption-88469 (Accessed: 14 June 2023).

Martínez-Mesa, J., González-Chica, D. A., Duquia, R. P., Bonamigo, R. R., and Bastos, J. L., 2016. Sampling: how to select participants in my research study?. *Anais brasileiros de dermatologia*, *91*, 326-330.

Martoff, C. *et al.*, 2021. "Analysis of gamma ray emisssions from fission product contributors to the Antineutrino Spectrum," *Analysis of Gamma Ray Emisssions From Fission Product Contributors to the Antineutrino Spectrum*[Preprint]. Available at: https://doi.org/10.2172/1825280.

Mast, J. and Kemper, B.P.H., 2009. Principles of Exploratory Data Analysis in Problem Solving: What Can We Learn from a Well-Known Case? *Journal of Quality Engineering*, pp 366 – 375.

Matak, N., Mimica, M. and Krajačić, G., 2022. "Optimising the cost of reducing the CO2 emissions in Sustainable Energy and Climate Action Plans," *Sustainability*, 14(6), p. 3462. Available at: https://doi.org/10.3390/su14063462.

Matsumoto, R. and Tabata, T., 2022. *Impact and Challenges of Reducing Petroleum Consumption for Decarbonisation*. Applied Sciences, 12(8), p.3738.

Mawande Amashabalala., 2021. More than half of SAPS flying squad vehicles in Gauteng are off the road (online) Available at: https://www.sowetanlive.co.za/news/south-africa/2021-07-26-more-than-half-of-saps-flying-squad-vehicles-in-gauteng-are-off-the-road/ {Accessed 29 March 2022}

McGrath, J., 2022. *Top 10 alternative transportation methods*, *HowStuffWorks Science*. HowStuffWorks. Available at: https://science.howstuffworks.com/environmental/green-science/10-alternative-transportation-methods.htm (Accessed: September 16, 2022).

Modise, J., Taylor, D. and Raga, K., 2020. Service Delivery from a South African Police Service Perspective. *Alternation - Interdisciplinary Journal for the Study of the Arts and Humanities in Southern Africa*, SP32(1).

Mohammad-Hosseinpour, A. and Molina, J., 2022. Improving the Sustainability of Urban Water Management through Innovative Groundwater Recharge System (GRS). *Sustainability*, 14(10), p.5990.

Mouton, J., 2022. *The managerial role of women in the South African Police Service : the case of Johannesburg SAPS*. [online] Repository.nwu.ac.za. Available at: <https://repository.nwu.ac.za/handle/10394/1105> [Accessed 26 July 2022].

Mthabini, E., Mazenda, A. and Masiya, T., 2020. "Promoting public value by implementing reverse logistics in the South African Police Service," *Journal of Transport and Supply Chain Management*, 14. Available at: https://doi.org/10.4102/jtscm.v14i0.524.

Myers, M.D., 2008. "*Qualitative Research in Business and Management"* SAGE Publications

Nhede, N.T., Mazenda, A. and Masiya, T., 2022. "The South African Public Service and the fourth industrial revolution," *Africa's Public Service Delivery and Performance Review*, 10(1). Available at: https://doi.org/10.4102/apsdpr.v10i1.420.

Nieuwenhuijsen, M.J. and Khreis, H., 2020. "Transport and health; present and future," *Advances in Transportation and Health*, pp. 453–467. Available at: https://doi.org/10.1016/b978-0-12-819136-1.00021-8.

Nyerere, J., 2022. "Intra-Africa academic mobility and the Fourth Industrial Revolution," *Global Initiatives and Higher Education in the Fourth Industrial Revolution*, pp. 107–129. Available at: https://doi.org/10.36615/9781776405619-05.

O Elimi, I. and Stoffberg, G.H., 2022. "The carbon footprint of Government Health Department Fleet Vehicles in Johannesburg, South Africa – A case study," *South African Geographical Journal*, pp. 1–20. Available at: https://doi.org/10.1080/03736245.2022.2081595.

Olivia, A., 2017. What is credibility in qualitative research and how do we establish it? [Online]. Available: http://www.statisticssolutions.com/what-is-credibility-in-qualitativeresearch-and-how-do-we-establish-it/ [Accessed 11 March 2022]

Olojede, O., 2021. Transport decarbonisation in South Africa: a case for active transport. *Scientific Journal of Silesian University of Technology. Series Transport*, 110, pp.125-142.

Palomas, O.D.G. and Jamet, C., 2000 *Urban Transportation and environment = transport urbain et environnement = Transporte Urbano y Medio Ambiente: Proceedings of the international conference CODATU IX, Mexico City, Mexico, 11-14 April 2000*. Rotterdam: A.A. Balkema.

Panigrahi, S., Bahinipati, B. and Jain, V., 2019. Sustainable supply chain management. *Management of Environmental Quality: An International Journal*, 30(5), pp.1001-1049.

Parra, D. *et al.*, 2019. "A review on the role, cost and value of hydrogen energy systems for deep decarbonisation," *Renewable and Sustainable Energy Reviews*, 101, pp. 279–294. Available at: https://doi.org/10.1016/j.rser.2018.11.010.

Patten, M.L. and Newhart, M., 2017. Understanding research methods: An overview of the essentials. Routledge.

Pratt, E.A. and Clinker, C.R., 2021. "The Industrial Revolution," *A History of Inland Transport and Communication*, pp. 186–194. Available at: https://doi.org/10.4324/9781003156154-17.

Pritha Bhandari., 2022. Ethical Consideration in research [online] Available at: https://www.scribbr.com/methodology/research-ethics/#:~:text=Types%20of%20ethical%20issues%20%20%20%20Ethical,but%20yo%20...%20%202%20more%20rows%20 {Accessed 29 May 2022}

Psaraftis, H., 2018. Decarbonisation of maritime transport: to be or not to be?. *Maritime Economics andamp; Logistics*, 21(3), pp.353-371.

QSR International, 2014. What is Qualitative Research? [Online]. Available: http://www.qsrinternational.com/what-is-qualitative-research.aspx [Accessed 14 March 2022].

QSR International, 2014. What is Qualitative Research? [Online]. Available: http://www.qsrinternational.com/what-is-qualitative-research.aspx [Accessed 11 March 2022].

Queiroz, M., 2019. A framework for sustainable supply chain in emerging economies. *Environmental Quality Management*, 28(3), pp.7-15.

Redmer, A., 2020. "Strategic vehicle fleet management–a joint solution of make-or-buy, composition and replacement problems," *Journal of Quality in Maintenance Engineering*, 28(2), pp. 327–349. Available at: https://doi.org/10.1108/jqme-04-2020-0026.

Republic of South Africa., 2022. Police and defence (online) Available at: https://www.gov.za/about-sa/police-and-defence {Accessed 24 March 2022}

Richards, G., 2018. *The differences between logistics, operations and Supply Chain Management, Kogan Page*. Available at: https://www.koganpage.com/article/the-differences-between-logistics-operations-and-supply-chain-management (Accessed: September 26, 2022).

Ritchie, H., Roser, M. and Rosado, P., 2022. *United Kingdom: Energy country profile*, *Our World in Data*. Available at: https://ourworldindata.org/energy/country/united-kingdom (Accessed: December 17, 2022).

Rodrigue, J. P. and Comtois C. (2011). The Environmental Impacts of Transportation. Available online from http://people.hofstra.edu/geotrans/eng/ ch8en/conc8en/ch8c1en.html [Accessed on 19 August 2012].

Rowley, J., 2012. Conducting Research Interviews. Management Research Review, [online] 35(3/4), pp.260–271. doi:10.1108/01409171211210154.

Rüdiger, D., Schön, A. and Dobers, K., 2016. Managing Greenhouse Gas Emissions from Warehousing and Transhipment with Environmental Performance Indicators. Transportation Research Procedia, 14, pp.886–895. doi: 10.1016/j.trpro.2016.05.083.

Santos, M. and Hanak, D., 2022. Carbon capture for decarbonisation of energy-intensive industries: a comparative review of techno-economic feasibility of solid looping cycles. *Frontiers of Chemical Science and Engineering*,.

Saps.gov.za. 2022. [online] Available at: <https://www.saps.gov.za/about/history.php> [Accessed 26 July 2022].

Saunders, M., Lewis, P. and Thornhill, A., 2012. *"Research Methods for Business Students"* 6th edition, Pearson Education Limited, pp 206-211

Schaal, G. and Kruse, S., 2022. How Does Causal Decision-making Influence Triple-Bottom-Line Performance? An Empirical Study. *Academy of Management Proceedings*, 2022(1).

Sekaran, U. and Bougie, R., 2016. Research Methods for Business: A Skill Building Approach. 7th Ed. Upper Saddle River: John Wiley and Sons, Inc.

Sekaran, U., and Bougie, R., 2019. *Research Methods for Business: A Skill Building* 8th ed, ISBN: 978-1-119-56214-8

Sesana, E., Gagnon, A., Ciantelli, C., Cassar, J. and Hughes, J., 2021. Climate change impacts on cultural heritage: A literature review. *WIREs Climate Change*, 12(4).

Shackelford, S.J., 2020. "Governing the internet of things," *The Internet of Things* [Preprint]. Available at: https://doi.org/10.1093/wentk/9780190943813.003.0005.

Sheldon, T.L. and Dua, R., 2020. "Gasoline savings from electric vehicles in the US," *Who's Driving Electric Cars*, pp. 45–62. Available at: https://doi.org/10.1007/978-3-030-38382-4_4.

Shi, Y. and Li, Y., 2022. An Evolutionary Game Analysis on Green Technological Innovation of New Energy Enterprises under the Heterogeneous Environmental Regulation Perspective. *Sustainability*, 14(10), p.6340. doi:10.3390/su14106340.

Shi, Y., 2016. Reducing greenhouse gas emissions from international shipping: Is it time to consider market-based measures?. *Marine Policy*, 64, pp.123-134.

Silva, C., 2022. *What's the difference between Logistics and Distribution?*, *Crown SDS*. Available at: https://www.crownsds.com/whats-the-difference-between-logistics-and-distribution/ (Accessed: November 16, 2022).

Simpson, V.P., 1978. “Optimum solution structure for a repairable inventory problem,” *Operations Research*, 26(2), pp. 270–281. Available at: https://doi.org/10.1287/opre.26.2.270.

Slaper, T. and Hall, T., 2022. *The Triple Bottom Line: What It Is and Why It’s Important*. [online] Business Insights Blog. Available at: <https://online.hbs.edu/blog/post/what-is-the-triple-bottom-line> [Accessed 29 July 2022].

Sosa-Núñez, G., 2015. Climate Change Policy and Energy Reform: An Assessment of Mexico's Foreign Policy. *Latin American Policy*, 6(2), pp.240-254.

South Yorkshire Clean Air Campaign. (2006). Here’s how you can eco-drive, Care 4 Air eZine, 7. Available online from http://www.care4air.org/downloads/C4A_ eZine_issue7.pdf [Accessed on 19 April 2022].

Sutherland, E., 2019. “The Fourth Industrial Revolution – the case of South Africa,” *Politikon*, 47(2), pp. 233–252. Available at: https://doi.org/10.1080/02589346.2019.1696003.

Taylor, S.J., Bogdan, R. and DeVault, M., 2016. *Introduction to Qualitative Research Methods: A Guidebook and Resource*. New Jersey: John Wiley and Sons, Inc.

Team, I., 2021. *4 ways to reduce carbon emissions generated by transport*, *Iomob*. Iomob. Available at: https://www.iomob.net/reduce-carbon-emissions-transport/ (Accessed: October 08, 2022).

Thomas, J., and Harden, A., 2008. *Methods for the Thematic Synthesis of Qualitative,* 204-206

Thousand Oaks, CA: Sage. Saldaña, J., 2015. *The Coding Manual for Qualitative Researchers.* Thousand Oaks, CA: Sage.

Tienhaara, K., Yun, S.-J. and Gunderson, R., 2022. “South Korea's Green New Deal 2.0,” *Routledge Handbook on the Green New Deal*, pp. 279–298. Available at: https://doi.org/10.4324/9781003110880-19.

Topolšek, D., Čižiūnienė, K. and Ojsteršek, T., 2018. Defining transport logistics: a literature review and practitioner opinion based approach. *Transport*, 33(5), pp.1196-1203.

Tran, T.-H., Mao, Y. and Siebers, P.-O., 2019. “Optimising decarbonisation investment for firms towards Environmental Sustainability,” *Sustainability*, 11(20), p. 5718. Available at: https://doi.org/10.3390/su11205718.

Treatise. (2005). Eco-driving - the smart driving style. Available online from http://www.thepep.org/chwebsite/chviewer.aspx?cat=c17 [Accessed on 15 April 2023].

Twi-global.com. 2022. *What is Sustainability and why is it so Important?*. [online] Available at: <https://www.twi-global.com/technical-knowledge/faqs/faq-what-is-sustainability> [Accessed 29 July 2022].

Tyler, E. and Hochstetler, K., 2021. Institutionalising decarbonisation in South Africa: navigating climate mitigation and socio-economic transformation. *Environmental Politics*, 30(sup1), pp.184-205.

Vaismoradi, M., Turunen, H., and Bondas, T., 2013. *Content Analysis and Thematic Analysis: Implications for Conducting a Qualitative Descriptive Study. Nursing and Health Sciences*, 15(3), 398-405

Venkatesh, V., Brown, S. A., and Bala, H., 2013. Bridging the Qualitative-Quantitative Divide: Guidelines for Conducting Mixed Methods Research in Information Systems. MIS Quarterly, 37(1). 105-109

W Lawrence Neuman and Robson, K., 2018. Basics of social research: *qualitative and quantitative approaches. Don Mills, Ontario*: Pearson Canada Inc.

Weekend News Producer., 2022. SAPS vehicles out of action: Chaos with over 1000 vans offline in Gauteng (online) Available at: https://www.thesouthafrican.com/news/saps-vehicles-gauteng-police-vans/ {Accessed 29 March 2022}

Williams, m., 2016. Police social work in south africa. *social work/maatskaplike werk*, 52(1).

Willig, C., 2013. *Introducing Qualitative Research in Psychology*. 3rd Ed. New York: McGraw – Hill.

Wilson, V., 2016. Research Methods: Mixed Methods Research. Evidence Based Library and Information Practice, 11(1(S)), p.56. doi:10.18438/b8qs53.

Wimbadi, R. and Djalante, R., 2020. From decarbonisation to low carbon development and transition: A systematic literature review of the conceptualization of moving toward net-zero carbon dioxide emission (1995–2019). *Journal of Cleaner Production*, 256, p.120307..

Wimbadi, R.W. and Djalante, R., 2020. "From decarbonisation to low carbon development and transition: A systematic literature review of the conceptualization of moving toward net-zero carbon dioxide emission (1995–2019)," *Journal of Cleaner Production*, 256, p. 120307. Available at: https://doi.org/10.1016/j.jclepro.2020.120307.

Winch, C., Todd, M., Baker, I., Blain, J. and Smith K., 2019. Methodologies. [Online]. Available: http://www.socscidiss.bham.ac.uk/methodologies.html [Accessed 11 March 2022].

Woods, D., 2019. *Logistics, Encyclopædia Britannica*. Encyclopædia Britannica, inc. Available at: https://www.britannica.com/topic/logistics-business#ref528537 (Accessed: August 16, 2022).

Wu, H., Sun, Y., Su, Y., Chen, M., Zhao, H. and Li, Q., 2022. Which Is the Best Supply Chain Policy: Carbon Tax, or a Low-Carbon Subsidy? *Sustainability*, 14(10), p.6312. doi:10.3390/su14106312

Xu, R., 2020. Electric Vehicle Applications in Agriculture and its Prospects. *Saudi Journal of Engineering and Technology*, 5(11), pp.413-415.

Yin, R.K., 2016. *Qualitative research from start to finish*. Guilford publications.

Yogashen Pillay., 2022. Police Minister Bheki Cele concerned about police vehicles being repaired and parked off at Durban stations (online) Available at: https://www.iol.co.za/mercury/news/police-minister-bheki-cele-concerned-about-police-vehicles-being-repaired-and-parked-off-at-durban-stations-8ee9f73b-d79c-49c0-8dca-de419a3e4257 {Accessed 24 March 2022}

Zekhnini, K., Cherrafi, A., Bouhaddou, I., Benghabrit, Y. and Garza-Reyes, J.A., 2020. Supply chain management 4.0: a literature review and research framework. *Benchmarking: An International Journal*.

Zhu, Q., Sarkis, J. and Lai, K., 2008. Green supply chain management implications for ‘closing the loop’. Transportation Research Part E: Logistics and Transportation Review, [online] 44(1), pp.1–18. doi: 10.1016/j.tre.2006.06.003.

Ziegler, D. and Abdelkafi, N., 2022. Business models for electric vehicles: Literature review and key insights. *Journal of Cleaner Production*, 330, p.129803.

Zipperer, V., Sato, M. and Neuhoff, K., 2017. “Benchmarks for emissions trading general principles for Emissions Scope,” *SSRN Electronic Journal* [Preprint]. Available at: https://doi.org/10.2139/ssrn.3100118.

Zis, T. and Psaraftis, H., 2018. Operational measures to mitigate and reverse the potential modal shifts due to environmental legislation. *Maritime Policy andamp; Management*, 46(1), pp.117-132.

APPENDICES

Appendix A: Interview Guide

Introduction

The aim of this study is to present the impact and contributions V-Poliza's fleet has on the environment and climate change. This research will give insight into initiatives that could be taken to have a more sustainable fleet and produce less vehicle emissions.

Participants are assured of confidentiality and permission is requested to use a digital voice recorder to record the interview.

1. **SECTION A: PARTICIPANT INFORMATION**

What is the rank of the participant?

Sergeant		Captain		Brigadier	
Constable		Major		Major General	
Warrant Officer		Lieutenant Colonel		Lieutenant General	
Lieutenant		Colonel		Other	

Participant's age group:

20-30		31-40		41-50		51-60		60+	

What is the position of the participant?

What are the duties of the participant?

How many years has the participant worked for the organisation?

2. **SECTION B: FLEET OF THE ORGANISATION**

How many vehicles are under the station?

What are these vehicles usually used for in the station?

How often are these vehicles used for productive police services?

How far do these vehicles go or allowed to go for productive police services?

What are the challenges faced with operations services of these vehicles?

What are other alternative forms of policing transportation besides vehicles?

3. SECTION C: SUSTAINABLE FLEET

What are the organisation's sustainability initiatives and activities to curb climate change? Elaborate.

How do you understand the concept of carbonization and decarbonisation?

What is the level of understanding of employees of the organisation, in relation to the emissions produced from vehicles and the damage it causes?

How does the organisation support sustainable fleet and decarbonisation of fleet?

In what ways do you think the organisation could decarbonize its fleet?

With the ways mentioned above, what do you think would be the main challenge with employees complying with decarbonisation initiatives?

With these ways mentioned above, what do you think would be the impact on the nature of police duties?

4. SECTION D: GOVERNMENT LEGLISATION

What are the industrial and/or governmental legislations influencing the decarbonisation initiatives?

How does governmental legislation assist to implement sustainable fleet and reduce emissions?

How has the government educated employees on decarbonisation and elaborate on the benefits of decarbonisation initiatives?

Please list any governmental organisation that has started decarbonizing or providing sustainable fleet.

5. SECTION E: THE ORGANISATION

What possible strategies do you think the organisation could use to provide a sustainable fleet?

How will the fourth industrial revolution changes in the transportation industry impact the organisation towards decarbonisation?

What challenges do you think the organisation would face in providing a sustainable fleet?

What benefits do you think decarbonising would have on the organisation and community?

Does the nature of the organisation encourage or motivate the organisation to provide a sustainable fleet?

Does not having any competitors or being a nonprofit service organisation contribute to the decisions the organisation makes in terms of sustainability?

If the decarbonisation initiatives mentioned before were to be implemented, how would the organisation ensure that every station is accommodated for regardless of their area and place?

Would employees of the organisation be open to trying alternatives to decarbonize its fleet?

Please state the possible challenges and desirable benefits for open trials and alternatives.

THANK YOU FOR YOUR TIME!!

Appendix B: English editor report

62 Ferguson Road
Glenwood
DURBAN 4001
Tel: 072 442 7896
Email: deanne.collins30@gmail.com

7 February 2023

This serves to confirm that I have edited the thesis, "Fleet decarbonisation for sustainable transport initiative: A case of V-Polizza," by Thandiswa Nkosingithandile Ndawonde, student number 217001491, excluding the List of References and the appendices.

DISCLAIMER: The editor cannot be held responsible for any errors introduced due to changes being made to the document after the editing is complete.

Yours sincerely,

[redacted]

(Ms) Deanne Collins (MA)

Appendix C: Ethical clearance letter

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

24 October 2022

Thandiswa Nkosingithandile Ndawonde (217001491)
School Of Man Info Tech & Gov
Westville Campus

Dear TN Ndawonde,

Protocol reference number: HSSREC/00004608/2022
Project title: Fleet decarbonisation for sustainable transport initiative: A case of V-Polizza
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 15 August 2022 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 24 October 2023.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd