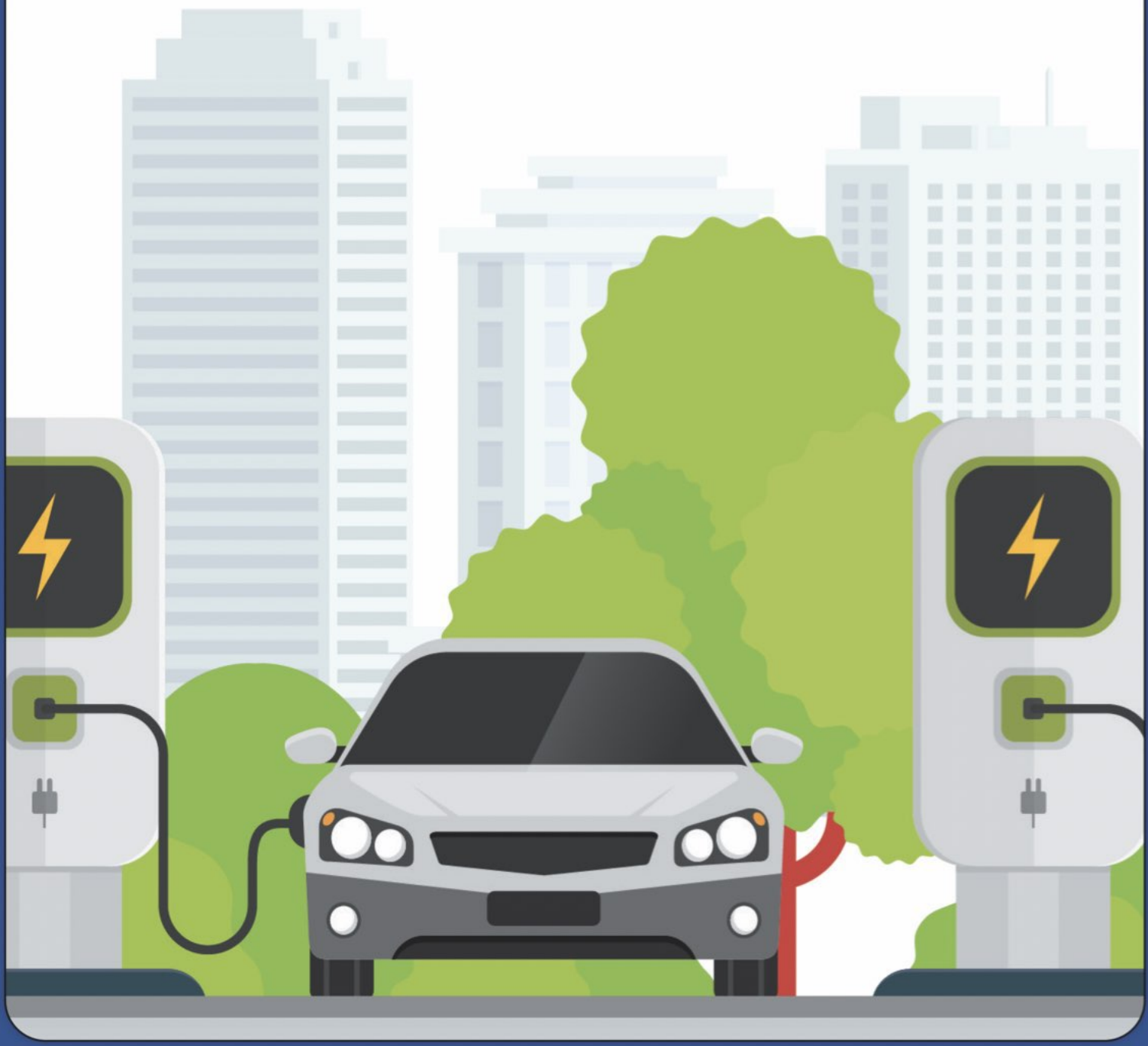
Western Cape Government

A Strategy for the Implementation of **Electric Vehicles**

Government Motor Transport Trading Entity

Department of Transport and Public Works



Electric Vehicle Strategy Executive Summary

The global response to climate change is accelerating, and leading countries have made challenging commitments towards reducing carbon emissions and becoming carbon neutral. These range from converting all government vehicles to electric vehicles, to banning internal combustion engine (ICE) vehicles from cities.

Simultaneously, the automotive industry is going through a historic transformation, not only with the transition towards electric vehicles, but also the development of the connected vehicle. The connected vehicle focuses on the development of advanced onboard systems, which range from infotainment to autonomous vehicles. It is expected that original equipment manufacturers (OEMs) will become some of the largest technology companies in the world.

The connected vehicle will not only fundamentally change the automotive industry, but also vehicle use and the complete mobility landscape. This landscape, which has already seen fundamental change through ridesharing, is expected to go through even more significant transformation.

South Africa is currently in the early stages of transitioning, with few electric vehicles in operation. A green paper recently published with the objective of setting guidelines and creating a framework for protecting the motoring industry shows that this is currently a significant part of the South African economy, not only from the perspective of job creation, but also earning foreign revenue. A framework for the creation of an Electric Vehicle Ecosystem in South Africa is envisaged.

Alternative potentional scenarios were formulated for South Africa based on many fundamental drivers, including the active role that government will play in the creation of a charging grid with national coverage providing convenient, low risk charging options for owners of electric vehicles. These scenarios identified High-, Medium- and Low-Road Scenarios. The objective of the formulation of these scenarios was to create a framework for the formulation of an electric vehicle implementation plan for GMT.

The Western Cape Government has set Vision-Inspired Goals for economic growth, job creation, and a better life for all citizens. The objective of the Electric Vehicle Strategy is broader than just transitioning from ICE vehicles to electric vehicles, but also supports these Vision-Inspired Goals through focusing on broader socio-economic objectives.

GMT has set itself a Massive Transformative Purpose (MTP) of *Innovative mobility solutions to co-create a better life for all*. This is in line with the MTP of the Department of Transport and Public Works (DTPW) of *Enabled communities leading dignified lives.* The Electric Vehicle Strategy is developed as a key mechanism towards achieving these goals.

The core focus of the Electric Vehicle Strategy is the development of an Electric Vehicle Ecosystem in the Western Cape. This ecosystem not only focuses on transitioning to electric vehicles, but also the creation of an electric vehicle industry in support of the broader socio-economic objectives.

A key cornerstone of the Electric Vehicle Strategy is for the Western Cape Government to play a leading role by setting a strategic plan that would provide the basis for collaboration between various departments, OEMs, and the broader industry. Key development projects are recommended for implementation to progress with the creation of the critical building blocks for the creation of the ecosystem. These projects are:

- The testing and placement of BMW i3 vehicles already purchased.
- The development of a provincial electric vehicle charging network.
- Collaboration with OEMs for the re-alignment of vehicle procurement to support market penetration targets.
- Testing of locally manufactured electric vehicles.
- Research and development projects for the conversion of existing vehicles to electric vehicles.
- Research and development to determine feasibility of battery recycling and repurposing.
- The development of a technology management platform for managing connected electric vehicles.

The completion of these projects through collaboration with various stakeholders would provide the foundation for the creation of an Electric Vehicle Ecosystem in the Western Cape to facilitate the transition to electric vehicles, stimulate economic growth, contribute to job creation, and achieve the broader vision-inspired goals of the Western Cape.

The five-year implementation plan is divided into three phases:

- A foundation phase of 12 months would provide the foundation for the implementation of the strategy. Aspects that would be addressed in the foundation phase include commencement with the identified projects and completing the negotiations for the collaborative partnerships with various stakeholders.
- The second phase, or development phase, of 24 months focuses on the completion of identified projects and preparing for commercialisation of these projects.
- The realisation phase of a further 24 months is intended to focus on the commercialisation of the projects towards creating an electric vehicle industry in the Western Cape.

The Electric Vehicle Strategy is intended for GMT and the Western Cape to become Electric Vehicle thought leaders in Africa.

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PICTURES: FREEPIK, PEXELS

1 Introduction

1. Introduction

Formulating an Electric Vehicle Strategy for GMT needs to be strategically aligned with the vision and Vision-Inspired Priorities of the Western Cape Government's strategic plan. Confirmation of this strategy thus provides the point of departure for the strategy document.

1.1 WCG Vision-Inspired Priorities

The Western Cape Government has formulated five Vision-Inspired Priorities (VIPs)[1] for the five-year strategic planning period 2020 to 2025, to give effect to its Vision and Plan of Action. This vision and Vision-Inspired Priorities are depicted in Figure 1.

VISION

A safe Western Cape where everyone prospers

1 **VISION-INSPIRED PRIORITY**
Safe and Cohesive Communities

2 **VISION-INSPIRED PRIORITY**
Growth and Jobs

3 **VISION-INSPIRED PRIORITY**
Empowering People

4 **VISION-INSPIRED PRIORITY**
Mobility and Spatial Transformation

5 **VISION-INSPIRED PRIORITY**
Innovation and Culture

Figure 1: WCG Vision-Inspired Priorities

GMT's Electric Vehicle Strategy would directly support these priorities as follows:

- Reducing carbon emissions and climate change impact improves community safety and cohesion by mitigating the negative impact that climate change is projected to have on communities in respect of:
  - Impact of vehicle emissions on public health outcomes, especially respiratory health.
  - The potential impact on and displacement of citizens, especially those from vulnerable communities, due to the negative impact of climate change arising from extreme weather conditions such as prolonged drought, flooding in certain low-lying areas and reduced water and food security.
  - Driving job creation through and investment in developing electric vehicle related infrastructure and its supporting industries and ecosystems.
  - Utilising domestic expertise and knowledge to drive innovation in the roll-out of the electric vehicle strategy.

[1] *GMT Strategic Plan 2020-2025/6*

The formulation of the Electric Vehicle Strategy will be focused on contributing towards the achievement of these priorities. Figure 2 translates these priorities into areas of focus, which provides further direction to the formulation of the Electric Vehicle Strategy. In addition, the WCG VIPs have underlying focus areas[2], which are also detailed in Figure 2:

The WCG Priorities

Vision-Inspired Priority	Focus Area
1 **Safe and Cohesive Communities**	• Enhanced capacity and effectiveness of policing and law enforcement. • Strengthened youth-at-risk referral pathways and child and family centred initiatives to reduce violence. • Increased social cohesion and safety of public spaces.
2 **Growth and Jobs**	• Increasing investment. • Building and maintaining infrastructure. • Growing the economy through export growth. • Creating opportunities for job creation through skills development. • Creating an enabling environment for economic growth through resource resilience.
3 **Empowering People**	• Children and families. • Education and learning. • Youth and skills. • Health and wellness.
4 **Mobility and Spatial Transformation**	• Create better linkage between places through safe, efficient and affordable public transport. • Inclusive places of opportunity. • More opportunities for people to live in better locations. • Improving the places where people live.
5 **Innovation and Culture**	• Citizen-centric culture. • Innovation for impact. • Integrated service delivery. • Governance transformation. • Talent and staff development.

Figure 2: WCG VIPs and focus areas

Vision-Inspired Priorities are further contextualised through the definition of focus areas, which provides specific strategic direction to the development of the Electric Vehicle Strategy.

The Electric Vehicle Strategy also addresses some key focus areas, principally:

Growth and Jobs | Mobility and Spatial Transformation | Innovation and Culture

[2] *GMT Strategic Plan 2020-2025/7*

1.2. Massive Transformative Purposes

1.2.1. DTPW's Massive Transformative Purpose[3]
The Department of Transport and Public Works' Massive Transformative Purpose GMT has adopted:

enabled communities leading dignified lives.

1.2.2. GMT's Massive Transformative Purpose
In support of the Department of Transport and Public Works' Massive Transformative Purpose, GMT has adopted as its own MTP[4]:

innovative mobility solutions to co-create a better life for all.

This MTP is supported by underlying design themes:

1 Thought leadership

Establishing GMT as a thought leader in Africa future mobility; including vehicle technology, service delivery, and financial governance.

2 Design-thinking

Establishing design-thinking methodologies within GMT.

3 Collaboration

Working together forms the foundation of excellence, as all parts need to be moving connectedly to create a successful Ecosystem of innovation.

4 Storytelling

Embedding storytelling into GMT in a way that it inspires, aligns, influences and acts as a catalyst for change.

5 Service delivery

Redefining a service delivery system for GMT with a focus on creating and enhancing value for the organisation as well as its clients through engaging, encouraging, and empowering employees to deliver the ultimate customer experience.

[3,4] *GMT Annual Performance Plan 2020-21/15*

The application of storytelling, one of the underlying themes to the GMT MTP, is illustrated in Figure 3, depicting "Re-imagining the future of mobility".

GMT's Strategic Vision, as directed by this MTP, is depicted in Figure 3. Electric vehicles and their related ecosystem form a critical part of this vision.

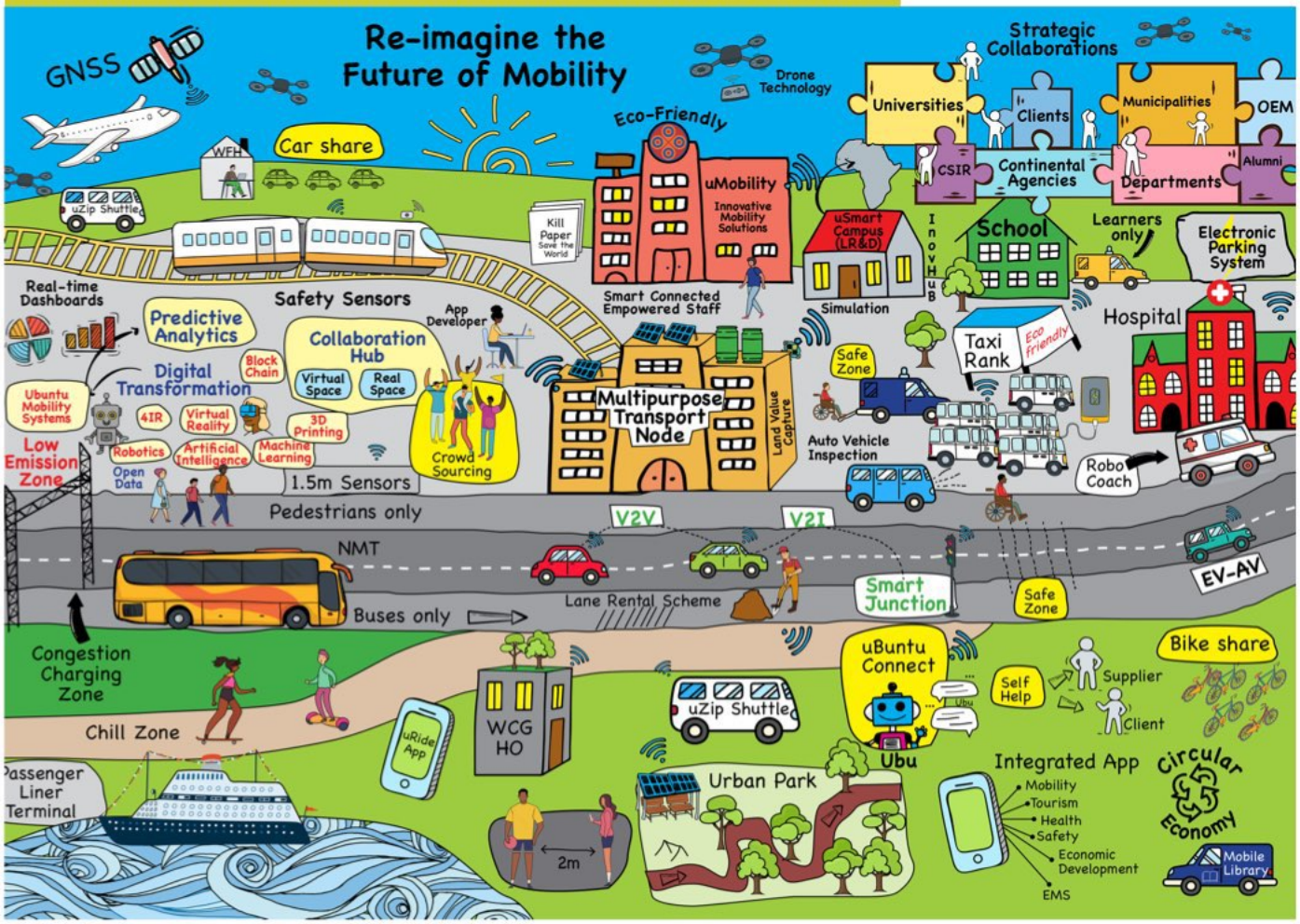
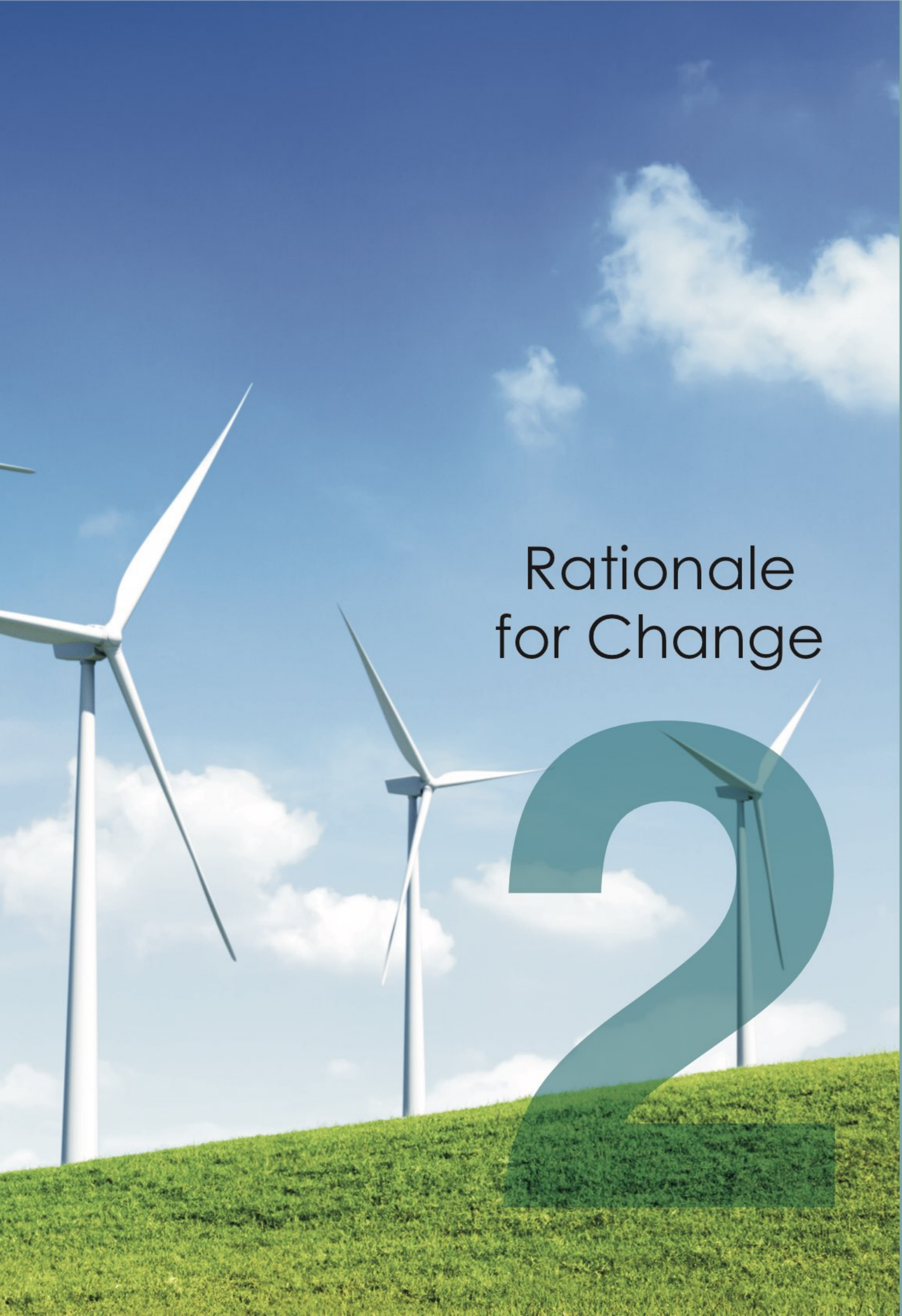


Figure 3: GMT's Strategic Vision

1.3. Electric Vehicle Thought Leadership

A key outcome of GMT's Electric Vehicle Strategy is to position GMT as the electric vehicle thought leader in Africa by:

- Taking leadership in developing the Electric Vehicle Strategy, policies for the Western Cape, and influencing and informing national and continental strategy and policy.
- Adopting an agile and innovative approach in swiftly prototyping initiatives and developing these to scale through collaboration and partnerships with stakeholders in government, academia, and the private sector.
- Being both citizen and client-centric in its approach and desired outcomes.



Rationale for Change

2

2. Rationale for Change

2.1. Global Climate Change

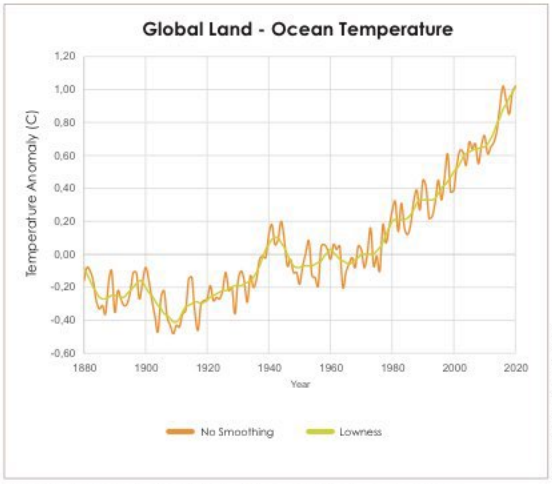
The term *climate* refers to the general weather conditions over many years. *Climate change* is a significant variation of average weather conditions, with conditions becoming warmer, wetter, or drier over a period.

When energy from the sun is reflected off Earth and back into space (mostly by clouds and ice), or when the Earth's atmosphere releases energy, the planet cools. When the Earth absorbs the sun's energy, or when atmospheric gases prevent heat released by the Earth from radiating into space (greenhouse effect), the planet warms. A variety of factors, both natural and human, can influence Earth's climate system and cause climate change. Records indicate that today's climatic warming, particularly the warming since the mid-20th century, is occurring much faster than ever before and cannot be explained by natural causes alone.

Human activity, more specifically, the greenhouse gas (GHG) emissions generated, are the leading cause of the Earth's rapidly changing climate. According to the Intergovernmental Panel on Climate Change (IPCC), the atmosphere's concentration of carbon dioxide – the planet's main climate change contributor – has risen by 40 percent since pre-industrial times[5].

Some of the CO_2 emissions from human activity is taken up by natural processes to maintain the natural balance, but increasing human activity is producing emissions at a higher rate – leading to an increasing imbalance.

Deforestation and other conversions of natural lands release roughly one billion metric tons per year[6]. According to the World Economic Forum's Global Risks Report[7], the failure to mitigate and adapt to climate change will be "the most impactful risk" facing communities worldwide in the coming decade. Figure 5 illustrates the relationship between CO_2 emissions and risks to sustainable development.



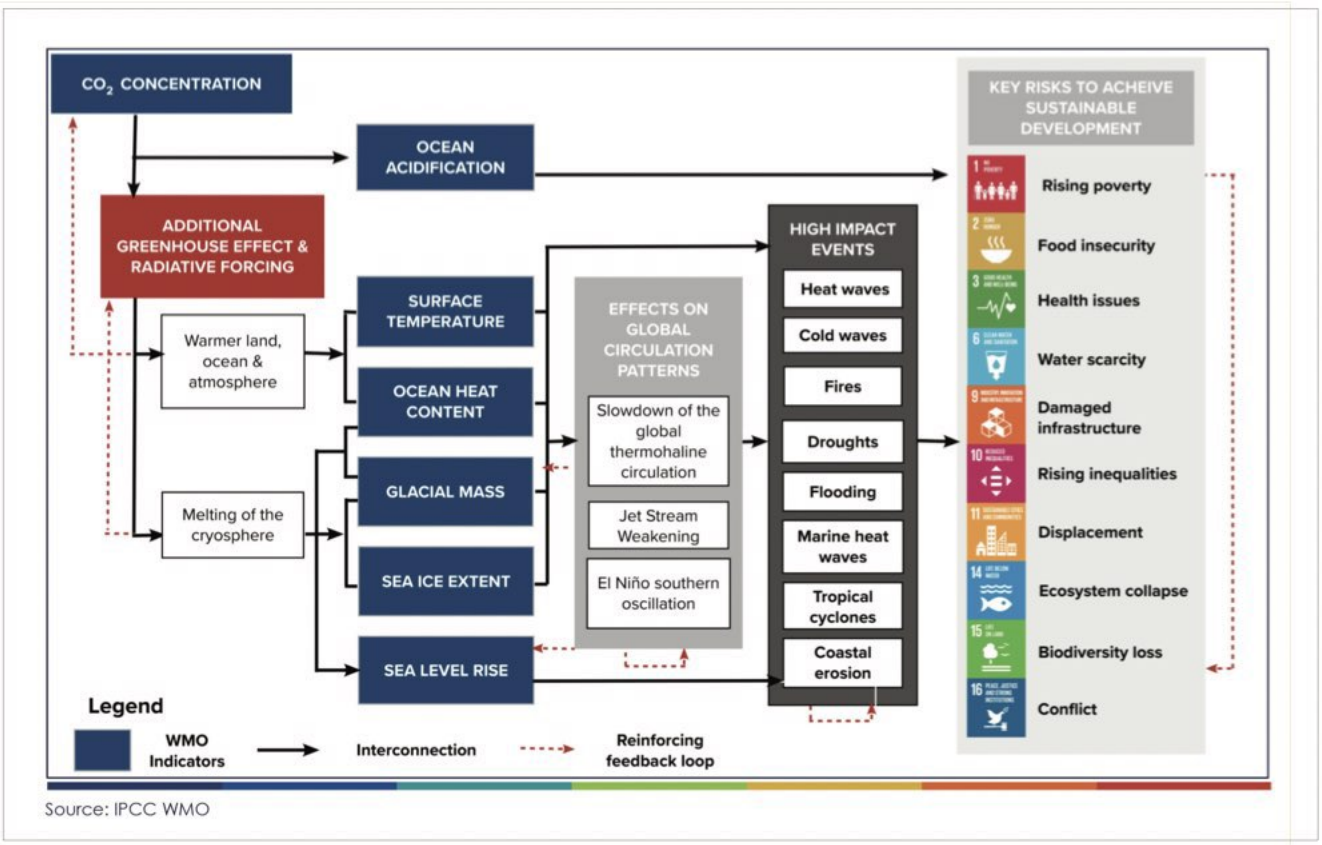
SOURCE:NASA, 2021

Figure 4: Global Land - Ocean Temperature

10 billion

metric tons of carbon per year of fossil fuels is released through unmitigated combustion

[5] *https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WGIAR5_SPM_brochure_en.pdf*
[6] *https://www.globalcarbonproject.org/carbonbudget/14/hl-full.htm*
[7] *http://www3.weforum.org/docs/GRR/WEF_GRR16.pdf*



Source: IPCC WMO

Figure 5: World Meteorological Organisation Global Warming Framework

Clearly, the impact of CO_2 emissions stretches much further than changes in climate, as socio-economic circumstances and basic human needs are directly impacted.

2.2. Air and Environmental Pollution

Major sources of toxic air pollutants include emissions from coal-fired power plants, industries and refineries, as well as from cars, trucks and buses.

Diesel-powered, gasoline-powered, and hybrid vehicles all produce vehicle exhaust emissions, as the fuel used to power them contains hundreds of differently structured hydrocarbons that burn at different rates in different ways. Most vehicle exhaust emissions are composed of carbon dioxide, nitrogen, water vapour, and oxygen in unconsumed air.

Particulate matter (PM) is composed of chemicals such as sulphates, nitrates, carbon, or mineral dust. Vehicle and industrial emissions from fossil fuel combustion, cigarette smoke, and burning organic matter, such as wildfires, all contain particulate matter.

Fine particulate matter (PM 2.5) is 30 times thinner than a strand of human hair. It can be inhaled deeply into lung tissue and contribute to serious health problems. PM 2.5 accounts for most health effects.

SOURCE: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, 2021

Figure 6: Comparison of particulate size

Vehicle exhaust emissions are also generated by the evaporation of fuel within the vehicle when the vehicle stops, and during fuelling.

Toxic air pollutants, such as the emissions from ICE vehicles, pose different health risks depending on the specific pollutant, including various forms of cancer, birth defects, damage to the nervous system and brain, etc. The World Health Organization (WHO) report on air pollution and child health found that every year around 7 million deaths are related to air pollution worldwide[8].

The battery-powered electric vehicle (BEV) produces no emissions at point of use and produces no emissions when used. Many of the components of the BEV can be repurposed or recycled. An electric motor could theoretically last more than a million kilometres and the potential battery life could be equally as long[9] [10] [11]. This means less waste and less pollution in terms of scrappage, which is typical of ICE cars. The use of higher value components such as aluminium, copper and battery minerals make the recycled components more attractive. The only emissions released to the air happens at the source of production of the vehicle and its components.

An electric motor could theoretically last more than a **million** kilometres

2.3. Energy Efficiency

The electric motor of an electric vehicle is much more efficient (80% - 90%) compared with the internal combustion engine (15% - 25%) in terms of energy required to drive the wheels.

This means that 80% - 90% of the energy consumed by an electric vehicle is turned into kilometres, whereas only 15% - 25% of the energy consumed by an ICE vehicle is turned into kilometres, as shown in Figure 7, based on conservative estimates. An example follows to put this into perspective. Assuming a consumption rate of 15kWh/100km for an electric vehicle and 8 litre/100km for the ICE vehicle it is compared with, the amount of energy consumed would be 54MJ and 272MJ for the electric vehicle and the ICE vehicle, respectively. To travel the same distance with the same size car, the electric vehicle would use 5 times less energy than an ICE vehicle of the same size. This improved energy efficiency leads to reduced costs (15kWh at R1.50/kWh is R22.50, while fuel at R17/litre will cost R136). More efficient vehicles require less energy from the point of generation, which could lead to less emissions (40% less).

It is expected that electric vehicles would have a longer useful life compared with ICE vehicles, to the extent that electric vehicles could last at least eight years before replacement. In addition, reduced maintenance and energy costs would result in significant savings from a fleet management perspective. In short, electric vehicles are more cost-effective to operate and maintain. All while being better for the environment.

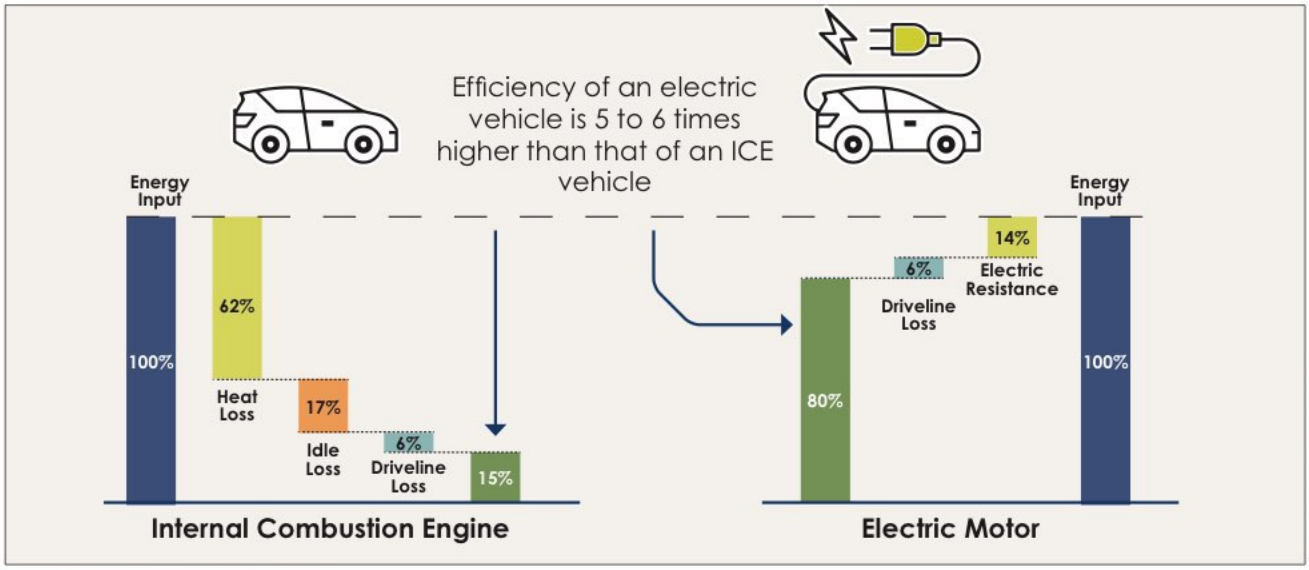


Figure 7: Energy losses in vehicles

[8] https://www.who.int/news/item/29-10-2018-more-than-90-of-the-worlds-children-breathe-toxic-air-every-day
[9] https://www.bloomberg.com/news/articles/2020-06-07/a-million-mile-battery-from-china-could-power-your-electric-car
[10] https://www.autoweek.com/news/a34620676/million-mile-batteries-theyre-coming/
[11] https://www.wired.com/story/what-happens-after-a-million-mile-battery-outlasts-the-car/

3

Global Commitment Towards Climate Change

3. Global Commitment Towards Climate Change

3.1. Key Interventions of Leading Countries

Interventions by national, regional and local government are critical to the widespread adoption of electric vehicles. Following is an analysis of the measures adopted by the European Union, China, and the USA in this regard.

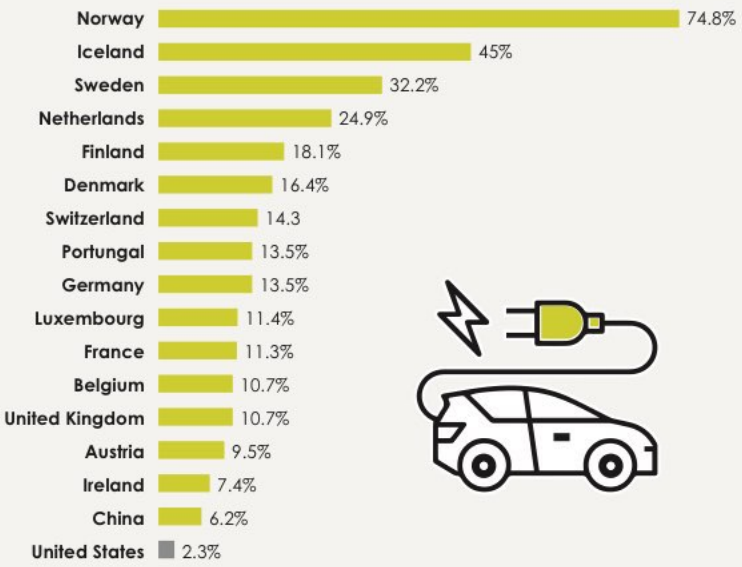
3.1.1. European Union

The European Union and its member countries have made climate mitigation one of the three main priorities in its COVID-19 recovery plan[12]. In July 2020, member state leaders agreed that at least 30% of its multi-annual budget and recovery fund are to be spent on achieving the European Union's climate neutrality goal by 2050 and meeting its increased 2030 emissions reduction goal of 55%.

In addition, both EU and non-EU member European countries have set timeframes for the phasing out of the sale of new combustion-engine vehicles.

Electric Mobility: Europe Races Ahead

Countries with the highest share of plug-in electric vehicles in new passenger car sales in 2020*



SOURCE: FLEETEUROPE.COM, ELECTRIVE.COM

This graph shows countries with the highest share of plug-in electric vehicles in new passenger car sales in 2020

Examples of these are:

- **2025:** Norway
- **2026:** Belgium
- **2030:** Denmark, Iceland, Ireland and the Netherlands, Sweden
- **2030:** The United Kingdom, excluding Scotland (non- EU)
- **2032:** Scotland (non-EU)
- **2040:** France and Spain

This is further supported by 17 European cities having declared their streets to be fossil-fuel free in terms of the C40 Fossil-Fuel Free Streets Declaration in 2019. Amongst these cities are:

- **Oslo:** City centre within Ring 3 by 2024
- **Paris:** No diesel by 2024 and no petrol cars by 2030
- **Rome:** City centre emission-free by 2030
- **London:** Central London emission-free by 2025
- **Brussels:** No diesel by 2030.

[12] *Pledges And Targets | Climate Action Tracker (EU)*

3.1.2. China

The Chinese government is planning to improve its climate change response in its renewed climate plan for China. In terms of this plan[13]:

- China will increase non-fossil energy to 20% of its energy consumption by 2030.
- It has also pledged RMB20 million (USD3.1 billion) to the South-South Climate Cooperation Fund to help developing countries address climate change.
- The Chinese Government committed to 40% electric vehicle sales as a percentage of total vehicle sales by 2030, with mandatory targets incrementally increasing.
- There is also a commitment to advance electric vehicle technology and have the average electricity consumption of new passenger BEVs at 12 kWh/100km by 2025.
- To achieve 100% electrification in public fleets by 2035.

Although China leads the world in the overall number of electric vehicle sales, it trails the European Union in terms of electric vehicle sales as a percentage of total vehicle sales. The Chinese Government set ambitious targets when it announced its New Energy Vehicle (NEV) mandate. Part of its plan was to sell 4.6 million electric vehicles by 2020 and ban cars with traditional internal combustion engines over the long term.

3.1.3. USA

Following the Trump Administration's withdrawal, the Biden Administration officially re-joined the Paris Agreement in January 2021 and announced a new Nationally Determined Contribution (NDC) in April 2021. The USA's latest NDC unveiled an ambitious climate change response[14] that included the following:

- Reducing the USA's greenhouse gas emissions by 50% by 2030.
- A pledge to reach net-zero emissions by 2050, in line with what the European Union is working towards.

- Electrification of the federal fleet of around 650 000 vehicles.

In addition, California issued an Executive Order requiring that by 2035 all new car and passenger light truck sales be electric vehicles. New York State, New Jersey, and Massachusetts are considering similar bans on internal combustion engines.

3.1.4. A Summary of Key Policy Interventions

A recent report by the International Energy Agency[15] analysed the measures adopted by leading countries, principally the European Union, China and the USA, to accelerate the transition to electric vehicles.

RMB20 million
has been pledged by China to South-South Climate Cooperation Fund to help developing countries address climate change

[13] *Pledges And Targets | Climate Action Tracker (China)*
[14] *Plan for Climate Change and Environmental Justice | Joe Biden*
[15] *IEA: electric vehicle Global Outlook 2021*

The measures were broken down into two categories:

3.1.4.1. Main Policy Drivers of Electric Vehicle Adoption to Date

These measures were put in place to give impetus to the adoption of electric vehicles and consisted of electric vehicle purchasing subsidies and incentives; implementing and subsidising the development of charging infrastructure, as well as penalties in the form of vehicle emission restrictions and low and emission-free zones in various large cities.

3.1.4.2. Broader and more ambitious policy portfolios to accelerate the transition

These subsequent measures were put in place to accelerate the transition and consisted of the gradual withdrawal of electric vehicle purchasing subsidies and incentives, supplementing these with penalties on ICE vehicles in the form of taxes on the vehicles and fossil fuels. In addition, measures were put in place to decarbonise power grids and broaden charging infrastructure, while putting in place timeframes for the banning of ICE vehicle sales.

A summary of these measures is depicted in Figure 8.

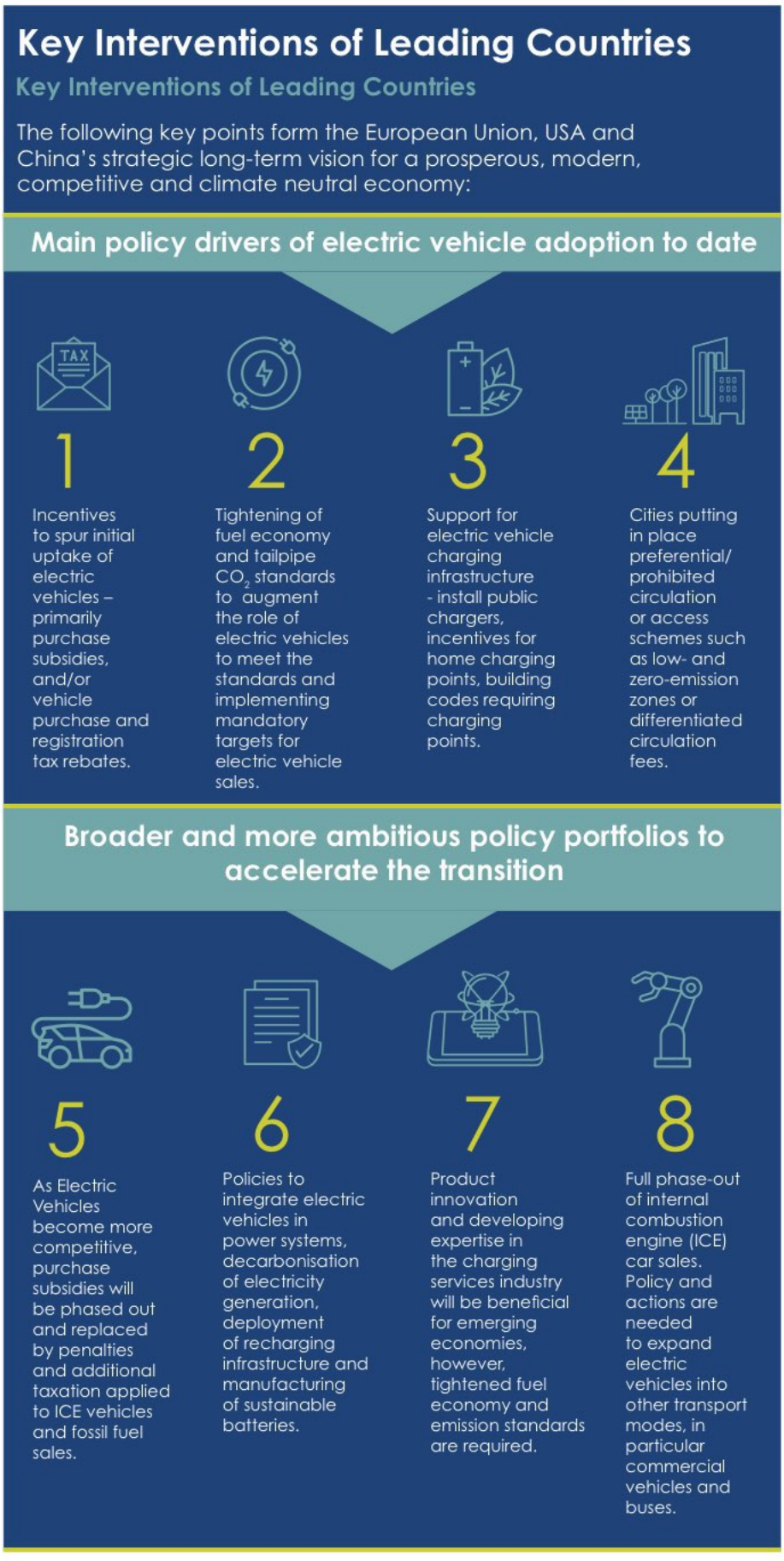


Figure 8: Summary of key electric vehicle interventions of leading countries

3.2. OEM Response

In response to both current and proposed regulations enforced by leading cities and countries, burgeoning consumer demand, and constantly improving battery technology, original equipment manufacturers (OEMs) have responded with ambitious strategies and targets for the introduction of electric vehicles and the phasing out of ICE vehicles. This is illustrated in Figure 9.

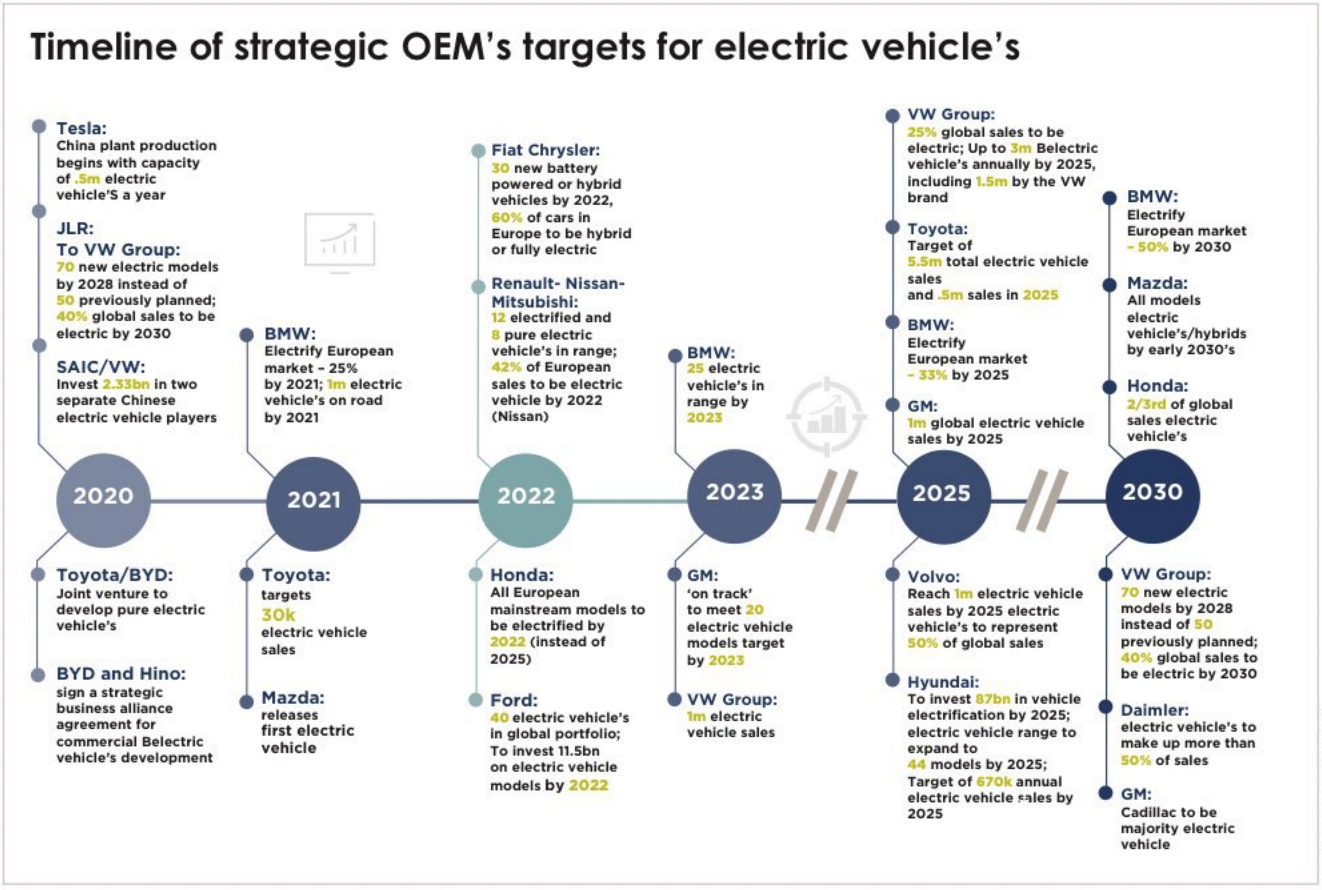


Figure 9: Timeline of strategic OEM targets for electric vehicles

From Figure 9, it is clear the responses from OEMs reflect multi-billion Rand commitment and that the switch to electric vehicles is accelerating. It is believed that by 2026, the price of electric vehicles will become lower than the price of ICE vehicles in Europe, as illustrated in Figure 10.

Figure 11 illustrates that the price of batteries, considered to be the most expensive component of the electric car, reduced 80% over the last 10 years thanks to innovations in manufacturing and increased economies of scale — greatly assisting the reduction in electric vehicle manufacturing costs. Simultaneously, the energy density of batteries increased. Essentially, batteries are becoming better and more cost effective at a rapid rate.

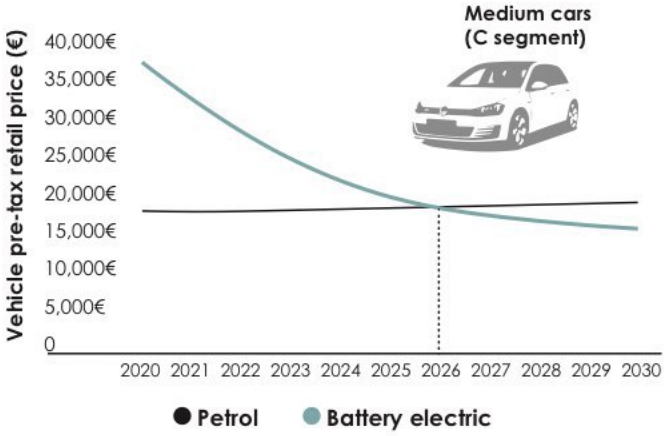


Figure 10: Price comparison of electric vehicles

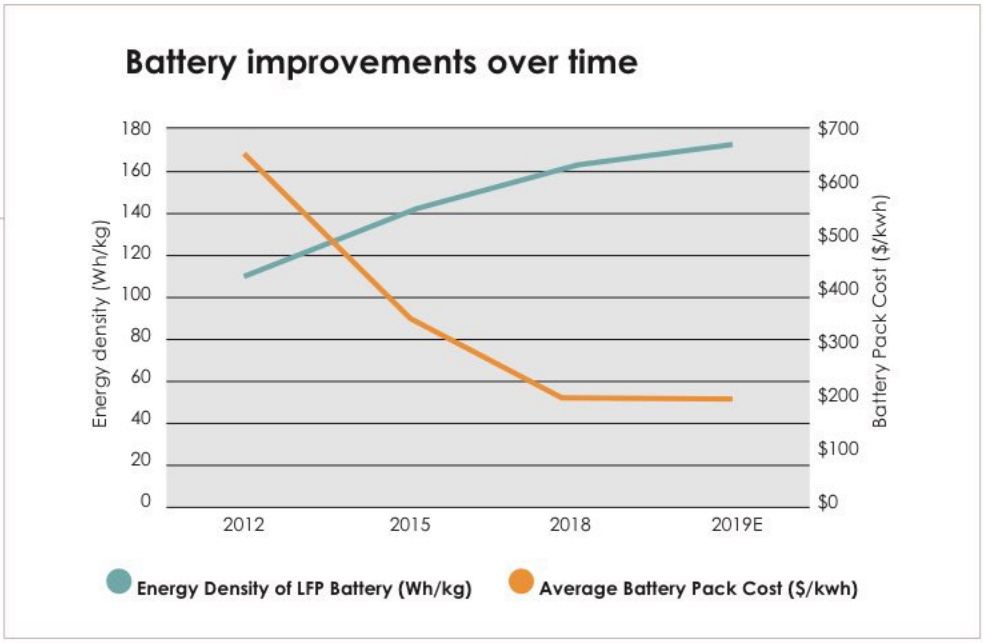


Figure 11: Battery improvements over time

With an electric vehicle share of 34.6% in Q1/2021, Europe leads the core markets ahead of China with 11% and the USA with 7.3%. Figure 12 illustrates the global increase in the share of electric vehicles as a percentage of total vehicle sales.

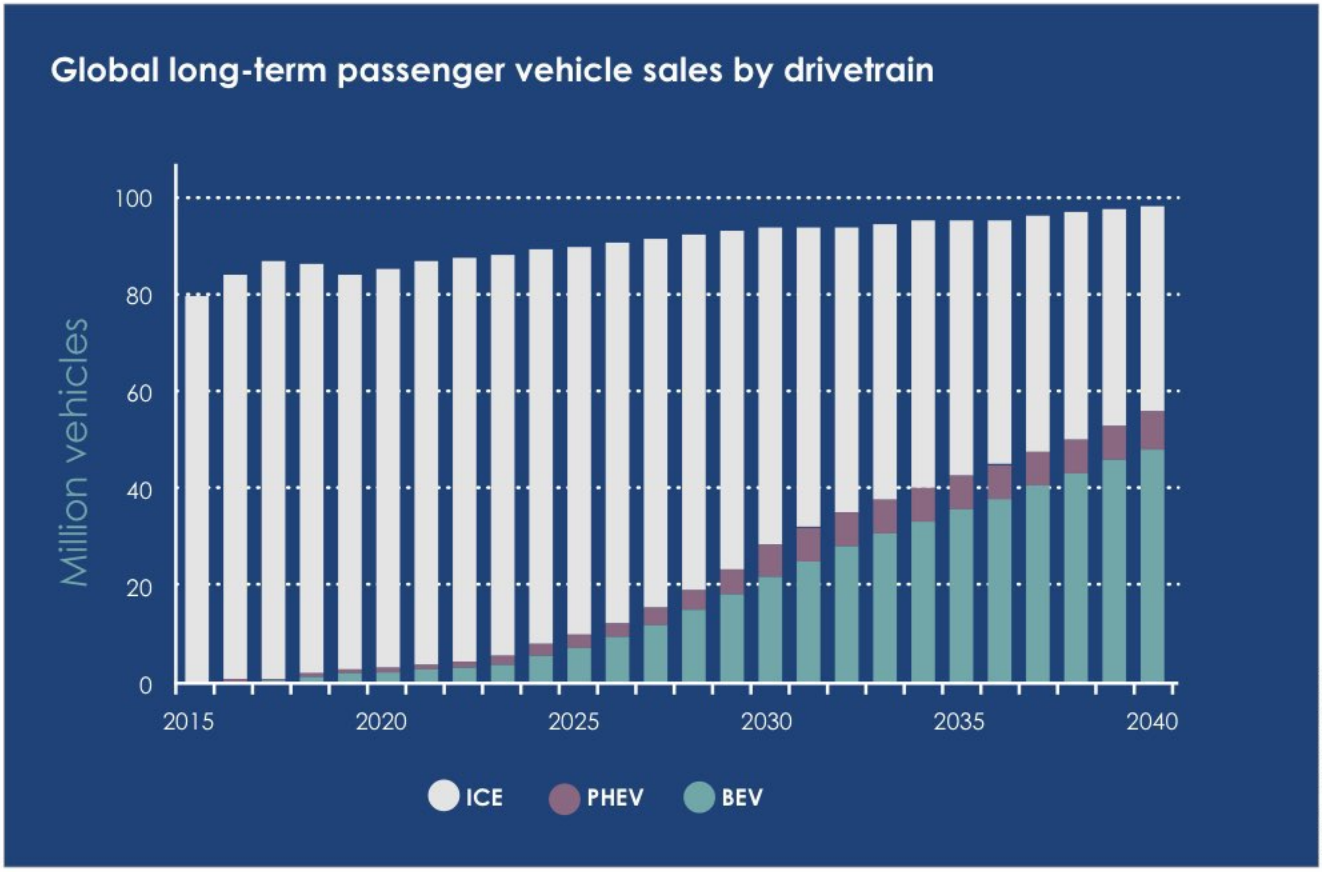


Figure 12: Global long-term passenger vehicle sales by drivetrain

3.3. Mobility as a Service

Mobility as a Service16 (MaaS), also referred to as Transportation as a Service (TaaS), is a real-time, on-demand platform that can include any combination of transport methods, such as car and taxi sharing, and it provides everything for the consumer from travel planning to payments.

The MaaS market size is expected to be USD 170billion by 2025 and USD 250billion by 2030 in the U.S. Trends in the MaaS space indicate that there is a rapidly increasing consumer adoption of this service framework in South Africa and many other countries, and it must be acknowledged for future GMT strategy.

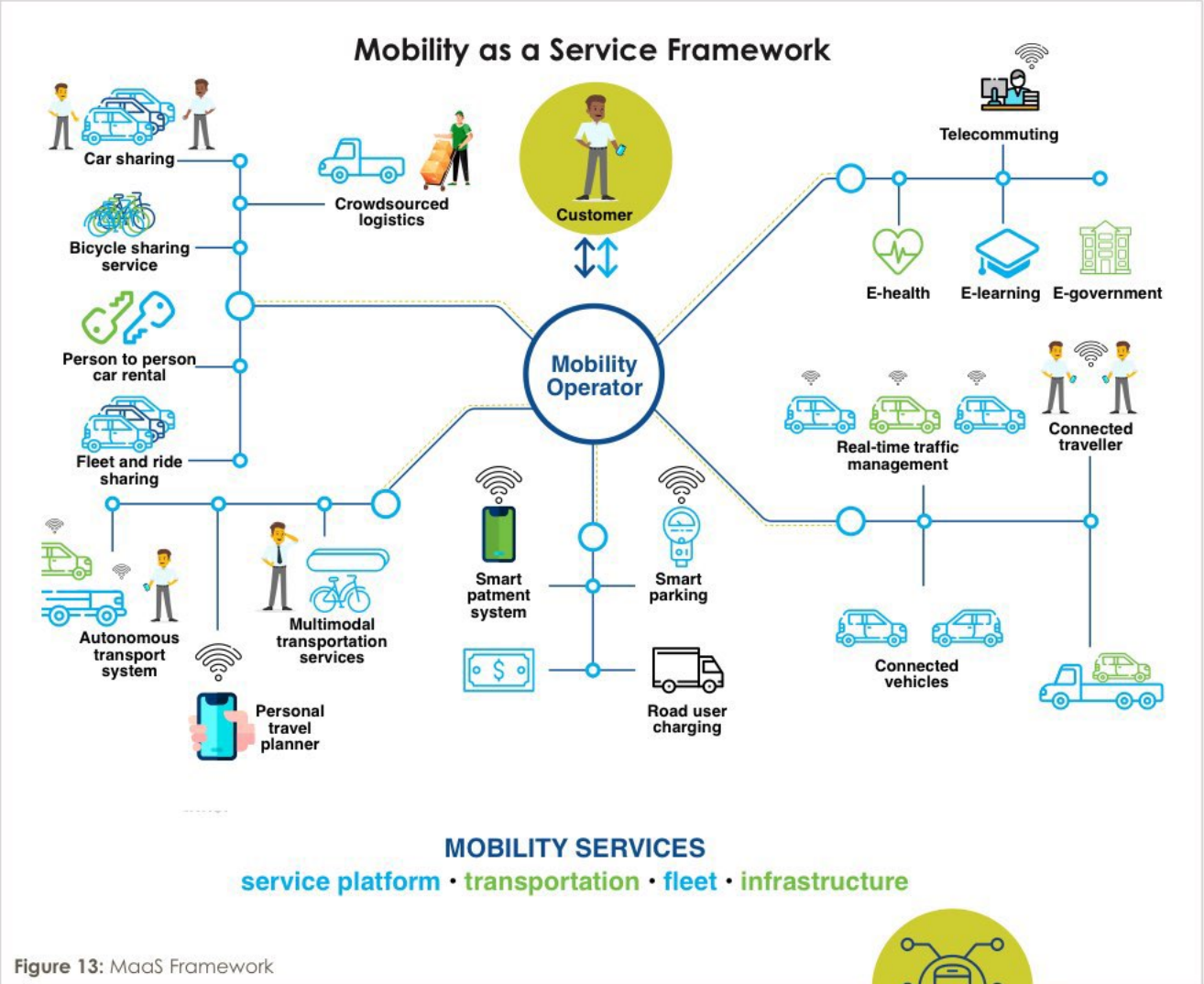


Figure 13: MaaS Framework

The MaaS market size is expected to be

USD 170 billion

by 2025 in the U.S.

3.4. Autonomous Driving

There are 6 levels of driving automation (0-5), ranging from no automation to full automation where no human intervention is needed. Figure 14 elaborates on the levels of driving automation.

Tesla and other OEMs have already advanced level 2 automation as standard in vehicles that can improve safety through features such as multi-vehicle collision aversion.18 The "always connected" nature of modern electric vehicles will ensure it is possible to upgrade and enhance automation features, such as safety features, remotely.

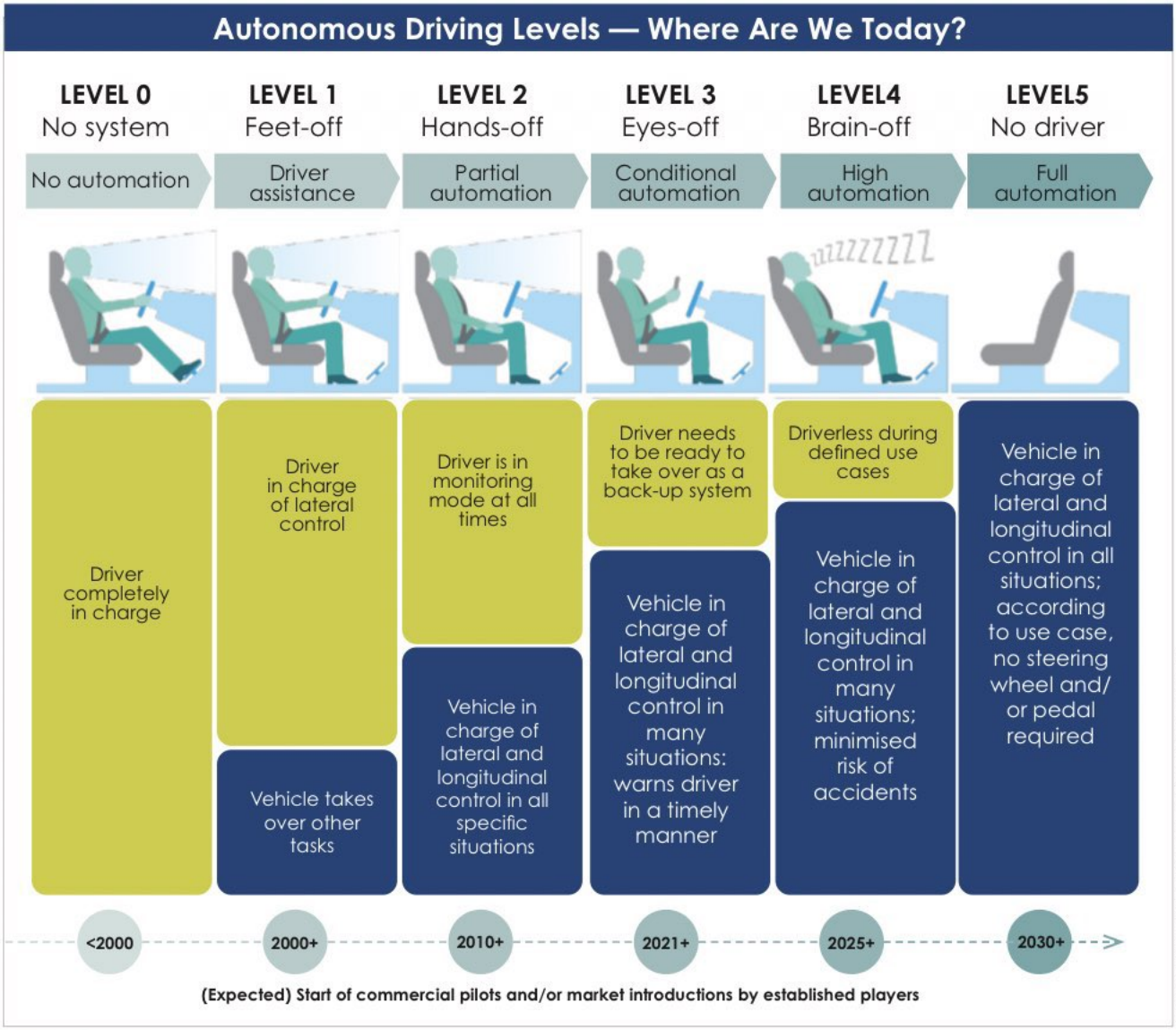


Figure 14: Levels of automation

Microsoft invested USD5 billion in IoT and intelligent edge, and OEMs such as BMW and Volkswagen are partnering with Microsoft. Volkswagen announced a partnership with Microsoft to create the Volkswagen Automotive Cloud with Azure and Azure IoT Edge where more than 5 million new Volkswagen vehicles per year will be fully connected from 2020[19]. In 2019, BMW announced the Open Manufacturing Platform, an open community framework to share smart factory solutions across the automotive and manufacturing sectors for the main purpose of accelerating IoT application in automotive manufacturing[20].

By 2030, the average car is expected to have around 300 million lines of code, and self-driving vehicles could have as many as 500 million lines of code. That is a major increase from the current average of 100 million lines of code in vehicles in 2020.

[16] *Future Mobility Finland, 2020*
[17] *Emergen Research, 2020*
[18] *Deloitte, 2020*
[19,20] *Microsoft, 2019*

South Africa's Commitment

4

4. South Africa's Commitment

4.1. Current Status of Electric Vehicles in South Africa

In South Africa, the market adoption for electric vehicles is currently low, as is illustrated in Figure 15. This is mainly due to the high upfront cost of electric vehicles, the small number of models to choose from, high depreciation rate, lack of confidence in the vehicle's range, and charging station availability. Unlike other world markets, no incentive is available in South Africa for the purchase of an electric car.

Another contributing factor is that electric vehicles are taxed at a higher rate (15% vs 18%) compared with other imported vehicles. To increase market adoption in South Africa, government policies and subsidies need to be more aggressive to improve the Electric Vehicle Value Proposition.

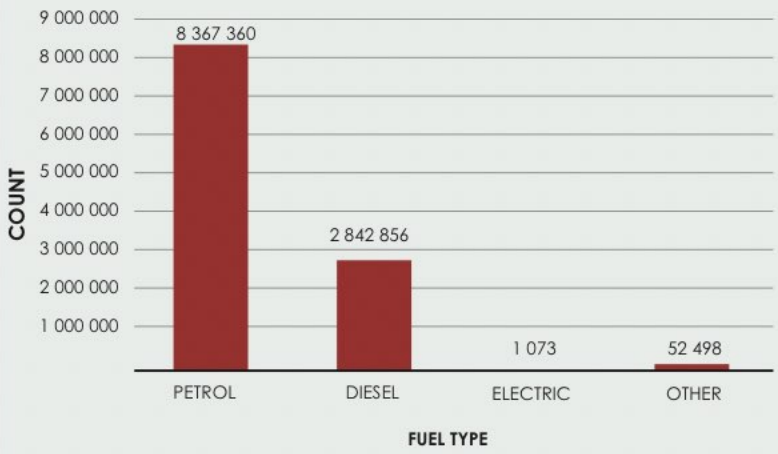


Figure 15: Vehicles registered in SA by fuel type

SOURCE: ENATIS, 2021

4.2. Charge Point Availability

South Africa has 184 public charging stations. These are primarily positioned where population densities are high (65% in the Johannesburg, Pretoria, and Cape Town metro areas), and along the N1, N3 and Garden Route portion of the N2 highway.

For effective use of current electric vehicles on most public roads in South Africa, a minimum range of 300km is needed. With electric vehicle prices declining and ranges expanding, charging could soon become the top barrier to consumer adoption in South Africa[21]. The charge point roll-out in South Africa is a private initiative and in order to increase the rate at which electric vehicles are adopted in South Africa, a much more extensive charging network is needed.

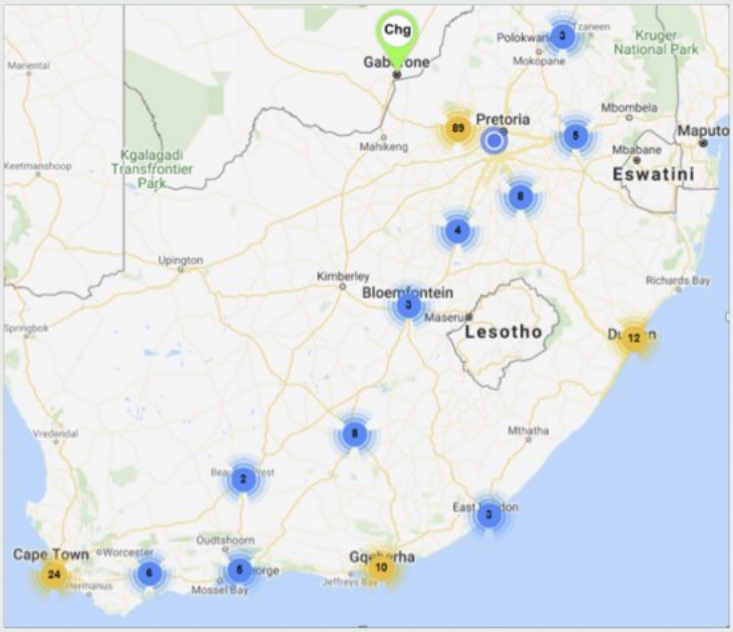


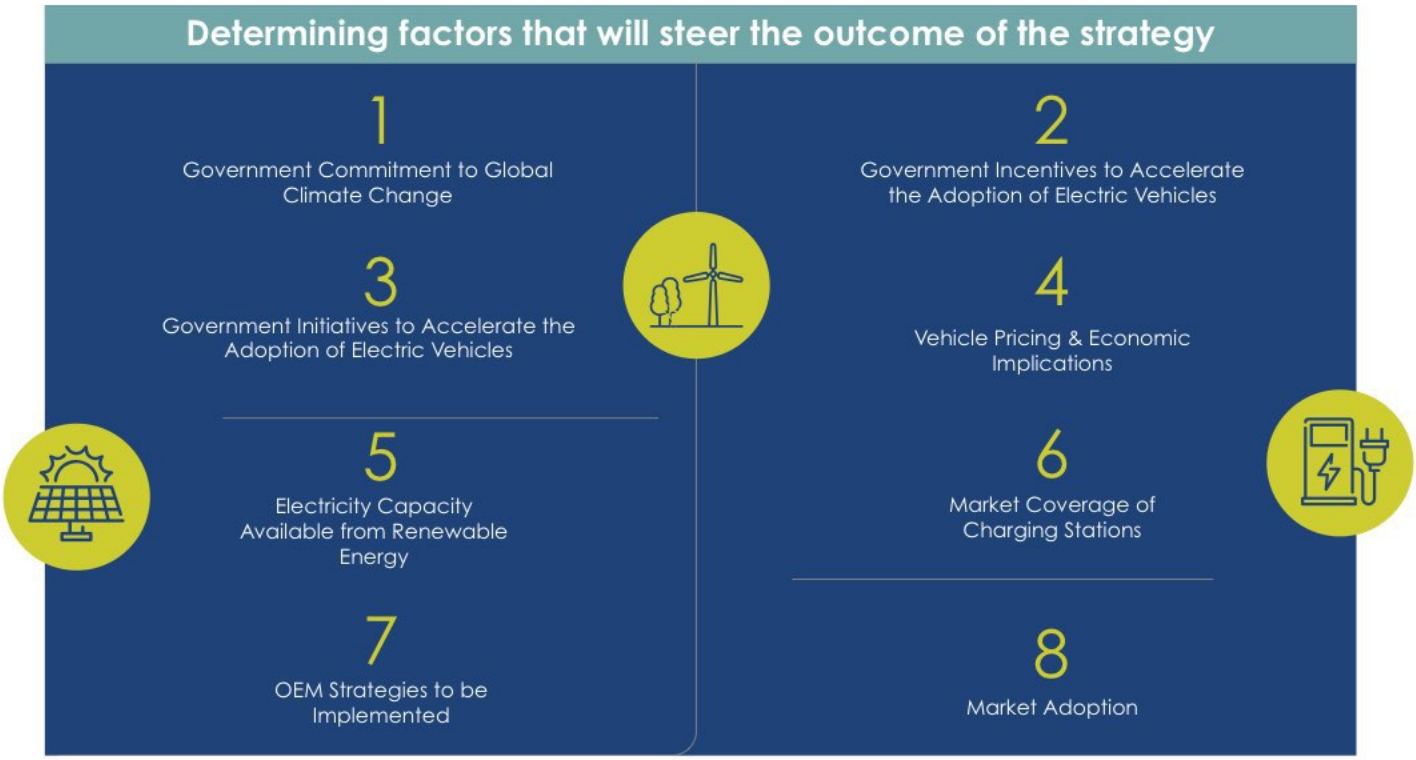
Figure 16: Distribution of public charging stations in SA

SOURCE: EV CHARGING, 2021

[21] *McKinsey | 2016 Electric Vehicle Consumer Survey*

4.3. Potential Scenarios

The implementation of electric vehicles in South Africa will be determined by a set of factors, as shown in the diagram (*Determining Factors*).



Based on these, the formulation of possible scenarios could provide guidance to the development of implementation plans. The graphs in Figure 17 provide an illustration of how the determining factors could play out in terms of market penetration of electric vehicles, following the path to each of three possible scenarios.

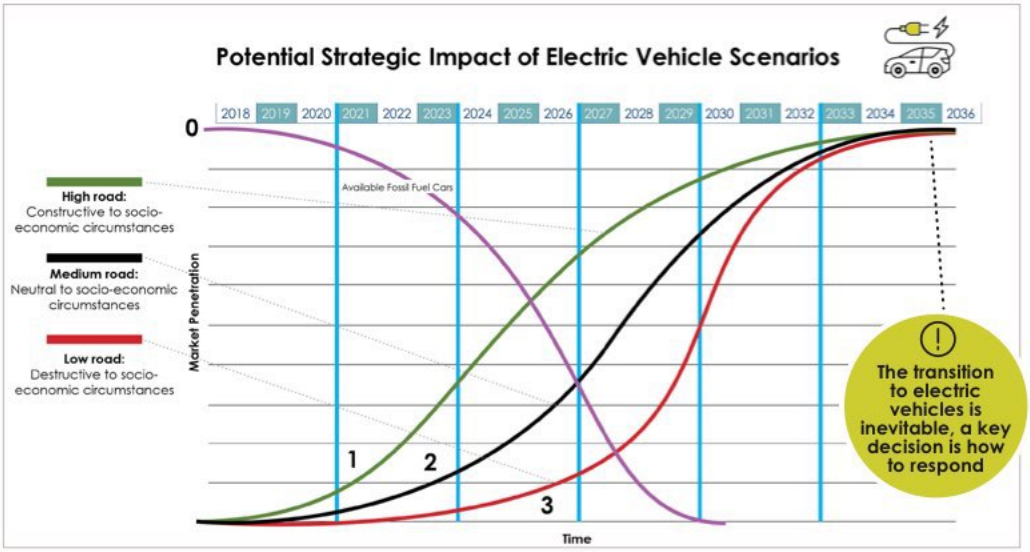


Figure 17: Potential strategic impact of electric vehicle scenarios

4.3.1. Curve 0: The Decline of ICE Cars

The "0" curve represents the volume of ICE cars – flowing from full market penetration to zero cars being sold. All other curves flow from zero market penetration to full market penetration, albeit at various rates of acceleration. What is clear is that the transition is inevitable, however, response to the inevitable transition varies. It is here that leadership makes the difference. It is estimated that the transition will take about 15 - 20 years. Please note that the global decline in the availability of fossil fuel cars started in 2018 (Bloomberg NEF).

4.3.2. Curve 1: The High-Road Scenario

The angle of the curve starts early in time and is moderate over the length of the curve until full market penetration is reached. This early adoption of electric vehicles is least disruptive and provides time to plan and implement the transition orderly. The benefit of being an early adopter is clear. Workers are re-skilled to prepare for new industries to enable local manufacture of vehicles and components. A local ecosystem and infrastructure come in place to support electric vehicles on a wide-scale, and socio-economic growth and development is well underway. The society is ready for stricter emission controls and regulations, and starts to move away from fossil energy to renewables.

4.3.3. Curve 2: The Medium-Road Scenario

The angle of the curve starts later than 1 and requires a higher rate of acceleration to keep up with the transition, due to the higher rate of ICE cars becoming unavailable. This is where most countries will find themselves. The transition happens but is uncomfortable in terms of getting things in place and plans that are not properly implemented.

4.3.4. Curve 3: The Low-Road Scenario

The angle of the curve starts late. New ICE cars are becoming increasingly difficult to source and the transition to electric vehicles is being "forced". The market for used cars disappears and possible stricter emission controls may limit the use of the old ICE car. Stranded assets become problematic for fleet owners. Lack of local manufacturing of electric vehicles results in massive imports needed to supply the demand for cars, which results in high costs. The local ICE manufacturing industry closes and jobs are lost.

4.4. The Auto Green Paper on the Advancement of New Energy Vehicles in South Africa

Recently, the Department of Trade, Industry and Competition (DTIC) in South Africa released an *Auto Green Paper on the Advancement of New Energy Vehicles in South Africa.* This document aggressively promotes the development of an industry that would produce the components for, as well as electric vehicles in South Africa. It recognised that the worldwide trend towards new energy vehicles would impact South Africa and if we do not participate competitively, we could lose our vehicle export market to Europe. This could be detrimental for our local component and vehicle manufacturing industries.

7 focus areas are envisioned:

1. Local market optimisation
2. Regional market development
3. Localisation
4. Automotive infrastructure development
5. Industry transformation
6. Technology and associated skills development
7. Institutionalising the SA Automotive Masterplan.

SOURCE: DTIC

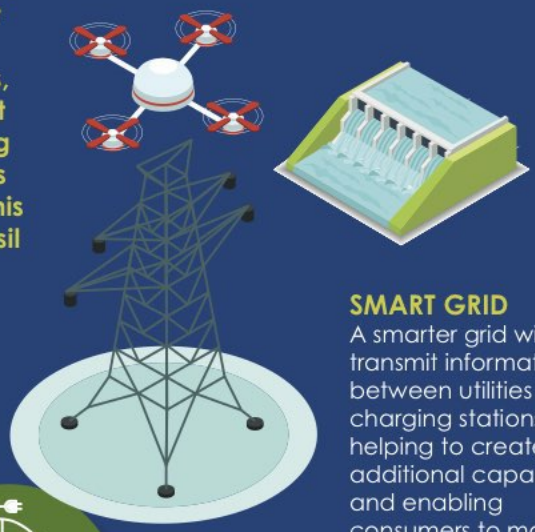
The recommended strategy focuses on the stimulation of the uptake of electric vehicles in South Africa.
To date, OEMs were struggling to get electric vehicles to market and offerings to the public were limited. It is expected that the high tax on electric vehicles will be reduced and the infrastructure for recharging batteries be expanded. This means that the "old" industry will need to be transformed to one that is focused on the development and manufacture of components and parts for the assembly of "new" energy vehicles – essentially battery electric vehicles (BEVs).

The document concludes with:
"South Africa has many of the materials and structures in place to build electric vehicles, but this will require new and different skills in the industry, as well as mandating that these skills be taught at tertiary education institutions. The increase in demand for electric vehicles create opportunities for South Africa in several areas as outlined below:

- The transformation from a raw material exporter to a product exporter,
- Local manufacture of electric vehicles and electric vehicle related components and accessories (chargers and wall boxes),
- Employee upskilling,
- Fuel retail transformation (from vehicle-centric to customer-centric offering opportunities to charge, rest, work, etc.),
- Businesses e.g., green tourism, recycling, etc.,
- Electric vehicle battery 2nd life – repurpose to supply homes with electricity to mitigate against power outages and a better balance of energy demand and supply-cycles, and
- Increased disposable income due to lower cost of operation can be spent in other sectors of the economy driving job creation in sectors not linked to electric vehicles."

The new environment that will enable the uptake and use of electric vehicles is shown in Figure 18.

The report mentions an ecosystem for electric vehicles. It is important to realise that the report is not just about vehicles, but includes the comprehensive support industries, infrastructure installations, internet connected systems and re-skilling of workers in the various industries – all making up the ecosystem. This includes new energy supply – fossil fuels making way for renewable energy sources.



SMART GRID
A smarter grid will transmit information between utilities and charging stations, helping to create additional capacity, and enabling consumers to manage vehicle charging costs.

INFRASTRUCTURE
Infrastructure solutions such as transformers, submetres, and load centres, that support the rollout of electric vehicles.

POWER SOURCES
Electric vehicles will be powered by energy from traditional and renewable sources like solar and wind.

GREENING THE FLEET TOGETHER!

LIGHTWEIGHT MATERIAL
Automotive designs have made electric vehicles more powerful and efficient than ever.

BETTER BATTERIES
Enable longer ranges with decreased charging times.

HOME CHARGING STATIONS
Most consumers will be able to plug an electric vehicle into any standard household 220V outlet and charge their vehicles at home.

Figure 18: The transition from ICE vehicles to new energy vehicles also requires a new Electric Vehicle Ecosystem

- An initial requirement would be a supportive infrastructure to recharge the vehicle batteries (charging data suggests that most charging happens at places of work and at home). This system can be smart – charging batteries at scheduled times and even be controlled remotely.
- Typically, batteries are replaced after losing 20% of range. The battery still has 80% capacity at that time and could be further used for energy storage of renewable energy to power homes, clinics, etc.
- Returning used batteries to the countries where they originated would be costly. It would be much better to have a local recycling industry. In this way the elements making up the battery could be recovered and used for manufacturing of new batteries.
- The opportunities exist for improved manufacturing processes to be established.
- The opportunities exist for workers to be re-skilled and upskilled for the new industries to be established.
- The transition from fossil powered vehicles to electric vehicles calls for the transition from fossil fuel powered businesses and factories to renewable energy supply.

The Auto Green Paper initiates the potential for planned change in South Africa to move from a transportation scenario where we relied on imported oil, paid for with money leaving the country, to a scenario where we could generate our own energy for transportation at a fraction of the previous costs. Also, we would be developing various industries and upskilling people – generating much needed economic growth leading to socio-economic development of our people.

Internationally the transition has started. Let us catch up.

The GMT Strategy for the Implementation of Electric Vehicles

5

5. The GMT Strategy for the Implementation of Electric Vehicles

5.1.GMT Strategy

With the global developments related to climate change, the accelerated transition to electric vehicles globally, and the current status in South Africa as basis, this section focuses on the formulation of an electric vehicle strategy for GMT.

5.2. Core Drivers of the GMT Electric Vehicle Strategy

With the core drivers of the implementation of electric vehicle in South Africa, and the potential scenarios identified in the previous section, the determining factors were applied to the Western Cape in this section. This is outlined in Figure 19.

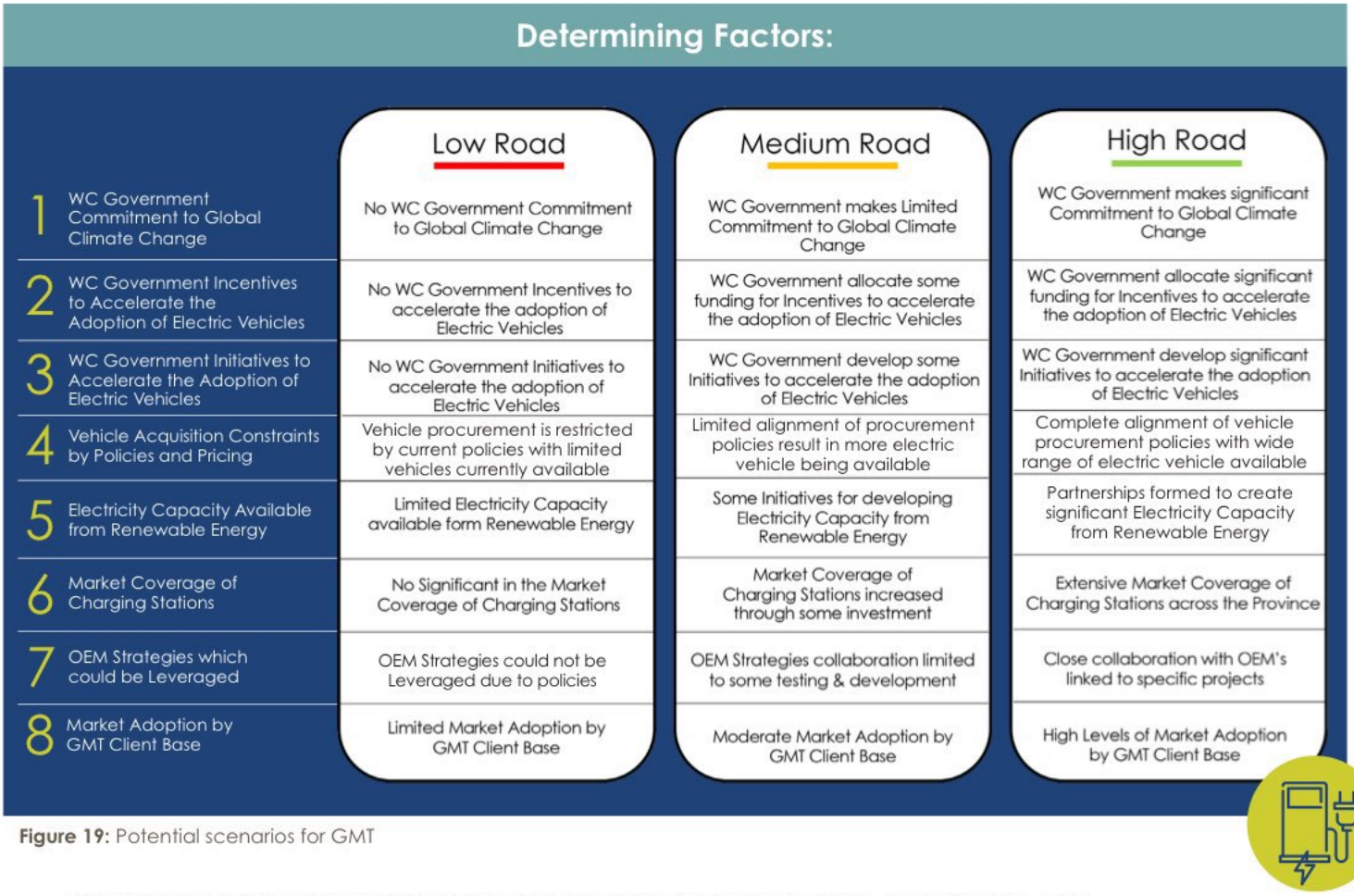


Figure 19: Potential scenarios for GMT

The driver factors for the Western Cape also translates into three possible scenarios, the Low-, Medium- and High Road Scenario. Based the vision inspired goals of the Western Cape Government, the strategic focus of the electric vehicle strategy, is achieving the High Road Scenario.

Translating the High Road Scenario into strategic objectives of the electric vehicle strategy, is outlined in Figure 20.

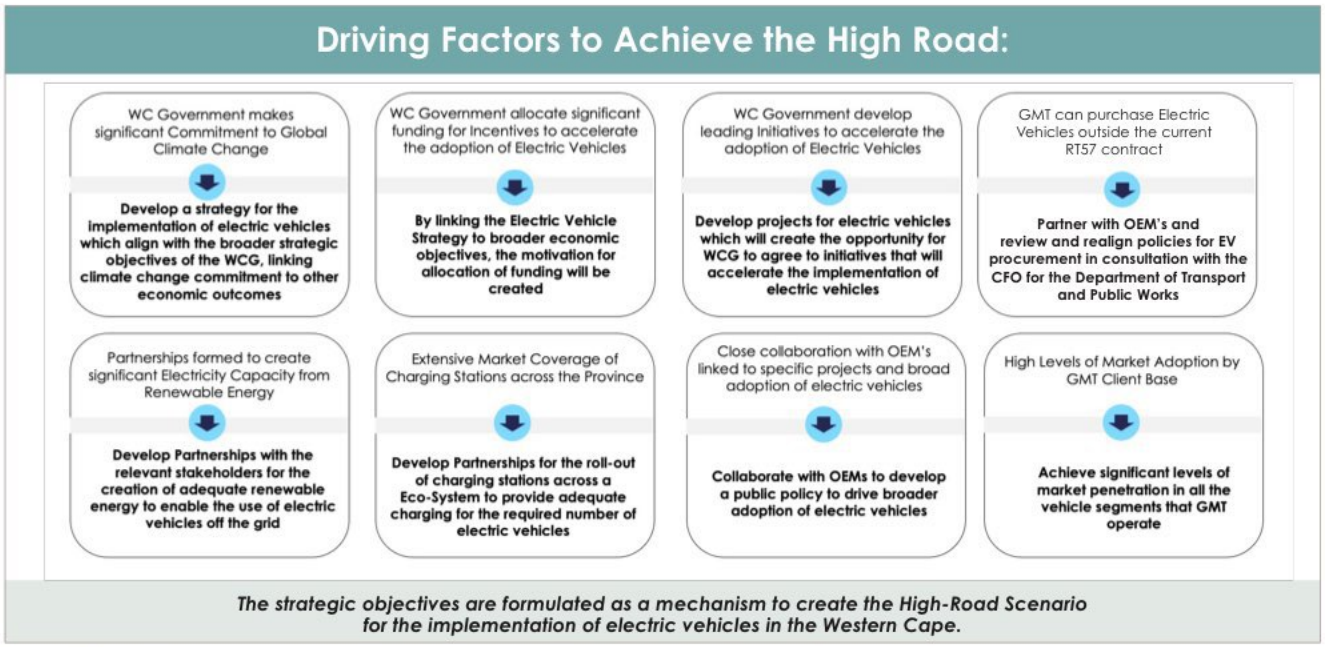


Figure 20: Strategic objectives addressing determining factors

5.3. Implementation of Electric Vehicles: A Decision-Making Framework

A decision making framework to guide the research and development of the electric vehicle strategy was developed. This framework, as depicted in Figure 19, focuses on all the key aspects which should be addressed in the strategy.

Figure 21 illustrates the Decision-Making Framework. Factors related to customer value, tariffs, asset and fleet management operations are elaborated on.

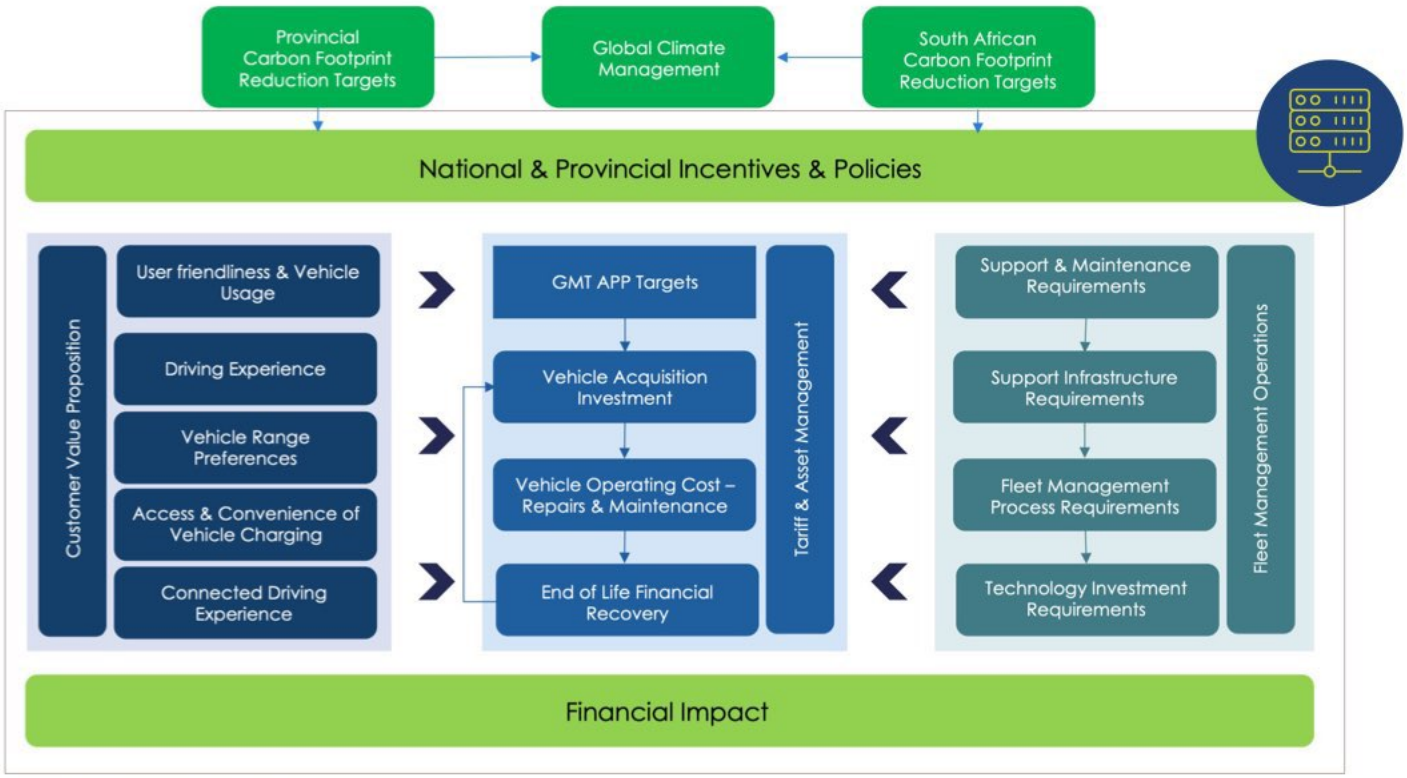


Figure 21: Decision-Making Framework

5.4. Customer Offering by Segment

5.4.1 Stakeholder and Segmental Analysis

The point of departure for the development of an electric vehicle offering to the GMT customer base is a stakeholder and market segmental analysis. This provides the basis for the development of a customer offering by segment, and a broader communication strategy for the promotion of electric vehicle adoption.

Table 1 illustrates the framework developed to identify key internal and external stakeholders, and the envisaged type of engagement.

Table 1 Stakeholder Map

Stakeholder	Types of Engagement			
	Influence	Education	Collaboration	Product
Motorists/Citizens				
GMT Drivers				
Client Institutions				
Policy Makers				
Community Leaders				
OEMs				
Banks				
Dealerships				
Vehicle Converters				
Other Institutions				
Energy Providers				

The different stakeholders include general motorists, GMT drivers, client Institutions, policy makers, community leaders and potential partners. The type of engagement envisaged can be categorised as:

- **Influence:** The objective of this is to create a positive perception about electric vehicles to accelerate the market adoption thereof.
- **Education:** Driving and maintaining electric vehicles is fundamentally different from internal combustion vehicles. The objective is to develop a broad base of educational initiatives to facilitate the transition to electric vehicles. This is not only focused on drivers, but also the broader ecosystem and community.
- **Collaboration:** The implementation of an electric vehicle strategy could not be achieved by GMT on its own and, as such, close collaboration with various stakeholders would be required.
- **Product:** This engagement is focused on the development of a product that would form part of the broader electric vehicle offering.

The next aspect relevant for market segmentation is the segmentation of vehicle types, which is outlined in Table 2.

Table 2 Customer Vehicle Segmentation

Vehicle segment							
Customer Segment		Light Passenger	Medium Passenger	VIP Passenger	Utility Vehicle	Customised Vehicle	Passenger Transporter
	Passengers						
	Staff						
	Transport Officers						
	Senior Officials						
	Premiers and Ministers						

The different vehicle segments range from passenger vehicles to utility vehicles, customised vehicles and passenger transporters. Utility vehicles include bakkies in different sizes while customised vehicles refer to specialised vehicles such as ambulances, which are converted for a specific purpose. Passenger transporters range from smaller buses to bigger buses focused on transporting passengers.

With this as a point of departure, the next section will provide more detail of the different customer vehicle segments.

5.5. Electric Vehicle Strategy: Potential Target Markets

5.5.1. Overview

To execute the strategy successfully, potential target markets need to be identified within GMT and practical projects must be initiated within these target markets.

GMT set specific APP targets to be achieved by March 2025, including that 2.5% of the fleet must be zero-emission electric vehicles and reducing the ratio of CO_2 emissions relative to the size/kilometres of the fleet to 3.4. To put these values into perspective, assuming the current number of vehicles in the GMT fleet – electrifying 2.5% of the vehicles – equates to approximately 175 vehicles, this should naturally result in reducing the ratio of CO_2 emissions relative to the size/kilometres of the fleet to 3.4. Figure 22 provides a breakdown of the GMT fleet by vehicle category, and the three largest target markets include:

- Light Passenger Vehicles
- Light Delivery Vehicles
- Shuttles

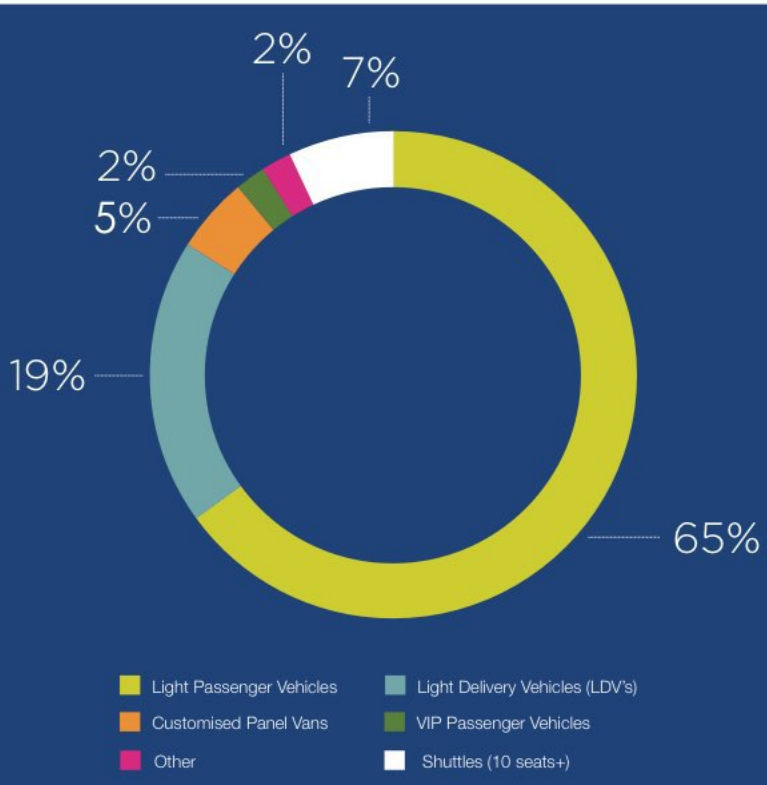


Figure 22: Breakdown of GMT's fleet by vehicle category

SOURCE: GOVERNMENT MOTOR TRANSPORT TRADING ENTITY STRATEGIC PLAN FOR THE FISCAL YEARS 1 APRIL 2020 TO 31 MARCH 2025.

5.5.2. Light Passenger Vehicles

Light passenger vehicles make up the largest market segment of the GMT fleet and emphasis is therefore placed on the electrification of this market. There are approximately 3 570 vehicles (65% of the fleet) in this category. The testing of potential electric vehicles for this segment is of major importance due to its significance in the GMT fleet. Testing the BMW i3, which was the only electric vehicle available at the time in terms of the procurement policy, was thus a major priority.

Assuming the electrification of the GMT fleet will be proportional to the current weights of the vehicle categories within GMT, approximately 65%, or a minimum of 114 light passenger vehicles, need to be electrified by March 2025.

Figure 23 indicates the current breakdown of light passenger vehicles in GMT by OEM. The Volkswagen Polo is primarily responsible for the large share held by Volkswagen in this target market.

A short-term constraint is that there are limited vehicles commercially available that fit this segment in South Africa. Nevertheless, OEMs have set aggressive targets to enter this category and various new models are expected to enter the South African industry in the coming years.

Pending the procurement policies contract restriction, close collaboration with selected OEMs may be required. Growth of this segment will be highly dependent on model availability, and the objective is to purchase locally manufactured electric vehicles as far as possible.

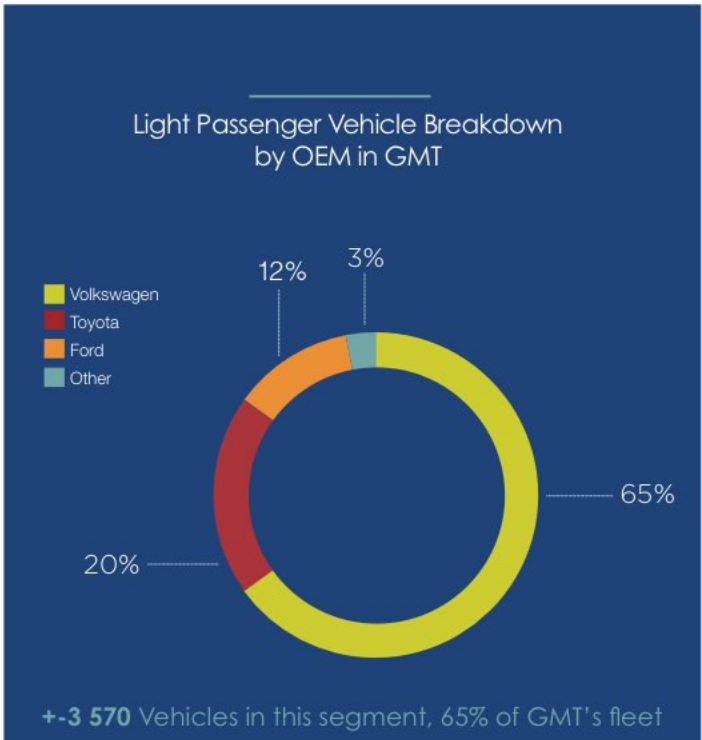


Figure 23: Breakdown of light passenger vehicles

Table 3 Summary of Light Passenger Vehicle Segment

Type of vehicle	Light Passenger Vehicles: Segment Summary
Size of the segment	3 570
Percentage of GMT fleet	65%
Major OEMs in GMT fleet	Volkswagen, Toyota, Ford
Minimum electric vehicle requirement by March 2025 based on APP target	114
Current number of electric vehicles	5
Opportunity	Achieving critical volumes for electric vehicle transition
Challenges	Vehicle availability in this section is a major challenge

5.5.3. VIP Passenger Vehicles

The VIP passenger vehicle segment is a small, but highly influential target market. The focus of this segment is on market development and not volume. There are 122 vehicles in this segment of GMT's fleet.

Assuming the electrification of the GMT fleet will be proportional, the current weights of the vehicle categories within GMT, approximately 2%, or a minimum of three VIP vehicles, needs to be electrified by March 2025.

There are
122
vehicles in this segment of GMT's fleet.

Figure 24: Jaguar I-Pace

This market will not be a major contributor in terms of number of electric vehicles, but rather to create electric vehicle ambassadors. An opportunity to achieve this, is for government executive leadership to become electric vehicle ambassadors.

The goal is to provide premiers and ministers with these vehicles to be proponents of electric vehicles.

Table 4 Summary of the VIP Passenger Vehicle Segment

Type of vehicle	VIP Vehicle Segment Summary
Size of the segment	122
Percentage of GMT fleet	2%
Major OEMs in GMT fleet	Mercedes Benz and BMW
Minimum electric vehicle requirement by March 2025 based on APP target	3
Current Number of electric vehicles	0
Opportunity	Influencing mechanism
Challenges	Cost of vehicles in this segment and convincing VIPs to convert to electric vehicles

5.5.4. GMT Shuttle Service

Shuttle vehicles, excluding buses with 35 seats or more installed, make up approximately 7% of GMT's fleet and it is the fourth largest section. Figure 25 illustrates a breakdown of the shuttles in the GMT fleet by OEM.

The Toyota Quantum model is popular within the GMT fleet at 68% of the shuttles. Toyota and other OEMs, however, have not announced much coverage in this section. Currently, ICE vehicles are used for first-and-last mile activities which is not ideal. Electric first-and-last mile vehicles are ideal, low cost alternatives. Nevertheless, in applications where electric first-and-last mile vehicles will not be sufficient, such as long-distance travelling, converting ICE vehicles to electric vehicles may be required.

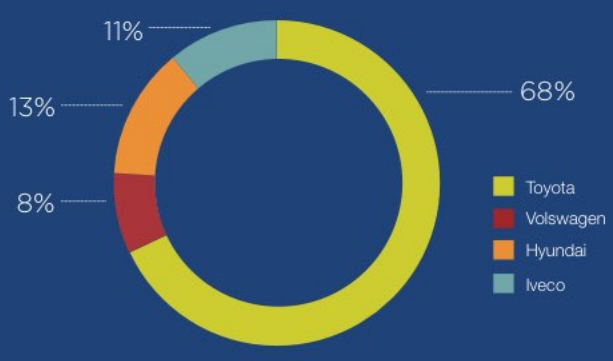


Figure 25: Breakdown of shuttles

Figure 26: First-and-last mile vehicle

Figure 27: Locally developed electric shuttle vehicle

Figures 26 and 27 showcase locally developed electric vehicles that may be ideally suited for many applications in this segment. Assuming the electrification of the GMT fleet will be proportional, the current weights of the vehicle categories within GMT, approximately 7% or a minimum of 13 shuttle vehicles, needs to be electrified by March 2025. The focus is to achieve this goal in the medium-term by acquiring first-and-last mile vehicles and converting end-of-life shuttle vehicles to electric.

Table 5 Summary of the GMT Shuttle Segment

Type of vehicle	Shuttle Vehicles: Segment Summary
Size of the segment	414
Percentage of GMT fleet	7%
Major OEMs in GMT fleet	Toyota, Volkswagen, and Hyundai
Minimum electric vehicle requirement by March 2025 based on APP target	13
Current number of electric vehicles	0
Opportunity	Quickly and cost-effectively introduce first-and-last mile electric vehicles into the fleet.
Challenges	Long-distance vehicles are not readily available to be purchased and a reliance is on conversion, which will have longer lead times.

5.5.5. Passenger and Public Transport

This segment consists of buses with a carrying capacity of more than 35 passengers. The objective is to support the local industry in South Africa, either to purchase and test a prototype electric bus from one of the local bus builders, or to use a local company to convert an ICE bus to electric.

Creating an environment where the conversion of buses is possible may enable local electric bus manufacturing in the Western Cape and South Africa. A goal is therefore to create partnerships within the local bus conversion industry.

This segment, however, is small in GMT at around 20 vehicles or less than 0.5% of the GMT fleet. Assuming the electrification of the GMT fleet will be proportional to the current weights of the vehicle categories within GMT, this equates to a minimum of one bus to be converted by March 2025. A recommendation is to be much more ambitious in this section.

Figure 28: Locally converted electric bus

Many people in the Western Cape and broader South Africa make use of buses as transport, and a reduction in maintenance and operating costs could contribute towards transportation services becoming more affordable. A goal is to establish a basis for the local electric vehicle industry in the Western Cape. This section holds the opportunity to leverage the switch to electric vehicles to better formalise, regulate and support the industry.

Table 6 Summary of Passenger & Public Transport Segment

Type of vehicle	Passenger and Public Transport: Segment Summary
Size of the segment	20
Percentage of GMT fleet	<0.5%
Major OEMs in GMT fleet	Hino
Minimum electric vehicle requirement by March 2025 based on APP target	1
Current number of electric vehicles	0
Opportunity	To establish a basis for the local electric vehicle industry in the Western Cape. Opportunity to leverage the switch to electric vehicles to better formalise, regulate and subside the industry.
Challenges	Electric buses are not manufactured locally. A heavy reliance is on local conversion and lead times may therefore be longer.

5.5.6. Light Delivery Vehicles

Light delivery vehicles (LDVs) make up the second largest portion of the GMT fleet at 19%. Figure 29 showcases the breakdown of OEMs in the LDVs segment of GMT's fleet.

A challenge in this segment is current availability of suitable vehicles in this segment, combined with limited forward visibility of vehicles planned by major OEMs, such as Toyota, Nissan and Ford.

Some South African companies are importing small LDVs. However, the goal in this segment is to enable the local development of special purpose LDVs.

A major focus in this segment is on the local development of niche, fit-for-purpose electric vehicles such as conservation patrol, maintenance, tractors, general farming, packhouse and many other vehicles. In addition to this, conversion of customised LDVs is recommended.

Assuming the electrification of the GMT fleet will be proportional to the current weights of the vehicle categories within GMT, this equates to a minimum of 32 LDVs by March 2025. A strong emphasis is placed on the local development of most or all these vehicles.

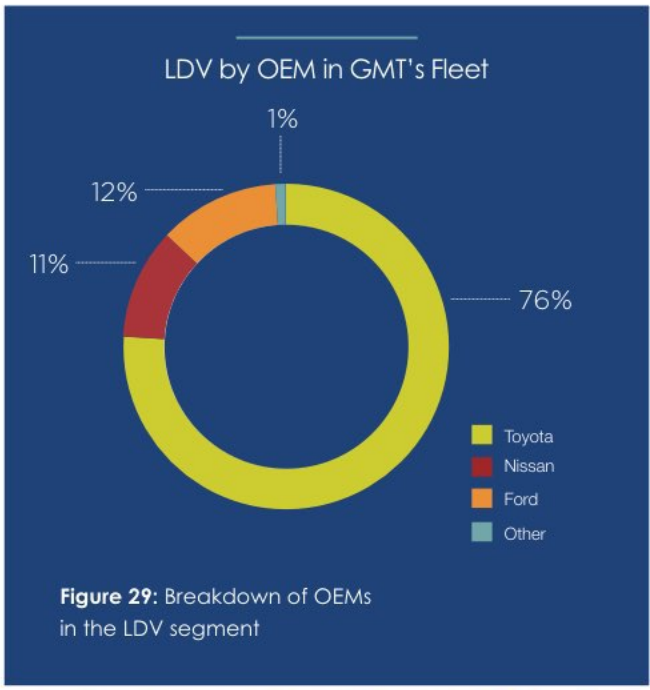


Figure 29: Breakdown of OEMs in the LDV segment

Figure 30: Electric LDVs manufactured abroad

Table 7 Summary of Light Delivery Vehicle Segment

Type of vehicle	LDV: Segment Summary
Size of the segment	1050
Percentage of GMT fleet	19%
Major OEMs in GMT fleet	Toyota, Ford and Nissan
Minimum electric vehicle requirement by March 2025 based on APP target	32
Current number of electric vehicles	0
Opportunity	Enablement of local development of purposeful LDVs
Challenges	Very few locally developed options available

5.5.7. Customised Vehicles

There is a segment in GMT where vehicles are customised for a range of specific applications such as ambulances, mobile clinics and mobile libraries. The potential in this segment is to combine this type of conversion with electrification, contributing toward the development of an electric vehicle industry in the Western Cape. Volkswagen Crafters make up the largest portion of this section. Assuming the electrification of the GMT fleet will be proportional to the current weights of the vehicle categories within GMT, this equates to a minimum of nine conversions of customised vehicles by March 2025.

Table 8 Summary of the Converted Vehicle Segment

Type of vehicle	Customised Vehicles Summary
Size of the segment	271
Percentage of GMT fleet	5%
Major OEMs in GMT fleet	Volkswagen, Toyota
Minimum electric vehicle requirement by March 2025 based on APP target	9
Current number of electric vehicles	0
Opportunity	Repurposing of end-of-life vehicles with capital spent on customisation. Essentially decreasing the cost of the electric vehicle and reducing overall conversion lead times.
Limited availability of special purposed electric vehicles	Conversions have longer lead times than vehicle purchasing.

5.6. Delivering the Strategy

5.6.1. Introduction

The stakeholder analysis and vehicle segmentation framework, provided earlier in the document, provides the basis for linking the strategy to the stakeholders and the vehicle segments. The mapping of the strategic positioning of the strategy back to the stakeholders is outlined in Table 9.

Table 9: Stakeholder engagement matrix

Stakeholder	Types of Engagement			
	Influence	Education	Collaboration	Product
Motorists/Citizens				
GMT Drivers				
Client Institutions				
Policy Makers				
Community Leaders				
OEMs				
Banks				
Dealerships				
Vehicle Converters				
Other Institutions				
Energy Providers				

Based on the stakeholder mapping, the strategy is positioned to engage all stakeholders in the Western Cape from the general motorist and client departments to providers of renewable energy. The type of engagement is also depicted, the focus however is different by stakeholder segment. In certain segments such as motorists, the objective is influencing for the adoption of electric vehicles. In most of the other segments, the objective is a combined form of engagement, which includes education, collaboration for product development, and the delivery of a product for GMT drivers and client departments. This engagement matrix also provides the framework for the development of marketing communication, which will be outlined in a subsequent section.

Positioning the Electric Vehicle Strategy on the vehicle segmentation matrix, as outlined in Table 9, provides the positioning in terms of the strategic focus on vehicle segments. This positioning is based on the current GMT fleet profile and the strategic goals set for the Electric Vehicle Strategy. The focus in the medium sedan segment is in line with the biggest concentration of the current fleet. Utility vehicles, customised vehicles and passenger transporters are vehicle segments with the opportunity for conversion to electric vehicles and the local manufacturing thereof.

Table 10: Strategic positioning in the vehicle segments

Customer Segment	Vehicle segment: Light Passenger	Medium Passenger	VIP Passenger	Utility Vehicle	Converted Vehicle	Passenger Transporter
Passengers				■	■	
Staff					■	■
Transport Officers				■	■	
Senior Officials				■		■
Premier and Ministers			■			

With the strategic positioning of the GMT Electric Vehicle Strategy linked back to the stakeholder mapping and the vehicle segmentation as a point of departure, the next section focuses on outlining the strategy.

5.6.2. Establishing Western Cape Government Leadership

For the Western Cape to achieve the strategic goals of the Electric Vehicle Strategy, it was already indicated that the development of a total ecosystem is required. The development and implementation of this ecosystem can only be achieved through broad based leadership of the Western Cape Government and the participation of all departments.

A Western Cape Electric Vehicle Ecosystem as outlined in Figure 31 is envisaged:

The Electric Vehicle Ecosystem integrated all the different aspects related to electric vehicles into a single ecosystem. The ecosystem is not only intended to enable the adoption of electric vehicles, but an equally important objective is also to achieve broader socio-economic objectives for the province. This could only be achieved through leadership from the Western Cape Government.

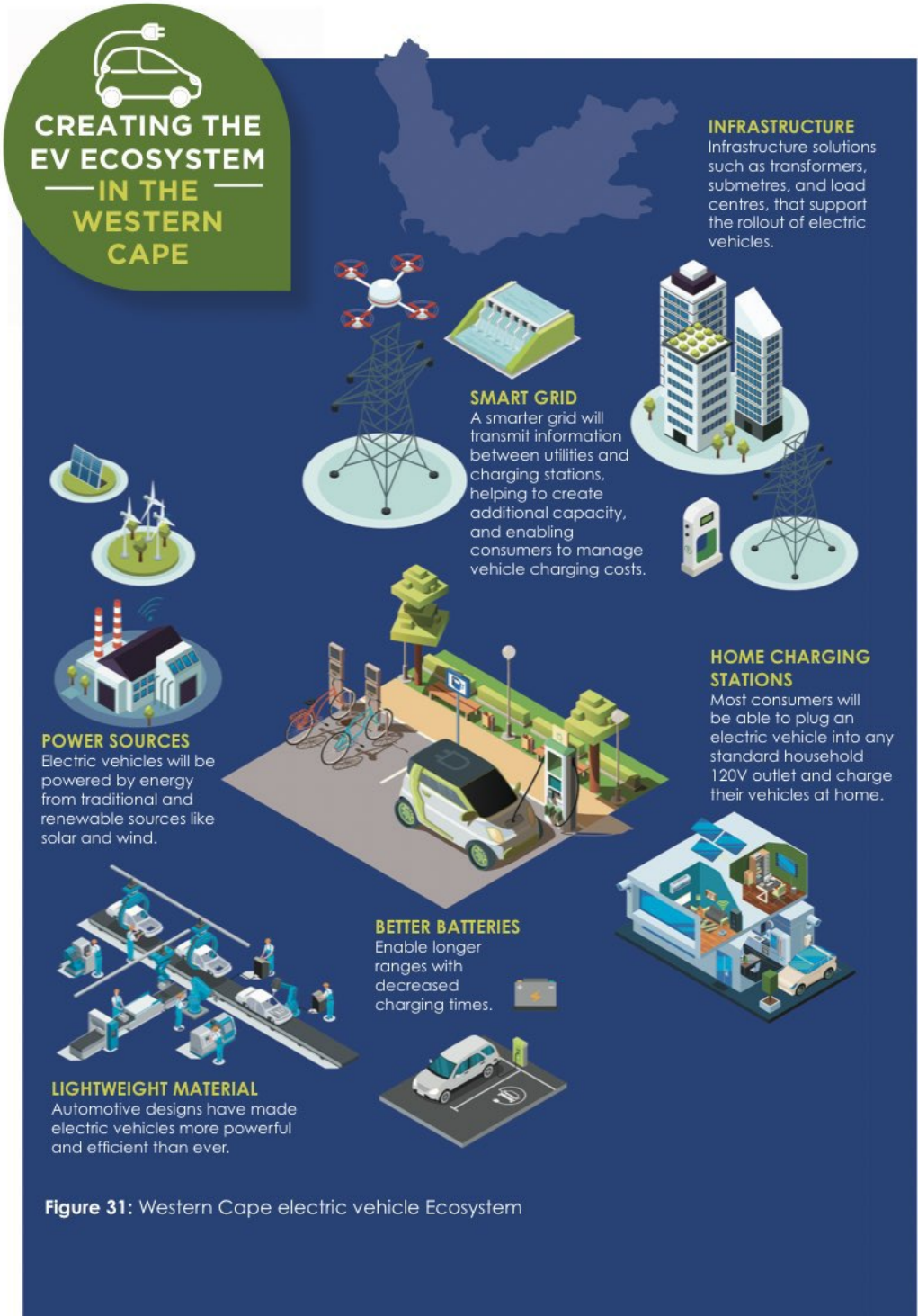


Figure 31: Western Cape electric vehicle Ecosystem

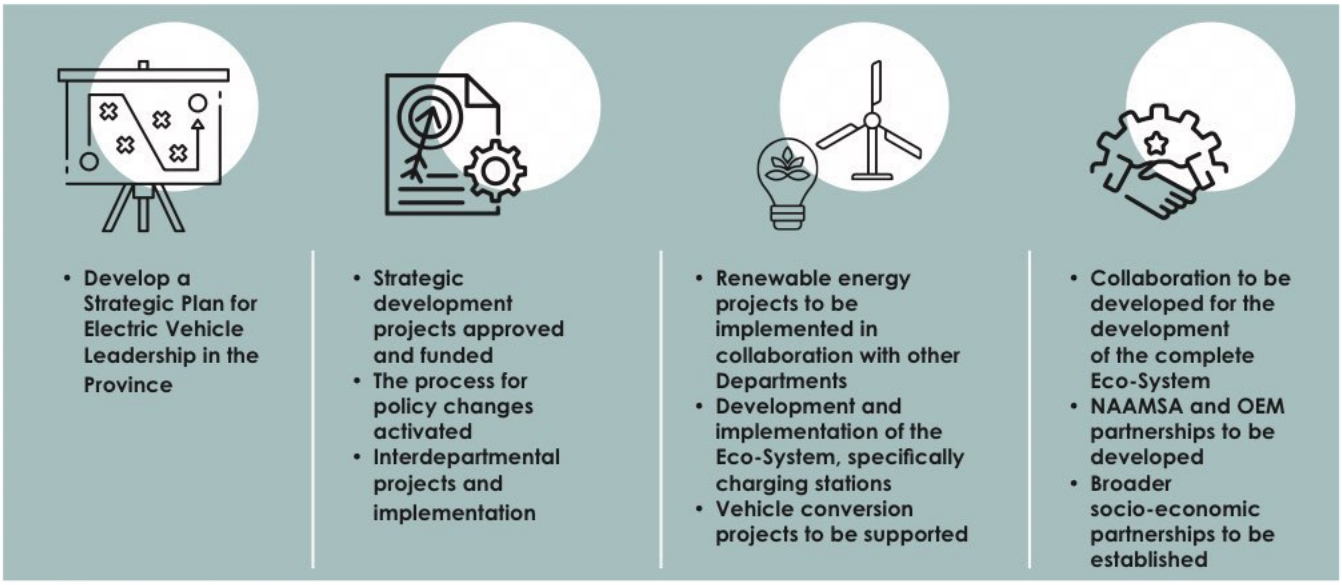


Figure 32: Leadership aspects

The aspects where leadership from the WCG is required are outlined in Figure 32.

- **The development of a strategic plan for Electric Vehicle Leadership in the province:** A strategic plan for the development of the ecosystem for electric vehicles is required to align the planning and execution of various projects, not only in the Department of Transport and Public Works, but also through the collaboration of various other departments towards achieving the total ecosystem. This is illustrated in Figure 33.
- **Strategic development projects to be approved and funded:** The strategic development projects that are recommended for the creation of the ecosystem need to be approved. This includes not only the project, but also the funding and the collaboration of different departments to deliver these projects.

Figure 33: Creating the Electric Vehicle Ecosystem in the Western Cape

- **Renewable energy projects:** A strategic goal of the Electric Vehicle Strategy is to contribute towards the province reducing its carbon footprint and mitigating the potential challenges of electricity availability in the short term. Utilising more electricity from sources that are not reducing the carbon footprint of the province would not achieve the broader objective of reducing the negative impact of climate change. The use of renewable energy as a source of energy for the charging of electric vehicles is thus a key success requirement.
- **The development of charging stations:** The development of a grid of charging stations that would provide easy access to charging across the province is a key requirement for the successful adoption of electric vehicles. This could only be achieved through collaboration between the different institutions.
- **Vehicle conversion projects:** A fundamental element of the Electric Vehicle Strategy is economic growth and socio-economic development. Vehicle conversion provides an opportunity for the Western Cape to establish an electric vehicle industry for the conversion of specific vehicle categories. This could, however, not be achieved without government initiatives by changing policies to accelerate the adoption of electric vehicles in specialised vehicle segments. Close collaboration between various institutions would also be required to achieve this objective.
- **Collaboration with key stakeholders:** Close collaboration with key stakeholders, such as NAAMSA, the OEMs, financial institutions, funding organisations and different departments, would be required to get projects defined, developed, and delivered.

The next section will outline the envisaged projects to create and deliver the envisaged Electric Vehicle Ecosystem.

5.6.3. The Envisaged Electric Vehicle Ecosystem for the Western Cape

5.6.3.1 The Ecosystem Defined in Detail

The concept of a broader ecosystem for electric vehicles, also aligned with the green paper, is a key global mechanism for achieving success with the implementation of electric vehicles. It was also outlined in the Green Paper released by the Department of Trade, Industry and Competition (DTIC).

The objective of this section is to translate the broader vision into a more specific definition of the ecosystem and identify recommended projects for the development and implementation of said ecosystem. The envisaged ecosystem for the Western Cape is outlined in Figure 34.

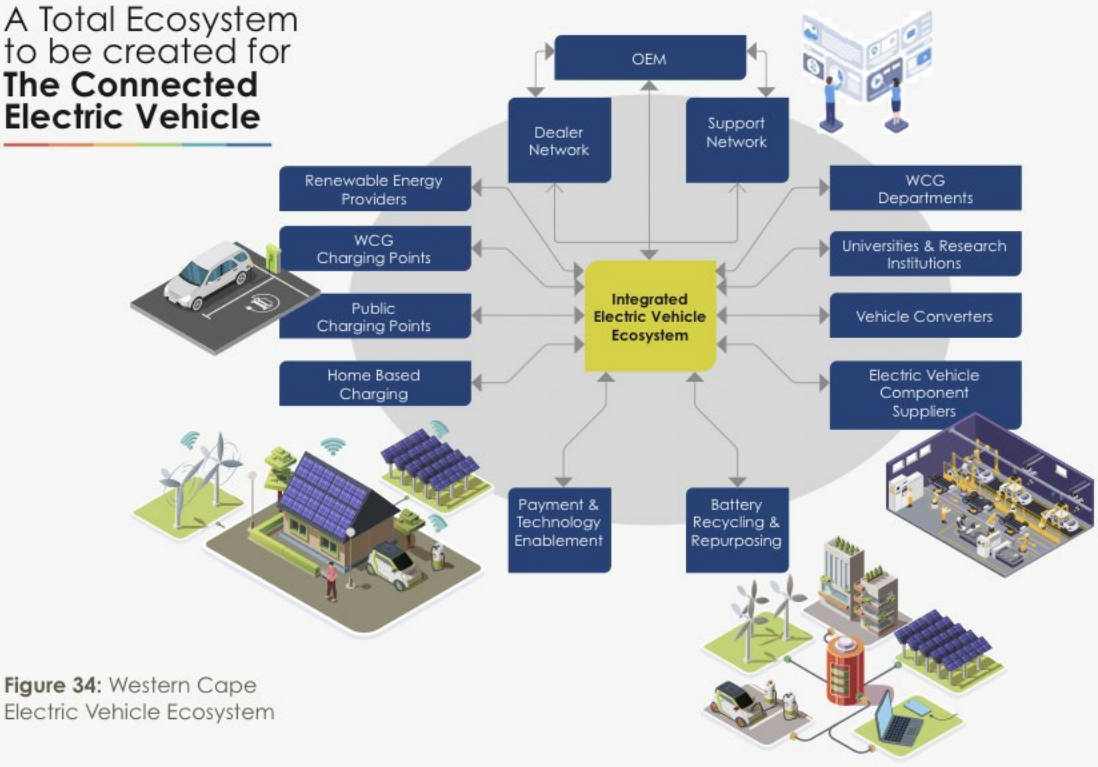
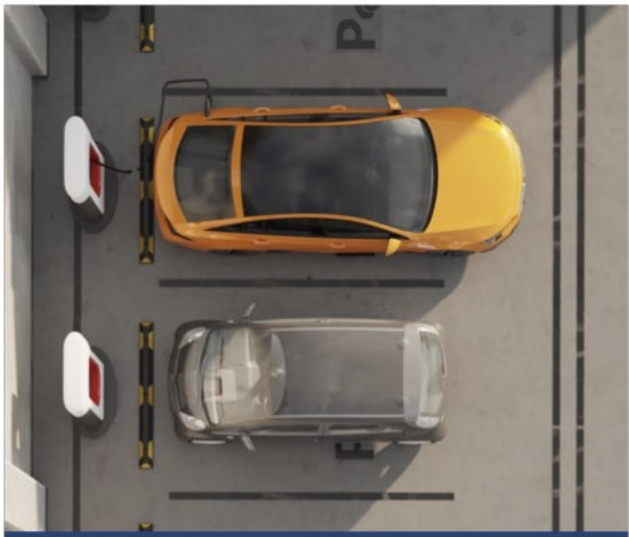


Figure 34: Western Cape Electric Vehicle Ecosystem

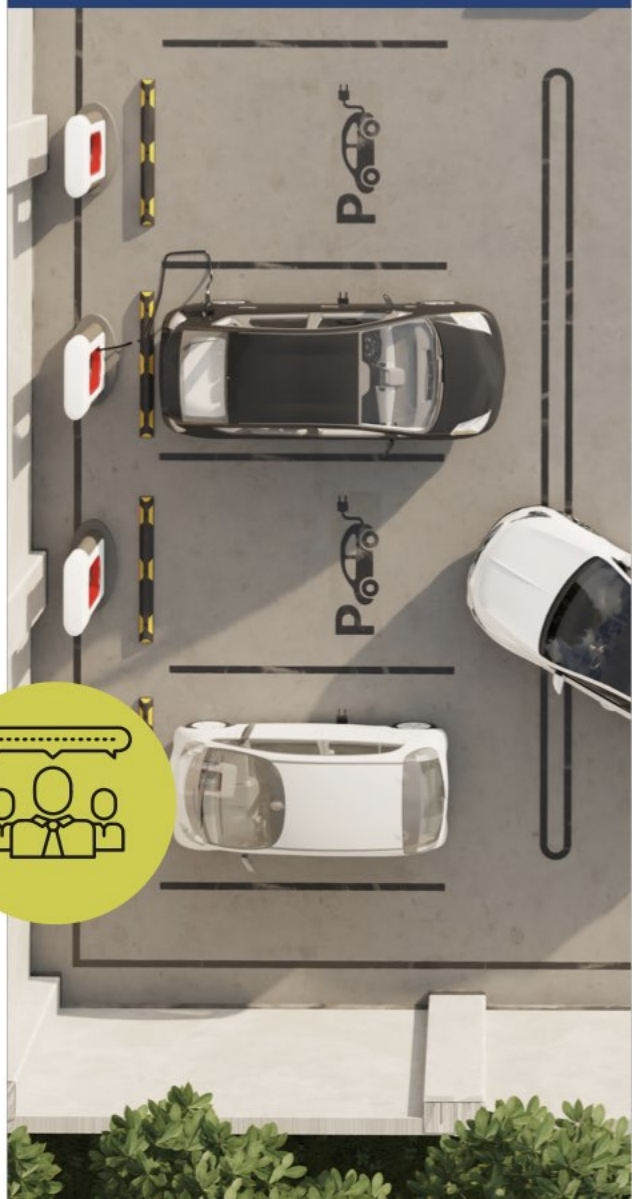
The key buildings blocks of the Electric Vehicle Ecosystem for the Western Cape are as follows:

- **OEMs:** The availability of electric vehicles for South Africa from leading OEMs is currently a challenge. Given the uncertainty about a national strategy for electric vehicles, the OEMs have not announced any specific plans for the introduction of electric vehicles in South Africa. It is recommended that the Western Cape Government actively engage with OEMs to participate in the development of the ecosystem in the province.
- **Dealer network:** Collaboration with the OEMs not only focuses on making electric vehicles available in the Western Cape, but also the establishment of a dealer network that could support these vehicles.
- **Support network:** An electric vehicle support network is also required to provide further support for the ecosystem. This would include service providers for the repair of electric vehicles after accidents, and the provision of parts and other services.
- **Renewable energy providers:** The key importance of the availability of renewable energy for charging electric vehicles was already highlighted. Active engagement with providers is required to ensure availability of renewable energy for charging electric vehicles across the charging grid.
- **The development of a comprehensive charging grid:** The availability of a comprehensive charging grid will be a fundamental requirement for the adoption of electric vehicles. This grid should exist of a combination of government, public and home-based charging points.
- **Payment and technology enablement:** A complete technology platform should be developed to enable all elements of the Electric Vehicle Ecosystem. This includes not only managing the Connected Electric Vehicle, but also payment for charging and enabling other strategic objectives of the Department of Transport and Public Works in terms of Road Safety and Law Enforcement.
- **Battery recycling and repurposing**: Battery recycling forms a key part of the ecosystem to ensure environmental friendliness of the electric vehicle across its complete life cycle. Battery repurposing offers significant broader socio-economic development.
- **Vehicle converters and component suppliers:** Vehicle conversion and providers of components for vehicle conversion forms a key part of the broader ecosystem. Opportunities for job creation and socio-economic growth could be created from this part of the Electric Vehicle Ecosystem.
- **Collaboration with universities and research institutions:** The creation of the Electric Vehicle Ecosystem requires research and development of various aspects. Collaboration with universities and other institutions would also provide not only the basis for the implementation of the ecosystem, but also the development of thought leadership.
- **Collaboration of government departments:** The important role of collaboration between government departments was already outlined in the previous section.

With the Electric Vehicle Ecosystem as a key deliverable from this strategy, the research and development projects envisaged to achieve this needs to be outlined.



Collaboration with OEMs is key to establishing an electric vehicle dealer network in the Western Cape.



5.6.3.2 Project for Delivering the Electric Vehicle Ecosystem

The projects envisaged for delivering the Electric Vehicle Ecosystem are outlined in Figure 35. More detail on each of these projects:

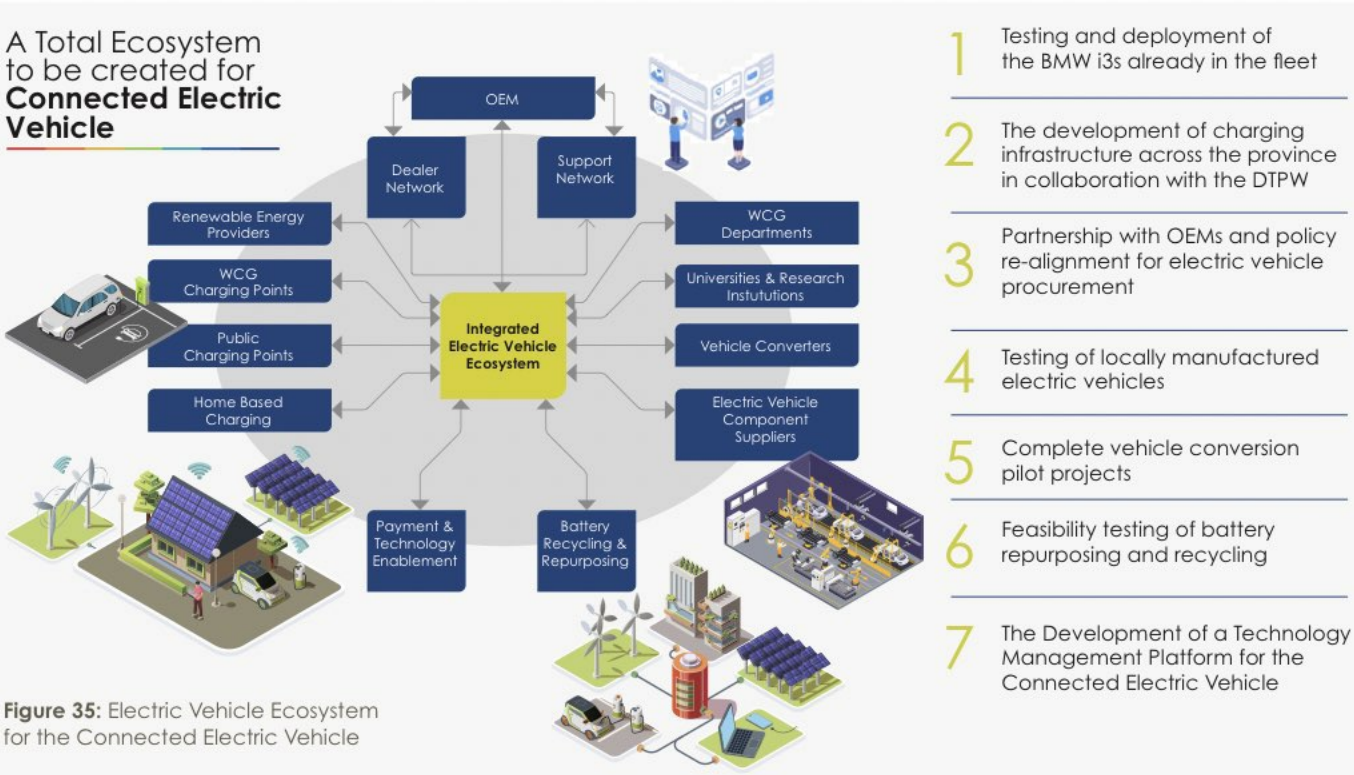


Figure 35: Electric Vehicle Ecosystem for the Connected Electric Vehicle

1 **Testing and deployment of BMW i3s:** GMT has already procured five BMW i3s. The objective of this project is to complete the testing of these vehicles and complete the preparation required to place these vehicles with clients.
2 **The development of charging infrastructure across the province:** The roll-out of charging infrastructure across the province in collaboration with the Department of Transport and Public Works and other departments.
3 **Partnership with OEMs and realignment of the procurement policies contract:** The challenge of availability of suitable electric vehicles in the current procurement policy is currently a major constraint that needs to be resolved.
4 **Testing of locally manufactured electric vehicles:** Various locally manufactured vehicles are available, which could provide the basis for developing an electric vehicle industry in the Western Cape. This project focuses on testing these vehicles to determine the future potential.
5 **Complete pilot conversion projects:** Vehicle conversion for special applications offers another opportunity to establish a local industry. This project endeavours to complete the first research and development.
6 **Feasibility testing of battery recycling and repurposing:** Battery recycling is a key priority for avoiding potential harmful effects on the environment at the end of the battery life cycle. This project focuses on exploring opportunities for either extending the life of the battery or recycling the battery for the manufacturing of new batteries.
7 **The development of a technology platform for managing the connected electric vehicle:** The connected electric vehicle offers significant opportunity for innovation and improvement of various travel and vehicle use aspects. This project focuses on the development of the technology platform for achieving that.

The following section outlines these projects in more detail.

5.7. Research and Development Projects

5.7.1. Project 1: Testing and Deployment of BMWi3 Electric Vehicles

GMT has procured an initial fleet of five electric vehicles (BMW i3s) for initial testing and subsequent deployment to clients. Testing of these vehicles has already commenced. The detail related to this project is outlined in Table 11.

Table 11: Scope of testing of electric vehicles

Initiative	BMW i3 Testing Scope
Challenge to be addressed	· Inadequate knowledge of electric vehicles. · Fleet management requirements of electric vehicles not defined. · User experience of electric vehicles not defined. · Vehicle specifications not tested. · Client acceptance criteria not defined.
Opportunity	· Develop thought leadership through testing of electric vehicles. · Define approach towards achieving good user experience. · Define fleet management requirements. · Enable GMT systems for management of electric vehicles.
Scope of the project	· Inadequate testing of electric vehicles. · Lack of driver experience with electric vehicles. · Vehicle specification not being verified. · Vehicle range to be confirmed under different conditions. · User experience to be defined. · Driver training requirements to be defined. · Fleet management requirements to be defined. · Vehicle repair and maintenance requirement to be defined. · Client perception of electric vehicles to be defined. · Financial modelling of electric vehicles to be defined. · Client pricing approach to electric vehicles to be defined. · Client placement requirements to be defined.
Deliverables of the project	· Thought leadership with managing electric vehicles. · Effective management of client acceptance of electric vehicles. · Mitigation of risks related to fleet management of electric vehicles.
Challenges	· Limited availability of different electric vehicles. · Overcoming the challenges related to a new vehicle concept.
Recommended approach	· Ensure application of international best practices during testing. · A phased approach will be followed: o Phase 1 Internal Testing o Phase 2 Client Testing o Phase 3 Client Placement · Ensure collection of adequate volumes of test data. · Collaboration with client departments during testing.
Targeted strategic outcomes	· Driver acceptance of electric vehicles. · Client placement of electric vehicles. · Overcoming initial perceived barriers to electric vehicle adoption. · Development of thought leadership for managing electric vehicles.

The next project focuses on the establishment of the first phase of vehicle charging points.

5.7.2. Project 2: Planning and Roll-out of a Network of Charge Points

A critical component of the Electric Vehicle Ecosystem required for the Western Cape is an effective and efficient system of public electric vehicle charging points, located at strategic points along key transport routes and nodes. This project establishes the basis for expanding such a network.

5.7.2.1. Types of Charge Points

The most simplistic and least cost charge point is a normal 15Amp/230V wall plug that is standard in buildings and homes all over South Africa. This could provide charging to the battery using the charger built into the electric car. It is anticipated that most charging will be done at home or work, however, this is to be confirmed. Various types of charge points are available (Figure 36).

These vary in terms of cost and speed of charge. The AC charge points are rated from 3.3kW single phase up to 22kW three-phase units. DC chargers deliver energy direct to the battery and charge faster. These are rated from 50kW upwards. Current research confirms that fast chargers rated 350kW, which can charge a relatively large electric vehicle battery in less than 30 minutes, are entering the market. It should be noted that the rate of charge is dependent on the battery size and the management system of the vehicle.

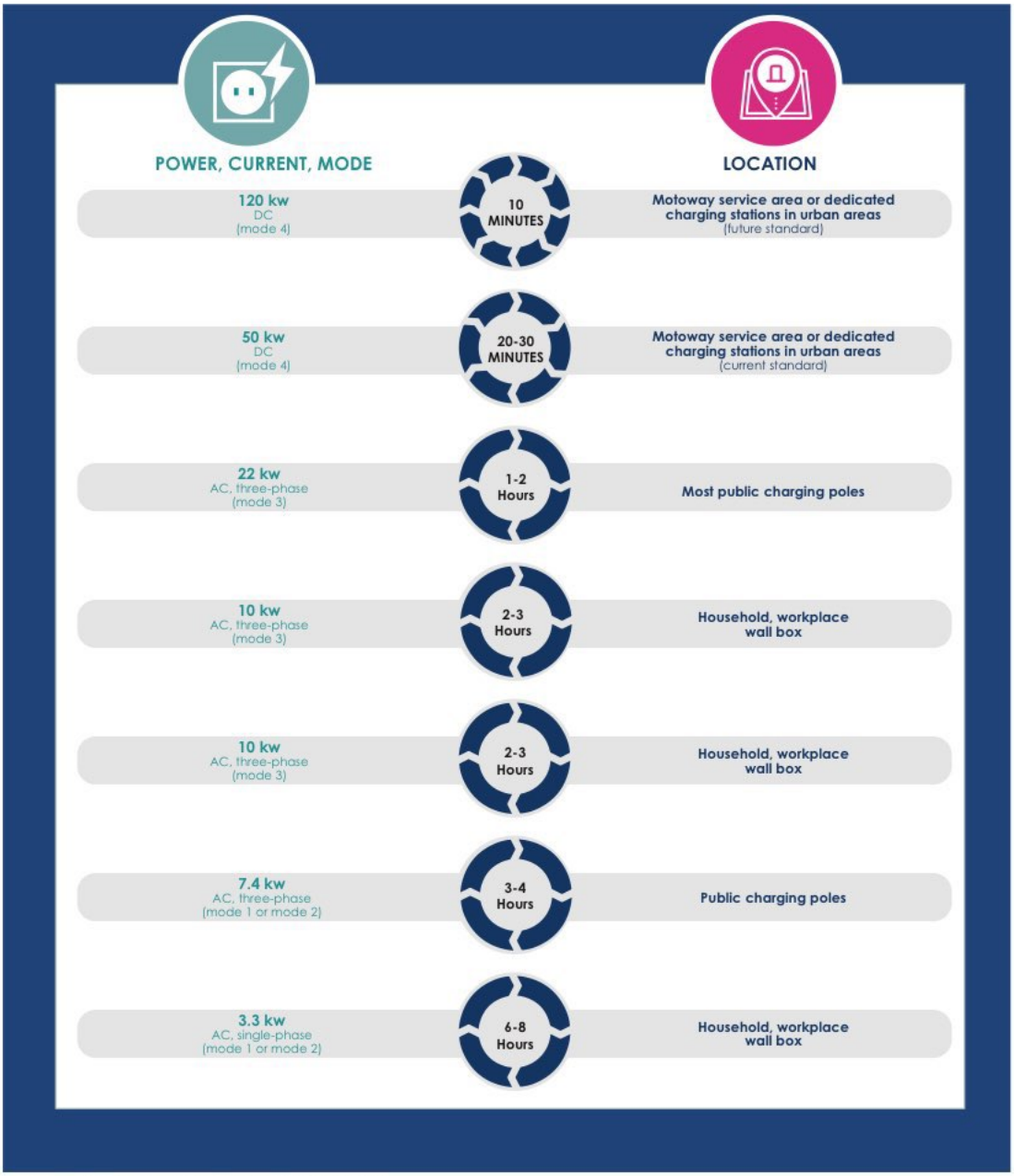


Figure 36: Charge points to choose from

5.7.2.2. Charge Point Placement

The transition to electric vehicles is fundamentally dependent on adequate vehicle charging points conveniently available. A possible methodology to determine the ideal location of vehicle charging points, is based on the analyses on the current travel patterns of GMT clients. Considering the March 2021 location data, using a conservative range average for the BMW i3 and similar electric vehicles of 220km, it was found that almost 99% of the vehicles in GMT's fleet will meet the daily range requirements of clients should the range of the vehicle be 220km. This means that only a single charge would be required per day for a vehicle with about the same range to sufficiently complete all its daily trips.

To identify good candidate charging locations, it is important to understand where vehicles are parked. Figure 37 indicates the switch-off locations with purple dots, and the heatmaps of Figures 37 and 38 indicate where vehicles cluster for the longest periods.

Figures 37 and 38: Locating potential charging points

This type of analysis may provide insight as to where good potential locations are for charge points based on client travelling patterns and which charge point types should be used based on the average time vehicles are stationary and the number of vehicles per cluster to sufficiently charge vehicles cost effectively.

5.7.2.3. Phased Approach Towards Establishing a Charging Network

Similar analysis of travel patterns will be completed to provide the basis for planning the extended rollout of the charging grid across the complete province. The approach for the next phase of rollout will be based on combining two objectives, firstly a minimum viable network across the complete province to enable electric vehicles to be driven to any place in the province. With a minimum viable network in place, the objective would be to increase the density of the network in a phased manner to improve the convenience of charging.

5.7.2.4 Renewable Energy for the Vehicle Charging Grid

The use of renewable energy as a main source for charging electric vehicles is a key objective. Tests using solar energy for vehicle charging are already complete and provide the basis for expanding the approach towards the establishment of the broader charging network. The rollout of renewable energy sources will be planned in close collaboration with the DTPW and other institutions.

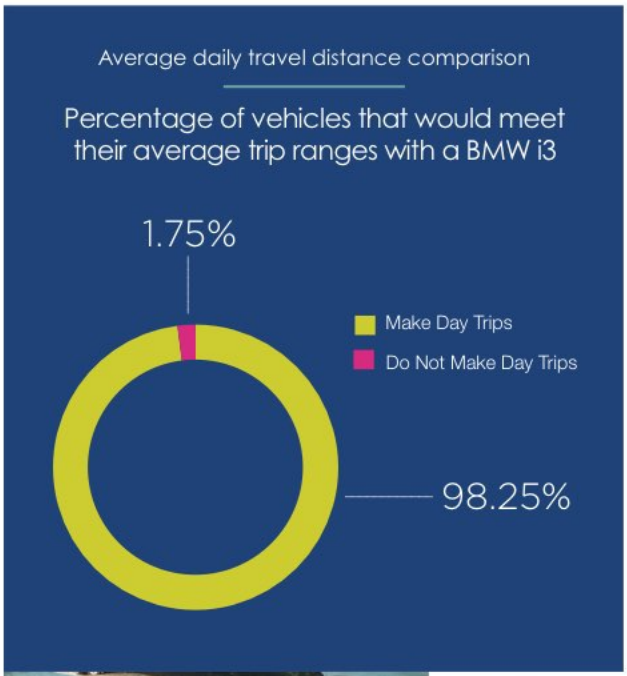


Figure 39: Solar powered charge point at the IDC

5.7.2.5. Project Summary

The accelerated market penetration and unconstrained operation of electric vehicles require an available infrastructure for the convenient charging of their batteries. Wherever the car parks, a connection to energy should be possible. In Table 12, a summarised approach is suggested.

Table 12 Summary of the Electric Vehicle Charging Grid Project

Initiative	Plan and Roll-out Electric Vehicle Battery Charging Infrastructure
Challenge to be resolved	· Lack of widespread charge point infrastructure.
Opportunity	· A first phase of expanding the current network could focus on concentrated areas and provide coverage for a significant number of electric vehicles without complete coverage of the province. · Collaboration with existing charging point providers. · Establishment of a provincial network of charging stations.
Scope of the project	· Develop a phased approach towards rolling out charging points. · Phase 1 would focus on GMT trips within the vehicle range. · Specific government buildings will be the first focus. · Subsequent phases will focus on extending the network of charging points.
Challenges	· Funding of charging points during early adoption phases. · Availability of land for setting up charging points. · Collaboration with private owners of land and charging points. · Availability of solar energy for charging. · Lack of agreed standards for electric vehicle charging points.
Project deliverables	· Availability of adequate charging points across the province. · Agreed minimum standards for the establishment of vehicle charging. · Seamless integration between government and public charging points.
Recommended approach	· A phased approach to be followed based on vehicle concentration. · Collaboration between government and private owners required. · Rollout to be based on minimum standards. · Seamless integration across public and private charging points required.
Potential strategic outcomes	· Charging of electric vehicle is accessible and convenient. · Provincial coverage is provided. · Seamless integration across public and private charging points.

5.7.3. Project 3: Partnership with OEMs and Policy Re-alignment

GMTs current vehicle procurement policy is primarily derived from National Treasury's transversal vehicle procurement contract, which is restrictive in respect of electric vehicle model availability. In order to effectively implement GMT's Electric Vehicle Strategy, the vehicle procurement policy will have to be realigned.

Table 13: Summary of the OEM partnership and procurement policy realignment project

Initiative	Policies Contract
Problem to be resolved	· No suitable electric vehicles are now available on the policies contract.
Opportunity	· Short-term opportunity: Vehicle procurement policy aligned with passenger vehicle opportunities. · Medium-term opportunity: Re-alignment of vehicle policy for the procurement of electric vehicles nationally.
Challenges	· Special permission required for short-term waiver. Medium-term challenge is the alignment of different fleet companies nationally with National Treasury.
Recommended approach	· Apply for short-term waiver while commencing with medium-term realignment of policies contract.
Potential strategic outcomes	· Policies contract becomes an enabler for national rollout of electric vehicles across all provincial fleet companies.

The realignment of GMTs vehicle procurement policy will be directed at providing access to a broader range of electric vehicles suitable to both GMT and its client institutions' specific requirements.

5.7.4. Project 4: Locally Manufactured Electric Vehicles

5.7.4.1. Strategic Context

The strategic context to this project is the achievement of the broader socio-economic benefits. The establishment of an electric vehicle industry in the Western Cape for the purpose of economic growth, job creation, and other socio-economic objectives is potentially limited to specific segments of electric vehicles.

Testing of electric vehicles that may be suitable for use in GMT and the broader Western Cape Government is thus of strategic importance. This project focuses on the testing of vehicles that could become part of the roll-out planning.

5.7.4.2. Electric Vehicles for the transportation of people

The shuttle segment of the GMT fleet, as outlined in the segmental analysis in the previous section of the document, is the potential target application of the vehicles that are suggested for testing in this segment. Significant potential also exists outside GMT for the application of these vehicles in the broader Western Cape Government. The following vehicles are suggested for testing:

Shuttle Vehicles

The electric vehicles displayed are locally developed products, which could provide transportation services to commuters from public transport end points to places of work and back. This could also be implemented as a shuttle service within GMT to transport clients between office buildings and vehicle parks. These electric vehicles could also be used for delivery of small parcels and other goods. An opportunity for establishing such a service for GMT clients is currently being investigated.

The golf cart type shuttle is also a locally manufactured vehicle that could be used for the same kind of application, but with a larger carrying capacity. These are ideally suited for small town, campus, or inner-city operation. The "hospitality shuttle" can carry passengers and has sufficient volume for luggage.

A further potential vehicle for testing is a 22-seat taxi or shuttle bus for local markets. Testing these vehicles for potential use within GMT could provide valuable experience and thought leadership, which could also be rolled out externally as similar applications. The testing data gathered will be used to perform feasibility studies to make decisions regarding further use of these vehicles.

Buses

A further opportunity is the testing of a locally manufactured bus. It has seating capacity for

65 people and could be deployed in a number of applications within GMT. Significant opportunity also exists for the deployment of this vehicle outside GMT in public transport across the Western Cape province.

5.7.4.3. Project Summary

The project is summarised in Table 14. In this market segment, opportunities exist to find a local better fit-for-purpose vehicle for the need or specific task that the vehicle is to be used. For example, short-distance passenger transport, small parcel delivery and public transport.

Table 14 Summary of Project for Testing Locally Manufactured Vehicles

Initiative	Testing of Locally Manufactured Electric Vehicles
Challenge to be resolved	· Availability of electric vehicles in a more specialised vehicle segment. · Opportunities for the development of a local electric vehicle industry.
Opportunity	· The establishment of a local electric vehicle industry. · Developing thought leadership through testing of locally manufactured vehicles.
Scope of the project	· Complete the testing of selected locally manufactured electric vehicles. · Develop thought leadership through testing of local electric vehicles.
Project deliverables	· Develop a testing programme for selected locally manufactured vehicles. · Complete testing of the selected electric vehicles. · Capture the learnings and outcomes of the testing. · Document the potential thought leadership. · Complete financial modelling for the for use of vehicles in GMT. · Include aspects of broader application in vehicle testing.
Challenges	· Testing agreement to be aligned with procurement policies. · Vehicle availability for the period of testing.
Recommended approach	· Alignment of testing agreements with broader procurement policies. · Collaboration with the DTPW executive for alignment on procurement approach.
Potential strategic outcomes	· Locally manufactured vehicles identified that could be procured. · Broader application of locally manufactured vehicles. · The establishment of a local industry for specific electric vehicles.

Various locally developed electric options can be tested in this segment. Not only will this initiative support local socio-economic development, it will also reduce operational costs that could result on lower fares for commuters.

5.7.5. Conversion of Existing Vehicles

5.7.5.1. Contextual Background

The analysis of the GMT vehicle segments identified converted vehicles as a special segment, which could offer the potential to support the development of a local electric vehicle industry. Vehicle conversions is an ideal opportunity to contribute towards the establishment of an electric vehicle industry in the Western Cape.

5.7.5.2. Current Fleet to be Converted

GMT's fleet has a number of vehicles due for replacement and among these are specialised technical vehicles, such as ambulances and shuttle buses. These vehicles are ideal candidates for electrification due to their robust chassis. These electric vehicle conversions could include:

- a technical back-up vehicle
- a back-up battery recharging vehicle
- a clinic for remote medical services
- a mobile office powered through renewable energy.

In addition, the conversion to electrification offers the opportunity to re-purpose and extend the useful life of these vehicles, with OEMs' potential initial focus being on passenger vehicles, vehicle conversions will be an essential part of electrification due to special purpose electric vehicles not being available in the early phases of OEM roll-out.

5.7.5.3. Project Summary

Table 15 Summary of Vehicle Conversion Project

Initiative	Vehicle Conversion
Challenge to be resolved	· Existing vehicle conversion to be aligned with the roll-out of electric vehicles. · Lack of experience with the conversion of existing vehicles to electric vehicles. · Availability of vehicle converters with experience in conversion of electric vehicles.
Opportunity	· The development of vehicle conversion capabilities in industry. · Gaining experience with electric vehicle conversions. · Developing thought leadership in electric vehicle conversion. · Contributing towards the creation of an electric vehicle industry in the Western Cape.
Scope of the project	· Convert selected vehicles in GMT to electric vehicles. · Gain experience in working with vehicle converters for converting existing vehicles to electric vehicles. · Develop thought leadership that could contribute towards the establishment of a vehicle conversion industry in the Western Cape.
Project deliverables	· Complete technical design documentation for the vehicle conversion. · Develop a testing plan for testing of the converted vehicle. · Complete costing and financials for the vehicle conversion. · Apply procurement policy in contacting a vehicle converter. · Complete the conversion of the vehicles. · Complete the testing programme for the converted vehicles.
Challenges	· Application of procurement policies. · Finding vehicle converters with relevant capabilities.
Recommended approach	· Complete the research to find potential vehicle converters. · Limit the scale of the project to retain the risk profile within allowable norms. · Focus on the development and completion of detailed technical, design and financial documentation. · Align procurement approach with Departmental Policies.
Potential strategic outcomes	· Successful vehicle conversions completed. · Thought leadership in vehicle conversion developed. · The development of local service providers for vehicle conversions. · Contributing towards the establishment of an electric vehicle industry in the Western Cape.

In addition to electrifying a key component of the GMT fleet, this project lays the foundation for the establishment of a Specialist Electric Vehicle Conversion industry in the Western Cape, with resultant job creation and socio-economic benefits.

5.7.6. Repurposing and Recycling of Used Electric Vehicle Batteries

5.7.6.1. Contextual Background

One of the key drivers in the research and development of electric vehicles is to ensure that the electric vehicle life cycle is managed end-to-end from an environmental impact. The objective is to ensure that all stages of the vehicle life cycle are optimised to ensure recovery of vehicle batteries at the end of the battery's usable life in the vehicle. The opportunities for ensuring full recovery of all materials from electric vehicle batteries at the end of its life cycle can be categorized into:

- Recycling of vehicle batteries by extracting the materials and minerals and utilizing these materials for the manufacturing of new vehicle batteries.
- The second category is the repurposing of electric vehicle batteries for alternative purposes, thereby generating a new life for the battery in a different application.

Figure 40 indicates the pathways the battery of an electric vehicle follows from the car to repurposing to being recycled and included in the process of manufacturing new batteries.

Both these activities offer potentially significant opportunities for the Western Cape from a broader socio-economic perspective. Potential research and development projects for this purpose are discussed in more detail in the next section.

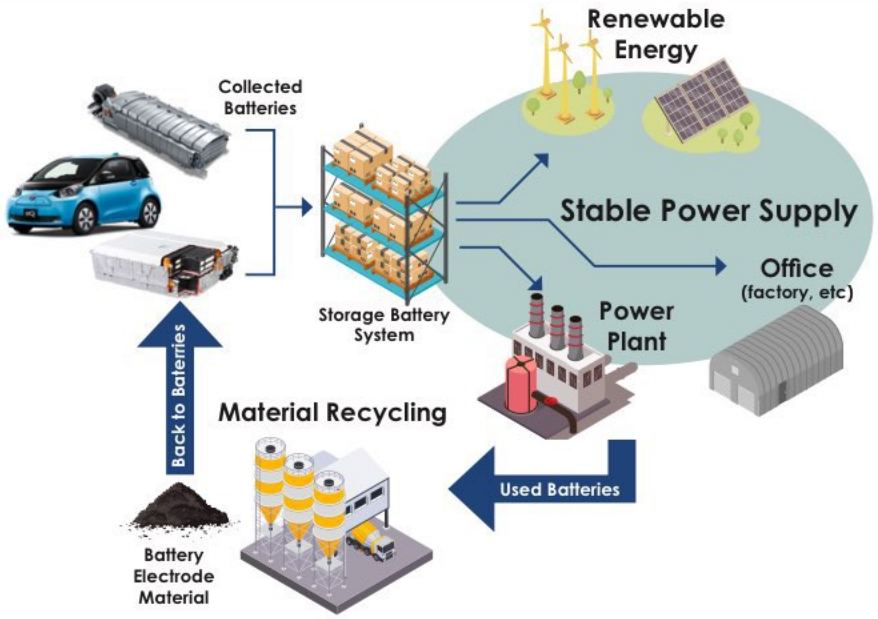


Figure 40: The repurposing and recycling of electric vehicle batteries

5.7.6.2. Battery Recycling

Major investments are made by various vehicle OEMs globally for the establishment of electric vehicle battery recycling. The objective is to manage the electric vehicle battery in a circular economy, as outlined in Figure 41.

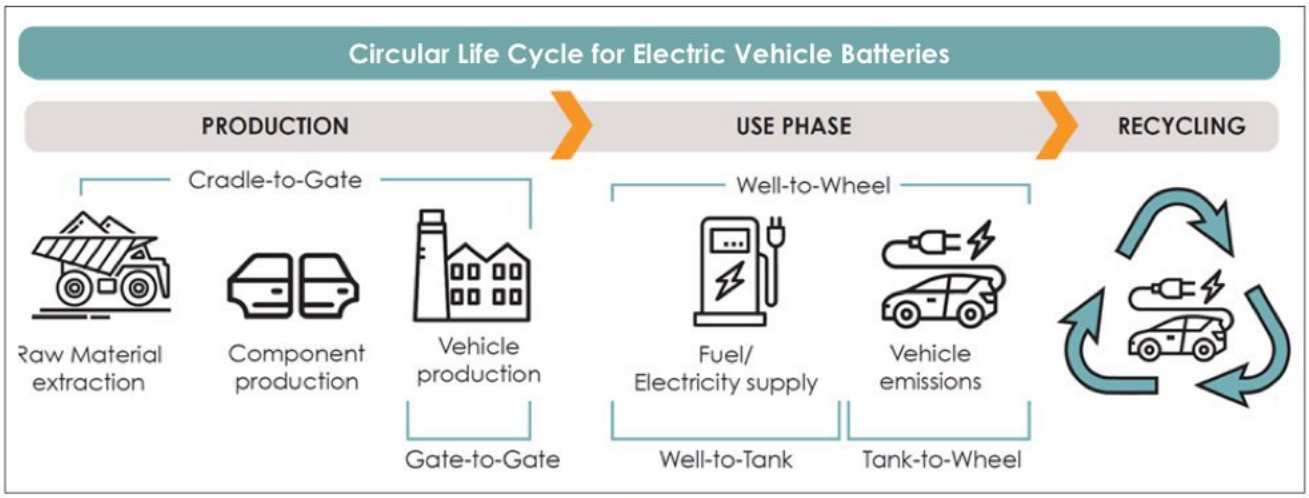


Figure 41: Circular economy life cycle management of electric vehicle batteries

Current lead acid car batteries can almost be recycled completely. Battery manufacturers are legally obliged to buy back old batteries. The money value of the lead makes the process sustainable. The lead is then recycled into the manufacturing of new batteries. The same would apply to lithium batteries. Currently, various initiatives are being set up to recycle lithium batteries and harvest them for the minerals to be used in the manufacture of new lithium batteries. It seems this also makes good business sense for the purpose of re-manufacturing, recycled materials are as good as virgin materials and they are cheaper. The opportunity exists for the Western Cape to take leadership in the development of a battery recycling and cell manufacturing industry.

A key project for research and develop is thus the feasibility testing of establishing such a facility in the Western Cape.

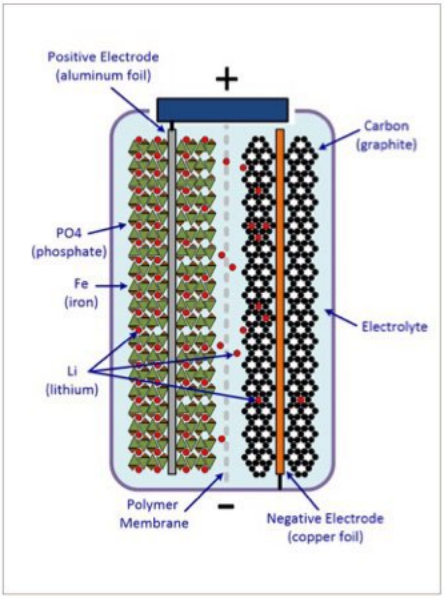


Figure 42: Lithium iron phosphate battery

5.7.6.3. Battery Repurposing

It is assumed and expected that when the batteries of electric vehicles have lost 20% of capacity, meaning 20% of their original range, the driver would feel the need to replace the battery with a new one with full range, or trade in the vehicle for a new one. This could be after 8 to 10 years for most electric vehicles. The battery however, still has 80% capacity and can thus be repurposed in various ways. Some of the alternatives are:

- As big energy storage systems to stabilise electricity supply, quality of supply, and to bridge outages during peak power demand.
- To accumulate and store energy produced from renewable sources such as wind and sun.
- As emergency power to rescue stranded electric vehicles requiring an emergency top-up.
- As energy storage to power small homes, critical medical equipment, or buildings off the grid.

Figure 43: A typical electric vehicle battery pack

Figure 44: Electric vehicle batteries repackaged for use at a utility

5.7.6.4. Project Summary

Table 16 Project Summary for Electric Vehicle Battery Recycling and Repurposing

Initiative	Battery Repurposing and Recycling
Challenge to be resolved	· Used electric vehicle batteries still have 80% capacity and high value. · End-of-life batteries contain valuable components and minerals. · End-to-end management of electric vehicle batteries require recycling or repurposing.
Opportunity	· Batteries repurposed locally and not exported back to countries of origin are profitable, more sustainable, and will lead to new industrial development. · The Western Cape has the expertise and capability to invest in a project of this nature. · This potentially offers a significant opportunity for economic growth and job creation.
Project scope	· Complete research and development project to test the feasibility of the creation of a battery recycling facility in the Western Cape. · Complete research and development project to test the feasibility of battery repurposing into other forms of economic enablement.
Project deliverables	· Completed research and development project for the creation of a battery recycling facility in the Western Cape. · Completed research and development project for the repurposing of electric vehicle batteries in the Western Cape.
Challenges	· These projects will be Green Fields projects in South Africa. · Funding the projects might be challenging.
Recommended approach	· Collaborate with OEMs with access to global expertise. · Approach various global funding organisations for funding if required.
Potential strategic outcomes	· Economic growth and job creation in the Western Cape. · The development of thought leadership. · Broad-based socio-economic enablement.

5.7.7. Technology Management Platform and the Connected Electric Vehicle

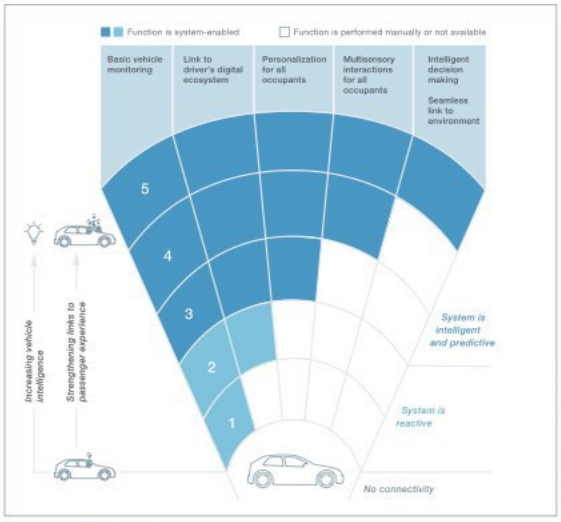
5.7.7.1. Contextual Background

The automotive industry and the future of mobility are going through fundamental changes, which is changing not only the core value proposition for the customer, but also the business model and core capabilities of the manufacturer. What is emerging is a new electric vehicle ecosystem driven by the connected car. Connected cars provide a unique customer experience while simultaneously delivering cost and revenue benefits to mobility companies, including OEMs, suppliers, dealers, insurers, fleets, tech players, and beyond (McKinsey).

The Connect Car Experience Framework outlined in Figure 45 provides some practical indicators of the potential benefits from the connected car. Five levels of connectivity are defined, ranging from basic vehicle monitoring to intelligent decision-making, with seamless connectivity to the environment. Global consumer surveys already indicate that customer choice in future will be driven by new benefits and value created through the connected on-board system.

The connected electric vehicle will not only have a profound impact on the customer experience, but will also impact the total automotive industry and related service industries such as vehicle finance, insurance, and the fuel industry. A completely new electric vehicle ecosystem is emerging. From the illustration of the new Vehicle Ecosystem provided in Figure 46, the scope of the new emerging business model is outlined.

The extended ecosystem will impact the commercial aspects of the industry and create the basis for innovation and improvement in traffic and road safety management. All aspects related to travel and mobility will be impacted and offers an opportunity for innovation.



SOURCE: MCKINSEY

Figure 45: The Connect Car Experience Framework

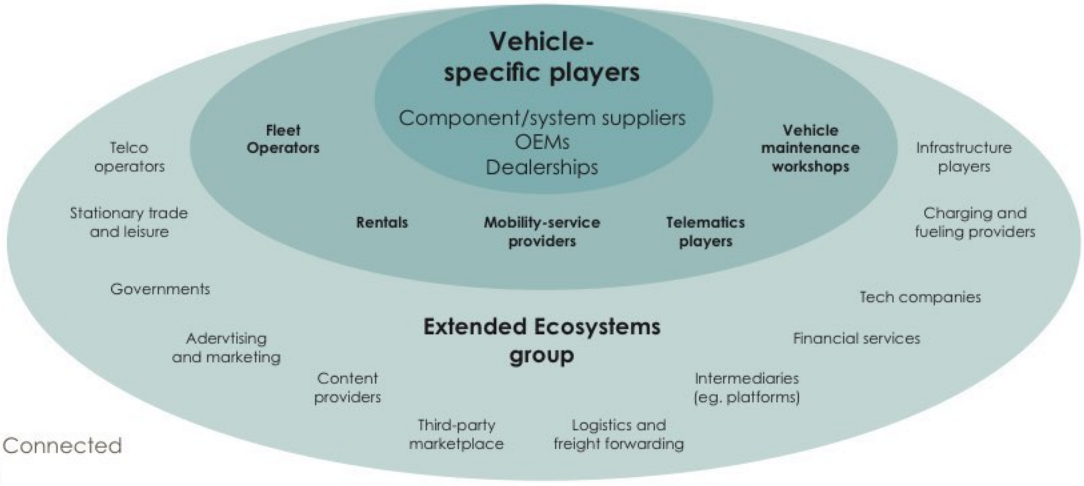


Figure 46: The new Connected Vehicle Ecosystem (Source: McKinsey)

5.7.7.2. The Development of a Technology Platform for the Connected Electric Vehicle

The focus of this project is to design and develop a new technology platform for managing the Connected Electric Vehicle. The envisaged platform will consist of three major building blocks as outlined in Figure 47.

Figure 47: The technology platform for managing the new Connected Electric Vehicle

The envisaged building blocks are:

- A mobile platform that will redefine the user and driver experience by leveraging the advanced on-board capability and connectivity. The objective is to provide a complete experience to the driver from driving assistance to a seamless interface with all GMT fleet management processes.
- An improved and expanded GMT Command Centre that would provide monitoring and assistance to drivers through being constantly connected to all electric vehicles. The objective is to provide real-time driver assistance to reduce concerns related to the conversion to electric vehicles, such as what vehicle range is left and access to the nearest charging point.
- A redeveloped fleet management system that will innovate based on vehicles being constantly connected, and provide for the unique requirements of managing electric vehicles.

5.7.7.3. Project Summary

Table 17 Summary of Technology Development Project

Initiative	The Development of New Technology Management Platform for Managing Connected Electric Vehicles
Challenge to be resolved	· Unique requirements for managing a fleet of electric vehicles to be defined. · Opportunities for real interfacing with electric vehicles to be defined. · Fleet management requirements of electric vehicles to be defined. · Technology platform to be developed for managing electric vehicles. · A mobile platform for real-time interfacing with drivers to be developed.
Opportunity	· Improve the value proposition for drivers. · Increase the safety of drivers through real-time connectivity. · Automation of the process of vehicle condition monitoring. · Assisting drivers of electric vehicles with vehicle range and charging. · Improvement of fleet management capability to reduce operating cost.
Project scope	· Development of new driver experience and value proposition. · Definition of business requirements. · Integration with the vehicle charging grid. · Evaluation of technology alternatives and options. · Design of a new technology platform. · Development of a new technology management platform.
Project deliverables	· A seamless real-time mobile interface with all drivers of electric vehicles. · A command centre for real-time driver assistance. · A fleet management platform for managing electric vehicles.
Challenges	· Access and connectivity to the data from the connected vehicle. · Fragmentation of various service providers across the Eco-System.
Recommended approach	· Close collaboration with the OEMs to develop the technology platform. · Partnerships with leading technology providers. · Adequate time and resources allocated for research and development.
Potential strategic outcomes	· Real-time connectivity to the Connected Electric Vehicle. · Seamless real-time interface with drivers to create a new experience. · Improved safety and efficiency from electric vehicles.

5.8. Marketing and Public Awareness

5.8.1. Marketing Communication

The intention of GMT to transition from internal combustion engine vehicles to electric vehicles is an initiative that will impact the business of several stakeholders and current industry players. This, then, should be communicated and positioned in a way that allows stakeholders to plan, position, and get ready for this transition. In this way, better buy-in and collaboration could be achieved with less resistance to the changes to come.

5.8.1.1. Marketing Plan

The marketing of GMT's Electric Vehicle Strategy would comprise the following aspects:

- Completing a stakeholder analysis to provide the basis for the development of a marketing communication programme.
- Focusing alternative marketing communication options on specific segments.
- Creating awareness of electric vehicles, for example, an electric vehicle Fleet Electrification Award.
- Using Electric Vehicle Ambassadors across all segments to encourage adoption.
- Positioning electric vehicles as a broader mechanism for achieving the MTP of GMT to gain thought leadership.
- Economic empowerment would be a central theme of the marketing campaign.

The planning and implementation of the Marketing Plan will be done in conjunction with the communications team at the Department of Transport and Public Works (DTPW).

5.8.1.2. Communication Mechanisms

The communication mechanisms to be utilised to address various customer segments are detailed in Figure 48.

Customer Segment	Communication Mechanisms					
	Vehicle Branding	Branding Charging Points	Electric Vehicle Launch	Event (Road trips)	Social Media	Education & Training
Internal GMT Staff	✓	✓			✓	✓
Drivers	✓	✓			✓	✓
Staff	✓	✓			✓	✓
Transport Officers	✓	✓	✓	✓	✓	✓
Middle Management	✓	✓	✓	✓	✓	✓
Other institutions	✓		✓	✓		
Policy makers & Ministers	✓		✓	✓		
Partners	✓		✓			
Service Providers	✓					
Motorists	✓			✓	✓	
Senior Officials	✓		✓	✓	✓	
Cabinet	✓		✓	✓		
Premier	✓		✓	✓		
Ministers	✓		✓	✓		

Figure 48: Customer segments and communication mechanisms

5.8.2. Stakeholder Engagement

Engagement with stakeholders will be based on the following factors:

- We are currently developing new initiatives that stakeholders may be unaware of. Upon approval, we need to present the strategy to stakeholders and get their feedback.
- Completing a stakeholder analysis to provide the basis for the development of a marketing communication programme.
- Defining and deciding on the message to each stakeholder group.

- We need to develop promotional events involving the public.
- Position electric vehicles as a broader mechanism for achieving the MTP of GMT to gain thought leadership.
- Economic empowerment would be a central theme of the marketing campaign.
- Sponsors and investment partners must be identified for the initiatives we would like to undertake.

The planning and implementation of the stakeholder engagement will be done in conjunction with GMT and DTPW's Management.

5.8.3. Potential Stakeholders

The following is a list of potential stakeholders identified for engagement. Engagement will commence upon approval by GMT and DTPW's Executive Management.

1	**International:** CEM Electric Vehicle City Pilots Project
2	**National, Provincial and Local Government:** • WCG Departments • Department of Science and Technology (DST) • Department of Trade, Industry & Competition (DTIC) • Department of Transport & Public Works (DTPW) • City of Cape Town • City of George
3	**SOEs, NGOs:** • CSIR • SANEDI • Green Cape
4	**Industry:** NAAMSA
5	**Educational Institute Engagement:** • UCT • UWC • US • CPUT

5.8.4. Client and Public Awareness

5.8.4.1. Planned Events and Promotion Initiatives

Custom electric vehicles such as game viewing vehicles for Cape Nature could be considered. Local and international tourists to gain awareness.

Formula E is coming to Cape Town in February 2022, preceded by a week-long E Festival. This is a great opportunity to showcase GMT 's electric vehicle Strategy, Leadership, electric vehicles and related projects and to create practical e-solutions around this event.

Electric converted vehicles can provide coffee and other services at events to promote green behaviour and empower socio-economic development

The idea is to create synergy between electric vehicles and socio-economic development

National and international marketing awareness can be created through branding vehicles and doing trips to the Eastern Cape (Transport month) and within the Western Cape. These trips would be modelled on the "Long Way Up" electric motor-cycle series and the Solar car challenge.

First-and-last mile electric vehicles and electric shuttles can transport people at events, in densely populated areas such as city centers and in rural communities.

Electric Vehicle Marketing Campaign

We will create an awareness campaign that speaks to the vision of the EV Strategy. The 360° campaign will use various channels (digital and print), which will target our different stakeholders, including internal stakeholders. The campaign aims to educate as well as drive individuals, departments and sectors to 'go green' and start using our electric vehicles and purchase their own.

The campaign will kick-start at the GMT EV Launch envisaged to happen during 2021.

GMT aims to form various partnerships with media and events companies and use these partnerships to bolster our campaign. GMT is currently engaging with FIA Formula E and EV Festival, which is due to take place in Cape Town next year.

Mobile messages

WhatsApp messages to staff and clients

Posters

Posters for internal messaging at offices in government buildings

Vehicle mirror tags

Mirror tags that are placed in all vehicles before pick up

360° Campaign

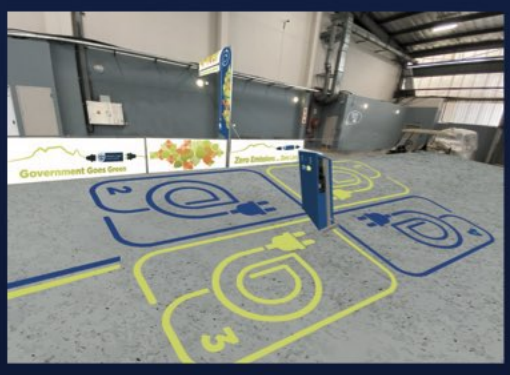
Draft concepts

Emailers to communicate updates to staff and clients

Emailers

Charging stations

Brand the charging stations with campaign messaging



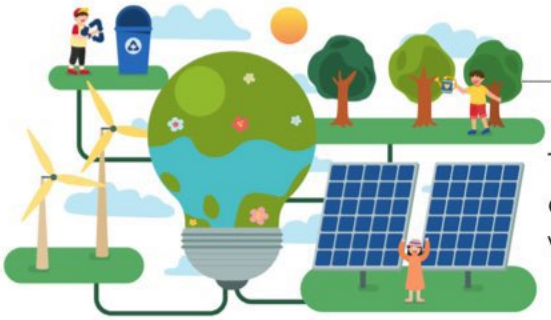
Email signatures

Include campaign on internal email signatures

5.8.4.2. Planned Social and Educational Investment

Electric vehicles can be used as mobile education centers in the Western Cape and South Africa. **- Knowledge Base**

This initiative could also stimulate entrepreneurship and career development. – **Lego EVs**



The role of electric vehicles and the impact on the world can be taught.

Children can be educated on energy saving and the impact of CO_2 on personal health and the environment.

This may also result in a more environmentally educated future generation that would act with purpose.

Electric vehicles and making a change in the world may seem more achievable for children with a lack of access to information.

5.9 Financial Modelling

5.9.1. An Electric Vehicle Suited to GMT's Broad Fleet Requirement

Sourcing electric vehicles best suited to GMT's requirements, especially in the passenger vehicle segment, is critical to the broader electrification of GMT's fleet. Currently, none of the limited range of electric vehicle models available in South Africa are an ideal match for GMT's broader passenger vehicle fleet requirements. This is because the models available are targeted at the luxury segment of the vehicle market. However, this is anticipated to change in line with global trends due to the declining cost of electric vehicles because of advances in battery technology and improved economies of scale.

It is projected that electric vehicles will be cheaper than equivalent ICE vehicles in Europe well before the end of this decade, as detailed in Figure 49. This trend should also hold true for South Africa, however, the timeframe and magnitude are more difficult to predict.

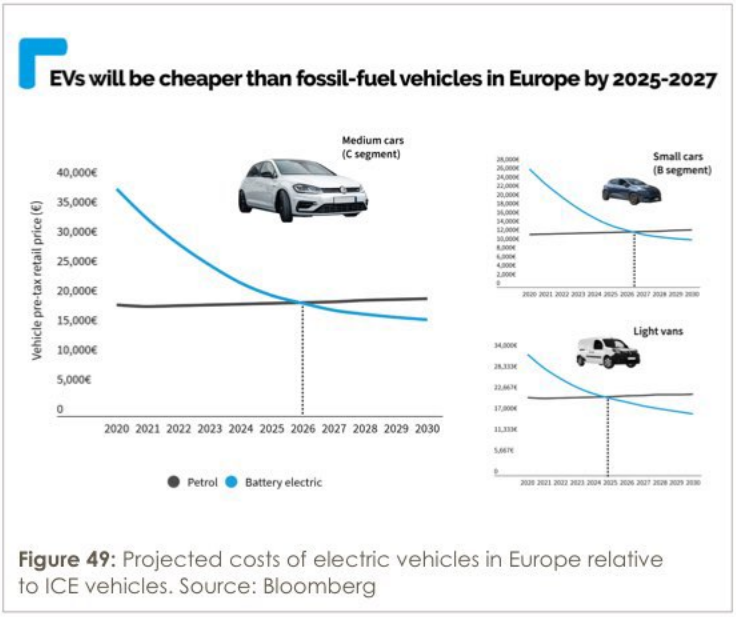


Figure 49: Projected costs of electric vehicles in Europe relative to ICE vehicles. Source: Bloomberg

5.9.2 The Significance of the VW Polo in the GMT Fleet

Passenger vehicles are by far the largest segment of the GMT fleet, comprising 65% of the total. The VW Polo is the largest component of the passenger vehicle segment and combined, the VW Polo Vivo and the VW Polo comprise 65% of the GMT passenger vehicle fleet and 46% of the total GMT fleet.

5.9.3. Modelling an Electric Vehicle More Closely Matched to GMT's Requirements

Given this scenario, we have elected to model the comparison of an assumed equivalent electric vehicle to the current VW Polo Sedan 1.4, which is the most common specific model in GMT's fleet. The operating costs of the assumed equivalent electric vehicle, both from an energy and maintenance perspective, were modelled on information obtained in respect of the BMW i3s currently in the GMT fleet. It should be noted that given the progress in battery technology and it being a smaller vehicle, this assumed electric vehicle would be more efficient than the BMW i3.

5.9.4. Vehicle Life Cycle Cost

In determining the cost comparison, the Vehicle Life Cycle Cost (VLCC) has been utilised, which is defined as the cost of procuring, operating, disposing, and replacement of a vehicle over its planned economic life cycle. The cost of replacing the vehicle has been factored, as the subsequent replacement of vehicles is fundamental to the sustainability of GMT's

business model. For the purposes of this modelling, the VLCC comparison was done utilising a five-year economic life cycle for both electric vehicle and ICE vehicles, notwithstanding that the electric vehicle should potentially have a longer functional lifespan, due to the inherent durability of its electric drivetrain versus that of an ICE vehicle. The five-year life cycle is consistent with GMT's existing policy for passenger vehicles.

5.9.5. Modelling Parameters

The VLCC comparison was determined utilising an equivalent electric vehicle with a price:

- equal to the VW Polo
- 10% more than the VW Polo
- 20% more than the VW Polo
- 30% more than the VW Polo.

These assumptions are deemed to be conservative, given the consensus opinion that electric vehicle prices will be lower than that of equivalent ICE vehicles.

5.9.6. Modelling Outcomes

The outcome of the VLCC comparison between the VW Polo and an equivalent electric vehicle is reflected in Table 18. In all four of the assumed pricing scenarios, the electric vehicle equivalent has a lower VLCC than that of the VW Polo, due to the electric vehicle's lower operating and maintenance costs over the planned economic life cycle.

The effect of this lower VLCC in respect of purchasing a tranche of vehicles consisting of 50, 100 or 200 units is depicted in Figure 50.

The savings range between a minimum of R9 million to a maximum of R29 million over the five-year planned life cycle, depending on the number of vehicles purchased and the equivalent electric vehicles price point relative to the VW Polo. It should be noted that this saving excludes the monetarised benefit of the reduction in vehicle emissions in the form of GHGs and particulates.

Table 18: VLCC comparison

Cost to procure, Operate, Dispose and Replace 1 vehicle	Assumed EV at 100% of VW Polo Pricing	Assumed EV at 110% of VW Polo Pricing	Assumed EV at 120% of VW Polo Pricing	Assumed EV at 130% of VW Polo Pricing	VW POLO 1,4 TRENDLINE (SEDAN)
VLCC over 5 years	R 342,097	R 374,568	R 407,039	R 439,510	R 484,837
% of VW POLO VLCC	71%	77%	84%	91%	100%

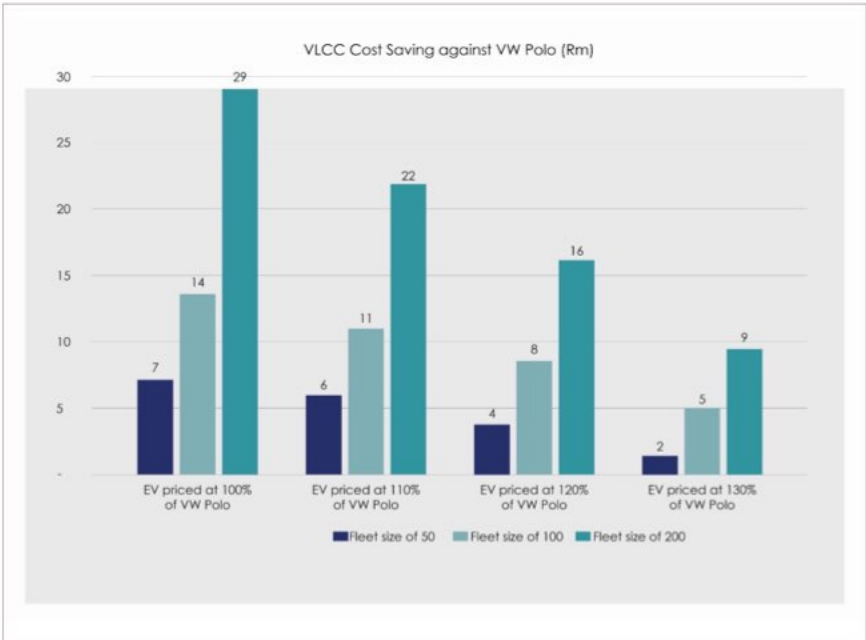


Figure 50: Savings on purchasing a tranche of electric vehicle equivalents at various price points

5.10. Implementation of the GMT Electric Vehicle Strategy

5.10.1. A Consolidated View of the Electric Vehicle Strategy

To provide context to the implementation plan, a consolidated view of the Electric Vehicle Strategy is provided in Figure 51.

Figure 51: Electric Vehicle Strategy: A consolidated view

In summary, the key building blocks of the Electric Vehicle Strategy are:

- **Leadership from the Western Cape Government:** The effective implementation of electric vehicles requires a broader focus on the socio-economic potential and how this could be used to achieve the strategic objectives and Vision-Inspired Goals of the Western Cape Government. To achieve these broader objectives would require leadership from the Western Cape Government and the collaboration of various departments.
- **Ecosystem creation:** The creation of an electric vehicle ecosystem is the key focus of this strategy. Successful adoption of electric vehicles could not be achieved without the broader ecosystem in place. The broader ecosystem also offers significant broader socio-economic benefits.
- **Vehicle procurement:** The alignment of vehicle procurement policies to enable the procurement of the broader spectrum of electric vehicles, including the creation of an extended industry, would require collaboration with relevant stakeholders to align the procurement policies and approach with achieving the strategic objectives.
- **Research and thought leadership:** The development of thought leadership and innovation through identified projects will be a key success requirement for achieving the strategic goals of this strategy.
- **Technology enablement:** The Connected Electric Vehicle offers the potential for redefining various aspects of mobility and vehicle usage. It also offers the potential for achieving broader benefits of improved safety and traffic management. The foundation for achieving these benefits will be provided through the creation of a technology platform that not only integrates the ecosystem, but also creates valuable insight from the data that becomes available.
- **Sustainability:** The implementation of the Electric Vehicle Strategy needs to be aligned with the broader provincial objectives for improved sustainability and the use of renewable energy. Ultimately, electric vehicles should also make a valuable contribution towards improving the carbon footprint of the province.

A number of strategic actions were identified in each of the building blocks, with specific strategic outcomes linked to each action. These strategic outcomes are intended to provide direction to the implementation of the Electric Vehicle Strategy.

5.10.2 Implementation: Pre-requisites for Success

The Electric Vehicle Strategy has the potential to add value to the Western Cape in various aspects and requires broad participation of different government institutions and industry. Given this potential, it is prudent to reflect on the pre-requisites for the successful implementation of the strategy. The following pre-requisites for success were identified and Table 19 provides the detail.

Table 19: Pre-requisites for implementation success

Electric Vehicle Strategy: Pre-requisites for Implementation Success	
Broader socio-economic focus	The Electric Vehicle Strategy could provide the basis for economic growth and job creation, impacting on the achievement of broader vision inspired goals in the province.
Strategic focus	The potential for long term industry creation requires a strategic focus on strategy implementation.
Creation of a complete ecosystem	The success of electric vehicles would require the establishment of a complete ecosystem in the Western Cape.
Government leadership	Government leadership needs to set the direction and create the platform for alignment and collaboration between departments.
Policy alignment with strategic objectives	The alignment of policies with strategic objectives will be required. These policy changes could accelerate the achievement of strategic outcomes.
Collaboration between departments	The creation of a complete ecosystem could only be achieved through collaboration between the different institutions.
Partnership with OEMs to ensure vehicle availability	Partnering with the OEMs is a fundamental building block; the availability of electric vehicles, and the supporting dealer network is a key requirement.
Partnerships for industry creation	Collaboration with various other companies and institutions is required for the creation of the electric vehicle industry.
Partnerships for technology innovation	OEMs and leading technology companies already made significant investments in developing the connected electric vehicle. Partnerships with these companies could significantly accelerate technology development and implementation.
Research and development for thought leadership	Research and development is required to test the feasibility of new concepts and opportunities. This would not only create thought leadership, but also provide the foundation for financial investment and industry creation.
Funding of development	Funding of projects is fundamental towards achieving the strategic goals defined for the project.
A phased approach should be followed	The implementation approach should be a phased approach based on short-, medium-, and long-term priorities.

The next section outlines the implementation approach and timelines.

5.10.3. Implementation Approach

The implementation approach is designed with the pre-requisites for implementation success as the point of departure. The approach is based on:

- **A phased approach:** A phased approach is suggested with short-, medium-, and long-term activities and outcomes as the drivers.
- **Time window:** The time window of the implementation is five years, which is largely guided by the timelines set globally for phasing out ICE vehicles. The potential strategic scenarios identified earlier in the document also provide context to this.
- **Phase 1 – foundation phase:** The foundation phase of 12 months focuses on getting the strategy approved and the implementation plan supported by the different institutions. The completion of key research and development projects as well as setting up partnerships with various stakeholders are all included in the foundation phase.
- **Phase 2 – development phase:** The development phase focuses on the conversion of development projects into commercial projects, which all form part of the broader ecosystem. The development phase will support the foundation for realisation of the outcomes in the next phase.
- **Phase 3 – realisation phase:** The realisation phase focuses on capitalising off the benefits from projects that went from research and development to implementation but could not achieve full commercial status through increasing volumes and output.

The detail of each implementation phase is outlined in the next section.

5.10.4. Implementation Phases

The detail of the aspects to be addressed in each of implementation phases is outlined in Figure 52. The potential involvement of the different departments in this implementation plan is outlined in the following section.

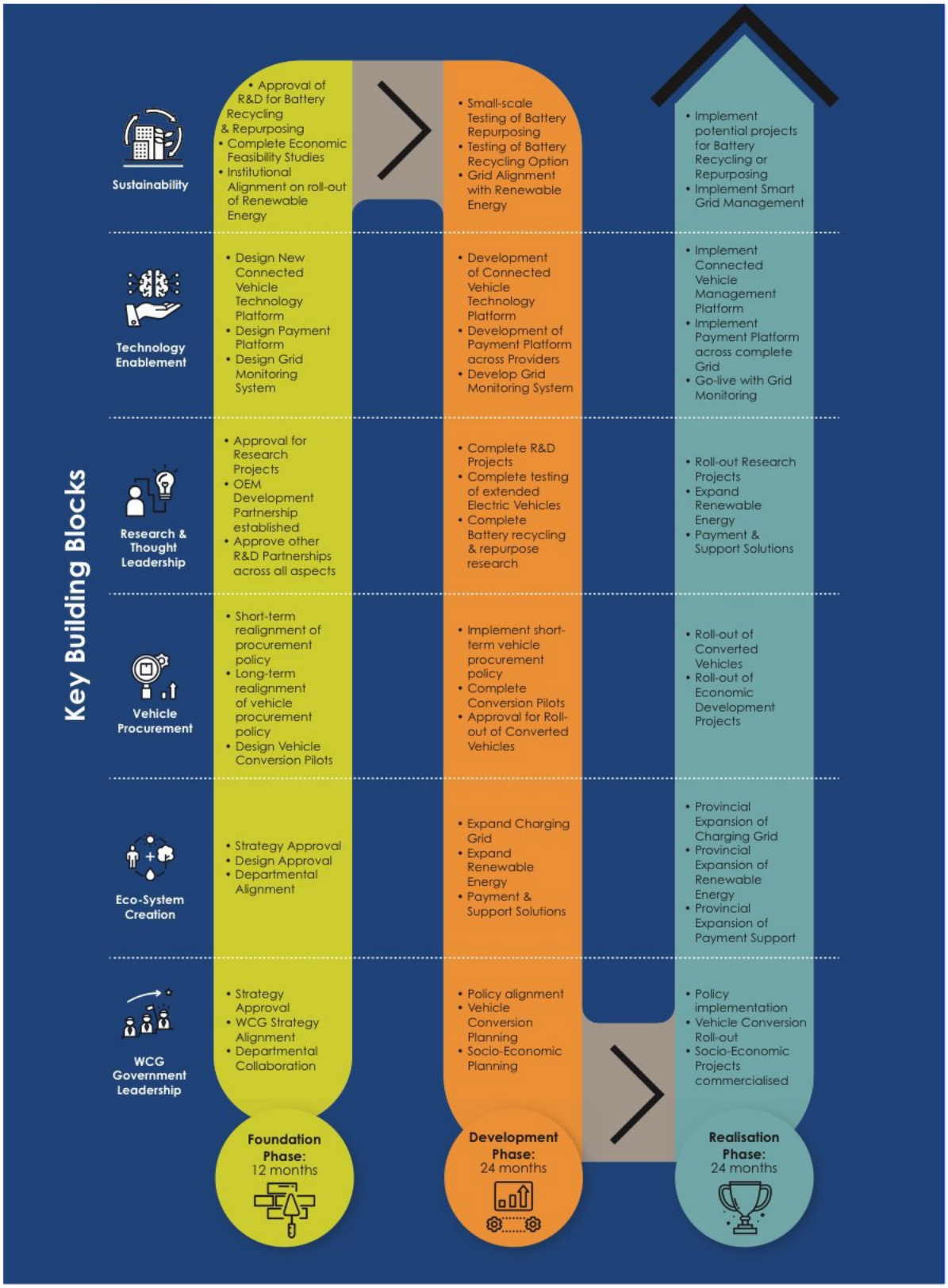


Figure 52: Details of the implementation phases

This strategy document has set out the context and urgent need for GMT to commence with the electrification of its fleet while also establishing an Electric Vehicle Ecosystem in the Western Cape. This will enable GMT and the Western Cape to become the Electric Vehicle Thought Leaders in Africa.

What is now required is the approval of GMT's Electric Vehicle Strategy in order to commence with the implementation thereof.