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# TRANSFORMING SOUTH AFRICA'S PASSENGER TRANSPORT SECTOR FOR SUSTAINABLE DEVELOPMENT

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# About this publication

This paper is part of a series commissioned by the Green Economy Coalition (GEC) to assess opportunities for transitioning to a sustainable low-carbon economy in South Africa. It assesses the current state of urban passenger transport in South Africa and investigates measures to achieve a meaningful and sustainable transformation of the country's transport sector.

The GEC is the largest global alliance of organisations working on a green economy. The membership spans Asia, Africa, South America, North America and Europe and represents a wide range of interests including the forest, the environment, business, the United Nations, research and government. Despite its diversity, the coalition is committed to accelerating the transition to green and fair economies. In South Africa, Trade & Industrial Policy Strategies (TIPS) and the African Centre for a Green Economy (African Centre) are active members of the coalition.

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# Key findings

- The transport sector is the second largest greenhouse gas (GHG) emitter in South Africa (11%) contributing to air quality problems, particularly in urban areas. It also leads to expensive fossil fuel imports. In addition, South Africa lags behind the latest fuel standards.
- While private vehicle use is rising, public transport (minibus taxis) is the main mode of travel for South Africans. The sector is, however, plagued by challenges, such as inefficient, expensive and unreliable systems, and a process of cannibalisation rather than complementarity.
- Unintegrated public transport networks and disparities in spatial planning have resulted in low-income households overspending on transport. Moreover, government subsidies are skewed towards rail and bus networks despite poor performance and low ridership volumes.
- Electric vehicles (EVs), ideally powered by solar energy, are the primary solution for private vehicles and display significant potential for mass rollout. Natural gas and biogas are promising opportunities for improving public transport fleets. While biofuels were, in the past, an attractive option for motor vehicles, new alternatives are more suited to mass rollout of motor vehicles.
- An alternate approach to tackling unsustainable transport is the Improve-Shift-Avoid (I-S-A) model. This aims to improve vehicle efficiency, encourage public transport use, and eliminate the need to travel. While improving vehicle technologies and modal shifts present short- and medium-term opportunities, a complete overhaul of the country's transport system would be insufficient without considering long-term spatial planning.

# Key recommendations

- Implementing the I-S-A approach will provide South Africa with an opportunity to develop an effective, integrated and sustainable passenger transport system. A shift away from the fragmented silo approach can ensure that plans to develop, enhance and improve sustainable infrastructure and transport systems materialise, including climate-compatible and socio-economic transport planning.
- Key to South Africa's transformation to a sustainable transport system is the need to reform and formally integrate the minibus taxi industry. Engagements should intensify to set a sustainable vision for the industry.
- The South African government should support eco-mobility, by decreasing or eliminating import duties and taxes on EVs and battery technologies, and by adopting policy instruments such as rebates on EV and gas vehicle purchases.
- Municipalities should spur demand for improved vehicle technologies by converting their existing fleets. The South African government should leverage existing programmes and procurement strategies to promote improved vehicle technologies.
- Additional measures, such as human resources (HR) policies incentivising public transport use, park-and-ride facilities, car-free zones in cities, and reduced or eliminated vehicle registration costs, could aid eco-mobility in South Africa.
- Synergies between EVs and renewable energy should be considered, particularly as EVs display a potential to unlock technologies, such as small-scale embedded generation in South Africa.
- An enabling environment for the country's automotive manufacturing sector should be created by engaging with original equipment manufacturers (OEM) on manufacturing and importing multiple brands of EVs.

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# Abbreviation

| | |
|---|---|
| APDP | Automotive Production and Development Programme |
| BRT | Bus Rapid Transit |
| CBG | Compressed Biogas |
| CNG | Compressed Natural Gas |
| DoE | Department of Energy |
| DEA | Department of Environmental Affairs |
| DST | Department of Science and Technology |
| dti | (the) Department of Trade and Industry |
| DoT | Department of Transport |
| DBSA | Development Bank of Southern Africa |
| EU | European Union |
| EVs | Electric Vehicles |
| GDP | Gross Domestic Product |
| GHG | Greenhouse Gas |
| HR | Human Resources |
| ICE | Internal Combustion Engine |
| IDC | Industrial Development Corporation |
| IPAP | Industrial Policy Action Plan |
| IRT | Integrated Rapid Transit |
| I-S-A | Improve-Shift-Avoid |
| NATMAP | National Transport Master Plan |
| NT | National Treasury |
| OEMs | Original Equipment Manufacturers |
| R&D | Research and Development |
| SANAS | South African National Accreditation System |
| SANTACO | South African National Taxi Association |
| SABIA | Southern African Biogas Industry Association |
| SABOA | Southern African Bus Operators Association |
| UNFCCC | United Nations Framework Convention on Climate Change |


# 1 Introduction

In recent years, a global sustainability crisis culminating in dire economic, social and environmental consequences has hindered growth and development, particularly in developing countries. South Africa is no exception.

In response, the country has made considerable strides towards sustainable growth and development. It is among the list of countries that have realised at an early stage that current business-as-usual practices are unsustainable and may result in detrimental socio-economic and environmental consequences in the long run. This is evident in the fact that South Africa participated in, and ratified, the Kyoto Protocol, and is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement on Climate Change. Correspondingly, the South African government has developed various national plans and policies geared towards a just transition to a low-carbon, climate-resilient and environmentally-sustainable economy, such as the National Development Plan, Nationally Appropriate Mitigation Actions under the UNFCCC, the National Strategy for Sustainable Development and Action Plan and the National Climate Change Response White Paper.

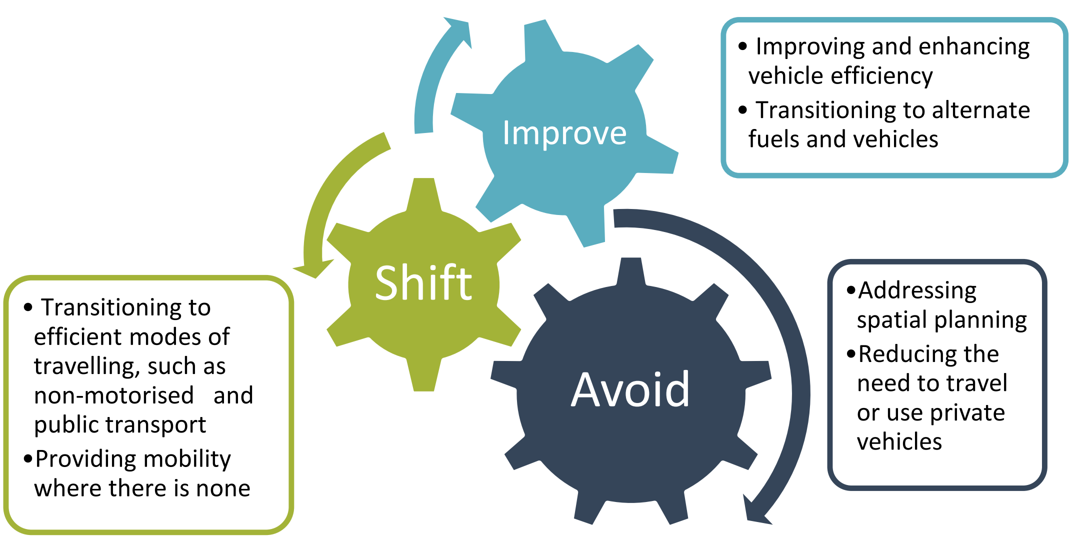
Transforming the transport sector is key for the transition towards a sustainable development model. After energy generation, the transport sector is the second largest GHG emitter in the country, contributing to 11% of overall emissions (DoT, 2018). From a holistic perspective, transport plays a major role in industrialisation, economic growth and social development; it moves goods, services and people daily. As the South African economy grows, so too does demand for transport, with reliance on fossil fuels continuing to dominate the space. South Africa is already embarking on transforming the transport system; however, the sector is plagued by numerous challenges, such as the lack of reliable transport (especially in rural areas), unintegrated public transport systems (particularly in urban areas), inefficient and high GHG emission profiles, and violence and tensions between various transport modes. Beyond environmental sustainability, the high costs of importing crude oil or producing these fuels through coal, growing congestion, and long commuting hours make reforming the transport sector a priority.

A meaningful transition of the country's transport systems requires an integrated approach to address the challenges in the sector and possibly a complete overhaul, leading to a key question: how can South Africa achieve and manage a meaningful and inclusive transformation of the country's transport sector?

There are complementary and intertwined routes to transform South Africa's transport sector, as depicted in Figure 1. It follows a three-pronged approach, building on the I-S-A analytical framework. However, it should be noted that the I-S-A model was designed from a developed country perspective and, in its design, assumes universal access to transport and ease of mobility, whereas in South Africa not all have easy access to transport. Components of the framework (illustrated in Figure 1) have therefore been revised to enable an analysis that presents some of the unique characteristics and nuances of South Africa's transport system. The **improve** component denotes enhancing vehicle technologies and improving sources of electricity to achieve energy efficiency and reduce GHG emissions from the country's transport sector. The **shift** aspect of the framework entails embarking on the transition towards more sustainable and efficient modes of travelling, such as public transport and providing transport services where these are limited or completely lacking. For this paper, public transport in urban areas is analysed. **Avoid** refers to measures that reduce the need to travel or use private vehicles, such as spatial planning. Although necessary for an inclusive transition, the avoid aspect of the I-S-A framework, a long-term approach, is not discussed in this paper.

This paper attempts to address which measures South Africa can implement to achieve and manage a meaningful and sustainable transformation of the country's transport sector. Focussing on the passenger transport industry, it investigates the state of transport in South Africa and reviews existing measures undertaken towards transforming the sector using the improve and shift framework, followed by key recommendations for each aspect. Finally, the paper concludes that South Africa has the opportunity and capability to develop an effective, integrated and sustainable passenger transport system.

Figure 1: Improve-Shift-Avoid (I-S-A) analytical framework




Source: Authors, based on Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH, n.d.

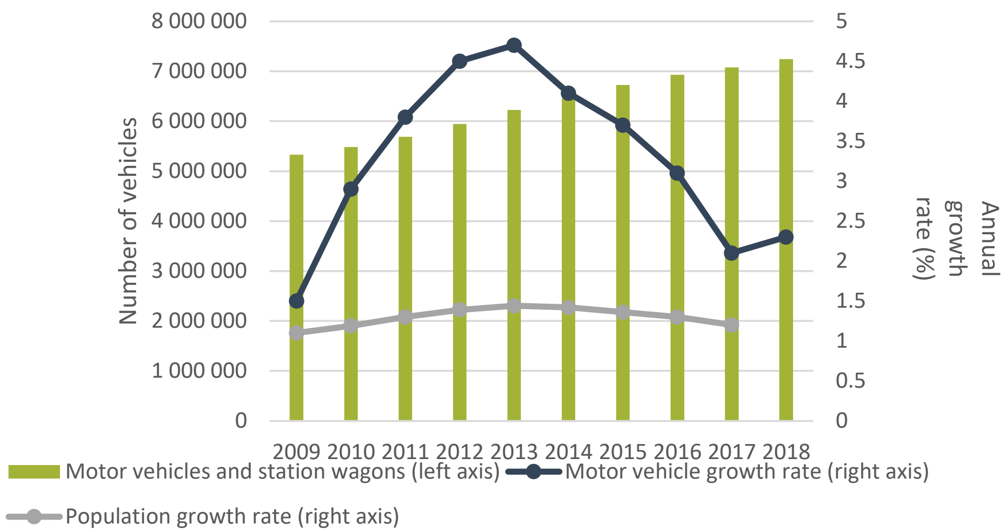

# 2 Improving vehicle technologies

The "improve" component of the I-S-A model revolves around enhancing energy efficiency and promoting technologies that will enable vehicles to achieve GHG emission reductions. Measures for improving vehicle technologies include using improved and alternate fuels (biofuels, liquid biofuel blending), alternate energy (compressed natural gas and compressed biogas) and encouraging the uptake of electric, hybrid-electric and fuel cell vehicles. This section provides an outline of the various technologies available to improve vehicle efficiency and sustainability, including an analysis of the state of vehicle technologies in South Africa.

## 2.1. Diagnostic: Unsustainable trends

Despite recent efforts to deter increased private vehicle use, such as the introduction of Bus Rapid Transit (BRT) systems and the Gautrain rapid rail network in Gauteng, the number of vehicles on the country's roads has steadily increased, reaching more than seven million in April 2018, as indicated in Figure 2. Vehicle ownership in the country is moreover increasing faster than population growth due to a catch-up phenomenon (growing middle-class), aspirations and necessity (eNaTIS, 2017; World Bank, 2017).

FIGURE 2: VEHICLE POPULATION IN SOUTH AFRICA FOR THE PERIOD 2009 TO 2018




SOURCE: AUTHORS, BASED ON DATA FROM THE NATIONAL TRAFFIC INFORMATION SYSTEM (ENATIS) AND THE WORLD BANK

The decline in sales of both petrol and diesel vehicles from 2007 to 2009, shown in Table 1, can be attributed to the global financial crisis.

TABLE 1: NUMBER OF NEW VEHICLES SOLD BASED ON FUEL-TYPE FOR THE PERIOD 2007-2018

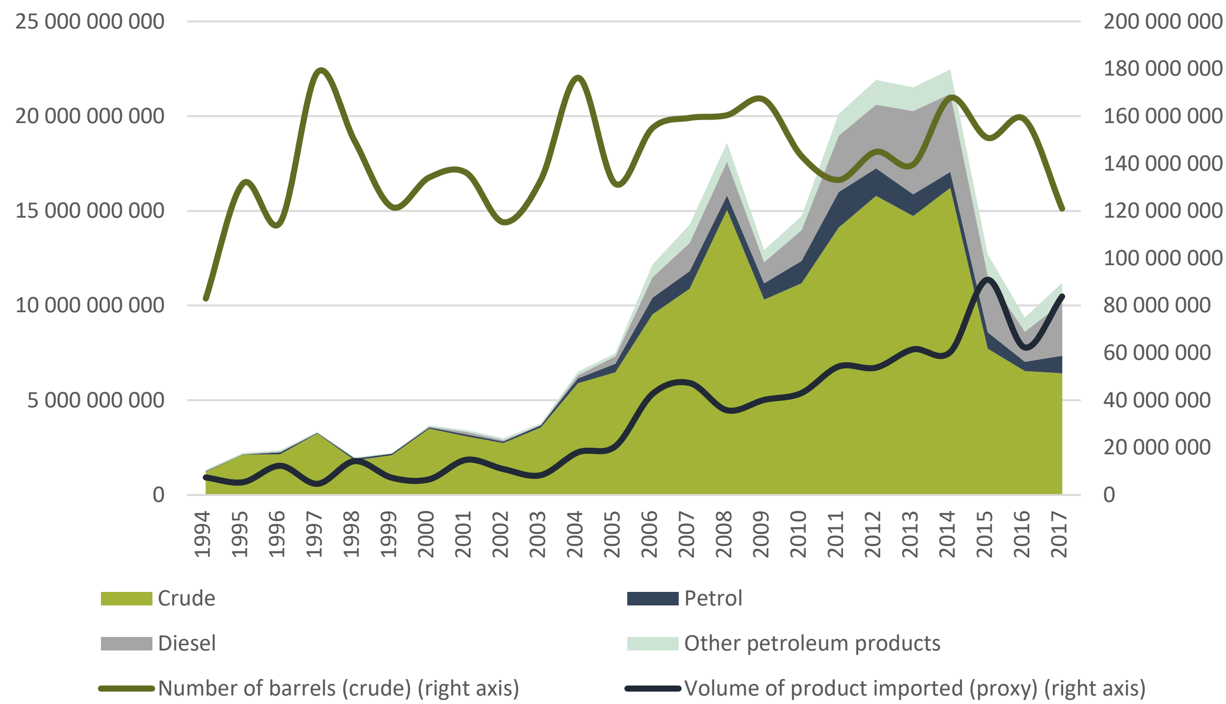
| | Diesel | Electric | Petrol | Plug-in Hybrid | Traditional Hybrid | Total |
|---|---|---|---|---|---|---|
| **2007** | 56 151 | 0 | 377 496 | 0 | 201 | **433 848** |
| **2008** | 45 240 | 0 | 282 709 | 0 | 242 | **328 191** |
| **2009** | 37 946 | 0 | 218 938 | 0 | 292 | **257 176** |
| **2010** | 48 598 | 0 | 289 911 | 0 | 430 | **338 939** |
| **2011** | 56 317 | 0 | 343 489 | 0 | 627 | **400 433** |
| **2012** | 68 260 | 0 | 373 022 | 0 | 766 | **442 048** |
| **2013** | 79 357 | 34 | 370 392 | 0 | 513 | **450 296** |
| **2014** | 78 155 | 14 | 360 122 | 0 | 646 | **438 937** |
| **2015** | 70 908 | 117 | 340 982 | 124 | 266 | **412 397** |
| **2016** | 63 765 | 100 | 297 019 | 168 | 213 | **361 265** |
| **2017** | 65 516 | 68 | 302 227 | 121 | 182 | **368 114** |
| **2018** | 62 605 | 58 | 302 440 | 89 | 55 | **365 247** |
| | **732 818** | **391** | **3 858 747** | **502** | **4 433** | **4 596 891** |

SOURCE: AUTHORS COMPOSITION BASED ON NAAMSA, 2019

Increases in the trajectory of petrol and diesel vehicles on South African roads is a worrying indicator for government's plans to shift towards sustainable transport systems, especially since the quasi-totality of existing vehicles is powered by internal combustion engines (ICE), releasing GHG emissions and adversely affecting air quality, particularly in urban centres, and consequently affecting human health (DoT, 2018). Furthermore, indirect emissions resulting from various fuel production and refining processes adds to the emission profile of the sector (DoT, 2018).

In addition, although declining in recent years, South Africa spends a tremendous amount of financial resources on importing petroleum products, as showed in Figure 3, with a peak at more than US$16 billion in 2014.

FIGURE 3: SOUTH AFRICAN IMPORTS OF PETROLEUM PRODUCTS IN US$ DOLLAR AND VOLUMES




SOURCE: DANE ET AL, 2019

With volatile crude prices, motorists in South Africa have been spending more money on fuel than on purchasing new and used vehicles. The average monthly fuel spend amounts to R14.8 billion compared to R14 billion for new vehicles and R9.8 billion for used vehicles (South African Market Insights, 2018).

Moreover, South Africa lags behind in vehicle efficiency and fuel-related Euro standards. Vehicle emission legislation in South Africa stipulates that exhaust emissions must comply with Euro 2 emission standards only, positioning the country years behind global fuel quality standards. While several local automobile manufacturers are introducing vehicles operating at Euro 5 and 6 into the market, these require engine and exhaust system adjustments to run on South Africa's sub-par fuel, thereby exacerbating inefficiency. Plans to produce and adopt Euro 5 fuel standards by mid-2017, as set by the Department of Energy (DoE), did not materialised, due to lack of investments and funding for production. The estimated cost of upgrading refineries ranges from US$3 billion to US$4 billion, with the South African Petroleum Industry Association indicating that the cost of upgrading refineries to produce cleaner fuels would push up the price of fuel (Oirere, 2017). However, BP Southern Africa has pledged to invest approximately R4 billion to upgrade the SAPREF refinery in attempts to produce diesel with lower sulphur contents (Engineering News, 2018). In January 2019, former DoE minister Jeff Radebe indicated that Saudi Arabia would be investing close to R138 billion in South Africa's energy sector to develop a new crude oil refinery and petrochemical plant. These plans have, however, not yet materialised (Dold, 2019).

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In terms of manufacturing, South Africa boasts a strong automotive sector with multiple leading OEMs locally manufacturing vehicles for domestic and international markets, with the sector being deemed an industrialisation success story. The sector remains the largest exporter of manufactured goods contributing 14.3% of the country's overall exports, amounting to R178.8 billion in 2018. The production of vehicles and related components contributed to 29.9% of the country's manufacturing output in 2018. The automotive industry as a whole contributed 6.8% to gross domestic product (GDP), comprising 4.4% of manufacturing and 2.5% of retail (Automotive Industry Export Council, 2019; Mahomedy, 2018a). Employment in the sector surpassed 350 000 people in 2017. Vehicles with internal combustion engines, and related components play a large role in South Africa's export capabilities, with catalytic converter exports contributing to 37.2% of component exports in 2017, amounting to R18.7 billion, followed by engine parts, tyres and engines contributing R3 billion, R2.5 billion and R2 billion respectively (Mahomedy, 2018a).

As the transition to EVs proceeds, the automotive industry in South Africa is at risk of losing its major markets such as the European Union (EU) and United States (Deonarain, 2019). In South Africa, job losses could happen at the component level, as the automotive industry's main focus is manufacturing ICE vehicles and related components. Since countries have committed to phasing out ICE vehicles, unless a transition mechanism is put in place, the local manufacturing sector could decline. As importing used vehicles is not permitted in South Africa (Mahomedy, 2018a), the risk of second-hand ICE vehicles coming into the market is low; however, countries still producing new ICE vehicles would have fewer locations to export to and may target South Africa, increasing the competition for the domestic market. As South Africa is part of the global automotive value chain, producing only a few product ranges, it is unlikely that the industry could rely on local demand to sustain an ICE industry. And while the rest of Africa is becoming an increasingly important market for South Africa's trucks and "bakkies", it is not a traditional market for South African-made cars. (Deonarain, 2019)

Taking into consideration changes in global vehicle parks along with commitments to abate GHG emissions, and rising vehicles numbers in the country, improving vehicle technologies is a crucial component in transitioning towards a sustainable transport system, as specified in the various strategies, plans and projects laid out by the state, such as the Transport Flagship Programme, the Government Vehicle Efficiency Programme and the Green Transport Strategy. The current state of play and evolution of South Africa's transport sector call for adopting a forward-looking approach focused on new trends and technologies. Three main technologies, i.e. biofuels, gas-based vehicles and electric vehicles, can be considered at this stage.

## 2.2. Introducing biofuels

The use of bioethanol and biogas for vehicle (and aviation) fuel in South Africa presents an opportunity to reduce foreign exchange expenditure on imported petroleum, enhance socio-economic development and reduce GHG emissions from the transport sector. Even though emissions occur when burned, biofuels are considered carbon neutral as the organic matter from which they originate absorbs carbon dioxide from the atmosphere (IRENA, 2017). These fuels are generally blended with conventional fuels, which is an advantage as the infrastructure and logistics required for biofuel production and transportation is similar to that of conventional fuels and are already present.

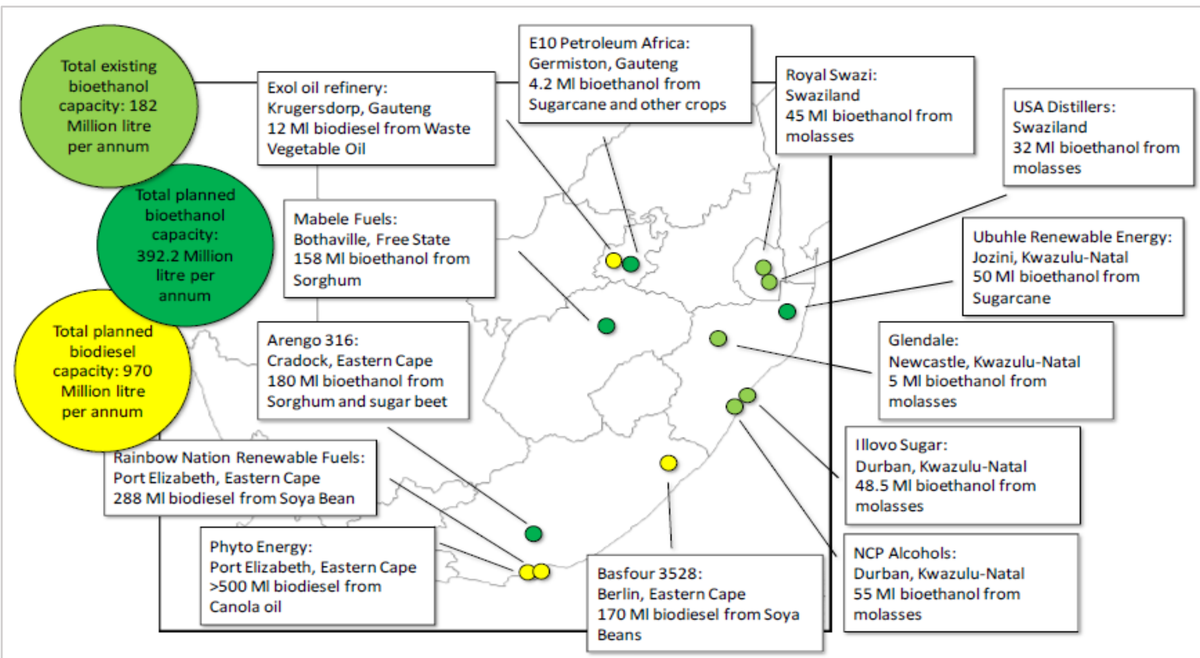
Ethical considerations should be accounted for when providing alternatives for petroleum products, hence it is important to note that while beneficial for the transition towards sustainable mobility, biofuels have been called out for threatening food security as competition for land, water, crops and skills arises in the agricultural and biofuel sectors (IRENA, 2017). National food security is not the only consideration. Regional food security could also be threatened, as South Africa has trade agreements with neighbouring countries for the provision of sugar. However, recent developments pertaining to using food waste have been gaining attention. One such case is the use of oil extracted from coffee-ground waste and blended with diesel to produce biofuels. An estimate of three billion cups of coffee a year are consumed by South African citizens (Frankson, 2017), the waste of which could be blended to fuel buses and taxis, without any conversion or modifications to their engines.

According to a recent study assessing biofuel potential in Sub-Saharan Africa (Bolse-Rentel et al., 2019), land available for cultivating of biofuel crops ranges between 0.5% and 0.9% of the total land area in South Africa, once food security and environmental considerations are accounted for. With biofuels from sugarcane, ethanol produced directly from sugarcane itself could amount to 85 litres per ton of sugarcane (Van Rijswijk and Radford, 2016). For the 2018/2019 period, an estimated 19 million tons of crushed cane will be produced in South Africa (South African Sugar Association, 2019), which could result in 1.6 billion litres of ethanol, culminating in an additional 24 000 new jobs for the industry (Baird, 2018). With residues, there is a large supply of bagasse off the back of the sugar industry, with an estimated 7.6 million tonnes of bagasse annually produced at South African sugar mills (Farzad et al., 2017). The potential of ethanol production from bagasse could amount to 182 million litres a year. It is estimated that a US$1.5 billion market for bioethanol could be created on the back foot of bagasse generation (Farzad et al., 2017). The use of bagasse at present has remained limited to electricity generation at production sites. In 2016/2017 Tongaat Hulett sold 28 662MWh of electricity to the country's national grid, while generating 436 322MWh of electricity overall (Mahomedy, 2018b). Bagasse diverted to producing ethanol would surpass the annual ethanol targets required, as set out in the biofuels strategy. If allocation commitments are revised, the abundant supply of sugarcane by-products, namely bagasse, could potentially stimulate a local bioenergy industry in the country.

*"The use of bioethanol and biogas for vehicle (and aviation) fuel in South Africa presents an opportunity to reduce foreign exchange expenditure on imported petroleum, enhance socio-economic development and reduce GHG emissions from the transport sector.*

In 2007, the Biofuels Industrial Strategy was approved by the South African Cabinet in attempts to develop a sustainable and thriving biofuels sector in the country. Figure 4 displays the existing and planned biofuel facilities in South Africa and the respective capacities. In terms of current sugar molasses bioethanol production, four South African companies and two companies based in Swaziland produce 182 million litres of bioethanol a year. As of 2016, four bioethanol and four biodiesel plants were awarded licences by the DoE to manufacture biofuels. At the time, it was estimated that proposed bioethanol facilities would produce 392.2 million litres of bioethanol a year while 970 million litres of biodiesel would be produced annually (Van Rijswijk and Radford, 2016).

FIGURE 4: PLANNED AND EXISTING BIOFUEL PRODUCTION FACILITIES IN SOUTH AFRICA AS OF 2016




SOURCE: VAN RIJSWIJK AND RADFORD, 2016

The Integrated Transport Master Plan has set out a Green Re-fleeting Strategy to encourage the transition to greener fuels in efforts to combat GHG emissions and air pollution particularly arising from congestion in cities (Gauteng Province Roads and Transport, 2013). Despite the country's attempts to establish a biofuel industry, such as the development of the 2007 Biofuel Industrial Strategy and the draft Biofuel Blending Regulatory Framework (stipulating mandatory blending requirements by October 2015 for diesel and petrol fuels), biofuel production in South Africa has not progressed significantly. Existing plans remain inoperable due to the absence of an enabling regulatory framework (the biofuel regulatory framework was never approved by government), continued feasibility concerns, and lack of committed investment from the private sector.

However, biofuels have been gaining traction again, with indications that the Biofuels Blending Regulatory Framework should be approved by Cabinet in 2019. The framework aims for biofuels to account for a mere 2% (400 000 litres) of South Africa's fuel consumption (Cloete, 2018).

## 2.3. Converting to gas-based vehicles

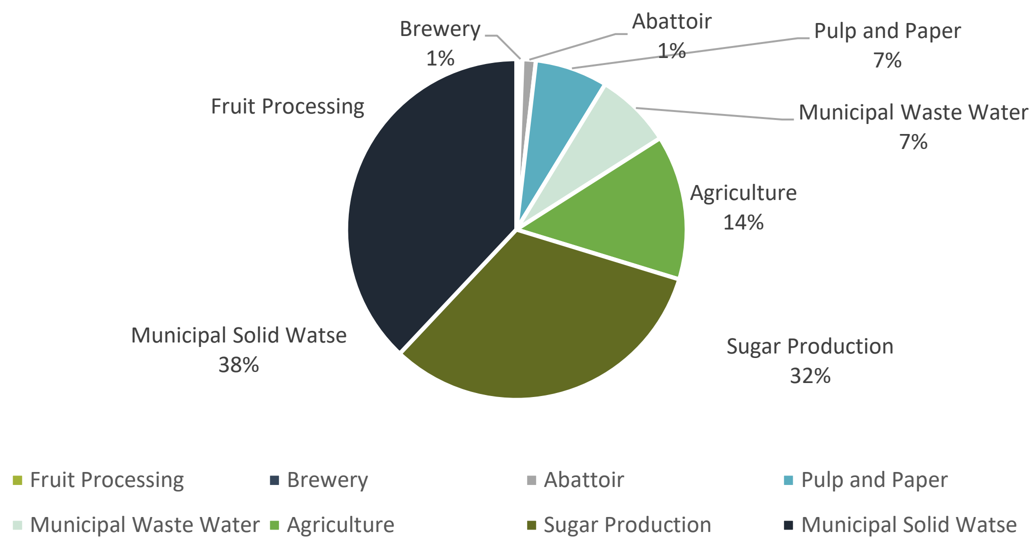
The conversion of vehicles to operate on gas, i.e. compressed natural gas (CNG) and/or compressed biogas (CBG), is the second route to improve the sustainability of vehicles. CNG and CBG[1] have proven to be an efficient alternate source of cleaner fuels. Despite classified as a fossil fuel, natural gas offers a 30% GHG emission reduction compared to conventional fossil fuels based on petroleum products (Suleman et al., 2015). Dedicated gas vehicles are able to operate solely on CNG/CNB and are a viable option for vehicles travelling on fixed routes where refuelling stations are readily available. Dual fuel vehicles require retrofitted gas engines, having the ability to operate on either gas or conventional fuels (EcoMetrix Africa, 2016b). In 2018, there were 26.5 million gas powered vehicles and more than 31 000 gas fuelling stations globally (NGV Global, 2019). The rise in gas-based vehicle numbers can be attributed to countries' commitments to combat GHG emissions, waste management and environmental instability.

In South Africa, as part of the gas-related policies and plans highlighted in the Industrial Policy Action Plan (IPAP), a Gas Industrialisation Unit was launched by the Department of Trade and Industry (the dti) in 2016 to explore the future of gas-based energy. Currently, South Africa is home to gas manufacturing, storage and transmission facilities that are comparable the world over, with gas imported by pipeline from Mozambique. The IPAP stipulates developing industry strategies that consider the efficiency and price advantage of gas compared to conventional fossil based energy such as coal, diesel, paraffin and petrol (the dti, 2017). The transitional requirement away from carbon-intensive fuel sources and towards gas-based fuel has also been highlighted as a sectoral focus within the IPAP (the dti, 2017).

In 2019, French oil and gas company Total discovered gas off the shores of Cape Town, with further exploration and investigation expected to continue. South Africa also has the potential to produce three million cubic metres of biogas a day (Figure 5), most of which sourced from municipal solid waste. Locally produced CBG would reduce expenditure on importing and refining crude oil or coal-based petroleum while encompassing a lower emissions profile. In addition, biogas production via waste streams is viewed as a sustainable measure to tackle waste management by capturing emissions produced at landfill sites.

[1] Biogas is a renewable source of energy produced through the process of anaerobic digestion, occurring during natural decomposition of organic matter in the absence of oxygen. Upgraded biogas, also known as bio-methane, is produced when methane is separated from carbon dioxide and trace gas molecules, producing a gas suitable for use as a vehicular fuel (Hofmann and Findeisen, 2017). Biogas can be produced from agricultural, municipal and commercial biomass feedstocks, such as animal waste, agricultural residues, wastewater from municipalities, breweries and the pulp and paper industry, and predominately municipal solid waste at landfill sites (EcoMetrix Africa, 2016a). Once upgraded, the chemical composition of bio-methane becomes similar to natural gas, which is advantageous as both the local and international markets are flooded with a plethora of technologies that enable biogas to be stored, compressed and thereafter used as a vehicular fuel.

Figure 5: Biogas potential in South Africa by sector




Source: Authors, based on data from EcoMetrix Africa, 2016a

In South Africa, the use of CNG to fuel vehicles is considered economically feasible as gas prices are exempt from fuel levies, thereby becoming cheaper than the conventional diesel and petrol fuels. In January 2019, the pump price of 93 and 95 unleaded petrol in the inland region stood at R13.79 and R14.01 per litre respectively, while a litre of diesel cost R13.16 (AA, 2019). In comparison, the price of natural gas at filling stations is lower, at R8.99 a litre equivalent (CNG Holdings, 2019).

The creation of the Southern African Biogas Industry Association (SABIA), the Biogas Platform and subsequent working groups is an indication that the country is showing signs of interest for biogas production and utilisation. The DoT and the dti have partnered with the Development Bank of Southern Africa's (DBSA) and the Industrial Development Corporation (IDC) to provide finance for CNG initiatives, such as the conversion of taxis to receive natural gas.

Gas as a vehicle fuel is slowly taking off in South Africa and future demand in cities is more than adequate for the creation of a local manufacturing base. As of 2016, there were 10 CBG/CNG fuelling stations and an estimated 1 000 gas-fuelled minibus-taxis operating in the cities of Ekurhuleni, Johannesburg and Tshwane (Montmasson-Clair et al, 2017).

“

*Gas as a vehicle fuel is slowly taking off in South Africa and future demand in cities is more than adequate for the creation of a local manufacturing base.*

Municipalities have indicated plans to procure CNG/CBG buses over the next few years (Table 2). The City of Johannesburg initiated a pilot project converting and adding 70 dual-fuel CNG buses to its public fleet. The Tshwane Municipality has similarly followed by purchasing 40 dedicated CNG buses operating in the A Re Yeng BRT fleet (South African Cities Network et al, 2015).

TABLE 2: TARGETS FOR PLANNED GAS-BASED BUS PROCUREMENTS OVER THE NEXT FIVE-TO-SEVEN YEARS FROM 2015

| Municipality | Planned order |
|---|---|
| **Johannesburg** | 402 |
| **Cape Town** | 320 |
| **Tshwane** | 130 |
| **Ekurhuleni** | 50 |
| **eThekwini** | 60 |
| **Rustenberg** | 25 |
| **Total** | **977** |

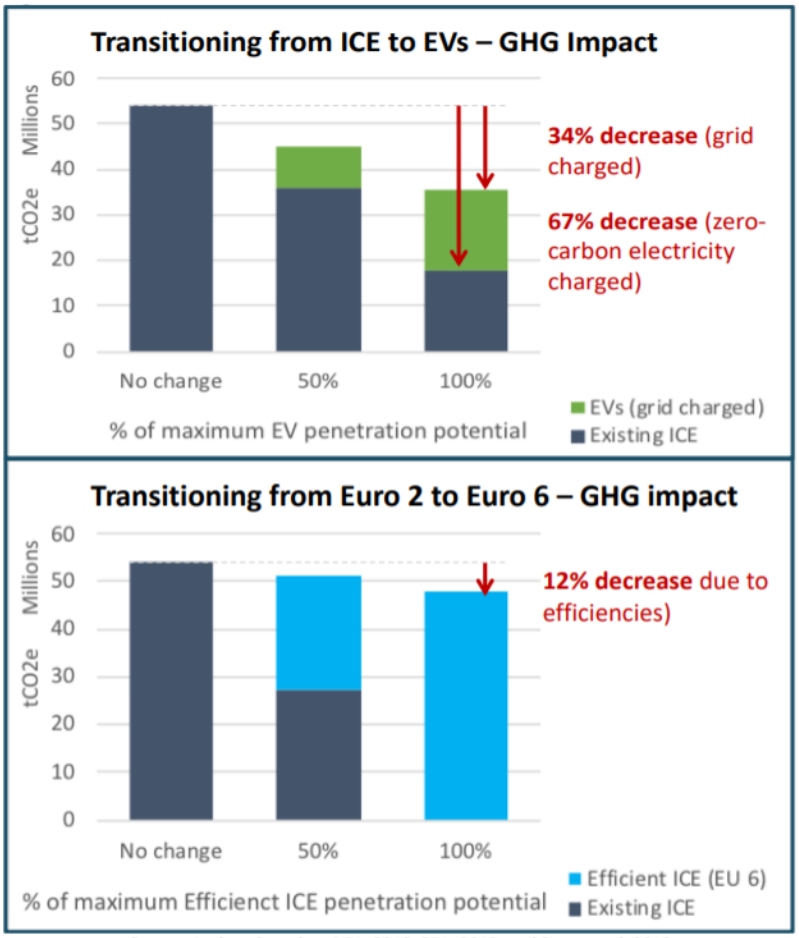
SOURCE: SOUTH AFRICAN CITIES NETWORK ET AL, 2015

CNG and CBG produce a lower emissions profile compared to internal combustion engines and offer an average cost savings of 24% on fuel expenses. In 2017, a reported 130 000 legal taxis and 25 000 buses were operating in South Africa, which can provide a market for the uptake of CNG/CBG (SABOA, n.d.; SANTACO, 2017). Waste collection vehicles are also prime candidates for conversion (at a once-off conversion cost of R8 000) as they would have daily direct access to biogas should biogas facilities be developed on site. To promote the uptake of dedicated buses, the DoT has signalled efforts to assist municipalities with draft regulations stipulating mandatory conversion of 10% South Africa's metrobus fleet per annum. In the long term, regulations requiring the conversion of public transport within the next 10 years are also under consideration (DoT, 2018).

## 2.4. Shifting to electric vehicles

Similarly, the development of EVs displays significant potential for transitioning towards sustainable mobility and enhancing automotive and component manufacturing. EVs produce no tailpipe GHG emissions. In countries such as South Africa, however, where electricity production is coal-based, upstream GHG emissions offset some of the benefits, calling for renewable energy-based solutions. However, EVs outdo conventional ICE vehicles in energy efficiency, especially in traffic congestion, due to regenerative braking, a process whereby EV batteries can convert kinetic energy into chemical energy (Suleman et al, 2015). Figure 6 shows the emission reduction potential of EVs powered by coal-based and solar electricity compared to ICE vehicles and the transition from Euro 2 to Euro 6 fuels.

FIGURE 6: GHG EMISSION REDUCTION ASSOCIATED WITH EVS VERSUS MORE EFFICIENT ICE VEHICLES




SOURCE: DANE ET AL, 2019

EVs charged by solar-powered electricity are by far the most environmentally efficient option, with reduction potentials amounting to 67%. Currently, there are less than 1 000 EVs and about 100 charging stations operating in South Africa. A lack of charging infrastructure has been cited as a major deterrent for the uptake of EVs in the country. Nevertheless, plans are underway to address this, with BMW, Jaguar, Nissan, BP, Shell and the IDC installing free fast-charging points at selected dealerships, and proposed charging stations at malls and office parks across the country. The Council for Scientific and Industrial Research (CSIR), Department of Environmental Affairs (DEA), the dti and Eskom have also realized the importance of low-carbon transport adding electric vehicles to their fleets (EVIA, 2017).

Furthermore, private sector involvement in the expansion of EV charging infrastructure and development of interactive electro-mobility technologies is gaining traction, due to continued efforts from companies, such as GridCars, which locally produce alternating current (AC) charging systems, while importing fast-charging direct current (DC) systems (Venter, 2017a). In addition, software systems provide users with real-time information on location and availability of charging stations as well as user transaction history, allowing consumers to keep track of their energy consumed and associated costs of charging (Venter, 2017a).

In South Africa, plans are underway to further facilitate the uptake and local manufacturing of EVs, with support from the DoT, the dti and the private sector. The dti has been driving much of the push for the uptake of EVs, as evident in the release of the 2013 EV Industry Roadmap. This states that tax incentives and rebates should be provided for those purchasing EVs, as well as support for research and development, in particular the creation of cost-efficient battery technologies, and the provision of charging infrastructure across the country, to highlight a few recommendations (EcoMetrix Africa, 2016b).

The pending Electric Vehicle Procurement Policy stipulates that, in future, at least 5% of government and state-owned enterprise fleets should be EVs. As part of the IPAP, the dti, with additional support from the Department of Science and Technology (DST), the DoT and local government, has encouraged the establishment of a local EV value chain manufacturing industry, realising that EVs display local manufacturing potential, including producing the complementary charging infrastructure and testing facilities (the dti, 2017; Suleman et al., 2015).

To stimulate localisation, the National Electric Vehicle Technology Innovation Programme provides a platform for private sector manufacturers, tertiary institutions and research and development (R&D) organisations to collaborate on efforts to further develop the EV industry, with particular emphasis on improving energy storage technologies and charging infrastructure (South African Cities Network, 2015). Automotive component and energy storage specialist Metair, in partnership with the South African Institute for Advanced Materials Chemistry based at the University of Western Cape, has initiated lithium-ion battery production at its South African operations. Metair will also collaborate with OEMs to develop lithium-ion batteries in the coming years (Venter, 2017b). The company has also partnered with local aluminium supplier Hulamin to produce aluminium foil for batteries (Venter, 2018). Hulamin has also entered the lithium-ion battery space by providing Tesla with aluminium required for the electric battery box base plates. Furthermore, the company is in talks with numerous other EV manufacturers which are opting for light-weight materials (Hedley, 2018).

The uYilo eMobility Technology Innovation Programme, initiated in 2013 and housed at the Nelson Mandela University in Port Elizabeth, has also been created to support technology development for electric mobility in South Africa through an "electric vehicle systems laboratory". Furthermore, as part of the programme, a South African National Accreditation System (SANAS) and ISO17025-approved national battery testing laboratory has been set up to undertake lithium-ion battery testing, among others, along with a live testing environment to conduct real-time and simulated tests on electric vehicles, micro-electric vehicles and electric bikes.

In adapting production to changes in sustainable mobility, Chinese-owned company BYD SA was awarded a tender in 2016 to produce electric buses and related equipment for the MyCiTI BRT bus fleet. Although the rollout has stalled due to tender irregularities, the conditionalities placed on the procurement included local assembly and aspects of the bus body work to be locally manufactured in South Africa, thereby ensuring job creation (Mahomedy, 2018c). German manufacturer Mercedes-Benz has also started manufacturing the hybrid-electric C class vehicle in East London, citing that the production of pure electric vehicles will be considered only once the proper infrastructure is in place (Venter, 2018d). Aside from the BYD SA and Mercedes-Benz ventures, other locally based OEMs have not indicated any intention to introduce electric vehicle manufacturing in South Africa.

Other initiatives underway, championed by the DST, include the exploration of hydrogen fuel cell technologies, which combine hydrogen and oxygen to produce electricity that can power automobiles. The Hydrogen South Africa (HySA) Infrastructure Centre of Competence was established by the CSIR and the North-West University to develop technologies for the production, distribution and storage of hydrogen in the country, and to undertake R&D in Platinum Group Metals beneficiation (HySA Infrastructure, 2012). Fuel cell technologies could provide a platform for local technology beneficiation using the country's platinum base. Platinum Group Metals companies have been encouraging research. However, fuel cells have not been prioritised in measures to ensure sustainable public and private transportation in South Africa.

## 2.5. Recommendations

South Africa has committed to transitioning towards sustainable modes of transport. Plans and policies are underway to encourage and facilitate the uptake of cleaner fuels and EVs. While biofuels were, in the past, an attractive option for motor vehicles, efforts should be directed to the use of biofuels for aviation, which has limited opportunities to decarbonise, as new alternatives more suited to mass rollout of motor vehicles have emerged.

To enhance attempts at increasing the use of gas, the DoT, the DoE, the National Treasury (NT), the DEA, local governments, the IDC, the SABIA and the oil and gas industry (primarily Sasol) should collaborate to develop mandatory use of biogas in the coming years. Requiring the conversion of government fleets and public transport vehicles could drive the industry forward while simultaneously decreasing imports and expenditure on unsustainable petroleum products and expanding local manufacturing in the process.

Moreover, the South African government, the IDC and the DBSA should provide concessional funding to encourage local content in the production of biogas technologies. Stakeholder engagement and the inclusion of the taxi and bus associations are vital in the successful conversion of these vehicles. The Taxi Recapitalisation Programme should be leveraged with clauses stipulating the mandatory conversion of taxis within the programme. Taxi operators can be incentivised to establish CNG/CBG refuelling stations, particularly at taxi ranks, thereby ensuring a constant supply of gas. In terms of the manufacturing potential, bus manufacturers in South Africa have indicated willingness to create and expand plants to produce gas- and electricity-powered buses if guaranteed commitment of purchase is signalled by the government (South African Cities Network, 2015).

As EVs produce zero tailpipe emissions compared to regular internal combustion engines, the uptake of EVs is the preferred option (at the private vehicle level) to shift to low-carbon transport systems. It has been indicated that the rollout of EVs would increase annual electricity demand by up to 7% (Dane et al, 2019). As per the Intended Nationally Determined Contribution to achieve mitigation targets, South Africa requires investments in EVs and plug-in hybrid electric vehicles (PHEVs) amounting to US$513 billion and US$488 billion respectively (EcoMetrix Africa, 2016b). EVs should, however, be recharged through low-carbon, clean, renewable sources of electricity. South Africa's abundant source of solar radiation provides a promising opportunity for solar-powered electricity. According to Suleman et al (2015, p. 23), while, on average, a person travels 15 000 km a year, "[t]he surface area of two carports could produce enough electricity in one year to provide 80 000 EV kilometres for a conventional sized electric car".

Overall, the market for alternate technologies remains nascent in South Africa. A shift away from the fragmented silo approach of project implementation towards a more integrated inter-departmental co-ordination could ensure that plans develop, enhance and improve sustainable infrastructure and that transport systems materialise. This includes policy, project and strategy alignment on achieving and promoting climate-compatible transport planning.

Regular purchases of EVs and gas-based vehicles are likely to reduce prices of these vehicles in the medium term. Current regulations and taxation are among the factors contributing to deterring the transition to low-carbon transport alternatives.

With import duties, while all passenger vehicles are subject to a 25% tariff, imports of ICE vehicles from the EU are subject to 18%, whereas vehicles from the Southern African Development Community are imported duty-free. While non-discriminatory, ad valorem tax remains higher on EVs compared to diesel and petrol vehicles, due to the high cost of EVs. To be eligible for, and benefit from, the Automotive Production and Development Programme (APDP) incentive framework, local manufacturers need to produce 10 000 EVs a year. In addition, the APDP allows local manufacturers to import vehicles at reduced tariffs; however, it does not allow OEMs to gain EV credits from the export of ICE vehicles. Furthermore, consumer awareness, or lack thereof, has contributed to slow uptake of EVs, as range anxiety and issues around the availability of charging infrastructure continues to form part of the discourse around EV uptake. (Dane et al., 2019; Deonarain, 2019)

As such, the South African government should provide the necessary support. One possible measure is decreasing import duties and taxes on EV battery technologies, making electric vehicles more affordable. A second measure includes tax exemptions or rebates on EV purchases and registration fees, and a third is Eskom offering preferential electricity tariffs for EV charging, which could promote the uptake of private use. Fourth, enforcement measures, such as low-carbon emission zones and car-free spaces, particularly in cities, could also deter the use of high GHG emitting and high-fuel consuming vehicles. Other measures include free parking and exemption from toll fees, as well as access to future car free zones in cities. Fifth, commitment to implementing the Government EV Procurement Policy, requiring mandatory EV fleet purchases, should be pursed proactively as procurement schemes for public transport and state-owned vehicles are an important policy tool to stimulate EV diffusion during the early stages of adoption, enabling local economies of scale around EV manufacturing. The state can use charging infrastructure technology advancements and declining prices of battery components to procure its proposed future EV targets for government and state-owned enterprise fleets. Last, government (the dti, the NT, the DoT, the DEA, the DoE) and the private sector should collaborate on efforts to develop emissions standards and labelling systems for new vehicles. Consistent market demand of electric and gas-based vehicles is likely to reduce prices in the medium term. With long-term strategies for infrastructure development, charging infrastructure expansion and attractive incentives, the EV industry could take off in South Africa fostered by government, and private-sector and consumer support.

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Measures should also be considered to accompany the transition of South Africa’s automotive manufacturing industry towards new vehicles technologies. As the transition to sustainable mobility takes place, several European countries have indicated plans to ban ICE vehicles: Norway by 2025, Germany by 2030, Scotland by 2032, along with England and France by 2040. Considering the number of EU countries committed to phasing out and completely banning new sales of ICE vehicles, the South African automotive industry will be affected by these changes. Such changes will impact the structuring of government incentives to maintain the local production of vehicles for exports, and also the manufacturing of components, as EVs do not require as many components as ICE vehicles. Catalytic converters, the highest component export along with conventional radiators, could see drastic declines once ICEs are no longer in use, as these components do not form part of the composition of EVs. International companies operating automotive plants would need to make significant investments to update the production lines and processes to continue the functionality of these plants to include electric and gas-based vehicles. As the global market gradually shifts to more sustainable modes of transport, incentives and institutional and physical infrastructure for the production of EVs and related components need serious consideration to retain and attract OEMs to the country.

South Africa's present policy landscape provides a mixed bag that could potentially hinder the transition to sustainable transport systems or provide an enabling environment for the system to flourish. The world is moving towards low-carbon vehicles, potentially signalling the end of the ICE age, and manufacturers will ultimately stop producing petrol/diesel vehicles. If South Africa does not get on board the electric train, the country will face multiple challenges in the years to come.


3

# Shifting to public transport

The shift element of the I-S-A framework involves the transition to more sustainable and efficient modes of travelling, such as public transport. This means ultimately moving commuters away from private vehicles towards public transport, ideally functioning on improved technologies.

An approach which fully uses the potential of public transport as well as non-motorised transport (i.e. walking and cycling) is one of the best possible ways to address constraints. Improving mobility for the majority of South Africans requires efficient and reliable public transport systems and the integration of transport modes.

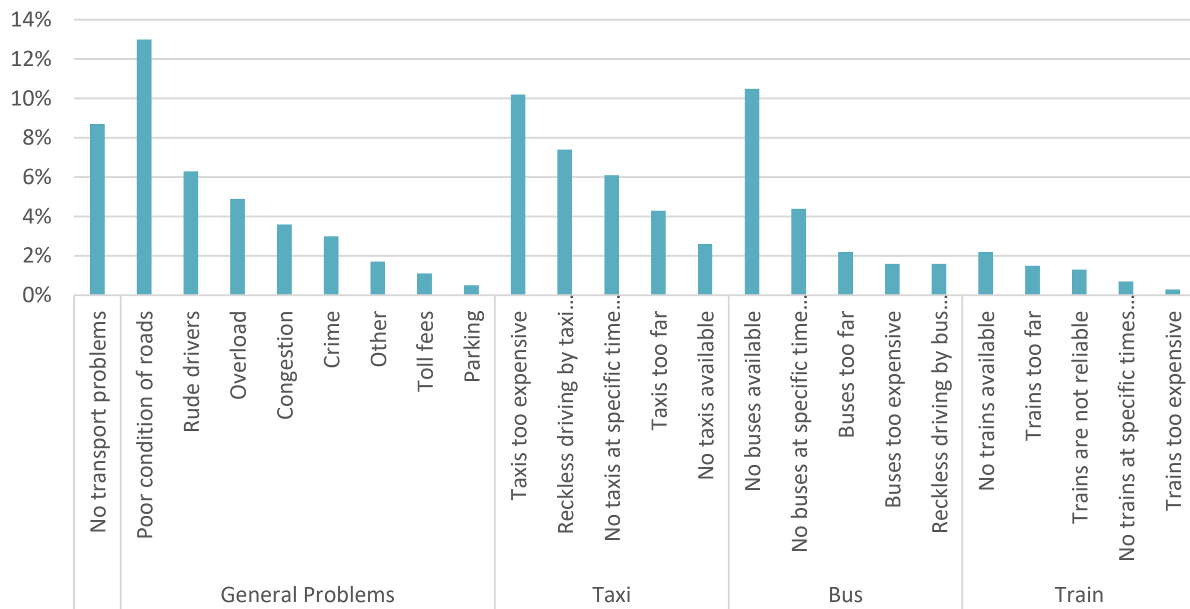
## 3.1. Diagnostic: Inefficient public transport systems

South African policies acknowledge the need for sufficient, efficient, reliable and affordable public transport with numerous policy documents and programmes available to support the development of sustainable public transport systems, such as the National Transport Master Plan (NATMAP) 2050, the Integrated Transport Master Plan, the Transport Flagship Programme and the Green Transport Strategy.

Despite meaningful public transportation on offer in urban areas with an array of service providers, such as minibus taxis, metro buses, rail, BRTs, and, the Gautrain (in Gauteng), South African commuters prefer, when possible, to use private vehicles as the sector is plagued by numerous challenges, such as inefficiency, unreliability, high costs of travel and unsafe commutes, which have reduced commuter satisfaction (Statistics South Africa, 2014). Figure 7 highlights the most important transport-related issues experienced by South Africans.

With minibus taxi-related issues, the high cost of travel, followed by reckless driving and infrequent timing are the main issues. On the bus front, South Africans cite lack of availability of bus services as one of the major public transport-related challenges they face daily, followed by infrequent bus times, especially at night, and distances travelled to the nearest bus stop. Train-related problems revolve around availability and reliability.

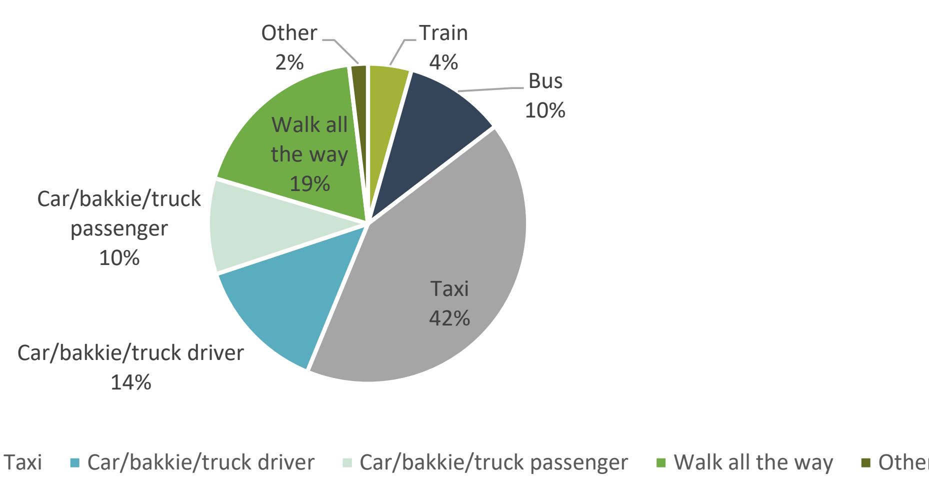
FIGURE 7: MOST IMPORTANT TRANSPORT-RELATED PROBLEMS EXPERIENCED BY HOUSEHOLDS, BY PROVINCE, 2013




SOURCE: STATISTICS SOUTH AFRICA, 2014

Nevertheless, a large majority of South Africans still rely on public transport as the main means of commuting. Figure 8 shows that, nationally in 2013, the majority of households used public transport as their main mode of transport, with minibus taxis (42%) leading, followed by buses (10%), and trains (4%).

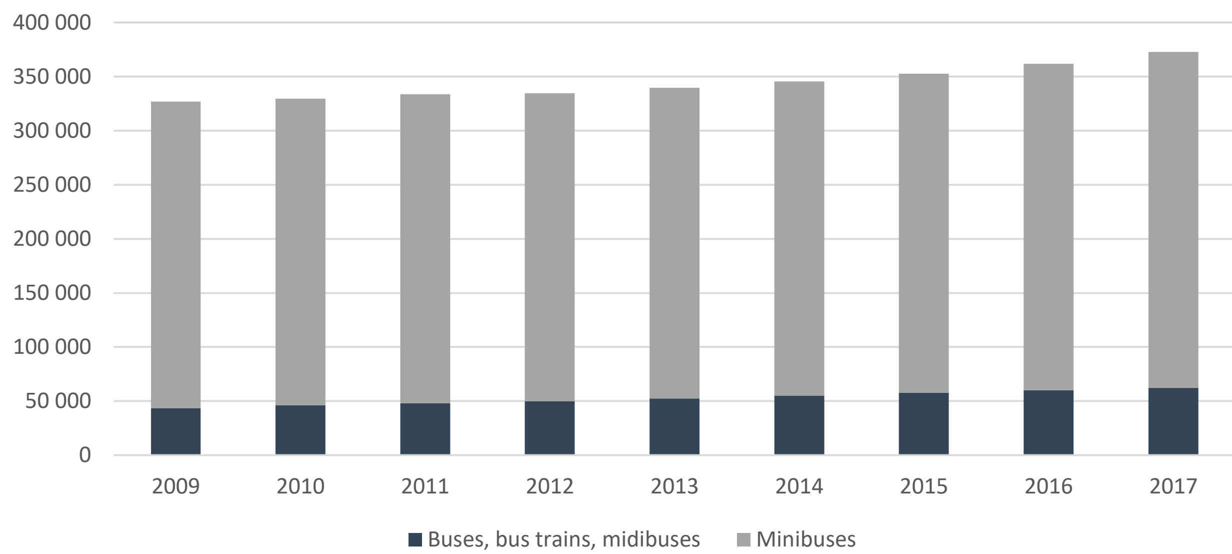
FIGURE 8: PERCENTAGE OF MAIN MODE OF TRANSPORT USED BY HOUSEHOLDS




SOURCE: STATISTICS SOUTH AFRICA 2014

To meet the demands of the South African population, the number of minibus taxis and buses has continued to increase over the past decade, as illustrated in Figure 9. Latest data on minibus taxis indicated that, in 2018, the taxi industry transported over 65% of South Africa's public transport commuters (90% being minibus taxis, and only 10% being metered taxis), with an annual fare revenue approximated at R120 billion (Mahomedy, 2018c). In 2019, the legally operating taxi fleet consisted of approximately 130 000 vehicles, with 95 000 taxis used for short- and medium-distance trips in the urban environment, and the remainder for rural and inter-city transport. More than a third of the vehicles operate in the Gauteng province (SANTACO, 2019).

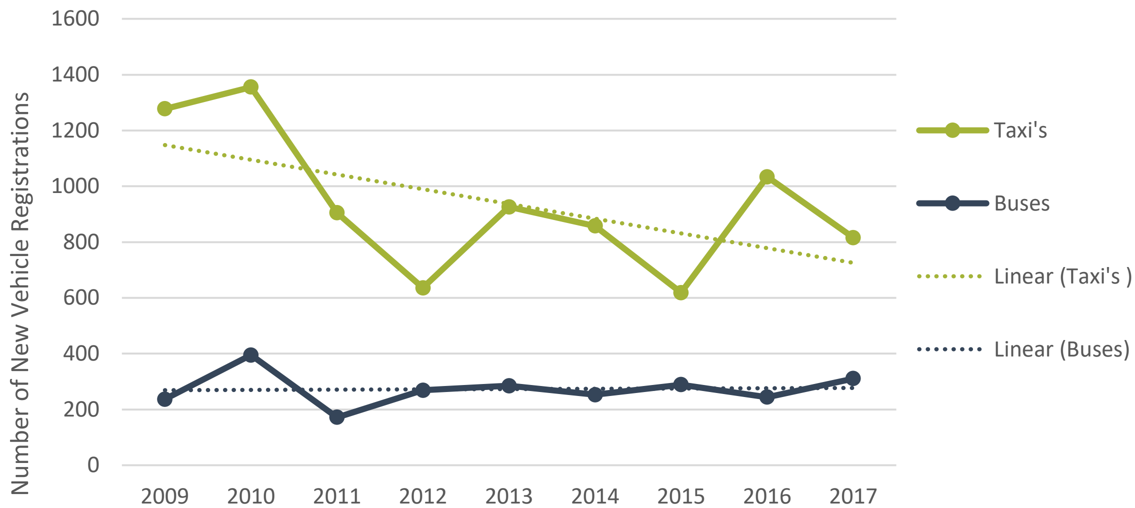
FIGURE 9: PUBLIC TRANSPORT LIVE VEHICLE POPULATION FOR THE PERIOD APRIL 2009-APRIL 2017




SOURCE: NATIONAL TRAFFIC INFORMATION SYSTEM (ENATIS), 2017

Historically, growth in the taxi industry came at the expense of state-subsidised buses (Walters, 2014), a pattern which continues to date. Interestingly, while minibus taxis account for the majority of the fleet, a shift in trend can be witnessed in recent years. New taxi registrations have been decreasing while, at the same time, new bus registrations have been growing from 2010 onwards, as indicated in Figure 10.

Figure 10: Number of New Minibus Taxi Registrations in South Africa for the period 2009-2017




Source: Authors' composition, based on National Traffic Information System (eNATIS), 2017

This could be attributed to the introduction of BRT services in several municipalities across South Africa, which integrated a number of taxi operators into the BRT systems on condition that they give up their routes and taxis. Launched in 2009 and 2010 respectively, Johannesburg's Rea Vaya and Cape Town's MyCiTi BRT programmes have incorporated infrastructure development and paratransit reform whereby some incumbent operators, after several rounds of negotiation, created new operating companies. As a user-friendly system, South Africa's BRT can measure equally to those in various countries across the globe, with commuters enjoying access to technological applications that provide regular updated information on scheduling, routes, delays and service disruptions, via a dedicated website and various social media platforms. In addition, bus fares can be paid using automatic fare collection systems. For instance, by 2015, the MyCiTi system operated on 28 routes, comprising of 300 bus stops and 35 stations on dedicated BRT lanes (City of Cape Town's Transport Authority, 2015). In 2015, the Rea Vaya BRT system transported approximately 38 000 passengers per day (South African Government, n.d.) with the MyCiTi system transporting 49 000 passengers for the same period, completing 23.3 million passenger journeys since inception (City of Cape Town's Transport Authority, 2015). The Tshwane municipality followed suit by developing the A Re Yeng BRT system, with other municipalities committing to roll out similar systems.

Despite the travel efficiency, safety, reliability and sophistication of South Africa's BRT network, these systems have thus far been implemented with varying degrees of success. Low volumes of ridership during off-peak periods and poor operational cost recovery have raised concerns (Walters, 2013). The majority of South Africa's commuters continue to resort to minibus taxi as the primary mode of transport, while BRT buses remain relatively empty, causing further inefficiencies in the sense that routes are being travelled for a limited number of passengers, whereas taxis operating on similar routes are often filled to capacity. In addition, fragmented public buses operating alongside the BRT systems, often servicing the same routes, further deters usage. For example, entities providing bus services in South Africa include:

- Privately-owned bus operations, such as Putco, InterCape and Greyhound;
- Municipal and provincial bus services, such as the Gautrain bus and City of Tshwane buses;
- Bus Rapid Transit operations; and
- Bus operations owned by parastatals, such as Autopax.

As a result, BRT systems have experienced higher than anticipated losses, only able to recover around 40% of operating costs in Johannesburg (National Treasury, 2017), while Cape Town's MyCiti has recovered around 49% of operational costs. In 2016, the National Treasury (NT) provided subsidies for overhead operating costs amounting to R290 million and R250 million for Johannesburg and Cape Town respectively (Van Rensburg, 2017). Fiscal investments of about R15 billion into the development of BRT systems in Gauteng has not matched intended returns, with only 75 000 people using the service in the province, such that South Africa's Minister of Transport has indicated that an urgent transformation of the system is needed (Venter, 2017c).

*The majority of South Africa's commuters continue to resort to minibus taxi as the primary mode of transport, while BRT buses remain relatively empty, causing further inefficiencies in the sense that routes are being travelled for a limited number of passengers, whereas taxis operating on similar routes are often filled to capacity.*

A process of cannibalisation rather than complementarity can be witnessed in some cases, leading to social unrest. In recent years, unhealthy competition between the different modes of transport, highlighted by ongoing tensions between metered taxis and e-hailing services, such as Uber and Taxify, as well as minibus taxis and BRT systems, has often culminated in violence, resulting in the destruction of transport infrastructure as well as private and public vehicles, and even death. Furthermore, the MyCiTi and Rea Vaya BRT systems have been opposed by minibus taxi operators. The deregulation of the minibus taxi industry in the 1980s unleashed uncontrolled growth of the industry and provided fertile ground for conflicts over routes and ranking facilities. Disagreements over taxi routes have been a cause of taxi violence for decades and, since 2010, violence has been exacerbated by the BRTs. If left to escalate, these unfortunate events can cripple the economy, especially as public transport is the main mode of transport for the working class.

Furthermore, unintegrated public transport networks and disparities in spatial planning have resulted in low-income households spending as much as 20% of their income on transport, as many employees reside on the peripheries of cities away from centres of economic opportunities (National Treasury, 2019a). The figure is even higher for rural residents, with 34% of monthly household income allocated to transport costs.

Moreover, uneven subsidies for the different modes of public transport have resulted in varied fares, thereby posing a challenge to the development of integrated transport networks (CoGTA, 2014). The National Land Transport Transition Act No. 22 of 2000 states that public transport subsidies should be targeted at "currently marginalised users and those who have poor access to social and economic activity". Most of the commuters captured in this description depend on minibus taxis as their main mode of transport. Public subsidies are distributed to private bus operators, to the new BRT systems in larger cities, to PRASA – the provider of intra-city train services – and to the Gautrain, which is mainly targeted at middle- and upper-class users, a select section of the population.

The South African government has further pledged a significant amount of economic resources on investing in infrastructure to support integrated sustainable public transport networks. The 2019 Budget Review indicates that R313.9 billion will be allocated to developing transport and logistics systems over the next three years, 2019 until 2021 (National Treasury, 2019b). National government will provide funding for municipalities to improve and implement integrated public transport systems through the *public transport network grant* (National Treasury, 2019b). Table 3 provides an overview of selected grants and subsidies highlight in South Africa's 2019 Budget Review.

TABLE 3: OVERVIEW OF SELECTED GRANTS AND SUBSIDIES (RANDS THOUSANDS) FOR PUBLIC TRANSPORT IN SOUTH AFRICA

| | 2016/17 | 2017/18 | 2018/19 | 2019/20 (estimate) | 2020/21 (estimate) | 2021/22 (estimate) | Total |
|---|---|---|---|---|---|---|---|
| **Public transport operations grant** | 5 400 292 | 5 722 871 | 5 990 298 | 6 325 755 | 6 749 581 | 7 120 808 | 37 309 605 |
| **Public transport network grant** | 5 592 691 | 6 107 057 | 6 286 669 | 6 468 248 | 7 495 172 | 8 366 935 | 40 316 772 |
| **PRASA (operations, capital, rolling stock fleet and refurbishments)** | 17 046 083 | 12 968 430 | 12 552 934 | 13 514 068 | 14 378 476 | 18 416 451 | 88 876 442 |
| **Taxi recapitalisation** | 359 352 | 233 542 | 411 605 | 434 655 | 458 559 | 483 780 | 2 381 493 |
| **South African National Taxi Council** | 20 275 | 21 289 | 22 524 | 23 785 | 25 093 | 26 473 | 139 439 |

SOURCE: AUTHORS BASED ON NATIONAL TREASURY, 2019B

Funds for the public transport network grant are allocated towards developing integrated public transport networks in 13 South African cities. The largest portion of government funds is geared towards bus (56% of subsidies) and rail public transport networks (44% of subsidies) (Mahomedy, 2018c), although minibus taxis serve the majority of the public transport population, funds received are unsubstantial when compared, which could be partly due to issues around formalisation of the industry.

Unsuccessful formalisation attempts have been made to improve the services and job quality within the minibus taxi industry. Minibus taxi operations are not subsidised, however, as part of an intervention to improve the effectiveness of the industry since its deregulation, the government introduced the Taxi Recapitalisation Programme in 2006. The programme presented new taxi vehicles designed to undertake public transport functions in the taxi industry. Vehicle owners that met the basic requirements handed over their old inefficient taxis for scrapping. In exchange, they would receive a R50 000 scrapping allowance that could be used as a deposit for a new vehicle. Despite this, the programme failed to meet expectations and many service providers in the country have continued using old and inefficient vehicles (Walters, 2013).

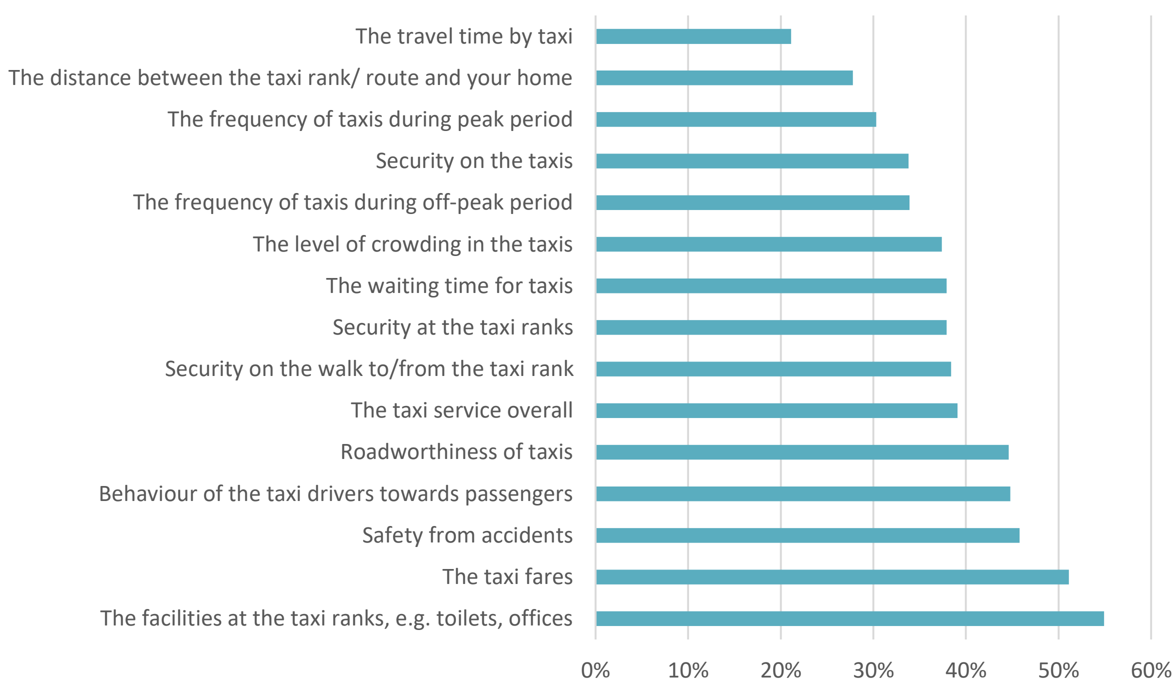
The formalisation of South Africa's taxi industry, in the sense of bringing the industry into the formal administration of government, is highly contentious. The informal reference or perceptions originates from the findings that, in contrast with the bus industry, there are few that operate with contractual agreement with any authority, there are no operating schedules or strict pick-up stops, and while there are designated taxi stops within cities taxi drivers stop wherever passengers hail them.

There have been efforts to bring formal structure to the taxi industry, key among these was the establishment of the South African National Taxi

Association (SANTACO) in 2001 after a national consultative process between government and taxi operators. The process aimed to create an umbrella body that would govern the industry and act as the primary representative. This was guided by the National Taxi Task Team recommendations of 1996 that rested on three pillars of formalisation, regulation and empowerment (SANTACO, 2017).

Still, the industry is not co-ordinated by any state authority. Areas in which taxi owners operate are organised into taxi associations that for the most parts agree on which routes they will operate. These routes are also not precise, as they are usually area based. There are some operators without licences who are therefore considered illegal. Worryingly, the number of unlicensed and unroadworthy vehicles stands over one million and keeps increasing (DoT, 2017). There are also no formal fare structures. These are fixed (i.e. a 5km trip can cost as much as 15km trip) and increases are based on decisions of operators of the industry, without recourse for commuters when fare structures are disadvantageous. As a result, 51% of South Africans cite expensive taxi fares as one of the main reasons for not using minibus taxis. In addition, safety from accidents (46%), behaviour of taxi drivers towards passengers (45%), security on the walk to/from taxi ranks (38%) and security at the taxi ranks (38%), contribute towards South Africans' decisions to not use minibus taxis, as depicted in Figure 11.

FIGURE 11: MAIN REASONS FOR NOT USING TAXIS ACROSS SOUTH AFRICA IN 2013




SOURCE: STATISTICS SOUTH AFRICA, 2014

## 3.2. Recommendations

Transformation from operating unreliable and poorly maintained buses and taxis, to creating formal and efficient transport businesses that are absorbed and integrated into the new BRT systems, is necessary for the transition towards sustainable transport in South Africa and to ensure that there are minimal job losses in the process (Olsen and Fenhann, 2015). To this end, consolidation of the numerous bus entities into a single service provider is worth exploring.

Acquiring information on the state and performance of South Africa's public transport fleet (both formal and informal) remains difficult. More research needs to be undertaken to assess the country's informal transport network along with a socio-economic and environmental analysis of existing BRT and municipal bus systems.

The BRT and Gautrain systems are proof that South Africa has the aspirations and capabilities of developing and implementing world class transport, however, the success of such systems has been hindered by socio-spatial and economic challenges.

The lack of integration between taxis, minibus taxis, buses, BRTs and rail services can be tackled using integrated infrastructure, such as a multi-use interoperable ticketing system whereby commuters are able to use one ticket for the various modes of transport, using a universal card that can be loaded with credit. To this end, Vix Technology have partnered with MyCiTI on the Integrated Rapid Transit (IRT) System, A Re Yeng and Go Durban implementing open payment systems by issuing contactless credit cards via Absa Bank, to enable commuters to pay fares. The card also serves as a debit card whereby funds loaded can be used to purchase low-value items at selected retail outlets (VixTechnology, 2018). The MyCiTi IRT systems include not only the BRTs, but select minibus taxis, Metrorail and private bus operators. To date, the card serves 35 000 daily trips operating on 210 buses in the country (VixTechnology, 2018). Complementary, mobile payments and information services can be developed to ease payment and reduce intermodal transfer times. The DoT along with various government departments, such as the dti and local government, as well as public-private entities, such as PRASA, BRT enterprises, SANTACO and the Southern African Bus Operators Association (SABOA) need to collaborate on expanding efforts to make integrated ticketing systems a reality in all South African municipalities.

In addition, the *Gauteng on the Move* mobile application has been functioning since 2018, providing commuters with real-time information of public transport across the Gauteng province, such as A Re Yeng, Rea Vaya, Gautrain Bus Services, Metrobus and Tshwane Bus Services as well as the Metrorail and minibus taxi services. Users can acquire information on fares, timetables and the locations of public transport stations. However, reviews by users of the *Gauteng on the Move* app have been mixed (Political Analysis South Africa, 2018). Information campaigns on accessibility and usage of such apps and ticketing systems could ease commuter frustrations and aid efficient and reliable journey planning.

> "
>
> *The BRT and Gautrain systems are proof that South Africa has the aspirations and capabilities of developing and implementing world class transport*

When developing policies and strategies both a top-down and bottom-up approach is essential to ensure that all affected stakeholders are consulted or involved in the planning process. Violent protests from the taxi and metered taxi industry due to the implementation of the BRT systems in several municipalities, and the growing popularity of e-hailing services, is evidence of the crippling effect that the sector can have not only on the safety of commuters, but the economy as a whole. Existing operators should be engaged in constant dialogue about how to integrate the taxi industry into BRT developments. The reform and formal integration of the minibus taxi industry is key to the transition to a sustainable transport system. To this end, engagement with industry stakeholders, public transport users, government and other affected stakeholders is essential. It is also important to set a vision for the industry and develop strategies and interventions inclusive of the industry.

Government has the responsibility of encouraging people to use public transport and non-motorised means of transport. One of the challenges is that the public transport system has to compete with the aspiration that people have to own vehicles as well as the convenience, comfort and sense of safety from private vehicles. The issue is making public transport more appealing than private vehicles. This may require associating a cost to the use of private vehicles in certain areas such as central business districts, by charging high parking fees and implementing car-free zones. A change in mindset and attitudes is required to move commuters away from private vehicle use to public transport or car sharing schemes.

The creation of more park-and-ride facilities on the outskirts of central business districts would allow vehicle owners to park private vehicles and use buses or trains into the centres of economic activities. Complementary HR policies subsidising travel costs for public transport, limited parking spaces or expensive parking fees are also measures that deter private vehicle use and encourage commuters to use the public transport services provided.

A complete overhaul of the public transport system is an angle to look into. Instead of multiple bus services operating on the same routes, a single system, whether it is BRTs or municipal buses, should be enforced, with minibus taxis serving as feeder systems to routes not yet expanded.

Furthermore, to reduce maintenance and fuel operating costs as well as improve safety, reliability and sustainability, the South African government, including respective municipalities, should impose a restriction on the maximum age of buses, whereby buses in municipal fleets have to be replaced after a certain period of time (seven-to-ten years based on international best practice). Although this will require engagement and agreement with affected parties, such as Putco and private bus operators, it is a necessary step towards transforming the public transport into a sustainable, efficient, safe and reliable system that serves the masses.

# 5 Conclusion

There are three complementary avenues for transitioning to sustainable transport systems. To achieve successful results, each component of the I-S-A model must complement the other and not operate in a silo. For example, spatially densified cities, with easily accessible public transport systems that operate on clean fuels, can sustainably transform South Africa's transport sector. Aside from the depletion of fossil fuel reserves, fluctuations in the pricing of crude oil, increases in the number of private vehicles, and the imminent threat of a changing climate, switching to alternate technologies makes socio-economic sense.

Gas-based vehicles and EVs present sustainable alternatives to improving energy efficiency and vehicle technologies, reducing reliance on imported crude oil and decreasing harmful emissions while creating and supporting local industry in the process. If South Africa does not get on board the electric train by proactively pursuing electric and gas-based vehicles, the country will face multiple challenges in the years to come. To achieve a meaningful transition towards sustainable transport, improving and enhancing vehicle technologies in the short term must be coupled with efforts to ensure that efficient and reliable public transport systems are rolled out in South Africa.

The state can capitalise on charging infrastructure technology advancements and declining prices of battery components to procure its proposed future EVs targets for government and state-owned enterprise fleets. The importance of charging infrastructure must not be overlooked. Since South Africa encompasses favourable solar radiation, a strong case can be made for the use of solar energy to charge EVs, the most sustainable option to date.

In terms of manufacturing, South Africa's automotive industry is one of the country's most successful industrial sectors and the largest export of products. The principal export market for locally produced vehicles and vehicle components is Europe, whose recent policy scenarios and consumer patterns indicate a potential end to the ICE age. To remain competitive globally, the South African automotive sector requires policy responses that support OEMs to invest in the local production of EVs and related components. While government can provide the enabling environment for sustainable transport, it is ultimately left to the private sector to drive mass uptake of improved vehicles and commuters to make use of the sustainable transport systems provided. With the appropriate policy landscape, the market for e-mobility could expand, paving the way for an opportunity to establish a competitive domestic manufacturing base.

The I-S-A approach needs to happen at the same time, but not necessarily at the same speed. While modal shifts present medium-term opportunities for transformation, improving vehicle technologies provides a suitable, complementary option for transitioning to sustainable transport systems in the short term. Furthermore, a complete overhaul of the country's transport system would be insufficient without consideration of long-term spatial planning.

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This policy paper relooks at Transforming South Africa's Passenger Transport Sector for Sustainable Development

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