TRADE & INDUSTRIAL POLICY STRATEGIES

POLICY BRIEF: 3/2018

Improving vehicle technologies for sustainable development in South Africa

OVERVIEW

Economic, social and environmental consequences of the global crisis of sustainability are hindering growth and development, particularly in developing countries. In response to the awareness of a changing climate, and ratified commitments to reduce greenhouse gas (GHG) emissions and improve sustainability, South Africa has embraced decarbonising the transport sector, the second highest emitter of GHG emissions in the country. Beyond environmental sustainability, the high costs of importing crude oil or producing and refining these fuels, growing congestion and long commuting hours, means reforming the transport sector is a priority. Attaining sustainable transport systems requires a modal shift towards environmentally-compatible, energy-efficient and low-carbon vehicles, the promotion of public transport and non-motorised transport, as well as spatial planning to reduce travel distances for commuters. While spatial planning and modal shifts present longer-term opportunities for transformation, this policy brief focuses on improving vehicle efficiencies, a suitable complementary option for transitioning to sustainable transport systems in the short term. The South African government should provide the necessary fiscal certainty and support to facilitate the uptake of gas-based and electric vehicles. These present low-carbon alternatives, to enhance energy efficiency and improve vehicle technologies, reduce reliance on imported crude oil and decrease harmful emissions while creating and supporting local industry in the process.

INTRODUCTION

The decision by the South African government to decarbonise the country's transport sector is evident in various national plans and policies, such as the National Development Plan: Vision 2030 (NDP), the National Strategy for Sustainable Development and Action Plan 2011-2014 (NSSD1), the Green Transport Strategy and the Industrial Policy Action Plan (IPAP).

After energy generation, the transport sector is the second largest emitter of GHGs in the country. Transport plays a major role in economic growth and social development, moving goods, services and people daily. As the South African economy grows, so too does demand for transport, and along with it, dependence on fossil fuels. Beyond environmental sustainability and social impacts, the high costs of importing crude oil or producing and refining these fuels, growing congestion and long commuting hours, means reforming the transport sector is a priority.

Government has acknowledged that transforming the transport sector and reducing reliance on imported fuels requires a modal shift towards environmentally-compatible, energy-efficient and low-carbon transport, along with promoting public and non-motorised transport as well as spatial planning that will reduce travel distances for commuters. A three-pronged framework, based on the Improve-Shift-Avoid (ISA) methodology, offers an integrated approach to tackling unsustainable transport while shifting to sustainable economies and societies.

The three complementary and intertwined routes to transform South Africa's transport sector are depicted in Figure 1 (page 2). Ultimately, the most favourable avenue is to develop densified cities, thereby avoiding private vehicle use altogether, and establish efficient and reliable public transport systems. Nonetheless, vehicles will remain an integral part of South African society until spatial issues and public transport gaps are addressed.

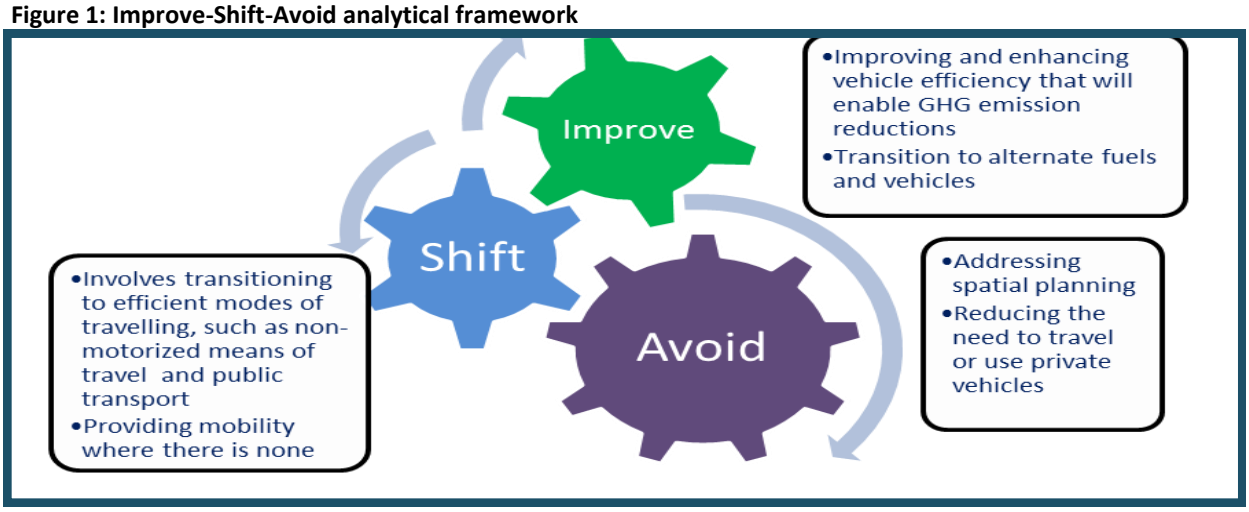
Accordingly, this policy brief focuses on the "improve" component of the ISA model. First, an analysis of the current state of transport in South Africa is provided. Thereafter, the measures available for improving vehicle technologies, such as using alternate fuels (biofuels, liquid biofuel blending), alternate energy (compressed natural gas and compressed biogas) and

Trade & Industrial Policy Strategies (TIPS) is a research organisation that facilitates policy development and dialogue across three focus areas: trade and industrial policy, inequality and economic inclusion, and sustainable growth

info@tips.org.za
+27 12 433 9340
www.tips.org.za

Policy Brief by
Bhavna Deonarain
TIPS Researcher: Sustainable Growth

Figure 1: Improve-Shift-Avoid analytical framework



Source: Deonarain and Mashiane, 2018

encouraging the uptake of electric or hybrid vehicles, are discussed. Finally, the brief formulates recommendations on a way forward.

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, the number of vehicles on the country's roads has steadily increased, reaching more than seven million in April 2017, as indicated in Figure 2. Vehicle ownership in the country is moreover increasing faster than population growth due to a catch-up phenomenon, aspirations and necessity. The trajectory of vehicle numbers 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).

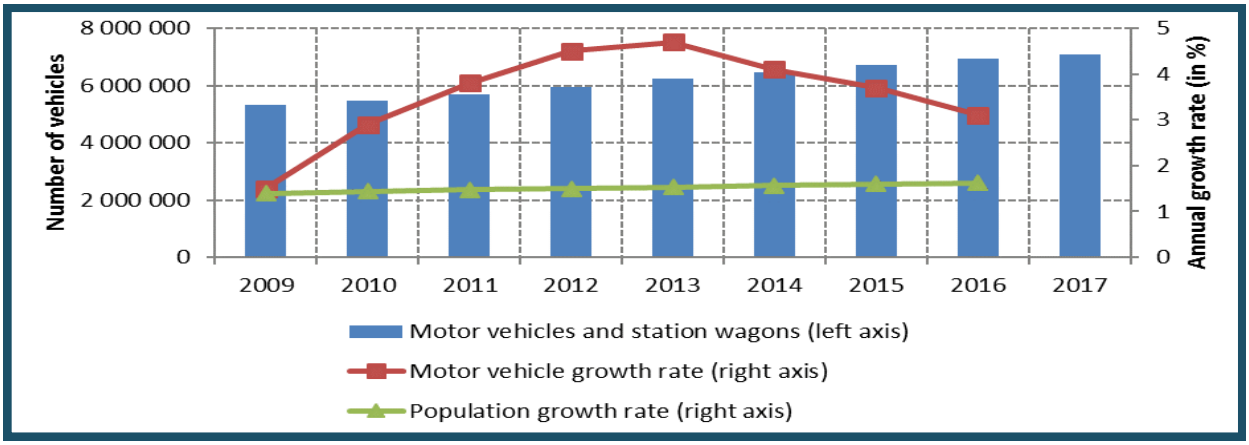
In South Africa, 98% of transport fuel is derived from refined fuels and crude oil (Gauteng Province Roads and Transport, 2013). Although declining in recent years, tremendous financial resources are spent on importing petroleum products, with a peak at more than US$16 billion in 2014 (see Figure 3).

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 a marginal number of 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. Furthermore, plans to produce and adopt Euro 5 fuel standards by mid-2017, as set by the Department of Energy (DoE) have not materialised, due to lack of investments and funding for production.

The estimated cost of upgrading refineries ranges from US$3-US$4 billion, with the South African Petroleum Industry Association indicating that the cost of upgrading refineries to produce cleaner fuels will push up the price of fuel (Oirere, 2017).

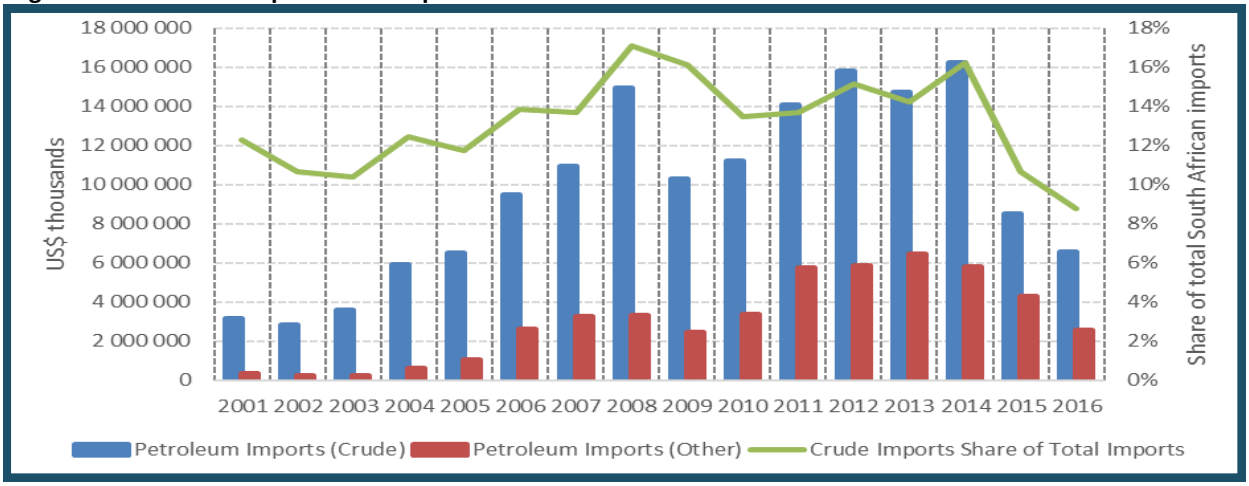
Moreover, the global roll-out of modified low-emission vehicles is planned for 2018. Soon enough, vehicle manufacturers will have difficulty reverse engineering vehicles to cater for the South African market (Droppa, 2017). Hence, a forward-looking approach is needed. Three main technologies, i.e. biofuels, gas-based vehicles and electric vehicles (EVs), can be considered at this stage.

Figure 2: Vehicle population in South Africa for the period 2009 to 2017



Author, based on data from the national Traffic Information System (eNaTis), 2017 and the World Bank, 2017

Figure 3: South Africa's petroleum imports from 2001 to 2016



Source: Author, based on data from Trade Map

INTRODUCING BIOFUELS

Biodiesel and bioethanol (derived from organic materials, for instance crops and waste residues) constitute the first main opportunity to reduce GHG vehicle emissions with minimal disruptions. Even though emissions occur when biofuels burn, they are considered carbon neutral owing to the fact that the organic matter from which biofuels originate absorbs carbon dioxide from the atmosphere (IRENA, 2017a). These fuels are generally blended with conventional fuels, which is advantageous as the infrastructure and logistics required for biofuel production and transportation are similar to conventional fuels and already exist.

However, 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, 2017a).

As a sustainable alternative, using food waste for biofuel production has been gaining attention. In South Africa, one such case is the use of oil extracted from coffee ground waste and blended with diesel to produce biofuel. South Africans consume an estimated three billion cups of coffee a year (Frankson, 2017). The waste of which could be blended to fuel buses and taxis, without any conversion or modifications to their engines.

Despite the country's attempts to establish a biofuel industry, such as the development of the 2007 Biofuel Industrial Strategy and the draft Biofuel Regulatory Framework (stipulating mandatory blending requirements by October 2015 for diesel and petrol fuels), progress in biofuel production has not been significant. 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.

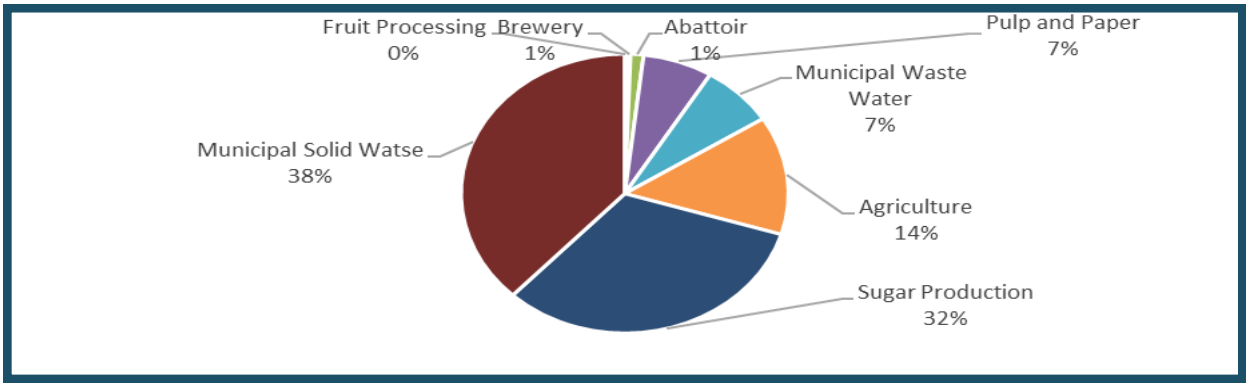
CONVERTING TO GAS-BASED VEHICLES

Converting vehicles to operate on compressed natural gas (CNG), and/or compressed biogas (CBG), is the second route to improving the sustainability of vehicles. While 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 can operate solely on CNG/CBG, and are viable for fixed routes where refuelling stations are available. Dual fuel vehicles require retrofitted gas engines, and can operate on either gas or conventional fuels.

Natural gas is reliant on imports. However, South Africa has the potential to produce three million cubic metres of biogas a day, most of which can be sourced from municipal solid waste (see Figure 4). Locally-produced CBG could reduce expenditure on importing and refining crude oil or coal-based petroleum, while achieving a lower emissions profile. In addition, biogas production via waste streams is viewed as a sustainable measure to tackle waste management. In South Africa, using CNG to fuel vehicles is considered economically feasible as gas prices are exempt from fuel levies, and therefore cheaper than conventional fuels. As of April 2018, the pump price of 93 and 95 unleaded petrol in the reef region stood at R14,23 and R14,48 a litre respectively, while a litre of diesel cost R12,75 (AA, 2018). In comparison, the price of natural gas at filling stations is lower, at R8,99 a litre equivalent (CNG Holdings, 2017).

The creation of the Southern African Biogas Industry Association, the Biogas Platform and subsequent working groups is an indication that the country is showing signs of interest for biogas production and use. Furthermore, the Department of Transport (DoT) and the Department of Trade and Industry (the dti) have partnered with development finance institutions, such as the Industrial Development Corporation (IDC), to finance vehicular gas initiatives, such as the conversion of taxis to receive natural gas.

Figure 4: Biogas potential in South Africa per sector



Source: Author, based on EcoMetrix Africa, 2016

Gas as a vehicle fuel is slowly taking off in South Africa and future demand for buses in cities is more than adequate for the creation of a local manufacturing base for these green buses, with municipalities indicating plans to procure CNG/CBG buses over the next few years (see Table 1). The City of Johannesburg, for example, initiated a pilot project which added 70 dual-fuel CNG buses to its public fleet. The Tshwane municipality has followed by purchasing 40 dedicated CNG buses operating in the A Re Yeng BRT fleet (South African Cities Network et al, 2015). As of 2016, there were 10 CBG/CNG fuelling stations and an estimated 1 000 CNG-fuelled taxis operating in the cities of Ekurhuleni, Johannesburg and Tshwane (Montmasson-Clair et al, 2017).

To further promote the uptake of dedicated CNG buses, the DoT has signalled efforts to formulate regulations stipulating mandatory conversion of 10% South Africa's metrobus fleet per annum. In the long term, regulations requiring the conversion of all forms of public transport within the next 10 years are also under consideration (DoT, 2017).

Table 1: Planned procurement of CNG/CBG buses by South African municipalities for 2015-2022

Municipality	Planned order
Johannesburg BRT/Metrobus	402
Cape Town BRT	320
Tshwane BRT	130
Ekurhuleni	50
eThekwini	60
Rustenburg	25
Total	**977**

Source: South African Cities Network et al, 2015

SHIFTING TO ELECTRIC VEHICLES

The development of electric vehicles (EVs) has significant potential. EVs produce no tailpipe GHG emissions. In countries such as South Africa, however, where electricity production is coal-based, upstream GHG emissions lead to similar levels of GHG emissions compared to smaller conventional vehicles operating on diesel and petrol (IRENA, 2017b), calling for renewable energy-based solutions. In addition, 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).

The industry is at its infancy in South Africa. As of early 2018, there were approximately 375 electric vehicles and around 100 charging stations in the country. A lack of charging infrastructure has been cited as a major deterrent for the uptake of EVs in the country (EVIA, 2017). Plans are underway to support the uptake of EVs, with government departments, in particular the dti and DoT, and the private sector, through the Electric Vehicle Industry Association (EVIA), established in 2016, actively championing the growth of the industry. Municipal pilot projects have been encouraging. The City of Cape Town for example launched the MyCiti Battery Powered Electric Bus pilot project in the latter part of 2016. Ten electric buses and two charging stations were introduced to the city's BRT network in 2017. BMW, Nissan and the IDC are also installing free fast-charging points at selected dealerships and proposed charging stations to be deployed to malls and office parks across the country (EVIA, 2017). The development of local, interactive electro-mobility technologies is also gaining traction, with some companies, such GridCars, pursuing local manufacturing (Venter, 2017).

As part of the IPAP, the dti, with additional support from the Department of Science and Technology (DST), DoT and local government, has encouraged the establishment of a local EV value chain manufacturing industry, including producing the complementary charging infrastructure, testing facilities and public awareness campaigns (the dti, 2017; Suleman et al, 2015). As part of the Automotive Production and Development Programme, the Automotive Investment Scheme provides cashback incentives amounting to 35% for manufacturers producing electric vehicles (South African Cities Network, 2015).

In addition, the 2013 Electric Vehicle Industry Roadmap proposes tax incentives and rebates for purchases, and support for research and development (R&D), in particular the creation of cost-efficient battery technologies and the provision of charging infrastructure across the country (EcoMetrix Africa, 2016b). Moreover, the National Electric Vehicle Technology Innovation Programme provides a platform for private sector manufacturers, tertiary institutions and R&D organisations to collaborate on efforts to further develop the industry, with particular emphasis on improving energy storage technologies and charging infrastructure (South African Cities Network, 2015).

Other initiatives underway, championed by the Department of Science and Technology, include 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 North-West University to develop technologies for 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.

POLICY IMPLICATIONS

In summary, there are three complementary avenues for transitioning to sustainable transport systems. While spatial planning and modal shifts present longer-term opportunities, improving vehicle technologies provides a complementary option for transitioning to sustainable transport systems in the short term. 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.

South Africa has committed to transitioning towards sustainable modes of transport. Plans and policies are under way to encourage and facilitate the uptake of cleaner fuels and EVs. While biofuels were an attractive option (and may remain for niche applications), attempts to grow a domestic market and industry in the past two decades have failed. Since then, new alternatives more suited to mass rollout have emerged. As EVs produce zero or reduced tailpipe emissions compared to regular internal combustion engines, their uptake is the preferred option (at the private vehicle level) to shift to low-carbon transport systems. With South Africa currently (2018) experiencing an electricity oversupply (Makgetla, 2017), ramping up the introduction of EVs could moreover provide a new source of demand in the near term. Locally produced power has the ability to substitute imported fuels and consequently reduce foreign exchange expenditure. Ideally, electric vehicles should be recharged through low-carbon, clean sources of electricity, such as solar energy. South Africa's abundant source of solar radiation provides a promising opportunity for the use of 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 2 carports could produce enough electricity in one year to provide 80 000 EV kilometres for a conventional sized electric car".

Similarly, using gas (preferably CBG), which produces a lower emissions profile compared to internal combustion engines and offers an average cost savings of 24% on fuel expenses, is ideal for fixed-route vehicles. In 2017, there were a reported 130 000 legal taxis and 25 000 buses operating in South Africa, which can provide a market for the uptake of CNG/CBG. Waste collection vehicles are also prime candidates for conversion as they could have daily direct access to biogas, should biogas facilities be developed on site. An opportunity also exists to combine CBG with electric motors to achieve more sustainable outcomes. Using renewable electricity and waste-based biogas can decrease GHG emissions while tackling waste management challenges and creating employment opportunities. However, the market for alternate technologies remains nascent in South Africa, despite multiple initiatives by both the public and private sectors. A shift away from the fragmented silo approach of project implementation and towards more integrated inter-departmental coordination could ensure that plans to develop, enhance and improve sustainable infrastructure and transport systems materialise. This includes policy, project and strategy alignment on achieving and promoting climate-compatible and socio-economic transport planning.

Regular purchases of electric and gas-based vehicles are likely to reduce prices in the medium term. Current regulations and taxation are deterring the transition to low-carbon transport alternatives. Import duties and Ad Valorem Tax on EVs remain higher than diesel and petrol vehicles. For example, EVs are subject to 25% import duties compared to 18% for ICE. Uncertainties over future levies on CNG are cited as additional causes for concern. In terms of hydrogen fuel cells, future demand remains relatively uncertain, with global projections indicating fuel cells will play a small role compared to battery-based EVs.

As such, the South African government should provide the necessary fiscal certainty and support. One possible measure is to decrease import duties and taxes on EV battery technologies, making electric vehicles more affordable. In addition, tax exemptions or rebates and preferential electricity tariffs for EV charging stations would promote the uptake of private use. In addition, demand reduction measures should be implemented to aid eco-mobility, by imposing taxes on high-GHG-emitting and high-fuel consuming vehicles while incentivising purchases of efficient vehicles (electric and gas-based vehicles). Furthermore, commitment to implementing the Government EV Procurement Policy, requiring mandatory EV fleet purchases, must be pursed proactively. The state can capitalise on charging infrastructure technology advancements and declining prices of battery components to procure its proposed future EV targets for government and state-owned enterprise fleets. In addition, government and the private sector should collaborate on efforts to develop emissions standards and labelling systems for new vehicles.

The policy landscape in South Africa provides a mixed bag where there is support for the transition to sustainable transport systems in some areas but not others. A great deal more needs to be done to align policies and limit the potential negative effects on South Africa's industrial capabilities in this transition process. Gas-based and electric vehicles present sustainable alternatives in attempts to improve 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 promoting electric and gas-based vehicles, the country will face multiple challenges in the coming years

It must be noted that, to achieve a meaningful transition towards sustainable transport, improving and enhancing vehicle technologies in the short term must be coupled with efforts to address unsustainable spatial planning while ensuring that efficient and reliable public transport systems are rolled out.

REFERENCES

AA, 2018. Fuel prices in South Africa [WWW Document]. AA South Afrca. URL https://aa.ensighthq.com/on-the-road/calculator-tools/fuel-pricing/ (accessed 5.4.18).

CNG Holdings, 2017. 2017 CNG Prices at Filling Stations.

Deonarain, B., Mashiane, K., 2018. Transforming South Africa's Passenger Transport Sector for Sustainable Development. TIPS, Pretoria, South Africa.

Department of Trade and Industry (the dti), 2017. Industrial Policy Action Plan: Part 2 2017/18–2019/20. Pretoria, SA.

DoT, 2017. Green Transport Strategy (final draft). Department of Transport, South Africa.

Droppa, D., 2017. SA's dirty fuel is costing motorists dearly [WWW Document]. IOL. URL https://www.iol.co.za/motoring/industry-news/sas-dirty-fuel-is-costing-motorists-dearly-11948623 (accessed 2.14.18).

EcoMetrix Africa, 2016. Facilitation of large-scale uptake of alternative transport fuels in South Africa – The case for biogas. Department of Environmental Affairs, Pretoria, SA.

Frankson, L., 2017. Converting waste coffee grounds to bus worthy biofuel [WWW Document]. Infrastruct. News. URL http://www.infrastructurene.ws/ 2017/11/20/converting-waste-coffee-grounds-to-bus-worthy-biofuel/ (accessed 11.21.17).

Gauteng Province Roads and Transport, 2013. Gauteng 25-year Integrated Transport Master Plan. Gauteng Province Roads and Transport.

HySA Infrastructure, 2012. HySA infrastructure overview. Available at http://www.hysainfrastructure.org. Accessed on 13.05.2018.

IRENA, 2017a. Innovation outlook advanced liquid biofuels. International Renewable Energy Agency, Abu Dhabi.

IRENA, 2017b. Electric Vehicles: technology. International Renewable Energy Agency, Abu Dhabi.

Makgetla, N., 2017. Responses to the electricity oversupply [WWW Document]. TIPS. URL http://www.tips.org.za/policy-briefs/item/3320-responses-to-the-electricity-oversupply (accessed 12.9.17).

Montmasson-Clair, G., Wood, C., Mudombi, S., Deonarain, B., 2017. A green economy industry and trade analysis: Assessing South Africa's potential. PAGE, SA.

National Traffic Information System (eNaTIS), 2017. Vehicle Population Statistics [WWW Document]. Natl. Traffic Inf. Syst. ENaTIS. URL http://www.enatis.com/index.php/statistics/13-live-vehicle-population (accessed 5.25.17).

Oirere, S., 2017. Refining: Uncertainty grips South Africa's Clean Fuels Program [WWW Document]. Hydrocarb. Process. URL http:// www.hydrocarbonprocessing.com/magazine/2017/april-2017/columns/refining-uncertainty-grips-south-africa-s-clean-fuels-program (accessed 6.11.17).

South African Cities Network, 2015. Accelerating the Transition to Green Municipal Fleets. The Green Fund, SA.

South African Cities Network, SANEDI, Linked Environmental Services, 2015. A business case for CNG and biogas as a green transport fuel, South African Cities Green Transport Programme. The Green Fund, South Africa.

Suleman, M., Gaylard, M., Synman, C., Tshaka, S., 2015. Policy Brief: South African Cities Network Green Transport Programme. Development Bank of South Africa, Midrand, South Africa.

World Bank, 2017. World Development Indicators [WWW Document]. World Bank. URL http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators# (accessed 9.19.17).

Venter, I., 2017. Private sector makes first move to build electric vehicle infrastructure in SA [WWW Document]. Engineering. News.