

CLIMATE CHANGE MITIGATION: IS THE SOUTH AFRICAN TRANSPORT SECTOR READY FOR CHANGE?

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ABSTRACT

Where climate change was once seen as mere speculation, it is now accepted that, without concerted effort by governments to honor their undertakings made under the Paris Agreement on Climate Change of 2015, the negative impacts of climate change and the 2050 Net Zero targets will not be realized. At the COP26 World Summit, it was recognized that many governments had not honored their greenhouse gas (GHG) reduction commitments, with the economic decisions which they had made leading to an increase in the rate of GHG emissions globally. It was understood that measures required to decrease GHG emission impacts, and the usage of fossil-fuels would need to be expedited, if Net Zero targets are to be met. Within the European Union, legislation has been adopted to decrease the production of fossil-fuel run vehicles and eliminate their production by 2035. Within all sectors of the logistics value chain, measures are being adopted to decrease logistics based GHG emissions. In this paper, the readiness of the South African transport sector to meet challenges posed by these changes will be discussed. Of relevance are the legislative changes and infrastructure required and the financial and economic impacts on the logistics sector. The readiness of the South African economy to make these changes and adaptations will also be discussed, together with possible impacts of delayed reaction to global economic logistics and legislative undertakings.

1. INTRODUCTION

The contribution of the transport sector towards increasing greenhouse gas emissions and climate change was discussed in depth in the BSR Cambridge Report Climate Change: Implications for transport, Key Findings from the Intergovernmental Panel on Climate Change Fifth Assessment Report (2014). According to the report, the transport sector, which consisted of road, rail, sea, air and coastal infrastructure, was responsible for a quarter of global energy-related carbon emissions. By 2021, the International Energy Agency (IEA, 2021) reported that end-user carbon-based emissions had increased to 37 percent globally, rising back to pre-Covid 19 levels. The reliance of the transport sector on oil is the main reason for this percentage. According to Statista (2023), in 2020, 48.6 percent of all oil consumed in Organisation for Economic Cooperation and Development (OECD) member states was related to motor vehicle usage. It was predicted that without aggressive and sustained interventions by the global transport sector to reduce these greenhouse gas emissions, the contribution of the transport sector will double by 2050. Some of the negative environmental impacts of the fossil-fuel usage by this sector include air pollutants such as ozone, nitrous oxides and particulates, as well as carbon dioxide (CO₂) (BSR, 2014). Given the recognition of the severity of the greenhouse gas impacts on the world's climate, it was agreed that climate change contributed towards escalating bad weather conditions such as more intense droughts and floods, heat waves,

thawing of permafrost and sea-level rise. Without well-timed interventions these could damage transport infrastructure such as roads, railways and ports, requiring extensive adaptation and changes to route planning in some regions. Governments have therefore, in accordance with the 2015 Paris Agreement on Climate Change (United Nations, 2023) committed themselves to substantially reduce global greenhouse gas emissions to limit the global temperature increase in this century to 2 degrees Celsius while pursuing efforts to limit the increase even further to 1.5 degrees; despite these commitments, it was expressed at the COP27 Summit that climate change mitigation was not progressing at the rate it should. If Net Zero goals were to be met by 2050, greenhouse gas emissions must be decreased by 43 percent, relative to 2019 levels (UNFCCC, 2023). Given the severity of the situation and the speed with which government interventions are required, the question of the readiness of the transport sector to adapt has to be raised. Prior to this discussion, the perceived impacts of climate change on the transport sector will be addressed together with legislation and practical global commitments made to decrease the use of fossil-fuels in the transport sector, as the dependence on oil and other fossil-fuels is the main contributing factor to the GHG issue.

2. POSSIBLE IMPACTS OF CLIMATE CHANGE ON THE TRANSPORT SECTOR

The BSR Report on the impacts of climate change on the transport sector (BSR, 2014) identified that anticipated impacts of climate change include escalating extreme weather conditions such as more intense droughts and floods, heat waves, thawing of permafrost and sea-level rise. The impacts of these escalating bad weather conditions would be felt on all four transport subsectors; road, rail, air and sea as well as coastal transport infrastructure. Some of these impacts are presented below.

2.1 Road Sector

Heat waves will lead to softening of bitumen paved roads. A solution to this issue will be the surfacing of roads with more durable and less temperature-sensitive materials. Increased freeze-thaw cycles in colder regions will damage both the base and paved surface. Increased flooding in some regions will increase the need for maintenance, and for investment in drainage and protection works. The intense KwaZulu-Natal floods of 2021 and 2022 also resulted in land subsidence, mudslides and the complete removal of sections of the roads. Bridges are also affected by flooding and require upgraded design specifications in new construction and retrofitting. It is estimated that adapting bridge infrastructure in the United States will cost USD 140–250 billion over the next 50 years; estimates for Europe are USD 350–500 million per year. Heat waves caused by global warming will also reduce the fuel and energy efficiency of public and private vehicles by increasing demand for cooling. It is predicted that energy consumption in the refrigeration of perishable freight will increase. The more intense rainfall likely in some regions may reduce driving safety, through poorer visibility and worse surface conditions, although less frost and ice will have the opposite effect. Thawing permafrost is also a systemic threat. Much polar transport infrastructure depends on permafrost for support in winter or all year. The winter ice road season has already decreased from 200 days in the 1970s to 100 days in some areas of Alaska. Large investments may be required to replace winter ice roads by conventional roads. The winter road network is projected to contract by an average 14% across the eight polar nations by 2050. (BSR, 2050) While the issue of permafrost may not be directly applicable to South Africa, colder highland areas that receive snow may also be affected.

2.2 Rail Sector

Rail beds are susceptible to increased rainfall, flooding and subsidence, sea-level rise and increased incidence of freeze-thaw cycles. Thawing permafrost may lead to ground settlement, which undermines the stability of railways. This is most likely to occur in the colder Arctic regions, however. Higher temperatures pose a threat to rails through thermal expansion and buckling. Underground electric rail systems are especially vulnerable to flooding. An example is the damage caused by Hurricane Sandy in 2012 to eight under-river subway tunnels (BSR, 2014).

2.3 Shipping Sector

More frequent droughts and floods along inland waterways will force businesses to use smaller vessels for inland shipping, for example along the Rhine in Germany or across the Great Lakes in North America, which will raise shipping costs. Within the South African context, inland shipping has not been an option because of the lack of large river waterways. Some inland waterways are projected to be useable for fewer days each year because of more intermittent water availability. With regards ocean-going vessels, a projected increase in storms in some regions may raise shipping costs by forcing ships to take longer less storm-prone routes. This may increase maintenance costs of ships and ports. More frequent delays and cancellations of ferries could also result from extreme weather events. With the melting of the ice caps the Arctic Ocean is projected to become progressively more accessible to shipping in summer as sea-ice extent decreases. By 2050 the area is predicted to be virtually ice-free. This will allow routine use of the Northwest Passage, the Northern Sea Route and other routes, and increase maritime access to coasts in northern Canada, Alaska (the United States), Russia and Greenland. However, the increase in shipping through these sensitive ecosystems could lead to an increase in local environmental and climate change impacts. The opening of these sea routes will also impact on other more established shipping routes (BSR, 2022).

2.4 Aviation Sector

More storms in some regions may increase the number of weather-related delays and cancellations in the aviation sector. Clear-air turbulence is also likely to increase in the Atlantic corridor, leading to longer and bumpier trips. More intense heat and rainfall will have similar impacts on airport runways as on roads. Higher temperatures at high-altitude and low-latitude airports may reduce the maximum take-off weight or require investment in longer runways due to less dense air (BSR, 2022).

2.5 Coastal Infrastructure

Extreme weather events like intense rainfall, high winds and storm surges are predicted to increase. These will be accompanied by rises in sea level due mostly to polar icecap melting but also increased sea-water volume at higher temperatures. As a result, roads, rail and airports near the coast will become more vulnerable to flooding and erosion as a result of sea-level rise and extreme weather events, as will ports. Globally, the value of all coastal assets (not just transport) exposed to flooding was estimated at 5% of gross domestic product (GDP) in 2005, projected to rise to 9% in 2070 (BSR, 2014).

The intensity of the anticipated damage will depend on the effectiveness of mitigating action taken and the pace at which the atmospheric temperature increases. Despite these projected impacts, researchers have questioned the methodology used to measure

potential economic costs, stating that most models are configured to determine short- and medium-term costs, without taking into account secondary costs. Using an adapted model, researchers from University College, London (2021), found that by 2100, global GDP could be 37% lower than it would be without the impacts of warming, when taking the effects of climate change on economic growth into account. In models that exclude lasting damages GDP would be around 6% lower, meaning the impacts on growth may increase the economic costs of climate change by a factor of six. Despite these models, there is still considerable uncertainty about how much climate-related damage continues to affect long-term growth and how far societies can adapt to reduce these damages. The level of damage will ultimately depend on how much growth is affected, with the economic costs of warming this century predicted to increase by up to 51% of global GDP (University College, 2021). From the study, researchers concluded that it is cheaper to reduce greenhouse gas emissions than it is to deal with climate change impacts. In addition, the economic damages from continued global warming would greatly outweigh most costs that could be involved in preventing emissions now. The risk of costs being even higher than previously assumed reaffirms the urgency for fast and strong mitigation. The decision to not reduce greenhouse gas emissions is therefore an extremely risky economic strategy (University College, 2021).

3. LEGISLATIVE INTERVENTIONS AND PROPOSED INTERVENTIONS

3.1 The 2022 United Nations Environment Programme (UNEP) Adaptation Gap Report

Despite the danger posed by climate change and the undertakings made by nations to reduce emissions to acceptable levels, the UN Adaption Report, “Too little, too slow”, has shown that governments were moving too slowly and that many had not complied with their undertakings to reduce fossil-fuel-related emissions. The 2022 United Nations Environment Programme (UNEP) Adaptation Gap Report: “Too Little, Too Slow” referred to the need for governments to accelerate their adaptation interventions in order to close the growing adaptation gap. The report referred to the impact of climate change on the developing world, indicating the projected impacts on the different continents (UNEP, 2022). According to the United Nations Framework Convention on Climate Change (UNFCCC) report of 2007 on the Impacts, Vulnerabilities and Adaptations of Developing countries, Africa will be the country most affected by climate change and therefore needs to begin monitoring and evaluating the impacts now. In addition to the monitoring of the air temperature increase and impacts of climate change on weather patterns, there is a need to monitor and evaluate the impacts of climate change on the oceans, with rising water levels, movement of fish from their traditional breeding waters, the death of coral reefs and decreasing sea grass and the impacts of these on the surrounding coastal areas as well as the marine environment (UNFCCC, 2007).

Some of the National Adaptation Programmes of Action which have been identified in the UNFCCC report of 2007 are:

- Coastal zone management including coral monitoring and restoration and improving coastal defences through afforestation, reforestation, set-back areas, and vegetation buffers.
- Improved health care through flood shelters and assistance shelters as part of community emergency preparedness programmes, better health education, better access to primary health care, such as distribution of treated mosquito nets and better malaria surveillance programmes and habitat clearance.

- Capacity-building to integrate climate change into sectoral development plans, involving local communities in adaptation activities, raising public awareness and education on climate change, and enabling representation at international meetings and promotion of sustainable tourism.

All these adaptations will require additional skillsets and new priority learning areas, over and above the areas in which there is already a lack of suitably skilled people.

3.2 Decision - CP 27 Sharm el-Sheikh Implementation Plan (2022)

In recognition of the need to expedite fossil-fuel reductions, the COP27 Sharm el-Sheikh Implementation Plan was adopted. Some of the primary undertakings related to adaptation, loss and damage, energy, financial assistance for developing nations, technology transfer and capacity building. The urgency of the document was related to the understanding that climate change goals were not being met and the adaptability gap was increasing. With regards to loss and damage, Provision 22 provides that Member states noted with grave concern, according to information in the contributions of Working Groups II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, “the growing gravity, scope and frequency in all regions of loss and damage associated with the adverse effects of climate change, resulting in devastating economic and non-economic losses, including forced displacement and impacts on cultural heritage, human mobility and the lives and livelihoods of local communities, and underlines the importance of an adequate and effective response to loss and damage” (UNFCCC, 2022).

In provision 23, they expressed deep concern regarding the significant financial costs associated with loss and damage for developing countries, resulting in a growing debt burden and impairing the realization of the Sustainable Development Goals. To assist with the growing debt burden and the costs of transition by developing and least developed economies, Provision 34 emphasized that “accelerated financial support for developing countries from developed countries and other sources is critical to enhancing mitigation action and addressing inequities in access to finance, including its costs, terms and conditions, and economic vulnerability to climate change for developing countries, and that scaled-up public grants for mitigation and adaptation for vulnerable regions, in particular sub-Saharan Africa, would be cost-effective and have high social returns in terms of access to basic energy”. In provision 33, parties expressed serious concern that the goal of developed country Parties to mobilize jointly USD 100 billion per year by 2020 in the context of meaningful mitigation action and transparency on implementation has not yet been met and urges developed country Parties to meet the goal (UNFCCC, 2022).

Other financial issues related to the costs of adaptation and reaching climate mitigation goals. These include the following (UNFCCC, 2022):

- a) About USD 4 trillion per year needs to be invested in renewable energy up until 2030 to be able to reach net zero emissions by 2050, Furthermore, a global transformation to a low-carbon economy is expected to require investment of at least USD 4-6 trillion per year (Provision 30).
- b) Delivering such funding will require a transformation of the financial system and its structures and processes, engaging governments, central banks, commercial banks, institutional investors and other financial actors (Provision 31).

- c) The growing gap between the needs of developing country Parties, in particular those due to the increasing impacts of climate change and their increased indebtedness, and the support provided and mobilized for their efforts to implement their nationally determined contributions are currently estimated at USD 5.8-5.9 trillion for the pre-2030 period (Provision 32).

On the issue of climate change mitigation, the parties:

- a) Recognized that limiting global warming to 1.5°C requires rapid, deep and sustained reductions in global greenhouse gas emissions of 43 per cent by 2030 relative to the 2019 level (Provision 11).
- b) Recognised that this requires accelerated action in this critical decade, on the basis of equity and the best available scientific knowledge, reflecting common but differentiated responsibilities and respective capabilities, in the light of different national circumstances and in the context of sustainable development and efforts to eradicate poverty (Provision 12).
- c) Called upon Parties to accelerate the development, deployment and dissemination of technologies, and the adoption of policies, to transition towards low emission energy systems, including by rapidly scaling up the deployment of clean power generation and energy efficiency measures, including accelerating efforts towards the phasedown of unabated coal power and phase-out of inefficient fossil-fuel subsidies, while providing targeted support to the poorest and most vulnerable in line with national circumstances and recognizing the need for support towards a just transition (Provision 13).
- d) Reiterates its invitation to Parties to consider further actions to reduce by 2030 non-carbon dioxide greenhouse gas emissions, including methane (Provision 14).
- e) Emphasizes the importance of protecting, conserving and restoring nature and ecosystems to achieve the Paris Agreement temperature goal, including through forests and other terrestrial and marine ecosystems acting as sinks and reservoirs of greenhouse gases and by protecting biodiversity, while ensuring social and environmental safeguards (Provision 15).

From a transport sector viewpoint, it is understandable that the key factor in climate change mitigation is the reduction and ultimately, the elimination of fossil-fuel usage to power transport and create efficient energy sources. Given the prevalence of fossil-fuel usage across all sectors, this is not an easy goal to pursue. Despite the difficulty of achieving these goals, Member states agreed that energy-related goals should be aggressively pursued.

With regards the transition to cleaner energy, the Implementation Plan (UFCCC. 2022):

- a) Emphasized the urgent need for immediate, deep, rapid and sustained reductions in global greenhouse gas emissions by Parties across all applicable sectors, including through increase in low-emission and renewable energy, just energy transition partnerships and other cooperative actions (Provision 8).

- b) Recognized that the unprecedented global energy crisis underlines the urgency to rapidly transform energy systems to be more secure, reliable, and resilient, including by accelerating clean and just transitions to renewable energy during this critical decade of action (Provision 9).
- c) Stresses the importance of enhancing a clean energy mix, including low-emission and renewable energy, at all levels as part of diversifying energy mixes and systems, in line with national circumstances and recognizing the need for support towards just transitions (Provision 10).

Given the difficulties facing developing economies, it was acknowledged that transition towards Net Zero should be implemented in a manner that is just and inclusive while minimizing negative social or economic impacts that may arise from climate action.

The Implementation Plan provided a pathway to transition, stating that (UFCCC, 2022):

- a) Sustainable and just solutions to the climate crisis must be founded on meaningful and effective social dialogue and participation of all stakeholders; and noted that the global transition to low emissions provides opportunities and challenges for sustainable economic development and poverty eradication (Provision 28).
- b) Just and equitable transition encompasses pathways that include energy, socioeconomic, workforce and other dimensions, all of which must be based on nationally defined development priorities and include social protection so as to mitigate potential impacts associated with the transition. It highlighted the important role of the instruments related to social solidarity and protection in mitigating the impacts of applied measures (Provision 29).

From the above provisions, it is understood that, despite recognition of the development goals of the different nations and the need for sustainable change, urgent mitigating action is expected of all parties, both developed and developing. With regards the finances required by developing nations, the undertaking to obtain funding from developed nations rests with the developing nations. The same holds true for technological transfers. Within developing nations, the development of protective legislation is expected, to ensure that citizens of these nations are not made to suffer unjustly. The goal of reducing 43 percent of fossil-fuel emissions by the end of 2030 places greater pressure on the transport sector to reduce logistics-related emissions by half. Although climate change mitigation requires collaboration across multiple sectors, there is still room for accelerated, targeted interventions by the South African National Department of Transport.

4. AREAS OF TRANSITION AND POSSIBLE MITIGATION STRATEGIES

From the above legislative directives, it is clear that there are three mitigation entry points.

These relate to the following areas:

4.1 Reduction of Predicted Damage to Road Infrastructure

Given that there are clear indications of the types of damage expected on roads and other transport infrastructure, preparation should be made to reduce damage to roads and road infrastructure by looking at elements that can add to road damage such as bad drainage systems, falling and loose rocks, mudslides and falling trees as well as high spillage areas

and low-lying bridges, which are constantly being flooded. As damage may occur across multiple jurisdictions, municipalities and government departments, it will require consistent effort from all affected stakeholders and governing authorities. With concerted effort and proper stakeholder cooperation and engagement as well as early warning plans and policies being adopted, damage can be minimised.

To ensure that all necessary interventions are made, action is required at a legislative, monitoring and evaluation, research and practical level.

- a) At a legislative level, it is necessary to adopt national, provincial and municipal level mitigation plans and mitigation strategies. These should include guidelines for interventions, such as damage record-keeping databases. Variables used to determine levels of risk should be utilised to assess the areas which are most vulnerable to water-based or heat-based damage based on comprehensive vulnerability assessments (e.g. Le Roux et al., 2019; Paige-Green et al., 2019). With risk assessment tools and updated databases, strategies and policies should be implemented to prevent damage, where possible. This will require engagement from all relevant government and municipal departments. Because their single window approach has not been implemented, it will be necessary to determine reporting software and systems that can be used by all departments and fed into a central system, where data is then analysed to determine risk and intervention types.
- b) Monitoring and evaluation will need to be consistent and rigorous, as the database needs to be constantly updated. In this way, patterns can be identified, and timely interventions made.
- c) Research should be done on types of materials that can be used to fortify roads and prevent overheating. Because the changes brought about by climate change are unprecedented, it is necessary to constantly assess and update the knowledge bank. This can be done through constant targeted research which will also feed targeted policy interventions. Research will also be needed to publicise the results of monitoring and evaluation reports.
- d) Practically, the drainage systems will need to be appraised and more reliable drainage systems used and properly maintained. Where bridges are too low and are constantly being flooded, they will need to be reinforced and, where possible, ways found to prevent flooding. This too will require research and partnerships with the private sector.
- e) Up-to-date warning systems and plans for extreme weather and disaster management systems must be adopted. With regards aviation and ports, the danger and damage from extreme weather conditions must be anticipated and reduced. Because of the threat of extreme weather patterns to port and airport infrastructure and the visiting ships and airplanes, plans need to be made to reduce damage, protect passengers, cargoes and vessels. Using systems adopted to mitigate climate change damage, ports and airports need to work together to reduce or prevent economic and human losses.

The above interventions can be seen as the easiest possible actions required. They are also the interventions that require the greatest speed, cooperation and stakeholder engagement. How the interventions and systems are implemented, will determine their efficiency. In addition, the actions adopted will affect the finances required. Whether the

South African National Department of Transport will be able to speedily make the required interventions will depend on the strength of their negotiations and ability to create lasting partnerships with all required stakeholders. This will need the department and other relevant parties to be properly briefed about the impending negative impacts of climate change through awareness programs.

4.2 Reduction in Fossil-Fuel-Related Emissions

These reductions relate to three separate but interdependent areas. These are clean energy production, the reduction and elimination of fossil-fuel dependent vehicles and vessels and transitional mitigating measures taken to reduce greenhouse gas emissions. In addition to these areas, there is the reduction of methane-related emissions as well as the reduction of carbon dioxide-based emissions. All of these measures need to be adopted at the same time. The level of effectiveness and the speed of their adoption is dependent on economic, social and socio-economic factors as well as access to resources and finances required to make the transition. Global efforts as well as domestic interventions in this regard will be discussed below. Given that the 2022 CoP 27 Decision called for accelerated efforts beyond the initial 2050 guidelines, current legislation and regulatory timelines for change will not be in line with expected changes and only those with immediate impacts will be discussed. With the timeframes required to enact and adopt new legislation, it is unlikely that taking this step will bring about immediate benefits. The principles applied in the National Climate Change Response Green Paper (2010), for the transport sector are applicable and provide guidance for interventions by the National transport authority.

Actions proposed by the Green paper include:

5.6.1 Continue to put in place transport policies and developments that result in a modal shift in passenger transport to public and low carbon forms of transport including plans to move freight from road to rail overtime,

5.6.2 Encourage the integration of land use and transportation planning in cities in a manner that encourages public transport, non-motorised transport (walking and cycling) and promotes alternative communication methods such as tele-commuting, in order to reduce long term transport fuel use patterns,

5.6.3 Improve the efficiency of our vehicle fleet across the board through a range of measures including the use of fuel standards.

5.6.4 Invest in the further development and deployment of cleaner technologies for the transport sector such as electric vehicles and hybrids.

5.6.5 Build capacity to deal with transport mitigation in the areas of planning, engineering, and relevant technical skills.

5.6.6 Support the production and use of cleaner fuel technologies and alternative fuels away from current fossil-fuels.

5.6.7 Implement the flat rate specific excise tax based on passenger vehicle carbon emissions which applies to each gram CO₂ vehicle emissions above a target range and investigate expanding the emissions tax to include other categories of motor vehicles.

5.6.8 Consider further incentives in the form of lower fuel taxes to encourage cleaner fuels, e.g., cleaner diesel fuel.

5.6.9 Integrate climate change information into transport planning, in order to minimise the potential risk to infrastructure from extreme weather events ‘

Although these measures were proposed in 2010, their implementation is critical, as they provide a roadmap for change and indicate a strategic action pathway. These proposed interventions will be discussed below.

4.2.1 Adoption of Electric and Other Non-Fossil-Fuel Driven Vehicles

At the COP 26 Conference on Climate change, 24 countries, including Canada, New Zealand, the Netherlands, Ireland, India, Iceland, Sweden, Mexico, Austria, Cyprus, Finland, Chile, Poland, Luxembourg, Azerbaijan, Denmark, and the UK, agreed to phase out new petrol and diesel car sales by 2030. Ford, Mercedes, Volvo, General Motors, Jaguar Land Rover and Mercedes-Benz were the only carmakers that signed the accord, pledging to reach the goal by 2035 in their main markets, as did numerous cities and regional governments, including New York, London, Barcelona and the Australian Capital Territory (The Guardian, 2021). Other countries, including India and Kenya, agreed to work intensely towards accelerated proliferation of zero-emissions vehicles, while a group of financiers and fleet owners have also vowed to phase out fossil-fuel-powered cars. Other countries, including the US, China and Germany, and car manufacturers, including Volkswagen, Toyota and BMW did not sign. A reason for their reluctance was the considerable uncertainty about the development of global infrastructure to support a complete shift to zero-emissions vehicles (The Guardian, 2021). In October 2022, European Union Member States agreed on a law to effectively ban the sale of new petrol and diesel cars from 2035, seeking to speed up the switch to electric vehicles and combat climate change. Negotiators from the EU countries and the European Parliament, agreed that carmakers must achieve a 100% cut in CO₂ emissions by 2035. This would make it impossible to sell new fossil-fuel-powered vehicles in the EU (Reuters, 2022). Despite these commitments, some stakeholders are against banning a specific technology and calling for internal combustion engines and hydrogen vehicles to play a role in the low-carbon transition. These alternatives are viable investments, especially in countries unable to make the transition as speedily as the European Union.

The EU decision has a direct impact on South African automobile producers exporting to the EU as well as the purchase of motor vehicles from European Car manufacturers, especially those who have committed to the production of electric and other non-GHG emitting technologies, as target dates for the phasing out of fossil-fuel powered vehicles grow closer. It is expected that momentum will grow and as more companies embrace the shift, the cost of electric vehicles, which are currently very expensive, will decrease and the price of fossil-fuel powered vehicles will increase, as production decreases. Within South Africa, there are three types of electric vehicles being sold: fully electric, hybrid electric and plug-in electric vehicles. In the first two quarters of 2022, more than 2000 of these vehicles were sold (Bubear, 2022). This was more than all the previous year's sales. Although the market is in its infancy, it is predicted to grow as the electric vehicle market gains momentum and more automobile companies phase out the production of fossil-fuel powered vehicles. The current issues affecting the electric vehicle (EV) market are price, charging points and range. There are already plans in place to increase the number of charging points and power them using alternative energy sources, thus protecting users from the impacts of loadshedding. It is also expected that, with increased economies of scale and increased demand for these vehicles, their prices will fall with price parity being

reached by 2025. Thereafter, the price of fossil-fuel powered vehicles will rise while that of EVs will continue to decrease. Market forces are likely to affect the market more than government interventions. The reduction of the price of EVs can also be assisted by subsidies to domestic producers, reduction in taxes and the offering of incentives. While new technology adoption is usually expensive, South Africa has been granted assistance for its transition from coal-based energy to alternative energy sources. Out of \$8.5 billion granted to South Africa from the US, UK, Germany, France and the EU in the form of loans, the latest plan suggests spending R128 billion on EVs, broken up between industrial development and innovation programs (Business Tech, 2023).

4.3 Government Interventions Through Subsidies, Incentives and Penalties

While the automobile market is likely to regulate itself, as it aligns with global climate change mitigating measures, there is still a major role to be played by the government in the regulation of current fossil-fuel powered vehicles. Already, the increasing price of petrol and diesel is affecting the South African consumer. As petrol and diesel prices continue to soar, it is likely that many drivers will consider changing to EVs. This change can be facilitated by incentives for new buyers or banks. Reduction on import taxes on electric vehicles will decrease the prices of these vehicles.

Other actions in line with the Green Paper response refer to penalties for vehicles with high emission levels. Given that most vehicles on South African roads are petrol or diesel powered, it may be necessary for the government to implement a phase out plan, with timelines for elimination. As many vehicle owners do not have the finances to purchase new vehicles, incentives may be required, together with the subsidization of EV car purchases. The manner in which these measures are adopted will have to be both just and fair.

5. CONCLUSION

The question raised by this paper was whether the Transport Sector is in a position to adopt mitigating measures and align with the changes required to meet global and domestic climate change commitments. While there is hard work ahead and difficult decisions will need to be made, if the public is made aware of the challenges being faced and assisted with the transition, then the Cop 27 goals could be met. Given that the impacts of climate change on the various subsectors are known and have already been experienced, proactive action by the SA National Department of Transport will ensure that these impacts are minimized. With the right mix of subsidies, penalties and incentives, it will be possible to accelerate the adoption of new technologies and the supporting infrastructure needed to increase consumer confidence and allay fears. Timely action and cooperation amongst the different stakeholder Departments will enable them to govern and reduce current GHG emissions while driving the transition towards cleaner technologies within the Transport sector. With timely action, nothing is impossible, especially if policy makers are mindful of the plight of lower-income consumers and implement sound intervention strategies to include them in the transition.

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