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The Green Transport Strategy of South Africa: GHG mitigation potential of road transport interventions and their economy-wide impact

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Key Messages

- A reduction in GHG emissions can be achieved with an improvement in economic growth and employment
- The electrification of transport in tandem with the deployment of low carbon power systems confer the most benefit for GHG emissions reduction
- The adoption of passenger and light commercial electric vehicles are shown to be the prime agent with which to satisfy the Green Transport Strategy (GTS) vision

Introduction

South Africa is a signatory to the Paris Agreement and the country's recent NDC revision [1] signals its commitment for ambitious reductions in GHG emissions. Second to the power sector, which remains a coal-centric system with an emissions intensity of approximately 0.9 $kgCO_2/kWh$, the transport sector was estimated to emit ~60 Mt CO_2eq in 2017, for which road transport was responsible for ~96% of the total. Accounting for ~13% of the national GHG inventory (including land use and natural sinks), the sector is comparable to the industrial sector and larger if emissions attributed to transport fuel production are included.

The National Transport Master Plan 2050 (NATMAP 2050) is South Africa's cornerstone policy instrument which outlines key transport planning themes. It emphasizes the preservation of the environment in tandem with accessible, cost reflective, and affordable transportation services. In accordance with NATMAP 2050 and in response to the National Climate Change Response Policy white paper which advocates a climate-resilient and low carbon economy by 2050, the Green Transport Strategy (GTS) was drafted [2]. The purpose of the GTS is to serve as an implementation plan, tabling interventions which would contribute equitably to meet the national objective of a low carbon transport sector.

Aim

This study assesses the 2018 revision of the GTS for its efficacy to achieve the GHG reductions envisaged within its strategic vision. Specifically, GHG emissions reductions and their economy-wide impact are quantified for interventions that target road transport, which is also the predominant focus of the GTS. The economic impact is quantified by comparing annual growth in employment and Gross Domestic Product (GDP) for the scenarios (or pathways) described below.

Approach

> The strategic vision of the GTS is "to substantially reduce GHG emissions and other environmental impacts from the transport sector by 5% by 2050", while maximizing the role of transport in promoting economic growth.

The GTS consists of 10 strategic pillars with 6 short-term strategic targets. These pillars and interventions provide objectives for the transport sector but do not necessarily indicate how these will be achieved or specify targets or deadline for achieving them. For this reason, the interventions modelled are those related to land transport which have sufficient information to be quantitatively assessed and/or can be further defined using other stated government targets.

The assessment is conducted utilizing a least-cost optimization modelling platform representing the national economy (SATIMGE). The platform consists of a linked bottom-up technology rich energy model (SATIM) and a Computable general equilibrium (CGE) economic model (SAGE) as illustrated in **Figure 1**. Investment choices and energy costs from SATIM are parsed to SAGE which in turn, parses sector growth and household income, determining technology adoption and timing of investments in SATIM.

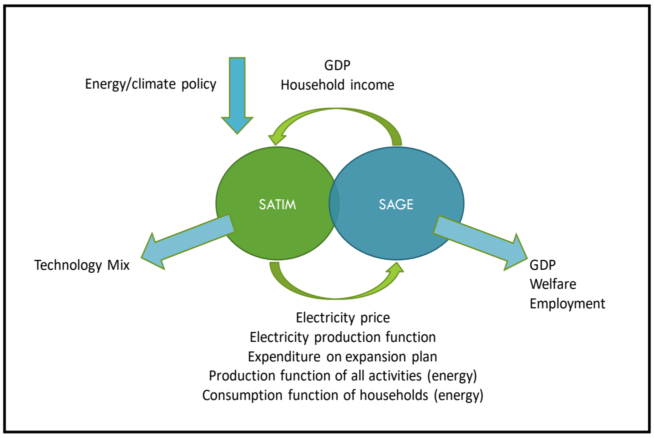

Figure 1: Linked energy-economy modelling framework (SATIMGE) [3]

Intervention	Attributes
Reference	Baseline scenario with EV premium at 25% relative to conventional present-day technology. Rail share of land corridor freight constant at 13% (2016 share)
FreiRail	30% road corridor migration to rail by 2030 reaching 50% by 2045
PassMode	20% relative shift to public transport by 2030 reaching 50% by 2050
AltVeh	Cost parity for all alternate vehicle technologies by 2030 (e.g., battery-electric or fuel-cell)
MinBusDual	Minibus taxi fleet converted to bi-fuelled natural gas and petrol by 2030
MetBusGas	Urban bus fleet converted to natural gas fleet by 2030
GTS All	All above mentioned interventions

Table 1: GTS interventions assessed in the framework

Findings

Table 1 lists the GTS interventions assessed utilizing the SATIMGE model for which the resulting GHG emissions are displayed in **Figure 2**, and the associated economic indicators in **Figure 3**. Figure 2 contrasts the impact of the transport sector, with GTS interventions implemented, against the evolution of the national inventory (which is primarily influenced by future investments in the power sector). As indicated by the national total for GHG emissions, the least-cost approach presumes a future electricity sector dominated by growth in low carbon technologies such as wind, solar, and batteries, potentially complemented with either hydrogen or natural gas [4].

The study assumes that by 2030 [5] cost parity of electric vehicles (EVs) is achieved with conventional vehicles and that by then either import tariffs for EVs are removed or that the domestic automotive sector produces EVs.

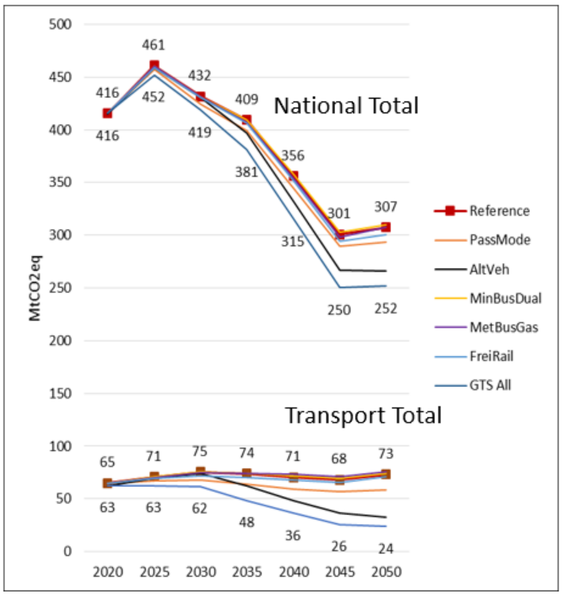

Figure 2: GHG emissions resulting from the GTS interventions

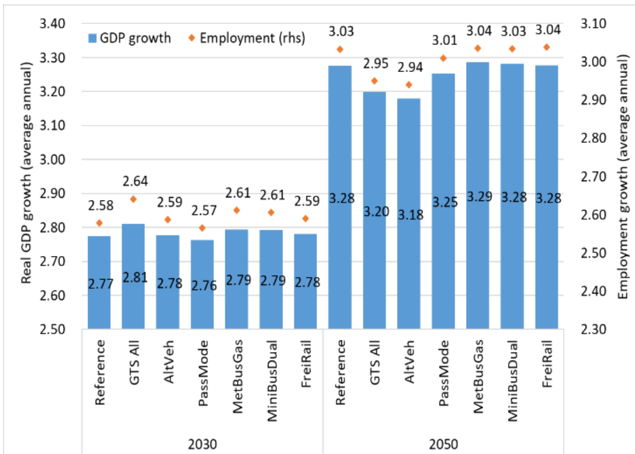

Figure 3: Real GDP and employment growth by GTS intervention

The findings show that a coherent policy approach to decarbonizing road transport is required to avoid counteracting and/or inconsequential interventions. A policy which incentivizes the adoption of electric vehicles, in line with global expectations of price parity with conventional vehicles by 2030, is shown to exceed the GTS vision for substantial GHG emissions reductions of 5% by 2050 from the transport sector. Import tariff reductions or strategically positioning the domestic auto industry to manufacture EVs present a feasible policy pathway.

Modal switching in both freight and passenger transport are interventions that are shown to be significant and policies encouraging alternatives such as rail and non-motorized transport should also be prioritized.

GHG Emissions

- A modal shift to public transport (PassMode) provides the largest near term (2030) gain followed by a migration to rail corridor freight (FreiRail).
- Rail freight transport contributes 2% of the emissions savings (FreiRail).
- The dual-fuel conversion of minibus taxis (MinBusDual) and the gas fuel conversion of Metrobuses (MetBusGas) achieve negligible national emissions savings.
- Presuming cost parity by 2030, alternate vehicle technologies (AltVeh) provide the largest gains during 2030–2050 (7%–13%) with a modal shift (PassMode) intervention the second largest contributor (3%–5%). Referring to **Figure 4** and **Figure 5**, the gains result primarily from the deployment of battery electric vehicles (BEVs) in the private passenger and freight sector (light duty vehicles). Notably, fuel cell vehicles (FCV), as alternate electric vehicles, feature in the heavy-duty vehicle segment in the freight sector.

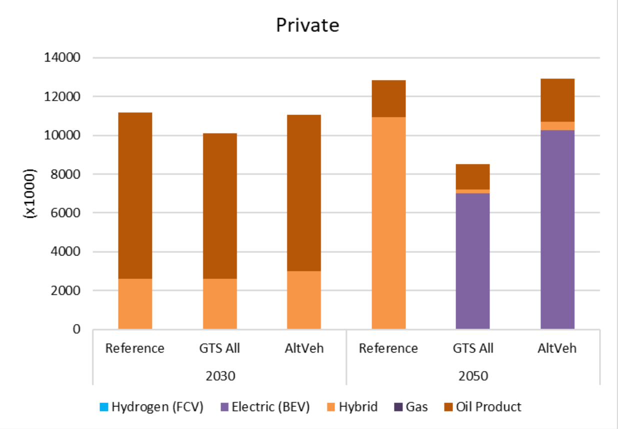

Figure 4: Evolution of private passenger fleet vehicles for selected GTS interventions

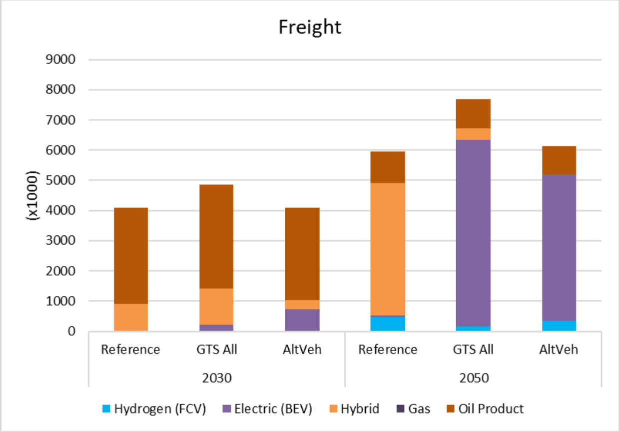

Figure 5: Evolution of freight fleet vehicles for selected GTS interventions

- That the avoided emissions in 2030 are solely attributed to direct transport activity indicates that the supply chain impacts are negligible during the near-term implementation horizon. To 2050, however, supply chain impacts are more pronounced.

Economy

- The macroeconomic results (Figure 3) show that relative to the reference case, the implementation of the GTS interventions leads to similar or higher economic growth and employment in both the short and long term. The exceptions are the GTS All and AltVeh scenarios. By 2030, average annual real GDP growth is 0.04 percentage points (%pts) higher and an additional ~229,000 jobs are created in the economy. The level of real GDP is 0.7% higher than in the reference case. By 2050, the benefits to the economy are larger with average annual growth increasing by 0.17 %pts relative to the reference case (or 3.8% in level terms) and employment increasing by 1.6 million.
- Crude oil and refined product imports account for ~3% of GDP. By 2050, crude oil and petroleum imports decrease from 0.6% of GDP in the reference case to 0.4% when all GTS interventions are implemented (GTS All).

> It is important to note that the associated benefits or costs related to productivity improvements or supporting transport infrastructure is not included in the economic assessment presented in this study. Neither is the positive impact of improved air quality on health and labour productivity

Recommendations

In this study, incentivizing the adoption of alternative vehicle technologies are shown to be the prime agent with which to satisfy the (Green Transport Strategy) GTS vision. Specifically, the electrification of transport — contingent on the deployment of low carbon power systems — offers the most benefit.

A policy encouraging the adoption of electric vehicles would exceed the GTS 5% mitigation benchmark.

The GTS alternative vehicle technology intervention as modelled in this study is dominated by electric vehicles in the passenger and light commercial fleet and these market segments should therefore be targeted for the creation of a domestic EV economy.

The conversion of public transport vehicles to natural gas offers negligible GHG mitigation benefit and presents a counteracting intervention in contrast to electrification.

Passenger modal shifting to public transport and road-to-rail migration of freight (in tandem with decarbonization of the electricity system) are revealed as interventions of significance, presenting effective mitigation gains in accordance with GTS vision.

The GTS could achieve substantial GHG mitigation in transport and the national inventory if the interventions are implemented as tabled. Furthermore, in light of continued technological innovation, the "5% by 2050" mitigation goal appears conservative and should be reviewed for a more ambitious target in accordance with South Africa's revised Nationally Determined Contribution (NDC).

This reduction in emissions can be achieved with an improvement in economic growth and employment.

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Notes

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