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TRADE & INDUSTRIAL POLICY STRATEGIES

EXPLORING THE POLICY IMPACTS OF A TRANSITION TO ELECTRIC VEHICLES IN SOUTH AFRICA

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ABBREVIATIONS

APDP	Automotive Production Development Programme
Bbl/d	Barrels Per Day
CF2	Clean Fuels 2
CTL	Coal to Liquid
EU	European Union
EVs	Electric Vehicles
GHG	Greenhouse Gas
GWh	Gigawatt hours
ICE	Internal Combustion Engine
LCOT	Levelised Costs of Transport
LPG	Liquefied Petroleum Gas
MaaS	Mobility-as-a-Service
OEMs	Original Equipment Manufacturers
RAF	Road Accident Fund
SADC	Southern African Development Community
SSEG	Small-Scale Embedded Generation
V2G	Vehicle-to-grid

OVERVIEW

The world is moving quickly towards electric vehicles (EVs). The transition to electromobility is happening and South Africa needs to prepare for this to manage the negative transition impacts and maximise the positive impacts.

The electric vehicle story

The transition from internal combustion engine (ICE) vehicles to EVs would have deep, multifaceted, macroeconomic implications for the South African economy. The net macroeconomic effect remains uncertain, but the cost bearers and beneficiaries are largely distinct making a net effect largely abstract to affected stakeholders.

The decrease in petrol/diesel consumption would lead to a reduction in government revenue, but would be compensated by a decrease in imports of crude, petrol and diesel. However, the closure of refineries would lead to an increase in imports of kerosene/jet fuel and other hydrocarbon products. Other impacts include a reduction in health expenditure and increased productivity, an increase in disposable income, and an (assumed) unchanged investment in road infrastructure.

Refineries' product mix cannot be easily changed. Reduced domestic demand for petrol, in particular, would require export of these products at global market prices, leading to refinery shut downs. For local refineries to produce EU5 enabling fuels (Clean Fuels 2 – CF2) in South Africa), they would need to undergo significant and expensive hardware upgrades without being able to recover those investments. Refineries may therefore shut down sooner than they would due to EVs displacing ICE vehicles. The Secunda coal-to-liquid (CTL) facility should be the last fuel production facility to shut down. Any investment in a new refinery risks becoming a stranded asset. Ports and import facilities would need to be modified/upgraded to handle a changed liquid fuel import product mix and increased volumes. Product would start to flow from inland to coast, requiring a shift in the logistics component of the liquid fuel value chain. Facilities in the sales and marketing component of the value chain would experience closures, leading to job losses and reduced value add.

EVs would increase annual electricity demand. This can likely be managed through proper planning and system operations requiring no significant investment in additional electricity generation capacity. Increased electricity sales, dampened due to the energy efficiency of EVs, as well as increased investment in embedded generation (rooftop solar systems), grid balancing and integration benefits (in the future) would be expected.

South Africa has built a world-class automotive sector production capacity that is a significant pillar of the country's economic landscape. As the EV transition unfolds, the industry (in its existing form) is likely to lose its principal markets. This would have structural impacts on the nature of government incentives required to maintain local automotive production in the country. The global decline in the use of catalytic converters (accounting for 39% of global platinum demand) could also pose severe implications for South Africa's platinum industry.

Lower transport costs would benefit energy-intensive sectors and increase the disposable income of all South Africans, but these would benefit the wealthy more unless coupled with efforts to broaden access and ensure a just transition. A significant reduction in local air pollutants from vehicles would improve health and reduce associated costs.

The opportunity exists to develop a proactive policy framework that would shape and drive a just transition for the benefit all South Africans in a balanced manner – this opportunity needs action now.

EVs consume less energy per kilometre travelled and could, given the current South African vehicle parc (vehicles in use). and largely coal-fired electricity grid, lead to a 34% decrease in road transport greenhouse gas (GHG) emissions. Charging EVs from renewable energy sources pushes the decline to 67%.

Policy implications

Proactive policy is necessary to drive the EV transition in a particular direction. Left to the market, the benefits and costs of an inevitable transition would not be equitable. A coherent policy framework is needed.

A liquid fuels transition plan is needed to minimise job losses and maintain the liquid fuel and petrochemical feedstock supply. This requires a reskilling programme and a mechanism to enable adequate planning in the face of potential refinery closures and an accompanying redesign of the logistics infrastructure and conversion, where possible, of the existing service stations to alternative uses. Any new modern world-scale refinery would need to meet the future, changing product slate.

Proactive measures are needed to mitigate potential negative grid impacts associated with clustering and uniform charging during peak periods. EV electricity tariffs should be designed to influence charging behaviour, coupled with direct controls, both tested and adjusted iteratively as demand increases.

Preserving the position of the South African automotive industry would require significant investments by original equipment manufacturers (OEMs) to update the production lines. While government has no direct control over the models manufactured by OEMs in the South African plants, proactive policy options are available to facilitate the transition. On the manufacturing side, while largely non-discriminatory, the policy framework in its current form penalises EVs, compared to ICE vehicles.

As the shift to EVs unfolds in the country, a just transition is imperative to ensure inclusive development in the long run. This requires that workers, small businesses and communities are adequately supported; and ensuring that the shift to EVs bring benefits to all layers of society. This requires a focus on access to public EV transport, shared ownership and inclusive urban planning.

The change to EVs would cause major changes in the government financing model owing to reduced fuel-related revenues but also reduced expenditure due to improved balance of payments, reduced transport costs and improved health. A key challenge is to address imbalances owing to different recipients of the costs and benefits of the transition. Budget needs to be allocated to ensure a balanced and just transition.

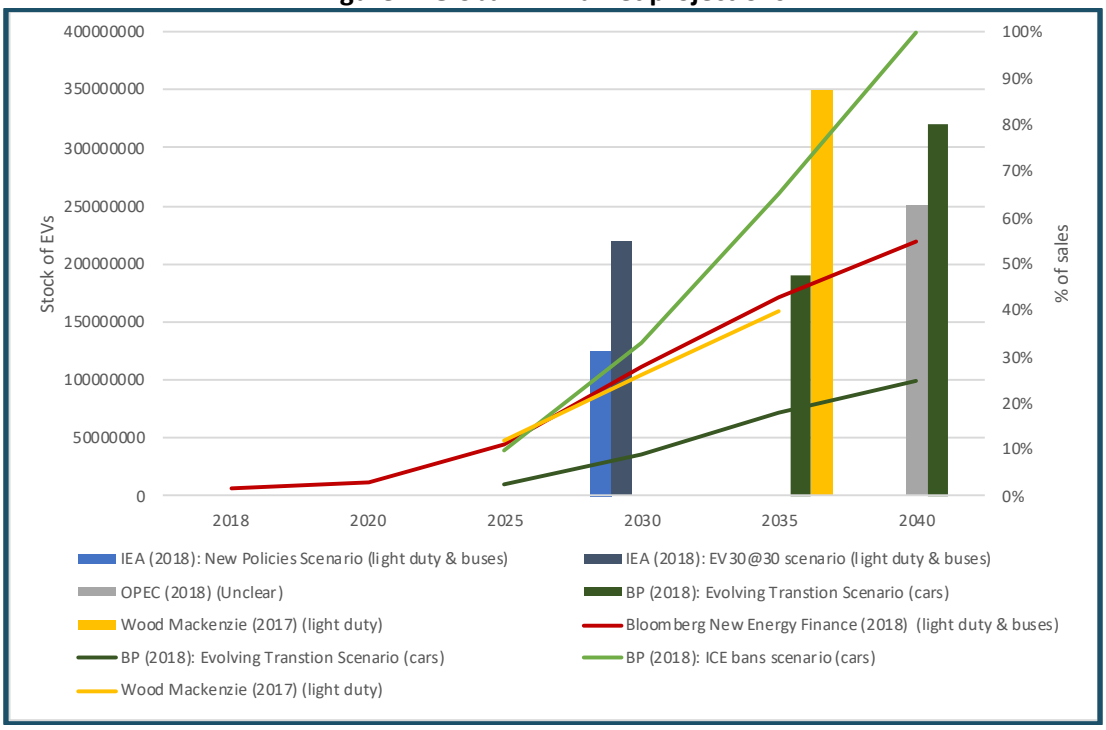
The opportunity exists to develop a proactive policy framework that would shape and drive a just transition for the benefit all South Africans in a balanced manner – this opportunity needs action now.

1 INTRODUCTION

Many **countries and regions have announced plans to phase-out fossil fuel vehicles and shift to e-mobility**. Leading examples include Norway's plans to have all new light vehicles, city buses and light commercial vans to be zero emission EVs after 2025 and all new heavy commercial vans, 75% of new long distance buses and 50% of new lorries to be zero emission EVs after 2030. All new cars are to be emission free by 2030 in the Netherlands, Ireland and Slovenia. Similar, but slightly longer term, goals and ambitions have been expressed by Scotland, California, France, Portugal, Spain, Sri Lanka and the United Kingdom. Most of the countries plan to ban sales of ICE vehicles. Other countries have set targets relating to the absolute number or overall share of EVs by a certain year (Solicit, 2019). **Numerous cities are following similar bold actions** with Seattle aiming for 30% EVs by 2030; 25% of all new vehicle registrations in New Delhi to be EVs by 2023; and all buses to be EVs in Hong Kong. Various cities, including Cape Town, have signed the C40 Fossil-Fuel-Free Streets Declaration (to procure only zero-emission buses from 2025) (SLoCaT, 2019).

Companies are responding, including major OEMs. The majority of global car manufacturers are developing long-term EV targets (differing widely in scale). Market trend reports vary, with absolute projections for electric vehicles on the roads in 2030 ranging from 71 to 160 million, however, **all analysts point to increased EV penetration over time** (SLoCaT, 2019), as shown in Figure 1.

Figure 1: Global EV market projections



Source: Authors, based on SLoCaT, 2019

The world is moving quickly towards EVs. The transition to electromobility is happening and South Africa needs to prepare for this to manage the negative transition impacts and maximise the positive impacts. It is important to understand the economic, social and environmental impacts of potential South African EV market scenarios to inform appropriate policy interventions.

2 ELECTRIC VEHICLES STORIES

International experience shows that regulatory support and incentives are a significant driver of EV penetration. The extent to which South Africa plans for the transition and establishes an enabling environment will dictate the speed at which EV technologies will be deployed in the country. Regardless of domestic policy, international regulatory drivers and market forces will continue to drive down the cost of electromobility and limit the demand for ICE vehicles globally. South Africa will experience an increase in the deployment of passenger and freight EVs and a changing global vehicle market that will result in different effects impacting the South African economy, its people and the environment.

2.1 Macroeconomic story

The transition from ICE vehicles to EVs would have deep, multifaceted, macroeconomic implications for the South African economy. The first and main channel would be through the supply and demand for ICE vehicles and petroleum products. The other channel would be through the spillover effects on the environment, households and infrastructure. While **the net macroeconomic effect remains uncertain**, clear-cut costs and benefits can already be identified. Importantly though, **cost bearers and beneficiaries are largely distinct,** making a net effect largely abstract to affected stakeholders.

The decrease in petrol/diesel consumption would lead to a reduction in government revenue, with a material decrease in the revenues collected from the fuel levies. In 2017/18, fuel levies contributed R70.9 billion to government's revenues, i.e. close to 6% of net revenues. Similarly, reduced sales in ICE vehicles would lead to a reduction in the carbon tax on motor vehicles, which raised R1.3 billion in 2017/18. The impact on the tax incentives[1] targeting motor vehicle production in South Africa, which totalled R28.4 billion in 2016/17, remains uncertain, as it depends on the levels of local production and imported vehicles (National Treasury, 2019).

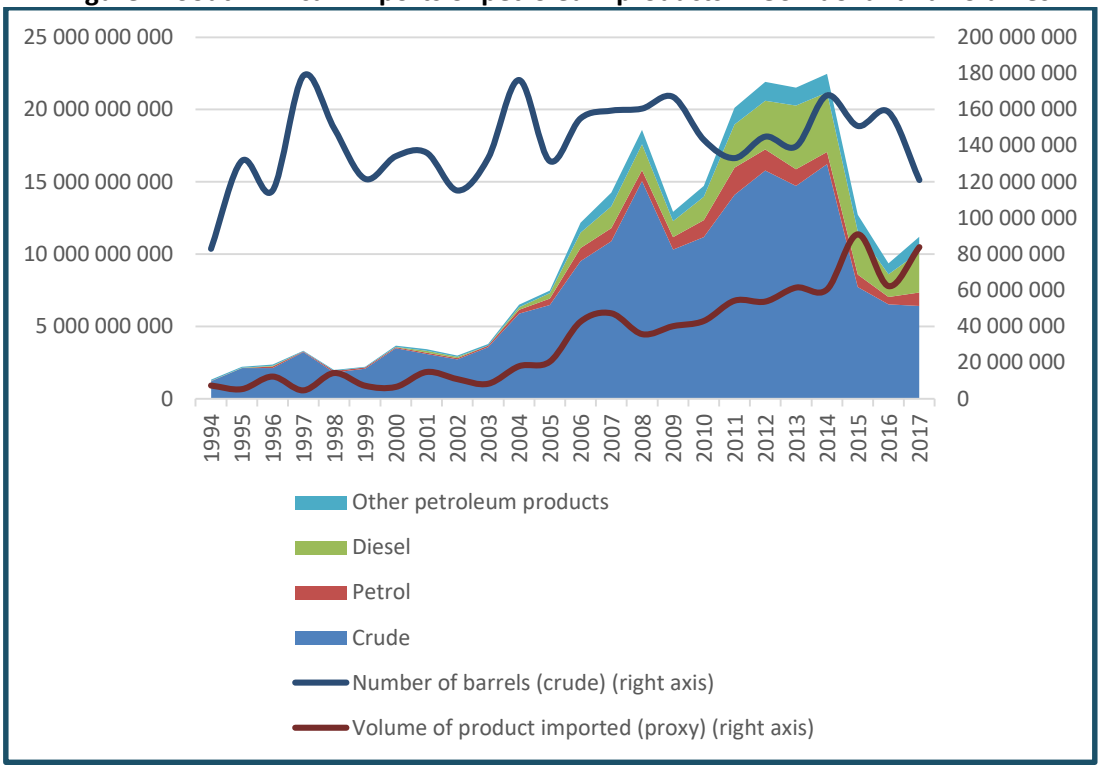
This negative impact would be compensated by a decrease in imports of crude, petrol and diesel, displaced by locally-produced electricity, with favourable impacts on South Africa's foreign exchange reserves, the Rand exchange rate and economic development. South Africa's need for petroleum products is met for 80% through imports, with petrochemical firm Sasol producing the remainder through the coal- and gas-to-liquid processes. Petroleum products are the largest South African import, valued at USD 11 billion in 2017, as showed in Figure 2.[2] A full transition of the country's vehicle fleet would lead to a decrease of imports by about two-third. Positive impacts on electricity load management may, in addition, reduce the need to use diesel-fired peaking plants, with further positive effects on diesel imports.

However, the closure of refineries will lead to an increase in imports of kerosene/jet fuel and other products unless refineries can stay open, based on the local market (as exports are not considered a viable option) or biofuels can be produced locally.

[1] This includes the Automotive Production Development Programme (APDP), the Import Rebate Credit Certificate and Duty Credit Certificates.

[2] While the value of imports has varied over time, due to the volatility of oil prices, volumes have remained largely constant over time. The composition of imports (in volume) essentially varies depending the productive availability of local refineries.

Figure 2: South African imports of petroleum products in USD dollar and volumes



Source: Authors, based on Trade Map for trade data, World Bank for oil prices, and South African Reserve Bank for exchange rates. Note: number of barrels estimated based on monthly trade data, exchange rates and Dubai crude prices; the volume of product imported is an imperfect proxy as the crude price is used rather than the weighted average price of the finished products, which is not available.

Other channels would include the following spillovers:

- EVs would have positive impacts on air quality, notably in urban areas, with beneficial health effects. This would, in the long run, lead to **a reduction in health expenditure and increased productivity**, with positive spillover impacts on the fiscus;
- The **increase in disposable income,** resulting from lower transport expenditure due to lower Levelised Costs of Transport (LCOT)[3] of some existing EVs and for most EVs in the future, while not enough to reduce the need for social grants would have a positive impact on households' and businesses' spending and indebtedness and, ultimately, economic activity, with positive impact on fiscal revenues;
- **Investment in road infrastructure is assumed to remain unchanged** as a result of EVs only**.** In the longer run, however, the greater use of public transport and the introduction of Mobility-as-a-Service (MaaS) and autonomous vehicles, all supported by EVs, would reduce the volume of vehicles on the road as well as improve road safety. Such trends would contribute to a decrease in infrastructure and Road Accident Fund (RAF) spending.

[3] LCOT is the discounted lifetime cost of ownership and use of a transport asset, converted into an equivalent unit of cost of transport in Rands per passenger kilometre or tonne kilometre.

The shift from ICE vehicles to EVs is a disruptive trend for the automotive industry worldwide and South Africa is no exception.

2.2 Economic story

2.2.1 Liquid fuels sector

The **demand for petrol and diesel by passenger vehicles would reduce** as the proportion of ICE vehicles in South Africa decreases and the proportion of EVs increases. The liquid fuels industry is a sunset industry, but it would not disappear suddenly. However, as fuel demand decreases, there would be different impacts in each sector of the value chain, consisting broadly of manufacturing/refining, logistics and distribution as well as sales and marketing.

Since current petrol and diesel demand exceeds local production, as demand reduces the initial response would be the **decrease in the volume of imports of petrol and diesel**. As demand reduces further, a point would be reached when local production will exceed demand**.** At this point, for refineries to continue operating, this **excess product would need to be exported**.

The product mix from refineries depends on the crude type that is processed together with the hardware configuration. As a result, without changing crude type, **the product mix cannot be easily changed** without losing efficiency (underutilisation of existing hardware) or adding new hardware, both of which would reduce profitability (Leffler, 1979).

Exported products are usually not as profitable as those sold locally due, at least, to the freight cost to the destination port being absorbed by the exporter. As more EVs come into use globally, more volumes would compete for the remaining export markets, further driving down prices. Once export volumes or prices reach a certain point, **refinery profitability would become negative and refinery owners may look to shut them down.**

At present, **South African refineries produce EU2 enabling petrol and diesel** whereas international standards are EU5 or EU6 (TransportPolicy.net, n.d). For local refineries to produce EU5 enabling fuels or as referred to in South Africa, Cleaner Fuels 2 (CF2), **they need to undergo significant and expensive hardware upgrades.** The tightly regulated pricing regime does not, however, allow for this investment to be recovered. Consequently, if government insists that all petrol and diesel sold in South Africa meets EU5 standards, some refinery owners may choose to shut their facilities down rather than invest in non-profitable, expensive upgrades. **The result would be that local refineries will shut down sooner than would be required due to EV displacing ICE vehicles**. Any shortfall in overall product demand arising from any premature refinery closures would be easily met by imports. Employment levels in the refinery and logistics sectors are around 50 000 and as refineries close, the number of jobs would be reduced as would those in the businesses that serve these sectors.

The Secunda CTL facility operated by Sasol should be the last fuel production facility to shut down due to the significant positive contribution it makes to the South African balance of payments and the large number of jobs it supports in both the coal mining and liquid fuels sectors. It also plays a crucial role as the feedstock producer for the polymer manufacturing sector (ethylene and propylene). It is critical to the sustainability of the petrochemical manufacturing industry in South Africa.

Consideration is being given to the construction of a new modern world-scale refinery by the South African government, together with support from Saudi Arabia. This decision needs to be thought through carefully since a new refinery is not likely to be economically viable (if it were, it would have already been built).

While a new world-scale (400 000 bbl/d) refinery would produce EU6 enabling fuel, it may accelerate the closure of existing refineries, and in its own lifetime (20 to 40 years) may become a stranded asset, as the global demand for petrol and diesel decreases due to any significant displacement of ICE vehicles by EVs.

The demand for non-road fuel products like jet and marine fuel, liquefied petroleum gas (LPG), bitumen and solvents would remain and possibly grow. As local refineries close, **the demand for these products should be able to be met by imports,** but the ports and the import facilities (wharfage, berths, unloading facilities, tankage) would all need to be modified and/or upgraded to handle both the import product mix as well as any increased volumes (unless the new refinery is appropriately designed).

The logistics component (the pipelines, trucks and depots) of the value chain would also be impacted by reduced demand for road fuels. This sector enables the distribution of product from point of supply to the market. Currently, the design of this sector is based on product moving from the coast, inland. If coastal refineries shut down, while sufficient demand remains, imports would still come in from the coast from imports. Once the inland facilities (Secunda and Natref) can meet the reduced local demand, the flow direction would need to change from inland to the coast.

Sales and marketing is the final component of the value chain to consider, with reduced fuel demand resulting in the need for fewer service stations. As demand decreases they would become unprofitable, leading to their closure. In the South African liquid fuels value chain, the largest value addition is from the retail sector (service stations) for all oil companies except Sasol (whose largest value add comes from the liquid fuels production facility).

The sales and marketing component employs around 130 000 attendants in around 6 000 retail sites. These small businesses account for around 0.7% of small businesses (Statistics South Africa, 2018) and they often act as retail anchors in rural and low-income communities. **Closure of service stations would negatively impact jobs and communities, notably where stations play an anchor role.**

2.2.2 Power sector

In the power sector, the rollout of **EVs would increase annual electricity demand** by up to 29GWh, leading to increased sales. This represents 7% of the 2050 electricity demand projected in the Draft 2018 Integrated Resource Plan. **This can likely be managed through proper planning and system operations, requiring no significant investment in additional electricity generation capacity**. If EV users can be incentivised to charge during off-peak periods, the impact on the demand curve would be positive: this would result in the sale of surplus capacity and reduce the need to invest in the network infrastructure. This is expected as, internationally, most charging (80%-90%) takes place during off-peak periods and largely at home for private passenger vehicles. Additional sales could increase power sector value add by up to 11%. The high energy efficiency of EVs relative to ICE vehicles dampens the potential revenue benefits associated with fuelling vehicles. EVs would also create the potential for **other positive grid benefits,** such as stimulating investment in embedded

generation, providing storage capacity that can help balance demand and enable greater integration of renewable energy in the system. These benefits are not available currently as smart technologies, such as Vehicle-to-grid (V2G) communication, are still maturing.

2.2.3 The automotive sector

South Africa has built a world-class automotive sector production capacity through state support and ongoing collaboration with global OEMs, such as Toyota, Volkswagen, BMW, Mercedes-Benz, Nissan, Ford, Scania and BAIC, manufacturers of components and labour (the dti, 2018). The shift from ICE vehicles to EVs is a disruptive trend for the automotive industry worldwide and South Africa is no exception.

The automotive sector is a significant pillar of the country's economic landscape. The production of vehicles and related components contributed 7% to the country's gross domestic product and 30% of the manufacturing output in 2017. The automotive sector also remains the largest exporter of manufactured goods, contributing 14% or R165 billion of the country's overall exports in 2017. Most vehicles produced in South Africa are exported and ICE vehicles and related components play a large role in South Africa's export capabilities, with catalytic converter exports contributing to 37% of component exports in 2017, amounting to R19 billion, followed by engine parts, tyres and engines contributing between R2 and R3 billion each (Mahomedy, 2018). About 100 000 people are directly employed in the manufacturing of vehicles and components while downstream activities (wholesale, retail trade and maintenance) employ more than 350 000 people (the dti, 2018). Garages (many township enterprises) also make up around 4% of all small businesses (Statistics South Africa, 2018). The employment impact of the industry as a whole has a far greater reach, with an estimated four million people directly and indirectly dependent on the sector (Maseko, 2018).

As the transition to EVs unfolds in high-income economies, **the South African automotive industry (in its existing form) is likely to lose its principal markets**, i.e. the European Union (EU) and the United States of America (US), while the domestic and African export markets should be stable for the foreseeable future. As of April 2019, no fully-electric vehicles were manufactured in South Africa, with only Mercedes-Benz manufacturing hybrid C-class vehicles in East London (Venter, 2018). The South African industry, which is part of the global automotive value chain, produces only a few product ranges and it is unlikely the industry could rely on local demand to sustain an ICE industry in the long run. Furthermore, while the rest of Africa is becoming an increasingly important market for South Africa's trucks and *bakkies*[4], it is not a traditional market for South Africa-made cars. In addition, going forward, other countries still producing new ICE vehicles would have fewer locations to export to and may target South Africa for their exports, increasing the competition for the domestic market (Deonarain, 2019).[5]

Such changes would have **structural impacts on the nature of the government incentives required to maintain the local automotive production in the country**, including the manufacturing of components (Tier 1 suppliers particularly), as EVs do not require as many components as ICE vehicles. Catalytic converters, the highest component export along with

[4] South African word for a pickup truck.

[5] As the importation of used vehicles is not permitted in South Africa, there is little risk of second-hand ICE vehicles coming into the market (Mahomedy, 2018).

conventional radiators, could see drastic declines once ICEs are no longer in use, as these components are not required in the production of EVs (Deonarain, 2019).

Furthermore, **the global decline in the use of catalytic converters could pose severe implications for South Africa's platinum industry**, as auto-catalysts accounted for 39% of global platinum demand in 2018 (Johnson Matthey, 2019). Increased recycling, notably by OEMs, has already led to South Africa's platinum sales (in volume) peaking in 2006 and declining since then.

2.3 People story

EVs are forecast to be competitive by 2024 on an unsubsidised basis (i.e. without policy support/ incentives) and reach parity due to lower battery prices by 2029. Parity will furthermore be reached sooner for buses than for private vehicles (BNEF, 2018). This translates into a lower LCOT resulting in **lower transport costs**. **This would benefit transport-intensive sectors of the economy (these indirect effects have not been assessed) and increase the disposable income of all South Africans.** Car owners would benefit directly (due to the EVs being cheaper than ICE vehicles on a LCOT basis) while public transport commuters (minibus taxis, buses) would benefit indirectly (a full pass-through of the cost reduction is assumed for this). The reduction in transport expenditure is similar across all deciles (up to 57%-60%). Due to the expenditure distribution, upper deciles (car owners) see a greater benefit overall, up to a 9% increase in disposable income, while the lowest deciles experience an increase of 4%. Measures to broaden access to affordable transport are needed to ensure a just transition and harness EVs to reduce transport-related inequalities. Further benefits could accrue due to the synergies with small-scale embedded generation (SSEG), i.e. energy efficiency, lower building energy costs and energy security enabled by the integration of energy generation and storage capacities.

A significant reduction in local air pollutants from vehicles would improve health and reduce associated costs particularly in urban areas. A material reduction in harmful emissions (CO, NOx, SOx, PM[6]) will have a positive spillover on health costs. These are components of smog and can trigger a variety of health problems, such as asthma, emphysema and chronic bronchitis (Schnell et al, 2019). Particulate matter smaller than 2,5µ ($PM_{2.5}$) causes various lung and arterial diseases that reduce life and lead to premature death. This has been the main reason for proposed ICE vehicle bans from cities. For example, 12 mayors, including the mayor of Cape Town signed the C40 Fossil-Fuel-Free Streets Declaration in October 2017, committing their cities to all-electric buses by 2025 and zero emissions in designated areas by 2030 (Burch, 2018) and the Supreme Court of India imposed a ban on petrol and diesel vehicles in Delhi (LiveMint, 2018).

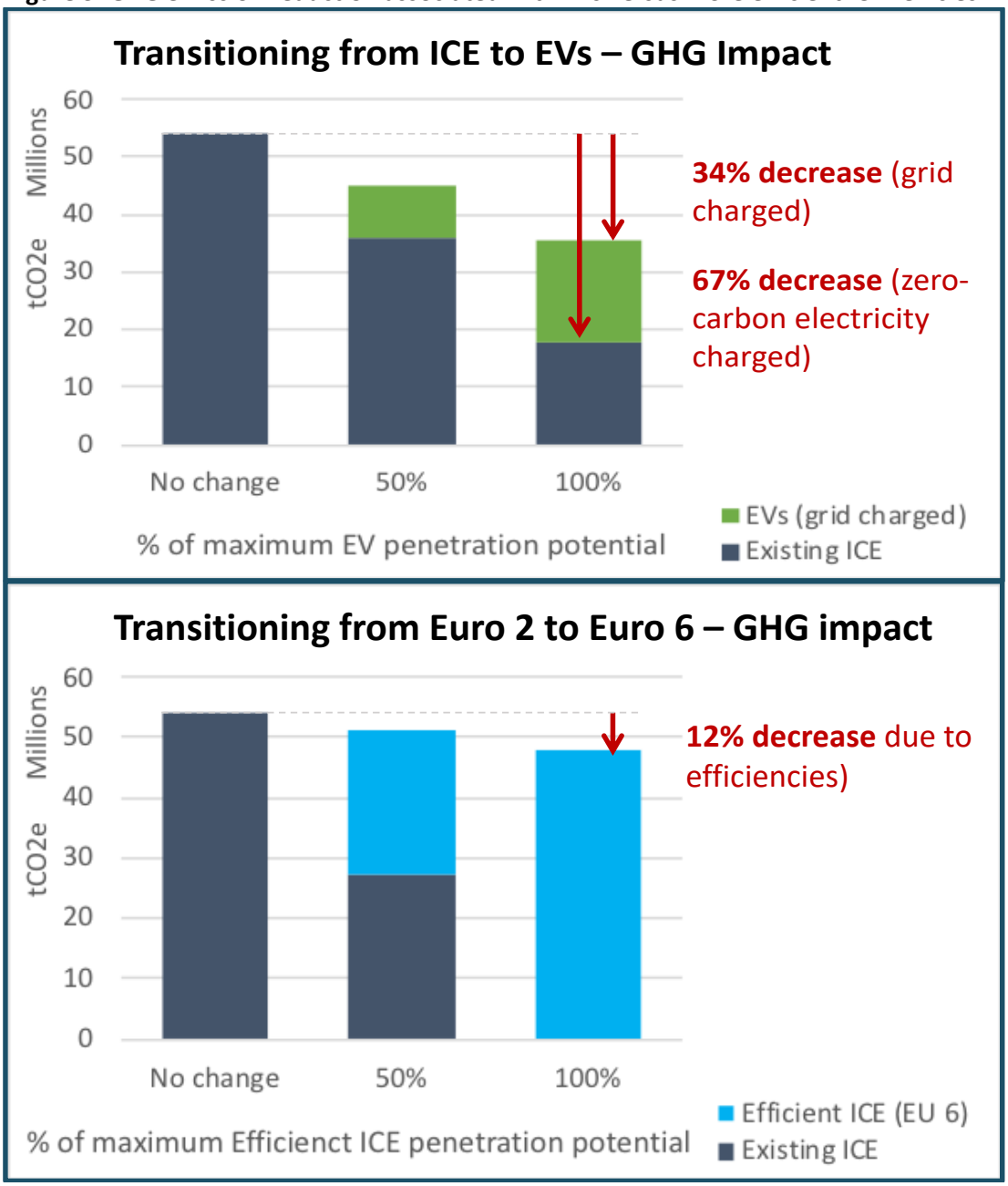
2.4 Environment story

EVs consume less energy per kilometre travelled. GHG emissions depend on the carbon intensity of how the energy is generated. Due to greater energy efficiency, and in spite of the carbon-intensive power generation fleet in South Africa, the benefits of grid-charged EVs over ICE vehicles is slightly positive (and depends significantly on the ICE vehicle used for the comparison). As power generation becomes cleaner, the benefits would increase and any charging using SSEG (generally based on solar energy) would deliver significant GHG

[6] CO = carbon monoxide; NOx = nitrogen oxides; SOx = Sulphur Oxides; PM = particulate matter

reductions. As shown in Figure 3, based on the current South African vehicle parc and largely coal-fired electricity grid, **the transition from ICE to EVs would lead to a decrease in GHG emissions** from the road transport sector. The decrease is greater than would be achieved with more efficient ICE vehicles (currently available) and would be even greater if fuelled by renewable electricity.

Figure 3: GHG emission reduction associated with EVs versus more efficient ICE vehicles



Source: Authors based on DEA, 2019, SEA, 2018, and Stone et al, 2018

The effect of a shift to EVs on air quality is complex and varies depending on the time of the year (this has not been assessed in detail in South Africa). EVs would result in a significant reduction in air pollutants at the point of use but an increase in demand for electricity would increase air pollutants from coal-fired electricity. EVs would likely result in a decrease in traffic NOx and ozone in summer and any increase in particulates ($PM_{2.5}$) associated with increased coal-fired power demand could be offset by a shift to low-carbon electricity sources (Schnell et al, 2019).

South Africa needs a coherent policy framework to enable the rollout of EVs. Experience internationally has shown that proactive policy is necessary to drive the EV transition in a particular direction. Left to the market, the benefits and costs of an inevitable transition would not be equitable.

3 POLICY IMPLICATIONS

3.1 Promoting EVs

Given the potential benefits, South Africa needs a coherent policy framework to enable the rollout of EVs. Experience internationally has shown that **proactive policy is necessary to drive the EV transition in a particular direction**. **Left to the market, the benefits and costs of an inevitable transition would not be equitable**. Given interlinkages, this requires a cross-cutting, integrated approach that reflects in various governmental policies. Table 1 provides a non-exhaustive list of policy options available to drive a high penetration of EVs, a successful automotive sector, the softest possible liquid fuels transition and limited additional investment in the electricity sector. Focus has been on passenger and freight transport but there is a need to look at broader mobility, urban planning, and future technologies (such as V2G integration).

Table 1: Possible policy options for a just EV transition

Success outcomes	What is needed	Policy options
High penetration of EVs	Lower total cost of ownership	• Reduced EV import tariff • Favourable electricity tariff structure • EV purchase subsidies (self-financing feebate with strong support for the transition of public transport vehicles) • Public Procurement Programme (EV fleet)
	Enabling environment	• Public charging infrastructure (enabled, incentivised or directly invested in) • Preferential access (such as free parking, reduced licence costs, dedicated lane access)
	Fears allayed	• Awareness/communication campaigns
Softest possible liquid fuel sector transition	Absorption of labour into other sectors	• Skills development • Incentives/subsidies • Regional economic development programmes
	Conversion of existing production and supply infrastructure	• Refinery upgrades (new slate) or new refinery capacity (ethylene / propylene) • New storage and pipeline capacity • Incentivising charging stations at forecourts

Managing the integration in the power sector	Optimal charging behaviour	• Charging controls (smartification) • EV electricity tariffs (price mechanism to change behaviour)
Successful automotive sector	Ability to compete in global EV market	• Enabling manufacturing support programme • Skills development • Research and Development (battery, charging infrastructure and systems, fuel cells)
Ensuring a just transition	Effective reconversion of workers, small businesses and communities	• Employment vulnerability assessment, combined with resilience plans • Active labour market policies (skills development) • Regional economic development programme
	Inclusive rollout of EVs	• Modernisation programme for public transport, with pass-through of benefits to commuters • Support to new consumption models that do not rely on ownership
Reconsider government financing model	Balanced and just transition	• Allocation of budget to address imbalances owning to recipients of the costs and benefits

Source: Authors

3.2 Managing the transition of the liquid fuel industry

A transition plan for the liquid fuels industry should be developed to minimise the impact of its gradual demise. There are six fuel manufacturing or refining facilities and 6 000 service stations in South Africa. Consequently, the closure of one refinery would have a much bigger impact than the closure of one service station.

As shown in Table 1, the two areas that would need to be addressed are **minimising the job loss impact and maintaining the liquid fuel and petrochemical feedstock supply** for as long as the product is needed. To minimise job losses, the focus would need to be on absorbing the displaced labour force into other sectors. This would require an employment vulnerability assessment, combined with resilience plans.

Refinery closures would be driven by market forces and economic viability, but a mechanism should be developed to enable adequate planning to cater for these closures to mitigate any negative impacts on the economy. For example, government may wish to specify that refinery owners must give (say) five years notice prior to closure.

The possibility of early closure of existing local refineries (rather than investing in upgrades to produce CF2 quality fuels) should also be factored into the transition plan. An issue to consider when developing the enabling policy for this transition is whether not converting

refineries to produce CF2 quality fuel is more cost effective for South Africa when considering the combined impact on the automotive and liquid fuels industries together.

Should **a new modern world-scale refinery** be included in the transition plan, then specific consideration should be given to its design. **It should be able to meet the future, changing product slate,** which would include decreasing volumes of petrol and diesel but increasing volumes of jet fuel/kerosene, LPG, bitumen, bunker fuel oil, solvents as well as substantial petrochemical feedstock, especially for polymer manufacture (ethylene, propylene).

The redesign of the logistics infrastructure handling liquid fuels should be linked to any closures of local refineries – where the remaining operating fuel production facilities are located and whether (and where) a new refinery has been built. Also, **the new logistics facilities should consider possible changes in the future product slate and the distribution pattern** that would be needed as EV penetration increases.

Possibilities of converting existing service stations to alternative uses, like charging stations or economic hubs for communities, should also be examined as options for the transition plan.

3.3 Managing the integration in the power value chain

The increased demand for electricity from EVs would be incremental and **any need for additional generation capacity can be planned**. Of more concern is the potential clustering and uniform charging during peak periods that would put pressure on the grid networks. **Cities, in particular, need to be proactive to mitigate negative grid impacts and avoid duplication cost and ex-post interventions**. In the context of a lack of a co-ordinated national EV policy environment and a lack of incentives, electricity tariffs would be important in contributing to uptake and managing charging behaviour.

Uptake would likely be slow initially, allowing for an iterative approach. Cities should invest in pilot studies and data collection (including grid smartification and coupling with SSEG programmes and policies) to best inform the evolving approach. The following interventions could be considered:

- set different electricity tariffs for different types of users depending on the extent to which a social benefit is delivered (e.g. electric buses would contribute to an inclusive and just transition);
- set Time of Use tariffs for residential customers;
- combine real-time pricing (and trading) and forced load control to leverage the benefits of both mechanisms;
- set appropriate standards in relation to payment platforms, charging technology, access to user data and building codes;
- develop a strong communications plan and focus on being customer centric; and
- better understanding of EV charging behaviour in the South African context.

3.4 Maintaining automotive industry competitiveness

In light of the unfolding transition towards EVs, **preserving the position of the South African automotive industry would require significant investments by OEMs to update the production lines** and processes to maintain the functionality of these plants to produce EVs.

This would have drastic implications on the existing supply chains, particularly Tier 1 suppliers which fit into the production of ICE and related components. While **government has no direct control over the models manufactured by OEMs** in the South African plants, **proactive policy options are available to facilitate the transition** and ensure that the country retains a strong automotive manufacturing industry in the long run.

As demand for ICE vehicles dwindles in the EU and the US, South Africa's traditional export markets, **the industry could reposition itself to service low- and middle-income countries**, notably in Africa. This would enable the industry to retain some of the existing production facilities without drastic changes, particularly for trucks and *bakkies*. Importantly though, as leading markets for ICE vehicles disappear, remaining markets, such as African economies, would face increasing competition. **The industry would have to initiate the transition to EVs to remain sustainable in the long run.** This is contingent on a vibrant domestic market as well as an enabling policy framework based on a renewed partnership between the OEMs, the wider automotive industry and the South African government.

The domestic market for EVs still remains in its infancy, hindered by a lack of demand. Awareness gaps, misinformation, a limited availability of models (only three models available as of May 2019), the high cost of proposed vehicles and still limited (although growing) charging infrastructure are the main root causes. Growing the domestic market would require effective communication and awareness-raising campaigns, a wider number of available models, particularly entry-level vehicles, and active support for the rollout of charging infrastructure, linked to embedded solar-based systems and a more cost competitive pricing structure.

On the manufacturing side, while largely non-discriminatory, the policy framework in its current form penalises EVs, compared to ICE vehicles. Imported EVs are subject to the same tariffs[7] as imported ICE cars, with the (important) exception of EVs originating from the EU, fetching higher tariffs than their conventional counterparts. Furthermore, while non-discriminatory, the Ad Valorem Excise Duty on imported vehicles, calculated on the basis of the retail price of vehicles, is harsher on EVs than ICE vehicles. Indeed, on a relative basis, the high cost of batteries makes EVs more expensive to purchase than conventional cars, a difference exacerbated by the Ad Valorem Excise Duty. In addition, the APDP, which allows local manufacturers to import vehicles into the country at reduced tariffs, while also non-discriminatory, *de facto* penalises EVs. The offset mechanism is vehicle-specific and does not allow OEMs to subsidise the import of EVs from the production of ICE vehicles. In order to benefit from the APDP, local manufacturers of EVs would have to produce a minimum of 10 000 units per year. Reaching such a threshold would require a vibrant local market, meaningful export prospects as well as concerted efforts from the sector.

Pragmatically, the policy framework would require some changes to ensure a level playing field for the domestic production and importation of EVs. Possible options include the levelling of import duties, the lowering of the production thresholds and the introduction of non-specificity into the APDP, allowing manufacturing to import EVs while manufacturing ICE vehicles.

[7] All imported passenger cars are subject to a 25% tariff, with the exception of ICE vehicles from the EU, which are taxed at 18%, and all vehicles from the Southern African Development Community (SADC) that enter the South African market duty-free.

Further support to the industry to develop local capabilities in the manufacturing of EV-related systems, infrastructure and components would also provide a platform for the South African industry to play a strong role in the developing EV global value chain. Indeed, besides OEMs, South Africa hosts a number of firms (GridCards, Metain, Hulamin) and research centres (National Electric Vehicle Technology Innovation Programme and the uYilo eMobility Technology Innovation Programme) which are well positioned to take advantage of the shift to EVs in the production and operation of charging stations (GridCards), battery systems (Metair) and components (Hulamin) (Deonarain and Mashiane, 2018).

A just transition boils down to two key dynamics: on the one hand, ensuring that workers, small businesses and communities which could be negatively impacted by the phase out of ICE vehicles are adequately supported; and on the other hand, ensuring that the shift to EVs bring benefits to all layers of society and contributes to reducing inequalities.

3.5 Ensuring a just transition

As the shift to EVs unfolds in the country, **a just transition is imperative to ensure inclusive development in the long run.** It points to the need for government to assist the affected industries and communities either to adapt to the impacts associated with the transition or to shift into more alternative (EV-based) activities, with a focus on workers, small and micro businesses and low-income communities which are inherently more vulnerable and less resilient. In the context of the shift to EVs, a just transition boils down to two key dynamics: on the one hand, **ensuring that workers, small businesses and communities** which could be negatively impacted by the phase out of ICE vehicles **are adequately supported**; and on the other hand, **ensuring that the shift to EVs bring benefits to all layers of society** and contributes to reducing inequalities.

The shift away from petroleum-based transport could affect both employment and small businesses in the liquid fuels and automotive sector value chains, as already highlighted. The impact will largely depend on whether transport providers, fuel stations and automotive assemblers are able to switch to EVs. Employment in the entire value chain is significant, from coal mining, refineries and pipelines, to the automotive manufacturing and retail industry, to petrol stations and transport providers.

To effectively address the negative impacts of the transition, an employment vulnerability assessment, combined with resilience plans, is required. Resilience plans can assist vulnerable actors to adjust to the effects of the transition to EVs through a combination of active labour market policies, which aim principally at supporting affected workers to take advantage of alternative economic opportunities; and spatial and industrial development strategies, which identify sustainable opportunities for growth for communities and industries and assist in setting up clusters to take advantage of them (TIPS, 2019).

A just transition also means ensuring that the shift to EVs brings benefits for the society at large. Car ownership in South Africa remains highly segregated. People living in urban areas are more likely to own a car (40%) than those located in rural areas (20%).

This is clear on a geographical basis, with the Western Cape and Gauteng displaying the highest ownership rates in the country. Car ownership is also directly correlated with levels of income and population groups. In addition, 41% of men own a vehicle while only 25% of women (Statistics South Africa, 2017).

Focusing the transition to EVs on car ownership would therefore be likely to leave a large share of the population behind and, in the long run, deepen inequalities. An inclusive approach is required to ensure that the transition to EVs benefits all citizens and not only the wealthiest, mostly urban populations. In this respect, promoting wider car ownership is not necessarily desirable nor possible. New consumption models that do not rely on ownership, such as MaaS, are progressively emerging and could provide interesting platforms for inclusive transport systems. In the short term, as shown in Section 2.3, ensuring that public transportation systems embark on the EV transition (along with gas-based propulsion) would enable reduced transport costs for everyone. In the longer run, integrating existing public transport systems with new MaaS offerings, along with more conducive urban development, would maximise the potential of EVs (as well as non-motorised transport).

3.6 Reconsider government financing model

The shift in the vehicle parc from ICE vehicles to EVs would cause major changes in the government financing model. The revenue stream from the taxes on fuels (fuel levy, RAF, carbon tax) would decrease as fuel demand decreases and it is unlikely to be replaced by similar taxes on electricity (the fuel for EVs) for a variety of reasons. However, there should also be a reduction in government expenses due to improved balance of payments, reduced transport costs and improved health arising from better air quality.

The factors driving the reduction in both revenue and expenses need to be better understood so that future mechanisms can be developed to ensure the net financial position remains balanced. Importantly, since the reductions in revenue and expenses are likely to occur in different sectors of government, it would be critical to understand the interlinkages and manage them to provide a balanced result. **It will be important that the benefits that should arise from the efficiency improvements in the transport sector are experienced by all citizens and that no one sector of government or society experiences a disproportionate negative impact.**

A specific budget to fund a just transition should also be developed and made available ahead of implementing the transition. This is an urgent matter since the transition is already starting, even though it may be slow at present.

A specific budget to fund a just transition should also be developed and made available ahead of implementing the transition. This is an urgent matter since the transition is already starting, even though it may be slow at present.

4 FURTHER CONSIDERATIONS

Not all economy-wide impacts have been considered or examined. Further work is needed in a variety of areas. Some of these **areas for further work** are:

1) The Integrated Energy Plan model should be used to test the impact of a "disruptive EV scenario" on both the liquid fuels and electricity sectors.

2) The important role the Secunda facility plays in the sustainability of the petrochemical manufacturing industry should be understood together with the impact that shutting down the facility would have on the South African economy. This would enable a plan to be developed that should ensure the petrochemical manufacturing industry continues without the Secunda facility in operation.

3) The issue of stranded assets needs further investigation: could a new modern world-scale refinery become a stranded asset?

4) Likely changes required in the liquid fuels logistics and distribution facilities need careful planning linked to refinery closures. Specific attention needs to be given to the future supply of liquid fuels to the rural areas.

5) The improved air quality benefits and associated health care benefits need further study to understand and quantify.

6) Fuel cell vehicles powered by carbon-free hydrogen could be part of the future EV mix. Their role and the benefit they would bring to the South African economy should be understood in order to help shape policies that would promote the development of this sector.

7) A revised government financing model should be developed as a result of the changes that will arise as the demand for liquid fuels decreases, together with the benefits that arise from the increase in EVs. A critical feature of the revised model will be the provision for a just transition and, to the extent possible, the balancing of the negative impacts across the sectors involved.

South Africa is at the start of the transition from ICE vehicles to EVs – it will happen regardless of any policy initiatives. **The opportunity exists now to develop a proactive policy framework** that would shape and drive a just transition for the benefit all South Africans in a balanced manner – **this opportunity needs action now.**

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