

Technological Change and Sustainable Mobility

An overview of Global Trends and South African Developments

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Introduction

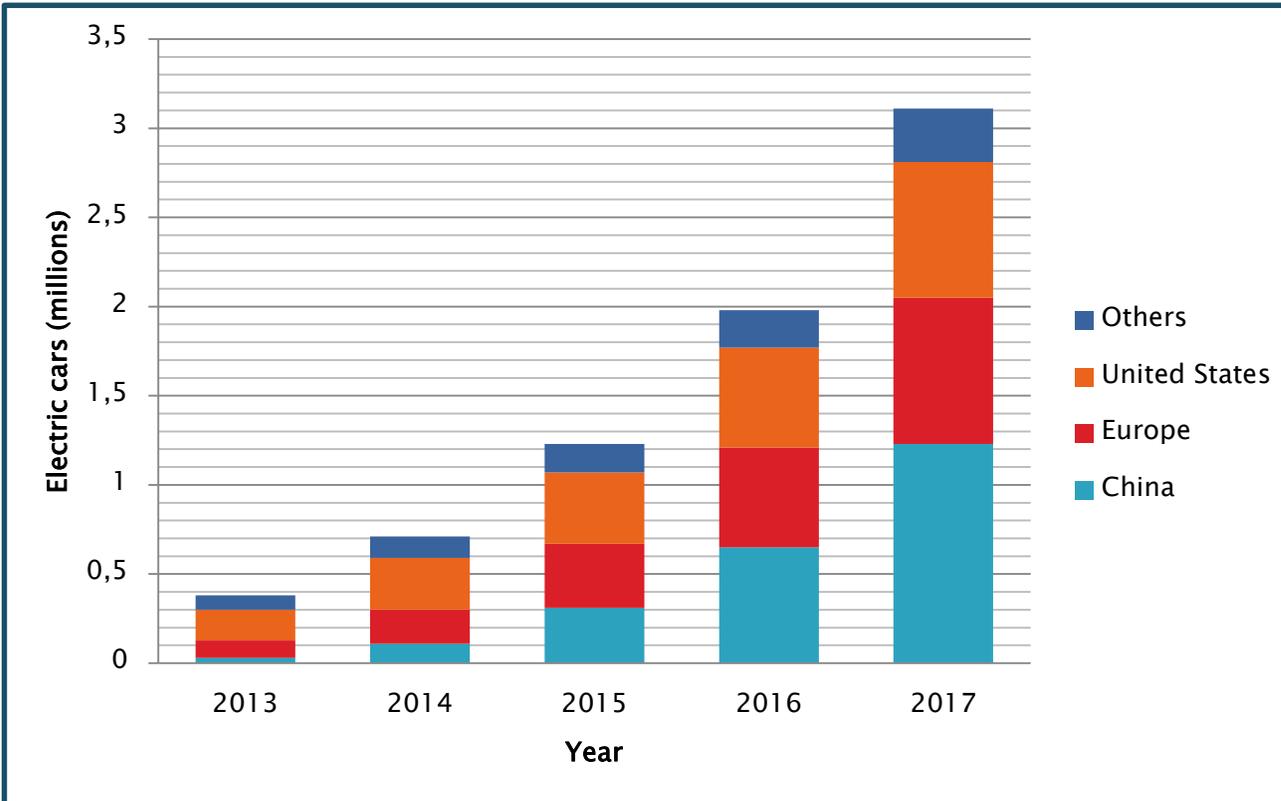
- **Industrialization** leads to socio-economic benefits, often at **environmental costs**:
 - *Resource depletion*
 - *Large-scale emissions*
- **However, technological changes are occurring globally...The 4th Industrial Revolution** presents a **promising opportunity**
 - **Sustainability and digitization** are changing business and societal models globally
 - **Electric vehicles, drones, digitised and automated technologies** along with changes in commuter preferences, has seen technologies been adopted at fast rates in recent years
 - Operating through **ICT networks**
 - Enabling **greater efficiencies in cost and time**

If not managed correctly the new wave of digitisation could also culminate in dire consequences for employment and the environment in numerous industrial, manufacturing and service sectors across the globe...the transport sector is no exception

Global technological trends in mobility: Electric vehicles

▶ Increased uptake in electric mobility technologies

Global electric car stock for the period 2013 to 2017



Evs could see price parity in the next 5 years

- **EV** adoption rates are **challenging** conventional internal combustion engine (**ICE**) vehicles
- Manufacturers expanding **EV versions** of most vehicle models
- BMW, Nissan and Volvo, Audi, Daimler, Ford, General Motors, Jaguar, Porsche and Volkswagen (VW)

- **Electric freight mobility** -> sustainable movement of goods
- **Daimler, Tesla, Volvo and VW** have begun testing electric and autonomous trucks
- **Solar and wind powered ships and aircrafts** have successfully completed journeys

Global technological trends in mobility: Drones and automation

Drone Technologies

- Drone delivery mechanisms are **faster and more cost-efficient (3 hours opposed to 3 days)**
- **Amazon, DHL, Google** and United Parcel Service (**UPS**) embarking on drone deliveries (U.S and Germany)
- In Shanghai **drone delivery of food and packages** are expanding
- Zipline uses drones to transport **medical supplies** to remote villages in **Tanzania and Rwanda**
 - **First option in cases of emergencies** such as blood transfusions, emergency vaccines and the delivery of products that have a short lifespan
- Australia: drones enabled **sea rescue** and will be used to monitor for sharks and emergencies
- **Security drones** have been used in law-enforcement

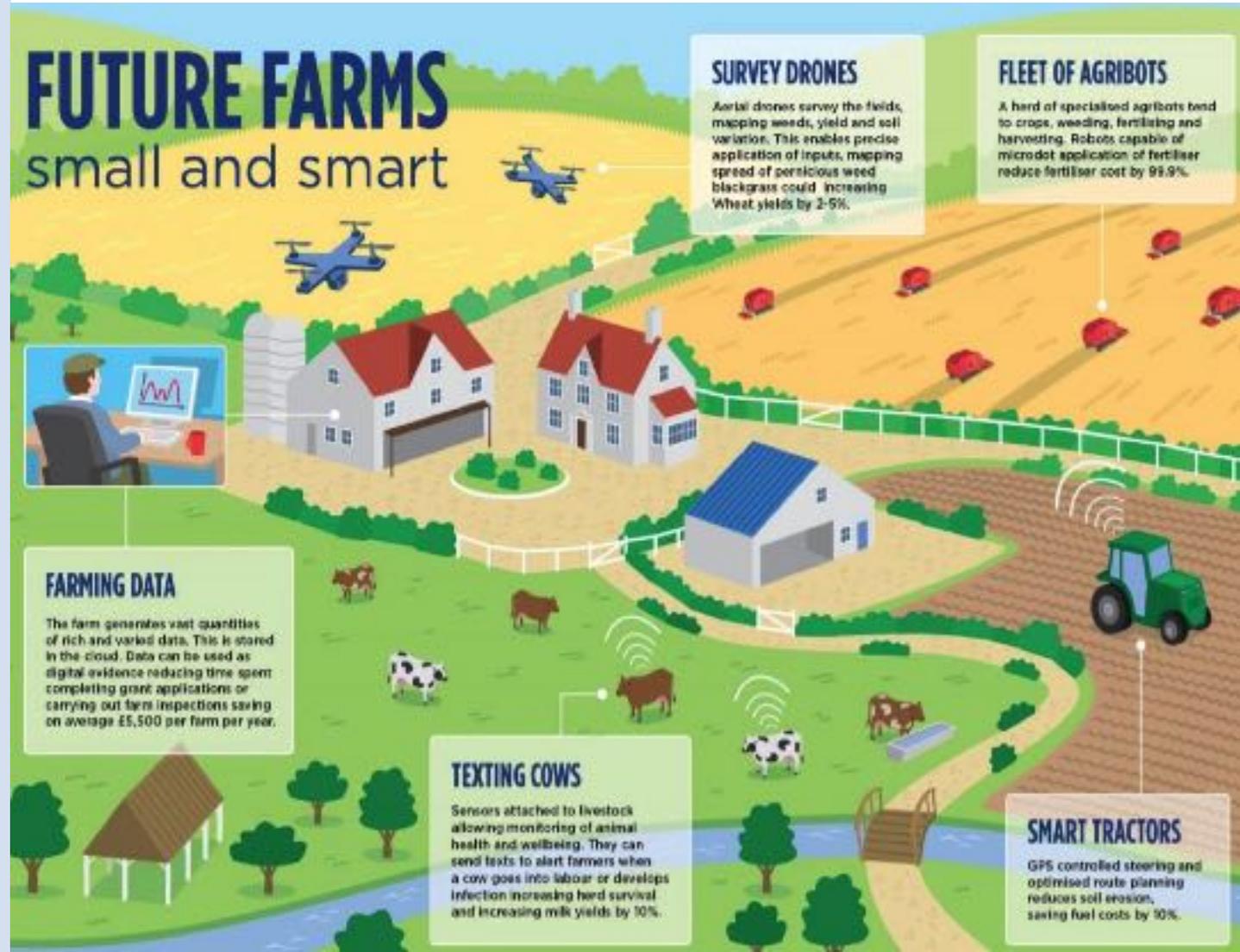
Digitized and connected mobility

- **ICT** interwoven with **production technologies**
 - **autonomous vehicles in warehouses** and **automated machinery and equipment** in factories
 - **cost and time savings** while **increasing productivity** outputs
- Ocado (UK): fully **automated robotic system** for the packaging of online grocery orders (**substituting human labourers**)
 - In-house air traffic control systems
- **Robots** have begun delivering food, beverages and packages
- Technology is owned by **Starship**, offering a fleet of over **150 robots** operating in selected cities across Estonia, Germany, the United Kingdom (UK) and the US through partnerships with Hermes, Postmates and Domino's pizza

Global technological trends in mobility: Agriculture

Farming 4.0

- Innovation within the agricultural sector **combining automated and GIS** to enable **cost-effective, efficient and environmentally compatible farming**
 - agribots, connected tractors and drone farming
- Farmers are able to incorporate GPS and sensor technology to determine shorter routes allowing for:
 - **lessened crop treatment and harvesting time**
 - **increased productivity**
 - **reduced fuel consumption**
- Digitised and automated systems for crop cultivation and harvesting are **displacing**:
 - **conventional labour**
 - **dated transport machinery and equipment**



Global technological trends in mobility: MaaS

- Passenger mobility patterns across the globe are changing

What is MaaS

Mobility distribution model that delivers transport needs to users through a single interface of a service provider

It offers a customer-centric, innovative, pay-per-use transport solution combining different transport modes

Characteristics

- Integration of transport modes
- Single platform
- Cloud computing
- Internet of things (IoT) and technology
- Personalisation and customisation
- Demand orientation
- Tariff options and transparency

What does MaaS mean for transport?

- Autonomous*: Driverless robotic vehicles
- Multimodal transport*: Passenger transport carried out by two or more operators
- Fleet and ride sharing*: Sharing of private vehicles by two or more passengers between destinations
- Personalised journey planning*: Search engine used to find an optimal means of travelling between locations
- Integrated payment systems*: Single fare structures for all city public transport allowing passengers to transfer seamlessly between modes
- Crowd logistics*: Platform-based logistics services provided by geographically dispersed transport operators

- Mobility as a Service (**MaaS**) is a fast-emerging concept -> aims to make **ease and convenience of mobility** more appealing for commuter
- **reduces vehicle ownership** and congestion

Industry 4.0- South African developments

- **WEF's Readiness Diagnostic Model Framework country assessment: S.A falls under the nascent quadrant -> limited production base while displaying a risk factor for the future**
- **Automation in the automotive sector is slowly emerging**
- In Uitenhage, **VW's** manufacturing plant utilises over **600 robots** to assemble around **3 000 units**
 - technologies have enabled the **plant to operate at full capacity** and during certain months in 2018, it operated **24 hours a day seven days a week**, resulting in an **addition of 300 more employees**

- Calculating the jobs impact of new technology is a complex process
- high skill levels like commodity traders can be absorbed elsewhere
- **mid-skilled production workers** may be at **greater risk unless reskilled**
- automation of production lines could potentially **displace 35%** of **all jobs in South Africa**
- Adopting technologies increases complexities in production in terms of managing technologies, and this will require:
 - the **skilling and re-skilling** of the country's labour force,
 - **investigating new manufacturing** potential to ensure a successful just transition.

Industry 4.0- South African developments

Overview of current usage of smart technologies in South Africa

Technology	Rate of adoption in South Africa
Advanced analytics	<ul style="list-style-type: none">• Strongest adoption within automotive sector; process industry are still catching up• Many manufacturers do not know what kind of data they have, how much it is already connected and what insights and benefits they could derive from it.
Cloud computing	<ul style="list-style-type: none">• Improved mobile infrastructure/connectivity-> increased adoption of cloud computing• Stronger adoption is happening by consumers than by businesses/industry
Drone technologies	<ul style="list-style-type: none">• New regulations around the use of drone technologies were issued in 2015• Agricultural sector: monitor crop growth and damage as well as for irrigation• Certain local governments & law enforcement agencies : drone technologies for security and surveillance.• State-owned enterprises investigating the use of drones for safety and security.• The rise of online shopping: drone deliveries by 2022, impacting the need for regular delivery vehicles.• Regulations will require amendments to expand the uptake of drones.

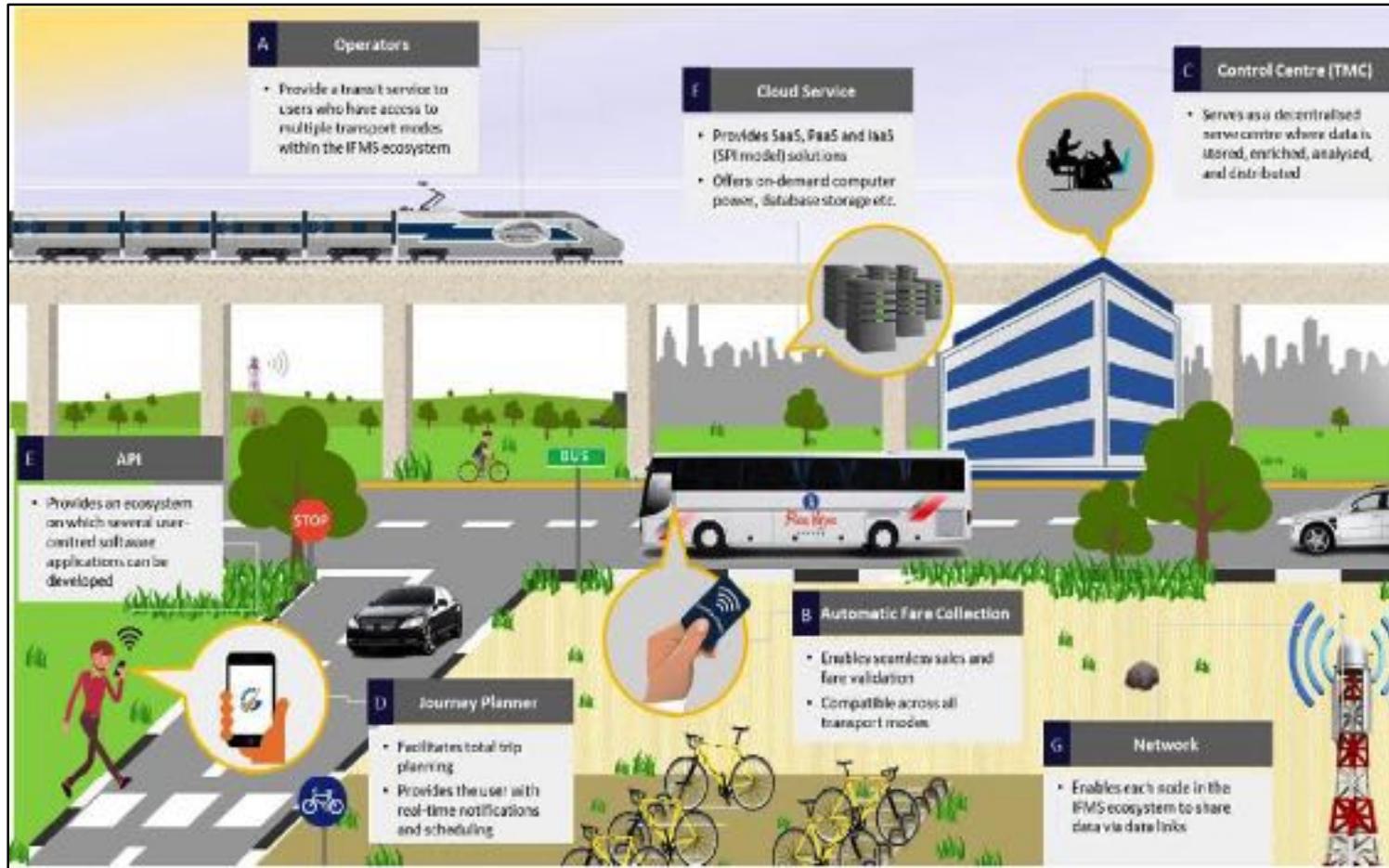
Industry 4.0- South African developments

Technology	Rate of adoption in South Africa
Advanced sensors	<ul style="list-style-type: none">• advanced sensor technology, eg. machine to machine (M2M) communication -> mostly at a foundation stage in South African <i>manufacturing</i>.• Higher traction in the automotive industry, agricultural and industrial mobility and non-manufacturing sectors (e.g. retail, logistics/freight).• agricultural sectors have been implementing sensor technologies to monitor crop health and weather patterns.• industrial sector advanced sensors have been used to track and scan goods as well as undertake quality control checks.
Advanced robotics	<ul style="list-style-type: none">• Adoption remains low across different South African manufacturing sectors.• Stronger adoption of advanced automation/robotics technology can be found only in a few industries, e.g. automotive sector with VW making use of automated machines for assembly.• Cost factors are a prohibitive adoption factor for many South African manufacturers.
Additive manufacturing (3D printing)	<ul style="list-style-type: none">• No widespread adoption of 3D printing yet within the South African manufacturing industry.• Affordability remains an issue in developing markets, compared to developed economies.• 3D printing could reduce the need for freight transportation

Industry 4.0- South African developments: MaaS

- **Commuter behaviour is changing:** seeking convenience, variety and time and cost savings
- **Proliferation of new technologies in the transport sector:** use of app-based transport service providers such as Uber and Taxify

- Gauteng plans to create a **transport authority** and a **transport management centre** which will carry out planning and data management of various public transport networks.
- **Gauteng on the Move App:** locations, timetables and fares for various rail and road transport systems
- **Integrated ticketing:** VixTechnology providing technological systems-> **BRT ridership and revenue has since increased** (due to ease of mobility)
- By **2020**, commuters would be able to make use of **one card**, such as the Gautrain card, **across different modes** of rail and bus services
- Further **collaboration** is required to make MaaS a reality



Industry 4.0- South African developments: Drones

The South African Civil Aviation Authority introduced new drone regulations in 2015:

- private operators to be over 18 with a license for the device
- drones are to be flown below 121.9m from the surface
- not allowed to hover in close proximity to people or above crime scenes, prisons and police stations, courts of law and nuclear power plants
- not allowed to be used for transporting goods and cargo
- unless for law-enforcement purposes, drones are prohibited from taking off and landing on the country's public roads

- **SAPS, City of Cape Town, Western Cape Government and South African National Parks** are exploring options for the use of drones in **surveillance, tracking and identification of suspects**
- **PRASA** signed a memorandum of agreement with the **Western Cape Department of Transport and Public Works and the City of Cape Town**, enabling drone technologies to be used for **monitoring railway tracks**, thereby **improving the safety and security** of the system and commuters

Industry 4.0- South African developments: Drones

- **Eskom**, in collaboration with **CSIR**, are beginning to investigate the use of drone technologies to inspect and **monitor power lines**
- **Aerial Monitoring Solutions**- drone to **monitor and track livestock and game** -> anti-poaching
- **Aerobotics**- monitor crop growth, maturity and damage while collecting data on irrigation patterns.
- **DroneClouds** has assisted over **400 South African farmers and agricultural companies** (including Bayer and Monsanto) with farming applications resulting in:
 - **crop yield increases** and **water savings** of up to **30%**
 - **reducing the need for conventional vehicles, equipment and human labour**
- **Ran Marine**- to partner with **Transnet** and the Port of Durban to sustainably **reduce water pollution** through the use of **solar-powered automated drones**
- **DroneScan** received grant funding to develop drone technology that **tracks warehouse inventory**
- South Africa **drone deliveries** are expected to operate **by 2021** due to the rise of online shopping

Industry 4.0- South African developments: Electric Vehicles

EVs: potential for sustainable mobility (if powered by solar) and enhancing automotive and component manufacturing

- Electric vehicles are at infancy in South Africa:
1 000 Evs and 100 charging stations
- Plans to develop EVs are underway with support from the: dti, DoT, DST, IDC, EVIA, the private sector and municipalities
- **Government EV Procurement Programme (draft)**
5% of government and state-owned enterprise fleet must be electric
- **Cape Town jurisdiction:** announced a Fossil-Fuel-Free Streets Declaration by 2030
- The **City of Cape Town-** launched the **MyCiti Battery Powered Electric Bus pilot-** 10 buses- aspects of the bus body work to be locally manufactured- assembled locally
 - **Buses remain idle due to tender issues**
- **BMW, Nissan, Jaguar and IDC:** Installing fast charging systems at malls, office parks and highways
- **National Electric Vehicle Technology innovation Programme:** emphasis on improving energy storage and battery technologies and charging infrastructure
- **Eskom:** keen on being the preferred electricity supplier for charging
 - investigating attractive **tariffs for off-peak charging of EVs**
 - **developing an EV app**
 - **will not be providing or installing charging infrastructure**
- **DST, CSIR and NWU:** exploration of **hydrogen fuel cell** technologies...demand for hydrogen fuel cells remains relatively uncertain

Industry 4.0- South African developments: Electric Vehicles

EVs: potential for sustainable mobility (if powered by solar) and enhancing automotive and component manufacturing

- **GridCars: locally produced charging systems and software systems** - real-time information on location and availability of charging stations
- **The uYilo eMobility Technology Innovation Programme:** technology development for electric mobility (EV systems laboratory)
 - South African National Accreditation System (**SANAS**) and **ISO17025** approved: **lithium ion battery testing laboratory**
 - **real-time and simulated tests** on electric vehicles, micro-electric vehicles and electric bikes.
- **Metair: collaborated with OEMs** to develop lithium-ion batteries
- **Hulamin: produces aluminum foil for Metair batteries**, provides **Tesla with aluminium** required for the electric battery box base plates (plans to **collaborate with other EV manufacturers**)

Industry 4.0- South African developments: Electric Vehicles

- **Procurement schemes for public transport and state-owned vehicles-** important policy tool- stimulate EV diffusion
- **Industrial Policy Action Plan (IPAP):** with additional support from the DST, DoT and local government- encouraged the establishment of a local EV value chain manufacturing industry, including producing the complementary charging infrastructure, testing facilities and public awareness campaigns
- **Automotive Investment Scheme** (within APDP): cashback incentives amounting to 35% for manufacturers producing electric vehicles
- **2013 Electric Vehicle Industry Roadmap:** proposes tax incentives and rebates for purchases, and support for R&D
- **Yet market for EVs remains nascent**
- Policy framework penalizes EVs (due to cost of vehicle)
- **Import duties: All passenger cars imported subject to 25% tariff**
 - **Except ICE vehicles from the EU (18% tariff)**
 - **SADC imports are duty-free**
- **Ad Valorem:** calculated on the basis of vehicle retail price hence **non discriminatory**
 - **EVs taxed higher** due to **higher retail price**
- **APDP:** allows local manufacturers to import at reduced tariffs
 - **Does not allow OEMs to substitute EV imports from ICE production**
 - **Local EV manufacturers** will have to produce **10 000 EVs per year** in order to benefit from incentives

Industry 4.0- South African developments: Case Study- implications for S.A automotive sector

South Africa displays **strong capabilities in automotive manufacturing**- leading OEMs locally manufacturing vehicles for domestic and international markets.

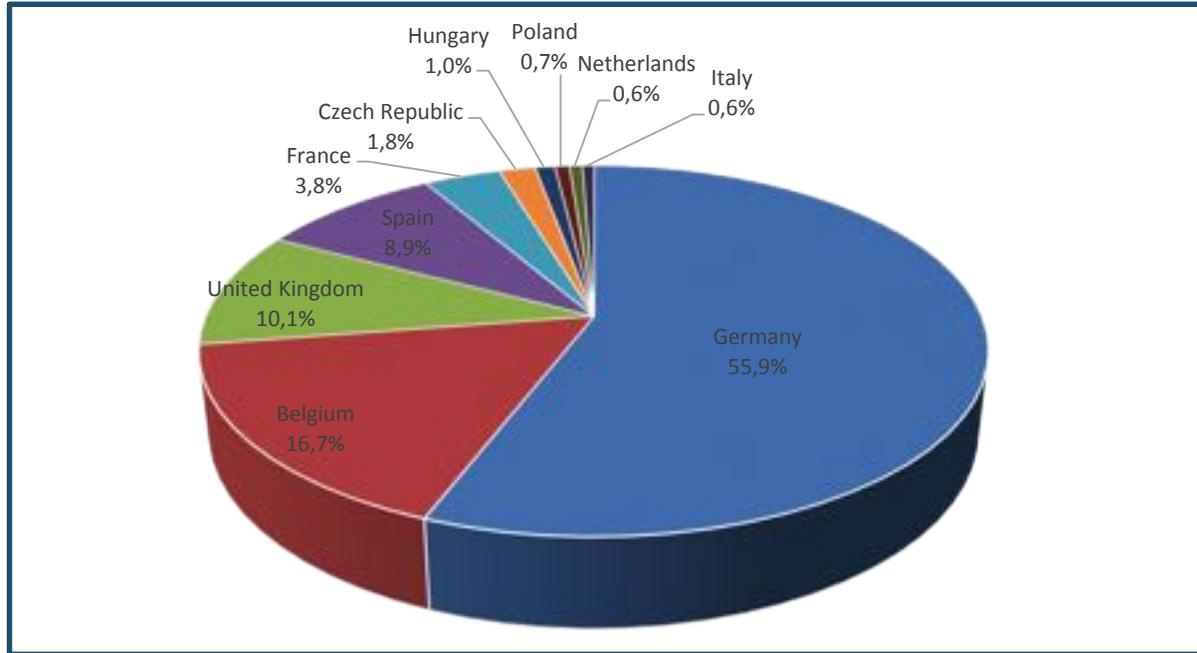
- **largest exporter** of manufactured goods contributing **14 %** of the country's **overall exports = R178.8 billion in 2018 vehicles** and related **components** contributed **29.9 % of the country's manufacturing** output in 2018
- **Employed 350 000** people in 2017 - formal and informal

Segment of Auto	Make	Model
Cars	BMW	4-door 3-Series and X3
	Ford	Everest
	Mercedes-Benz	4-door C-Class, hybrid-electric C class vehicle
	Nissan	Livina and Tiida
	Toyota	4-door Corolla, new and previous series (Corolla is now known as the Quest) and Fortuner
	Volkswagen	Polo new and previous series (designated Vivo)
Light Commercial Vehicles	Ford	Ranger
	Isuzu Motors	KB and D-Max
	Mercedes-Benz	Mitsubishi Triton
	Nissan	NP200, NP300 Hardbody
	Toyota	Hilux and Quantum

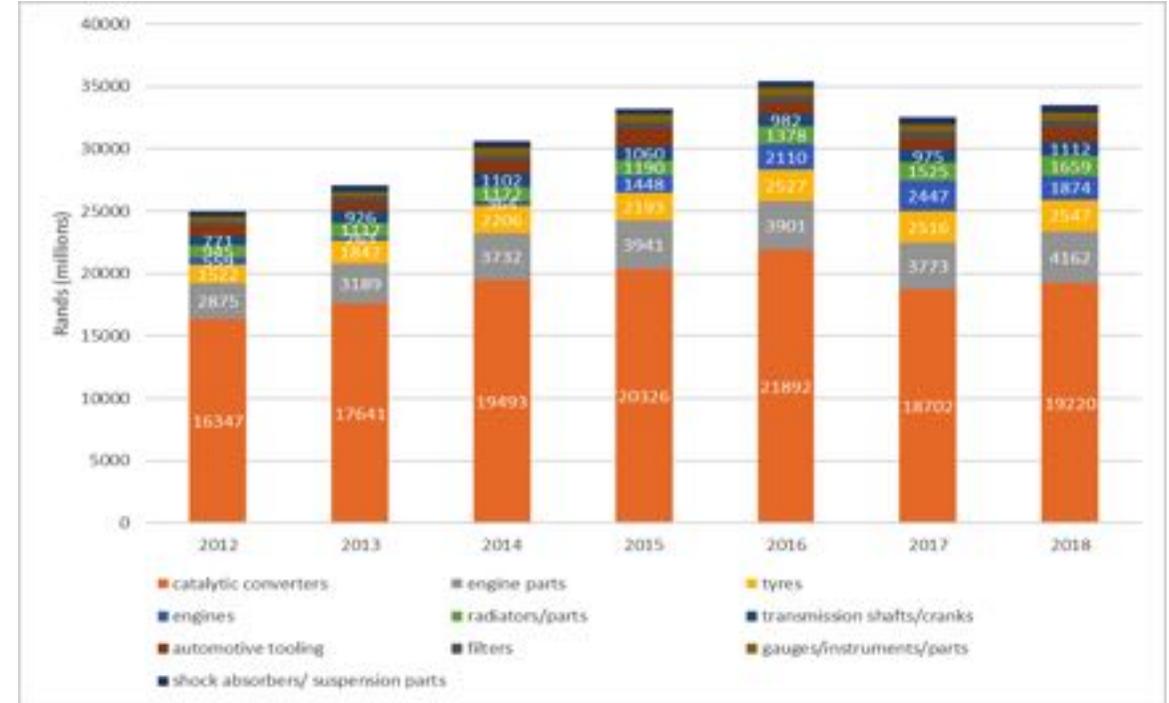
Industry 4.0- South African developments: Case Study- implications for S.A automotive sector

EU - largest market for South African automotive exports accounting for **58.8% (R105.5 billion)** of total auto exports in 2018

Top 10 EU destinations for South African automotive exports, 2017



Top 10 exports by component type, 2013 to 2018 (R Million)



- **catalytic converter** exports- **37.2%** of component exports in 2018 (largest component export-**R19.2 billion**) followed by **engine parts**, **tyres** and **engines** contributing **R4 billion**, **R2.5 billion** and **R1.8 billion** respectively
- Several **EU countries** have indicated plans to **ban ICE vehicles**: Norway by 2025, **Germany by 2030**, Scotland by 2032, along with England and France by 2040
- **Automotive plants would need to make significant investments to update the production lines and processes to include electric and gas-based vehicles**

Industry 4.0- South African developments: Case Study- implications for S.A automotive sector

Possible implications of not managing the transitioning

Since countries have committed to phasing out ICE vehicles, the **local manufacturing sector could see a decline-** unless transition mechanisms are put in place

- **Catalytic converters**, the highest component export and **conventional radiators**, could see **drastic decline**
 - declines components could pose **severe implications for South Africa's platinum industry**
- Unlikely that the industry could rely on local demand to sustain an ICE industry
- Africa becoming increasingly important market for South Africa's trucks and 'bakkies'
 - However not a traditional market for South African made cars.

As the **global market gradually shifts to more sustainable modes of transport**, incentives and **institutional and physical infrastructure for the production of electric vehicles and related components** need serious consideration to **retain and attract OEMs to the country.**

Conclusion

Careful social, economic and environmental consideration must be taken when **managing the just transition to technology integration and adoption in the transport sector**

- **drones and sensors, automated and connected vehicles** are being incorporated into **agricultural, industrial and freight mobility**, thereby **reducing the need for conventional vehicles and mobility equipment**.
- **Technological innovation- could potentially have devastating impacts on sectors such as the automotive industry in South Africa if mitigation measures are not put in place.**
- **Integration of technologies and sustainable mobility across all sectors requires strong governance and sound policy frameworks coupled with investment in R&D**
- **South African automotive sector requires policy responses that support OEMs to invest in the local production of electric vehicles and related components.**
- **The quadruple helix of collaboration between government departments, academics and researchers, civil society as well as the private sector could ensure a sustainable technological transition prevails without undermining economic growth and social development.**

Closing remarks...

Our two largest auto export markets at risk of disappearing- EU and USA

Could look to other markets across the globe but there is strong competition

- Should South Africa leapfrog or gradually transition?
- Should the country bypass upgrading existing refineries and avoid investing in new refineries?

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