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Global Automotive Trends

Growth of EVs and the role of South Africa in the value chain

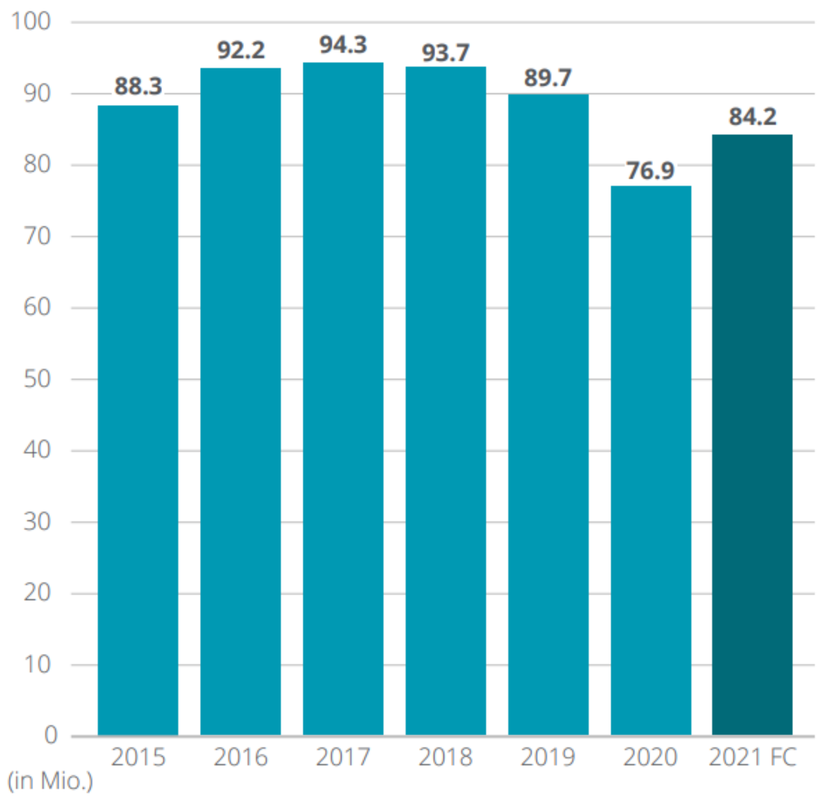
10 November 2021

Agenda

Current Global Automotive Sales Trends

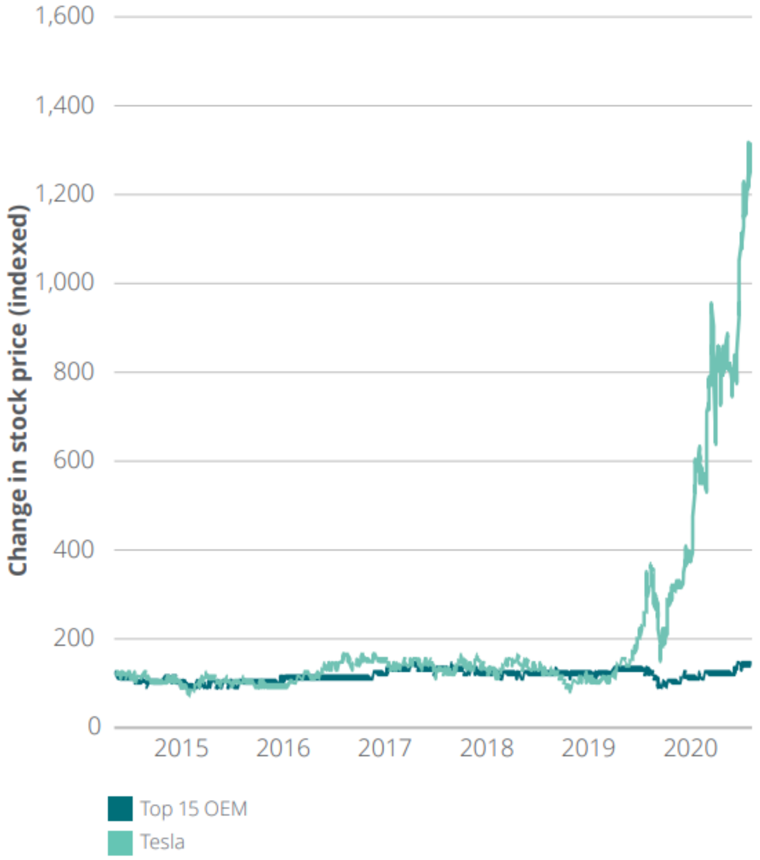
We have seen a serious drop in light-vehicle sales, the decline was further exacerbated by COVID-19

Global light vehicle sales



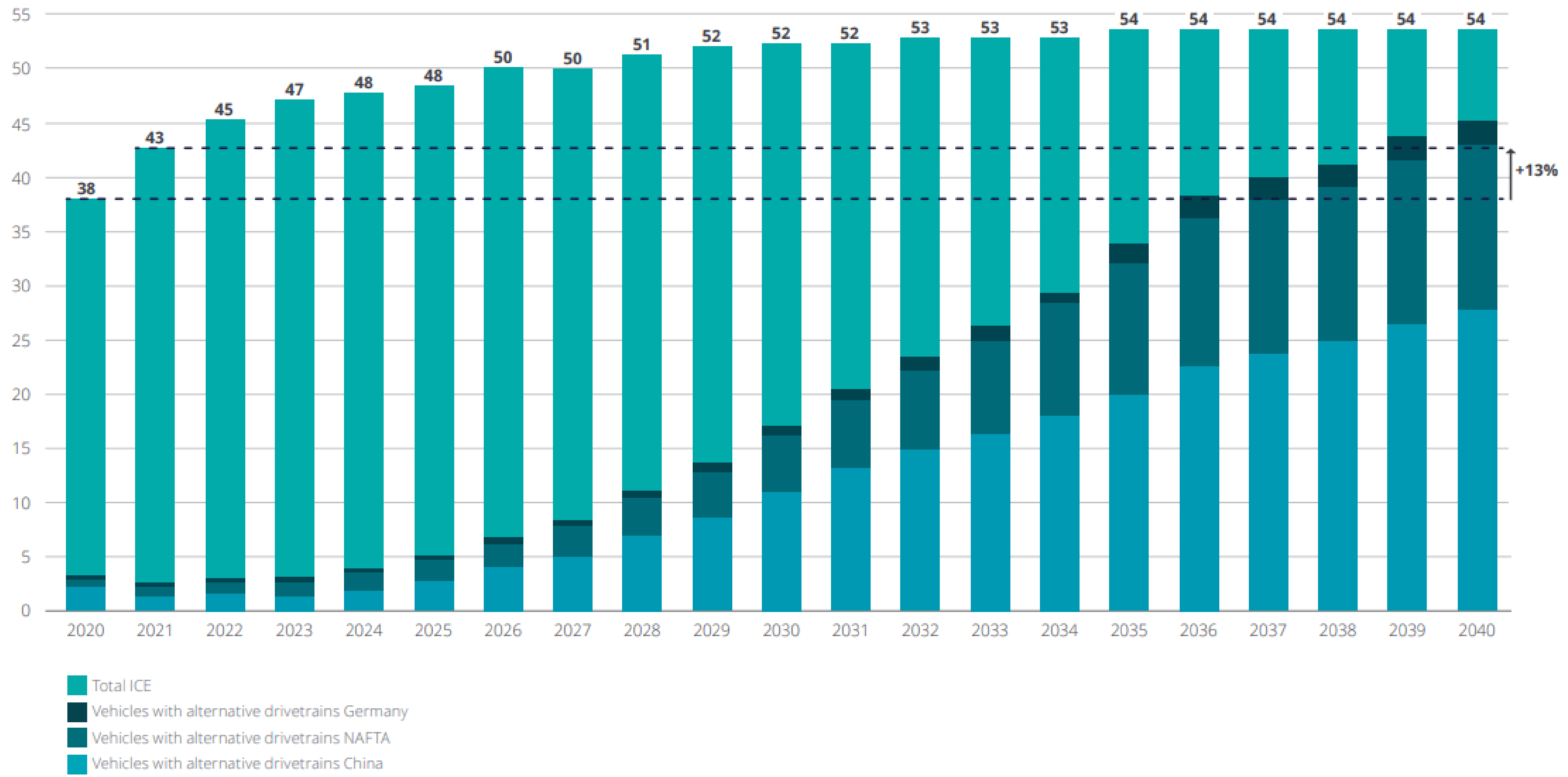
Source: IHS Markit.

Change in stock prices (Jan 2015 = 100)



Forecasted Global Automotive Sales

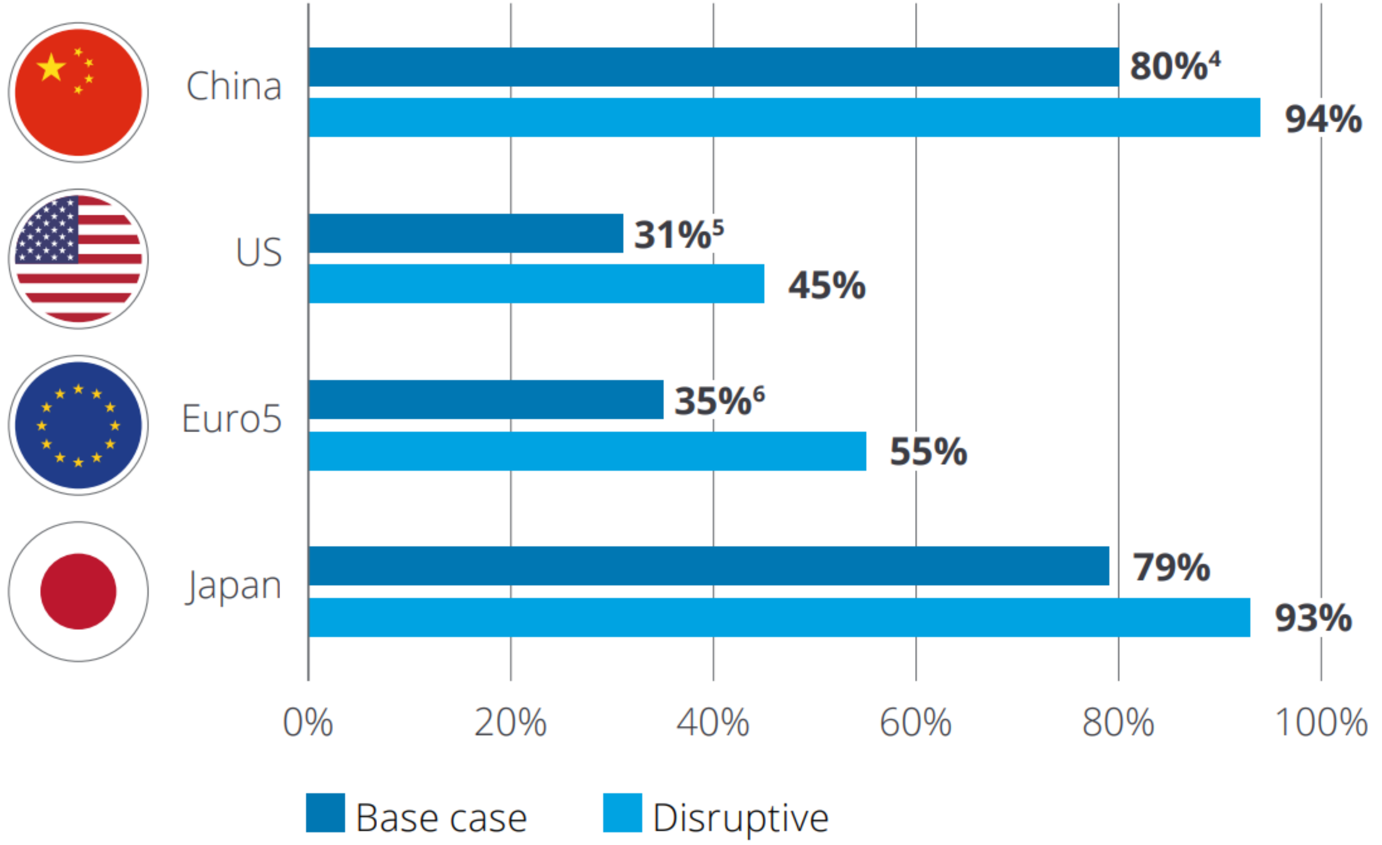
Global sales are expected to rebound sharply, as we emerge out of COVID-19



Source: Deloitte - *Future of automotive sales and aftersales study, 2021*

2035 Global Sales Forecast – New Vehicles

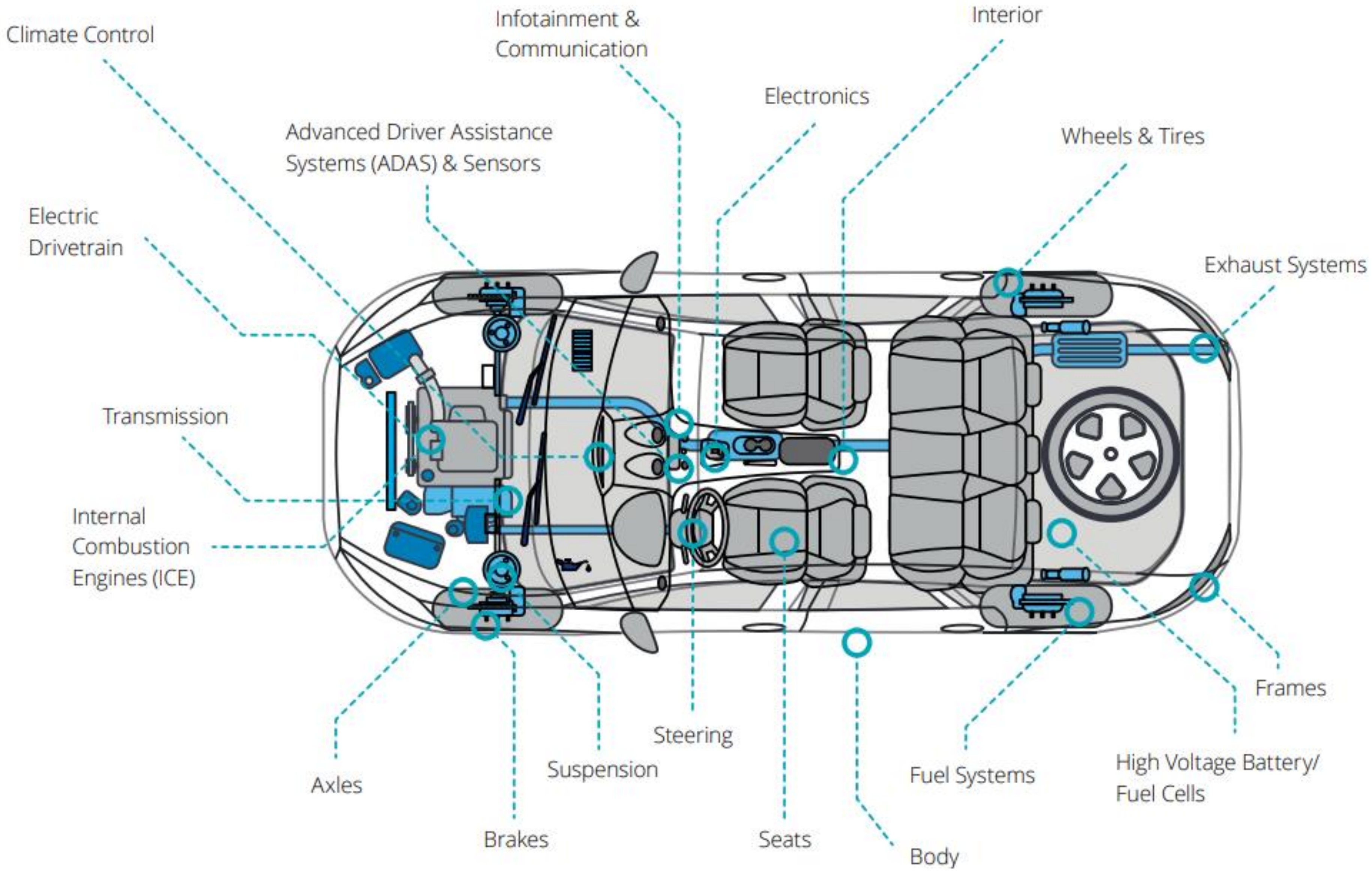
Alternative drivetrains are expected to continuously gain share in overall drive trains trends



- Emerging alternative drive trains include primarily:
  - battery-electric vehicles (BEV),
  - hybrid electric vehicles (hybrid) and
  - fuel cell vehicles (FCV)
- It is unlikely that we will see a complete end to all ICE sales.
- Selected providers many even find business potential in strongly consolidate market

Source: Deloitte - *Future of automotive sales and aftersales study, 2021*

Overview of the Vehicle Components clusters



Source: Deloitte - The Future of the Automotive Value Chain Global Supplier Risk Monitor 2021

Risks presented by the Future of Automotive Value Chain

With increased sustainability focus, alternative vehicles look set to grow, posing risk on ICE related components cultures

The highest risk is in clusters focused on Exhaust Systems and ICE. The highest internal risk we observed is in the Axles cluster (low earnings and bad balance sheet structures). The cluster with the highest external risk is ICE (decreasing market volume, high market consolidation, high adverse impact of legislation).

The lowest risks are found in the ADAS & Sensors and Electric Drivetrain clusters. The ADAS & Sensors cluster has the lowest exposure in five out of six risk categories, among the five clusters with the lowest risk level. The cluster adaptability and capacity for innovation factors as well as credit rating have a particularly positive impact on risk levels.

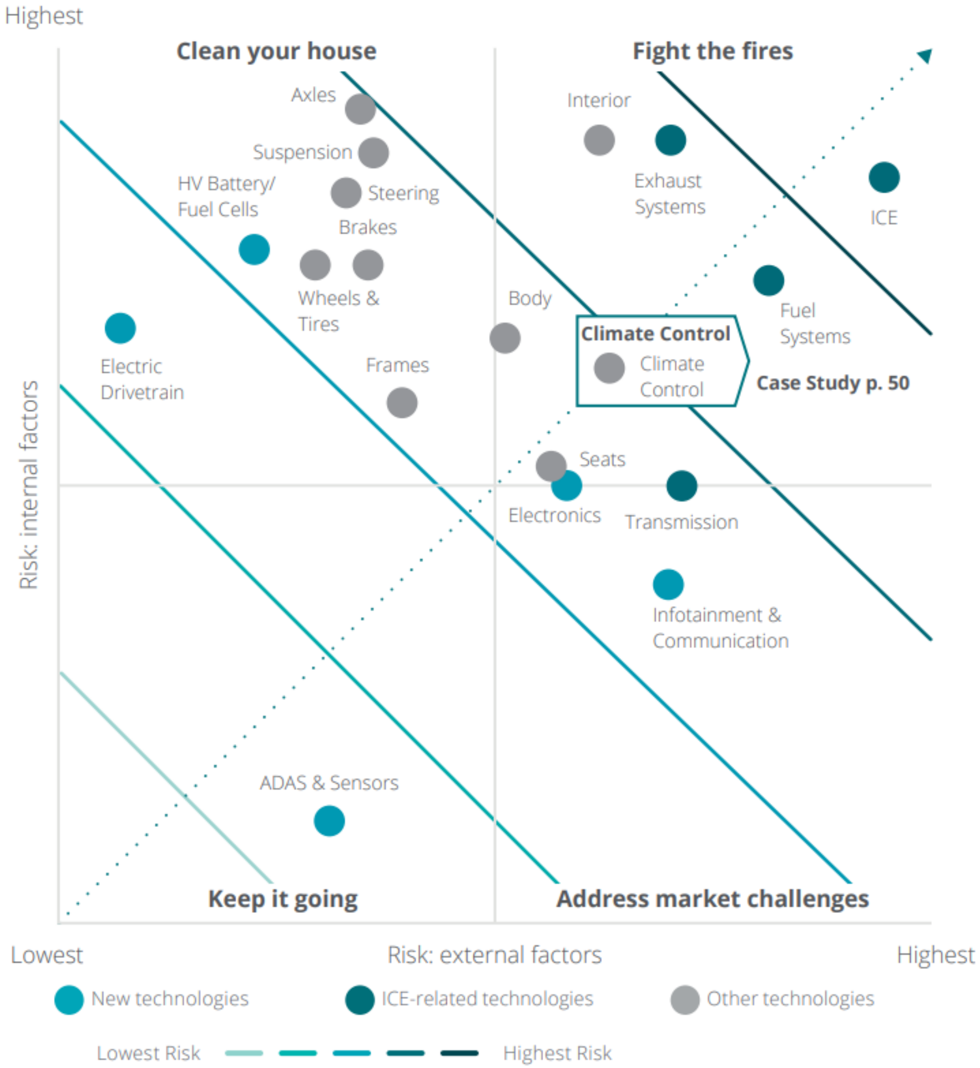
Risk rank	Change*	Cluster	Risk score
1	→	**ICE**	4.74
2	→	**Exhaust Systems**	4.25
3	→	**Interior**	4.09
4	→	**Fuel Systems**	4.01
5	→	**Climate Control**	3.55
6	→	Axles	3.51
7	→	Suspension	3.45
8	→	Transmission	3.44
9	→	Body	3.37
10	→	Steering	3.19
11	→	Infotainment & Communication	3.04
12	→	Brakes	3.03
13	→	Electronics	3.02
14	→	Seats	2.98
15	→	**Wheels & Tires**	2.87
16	→	**HV Battery/ Fuel Cell**	2.68
17	→	**Frame**	2.62
18	→	**Electric Drivetrain**	2.26
19	→	**ADAS & Sensors**	1.36

- COVID-19 is having a particularly negative impact on demand for vehicles with traditional drivetrains, at least over the near term.
- Governments are seizing the opportunity presented by the crisis to promote sustainability.
- The market for alternative vehicles, by contrast, looks set to continue to grow

Source: Deloitte - The Future of the Automotive Value Chain Global Supplier Risk Monitor 2021

How the varying risks are influenced by internal vs external factors

Adoption of alternative drivetrains does not pose the same type of risks in the automotive value chain

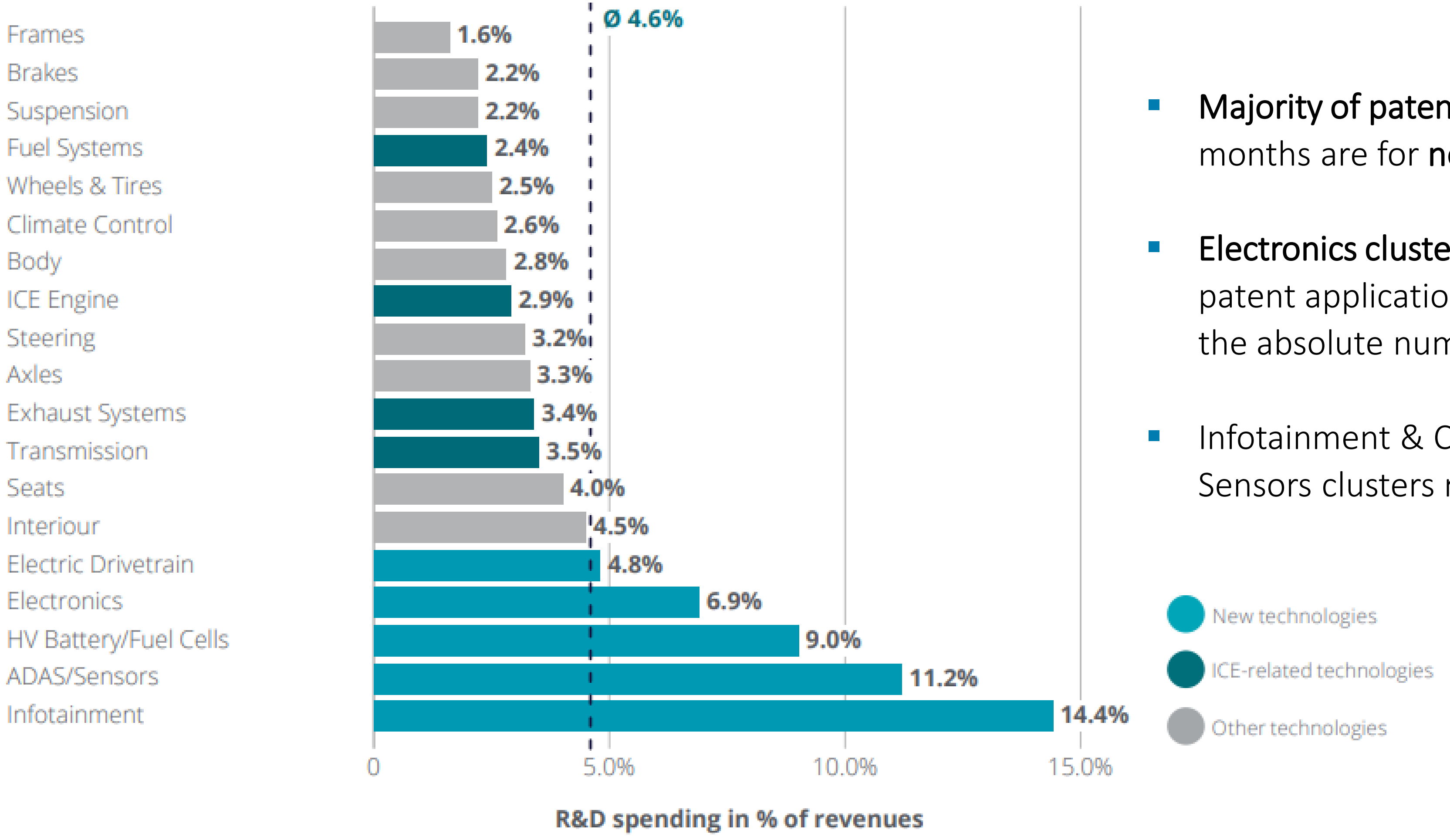


- **ICE and ICE related fuel systems clusters** are expected to see a reduction in market volumes over time due to **climate control mitigations**
- **ADAS & Sensors, Electric Drivetrain**, followed by Electronics are cluster systems are subjected to the least risks in the long term.
- **Remaining system clusters** need to continue managing their medium risk exposure, particular in relation to climate impact. These however **remain relevant** in the future, despite advent of alternative drivetrains future.

Source: Deloitte - The Future of the Automotive Value Chain Global Supplier Risk Monitor 2021

2035 Global Sales Forecast – New Vehicles

Adoption of alternative drivetrains does not pose the same type of risks in the automotive value chain



- **Majority of patents** registered within the last 24 months are for **new technologies**
- **Electronics cluster** has the highest number of patent applications in absolute terms (at 19% of the absolute numbers)
- Infotainment & Communication and ADAS & Sensors clusters rank the **highest in R&D spending**

Source: Deloitte - The Future of the Automotive Value Chain Global Supplier Risk Monitor 2021

Key Messages and takeaways for skills development prioritisation

ICE Technologies

Despite questionable long-term outlook:

- Reporting above average investment
- Continued investment in shrinking market is likely to reduce investment return, be it in R&D or skills development

Infotainment

Highest share of R&D spending

- Manufactures are looking to redesign the value proposition of the automobile
- This is a key area of differentiation and continuous developments

Electronics and ADAS & Sensors

Strong relevant in EVs and autonomous vehicles

- Actively developing new technologies
- Together they account for about 30 percent of all new patents

Source: Deloitte - The Future of the Automotive Value Chain Global Supplier Risk Monitor 2021

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Source: Deloitte - The Future of the Automotive Value Chain Global Supplier Risk Monitor 2021

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Let's Talk Business!

Sustainable Automotive Technologies and Skills Development

November 2021

Vishay Rabbipal
Head: Renewable Energy

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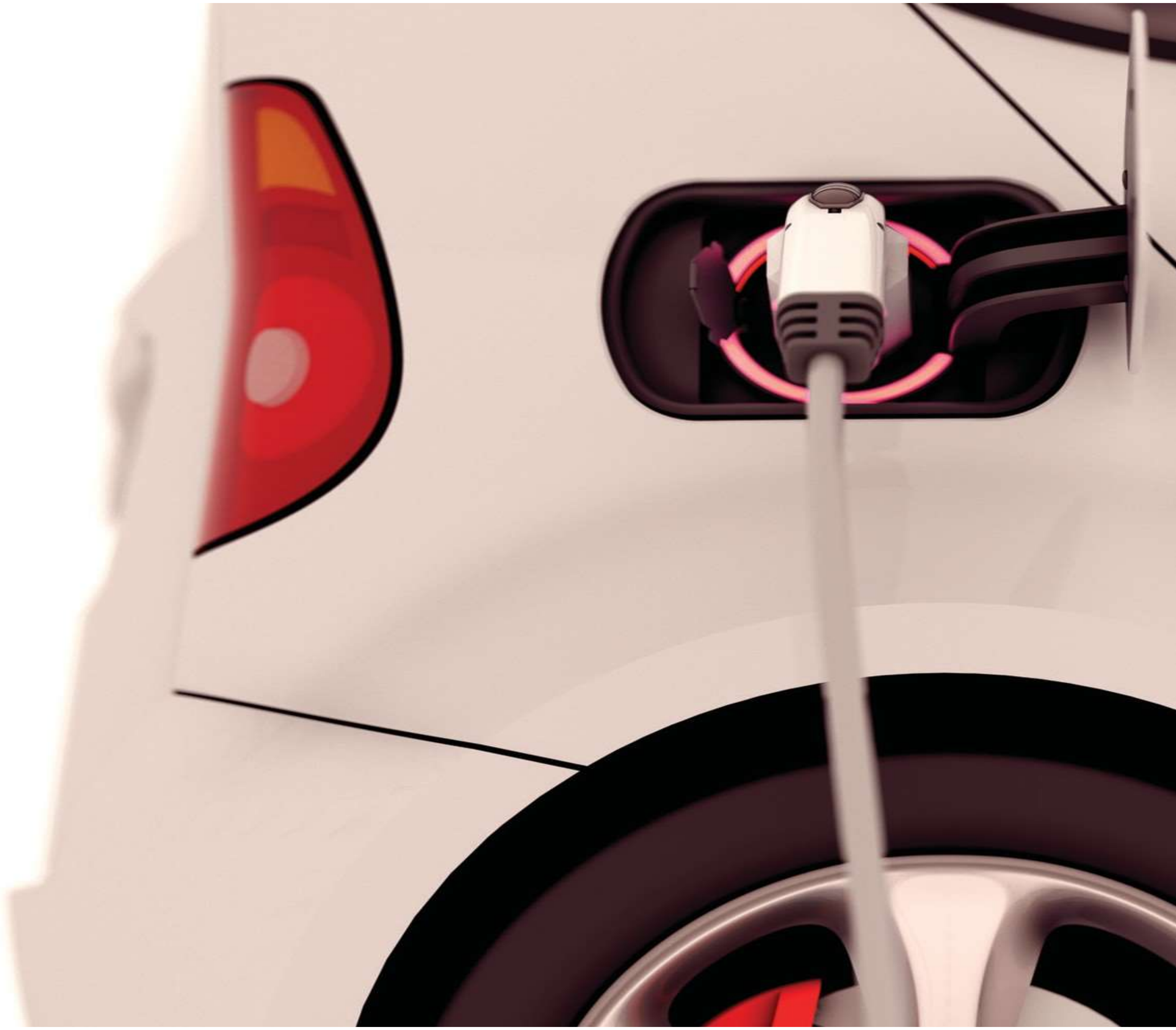


Introduction

The cost of electric vehicles and the wider value chain change year on year, with improved affordability. Therefore, understanding the current and forecasted total cost of ownership of electric vehicles is vital for any commuter and fleet owner to make decisions on investing into electric vehicles and for regulators, manufacturers, motoring associations and banks to create policies and frameworks to support cleaner mobility.

Towards increased uptake of EVs

Consumer Acceptance Challenges

Most commonly cited barries to purchase are related to limitations in EV technology and current EV model selection today but other barriers are linked to misconceptions that can be overcome through consumer education and EV experience

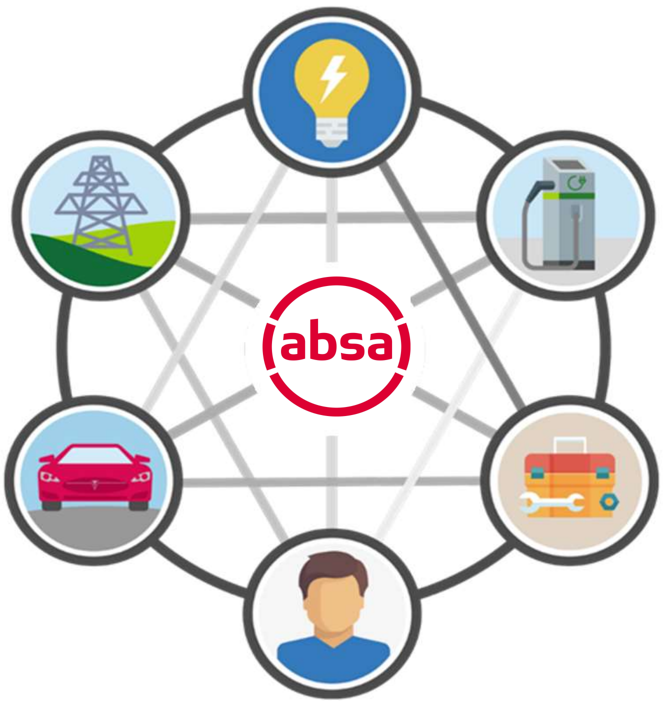
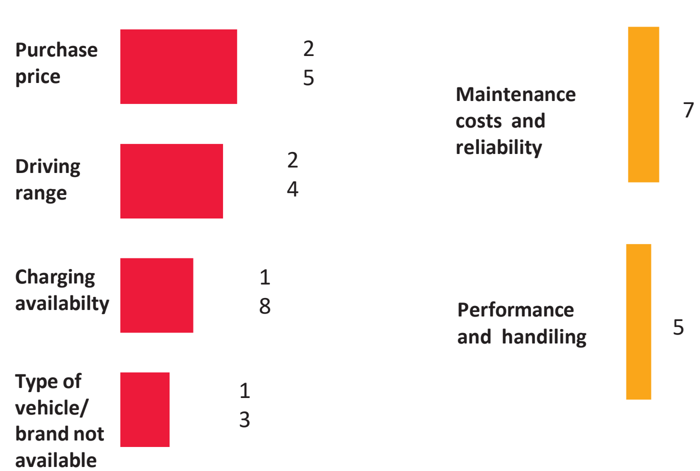


Figure 1: Consumer Acceptance Challenges

Percentage of responses, US and Germany

A 2016 US and German customer survey identified purchase price, driving range and charging infrastructure availability as the main barriers to increased uptake of EVs, as shown in Figure 2. Misconceptions about EV maintenance costs, reliability and driving performance also act as barriers to EV uptake.



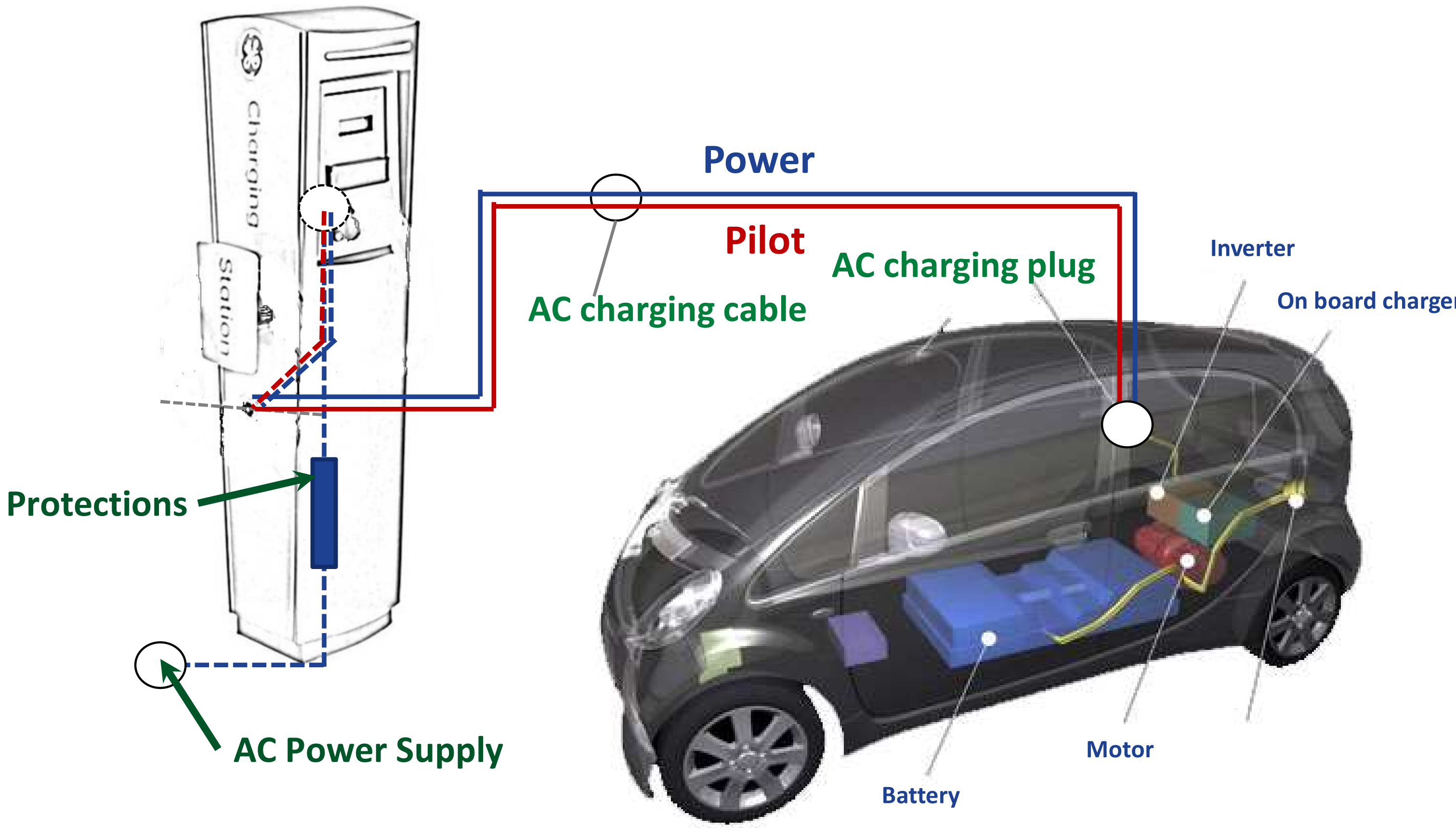
- Battery electric vehicles (BEVs) have lower maintenance costs than ICE models
- Warranties of 8 years/100k miles are now common for EV powertains[1]
- Several automakers are launching new EV's that are specifically optimized for driving experience[2]

1US Department of Transportation
2Statements to press by automakers

Figure 2: Misconceptions about EVs. Source: [8]

Electric vehicle charging

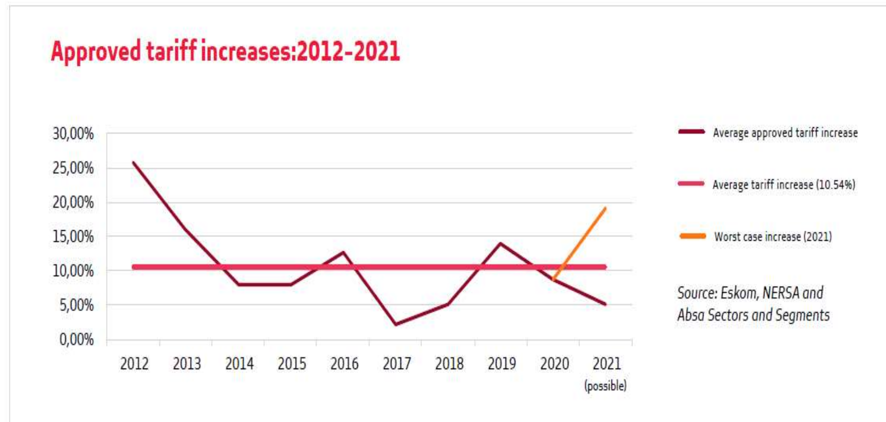
Electric vehicle charging



Source: GE Electric charging

Drivers of the EV Business Case

Electricity Tariff Increases



Source: Eskom, Absa Sector & Segments

The National Energy Regulator of South Africa (NERSA) approved:

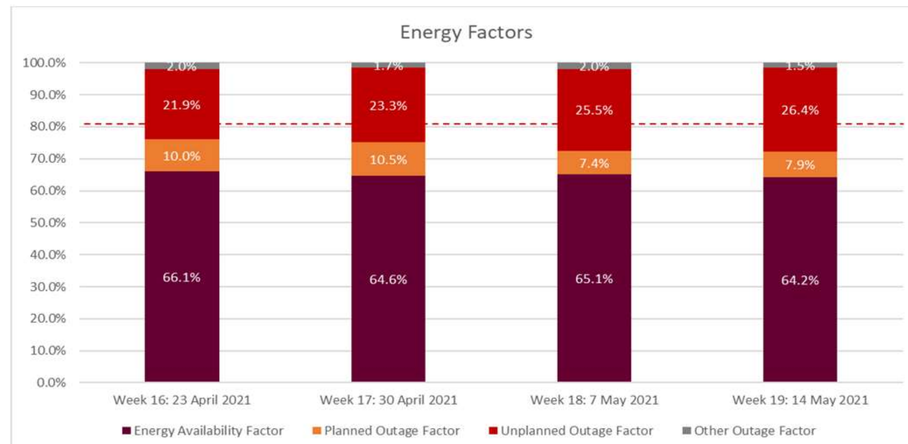
1. Eskom's applications for the third Multi-Year Price Determination (MYPD3),
2. Eskom's supplementary tariff application for **R6 billion**, to be recovered in the 2021/22 financial year.

In addition to the above , on the 16th February 2021, the High Court of South Africa has ordered that an amount of **R10 billion** be recovered from tariff customers in the 2021/22 financial year.

This will result in an average tariff percentage increase of **15.63%** in the 2021/22 financial year from 1 April 2021, while the tariff for municipalities will be implemented on 1 July 2021

Drivers of the EV Business Case

Risk of load shedding to continue to spur increase private sector participation in the energy sector



Source: Eskom, Absa Sectors

- Eskom has been struggling to increase its Energy Availability Factor (EAF).
- The national energy blueprint, the IRP2019, modelled energy availability at 80%, but the current availability is barely above 60%.
- The lower EAF has resulted in increased load-shedding over the past few weeks, which is expected to continue well into 2021.

Drivers of the EV Business Case

Eskom forecast that predicts the risk of load shedding for the next 13 weeks

Week Start	Week	Total Installed Dispatchable Capacity	Planned Maintenance	Available Dispactable Generation Capacity	Unplanned Outage Assumptions (UA)	Emergency Reserve (ER)	Available Capacity (less UA & ER)	Required Capacity (to meet demand and reserve)	Net Available Capacity	Energy Availability Factor
06-Sep-21	36	48,651 MW	5,739 MW	43,851 MW	11,000 MW	2,200 MW	30,651 MW	31,398 MW	-747 MW	66.0%
13-Sep-21	37	48,651 MW	6,077 MW	43,513 MW	11,000 MW	2,200 MW	30,313 MW	31,495 MW	-1,182 MW	65.3%
20-Sep-21	38	48,651 MW	5,784 MW	43,806 MW	11,000 MW	2,200 MW	30,606 MW	31,271 MW	-665 MW	65.9%
27-Sep-21	39	48,651 MW	6,124 MW	43,466 MW	11,000 MW	2,200 MW	30,266 MW	31,268 MW	-1,002 MW	65.2%
04-Oct-21	40	48,651 MW	5,994 MW	43,596 MW	11,000 MW	2,200 MW	30,396 MW	31,507 MW	-1,111 MW	65.4%
11-Oct-21	41	48,651 MW	5,994 MW	43,596 MW	11,000 MW	2,200 MW	30,396 MW	31,480 MW	-1,084 MW	65.4%
18-Oct-21	42	48,651 MW	6,669 MW	42,921 MW	11,000 MW	2,200 MW	29,721 MW	31,095 MW	-1,374 MW	64.0%
25-Oct-21	43	48,651 MW	6,697 MW	42,893 MW	11,000 MW	2,200 MW	29,693 MW	30,982 MW	-1,289 MW	63.9%
01-Nov-21	44	48,651 MW	6,504 MW	43,086 MW	11,000 MW	2,200 MW	29,886 MW	31,007 MW	-1,121 MW	64.3%
08-Nov-21	45	48,651 MW	5,942 MW	43,648 MW	11,000 MW	2,200 MW	30,448 MW	31,060 MW	-612 MW	65.5%
15-Nov-21	46	48,651 MW	6,559 MW	43,031 MW	11,000 MW	2,200 MW	29,831 MW	30,776 MW	-945 MW	64.2%

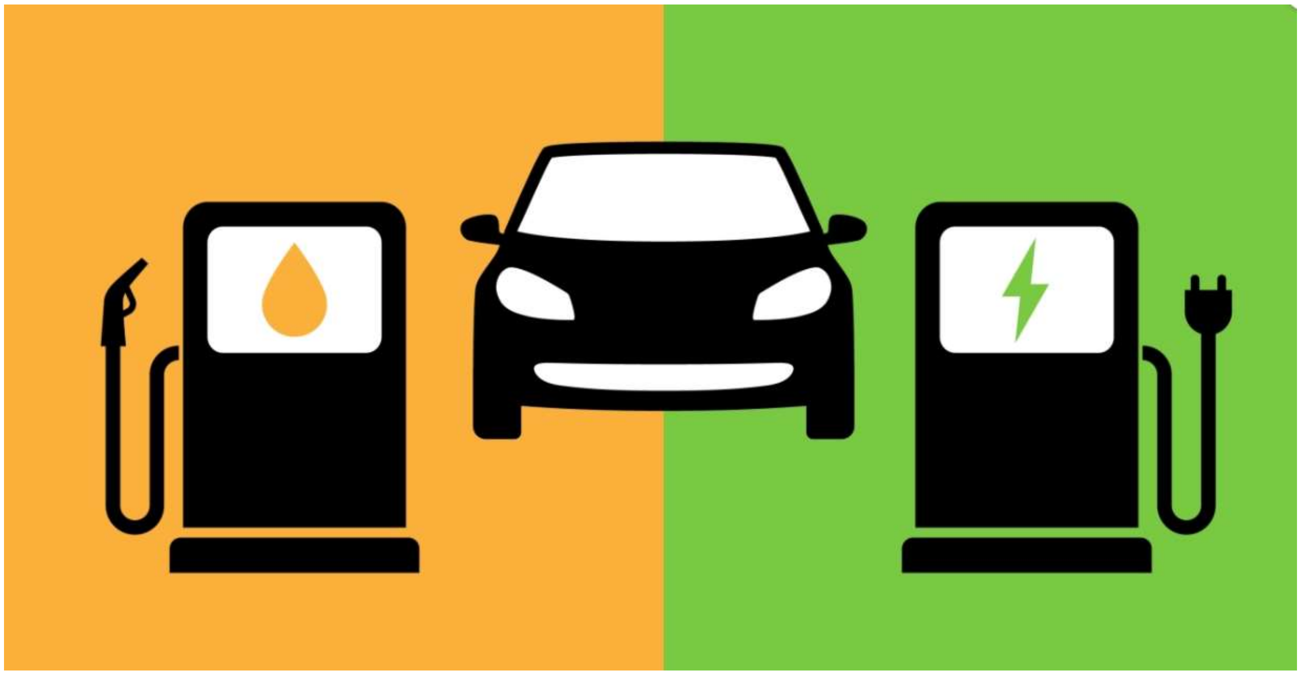
Notes:

1. RSA Contracted Load Forecast is the total official day-ahead hourly forecast. Residual Load Forecast excludes the expected generation from renewables.
2. Available Dispatchable Generation means all generation resources that can be dispatched by Eskom and includes capacity available from all emergency generation resources
3.Eskom installed capacity (incl. non-comm. Kusile units): 47 646MW
4. Total installed Dispatchable Capacity (including imports and emergency generation resources) = 48 651 MW (Incl. non-comm. Kusile units).

Risk Level	Description
(green)	Low risk of load shedding
(yellow)	Medium risk of load shedding
(red)	High risk of load shedding

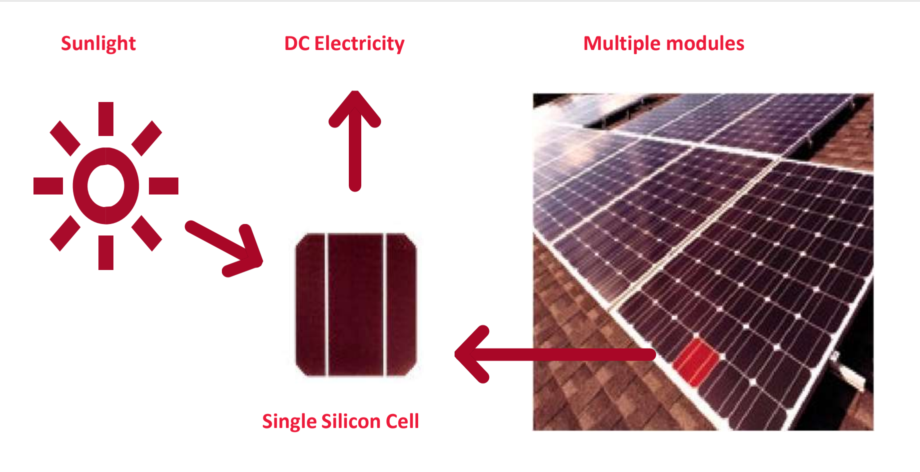
- **Total Installed Dispatchable Capacity** is the total generating capacity in the country.
- **Planned maintenance** (this is essential to keeping generating units online and producing optimally in the long run) is deducted to give the Available Dispatchable Generation Capacity.
- **Unplanned Maintenance** as well as **Emergency Reserves** are then deducted to get to the final likely Available Capacity
- Available and Required Capacity are then compared to determine the **Net Available Capacity**.

Sustainable Automotive Technologies



Among all technologies, solar PV installations coupled with EV Charging is the most viable solution

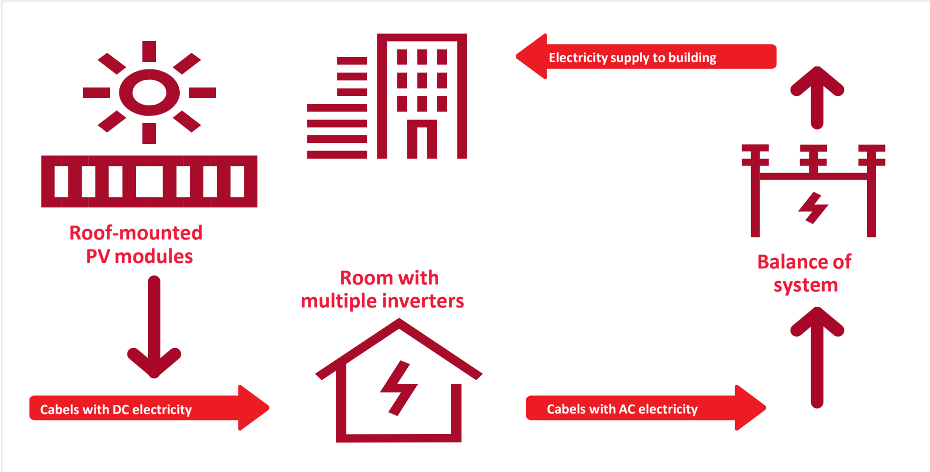
Technology



PV stands for photovoltaic, which is derived from the ancient Greek word phôs, meaning light, and the word volt, an electrical term named after the Italian physicist Alessandro Volta.

In essence, PV modules (commonly referred to as “panels”) are composed of interconnected silicon cells that convert solar radiation into electricity. The cells absorb photons (light) to create a flow of electrons. This flow of electrons is what we commonly refer to as direct current (DC) electricity.

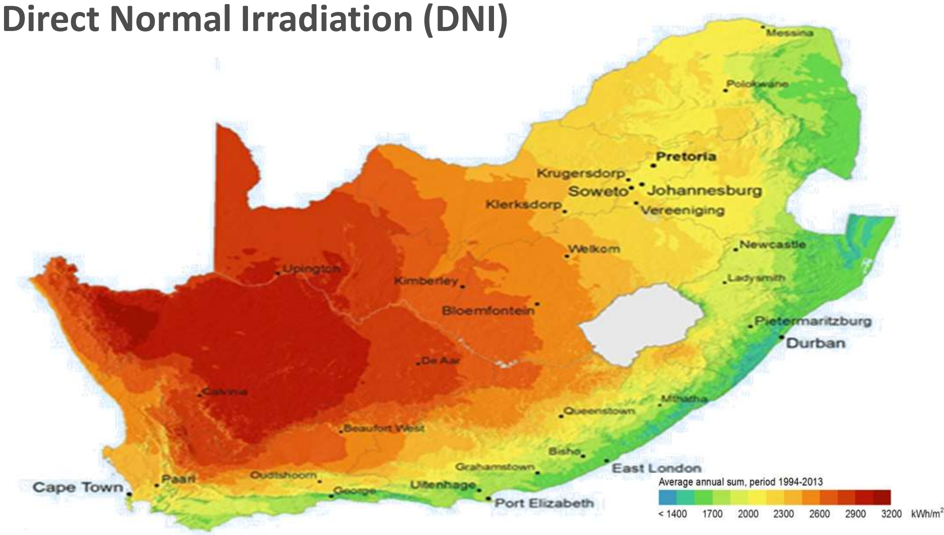
Typical Installation



1. An electric field is created when sunlight hits the solar panels
2. Electricity is Generated and flows into the conductive wire
3. The conductive wire carries DC (Direct Current) electricity to the inverter, where it is converted to AC (Alternate Current) electricity, which is used in homes and businesses
4. The AC electricity travels from the inverter to the Electric panel (or breaker box), which delivers the electricity throughout the facility.
5. Any unused electricity is wasted. With the use of Battery Energy Storage Systems (BESS) the wasted energy can be recovered and utilized when there is no sunlight.

Drivers of the EV Business Case

Direct Normal Irradiation (DNI)

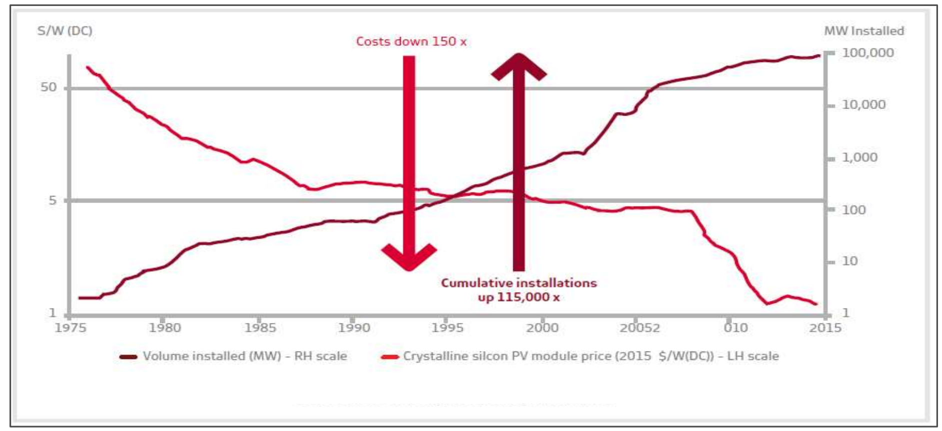


Source: Solar GIS

South Africa has the one of the highest solar irradiation (power per unit area received from the sun) levels globally. However, as can be seen in the below, not all provinces have the same irradiation levels. For example, an installation in the Northern Cape might not yield the same energy as an installation in KZN. This is an important factor to consider in feasibility studies.

Drivers of the EV Business Case

Solar PV Cost



Source: Bloomberg New Energy Finance

We've seen Solar Panel prices decrease rapidly in recent years and therefore the cost of Solar PV installations coming down. See the below for how Solar Panel prices have decreased in time:

According to Bloomberg New Energy Finance, Solar Photovoltaic (PV) prices have decreased by over 150 times over the last 40 years, with installations increasing 115,000 times. Decreasing costs of solar panels (as well as the increasing costs of traditional sources of Energy) has had a positive impact on the investment case for Solar PV installations.

Drivers of the EV Business Case

EV charging stations in South Africa

EV charging stations in South Africa as at November 2021. Brown points indicate high-power charging stations. Source: plugshare.com

- 134 charging stations installed nationwide by November 2019
- 250 charging stations installed nationwide by November 2021

Internal Combustion Engines vs. Electric Vehicles

ICE and EV cost of ownership comparison

Specification	ICE	EV
Purchase price in the USA	$32 500	$35 000
0-100 km/h	8.1 sec	5.6 sec
Max range	796 km	352 km
Top speed	250 km/h	208 km/h
Power	140 kW	285 kW
Torque	250 Nm	441 Nm
Warranty	4 years/80 000 km	4 years/80 000 km
Fuel consumption	17.5 km/l	5.16 km/kWh
Fuel cost per unit fuel in SA	R19.32/l	R1.54/kWh
Fuel cost per km in SA	R1.10/km	R0.30/km

- EV and ICE models USA (excluding government purchase price incentives), while South African fuel and electricity costs are assumed.

Financial considerations

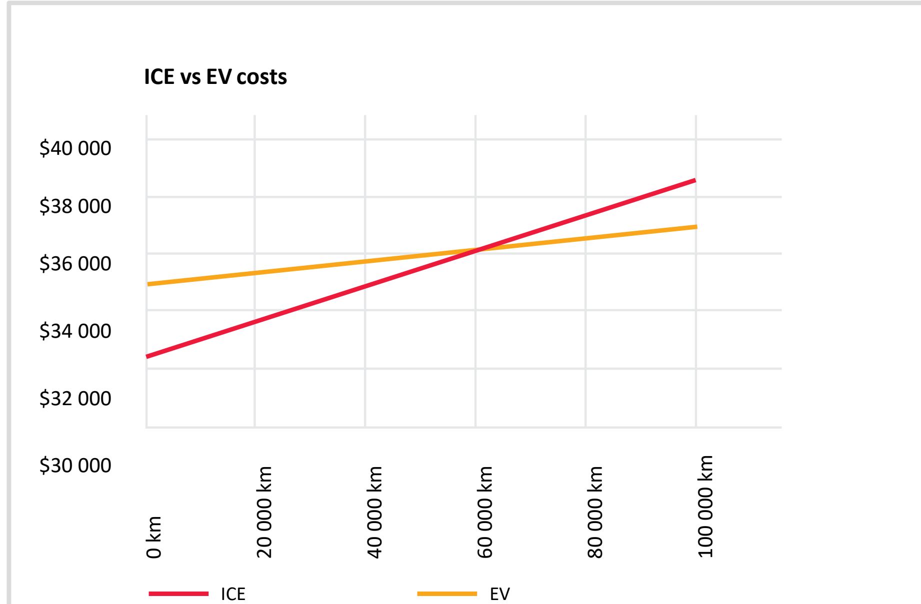


Figure : EV and ICE costs (purchase price and running costs) compared over 100 000km of ownership.

- EVs promise to be more affordable than ICE in the long run when
- The total cost of ownership of the EV becomes less than that of the ICE after around 60 000km.

Thank you

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E-MOBILITY PROGRAMME
enabling electro-mobility innovation

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An initiative of:
technology innovation AGENCY

Skills development - Transitioning from a traditional automotive supply chain towards an electric vehicle (EV) future

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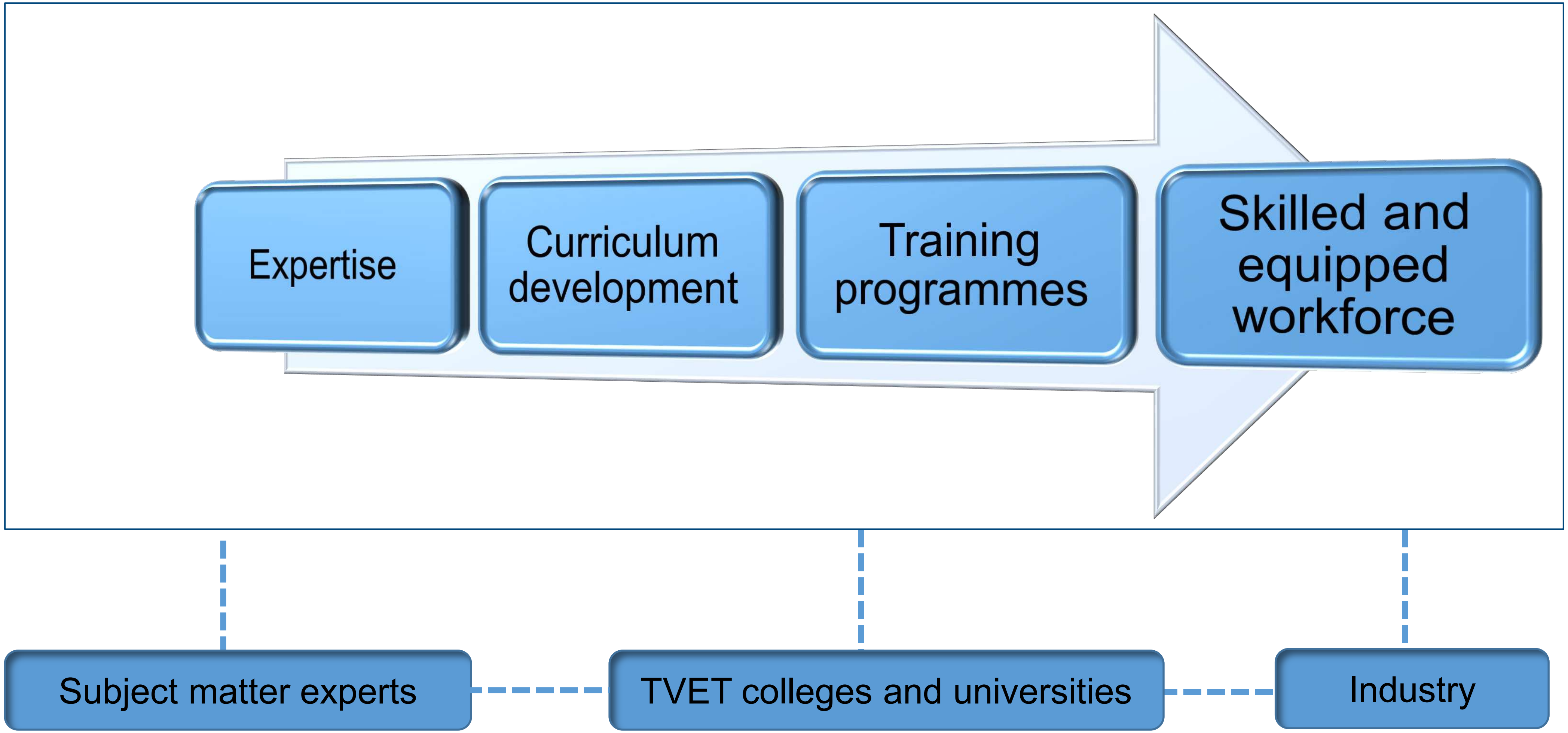
The electric mobility technology ecosystem

Skills required for electric mobility industry

Research and Development	Chemistry: materials scientists, battery-scientists, physics: solid state, renewable energy, computer science: systems integration, software development, software platforms
Engineering	Electrical, chemical, industrial, mechanical engineers
Manufacturing	Electrical and electronic equipment assemblers; electromechanical equipment assemblers; computer-controlled machine tool operators; machinists
Maintenance	Automotive service technicians, mechanics with focus on electric vehicles and high voltage technology training
Infrastructure	Urban and regional planners; electrical power-systems installers and repairers; electricians, charging station infrastructure
Social	First responders: Police , ambulance, fire firefighters, rescue and recovery services
Business	Customer services, sales, marketing, entrepreneurship

Skills development: electric vehicles (EVs)



Skills development: electric vehicles (EVs)

High voltage technology: vocational training

Image source: Electric and Hybrid Vehicles, Tom Denton, IMI

Electricity is invisible

You can't see it,
smell it,
or hear it

Skills development: electric vehicles (EVs)

High voltage technology: vocational training: specialist tools and safety equipment: PPE

Image source: CATU

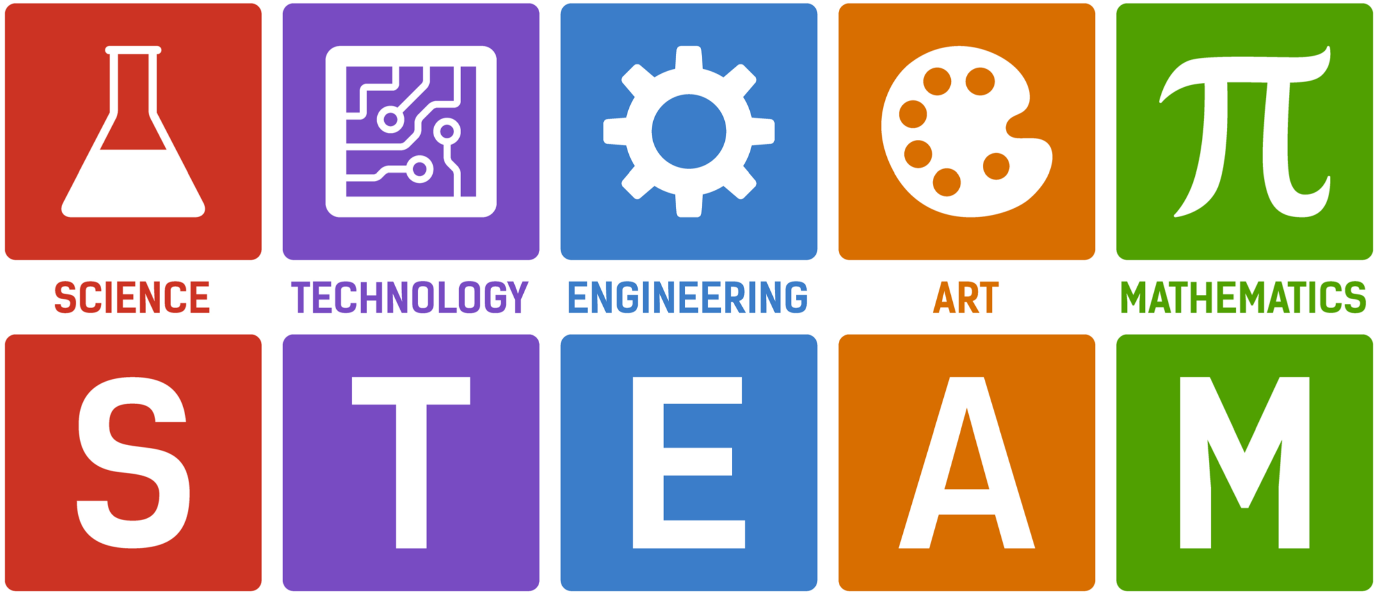
Skills development: electric vehicles (EVs)

High voltage technology: vocational training: workshop safety

Image source: CATU

Image source: CATU

STEAM education: future proof a sustainable skills pipeline for eMobility



uYilo eMobility Programme

The uYilo eMobility Programme was established in 2013 to serve as a **national multi-stakeholder,** collaborative programme focused on **enabling**, **facilitating** and **mobilising** growth in electric mobility within the transport, and complimentary green economy sector in South Africa.

Aligned to **global technology advancements** across **transport**, **energy** and **ICT** that electric mobility impacts on, uYilo has created a footprint in the local industry, while also leveraging international networks towards advancing the uptake of electric mobility through **government lobbying,**

industry engagement,

enterprise development,

pilot projects,

thought leadership and

skills development

technology innovation AGENCY

UYILO E-MOBILITY PROGRAMME enabling electro-mobility innovation

uYilo electric mobility ecosystem

technology innovation
AGENCY

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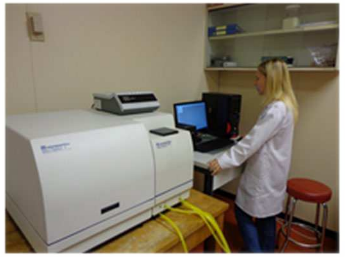
uYilo's facilities

Accredited battery testing and materials characterisation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Electric Vehicle Systems



Smart Grid EcoSystem – Testing, Development and Demonstration







Smart grid ecosystem for EV-grid interoperability

- Solar Energy **Generation**
- **Storage** through second-life EV batteries in stationary applications (Multi-manufacturer)
- **Distribution** through multiple charger network (AC charge points, DC fast chargers)
- **Vehicle-to-Grid** Ancillary Services
- Energy **Management** System
- IEC 61850 Smart Grid remote **Communications**

UYILO
E-MOBILITY PROGRAMME
enabling electro-mobility innovation

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