CSIR's Electric Vehicle Fleet

ELECTRIC VEHICLE TECHNOLOGIES SUMMIT - 2019

CSIR Energy Autonomous Campus

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CSIR Background

Background (1/2)
The CSIR is South Africa's multidisciplinary research council

- The CSIR is a science council, classified as a national government business enterprise
- IN NUMBERS:

73yrs
2018

2 344
Total staff

1 608
SET base, 36% female,62% Black South African

536
Publication equivalents

319
Journal articles

19
New patents

320
Staff with PhDs

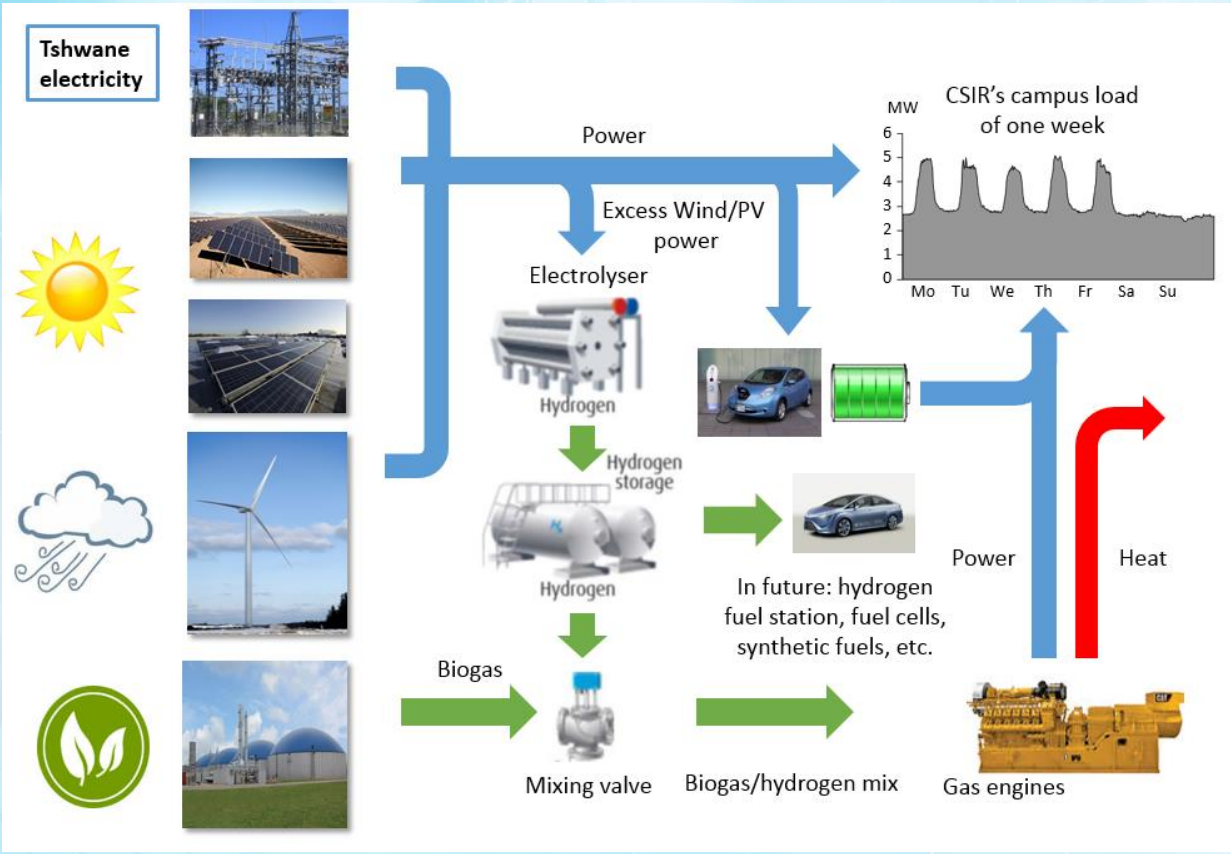
R 2 534 m
Total Income

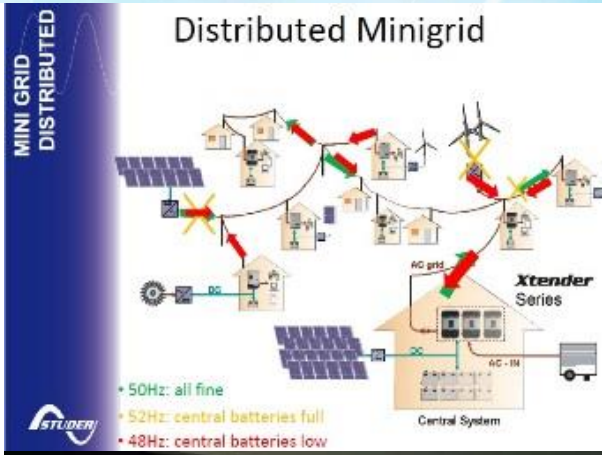
Background (2/2)
South African Public Research Institutions

Research undertaken by the CSIR is directed and multidisciplinary, unlike other research institutions that focus on a specific area of research.

Introduction

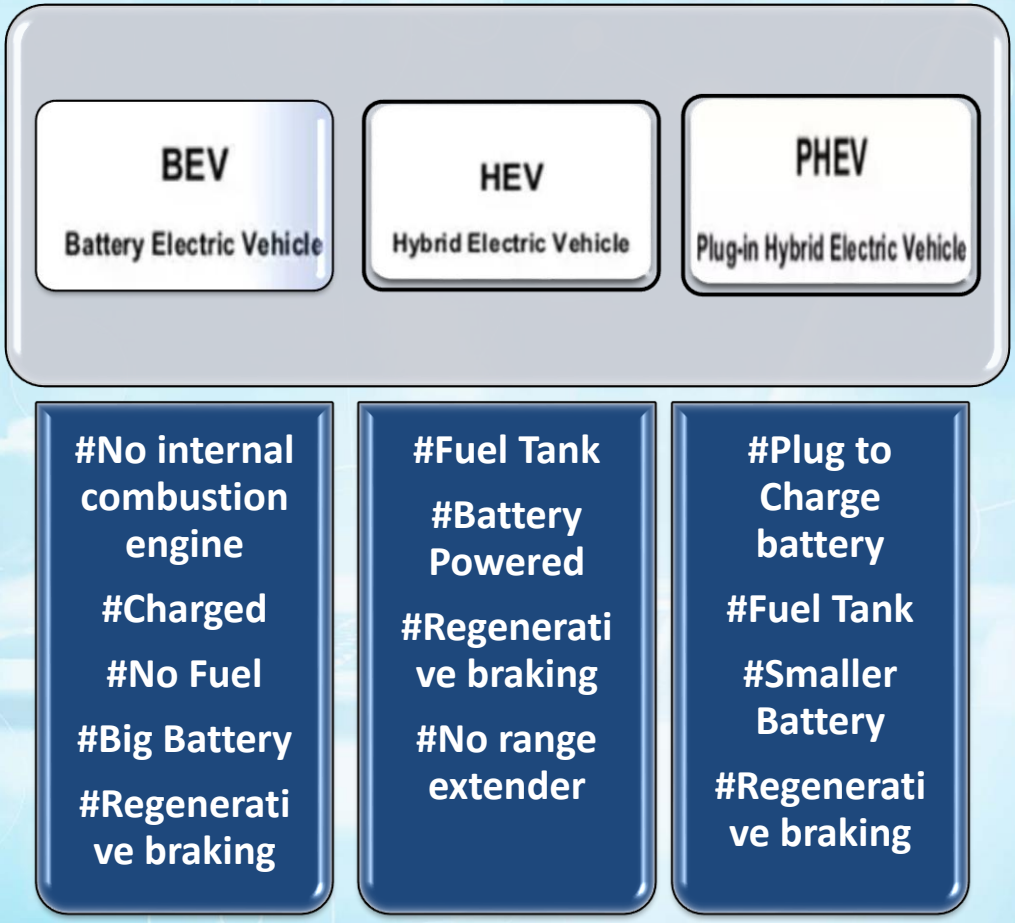
Introduction (1/2)
CSIR Energy-Autonomous Campus in Pretoria





Introduction (2/2)
Electric Vehicles

- **Electric Vehicle** is an automobile that is powered entirely or partially by electricity.
- **Electric Vehicles** are categorized differently as shown in the diagram.
- **EVs are environmentally friendly**
  - No tail pipe air pollutants at the place where they are operated.
  - They generate less noise pollution than an internal combustion vehicle, whether at rest or in motion.



Advantages of Electric Vehicles

- **Ability to link sectors:**
  - Electric vehicles can link the transportation sector to the power sector.
- **Savings:**
  - Spend less on fuel (or not at all) and low maintenance costs.
- **Home charging:**
  - Electric vehicle owners can deploy their own charging equipment at their homes.
  - Control the time of charging to save cost of electricity.
- **Sustainable mode of transport:**
  - electric vehicles can be charged using electricity from renewable energy resources.
- **EVs are environmentally friendly:**
  - Promote healthy living (zero emissions)
  - Less noise pollution.
- **Performance:**
  - More efficient.
  - Instant torque, smooth & whisper-quiet drive
  - Participate in reducing global warming through zero emission transportation
- **Style:**
  - Speed (fast acceleration), simplicity, and even untraditional designs.

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What is different today as compared to just a few years ago?

- **Battery prices have been decreasing globally:**
  - Electric vehicles starting to be cost competitive to conventional cars
  - Economies of scale (there has been talks of mass production by some companies)
  - More battery research done to improve the battery technology (increasing rage)

- **Technology advances:**
  - Longer range (improved research on battery technology)
  - Look and feel of a “normal” car

- **New Regulations aimed at promoting EVs:**
  - Governments setting aggressive targets (production quotas)
  - Car manufactures committing to increasing investments in EV production,
  - Introduction of carbon emission tax

Electric vehicles at the CSIR

The CSIR Electric Vehicle Fleets

- **Plug in-Hybrid EV:**
  - Battery – 18.8.kWh
  - Synchronous Motor, No engine.
  - Electric range, everyday use – up to 150 km + 150 REX.
  - Quick charge time – 30 Mins
  - Energy consumption – 13.5 kWh/100 km
  - Top speed – 150 km/h
  - Regenerative mechanism
- **Battery Electric Vehicle:**
  - Battery – 24 kWh
  - Synchronous Motor, No engine.
  - Electric range, everyday use – 135 km
  - Quick charge time – 30 Mins
  - Energy consumption – 18.6 kWh/100 km
  - Top speed – 144 km/h
  - Regenerative mechanism

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Value Proposition of the Electric Vehicle at the CSIR

- **Demand Side Management (V2G):**
  - EVs can be plugged into the electric grid when not in use e.g. during peak periods
  - Charging at night, when there is unused generating capacity (energy cost saving).
  - Potential to reduce the need for new power plants through V2G/G2V technology.
- **Complement/supplement variable loads such as Wind and Solar PV:**
  - Current electricity infrastructure will need to cope with increasing shares of variable-output power sources such as windmills and PV solar panels.
  - Variability could be addressed by adjusting the speed at which EV batteries are charged and discharged.
- **Other objectives:**
  - Awareness raising and lowering EV perceptions e.g. range anxiety.
  - Promoting zero emissions in transportation.
  - EV Performance analysis in an African concept.
  - Contribution towards enhancing the adoption of EVs in South Africa and possibly the continent through directed research.

Market challenges the EVs at the CSIR aims to solve?

Increase the low uptake of electric vehicles in South Africa.

- Raising awareness in schools.
- Influencing & educating youth at science fairs, inductions etc.

Analyse the impacts of demand increase on the grid during high share of EVs.

- Studies and research work done on grid stability when they is increase share of EV charging.
- How the grid reacts by analysing the impact of increase in demand during charging times i.e. charging at home and at work.

Understanding V2G and G2V integration and storing energy from the PVs.

- Understanding the infrastructure of V2G, which is a method that assist the grid in trying to balance the supply and demand fluctuations.
- Absorbing excess power from the grid typically in systems with high renewable energy fraction and storing it in the battery.
- Vehicle-to-Grid (V2G) is also use to balance demand and supply by putting power back into the grid when needed or if there is a supply gap.

Understand the charging infrastructure that will alleviate “range anxiety”

- Analyse fast charging and slow charging patterns, grid stability when they is high share.
- Look at different technologies under charging i.e. wireless charging, smart charging etc.

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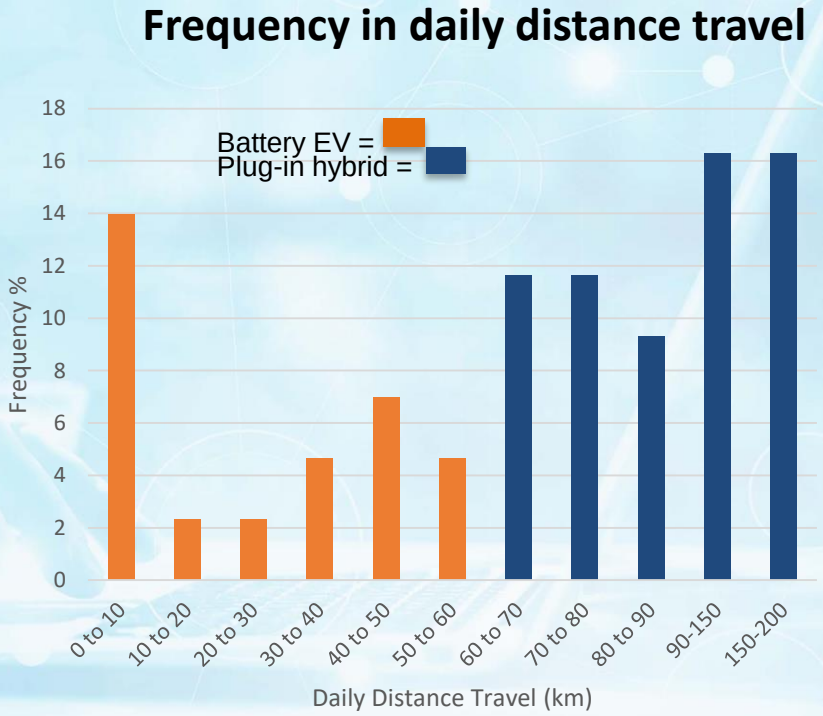
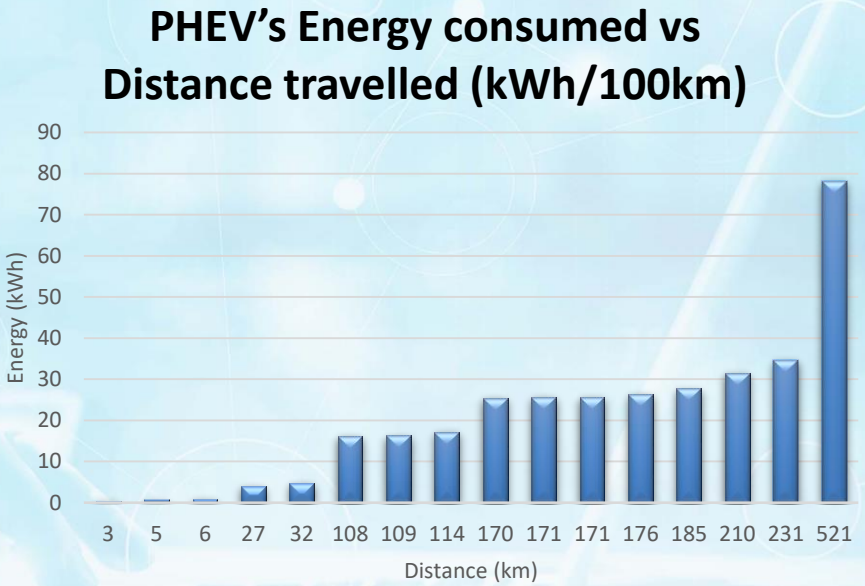
Travelling Patterns (1/2)

- **Plug-in Hybrid Car = Blue bar graph**
- **Battery EV = Yellow bar graph**
  - The plug in hybrid is popular for longer distances because of its Range Extender feature.
  - The BEV still creates a lot of range anxiety amongst the drivers, It lacks a REX mode.
  - The range is what hinders personal ownership interests amongst the users.



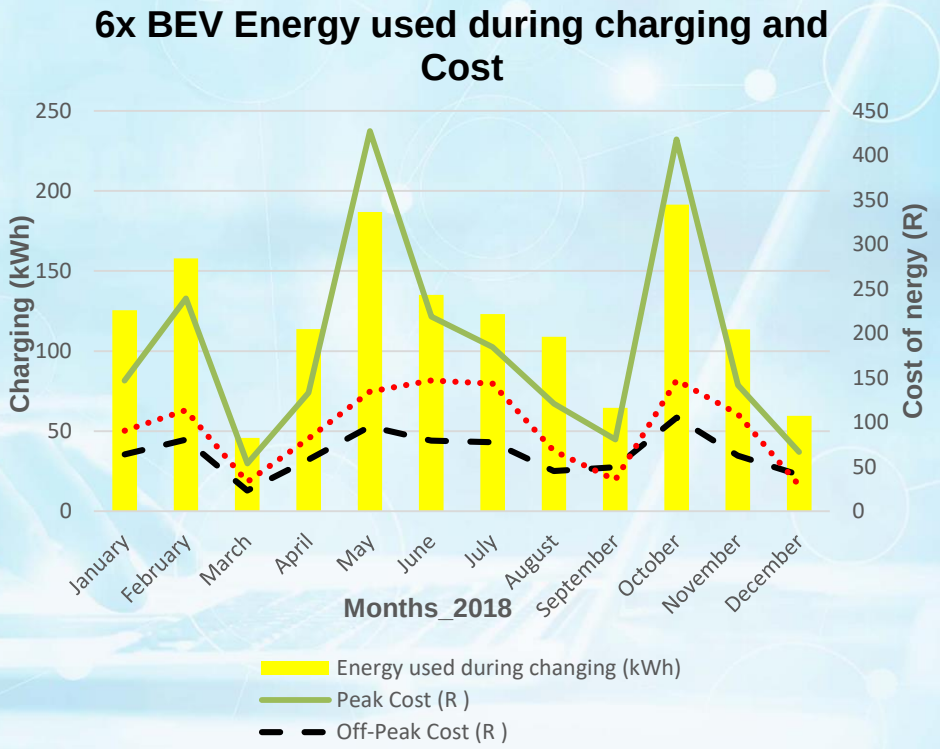
Travelling Patterns (2/2)

- **Plug-in Hybrid Car**
  - Calculated using data assuming “good driving”, from car specs.
  - The car does use about 15 kWh of the battery at about 100km as per its specification.
  - A conversion factor was used thus if 1km = 0.15kWh then the results are calculated using distance travelled data, the results are shown in the bar graph.



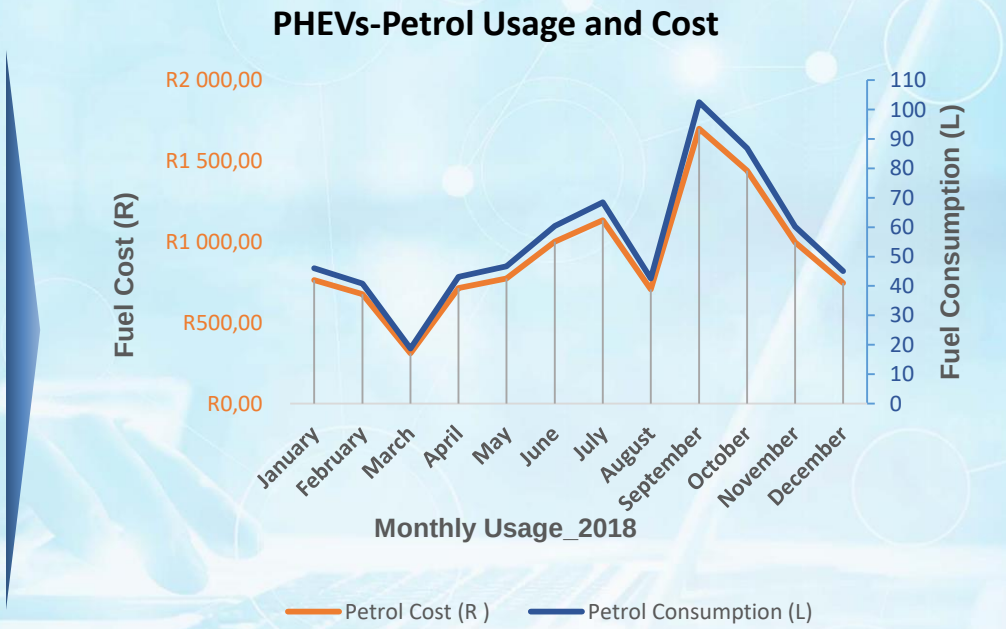
Electric Vehicle Performance (1/2)

- The energy cost used to charge the EVs is cheap even during peak times.
- The energy used for charging per month is at its peak at about 188kWh.
- EVs are cost competitive than ICE cars especially when powered by clean and cheaper energy like the PVs.



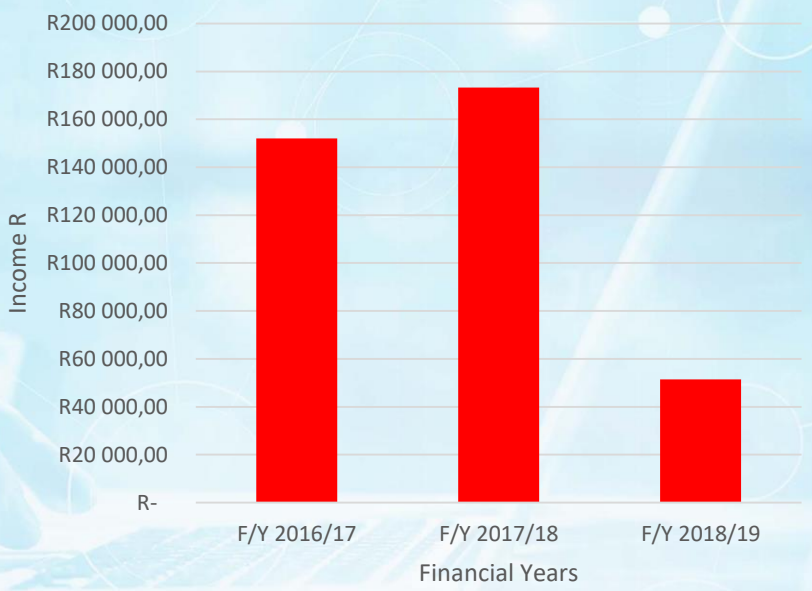
Electric Vehicle Performance (2/2)

- The cost of fuel per month when using the PHEVs is close to R1500 at its peak when travelling longer distances and frequently.
- Although the PHEV consumes fuel to extend the range, the fuel is always converted into electricity (feed back to the battery) in order to always drive the PHEV in electric mode.
- The EVs save on fuel cost when compared to ICE cars on everyday average usage.



Electric Vehicle Fleet Recoveries

- Both EVs at the CSIR are used also as fleets.
- Employees are encouraged to use the cars during office hours for business trips, as an incentive to save the organisation money on mileage claims .
- Each department is charged a rate of R/km for the usage and the money is collected through calculations of recoveries (Income).
- The EVs have not made profit because of the minimal income generated from their usage vs the cost of investment.

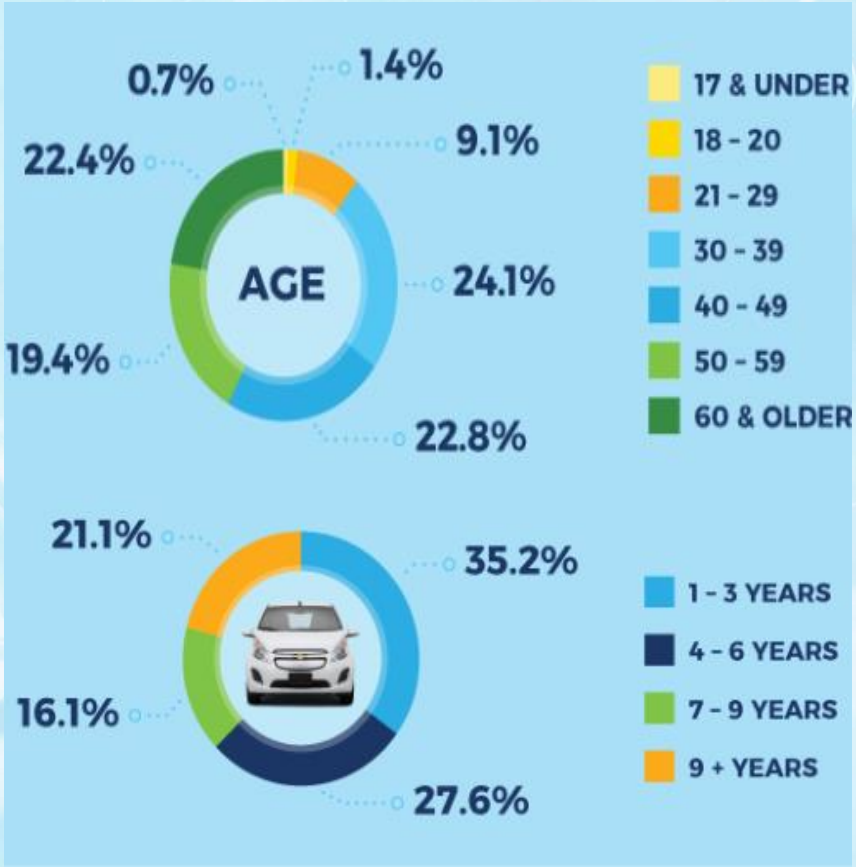


Electric Vehicle

They is a survey being carried out to understand the CSIR employee's perceptions, interests and concerns regarding EVs.

The survey focuses on understanding the following:

- The gender, race and age interests in owning electric vehicles.
- What are the drawbacks of an electric car?
- How likely would they recommend EVs to family members based on their experience at the CSIR?
- How long would they plan to keep EVs when they own one?
- How much would you be prepared to pay for a similar model but electric car?
- Approximately how many miles a day do you travel every day?
- Should the SA government provide incentives for people to buy an electric car?



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Activities done with the EVs

Research work associated with EV at the CSIR

Conference presentation: Potential benefits of planned & coordinated (smart) charging of EVs under high penetration in South Africa (2018)_Dr P Mukoma

Future Study: Analysis of consumer incentives to drive the uptake of EVs in SA.

Future Study: Understanding the impact of economic growth and job creation with e-mobility in SA.

Future Study: Impact analysis of grid stability with high uptake of EVs in SA.

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Electric vehicle activities at the CSIR.

- **Integrated into the CSIR Fleet**
  - Available to all CSIR employee
- **Promoting the EVs at Conferences and Fairs**
  - CSIR Conference
  - Science Forum South Africa (SFSA)
  - EV awareness campaigns at the CSIR campus
- **Research:**
  - Understanding the technical performance and ownership impact.
  - Debottlenecking challenges with the technology.
  - Understanding opportunities for local industry and market creation.

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Current challenges

- **Battery failure on BEV:**
  - Although life span is suppose to be about 20 years.
- **Low utilization on campus (especially with the BEV):**
  - BEV are limited by battery range
  - Slow charging system available at campus. (EVs take approx. 8 hours to be about 90% fully charged)
  - Perceptions
- **Contractual constraints:**
  - Limiting factor

Projects on the pipeline.

- **Increase internal and external awareness raising of electric vehicles and collaborations:**
  - Collaborate with various stakeholders and alleviate the uptake of EVs.
  - Assist commercial market or manufactures to understand user perceptions, requirements and potential barriers (real and perceived) to electric vehicle technology adoptions and communicate effective methods of evaluating such parameters.
- **Charging stations:**
  - Sourcing funding for installing and researching on fast charging, currently the CSIR invested in 12 Level I (slow chargers).
  - Encouraging other stakeholders to invest in deploying more charging stations across Gauteng to build up people's confidence around purchasing EVs.
- **Vehicle to Grid (V2G) or Grid to Vehicle (G2V) demonstration:**
  - Looking at:
    - Best way of handling excess electricity generated from intermittent renewable energy resources and balancing power supply-demand fluctuations.
    - Renewable energy integration with electric vehicles and requirements for grid management.
    - Socio-technical impact, and market acceptance criterions and rewards of vehicle to grid/grid to vehicle services.

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Conclusions

- Electric Vehicles create energy security when integrated through V2G/G2V.
- Electric Vehicles promote a reduction in carbon emissions and reduce noise pollutant making them an environmentally friendly means of transportation.
- Electric Vehicles reduce the dependency of fuel, which is currently very expensive in South Africa.
- Its government incentives and policies put in place that will assist in increasing EV adoption rapidly and meeting the desired target by year 2030 in SA.
- The CSIR will continue to actively get involve in creating awareness and conducting research on EVs, especially when integrated into creating a smart grid system.

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Re a leboha

Ha Khensa

Enkosi

Siyathokoza

Siyabonga

Re a leboga

Ndo Livhuwa

Thank you

Dankie