Decentralised EV Charging, OCPP for Grid Management

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EV adoption in South Africa

- In South Africa we are arriving at the inflection point of the S curve of EV adoption.
- There are several EV brands in the country, starting with early adoption of the Nissan Leaf in 2013. Eskom tested over a dozen Leafs extensively of 2 years. The range at the time was limited to just of 113km. Charging stations were set up at universities and research facilities around the country to understand the technology as well as its potential.
- Uyilo (The national electric mobility program in South Africa) under partnership with Nissan Japan conducted early testing and evaluation of V2G feasibility and potential benefits.
- The lessons learnt include the following:
    - Varied discharge speed that varied on the SoC, and decreased significantly when the SoC was low.
    - Limited depth of discharge to 10% SoC.
    - Session interruptions and limitations

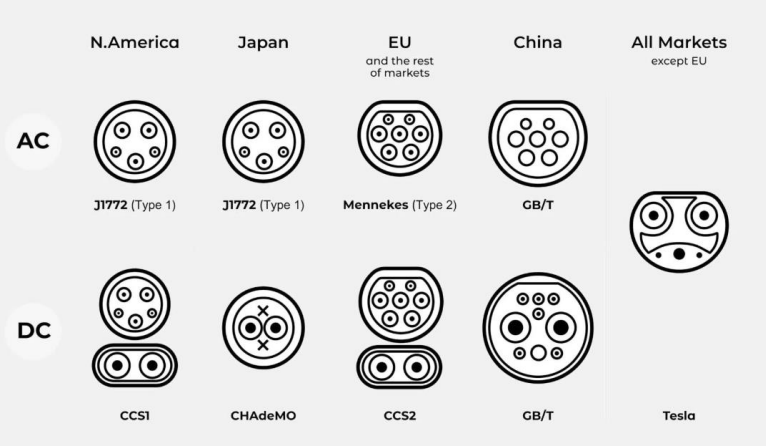
EV Charger History

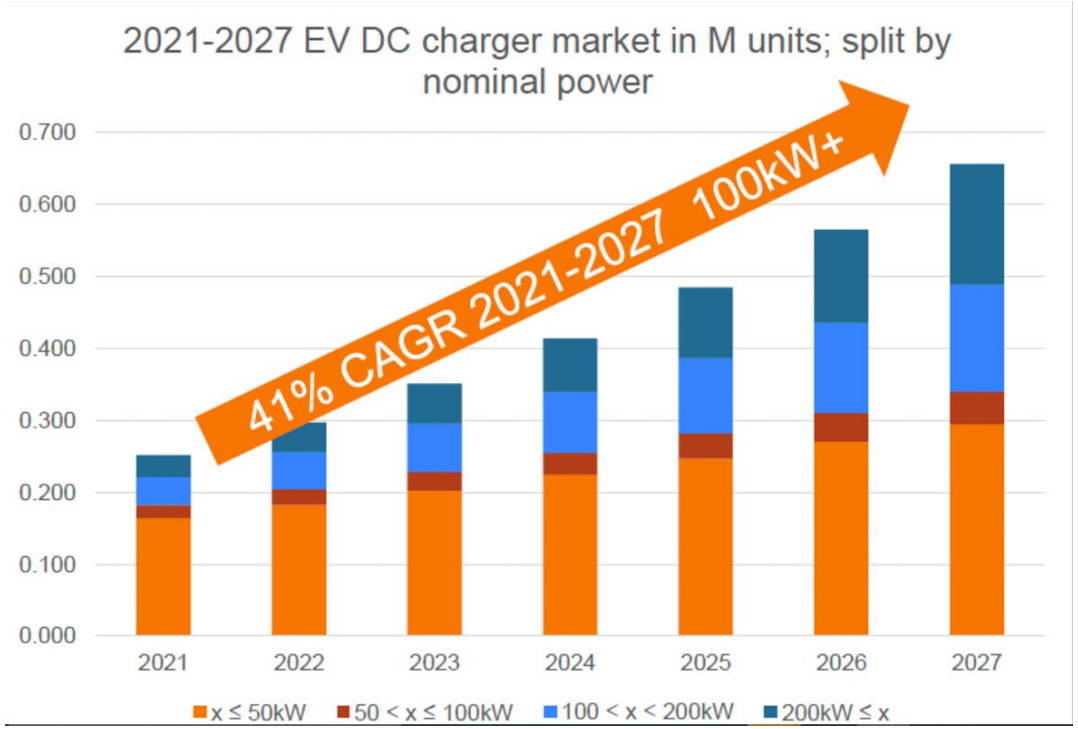
AC

- AC Charging is generally used at home or office when there is sufficient time to slow charge an EV.
- The advantages include less demand on the electrical infrastructure and better overall life cycle of the EV battery
- AC Charging ranges from up to 7kw single phase and a maximum of 22kw three phase 230v

DC

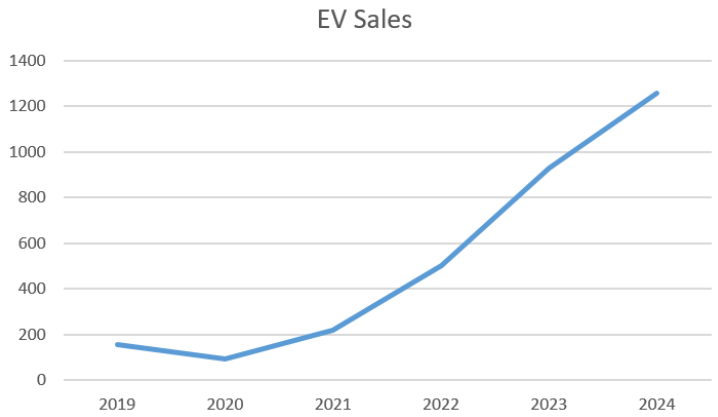
- DC Charging has rapidly progressed over the past few years and still increasing with 200Kw DC chargers in the market presently.



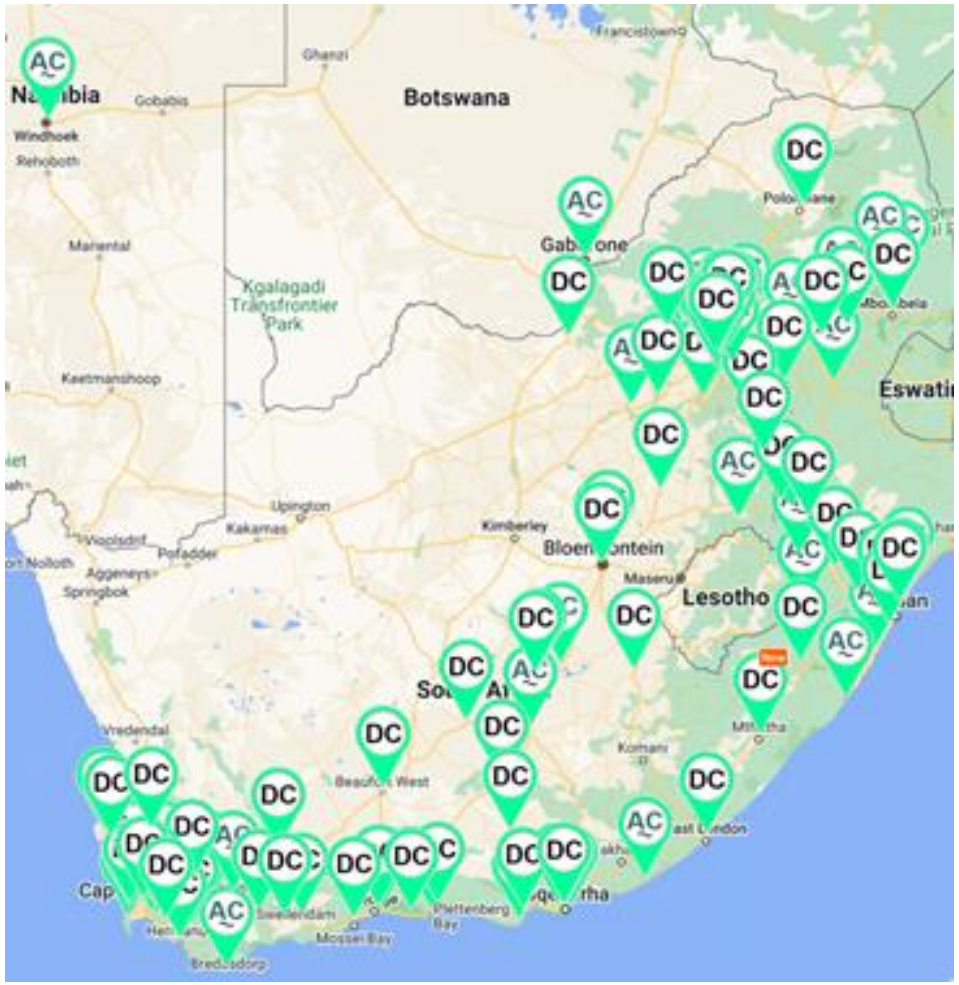


EV adoption in South Africa (Cont)

- Currently the following brands of electric vehicles are in the county
  - GWM
  - BYD
  - Volvo
  - Mini
  - Jaguar
  - BMW
  - Mercedes
  - Audi
  - Maxus
  - City Blitz



- There are currently over 400 Public Chargers in the country.
- Ranging from 22kW AC to 200kW DC fast chargers.
- There are currently BEVs in South Africa with the following growth
- 2019(154),2020(92),2021(218),2022(502),2023(929),2024(1130)



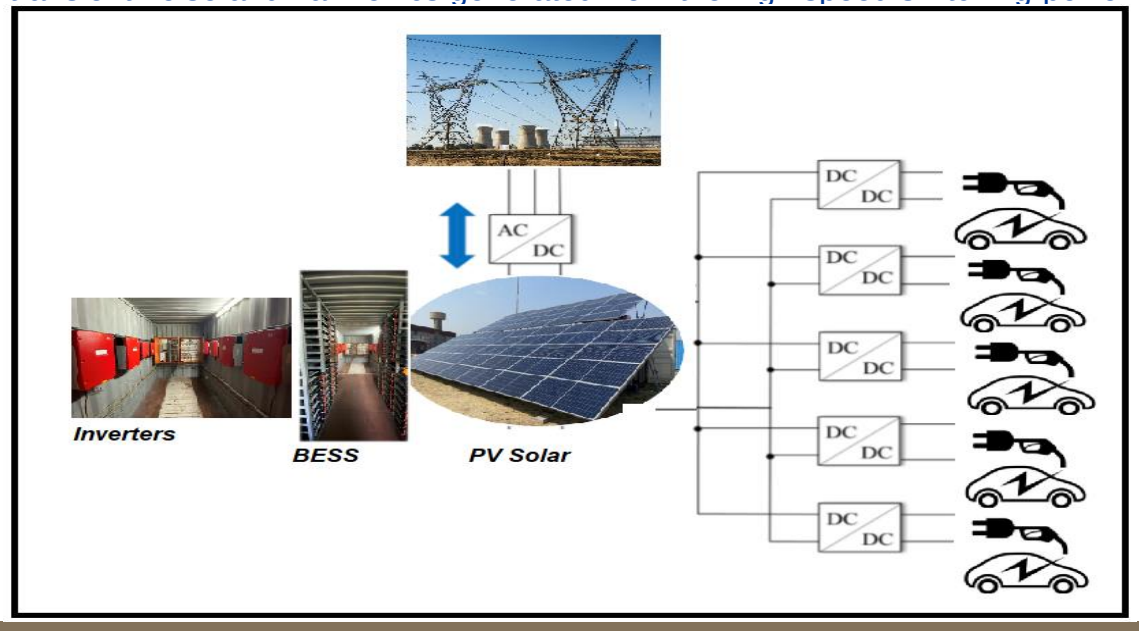
Containerised Microgrids in Eskom & Next Generation of CMG

- Microgrids, both the rural example in Ficksburg as well as the Containerised Microgrid examples at Swart kop were examples of demonstration pilots that have been adopted and implemented with the Eskom. The learnings from the demonstrations have led to detailed engineering specifications being developed and these current designs are being mass manufactured at Komati power station.
- Predicted EV's sales will account for 19.2% share of the light-vehicle market in 2024
- Expects 17 million EV sales by the end of 2024, which would be a more than 20% year-on-year increase.

Coupling these facts with 100 year old utility electrical infrastructure raises the concern of whether we can accommodate such immense growth in this sector without challenges.

Microgrid: EV charging Value proposition

- Eskom can manage the uptake of electric vehicles by either upgrading existing infrastructure to manage these new erratic mobile loads that can impact any part of our distribution grid or by buffering the impact of these loads from the main grid by utilizing large scale battery storage and renewable sources in-between the charging infrastructure and the grid found within CMG solution. Communication and control equipment can be extended to manage EV charging demand and supply.
- PV panels generate low voltage DC, which are aggregated upwards into charge controllers that provide combined DC voltages into Power Inverters that create either single phase or 3 phase AC outputs.
- EV chargers are generally connected from an AC grid and uses AC-DC inverters to charge DC batteries in Electric cars.
- Microgrids can simplify this extremely inefficient process of DC to AC and AC back to DC by adopting direct DC-DC charging of EV's.
- High voltage DC to DC charging has significantly increased charging times when compared to AC to DC. The speed of charging an EV has always negatively impacted the uptake as compared to time taken to refill ICE vehicles at filling station.
- Configuring a Containerised Micro Grid depicted in the figure 1 below will shield the main AC electrical grid from the direct load of the EV as well as the transient noise and harmonics generated from the high speed switching power electronics.



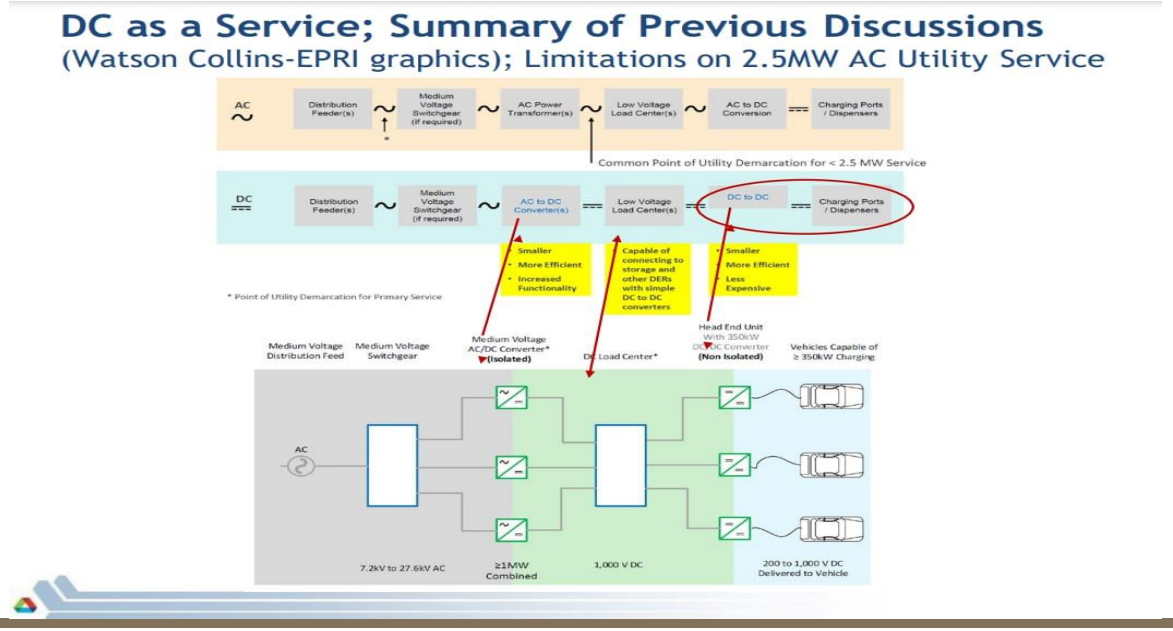


Figure 1 – Containerised Microgrid configured as a Grid tied EV charging Station

Test case Containerised Microgrid EV Charger Specifications

- Modular and mobile CMG for easy transportation and setup, 12m design that can be equipped with 60 PV panels producing 40 kW peak and over 200kWh off-grid energy per day. Multiple CMGs can be coupled together at accommodate needs.
- BESS systems are included to store energy for 24 hour operations and can range up to 250 kWh for an off grid application and 2MWh per CMG for grid tied applications
- Each CMG can equip 3 x 60kW DC chargers or 1x 180kW DC charger.
- In off-grid application the CMG a total of 200kWh a day that equates to the following number of charged vehicles at respective charge levels. A total of 1300km can be achieved per CMG per day.

Power from single off-grid CMG EV charging station				
EV kWh Battery	100% SoC	Km Range/charge	50% SoC	Km Range/charge
45	4	340	8	170
60	3	427	6	214

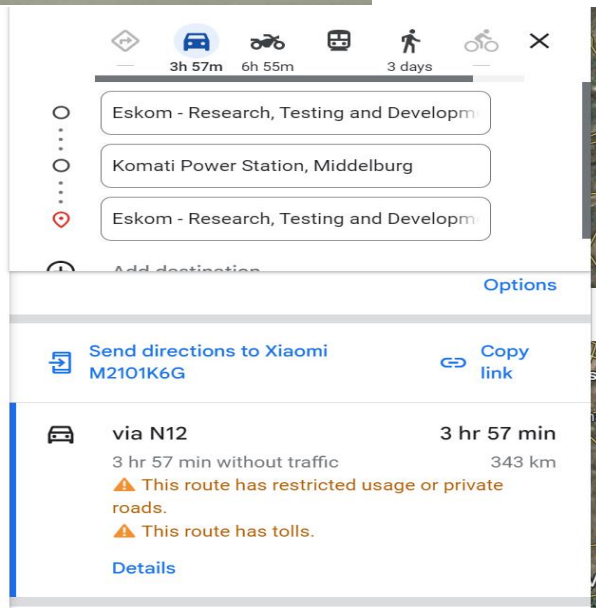
Open Charge Point Protocol (OCPP 2.0.1)

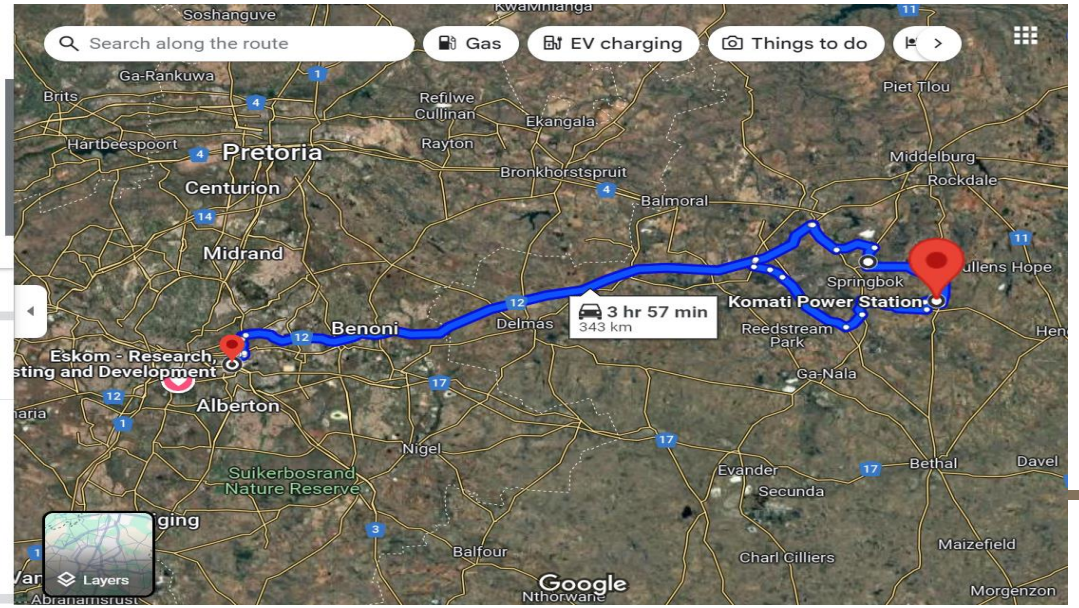
- Pros:
  - Open Standard, Ensures Interoperability between different Charging stations and network operators.
  - Scalability: supporting the growing demand of Ev charging
  - Security: Encryption and Authentication to protect data and transactions
  - Remote monitoring

- Cons:
  - Open nature can make it vulnerable to cyber attacks (data and charging operations), Variations from standarisation communications can lead to compatibility problems and potential vendor lock-in
  - Complex hence requires a level of skill to implement and can be challenging.
  - Centralised Architecture can be a bottleneck
  - Internet reliance and can be a concern in areas with slow or unreliable internet.

- Opportunities:
  - From a customer centricity standpoint it will offer a unified and efficient charging experience that’s customizable and flexible
  - Better grid management and optimisation by managing peak demand and promoting an efficient and sustainable energy ecosystem.
  - Smart Charging and V2X applications.

EV Charger connected to 32kW CMG @ Komati





Thank You

Questions?

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