

Potential and Challenges for Large Scale Introduction of Electric Buses in South Africa

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Agenda

- Electric Bus Challenges
- Bus Charging Potential
- Initial Test Results
- ICE to e-Bus Conversions
- Hydrogen?



Solar PV Installations

- Solar PV installations @ 6 Golden Arrow depots
 - 2017 1st installation
 - 2022 1.7 MWp installed
- 2 700 000kWh Projected annual production
- Good experience for future large scale installations



Roof Top = \pm 90% of Installations



“Car Port”

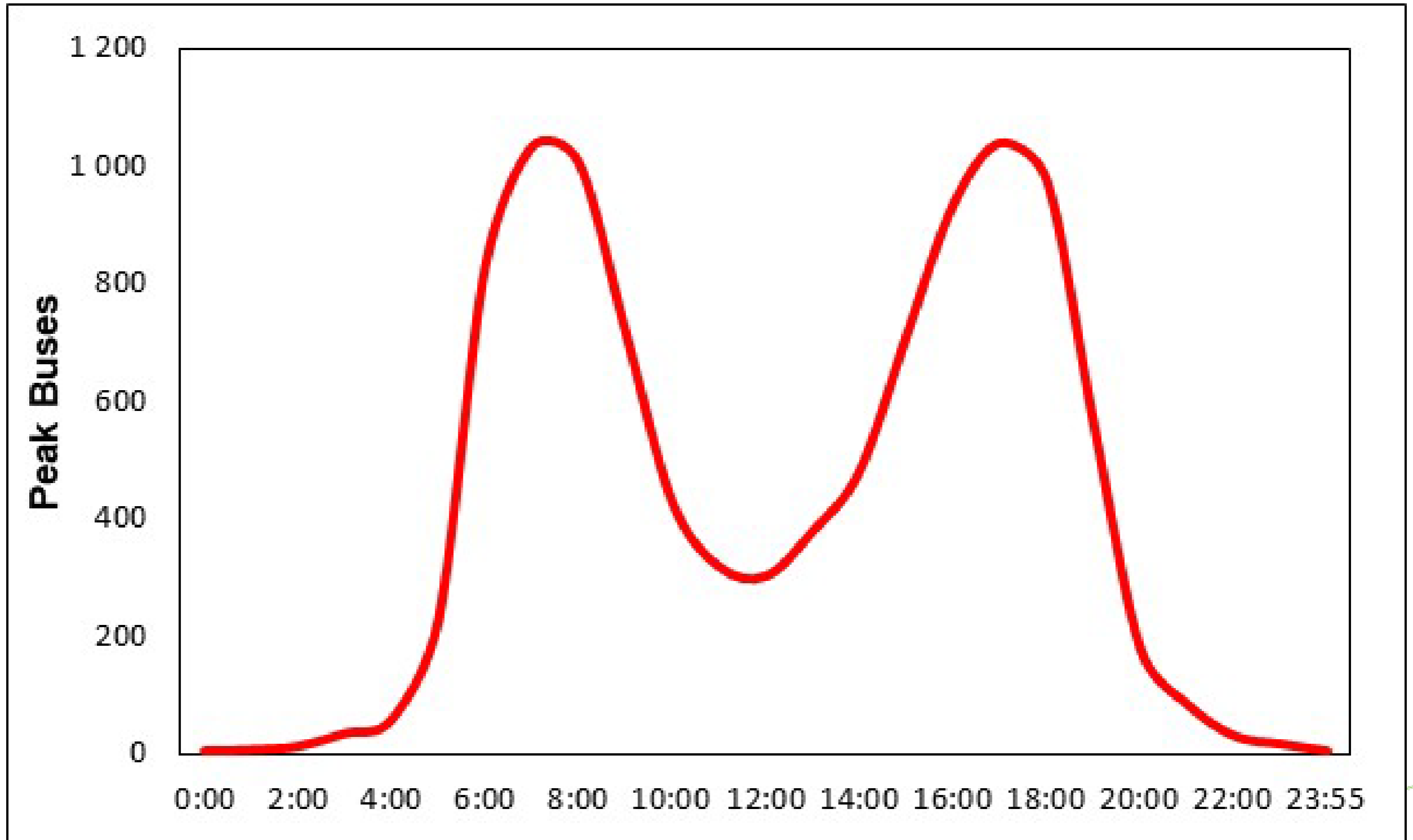


Depot Size

- Additional depot space required due to charging
- More and smaller depots?
- Combine depot and charging stations?



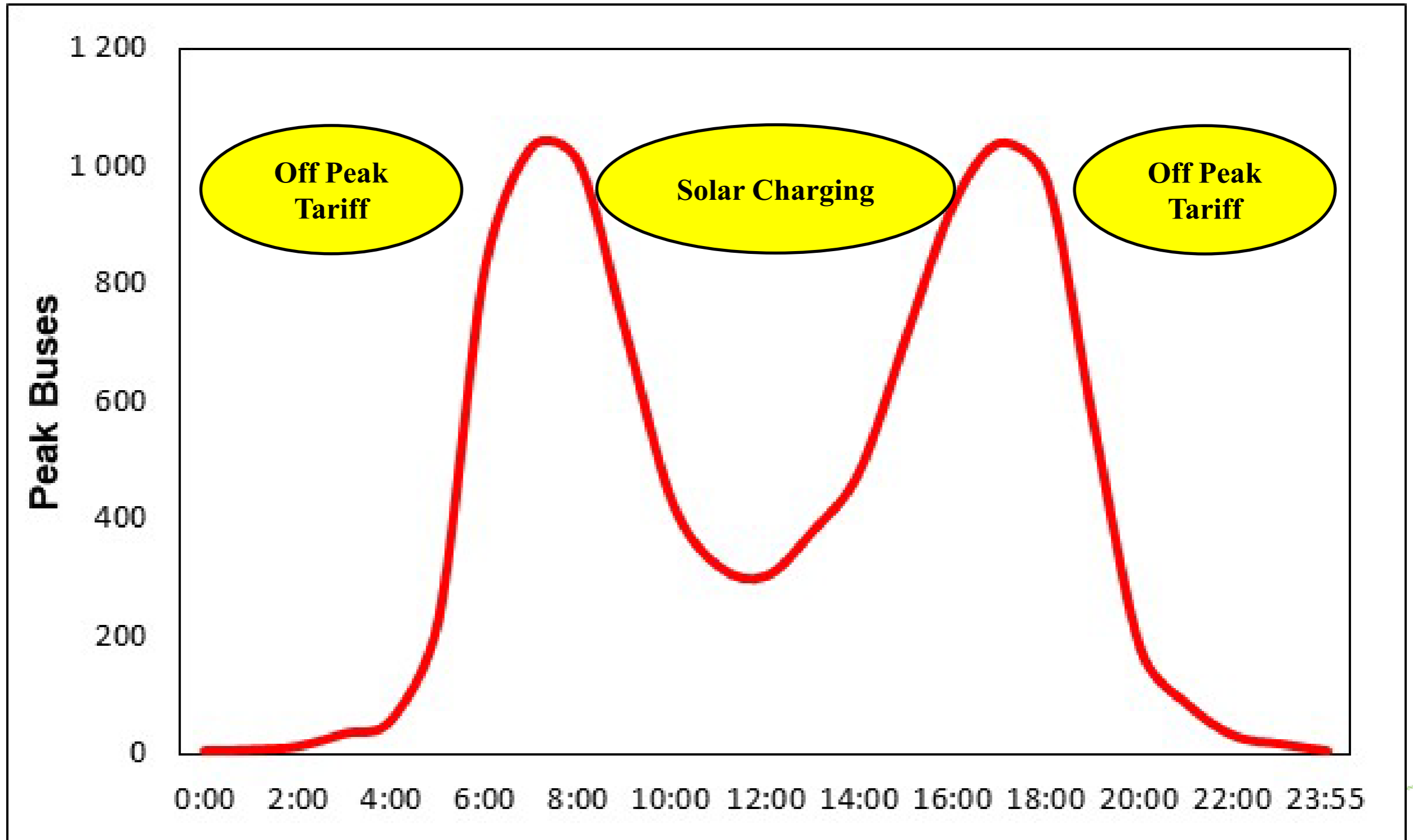
Peak Bus Utilisation



Potential Charging Hours

- Morning peak
 - 04h00 to 09h00 high utilisation
- Mid-day off peak
 - 09h00 to 15h00 $\pm 30\%$ utilisation → 6 charging hours
- Afternoon peak
 - 15h00 to 21h30 high utilisation
- Night time off peak
 - 21h30 to 04h00 $\pm 5\%$ utilisation → 6.5 charging hours

Charging Potential



Initial Test Results [1]

- 2 x 37 seater BYD buses tested since April 2021
- $\pm 7\ 000$ kilometers non-passenger testing
 - Maximum weigh simulated with sand bags
 - Safety and range testing
- $\pm 70\ 000$ Kilometers operational testing
 - Passenger introduction on 28 June 2021



Initial Test Results [2]

- Energy
 - 0.99kWh per Km
 - Energy costs vs diesel bus → -69% [Dec21 Diesel]
- Spare parts → -50% estimate
- Oil & lubes → -80% estimate
- Tyres → no impact
- Labour → -30% estimate



Initial Test Results [3]

- Charging
 - 80 kW existing chargers' rating
 - ± 75 kWh "charged" per hour
 - ± 75 km range charged per hour
 - 200 average km per bus per day
 - 2.7 charge hours per bus per day
 - 80 charge minutes per bus between peaks

- 120 kW new charger's rating
- 60 charging minutes / bus / peak



Electric Conversions?



- Partner with University of Stellenbosch
- Potential “kick start” for large scale conversions



Golden Arrow Next Steps

- 2023
 - Test 65 seater e-bus
 - Work with OEM's to develop SA version of 65 seater e-bus
 - Partner with Stellenbosch University: e-bus conversions
- 2024
 - 60+ electric buses to be built in SA
 - Reduce import taxes, create jobs
 - Convert 30 to 60 diesel buses to electric buses?

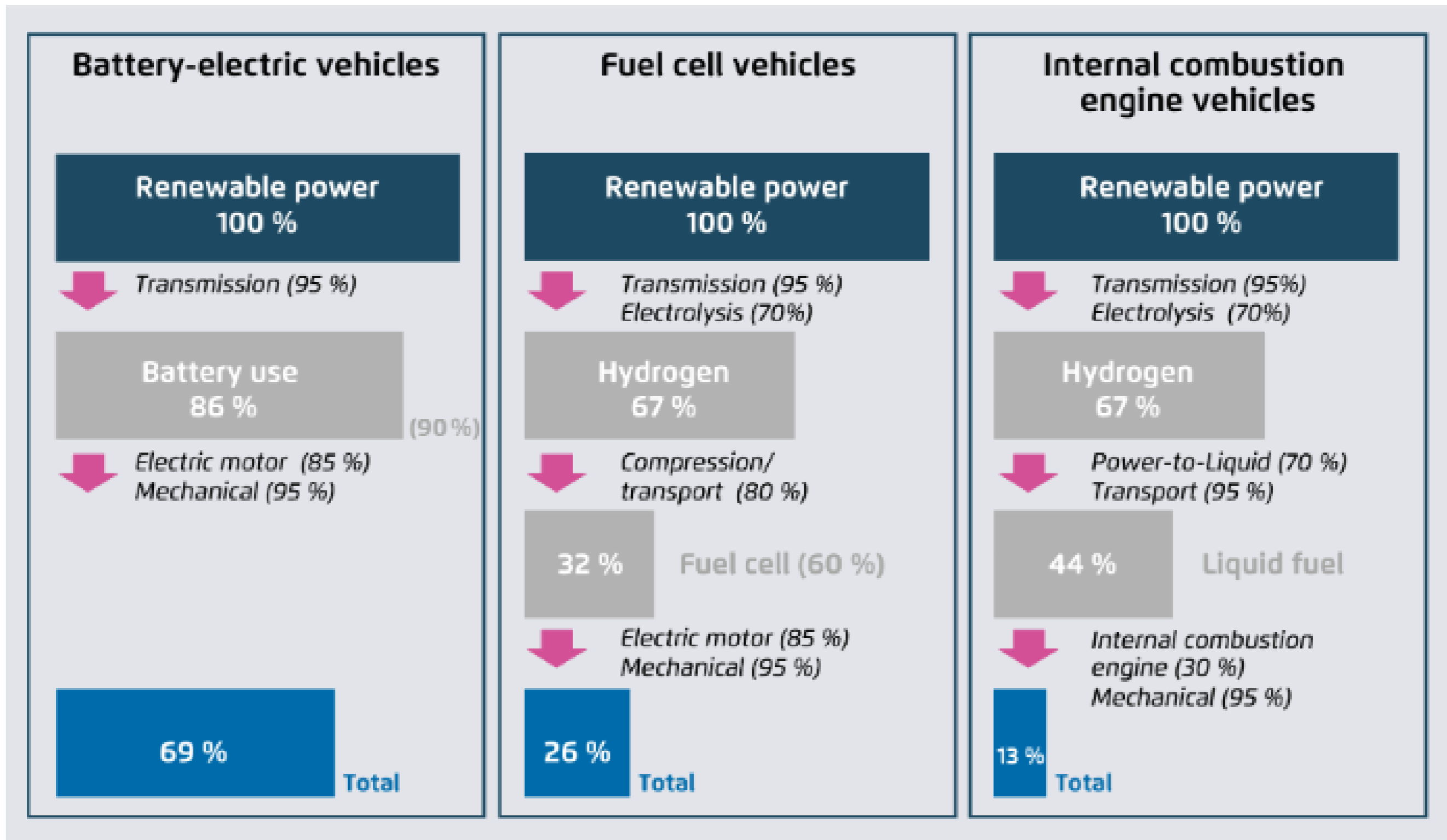


Hydrogen?

- Energy intensive
- OEM's
 - Available in SA towards end of decade?
- Battery electric 1st
- Opportunities
 - Energy storage?
 - Long distance / heavy loads?



Individual and overall efficiencies for cars with different vehicle drive technologies



Government's Role

- Provide certainty to encourage investment
- Central government
 - Address tax discrepancies with ICE vehicles
 - Removal will hurt local manufacturing
 - EV purchase / manufacturing incentives?
- Local government
 - Off peak electricity tariff incentives
 - Support alternative electricity generation and distribution



Local Government Next Steps?

- Encourage roof top solar installations
 - Follow Cape Town example

Thank You!

