E-Buses - the future of student transport

UCT Leading the way

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Content/Agenda

Introduction

The Team presenting

- Zutari Team

Corné van Diemen

PROJECT MANAGER

Corné is a senior consultant at Zutari, where he specialises in geographic information systems (GIS) and project management information systems (PMIS).He helps to define, enhance, setup, execute and deliver over a broad spectrum of asset management and advisory projects. Corné obtained a Bachelor of Humanitarian and Community Studies (BHCS) (Honours) in Historical Studies in 2009 and BA English Studies: Journalism in 2007, both from the University of Pretoria in South Africa. He also obtained a National Diploma in Information and Communication Technology (ICT) in 2019 from the University of South Africa (UNISA). He is a registered professional with the Project Management Institute (PMI) and is a certified associate in project management (CAPM) based on PMBOK® principles.

Prakash Sewnarain

CHARGING AND POWER SUPPLY LEAD

Prakash is employed as a principal technician in Aurecon's Energy Team, where he is involved with electrical design, design verification, compilation of operating philosophies, protection grading studies, relay settings compilation and the development of standards for substation automation on various projects. He is also a qualified facilitator and assessor and has been involved in training on medium-voltage (MV) commissioning courses for Eskom. Prakash obtained a National Diploma in Electrical Engineering, specialising in heavy current, from the ML Sultan Technikon, South Africa, in 2001. He is member of the South African Institute of Electrical Engineers (SAIEE).

The Plan – Understanding the foundation

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What it is based on

Scope

The main aim of the current project with UCT, through PURCO, is to establish the roadmap to replace their current student Internal Combustion Engine (ICE) fleet, with a low carbon footprint Electric Bus fleet. This would not simply be a like for like comparison but rather a process to gain a holistic view on the whole operation. In essence moving from an analogue to digital solution with all the components required.

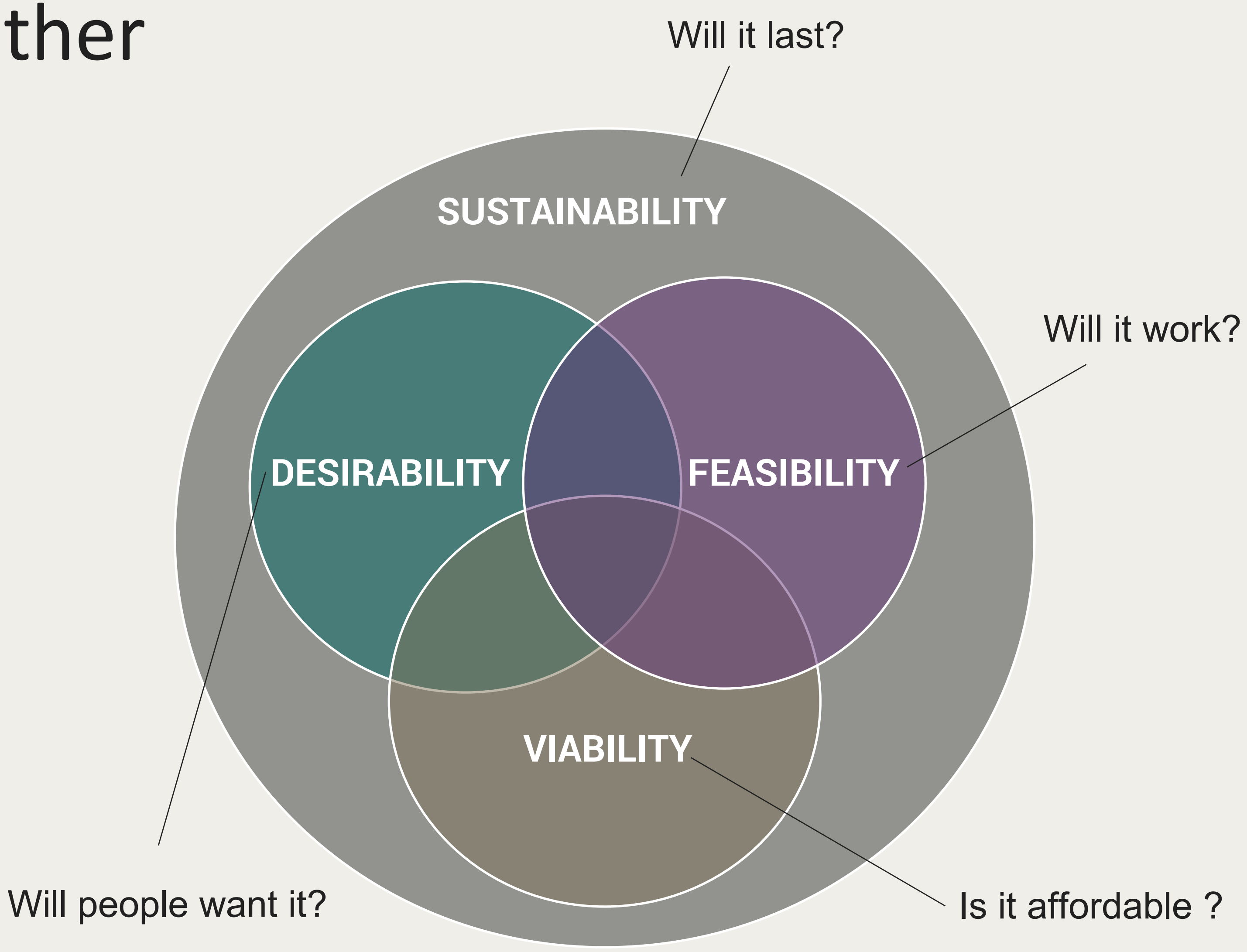
This project needs to be done through the lens of

- Desirability
- Feasibility
- Viability
- And Ultimately Sustainability

Achieving our goals together

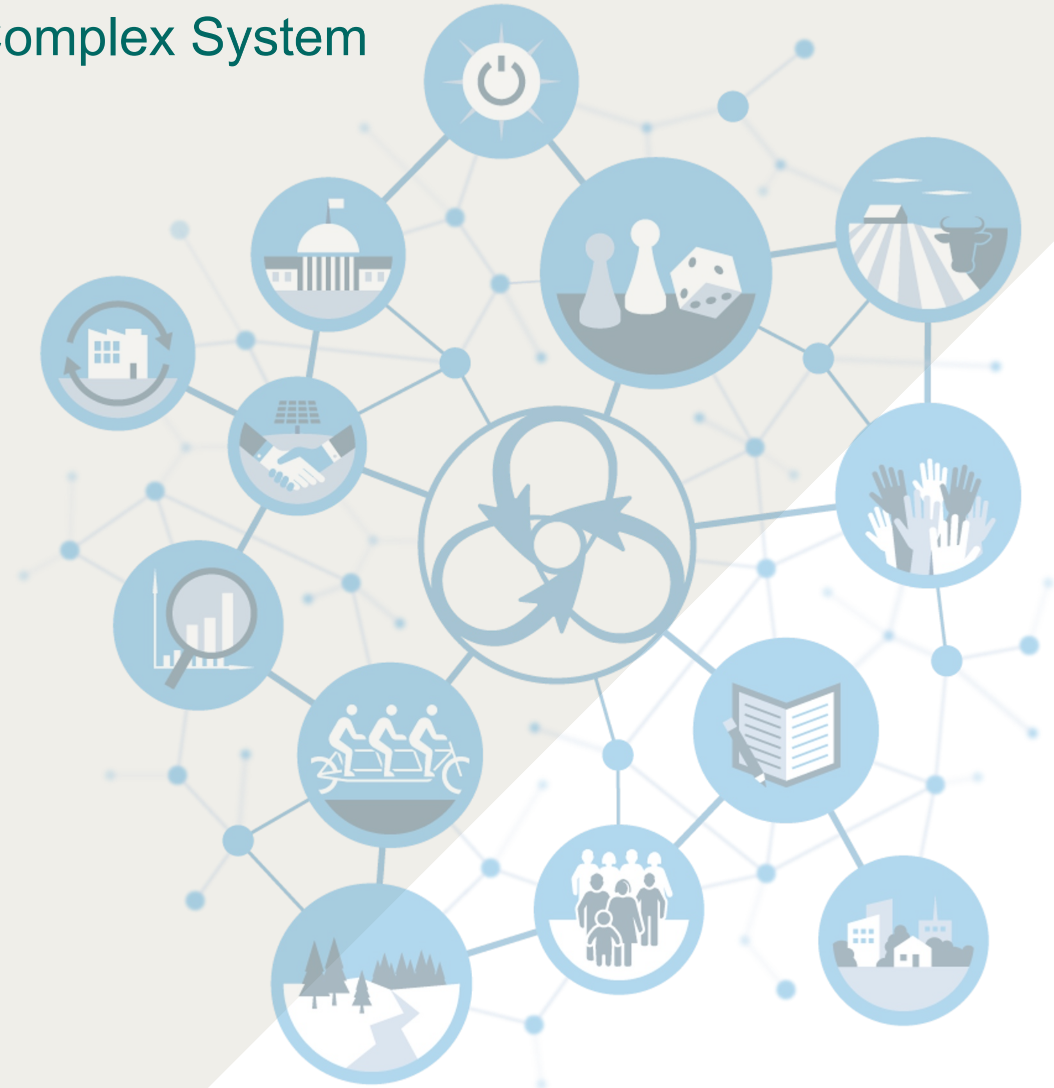
It helps to explore solution options through the lenses of human desirability, technical feasibility, business viability and environmental sustainability. This helps to navigate complexity in order to find the sweet spot of best impact.

These interconnected nodes need to all share a common goal and subscribe to an overlapping outcome of ensuring the most efficient and workable outcome especially through the lens of sustainability



Multiple Factors Broken down

Complex System



A complex system is a system composed of many components which may interact with each other. Examples of complex systems are Earth's global climate, infrastructure such as power grid, transportation or communication systems, complex software and electronic systems and social and economic organizations (like cities) amongst others

By deploying e-Buses, the operations of normal Bus/Route/Depot/Refuel system changes and more complex systems start interacting with one another. Grid connections, electrical supply, charging strategy and Smart Systems, all start forming part of an interconnected world, adapting to an overall system as it progresses. Understanding the development of this Complex Systems and nodes that it connects to, becomes integral, moving from set process to dynamic interactions to accommodate these system changes.

Opportunity for change – Drilling Down

75% of people will live in Urban areas by 2050

South Africa has large rural-urban migrations, that continue to rise putting strain, on existing infrastructure

Human centric mobility within urban areas become essential with goals to reduce carbon emission and enhancing inner-city transport essential.

Change of bus technology opens a chance for change of approach for incorporating sustainable design and approach.

End Users buy in – Changing user behaviour to make use sustainability use is ensured. Students at UCT have a high usage of the service due the needs being met, economically viable, and day to day feasible. Fit for Purpose

People stay at the heart of it all. Without User/Passenger buy in to using the available technology...

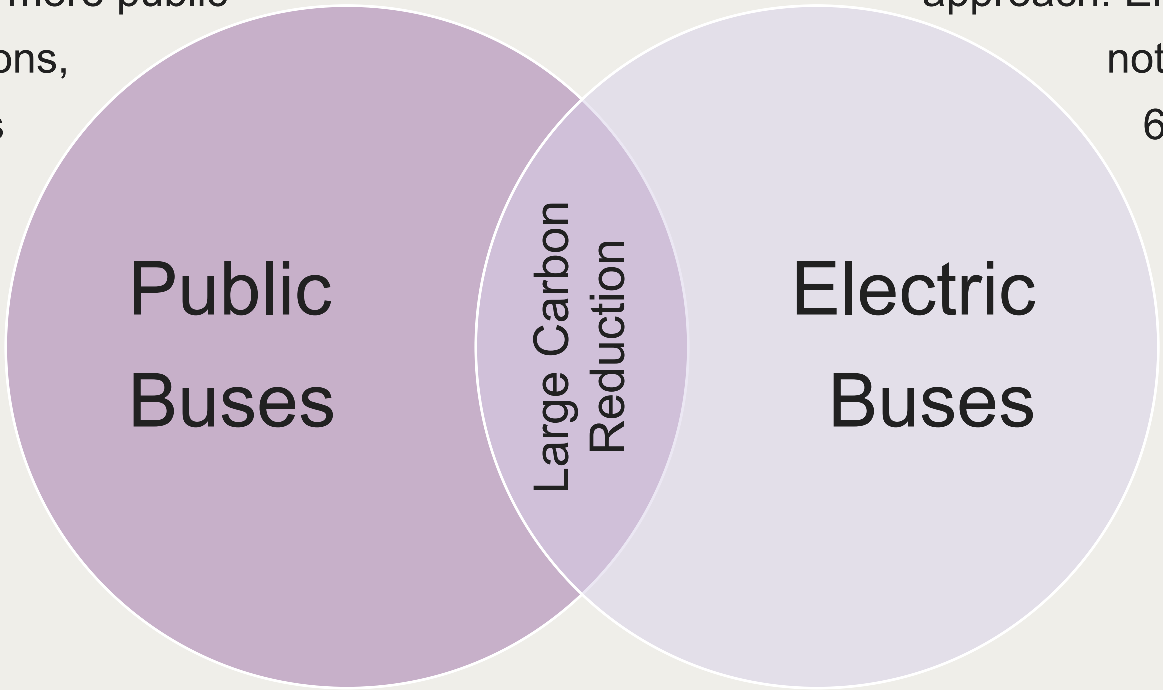
Buses – Human Centric Approach

Carbon emission Reduced

Public Transport - Carbon Emissions revolving around human centric approach - By reducing dependency on single passenger car trips and relying on more public Transport, it lowers carbon emissions, reduces climate anxiety and works towards more sustainable environmentally friendly future.

Carbon emission Reduced

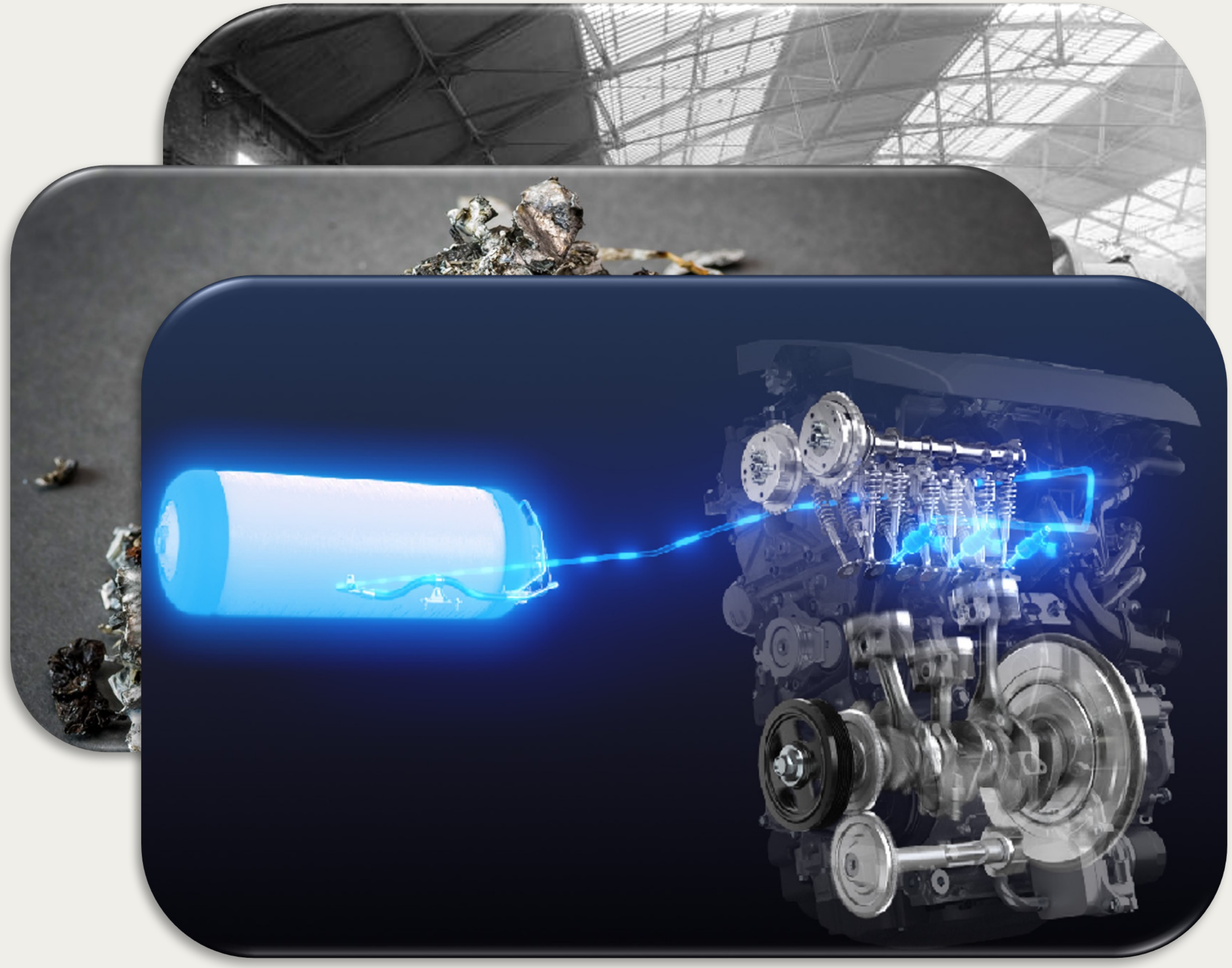
Electric Busses – Carbon footprint reduced buy lower bus emissions and more environmentally friendly transport approach. Electric Vehicles, by its nature is not carbon neutral but as of 2018 62% less carbon emission than similar internal combustion engines (after taking account of production components)



Assumptions

We all have them

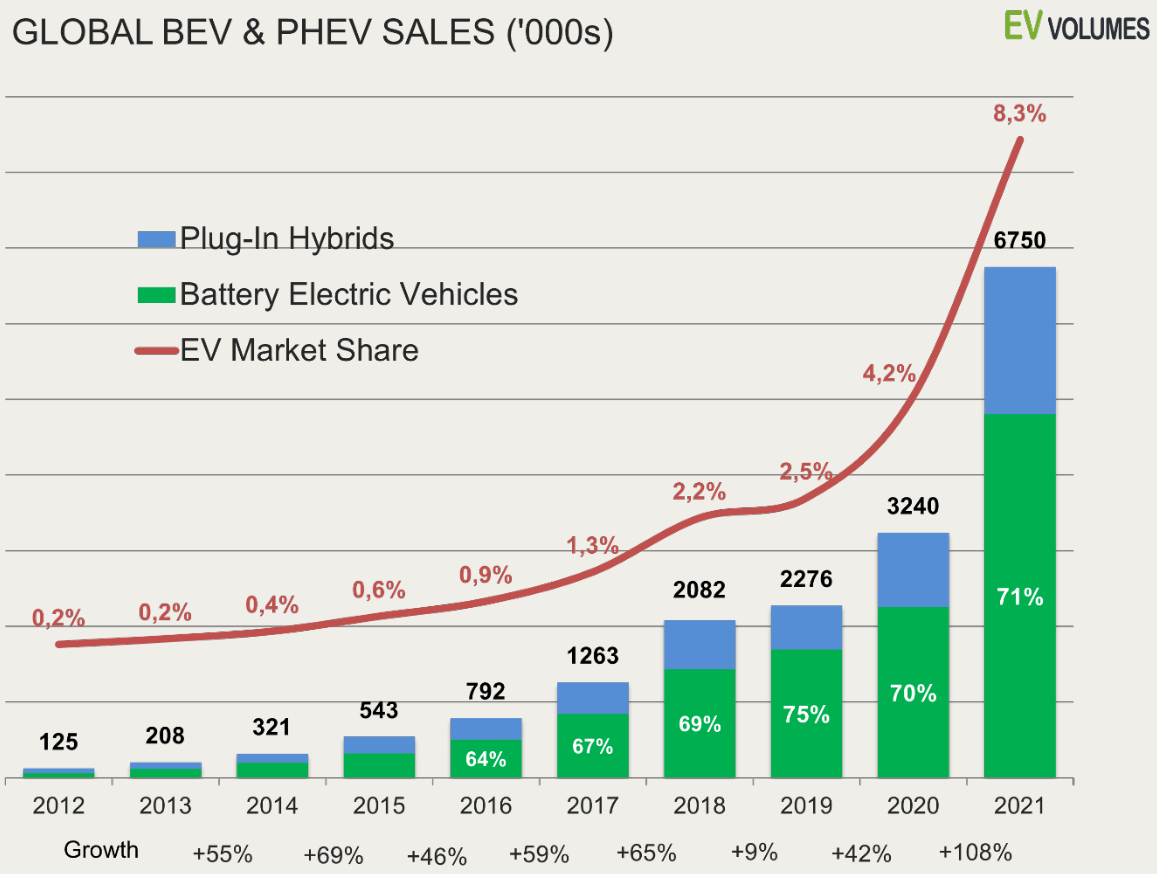
- Electric Vehicle technology is new – 1874 first rechargeable EV – Photo 1917 around 25% of the global market was electric
- Electric = Carbon Neutral – Battery disposal and increase in mining for additional resources increase carbon output (still better but not ideal)
- Electric Vehicles is the way of the future – Currently electric vehicles are the most mature and ready for general roll out green technology but Hydrogen and Biogas also green options – Future will mean mixed technology



EV uptake Globally

Light Vehicles

- EV uptake Globally
- Buses are slightly behind
- Technology is Improving
- SA trend gaining traction – Has a low base start but 1500 sold in first quarter of 2022 – Double that of 2020 and 2021 combined



*https://www.ev-volumes.com/

EV Uptake challenges for RSA

Challenges experienced

Project challenges:

- Early adopter challenges
- Availability of technology for the local market and specifically for student transportation
- Information availability
- Electrical grid capacity challenges
- Fast Charging technology availability in South Africa
- Going green with the existing infrastructure and implications

Local GHG Emissions present to 2050

Where we would like to reach...

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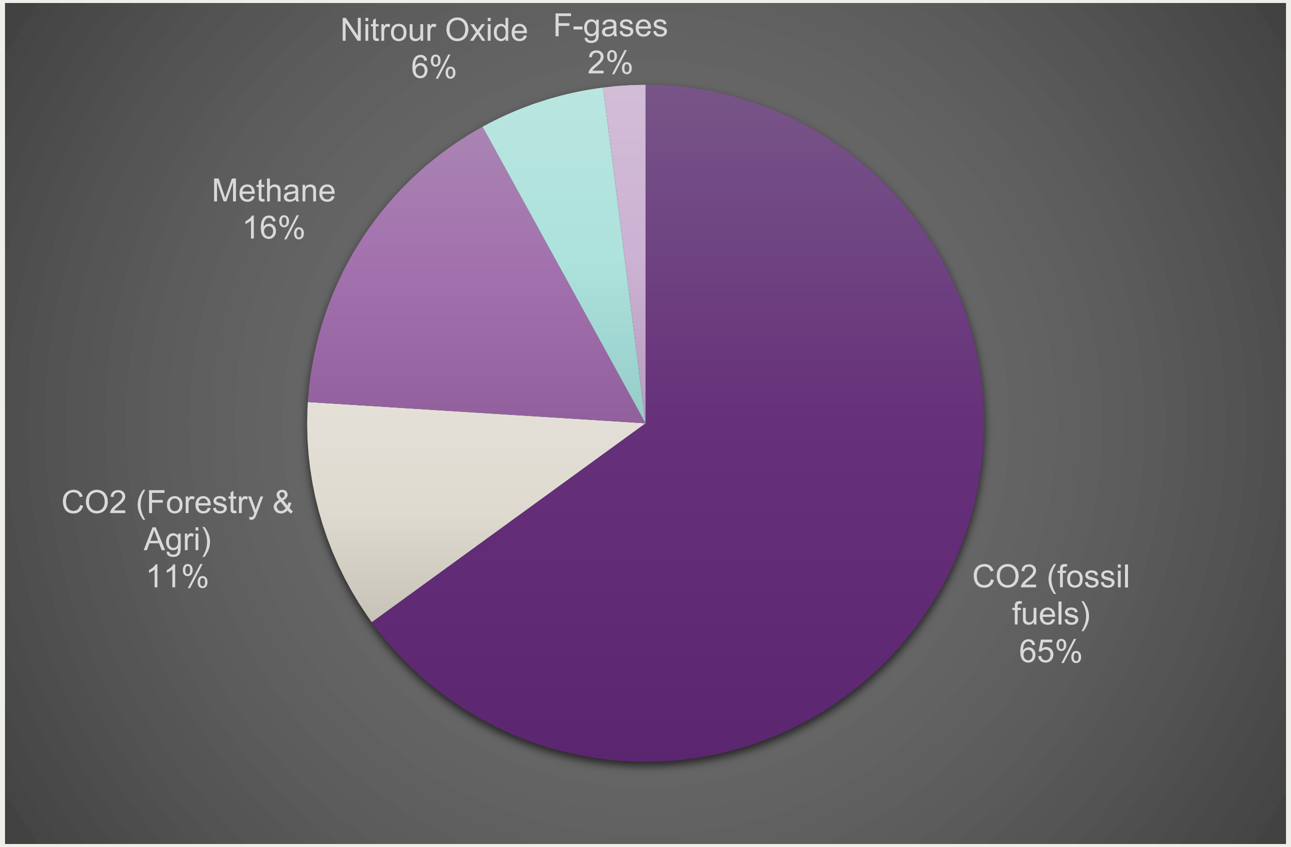
Destination 2050

Guidelines for a cleaner future

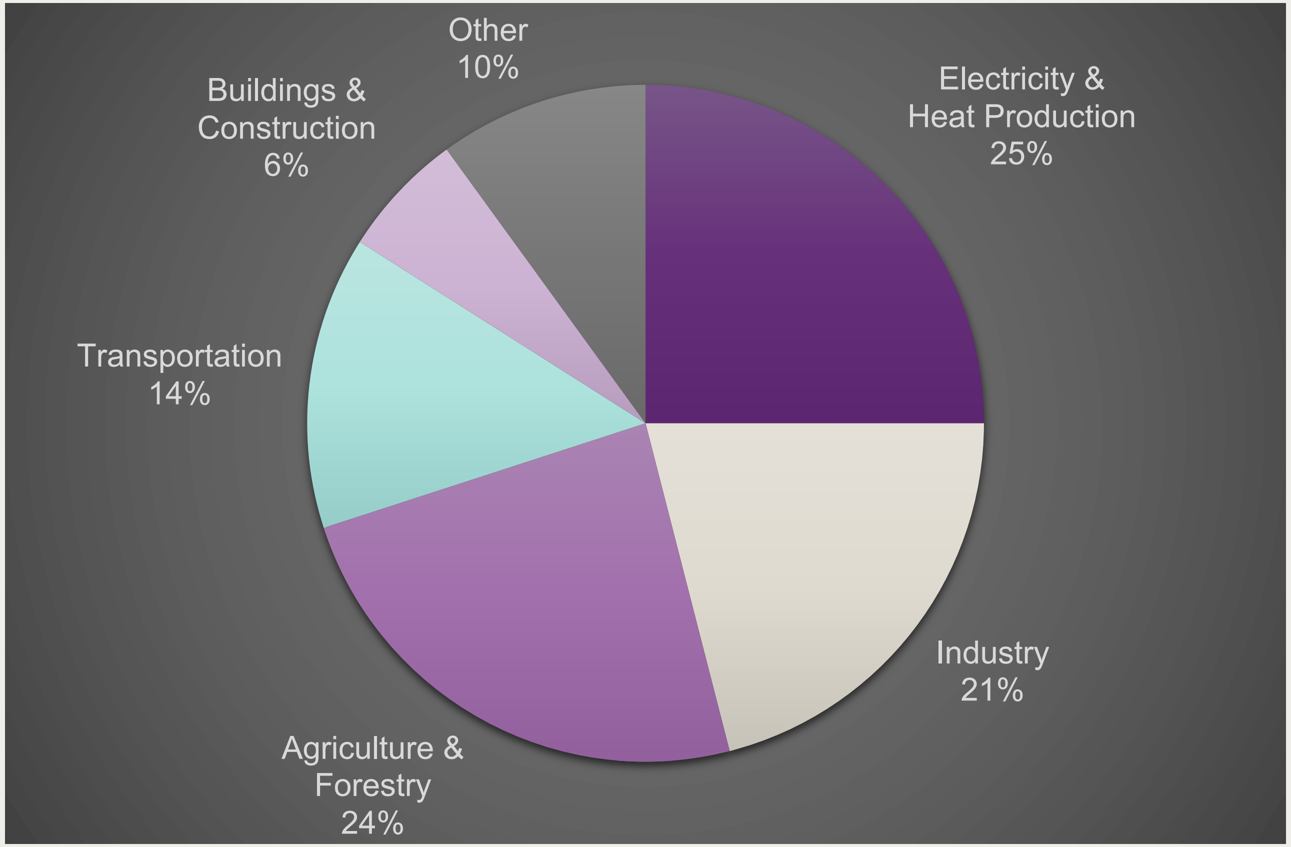
1. The Paris Agreement – aims to keep global average temperature to below 2°C above pre-industrial levels and to pursue efforts to limit temperature increases to 1.5°C above pre-industrial levels.
2. South African Government acknowledges the need for a cleaner greener future as part of the G20, understanding that if we do not make the change, our economy can be impacted.
3. Local municipalities are already looking into green solutions and reducing their carbon footprints to become part of the Green economy. This includes various municipalities that have published their Climate Action Plans for a cleaner more environmentally friendly future.
4. DoT approach green transport and supporting the Green economy.

Global GHG Emissions – by gas



- Most prevalent GHG gas present is CO_2 (65%) with direct sources from fossil fuels used for transport and energy generation using ICE technologies.
- Other CO_2 (11%) sources include agriculture and forestry and are linked to deforestation and other activities.
- Methane (16%) a by product of the agricultural, waste management and biomass burning.
- Nitrous Oxide (6%) is emitted mainly from agricultural activities using fertilizers. Fossil fuels also contribute to N_2O gases.
- F-gases (2%) is emitted from industrial processes, mainly related to refrigeration.

GHG Emissions by sector



- Local transport sector is responsible for 10.8-12% direct GHG emissions.
- Globally the transport sector is the fourth largest GHG emissions contributor.
- ICE engines gives off various other harmful gases besides CO_2 this has other harmful effects to public health and well-being.
- Identify the sectors that are most relevant to apply the transition to cleaner energy

Factors in Case Study

Key aspects to be considered

We anticipate that the proposed assignment will require the integrated assessment of four specific aspects as shown below. Our Zutari team will have subject matter experts leading each of these workstreams, working in an integrated fashion (with close involvement from the UCT team) to develop an optimal solution.

Fleet and transport operations

- Fleet size and characteristics
- Configuration of vehicles
- Universal access requirements
- Fleet operations plan
- Routes and scheduling
- Storage during holidays
- Driver reskilling

Physical Infrastructure

- Parking strategy and location
- Depot area development
- Routes and drop-off points
- Changes to existing infrastructure

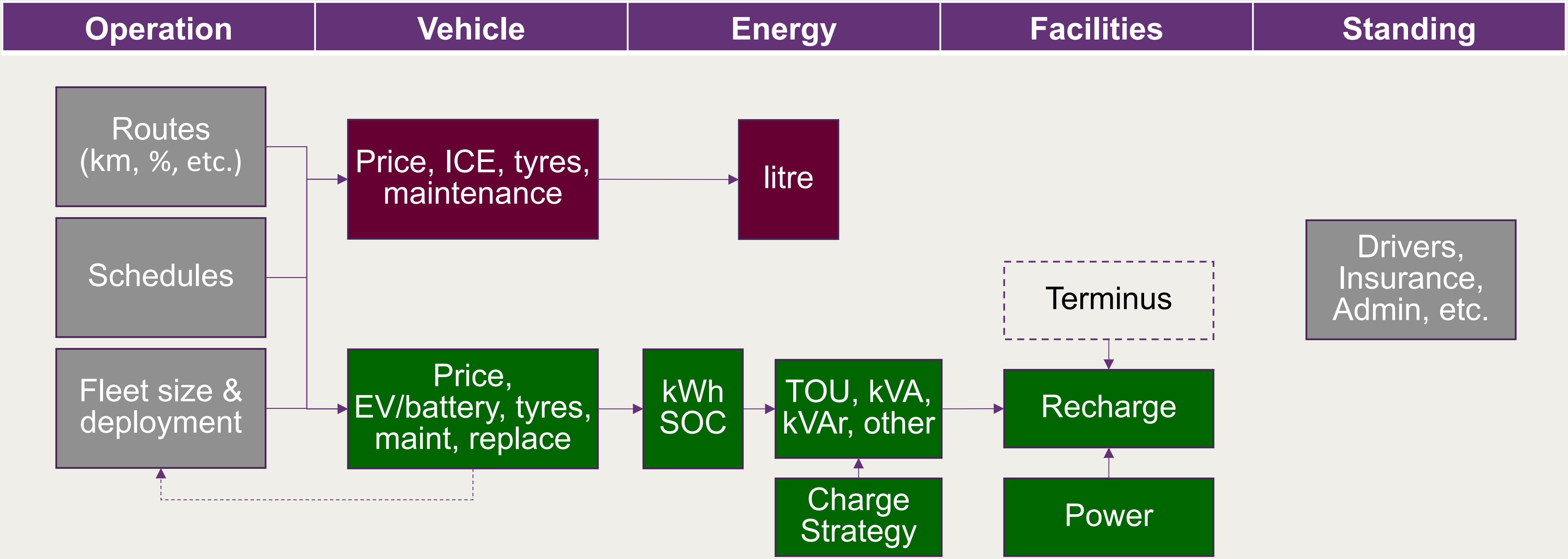
Charging infrastructure and power supply

- Charging strategy
- Location and number of charging bays
- Charging type (AC or DC and charging capacity)
- Grid connectivity
- Embedded generation plan
- Backup power supply and storage

Procurement and implementation

- High level business case to enable University approvals
- Procurement of pilot
- Municipal approvals
- Marketing and sustainability reporting
- Lease term and conditions
- UCT procurement guidelines

ICE vs. EV

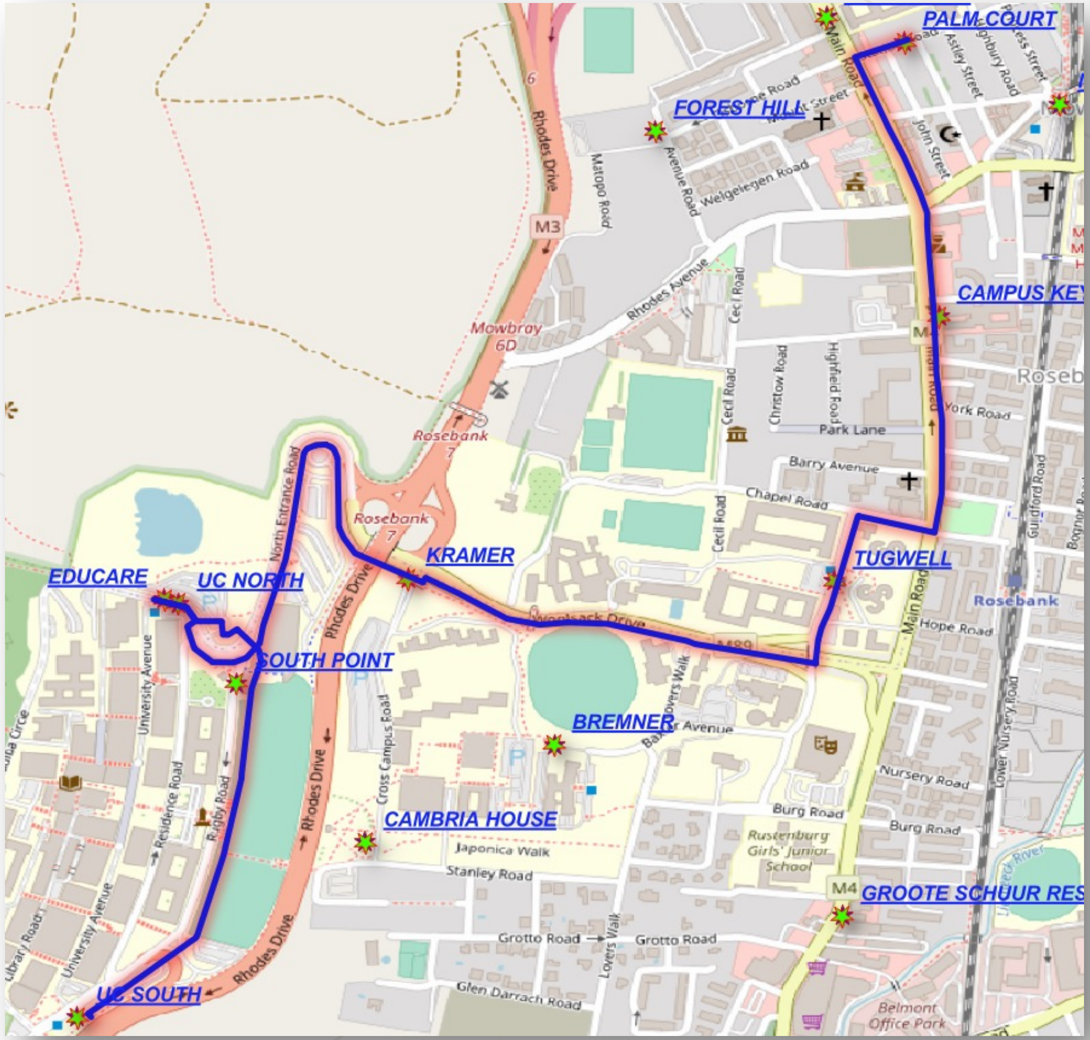

Operation
Vehicle
Energy
Facilities
Standing
Routes (km, %, etc.)
Schedules
Fleet size & deployment
Price, ICE, tyres, maintenance
litre
Price, EV/battery, tyres, maint, replace
kWh SOC
TOU, kVA, kVAr, other
Charge Strategy
Terminus
Recharge
Power
Drivers, Insurance, Admin, etc.

Route Profile

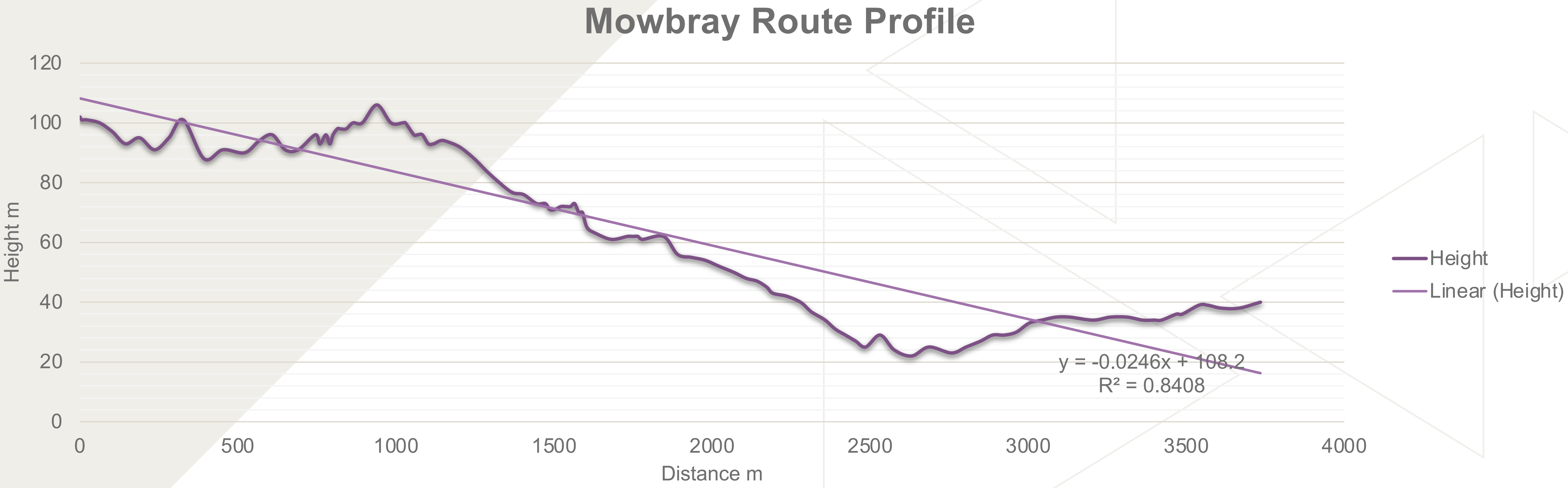
Understanding Operations

Understanding complete operations of fleet operations is vital to understanding how to create a holistic solution going forward.

- Bus Needed (Size)
- Passenger Count
- Frequency of Route (time)
- Distance per Trip
- Route Profile (incline/decline)
- Operational Needs



Route Profile



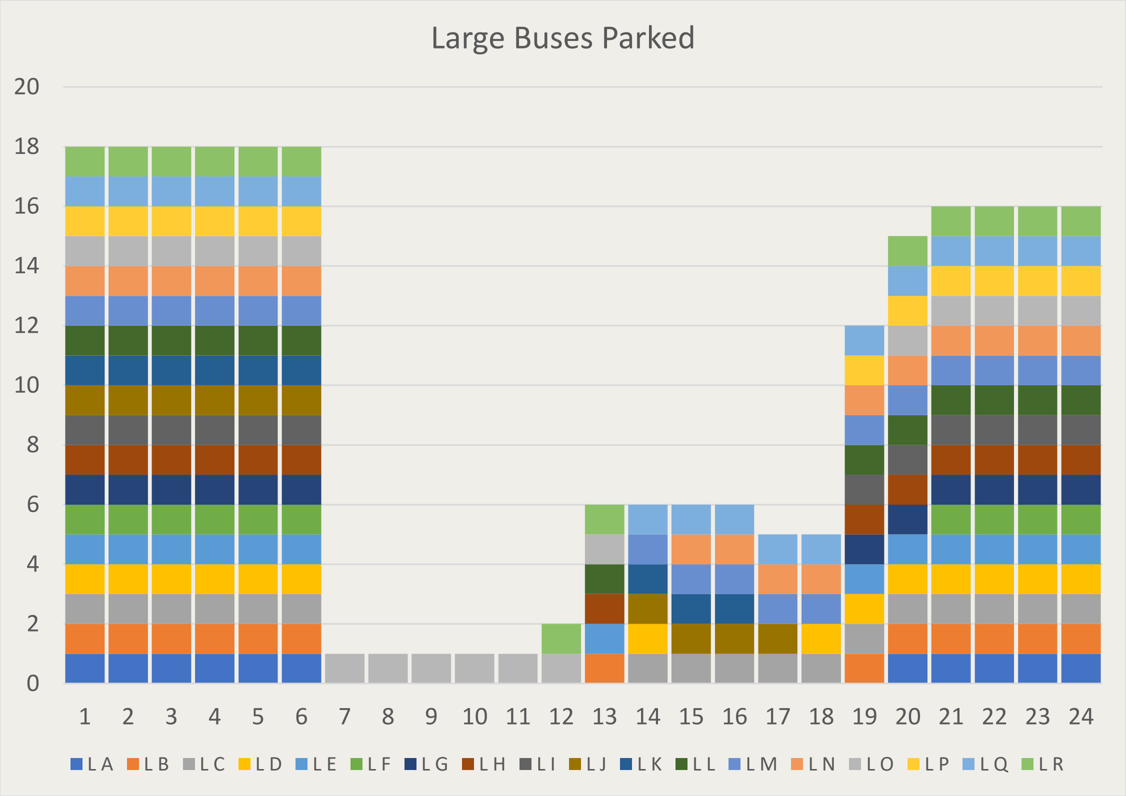
Understanding the Basics

Understanding Infrastructure

1. The Route Distance, Length and incline multiplied by amount of trips give a good indication of the day to day need
2. This can be extrapolated to the needs of the Operational and Maintenance planning including
3. Battery capacity of the EV Bus needs to be identified based on the above requirements
4. Charging strategy and costs evaluated based on time of use tariffs and other factors

Availability for Recharging

Large buses



- Most buses are parked during off-peak Time Of Use
  - Uninterrupted 8-hour period overnight
- But note that:
  - Total recharge time required is 73 mins
  - Half-day recharge is <40 mins
  - ±10 unique buses are available for part charge in early afternoon
- Recharging –
  - Can be during off-peak periods only
  - May avoid additional kVA, kVAr and admin cost

Charging Strategy and Infrastructure

Understanding Infrastructure

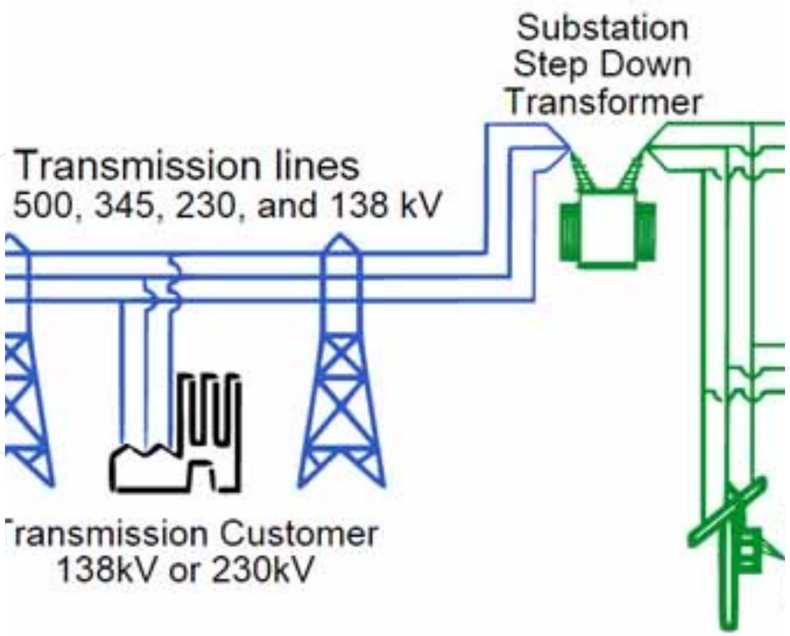
Infrastructure required for EV applications includes

1. Upgraded Electrical grid connection
2. Charging stations and dispensers
3. Revised Parking strategy
4. ICT infrastructure where required
5. Building/ depot management systems

Charging Strategy and Infrastructure

Grid connection

- Fleet size and power requirements.
- Charging strategy
- Grid connection sizing and possible upgrades
- Local generation and backup systems
- Further considerations e.g. maintenance and skills requirements for electrical infrastructure.



Charging Strategy and Infrastructure

Charging stations and dispensers

- Charging stations – Conversion of grid power to power for battery replenishment.
- Power consumed from grid to EV battery
- AC and DC charging options
- Slow vs Fast charging
- Charging limitations

Charging Strategy and Infrastructure

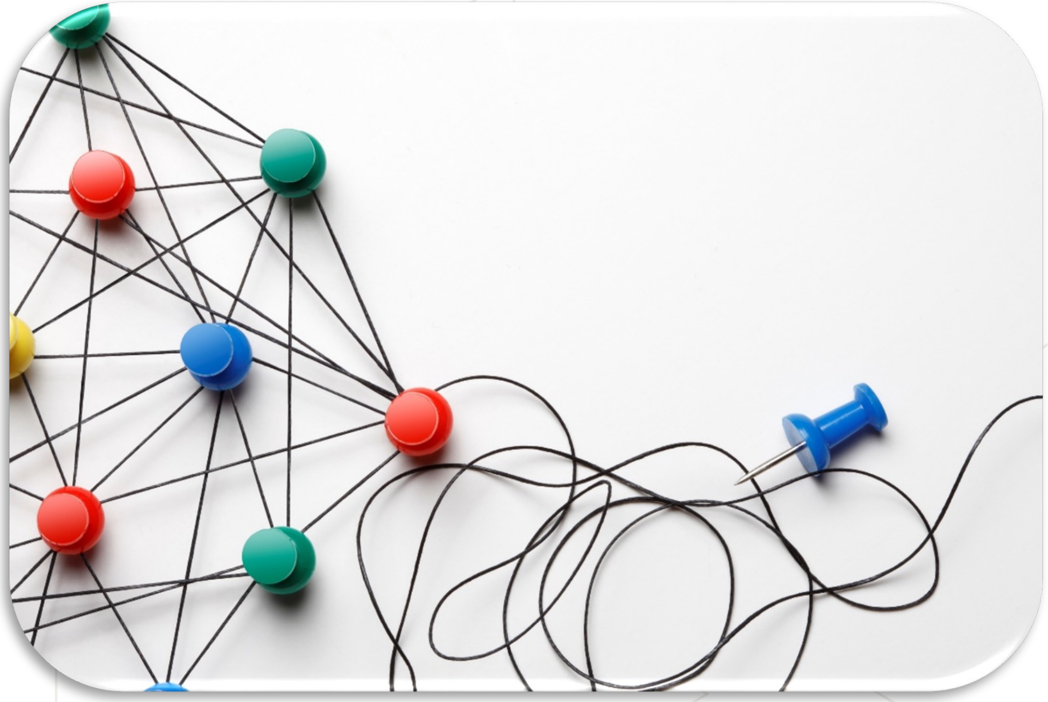
Parking strategy

- Existing vehicle parking layouts
- Strategy for inclusion of charging dispensers
- Location of charging stations
- Opportunity for on site generation?

Charging Strategy and Infrastructure

ICT Infrastructure

- Requirements for communications – IEC61851 and IEC 15118
- Communications with depot management systems
- Communications for fleet condition and statuses
- Future ready for Smart City and fleet deployment



Charging Strategy and Infrastructure

Building management Infrastructure

- Building management and integration with grid supply and charging infrastructure
- Control rooms and integration with fleet
- Fleet operations centre
- Data access from vendor provided services
- Smart charging

Efficiency

Technology efficiencies

ICE technologies – a maximum of 25%
Battery EVs have an efficiency of approximately 75%
FCEVs have an expected efficiency of approximately 50%

Looking to the future

Future for Students

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Fit for Purpose –Looking to the future

Ensuring the need is there

- Alleviating Climate Anxiety
- All public and mass transport is based on the needs of the users, for this reason any approach has to be human centric.
- Energy mix - availability and investments going into the future – Sustainable Climate friendly Energy
- Ease of Access with fit for purpose Infrastructure.
- Industry development to improve the operations of the EV market.

- Ensuring a path to a sustainable future

- **Go Learn, and Go Engage.**

Q & A

Thank you

In diversity there is beauty
and there is strength

MAYA ANGELOU

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