

# SCHEDULING FOR ZEBs

The Art of  
Scheduling



KATHY LAZANAS, CEO  
27 July 2024

I would like to acknowledge the traditional owners on the land from which we are meeting and pay our respects to elders past and present.

## Our Services

### Timetabling, Scheduling & Rostering

We specialise in providing comprehensive timetabling, scheduling and rostering services for all modes of transport, regardless of size or complexity. Our innovative Scheduling as a Service (SaaS) model offers a stress-free approach for Public Transport Agencies (PTA's) and operators alike. While our unique mentoring services in Hastus empower your team to excel in their day to day work.

### Network Planning Services

We specialise in designing transport networks with both operators and customers in mind. We understand the importance of striking the right balance between efficient operations and delivering services that align with the needs and expectations of passengers.

### Transport Policy, Strategy & Advisory Services

Our Urban Strategy team provides expert guidance and advice on how inclusive and accessible transport solutions shape the very fabric of our towns and cities. With a keen focus on fostering mobility for all, we're committed to redefining urban landscapes to ensure that transport is not just a means of movement, but a catalyst for connectivity, equity and social inclusion.

### Transport Data & Analytics

Our Data Science team are experts in operationalising Hastus. We are also dedicated to unlocking the full potential of data to shape the future of transport networks. We specialise in leveraging advanced analytics and cutting-edge technologies to extract insights, understand trends, and drive informed decision-making.

### Zero Emission Bus Operations

Our team of seasoned bus experts possesses unparalleled knowledge when it comes to operationalising the transition towards zero emission technologies in the bus industry. We have a deep understanding of the unique challenges and considerations involved in this transition, and we leverage our expertise to guide our clients every step of the way.

## Scheduling Services

- Auditing
- Training & Mentoring
- Scheduling as a Service
- One-off Projects

**NAVIGATING THE FUTURE.**



# The Evolution of Zero Emission Buses

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DIESEL BUSES



LOW EMISSION BUSES



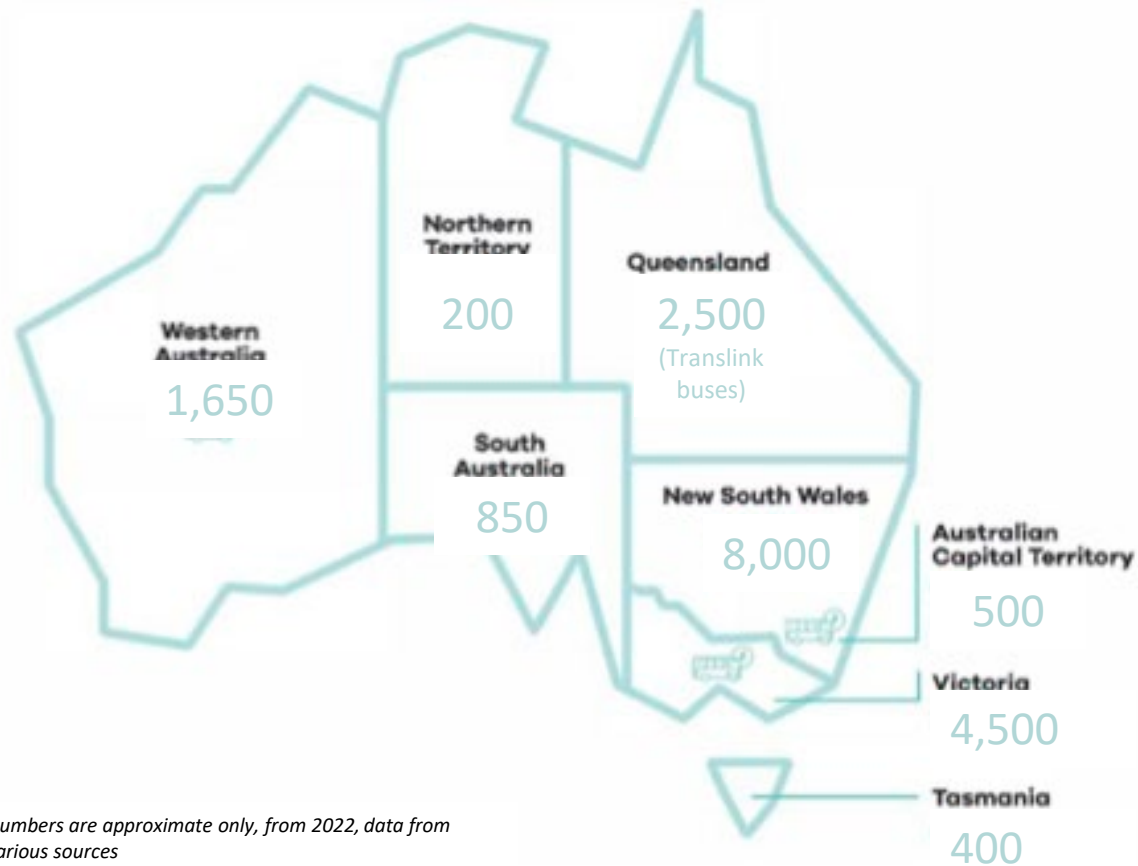
HYBRID BUSES



ZERO EMISSION BUSES

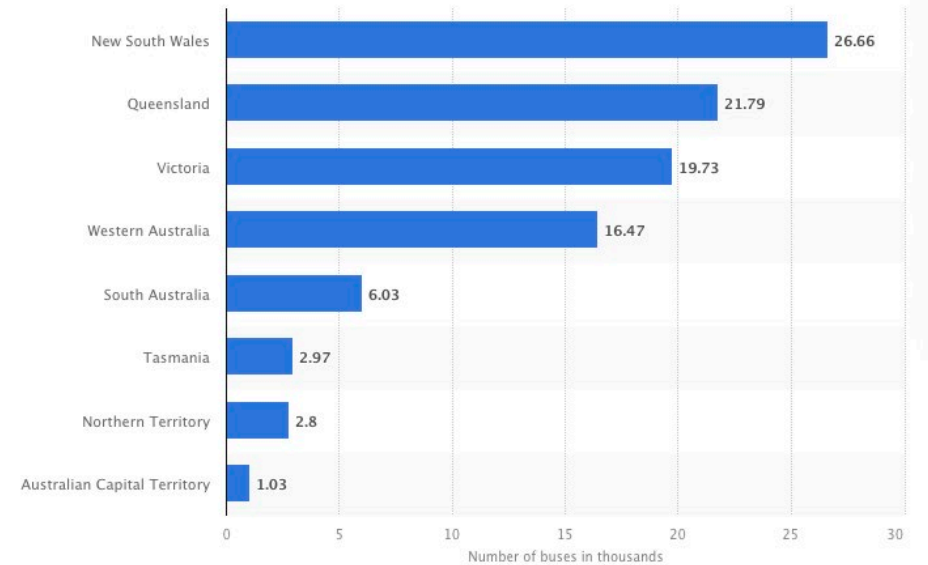


# Size of Bus Market in Australia



Numbers are approximate only, from 2022, data from various sources

- Total Number of Registered Buses in Australia – Approx 100,000 in 2024



Source: <https://www.statista.com/statistics/824830/australia-number-of-registered-buses/#:~:text=As%20of%20January%202023%2C%20Australia,followed%20by%20Queensland%20and%20Victoria.>

# ZEBs in Australia

State	Government commitment
Australian Capital Territory	Electrify the entire bus fleet with a zero emissions public transport system by 2040
New South Wales	Electrify the entire fleet of over 8000 buses. The transition delivers on the NSW Government's commitment to achieve net zero emissions by 2050.
Northern Territory	The NT EV Strategy and Implementation Plan includes an action to investigate the feasibility of trialling low and zero emission buses in the NT urban fleet and this work is currently underway.
Queensland	From 2025 ageing diesel buses will be replaced with zero-emission buses. The government has vowed to build its next fleet of electric buses in Queensland. Some buses are currently being built on the Gold Coast and in Brisbane.
South Australia	Plan to trial two hydrogen fuel cell buses.
Tasmania	The Tasmanian Government has pledged to transition its entire fleet to battery-electric, plug-in hybrid and hydrogen vehicles by 2030. An initiative for emission-free buses is also underway to determine whether hydrogen or electricity is more appropriate.
Western Australia	Western Australia has committed \$250 million. The \$250 million program will deliver 130 new locally-built electric buses and charging infrastructure at key depots.
Victoria	From 2025 ageing diesel buses will be replaced with zero-emission buses. 4,000 public diesel buses will transition to zero emissions.

Electric buses by jurisdiction

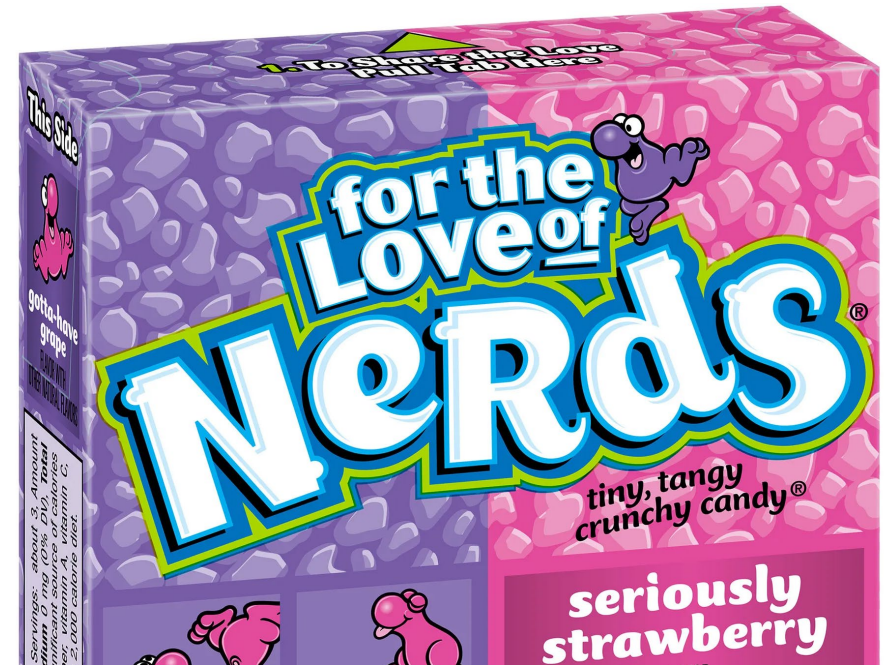


Source: [NTC, Electric Bus Evaluation, Sept 2023](#)

# What is Bus Scheduling??

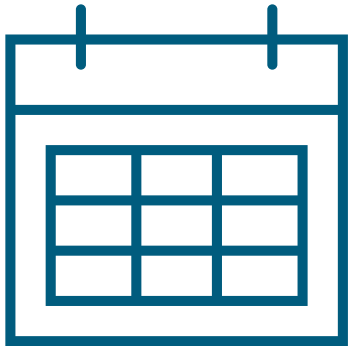
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“Bus Scheduling is a series of processes and complex mathematical equations that brings together critical bus planning elements including bus stops, routes, timetables, vehicle blocks and driver shifts in an efficient, contract compliant and cost-effective manner that meets customer needs.”



# Bus Scheduling is COMPLEX!

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# Scheduling Tools

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- There are lots of tools in the market that ‘promise’ they do everything!
- As technology continues to grow, so do the amount of tools but this isn’t enough...

*“The tool is only as good as its user”*

# UT & The Dark Arts

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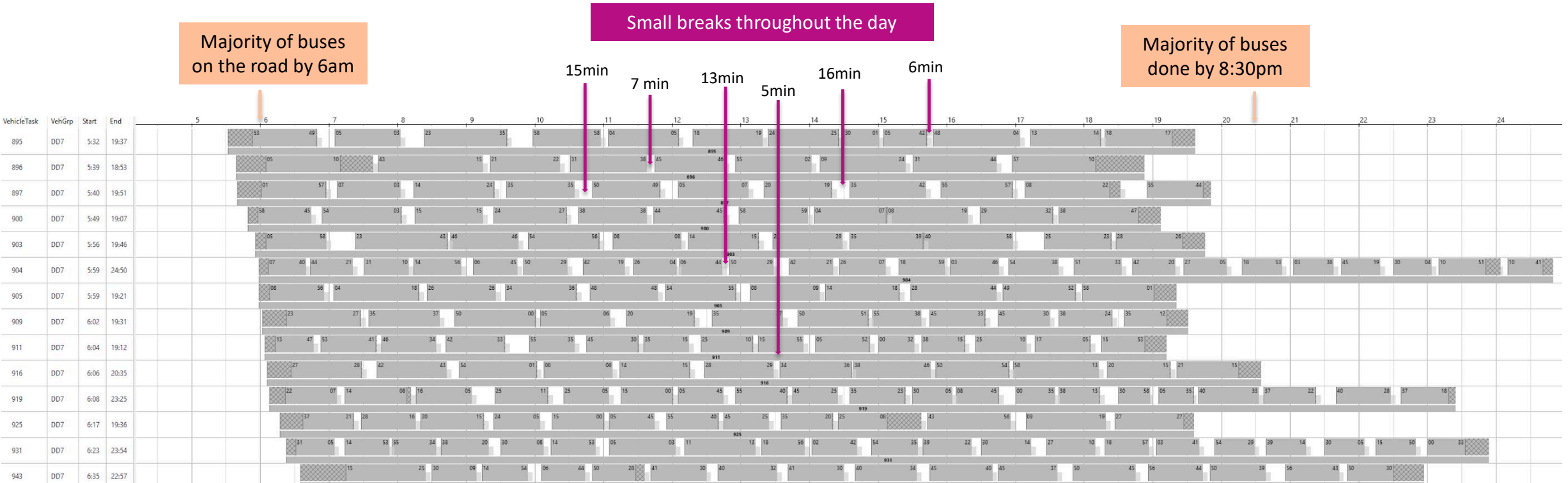
"The Dark Arts are many, varied, ever-changing, and eternal.

Fighting them is like fighting a many-headed monster, which, each time a neck is severed, sprouts a head even fiercer and cleverer than before.

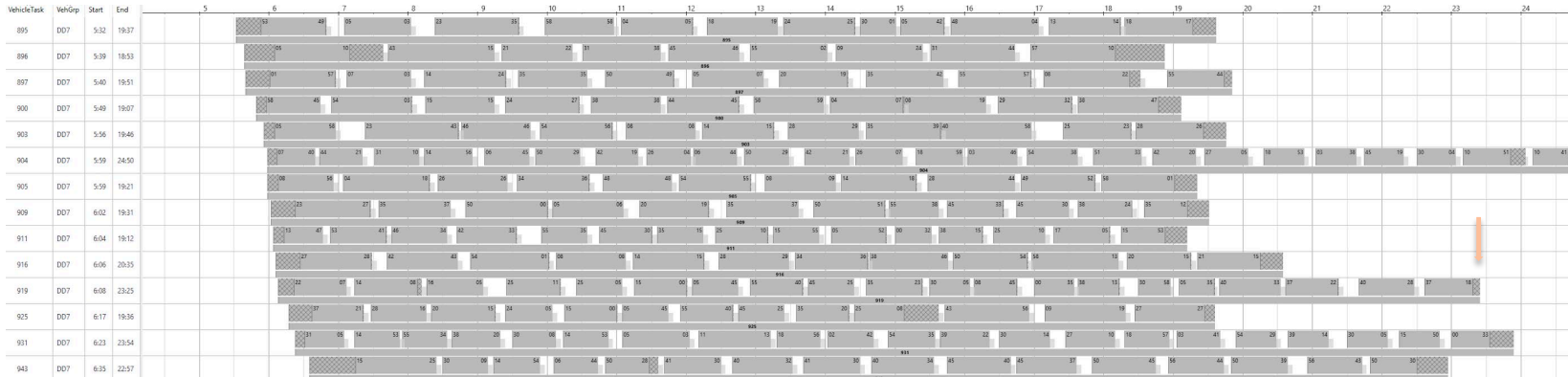
**-Severus Snape**



# Diesel Bus Scheduling (long blocks)



# Diesel Bus Scheduling



From here, we then create our Crewing, this takes into account:

- How many drivers we have
- The timetable we need to service
- The length of shifts (& shift types)
- The various Enterprise Agreement (EA) clauses
- Fatigue compliance legislation

# An EV Bus Schedule (long blocks)

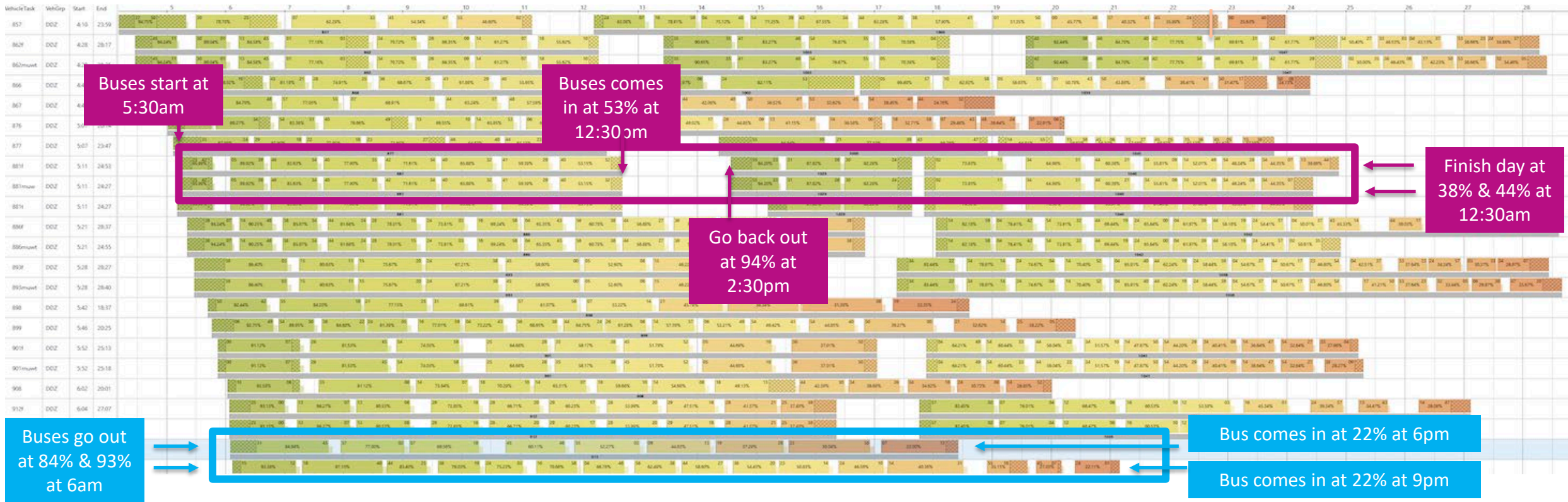
Majority of buses on the road by 6am

Much larger breaks required for charging

Majority of buses done by 11pm



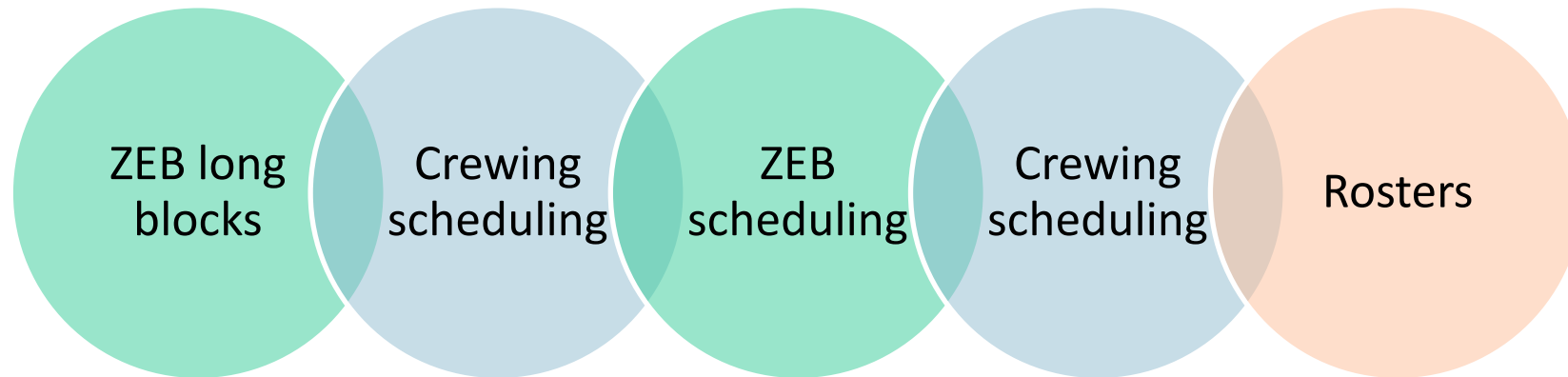
# An EV Bus Schedule (long blocks)



# Scheduling for ZEBs

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- So now we know what our buses can do we then commence the crewing, but wait, crewing doesn't align with our buses because our people shifts are different lengths...
- Operational knowledge and knowing our tools is essential!



# ZEB's Are Like People

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## **They need to rest and recharge**

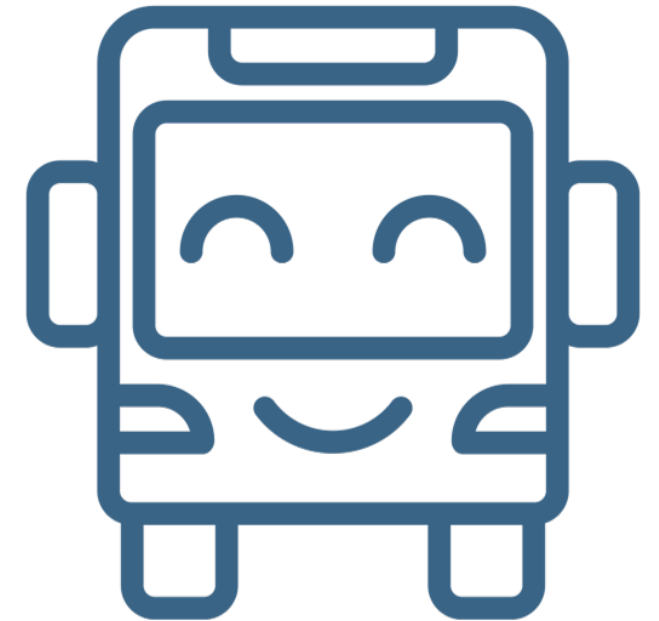
- Stated range of batteries is different to operational range, this can vary dramatically based on route characteristics including topography, dynamic traffic conditions, weather conditions and driver behaviour.
- Recharging options vary widely, fast/slow,

## **They behave differently when it's too hot and too cold**

- Research shows that higher wind speeds and lower temperatures are associated with increased energy consumption and decreased total energy regeneration rates. In some jurisdictions cold temperatures have been found to impact bus range by up to 40%!

## **Their maintenance (health) is different & more complex**

- Right now we try and keep our operational range of batteries between 20% - 80% - this changes over the life of the battery.





# Scheduling ZEBs today

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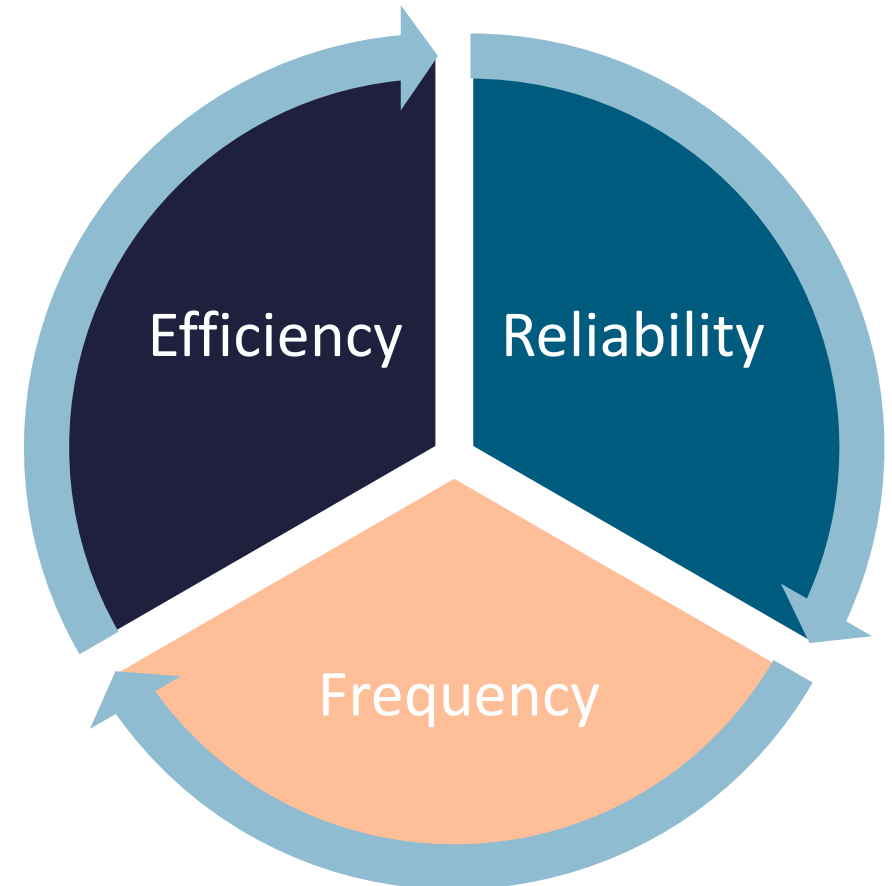
Right now, Scheduling for ZEB's in Australia & New Zealand, is relatively easy!

- We only have a handful of buses in various operations
- We are purpose building depots to accommodate ZEB's
- Today we are focused on ENERGY
  - How much do we need?
  - Where do we get it from?
  - How do we keep it coming?

# Scheduling ZEBs for Tomorrow

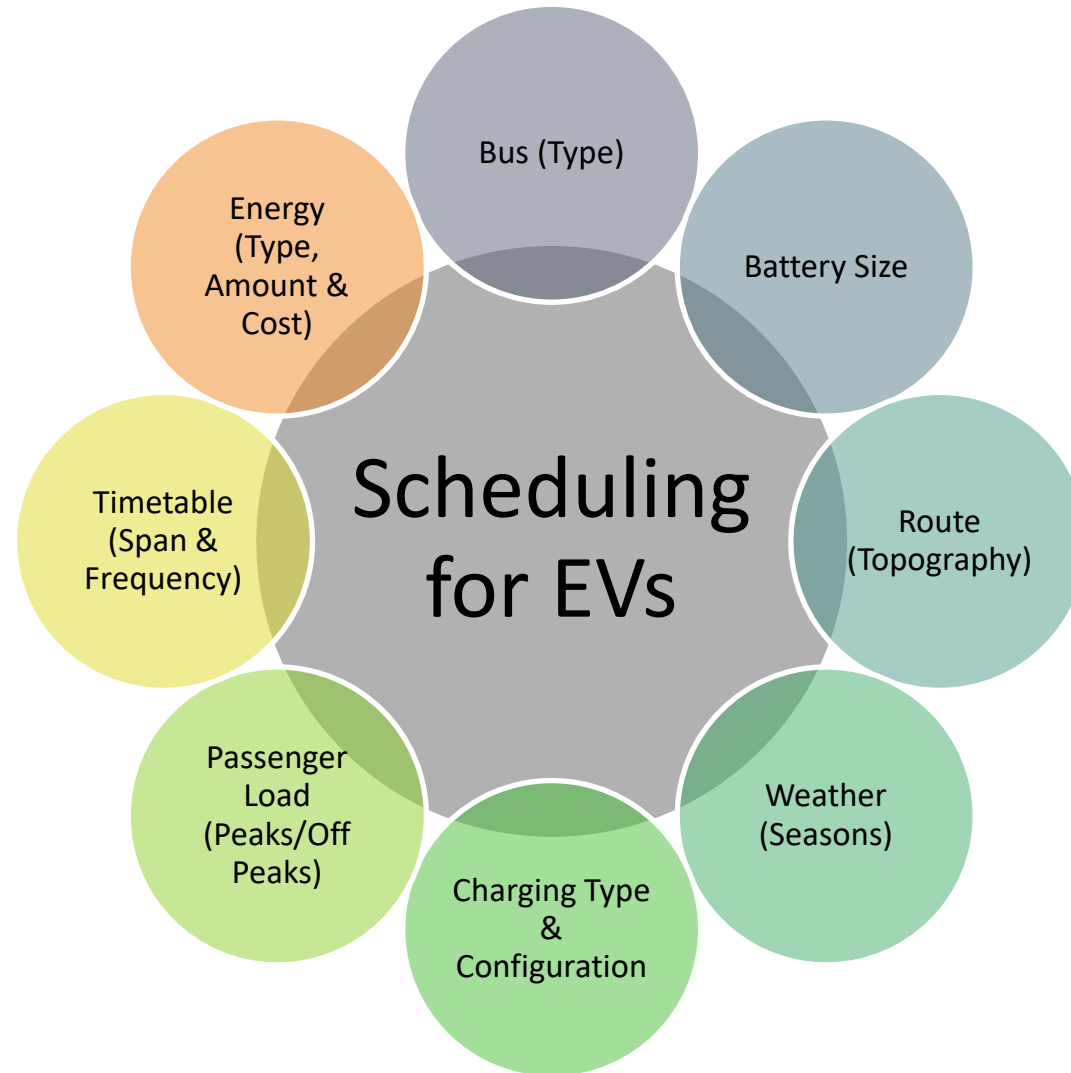
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- Within the next 5-10 years Scheduling of ZEB's will become a critical factor.
- As we introduce more ZEB's into our fleets we will need to better manage:
  - Our workforce
  - Our fleet (battery & vehicle maintenance)
  - Our depots (size, location, layout)
  - Our operational costs and network efficiencies



# EV Bus Scheduling Essentials

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# The Eternal Balancing Act

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KATHY LAZANAS, CEO  
E: [KLAZANAS@URBANTRANSIT.COM.AU](mailto:KLAZANAS@URBANTRANSIT.COM.AU)  
P: +61 401 484 252

THANK YOU



QUESTIONS