

# Zero Emission Bus (ZEB) Trials

BAV July 2024



Department  
of Transport  
and Planning

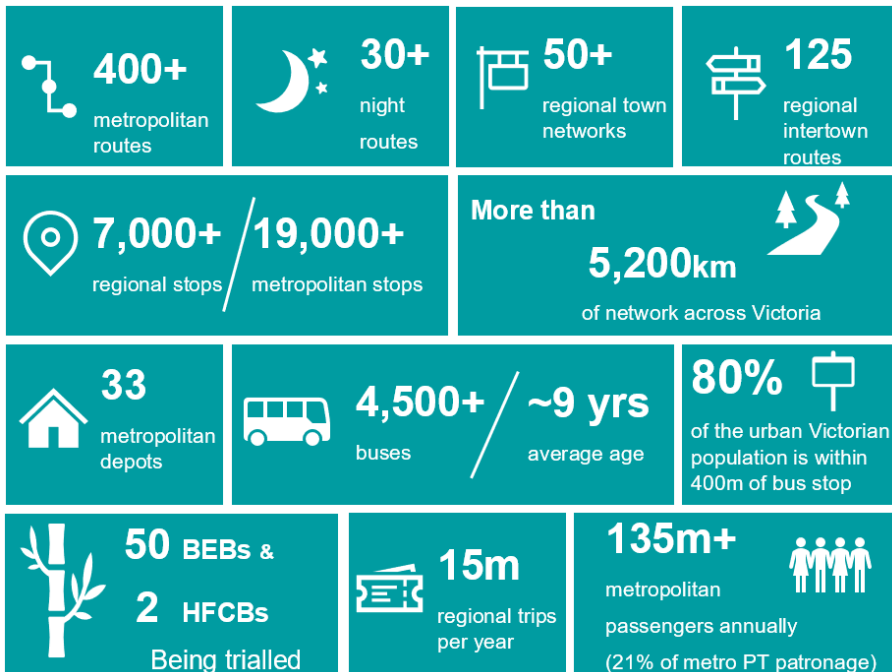


# Trial Overview



- The \$20 million Zero Emissions Bus Trials are one of the actions within the Government’s *Zero Emissions Vehicles Roadmap*.
- The trials support and inform the Government’s commitment to **only buy public transport ZEBs from 2025**.

# Context and Overview



## Victoria's Current Bus Operating Environment

- Range of large, small, urban and regional operators
- Different contracts for different types of service
- Most buses and depots are privately owned
- Local content requirements to support local industry
- *Victoria's Bus Plan* is introducing further reforms in parallel to the ZEB transition

## National collaboration

- Other Australian jurisdictions are on similar journeys
- We're sharing what we learn
- We all want interoperability between buses and consistent ZEB standards

# Context and Overview

## ZEBs are critical to reducing transport sector emissions...

The transport sector emits ~25% of emissions (the second largest after energy generation).

The ZEB transition support the Victorian Government's target of net zero by 2045.

## ... and deliver significant other benefits.

- Value for money and lower operating costs
- Smoother and quieter journeys
- Better air quality and quieter neighbourhoods
- Job creation and local industry development.

## Global Snapshot

Global deployment share of e-buses:

**17%** in 2020

**39%** in 2035

**67%** in 2040

Global market is expanding rapidly

**32%**

increase of global e-bus sales in 2019



**27%**

expected growth in units until 2027

Europe acquisition of e-buses growing exponentially as older fleets are retired

**5000**  
battery electric buses in operation



**150**  
hydrogen powered buses in operation

# Context and Overview



**52 ZEBs** (50 battery electric and 2 hydrogen fuel-cell) across 6 operators and 7 trials – in Melbourne, Seymour and Traralgon.

- Another 36 ZEBs via the Metropolitan Bus Franchise

**81 ZEBs** already in operation (as of July 2024), including Trial buses and Kinetic's ZEBs. (50 Trials, 30 MBF, 1 Ventura).

### Key learnings so far:

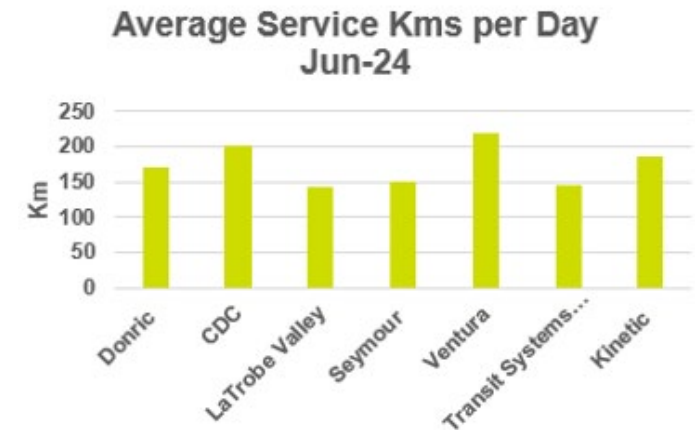
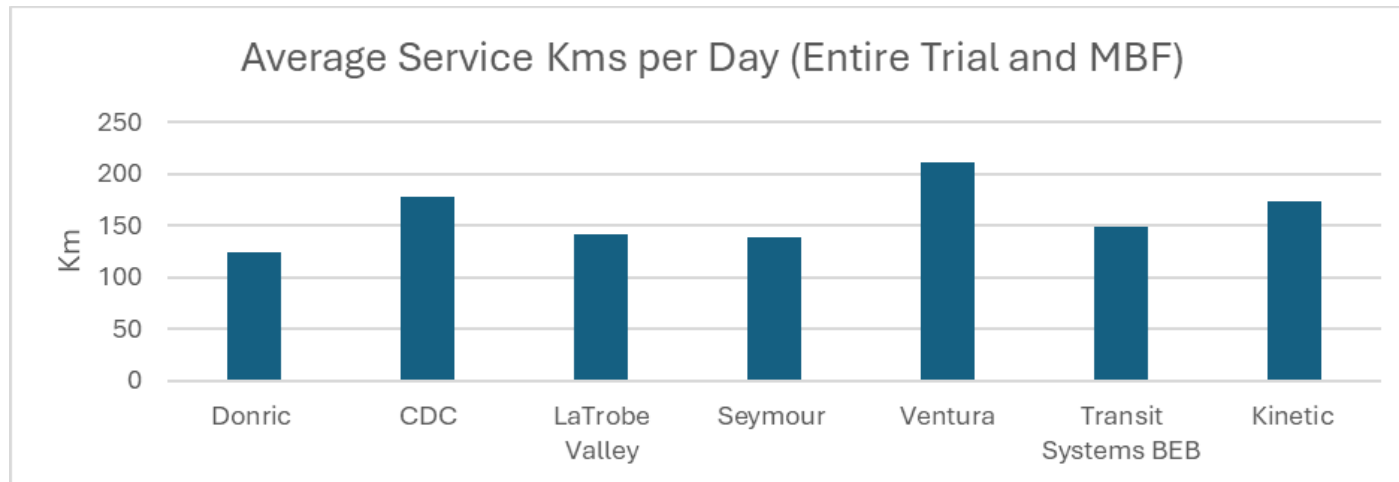
- The ZEBs are delivering the services
- Main challenges are at the **depot**
- **Long lead times** for power upgrades
- Some initial issues with bus-charger interface (**interoperability**)
- Capital costs higher, **operational costs lower**

# Victoria's ZEB trials:

Averages based on all data provided up to Jun-24 (inclusive)

## Range Anxiety: Can BEBs do a day's work?

- The ZEBs are collectively averaging **193km of service per day**, their diesel counterparts average 171km
- ZEBs are covering a range of different conditions and distances.
- Operators have grown more confident and are using their ZEBs on longer runs, particularly in metro areas.

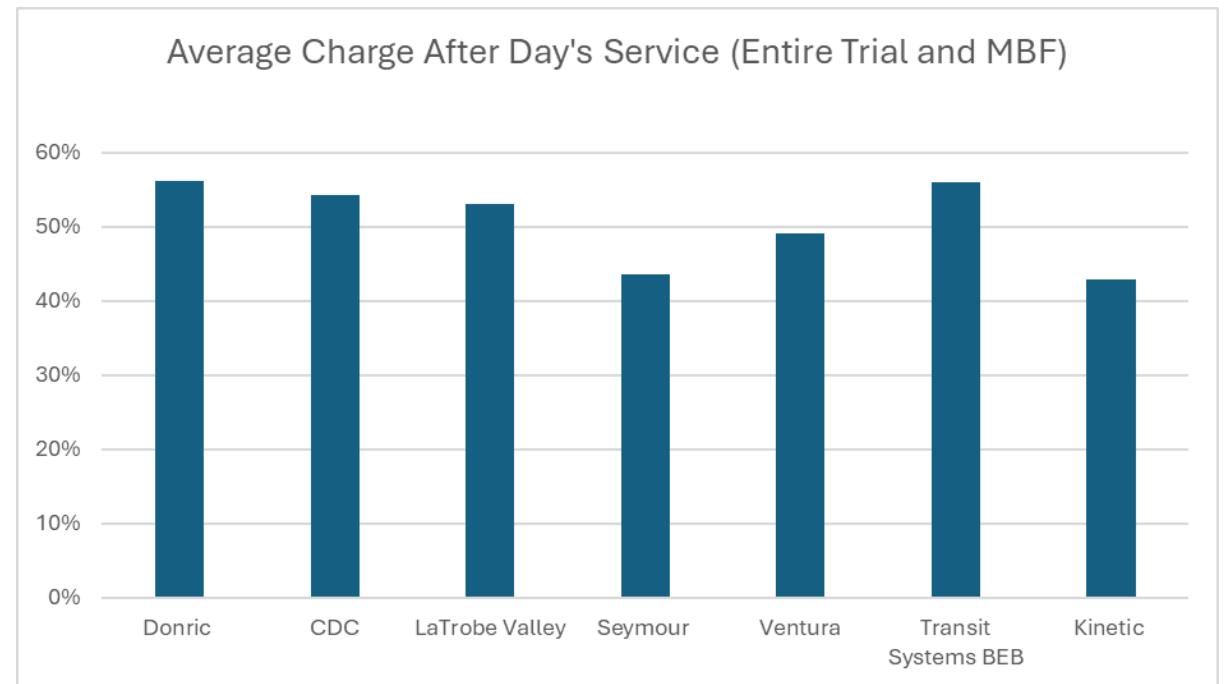


# Victoria's ZEB trials:

Averages based on all data provided up to Jun-24 (inclusive)

## Battery Capacity: What's left in the tank at the end of the day?

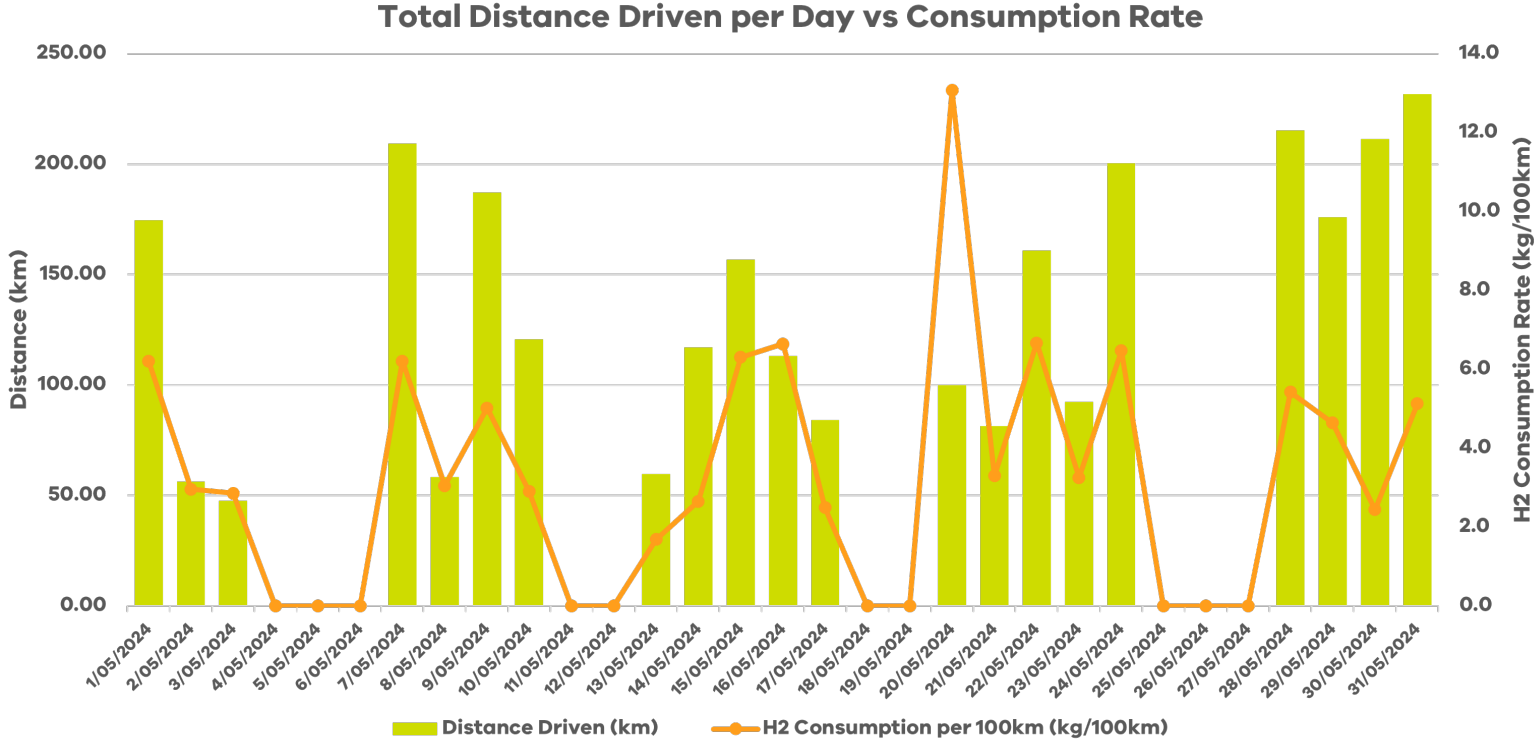
- Comfortably covering their *current* duties with plenty of battery life remaining.
- CDC's BEBs return with relatively high charge due to offsite charging at Monash University.



# Victoria's ZEB trials:

Averages based on all data provided up to May-24 (inclusive)

## Hydrogen Fuel Cell Buses (HFCB): Maturity and VfM



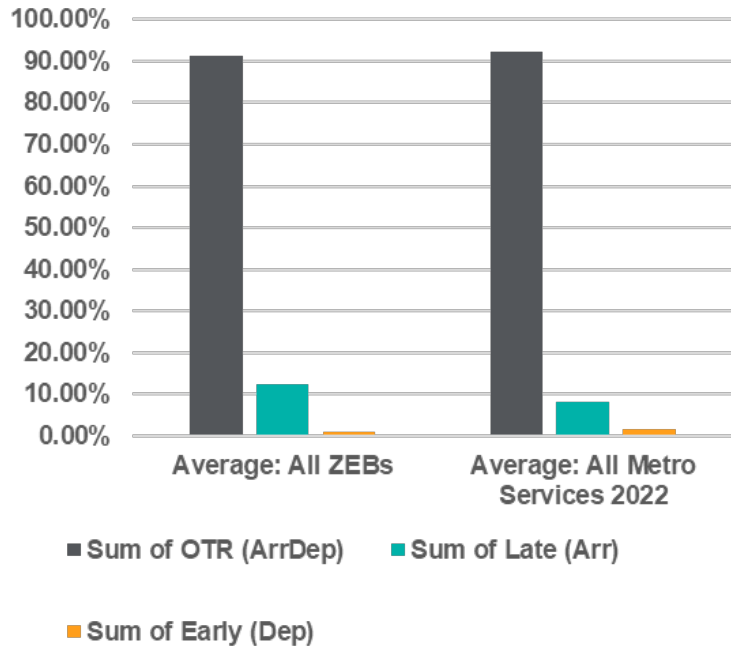
- Transit Systems has trialled the 2 HFCB on both short and long runs (50 – 200km) since May 2024.
- The HFCBs are performing well with an average consumption of **4.71kg(H2) per 100km** in May-24.
- The HFCBs spent a total 62hrs refuelling in May-24, at an average of **4:31h** per refuelling session.
- Transit Systems is using a low powered rental refueller.



# Victoria's ZEB trials:

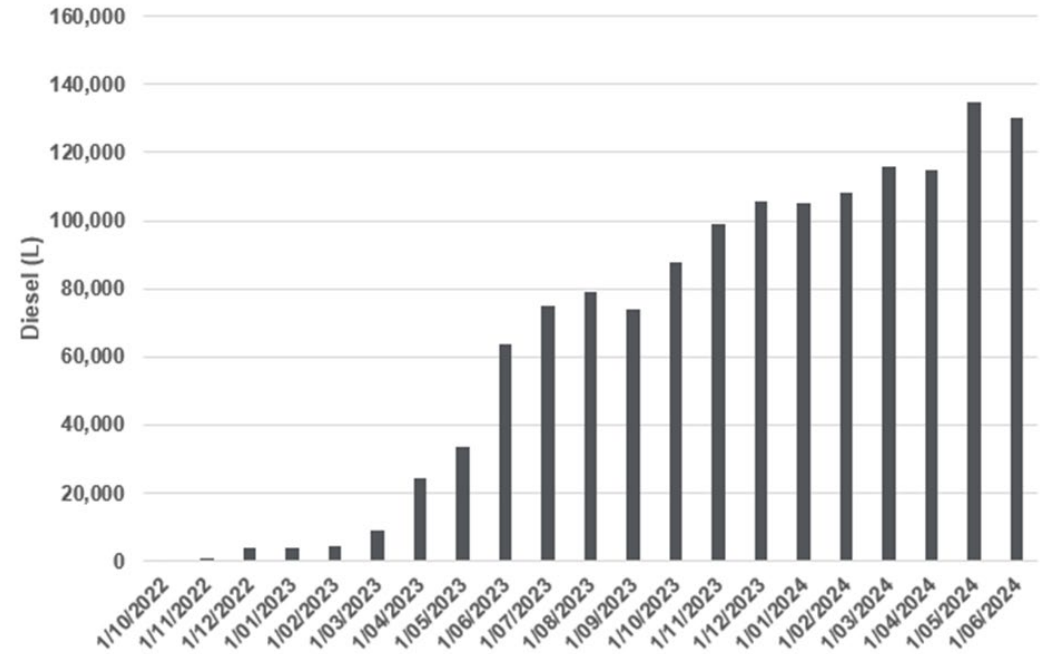
Averages based on all data provided up to Jun-24 (inclusive)

## Punctuality Performance (Oct-23)



- From the passenger perspective, ZEB services are identical to diesel services.
- Slightly higher late running is attributed to majority of ZEBs running on congested inner-city routes

## Diesel Saved by ZEB Trial



Litres of diesel saved is approximated based on the distance travelled by ZEBs.

- Approx. 348t CO<sup>2</sup> saved in June 2024
- Approx. 3,647t CO<sup>2</sup> saved to date.

Please note MBF data was received by the ZEB team in June 2023 for the first time.

# Fire and Safety Management



- The cause of a fire on a BEB is very different to a diesel bus, but the management is similar.
- **Fire Rescue Victoria** has advised they do not change their approach to managing the fire - It remains ensuring the area is safe and that the fire does not spread.
- **The priority remains safely exiting the bus, moving to a safe place and dial 000.**
- Emerging technologies for battery monitoring and thermal detection is important, and these are now being included




As specification requirements for example in recent ADR updates.

- Simpler technologies like burn bays, fire blankets, and smoke curtains are important considerations

**DTP is working with other jurisdictions to develop a consistent requirement in this area of fire and safety requirements for ZEBs.**

# Charging...

This gets complicated

	Size & Weight	Power	Input
 <p>Kempower Movable Charger</p>	640 x 670 x 1220 mm  135kg, with wheels	DC	Three phase – 32 or 63-amp
 <p>ABB Terra 24 Wallbox DC</p>	584 x 294 x 770 mm  60kg	DC	Three phase – 40 amp
 <p>Ocular Atlas DC Charger</p>	2338 x 1050 x 956 mm  450 kg	DC	Connected via LV switchboard

- There are a wide variety of charging units available, from portable AC (common household supply) to fixed pedestal dual twin gun DC three phase chargers that will need switchboard upgrades
- At one end of the scale portable chargers will manage 1-2 buses charging overnight
- If you have more than 5 buses to charge per night you will need a bigger charger – maybe a switchboard or electrical upgrade
- Interoperability important – we tested this on the trial
- Portable chargers as back up – worked in the Trials and other applications

DTP is working with industry to promote interoperability across charging hubs and with the DNSPs to determine power requirements and facilitate power upgrades where needed.

# ZEB Consultation

Undertaken in Late 2023

## Key learnings from the engagement:

- There is generally strong market support for the ZEB Transition
- Government has a key role to play to define consistency in standards, specifications and support operators in undertaking the transition efficiently.
- Depot upgrade works (including grid upgrades) will take planning and time. Risks, including planning and approvals process, require ongoing monitoring and management.
- Different commercial models exist to support the ZEB Transition
- Local content considerations (particularly for fleet manufacturing) present an opportunity to grow local manufacturing capability in Victoria to support the ZEB Transition.



# Next Steps towards Transition

## Key learnings so far:

- The **buses are performing well**, with no changes to timetables
- Main challenges are at the **depot**, such as **long lead times** for power upgrades
- Capital costs higher (the vehicles and the charging infrastructure), but **operational costs lower**
- **People and drivers like them!** They are smoother, quieter, with no fumes or rattles.

Feedback from this consultation, together with learnings from our own ZEB trials, and experience from other jurisdictions is informing the final **ZEB Transition Plan** which is expected to be released in the second half of 2024.