



ACT
Government

ZERO-EMISSION TRANSITION PLAN FOR TRANSPORT CANBERRA 2024 REFRESH



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Contents

Minister's foreword	3
Summary action plan	4
Global challenges, local opportunity	5
Transport Canberra	7
Our progress to date	12
Preferred transition pathway	18
Transport Canberra now vs the future.	33
Transition principles	34
Bibliography	35

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MINISTER'S FOREWORD

The ACT Government is continuing to lead the nation in our responsible approach to managing climate change and our environment.

In 2020 when we released the original Transport Canberra Zero-Emission Transition Plan, we had become the first jurisdiction outside Europe to reach 100% renewable electricity. Since then, we have made significant progress towards transitioning the largest source of emissions: transport.

Light rail continues to play a significant part in our journey to zero-emission public transport since operations commenced 5 years ago. Its ongoing popularity has continued to see 20% of public transport trips powered by 100% renewable energy and has been demonstrated to be a key driver in attracting passengers to public transport and shifting their mode of travel away from petrol and diesel vehicles.

With this refreshed plan the ACT Government will continue to take a nation-leading approach to transitioning our city's bus fleet to zero-emissions.

The plan has been updated to reflect key Government decisions since 2020 and with the expert advice of consultancy firm WSP to incorporate the knowledge and experience gained since the Plan was first developed. Through the delivery of key elements from the original plan, we have gained a better understanding of the ever evolving technology within the zero-emission sector and the infrastructure, investment and skills needed for the ongoing success of our transition.

With this refreshed plan the ACT Government will continue to take a nation-leading approach to transitioning our city's bus fleet to zero-emissions. Since the original plan was released, we have undertaken procurement activities to buy and lease 106 battery electric buses. Buses delivered to date have been providing Canberrans with cleaner, quieter, more comfortable and more reliable electric bus services and the ACT leads the country in terms of the proportion of zero-emission buses in the fleet according to the Australia Institute. The work done to support this Plan has supported Transport Canberra's overall fleet management strategy.

To provide capacity for the growing zero-emission fleet, the ACT Government made a key decision to invest in

augmentation of the electricity grid to supply our electric bus depots. The decision to bring forward the high voltage connection to Tuggeranong depot to support up to 200 buses has now been completed and this has meant that a fourth depot on the Northside will be needed later in the decade. This change is reflected in the updated transition plan.

The Woden Bus Depot as a fully zero-emission facility will provide capacity for up to 100 battery electric buses and it will be the largest purpose-built electric bus depot in Australia and New Zealand.

The updated action plan reflects the work to date and considers new opportunities to support the ACT's overall transition to zero-emissions. Transport Canberra have also partnered with transport agencies across Australia and New Zealand to share experiences and lessons learnt on their journeys towards a zero-emission bus fleet, together monitor and investigate emerging technologies, and implement best practice in terms of sustainable transition. These partnerships will continue to play a crucial role in progressing our identified transition pathway.

Through this Plan we will continue to support a just transition for our transport workforce. Transport Canberra have worked with the Canberra Institute of Technology and the Australian Government to establish Australia's first Skills Centre of Excellence which will focus on electric vehicles. This includes the delivery of Automotive Electric Vehicle Technology (Heavy) training providing existing and new staff with the skills they need to work on the new electric fleet. Incentives for trade staff members who have obtained these new skills have also been introduced through industrial arrangements.

Finally, key to addressing climate change is encouraging more Canberrans to use public transport. This plan expands on the actions we will undertake to make public transport an accessible and attractive option for moving efficiently around our city and improve the health and liveability of our community.

Chris Steel MLA

Minister for Transport



SUMMARY ACTION PLAN

Action		Progress
Strategic priority 1 – Building the infrastructure we need		
Action 1.1	Deliver a temporary infrastructure solution for the first tranche of zero-emission vehicles.	Completed
Action 1.2	Undertake a depot feasibility study to identify the timing and scope of future needs.	Completed
Action 1.3	Upgrade Woden depot to support zero-emission buses.	In progress
Action 1.4	Build a new zero-emission depot by 2030.	In progress
Action 1.5	Convert remaining existing depots to zero-emissions by 2040.	In progress
Action 1.6	Explore potential for the Transport Canberra zero-emission bus transition to support the charging needs of other fleets.	New action
Strategic priority 2 – Procuring a zero-emission fleet		
Action 2.1	Procure a first tranche of battery electric buses which are supported by a temporary infrastructure solution.	Completed
Action 2.2	Continue to monitor changing commercial models, technology developments and power advances.	In progress
Action 2.3	Develop standard operating procedures for depot and fleet management to respond to the needs of battery electric buses.	New action
Strategic priority 3 – Partnering with the energy sector		
Action 3.1	Engage early with different service providers and the energy market.	In progress
Action 3.2	Participate and partner with the energy sector.	In progress
Action 3.3	Monitor discussions on future power technologies and advances.	In progress
Action 3.4	Work with other jurisdictions to identify shared solutions to shared problems.	In progress
Strategic priority 4 – New skills, protecting jobs, and growing the economy		
Action 4.1	Engage with workforce to deliver a just and fair transition.	In progress
Action 4.2	Expand transition benefits to the ACT local market, involving businesses and organisations across the electric bus supply chain.	In progress
Action 4.3	Train and upskill workers and expand these to regional and nationally recognised certifications.	In progress
Action 4.4	Support the sustainable repurposing and recycling of bus batteries.	New action
Strategic priority 5 – Increasing public transport use through better buses and a better service		
Action 5.1	Co-design technology advancements with the introduction of new fleet that enhance service and performance.	In progress
Action 5.2	Consider place-based initiatives that showcase the benefit of zero-emission vehicles in the urban environment.	In progress
Action 5.3	Develop bus stop infrastructure improvements and initiatives to encourage public transport use.	New action
Action 5.4	Deliver bus network optimisation to leverage new infrastructure.	New action

GLOBAL CHALLENGES, LOCAL OPPORTUNITY

We are on a journey to transition our fleet to zero-emissions technology by 2040. This journey reflects urgent action locally and globally to move to a prosperous zero-emissions future.

At a global level, the United Nations is leading the effort to address the climate change crisis, calling for net-zero-emissions by 2050. In response, each Australian state and territory has pledged targets for achieving net-zero and reducing emissions (Table 1.1). Leading the way is the ACT Government, which is dedicated to pioneering efforts

towards a sustainable future for the Territory. The ACT Government released the ACT Climate Change Strategy 2019-2025, which sets several interim targets and key actions for achieving success. This includes net-zero government emissions by 2040.

Table 1.1 Public transport fleet transition targets

State or territory	Emission reduction targets	Renewable energy targets	100% fleet transition targets
Australian Capital Territory	50-60% by 2025 65-75% by 2030 90-95% by 2040 <i>(compared to 1990 levels)</i> Net-zero by 2045	100% renewable electricity since 2020 Transition away from gas by 2045	Zero-emission bus (ZEB) fleet by 2040
New South Wales	50% by 2030 <i>(compared to 2005 levels)</i> Net-zero by 2050	12 gigawatts of renewable energy by 2030	Greater Sydney – 100% ZEB fleet by 2035 Outer Metropolitan – 100% ZEB fleet by 2040 Regional NSW – 100% ZEB fleet by 2045
Northern Territory	Net-zero by 2050	50% by 2030	No fleet transition target in place
Queensland	30% by 2030 <i>(compared to 2005 levels)</i> Net-zero by 2050	50% by 2030 70% by 2032 80% by 2035	South-East Queensland – 50% ZEB fleet by 2025 All Queensland – 100% ZEB fleet by 2050
South Australia	50% by 2030 <i>(compared to 2005 levels)</i> Net-zero by 2050	100% by 2030 500% by 2050	100% ZEB fleet by 2050
Tasmania	Net-zero by 2030	100% renewable electricity since 2020 150% by 2030 200% by 2040	100% ZEB fleet by 2030
Victoria	28-33% by 2025 45-50% by 2030 75-80% by 2035 <i>(compared to 2005 levels)</i> Net-zero by 2045	65% and 2.5 gigawatts of storage planned by 2030 95% and 6.3 gigawatts of storage planned by 2035	100% ZEB fleet by 2030
Western Australia	80% emissions reduction target for government operations, <i>(compared to 2020 levels)</i> Net-zero by 2050	State-owned Synergy coal fired power stations to be retired by 2030	No fleet transition target in place

Transport sector emissions are a significant and growing contributor to Australia's carbon emissions, accounting for more than 60% of the Territory's emissions. While most of these emissions come from private vehicles, we recognise our responsibility to spearhead the transition through our own emission reductions. While the Transport Canberra bus fleet currently contributes approximately 3% of the Territory's emissions, they represent over half of the government's emissions.

An important factor in achieving our emissions reduction target is through providing a dependable and sustainable public transport network. The ACT Transport Strategy sets out the objectives for Canberra's integrated transport system, to support our ambitions for a sustainable and resilient city. We recognise the efficiency of public transport in facilitating the movement of people over distances and our objectives include improving service utilisation and reducing CO2 emissions.

Alongside transport agencies across Australia and the world, since 2020 we have been on a journey to transitioning our fleet to zero-emissions. This has involved working closely across the ACT Government and industry, as well as collaborating with other transport agencies and jurisdictions to share lessons learned along the way. Transport Canberra is a member of the Public Transport Association Australia and New Zealand which is the peak body for public transport and sustainable mobility solutions in our region. Our involvement with this organisation facilitates cross-jurisdictional collaboration to better inform the transition of our bus fleet.

In 2020, we released the Zero-Emission Transition Plan for Transport Canberra which outlined a pathway to transition our fleet to zero-emission and support the government's wider transition targets, with a requirement to review and refresh the Plan periodically. This first refresh of the Plan demonstrates our continued commitment, presents our progress towards achieving our targets and identifies key actions for the next 5 years.

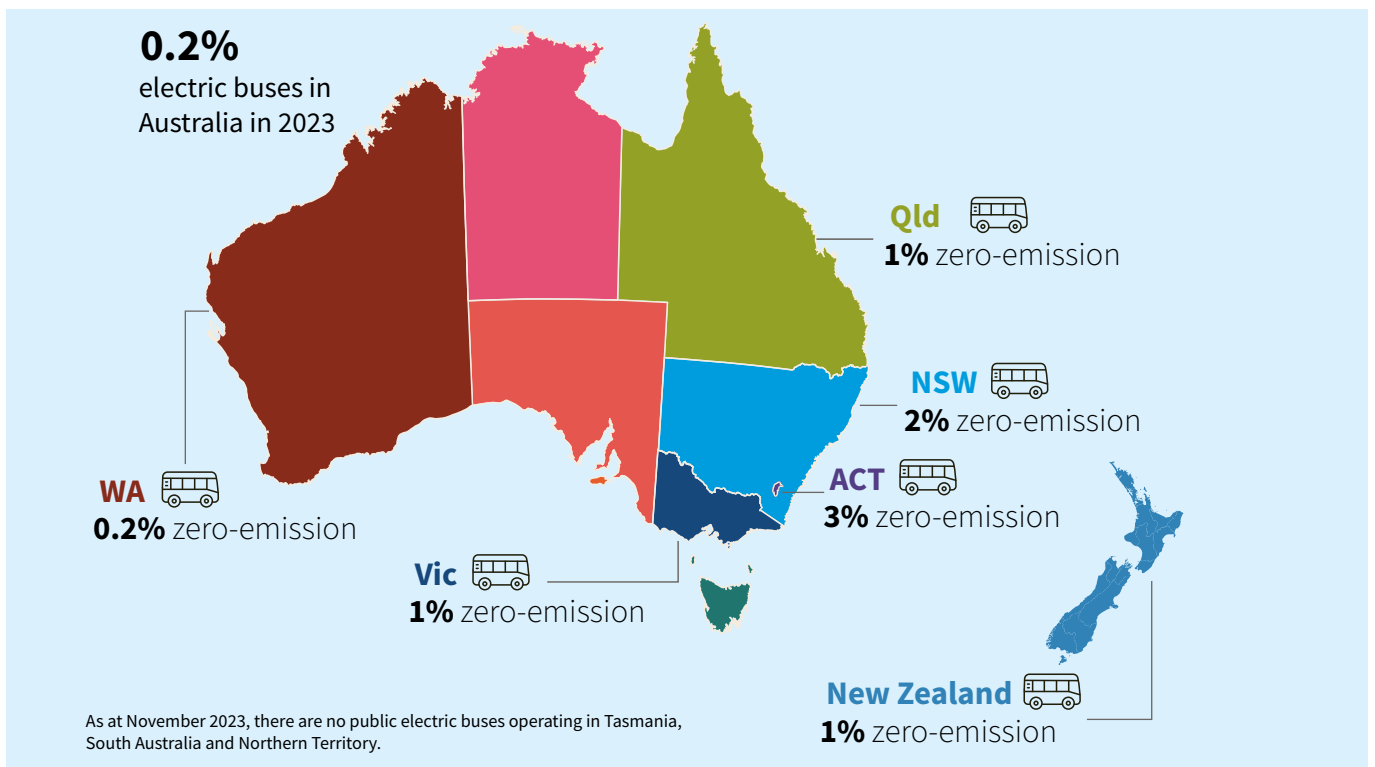
Figure 1.1 2024 projected emissions sources

Category	%	CO2-e(t)*
Transport Canberra buses	51%	34176.28
Fleet vehicles	10%	6450.73
Natural gas (other facilities)	18%	12098.45
Natural gas (health facilities)	10%	6802.40
Natural gas (schools)	9%	6284.70
Refrigerants	2%	1177.94

* total greenhouse gas emissions (tonne of carbon dioxide equivalent)

Source ACT Climate Change Strategy

Figure 1.2 Australia's zero-emission bus transition



Source data - Slow lane - Electric buses (australiainstitute.org.au)

TRANSPORT CANBERRA

The ACT’s public transport network is the backbone of our integrated transport system, helping us to achieve the region’s social, economic, and environmental objectives. Transport Canberra’s bus service is a significant component of this system, offering essential services throughout the city. Transitioning this fleet to zero-emissions is integral to supporting the ACT’s successful achievement of zero-emission targets.

Canberra’s bus services are publicly owned, operated, managed, and maintained by Transport Canberra, and the ACT Government is responsible for delivering existing and future public transport infrastructure (including interchanges and layovers). Each weekday, over 53,000 trips are made by public transport in Canberra across bus and light rail modes. A large proportion of these trips are made by Transport Canberra bus services, which completed over 22 million in-service kilometres in 2023/24. Canberra’s public transport network is a 2-tier structure:

- ★ **Rapid**
- ★ **Feeder and local**

The network is also comprised of the flexible transport service, dedicated school services, peak express services, and special needs transport. Most trips are undertaken by the rapid and local/feeder network.

Table 2.1 Service kilometres per annum

Service type (buses only)	2023/24 service kms
Rapids	9,287,562
Regular local and feeder	12,203,529
Dedicated school services	691,517
900 Series local services	291,285
Total	22,473,893

Transport Canberra’s bus fleet is all publicly owned, which differs from many other Australian cities where some or all bus services are operated by the private sector under franchised contracts. The Canberra bus fleet is operated out of 2 publicly owned depots in Tuggeranong and Belconnen, with a third depot under construction in Woden, expected to be operational in 2025. To support bus operations, Transport Canberra directly employs all executive, administrative staff, bus drivers, transport officers and workshop mechanics.

Transport Canberra also sets the policy for the transport network and is responsible for strategic network and operational planning, management of network operations, service monitoring, maintenance, and reporting. As part of an integrated network, the bus network supports Canberra’s light rail network with the first stage in operation between the City and Gungahlin.

Table 2.2 Transport Canberra operations (as at 30 June 2024)

Fleet	Zero-emission fleet	23 buses
	Total fleet size	450 buses
Depots	Existing depots	Tuggeranong and Belconnen depots
	Depot in construction	Woden depot
Workforce	Transport Canberra workforce	Over 1,000 staff
	Bus workforce	Over 800 staff

Fleet

The Transport Canberra bus fleet summarised in Table 2.3 comprises approximately 450 vehicles, currently housed at Belconnen and Tuggeranong depots. The number of in service buses on any particular day is variable and dependent on factors such as scheduled maintenance, repairs or vehicle incidents. The 2020 Zero-Emission Transition Plan for Transport Canberra outlined an interim emission reduction target in line with the 2019 ACT Climate Change Strategy to reduce government emissions by 33% by 2025. As Transport Canberra’s diesel and gas buses comprise over half of government transport emissions, replacing them with a zero-emission fleet would make a notable contribution to achieving this target.

Since the release of the 2020 Zero-Emission Transition Plan, Transport Canberra has entered into a contract with Vehicle Dealers International for 12 battery electric buses in October 2022. The first Yutong entered service in January 2023, with all 12 in service by the first half of 2023. Transport Canberra also executed a further contract with Vehicle Dealers International in May 2023 for 90 battery electric buses, with the first of these 90 buses delivered in May 2024. In June 2023, Transport Canberra entered into a contract with Custom Denning to procure a further 4 battery electric buses. There are now a total of 23 battery electric buses in service.

Transport Canberra is committed to integrating all 106 battery electric buses into the operational fleet by the end of 2026.

These buses are operating out of Tuggeranong and Belconnen depots, and Woden depot on opening, and are enabling the retirement of the compressed natural gas bus fleet.

While we are dedicated to upgrading the Transport Canberra fleet, a small number of older buses remained in operation longer than anticipated due to supply chain constraints impacting delivery timeframes of more environmentally

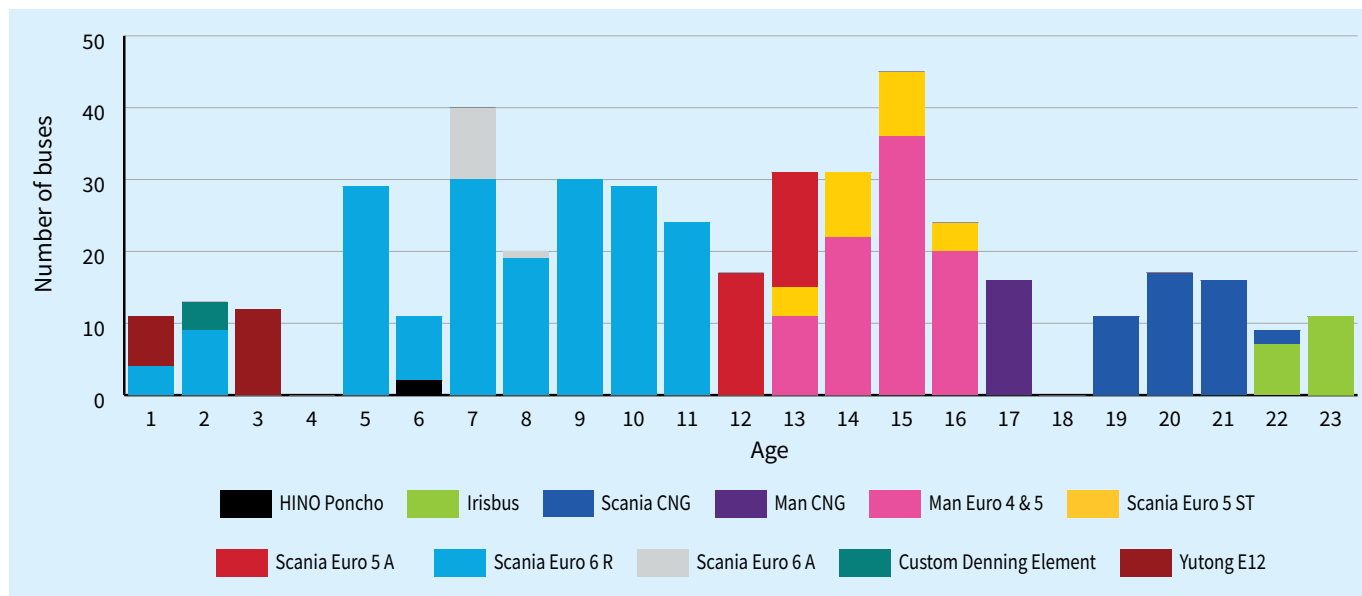
friendly diesel buses. This included the Renault PR100.2 buses, which first entered service in 1987, which predated the first European emission standards, implemented in 1992, and did not meet accessibility requirements under the Disability Discrimination Act standards. The 3 remaining Renault buses will leave the Transport Canberra operational bus fleet by the end of August 2024, however 4 will still be utilised for training purposes only and will not carry passengers.

Transport Canberra is also planning for an increase in the number of buses in the Transport Canberra fleet over time to support the ACT's urban development and growth and meet the needs of the community. The ACT government is also developing a zero-emission vehicle transition plan for the Territory's non-bus heavy vehicle fleet, which includes vehicles such as waste trucks. Transport Canberra will coordinate with that plan to identify opportunities for alignment.

Table 2.3 Transport Canberra bus fleet composition

Bus type	Count	Average age	Fuel			Disability Discrimination Act	Euro-emissions standard							
			Electric vehicle	Diesel	Gas		No	2	3	4	5	6		
Irisbus	18	22		✓		Yes		18						
Scania CNG	46	19			✓	Yes			46					
Man CNG	16	16			✓	Yes					16			
Man Diesel	89	14		✓		Yes							89	
HINO Poncho	2	5		✓		Yes							2	
Scania 14.5m	26	14		✓		Yes							26	
Scania Articulated	44	9		✓		Yes							33	11
Scania Euro VI	183	7		✓		Yes								183
Custom Denning Element	4	1	✓			Yes								
Yutong E12	19	2	✓			Yes								
Total	447	11	23	362	62		0	18	46	16	150	194		

Figure 2.1 Fleet age by vehicle type



Depots and infrastructure

Bus depots are integral to Transport Canberra's bus fleet operations. They provide a location for housing and refuelling our fleet. Transitioning to a zero-emission bus fleet will require significant depot upgrades to accommodate charging and maintenance equipment and the associated space and layout requirements. Electric bus charging equipment must be in place in bus depots before they can accept and operate battery electric buses. This also entails installation of high voltage electricity supply, transformers, and switchboards.

Bus services operate out of 2 depots at Belconnen and Tuggeranong, shown in Figure 2.2.

In December 2023, 2 chargers were installed at Belconnen depot. Due to limited energy capacity in the area Belconnen only has the capacity to charge 4 battery electric buses simultaneously during off-peak time. Investigations have determined that to meet current codes, any upgrade to Belconnen depot would require upgrading of nearby, non-Transport Canberra infrastructure such as streetlights and traffic lights and therefore has not been deemed viable at this stage due to the additional cost, which may have exceeded \$1m. The depot itself is an ageing facility and would require major upgrades to bring the depot up to current standards.

Belconnen depot will continue to have the ability to simultaneously charge 4 battery electric buses overnight with limited impact on operations. Due to there being overall limitations on available power in the Belconnen area, the number of battery electric buses to be housed at Belconnen will be limited until upgrades to the broader electricity

network are made. Transport Canberra continue to monitor the situation and are undertaking further investigations into options for upgrading the depot (dependent on Evoenergy upgrades of the broader network) or decommissioning/retirement and replacing with a depot in an alternative location.

New depots in Canberra's northern growth area are being investigated to support existing and future bus fleets. Such investigations are also considering maintenance facility needs to support the entire Transport Canberra bus fleet.

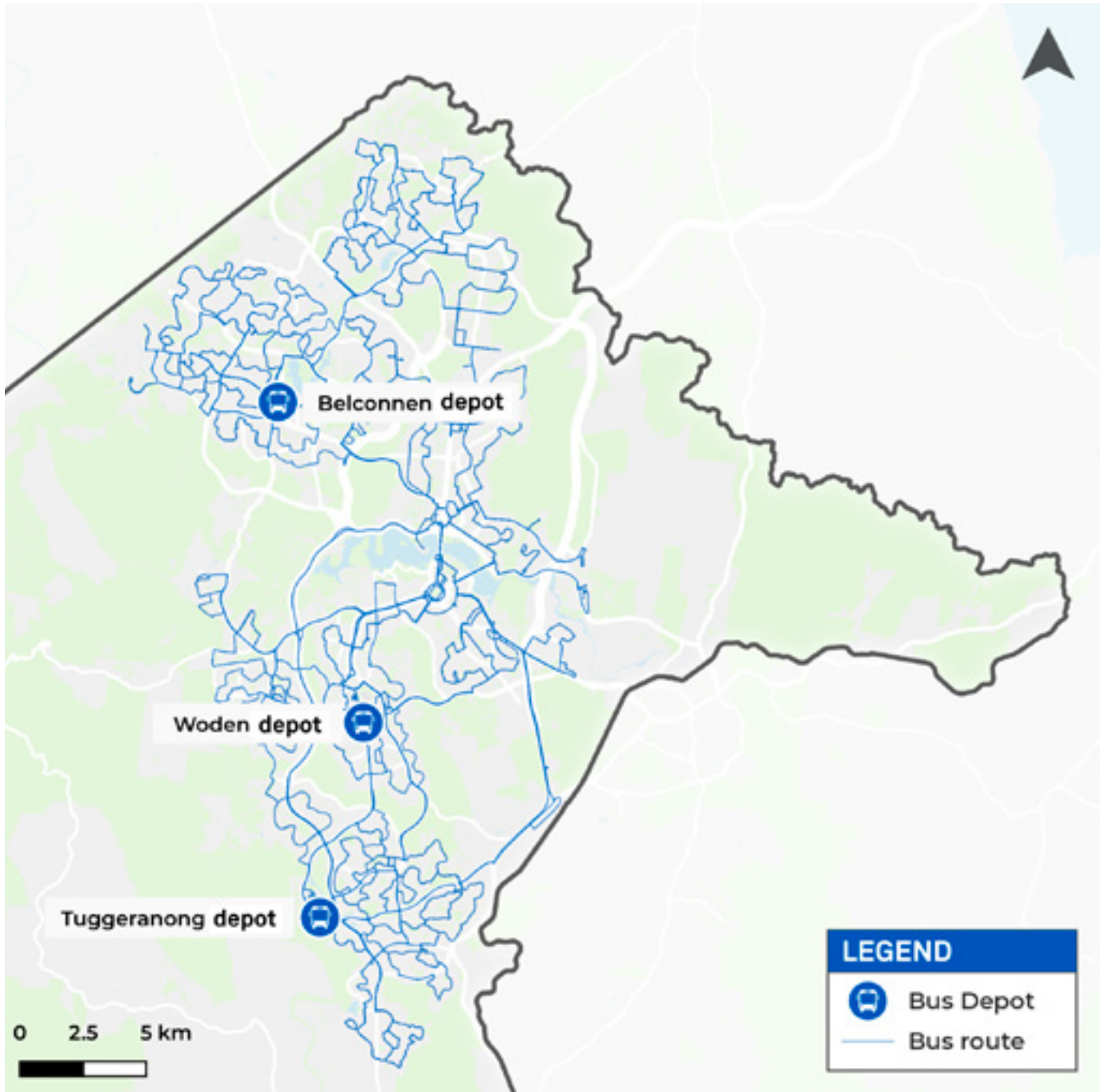
In January 2023, 6 charger units were installed at Tuggeranong depot, providing the ability to charge 12 buses simultaneously. Transport Canberra are also completing further electrical infrastructure upgrades at Tuggeranong to support larger numbers of battery electric buses – this work, to be done in stages, will provide charging facilities for up to 200 battery electric buses. Transport Canberra are leveraging lessons learnt with the construction, charger, cable design and procurement of Woden depot to inform next steps for Tuggeranong depot infrastructure upgrades.

Woden depot construction continues to progress well, inclusive of future proofing to accommodate a battery electric fleet of up to 100 buses. Construction works are expected to be complete, and the depot commissioned, in early 2025. The opening of Woden depot will provide the ability to accommodate up to 100 battery electric buses and would provide a significant increase in the number of battery electric buses Transport Canberra could operate in the shorter term. In the first instance Woden depot will house both diesel and battery electric buses.



Woden Bus Depot under construction

Figure 2.2 Transport Canberra depot locations



2.3 Workforce

Transport Canberra employs over 1,000 staff, the majority (800) being part of the bus workforce. These staff members are often the public face of our organisation and are supported behind the scenes by our transport officers, workshop staff, fuelers, starters, depot managers and administration staff. Working to also support the broader workforce is the Network Team, a dedicated Procurement Team as well as a Business Improvement Team who work to support the delivery of bus services and the transition of our fleet to zero-emissions.

The transition to a zero-emission fleet requires our workforce to learn a new set of skills to work with the new technology. Specific training is being rolled out for the various roles our workforce is playing in enabling and working with zero-emission buses. Guided by a workforce and skills working group, Transport Canberra has developed internal training modules, and collaborated with the Canberra Institute of Technology (CIT) to deliver the necessary skills and accreditations to safely work with zero-emission buses. This training has been well received by Transport Canberra staff members, with over 500 employees having received formal training in at least one of the available zero-emission bus training courses.

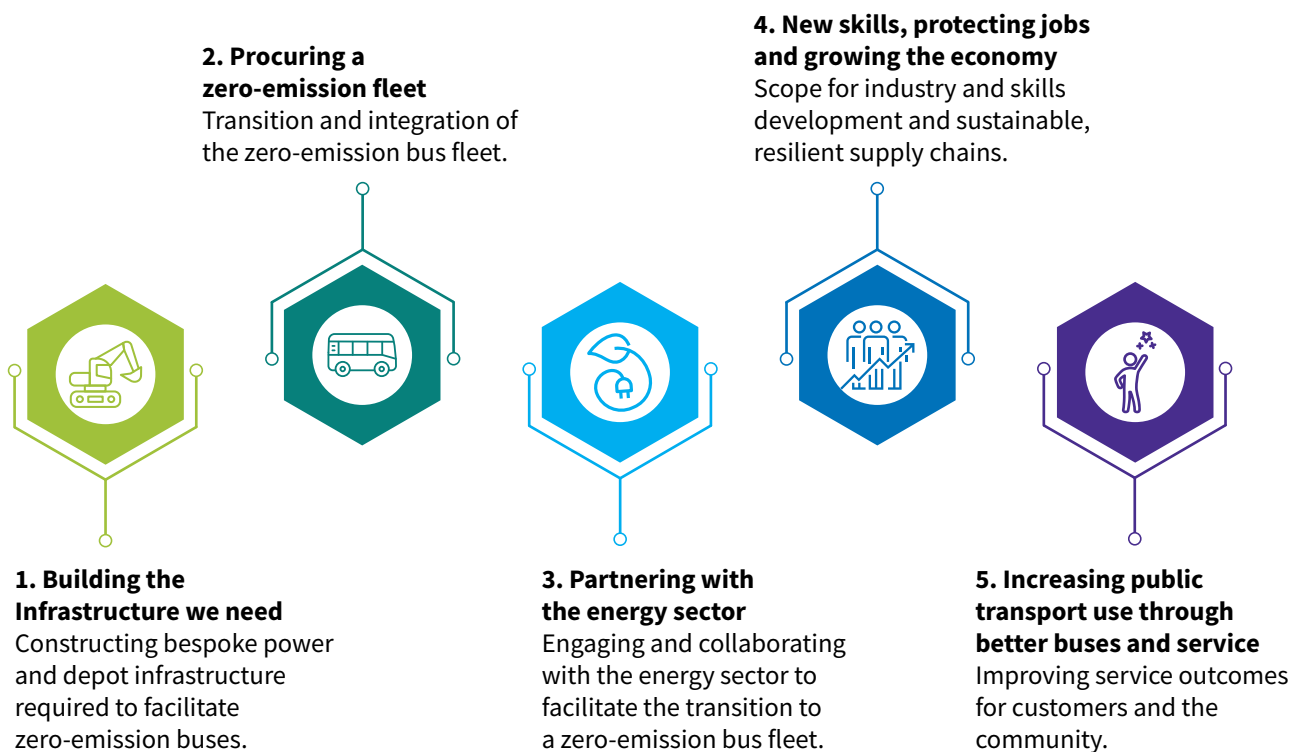
Figure 2.3 Our workforce



OUR PROGRESS TO DATE

We are advancing the transition of Transport Canberra’s fleet to zero-emissions. The ACT Government continued to deliver actions outlined in the 2020 Zero-Emission Transition Plan for Transport Canberra. This included progressing the 16 actions against our five Strategic Priorities such as the design development and construction of Woden depot, procuring the first tranche of zero-emission buses, progressing power requirements for Woden and Tuggeranong depots and establishing and implementing training packages for our staff (Figure 3.1).

Figure 3.1 Our progress against the five strategic priorities



This 2024 Zero-Emission Transition Plan Refresh for Transport Canberra presents the work to date as well as outlining considerations which have come to light since the release of the 2020 Plan. Such considerations include the potential for hydrogen and other alternative zero-emission fuels, sustainability initiatives including reuse, repurposing and recycling of bus batteries, and a need for greater focus on planning for the essential power infrastructure to enable the transition.

Transport Canberra’s progress to a zero-emission fleet reflects global themes and trends. This includes drivers of change, transition targets and technology choice. Worldwide, battery electric buses are the preferred vehicle technology to power the transition. For example, in Europe, there are 5,000 battery electric buses in operation today compared to 150

hydrogen fuel cell buses.¹ While battery electric buses are the current technology of choice, hydrogen and other alternative fuel buses are being investigated and trialled. With few organisations committing to hydrogen fuelled buses, battery electric buses are likely to remain the preferred zero-emission technology in coming years.

Collaboration has been and will continue to be essential to the success of the transition. Our progress so far is a result of working closely across a number of sectors of the ACT Government, with industry and by sharing information with other states and territories. This includes collaboration with the Territory’s electricity provider Evoenergy, education, skills and training providers such as Canberra Institute of Technology, and the planning sector including the Environment, Planning and Sustainable Development

¹ Victorian Government: Department of Transport and Planning (2023) Zero-Emission Bus Transition Consultation Paper

CIT collaboration

Transport Canberra worked closely with the Canberra Institute of Technology to establish tailored training programs and accreditations for battery electric bus maintenance personnel.

These initial training programs have garnered significant participation from Transport Canberra employees. The summary of zero-emission bus training courses and participation rates is as follows:

- 80+ workshop staff have completed the Connect and Disconnect Safety training
- 25+ workshop staff have completed Diagnosis and Repair training
- 500+ staff have completed the Bus Familiarisation training

Transport Canberra Workshop Trades are enrolled in the Certificate III in Electric Vehicle Technology (Heavy Vehicle) Bridging course that commenced in 2024 and will continue throughout the transition as required.



Directorate. The transition to zero-emissions is a complex and multifaceted challenge which will continue to require agility and close collaboration between various government and non-government organisations.

Lessons along the way

Transport Canberra's transition to zero-emission buses has made significant strides since its beginning, setting the Territory up for success in achieving a 100% zero-emission bus fleet by 2040. Zero-emission fleet transition is a dynamic field, with Transport Canberra, alongside transport agencies across the world having to respond to technological and market developments and the experiences of other cities to refine bus fleet transition planning.

As identified in the 2020 Zero-Emission Transition Plan for Transport Canberra, our transition pathway must continue to be adaptable, and our organisation agile to adapt to changes.

Hydrogen and alternative fuels

Hydrogen and other alternative fuels will continue to be considered to support the transition to zero-emission buses in the ACT. Hydrogen fuel cell buses may play a strategic role in the long-term transition to zero-emission. Hydrogen fuel cell buses have a number of potential advantages, including refuelling times that are comparable with diesel buses, while battery electric buses

can require hours to charge, and a lesser impact on bus depot capacity from the refuelling infrastructure compared with battery electric buses.

There is considerable interest in the potential for hydrogen fuel cell buses to have a role in the zero-emission bus fleet, in Australia and overseas. However, to date, uptake of hydrogen fuel cell buses has been limited, largely due to hydrogen supply chain issues (particularly for green hydrogen), and other challenges surrounding supporting infrastructure.

Australian transport agencies continue to trial hydrogen fuel cell buses, with current limited trials with small numbers of buses in NSW, Victoria, South Australia and Tasmania, as well as strong interest in Western Australia, but we note that the availability of green hydrogen at sufficient scale is uncertain in Australia before 2030.

The Australian Government is currently revising the 2019 National Hydrogen Strategy², after the release of the State of Hydrogen report in 2022. This report documents a modest growth in global demand for hydrogen, though the majority is sourced from fossil fuels, and slow progress in heavy vehicles, but still suggests substantial economic benefits for Australia through continuing with a program to produce green hydrogen for domestic use and export. The report also highlights how Australia's progress has been slow and that substantial acceleration in delivering the National Hydrogen Strategy³ will be required to achieve the previous targets for availability at scale by 2030.

Hydrogen fuel cell buses may play a part in the long-term transition to zero-emission in the ACT after 2030, when the hydrogen industry has developed to a sufficient scale to be able to supply hydrogen at scale for fuel cell vehicle operations, however the following issues will need to be addressed and considered.

Production of green hydrogen via electrolysis is the only ‘clean’ hydrogen production method. Electrolysis is the process of using electricity to split water into hydrogen and oxygen. The other 2 techniques use fossil fuel and are how most hydrogen is now produced.

Green hydrogen cost at the pump is currently high. The cost of production of green hydrogen ranges from AU\$4.10 to AU\$7 per kg. The adoption of hydrogen as a viable option is underpinned by a significant production cost reduction over time. Several studies show that H² needs to be under \$2/kg to be cost effective.

In addition, a production facility will need about 9 litres of freshwater to generate 1 kg of hydrogen which might

influence the location of hydrogen production plants, to be near water (ocean through desalination, or storage dams). In the ACT, 4 dams across 2 water catchments service Canberra and Queanbeyan. The ACT region uses about 50 gigalitres (GL) of water per year and this consumption would significantly increase when the hydrogen industry develops.

According to bus manufacturers, hydrogen fuel cell buses have a typical tank of 30–40 kg of hydrogen, which enables a range of about 400 km per tank. Consumption rates vary between 8 and 10 kg/100 km.

At present, hydrogen fuel cell bus refuelling stations are generally limited to volumes which would be adequate for a small fleet, up to 15 buses (in the order of hundreds of kilograms per day). To support larger hydrogen fuel cell bus operations, fuelling facilities would need their daily output to increase ten-fold, with capability still remains largely theoretical in Australia at this time. European organisations are investigating the feasibility of large-scale hydrogen fuelling, but there are still gaps in understanding of operations at this scale.

Table 3.1 Fleet size and hydrogen production facility size

Fleet size	# skid	H ² production required	H ² production capacity (kg/24 h)	Daily water consumption	Electrical power requirement
10 battery electric buses	1	Up to 350 kg/day	1,100 kg/day	Up to 3,050 l/day	2,500 kW
50 battery electric buses	2	Up to 1,750 kg/day	2,100 kg/day	Up to 15,250 l/day	5,000 kW
100 battery electric buses	4	Up to 3,500 kg/day	4,250 kg/day	Up to 30,500 l/day	1,0000 kW
200 battery electric buses	7	Up to 7,000 kg/day	7,400 kg/day	Up to 61,000 l/day	17,500 kW

A bus depot operating hydrogen fuel cell buses can produce hydrogen directly on-site or it can be produced off-site and delivered to the depot. There are many factors to determine if on-site or off-site production is the best option. This includes timing of development and consideration to wider hydrogen manufacturing networks and how this impacts the decision to invest in an on-site production facility.

Comparison of the spatial requirements for on-site and off-site hydrogen production is presented in Table 3.2. This

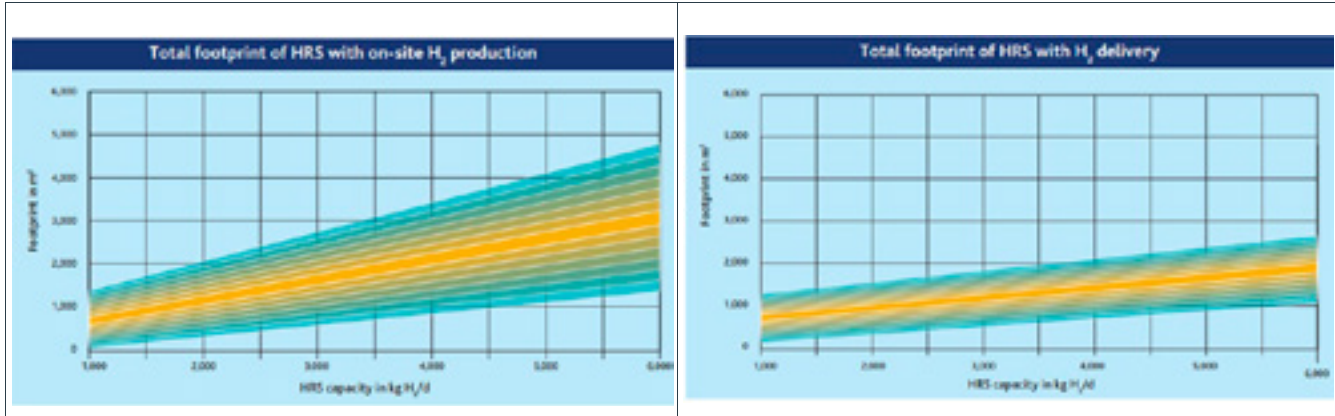
table is informed by a study by New Bus Fuel (and Fuel Cells and Hydrogen joint undertaking consortium) which carried out engineering studies for 13 different large scale hydrogen fuelling stations designs at 12 different sites. The table is informed by the footprint estimations in Figure 3.2. This shows that for a fleet size of 100 hydrogen fuel cell buses or larger, the additional space required to produce hydrogen on-site compared to off-site is minimal.

Table 3.2 Fleet size and hydrogen production facility size

Fleet size	Off-site	On-site	Difference to produce on-site
10 buses – 250 kg h ₂ /d*	680 sqm	650 sqm	5% decrease
50 buses – 1,250 kg h ₂ /d	750 sqm	800 sqm	6% increase
100 buses – 2,500 kg h ₂ /d	~1,000 sqm	~1,400 sqm	40% increase

Fleet size	Off-site	On-site	Difference to produce on-site
200 buses – 5,000 kg h ₂ /d	~1,700 sqm	~2,600 sqm	53% increase

Figure 3.2 Approximate footprint of on-site production and off-site hydrogen production (delivery)



Transport, through hydrogen powered vehicles, is one of the identified uses. However, it is not the driver for the development of the hydrogen industry. It will benefit from large scale infrastructure developed for export or ammonia production.

Having hydrogen production close by a depot will reduce its transport costs, which could significantly impact the overall cost. However, as Transport Canberra has not committed to hydrogen fuel cell buses in the future, a whole-of-government commitment or direction will be required to confirm the need for a hydrogen production plant.

Hydrogen fuel cell buses are not currently planned for procurement in the ACT at this stage of the transition.

Greater certainty about HFCBs adoption in ACT is needed before committing to hydrogen production, storage and distribution near the future bus depot.

Distribution via the existing natural gas network may be possible once it is no longer used to transport natural gas, however this will be challenging and work on such a proposal is only in its infancy.

Hydrogen may be suitable for other fleets, such as waste trucks, if Transport Canberra doesn't have plans for a HFCB fleet, hydrogen provision for secondary or tertiary uses is considered less critical.

Victoria hydrogen bus trial

In November 2023, the Victorian Government announced the deployment of 2 Australian designed and manufactured hydrogen buses. These hydrogen buses were part of a comprehensive rollout of 52 zero-emission buses throughout Victoria and are the first hydrogen buses to join Victoria's public transport fleet.

The findings from this trial will be used to provide information on how these buses perform. It is estimated that these 2 buses alone will save around 90 tonnes of emissions annually.

It is noted that grey hydrogen will initially serve as the fuel source for this trial. Grey hydrogen is derived from natural gas or methane and the production process results in CO₂ emissions. To realise the zero-emissions potential of hydrogen fuel cell buses, transitioning to green hydrogen (produced from renewable energy sources) is important.



Central Coast hydrogen bus trial



A trial initiated in late 2022 has offered valuable insights into the operational and refuelling challenges of incorporating HFCBs into the Central Coast bus fleet. Financed by the NSW Government, this trial involved a collaboration between HFCB manufacturer ARCC, H2H Energy, and Red Fleet bus operator.

The key challenges that emerged throughout this trial included the high upfront civil costs and logistical considerations in establishing hydrogen refuelling infrastructure at the depot. Additionally, the hydrogen refuelling process encountered some complexities, with refuelling time taking as long as 5 hours. Consequently, the original contractors engaged to build the hydrogen charging facility withdrew from the program, leading to the current utilisation of a portable hydrogen refuelling solution.

This case study provides valuable insights into the intricacies and considerations integral to the deployment of hydrogen fuel cell buses. This case study provides valuable insights into the intricacies and considerations integral to the deployment of hydrogen fuel cell buses.

New challenges with new technology

Whilst the transition to zero-emission technology is beneficial to meeting net-zero targets and ensuring the ongoing success of Transport Canberra bus operations, new challenges will need to be overcome. For zero-emission bus operations these challenges can be related to fire and life safety, electricity grid capacity constraints, battery technology developments and charging operational challenges. Effectively managing and minimising these challenges will be crucial to the successful implementation of zero-emissions technology. Transport Canberra is committed to investigating global best practices and lessons learnt, to ensure our bus operations are adapted accordingly.

Sustainability

The Territory is fuelled by 100% renewable energy, demonstrating our commitment to a sustainable zero-emissions future. As per our 3 transition principles, sustainable, collaborative, and innovative we recognise it is important that sustainability is a major focus of the transition to zero-emission buses.

Of particular focus is the sustainability procedures around batteries including the reuse, repurpose and recycling of bus batteries once they reach the end of their useful life (at present, this is expected to be after about 8 years of operation – less than half the life of the bus).

Battery reuse, repurpose and recycling is an emerging area which will continue to develop over coming years. We will continue to investigate advancements in this area and leverage national and global learnings to ensure ACT's transition to zero-emission buses is sustainable.

Battery recycling in the US

Battery recycling offers significant environmental and economic benefits by facilitating the reuse of valuable and high-cost natural resources commonly found in batteries. The California EV Battery Recycling Program, established in 2017 by Redwood Materials, has developed pathways for the disassembly, breaking down and recycling of end-of-life battery packs. This initiative has proven highly successful, achieving a 95% extraction rate of metals from used battery packs.

In Australia there is a need for an increase in battery recycling efforts. In 2021 only 10% of Australia's lithium-ion batteries were recycled and it is anticipated that battery waste will continue to grow by 20% per year. Several Australian companies have taken strides to address this challenge, including Envirostream, Ecobatt, and Ecoactiv, providing recycling services for electric vehicle batteries and home solar energy packs.



New Zealand battery storage

A collaborative effort between Z Energy and Zenobē has seen the repurposing of retired electric bus batteries, enabling a 'second life' of operations. These batteries are being repurposed as a power storage unit to facilitate the charging of EVs. Located at Tom Pearce Drive near Auckland Airport, this technology enables the charging of two EVs simultaneously. Deploying this battery storage technology removes the need for upgrades to the grid as demand can be more easily managed.

This technology offers a practical solution for providing EV charging capabilities in areas where the installation of direct current charging and network enhancements would be economical and logistically impractical. It extends the operational lifespan of the batteries by up to an additional 10 years during their second usage phase. Once these batteries are no longer functional as a storage unit, the battery modules will be recycled, and the raw materials will be returned to the local supply chain where feasible.



PREFERRED TRANSITION PATHWAY



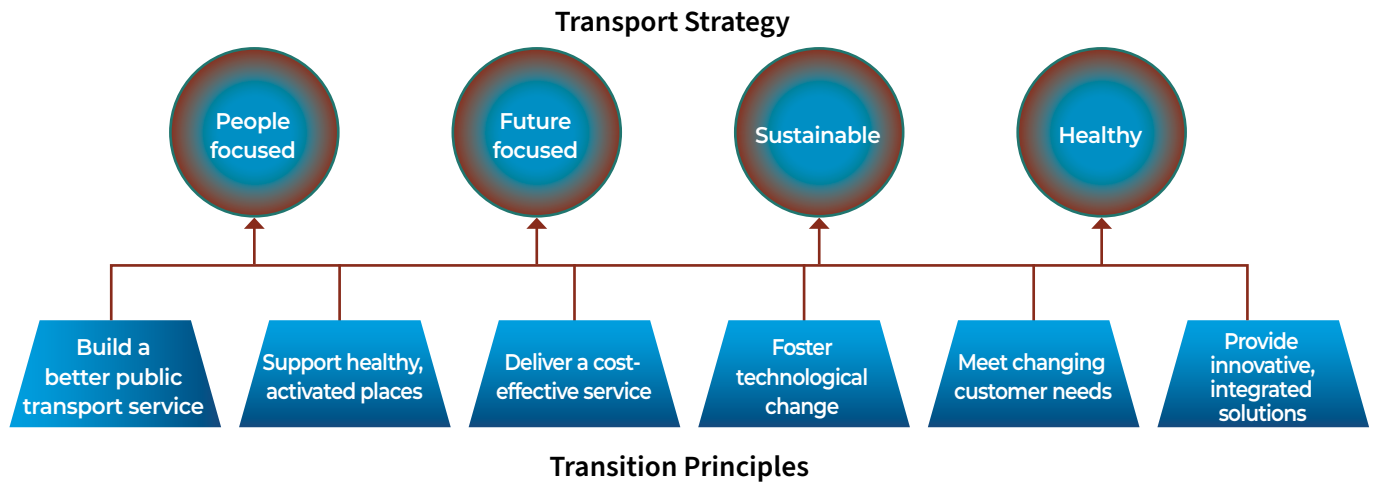
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040				
Transition planning																									
Strategic and technical planning	Strategic and technical planning, depot and electrification study, transition planning																								
TC-Evoenergy working group for energy provision planning	TC/Evoenergy and working group																								
TC-CIT collaboration for ZE workforce training	TC/CIT Collaboration and working group																								
Network optimisation with new depot commissioning					Network planning							Network planning							Network planning						
Depot provision																									
Belconnen depot (existing)																									
Tuggeranong depot (existing)				Staged conversion																					
Woden depot (in construction)	Design and early works		Construction																						
North Canberra depot (future 4th depot)				Feasibility and planning		Design and early works			Construction																
West Belconnen depot (future 5th depot)								Feasibility and planning			Design and early works		Construction												
Energy provision																									
Electricity grid upgrades to support charging				Tuggeranong / Woden							North Canberra							West Belconnen							
Fleet procurement																									
				23% battery electric buses				Transition to 46% battery electric buses				Transition to 100% zero-emission by 2040													
Workforce planning																									
Training/charging by manufacturer				Training by manufacturer																					
Training for in-house staff	Training in collaboration with CIT																								

This diagram represents our current preferred zero-emissions transition pathway. We will continue to refine and update the pathway during the transition based on funding, experience from earlier stages, updated operational plans/requirements, coordination with energy providers, and technology improvements.

Transition objectives

In 2020, the Zero-Emission Transition Plan outlined the 6 objectives that will deliver on the Territory's transport objectives. These objectives continue to guide future investment and decision-making for our transition to zero-emissions to ensure the decisions we make at the local level contribute to city and global outcomes. These transition objectives underpin the 5 strategic priorities which guide the pathway to a zero-emission fleet.

Figure 4.1 Transition objectives alignment with Transport Strategy



Source: Zero-Emission Transition Plan for Transport Canberra, 2020



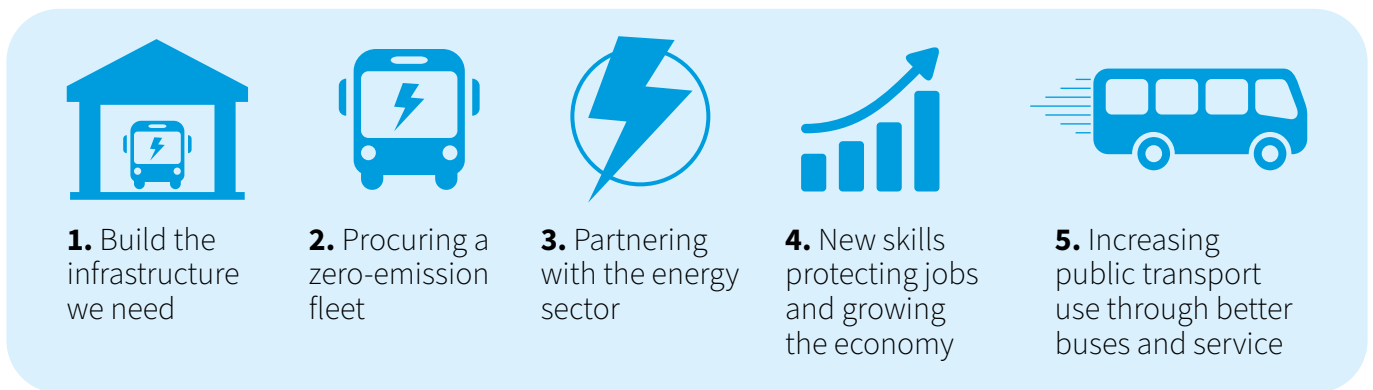
How are we progressing in our zero-emission transition?

The transition pathway defines the major steps in Transport Canberra’s journey towards a zero-emission fleet, guided by 5 strategic priorities. The pathway considers local and international learnings from transitioning bus fleets as well as continuing to provide the opportunity for the Territory to lead and influence the transition. We will continue to learn and collaborate with national and international transport agencies to ensure our pathway considers the latest learnings in the transition to zero-emissions. Our approach will continue to remain agile, enabling Transport Canberra to respond to changes where required.

The existing pathway has been revised considering progress to date, things we have learnt and expected timeframes as better information on lead times for critical works becomes available. The pathway balances the key risks and opportunities to deliver a measured approach considering technology, skills, infrastructure capacity, innovation, value for money and community outcomes. It capitalises the Territory’s unique social, policy and economic characteristics within the transition process to maximise the benefits a zero-emission fleet will deliver.

Consistent with the 2020 Zero-Emission Transition Plan, the refreshed transition pathway continues to be centred around five strategic priorities, which are underpinned by actions to direct our zero-emission journey (Figure 4.2).

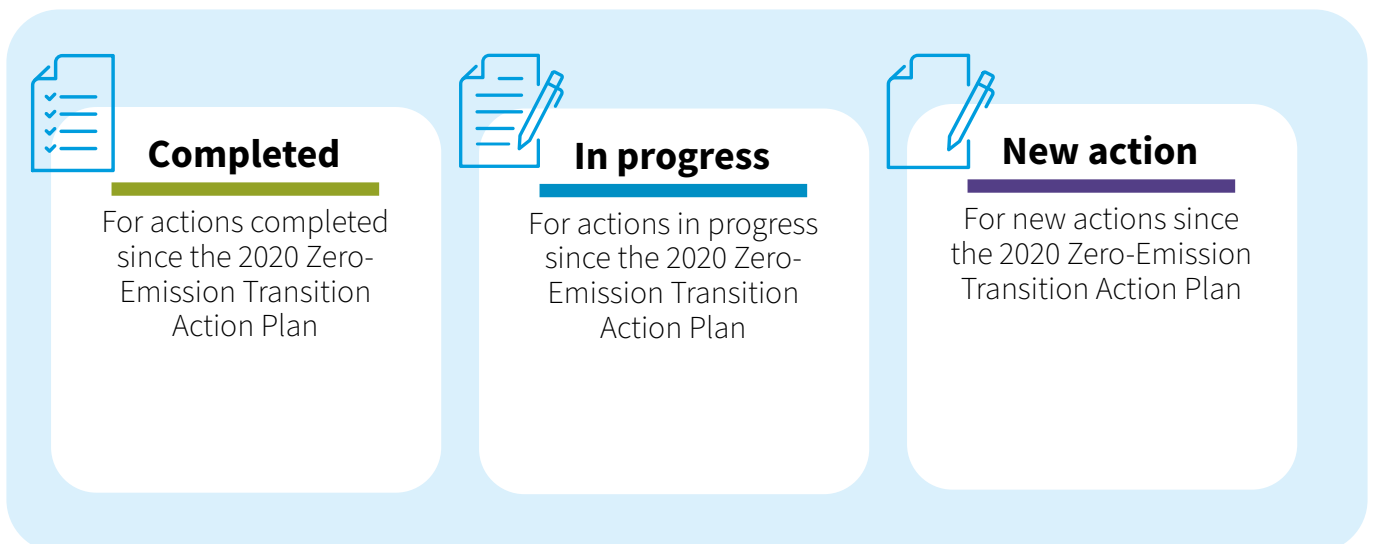
Figure 4.2 5 strategic priorities



Tracking our progress

Tracking our progress against the 2020 Zero-Emission Transition Plan is an important step in acknowledging our achievements and understanding the remaining tasks at hand. Our revised transition pathway identifies the status of each action identified in the 2020 Plan, as well as identifying new actions required by 3 categories: **completed**, **in progress** and **new action**. Each action is presented with a status, progress over the past 3 years, and further action required looking towards the next 5 years (Figure 4.3)

Figure 4.3 Status of actions.



Strategic priority 1 – Building the infrastructure we need



It is crucial that a zero-emission fleet is supported by the necessary power and depot infrastructure. Existing depots and the electricity grids providing energy today are currently constrained. Therefore, the transition is required to identify a pathway to supporting a zero-emission fleet considering new infrastructure including new depot requirements and electrical grid upgrades to support the number of buses required.

Canberra's 2 existing bus depots, Tuggeranong and Belconnen, will play a key role in supporting the transition. Power infrastructure and chargers have been installed at Tuggeranong for the depot to support 12 battery electric buses simultaneously. Additionally, feeder augmentation works are underway to ensure Tuggeranong and Woden depots have the energy capacity to charge larger numbers of battery electric buses. The works commenced in January 2023 and are expected to be completed by end of 2024.

Construction works at Woden depot continue to progress well to support commissioning in early 2025. This work has focused on the redesign of Woden as a zero-emission bus depot supporting up to 100 battery electric buses from day one of operations. This will provide a significant increase in the number of battery electric buses Transport Canberra can operate in the short term.

Transport Canberra have also been working to identify and progress planning of our future depot requirements. This included the investigations which identified a potential 200-bus depot site in North Canberra. Next steps have been identified to progress development of the future depot and planning work is underway.

Action 1.1		Deliver a temporary infrastructure solution for the first tranche of zero-emission vehicles.
Status	Completed	
Action update since 2020	<ul style="list-style-type: none"> — Early investigations into temporary off-site infrastructure solutions were deemed not suitable. The originally identified procurement process for a temporary charging solution was tested by a market approach but not pursued further due to inadequacy of responses. It was determined that it would be more efficient to support the first tranche of zero-emission buses by opening Woden Bus Depot as a fully zero-emission facility and upgrading Tuggeranong depot to support battery electric buses earlier than first planned. This solution optimises existing planned infrastructure, delivering cost and operational efficiencies. 	
The next five years	<ul style="list-style-type: none"> — Completed. No further action needed. 	
Action 1.2		Undertake a depot feasibility study to identify the timing and scope of future needs.
Status	Completed	
Action update since 2020	<ul style="list-style-type: none"> — A comprehensive study was completed in 2022 and identified North Canberra as preferred area for construction of a new 200-bus depot with environmental investigations now underway. West Belconnen has been identified as being required in mid 2030s when a suitable site will become available. — The new North Canberra depot will be a few years later than originally identified due to the decision to upgrade Woden and Tuggeranong depots in the first instance. 	
The next five years	<ul style="list-style-type: none"> — Transport Canberra will focus on securing the site and design development for the new North Canberra depot, with a planned commission date by 2030. — Transport Canberra will use lessons learnt from the construction of Woden depot to inform the design and requirements for the new North Canberra depot. 	

Action 1.3 Upgrade Woden depot to support zero-emission buses.	
Status	In progress
Action update since 2020	<ul style="list-style-type: none"> — Completed design work for necessary infrastructure and future proofing to accommodate battery electric buses. — Construction of the depot has commenced and is due for completion in late 2024.
The next 5 years	<ul style="list-style-type: none"> — Transport Canberra will work closely with the design and construction contractor to supply required bus charging infrastructure and commission Woden depot as early as possible, with a target of early 2025.

Action 1.4 Build a new zero-emissions depot by 2030.	
Status	In progress
Action update since 2020	<ul style="list-style-type: none"> — The 2020 Zero-Emission Transition Plan identified the need to build a new zero-emission bus depot by 2026. A study was conducted to identify the timing and scope of future depot needs to support the transition, including the electricity grid upgrades required to support a new 200-bus depot in North Canberra. — The new zero-emissions bus depot is envisaged to be commissioned by 2030, with a capacity of 200 zero-emission buses from day one, later than originally planned due to Woden depot and Tuggeranong depots undergoing electrification earlier than first planned.
The next 5 years	<ul style="list-style-type: none"> — Transport Canberra will undertake planning and design development for the new North Canberra depot, including working closely with Evoenergy on delivering high voltage connections to the site.

Action 1.5 Convert remaining existing depots to zero-emissions by 2040.	
Status	In progress
Action update since 2020	<ul style="list-style-type: none"> — Completed investigations which included concept plans for converting the existing Tuggeranong and Belconnen depots to zero-emission. — Completed an Electrification Feasibility Study (2023) identifying the works needed to supply sufficient electrical power to Tuggeranong and Belconnen depots. — Installed electrical infrastructure to support the charging of 12 battery electric buses simultaneously at Tuggeranong depot and 4 battery electric buses simultaneously at Belconnen depot.
The next 5 years	<ul style="list-style-type: none"> — Continue redevelopment of existing depots, consistent with the transition plan, with a focus on delivering high voltage power supply in collaboration with Evoenergy. — Continue upgrades at Tuggeranong depot to facilitate up to 100 battery electric buses in the short term and up to 200 battery electric buses by late 2028. — The upgrade of Belconnen depot is not considered feasible at this stage; however, Transport Canberra will continue its investigations and planning for the future of Belconnen depot.

Action 1.6 Explore potential for Transport Canberra transition to support the charging needs of other fleets.	
Status	New action
Action update since 2020	— N/A
The next 5 years	<ul style="list-style-type: none"> — Maximise infrastructure investment by exploring the potential for depots to support charging of other Transport Canberra electric vehicle fleets, other government department electric vehicle fleets.

Strategic priority 2 – Procuring a zero-emissions fleet



The procurement and delivery of battery electric buses (and the retirement of diesel buses) must be coordinated with the delivery of bus depot space and charging equipment to ensure the new zero-emission buses can be housed and charged, so there are no interruptions to bus services.

Since the 2020 Zero-Emission Transition Plan was released, significant progress has been made to procure a zero-emission fleet. To date, 23 battery electric buses are in operation on our network, and these have travelled over 800,000 kilometres since entering service. This fleet is supported by the charging infrastructure in place at Tuggeranong and Belconnen depots. Transport Canberra expects the remainder of the procured 90 Yutong E12 battery electric buses to be delivered by end of 2026.

Transport Canberra continues to monitor national and international developments in zero-emission bus technology and liaises with other Australian transport authorities undertaking zero-emission bus fleet transitions to ensure we benefit from best practice and learn from experiences in other cities.

Globally, transition of bus fleets to zero-emissions is still in its early stages, with zero-emission buses estimated to make up less than 10% of the city bus fleet, with the majority of these being battery electric buses. While some Australian cities are including diesel-electric hybrid buses in their fleets, and trialling hydrogen fuel cell vehicles, our transition plan is focused on battery electric buses for at least the next 5 years, and we can be confident, based on trends in Australia and overseas, that this is the best approach for the Territory.

As part of our transition planning activities, we will continue to conduct investigations into hydrogen and alternative fuels to see if they will have a role in our zero-emission bus fleet in the future.

Figure 4.4 Transport Canberra’s zero-emission buses



Action 2.1

Procure a first tranche of battery electric buses which are supported by a temporary infrastructure solution.

Status

Completed

Action update since 2020

- Throughout 2022 preparatory and procurement activities were undertaken to secure 106 battery electric buses, including completion of a 2-stage procurement process resulting in a contract to deliver in tranches between 2023 and 2026.
- The original identified procurement process for a temporary charging solution was tested by a market approach but not pursued further due to inadequacy of responses. Instead Transport Canberra fast tracked upgrades to existing and under-construction depots.
- Procurement and installation of chargers for battery electric buses is now being undertaken by the contractor delivering Woden depot. Once completed there will be capacity to charge 100 buses.

The next five years

- Delivery and operation of 90 battery electric buses between 2023 and 2026. Funding has been secured for the delivery of electrical upgrades at Woden and Tuggeranong depots, to support the integration of these buses into the operating fleet. As delivered, these buses will replace the existing compressed natural gas fleet and remaining ageing buses.
- Delivery of 26 Euro-6 emission standard compliant diesel buses in 2024 (delayed due to global supply chain issues).
- With the funding secured for delivering initial electrical upgrades at the existing depots, the main limitation to procuring additional battery electric buses over the next 5 years will be the timing of electrical upgrades required. There is potential for additional battery electric buses to be accommodated at Tuggeranong and Belconnen depots through logistical charging and strategic fleet management.
- Transport Canberra will identify a transition approach for the special needs fleet operated by Transport Canberra out of Fyshwick Depot.



Action 2.2**Continue to monitor changing commercial models, technology developments and power advances.****Status****In progress****Action update since 2020**

- Suitability and commercial viability of different delivery solutions have been and will continue to be assessed to inform future procurement strategies. This considers the future partnership and procurement modes which could enable accelerated progress on transitioning to a zero-emission fleet.
- Transport Canberra continues to monitor developments in zero-emission bus technology in Australia and overseas, including completion of investigations into the potential for hydrogen fuelling and production to be incorporated into a planned fourth bus depot.
- Transport Canberra is continuing to take advantage of opportunities to share insights across jurisdictions, including insights and information on infrastructure development and upskilling the workforce. Transport Canberra are engaged in cross-jurisdictional discussions on infrastructure developments, lessons learnt and zero-emission vehicle technology through industry forums. Transport Canberra has also participated in a cross jurisdictional data sharing consultancy that has seen data on our battery electric bus introduction being shared with participants around the country and New Zealand.
- Ongoing collaboration with Evoenergy to identify the best approach to deliver the energy requirements of a zero-emission fleet. Upgrades to the power supply at Woden and Tuggeranong depots are currently underway and will allow for a charging capacity of 300 battery electric buses when completed.

The next five years

- Transport Canberra will continue to assess suitability and commercial viability of different delivery solutions, monitor technology developments, and collaborate with transport agencies across Australia and New Zealand and energy provider Evoenergy.
- Continue to stay up to date on the latest trials of hydrogen buses and alternative fuels and consider applicability to support the transition of the Transport Canberra fleet.

Action 2.3**Develop standard operating procedures for depot and fleet management to respond to the needs of battery electric buses.****Status****New action****Action update since 2020**

- N/A

The next five years

- Develop standard operating procedures for depot and fleet management, to mitigate safety and operational risks at depots operating battery electric buses.
- Transport Canberra will seek specialist advice on fire and life safety considerations informed by best practices from Australia and overseas as part of the planning for future depots.

Strategic priority 3 – Partnering with the energy sector



Working with the energy sector is crucial to the success of the transition. The procurement of battery electric buses has made Transport Canberra a major energy customer. This relationship delivers an array of opportunities for the ACT Government including new ways to manage demand of the electricity grid, reduced costs, potential new sources of revenue, and shared solutions to meet our growing energy needs.

Transport Canberra have been part of a whole of government approach to understand current capacity and future requirements from a collection of projects across the ACT. Transport Canberra has provided future consumption needs of battery electric bus technology to Evoenergy to help determine energy requirements.

Transport Canberra have established a close relationship with Evoenergy to plan and deliver electrical infrastructure required to enable the operation of a battery electric bus fleet.

In addition to working locally, Transport Canberra have partnered with transport agencies across Australia and New Zealand to share experiences and lessons learnt on their journeys towards a zero-emission bus fleet. These partnerships will continue to play a crucial role in progressing our identified transition pathway.

Action 3.1 Engage early with different service providers and the energy market.	
Status	In progress
Action update since 2020	<ul style="list-style-type: none"> — A whole-of-government approach to establish partnerships with energy market has been finalised. It was determined that Transport Canberra will continue to engage with this process where beneficial but also would work independently with Evoenergy where necessary to ensure timeframes are met. — Transport Canberra have been involved in a whole-of-government approach to understand current capacity and future requirements from a collective of projects, in particular the Woden Valley precinct and more widely across the Territory. This includes regular engagement with other government directorates to discuss renewable energy policy and the zero-emissions transition, as well as the delivery of other climate related projects to ensure consistency and collaboration across the board.
The next five years	<ul style="list-style-type: none"> — Transport Canberra will continue to explore opportunities with various service providers to partner with for investment which could provide benefits for both parties. This could include behind the meter electricity generation, providing access to batteries for off peak storage or locating new bus depots close to major electrical infrastructure. — Continue to investigate battery energy storage system solutions and work closely with Environment, Planning and Sustainable Development Directorate to identify opportunities for battery energy storage systems and develop required planning. — Work with energy sector to investigate potential for micro-grids to maximise reliable green power delivery. — Transport Canberra has been working closely with Evoenergy to ensure the plans for a new zero-emission bus depot in Canberra’s north are well understood and that the timing for upgrades to the distribution network during the next investment period and beyond align with the plans to invest in new zero-emission bus depots.



Action 3.2 Participate and partner with the energy sector.	
Status	In progress
Action update since 2020	<ul style="list-style-type: none"> — Transport Canberra worked closely with the energy sector including Evoenergy to deliver the electrical infrastructure required to support a zero-emission fleet. This includes developing an understanding of their delivery structure and requirements. — Transport Canberra has worked closely with Evoenergy to develop detailed designs for the civil works and infrastructure acquisitions (11kV feeder augmentations) to deliver the required distribution network upgrades to Woden and Tuggeranong depots by end of 2024. — Investigations have determined that upgrading Belconnen depot is not infeasible at this stage, given the required upgrades to additional nearby infrastructure. Belconnen depot will continue to charge four battery electric buses overnight with limited impact on operations. Transport Canberra will continue to monitor the situation and further investigate the options for upgrading the depot or decommissioning and replacing it with a depot in an alternative location.
The next 5 years	<ul style="list-style-type: none"> — Continue to work with Evoenergy to deliver electrical infrastructure required at Transport Canberra bus depots as identified in the transition plan. — Transport Canberra will continue to monitor advancements in green energy including green hydrogen and other alternative fuels and consider implications to current transition approach.

Action 3.3 Monitor discussions on future power technologies and advances.	
Status	In progress
Action update since 2020	<ul style="list-style-type: none"> — Transport Canberra staff participate regularly in inter-jurisdictional discussions on developments in zero-emission vehicle technology. Market research and monitoring of developments are continually undertaken as part of the transition to a zero-emission bus fleet including site visits to interstate facilities. Transport Canberra also has memberships with peak industry bodies in the transport sector, which provide access to information on the latest technology enhancements and best practice in the industry.
The next 5 years	<ul style="list-style-type: none"> — Transport Canberra will continue to monitor discussions on future power technologies and advances throughout the duration of the transition, looking for opportunities to optimise the transition.

Action 3.4 Work with other jurisdictions to identify shared solutions to shared problems.	
Status	In progress
Action update since 2020	<ul style="list-style-type: none"> — Transport Canberra has continued to take advantage of opportunities to share insights across jurisdictions, including insights and information on infrastructure development and upskilling the workforce. — Transport Canberra is engaged in cross-jurisdictional discussions on infrastructure developments, lessons learnt and zero-emission vehicle technology through industry bodies. — Transport Canberra has participated in a cross jurisdictional data sharing consultancy that has seen data on our battery electric buses shared with participants around the country and New Zealand.
The next 5 years	<ul style="list-style-type: none"> — Transport Canberra will continue to work with other jurisdictions to streamline the battery electric bus procurement process and provide more certainty to the bus manufacturing industry.

Strategic priority 4 – New skills, protecting jobs, and growing the economy



The successful transition to zero-emission buses requires industry and skills developments, as well as work to foster a sustainable and resilient supply chain. This will ensure the transition contributes to the ACT’s skills development, job availability, supporting our broader economy.

New skills are required to support the work with a zero-emissions fleet compared to a diesel and compressed natural gas fleet, which are currently in operation today. Transport Canberra have established a Workforce and Skills Working Group to understand new skill needs and implement appropriate skills and education programs. Work to date has seen:

- **Connect and Disconnect Safety** training completed by over 80 workshop staff.
- **Diagnosis and Repair** training completed by over 25 workshop staff.
- Over 500 staff (including trainers, drivers, refuelers, field officers and communication centre staff) have undertaken **Bus Familiarisation** training.

Transport Canberra have worked with the Canberra Institute of Technology to establish a course in automotive Electric Vehicle Technology (Heavy) for apprentices and trades staff. This qualification will help existing and new staff work with the zero-emissions technology with Transport Canberra Workshop Trades staff participating.

We will continue this focus over the course of the transition, with further roll-out of training and upskilling programs and development of new training programs as required to respond to new learnings.

Action 4.1 Engage with our workforce to deliver a just and fair transition.	
Status	In progress
Action update since 2020	<ul style="list-style-type: none"> – Developed a communication strategy for the Zero-Emission Transition Plan which includes workforce engagement to facilitate a seamless transition. – Transport Canberra has engaged with depot and workshop staff through Q&A sessions to ensure staff are informed on transition progress and upskilled staff through a variety of training programs.
The next five years	<ul style="list-style-type: none"> – We will continue to engage and upskill the workforce to support the transition and establish Transport Canberra’s zero-emission training and accreditations as business as usual. – Diesel buses will continue to be part of the fleet for the next 5 years and will be maintained and repaired by Transport Canberra engineering staff. – Any matters affecting the workforce such as skills, training, new technologies and new and transitioning depots will be discussed through regular general meetings of employees and executive members, as outlined in the Transport Canberra Operations (ACTION) Enterprise Agreement (2023-2026). – New incentives will be paid for Trades staff members that successfully complete the required competencies and learning outcomes to obtain a third Certified Trade Qualification, including successful completion of the Certificate III in Automotive Electric Vehicle Technology Trade Course or Statement of Attainment in Automotive Electric Vehicle Technology in conjunction with previously attained Certified Mechanical Trade Qualification as outlined in the as outlined in the Transport Canberra Operations (ACTION) Enterprise Agreement (2023-2026).

Action 4.2		Expand transition benefits to the ACT local market, involving businesses and organisations across the electric bus supply chain.
Status	In progress	
Action update since 2020	<ul style="list-style-type: none"> — Procurement process for all high-value procurements related to this plan will include an element to assess the contribution of the potential suppliers to the local economy. — While the opportunities for the local electric bus supply chain are limited, we have provided opportunities for the local economy to participate in the transition through upgrades of our infrastructure to charge electric buses. 	
The next five years	<ul style="list-style-type: none"> — Work across the ACT Government to identify opportunities for co-location of zero-emission vehicles to maximise investment in depot infrastructure. This could include other Transport Canberra and City Services fleet, other ACT government agency fleet such as emergency vehicles and potentially privately owned electric vehicles. Opportunities for this level of cooperation will become more likely as new depots are built and other areas of the ACT government begin their transitions. 	

Action 4.3		Train and upskill workers and expand these to regional and nationally recognised certifications.
Status	In progress	
Action update since 2020	<ul style="list-style-type: none"> — Training of the Transport Canberra workforce is underway, and a Workforce and Skills Working Group has been established to primarily focus on training and upskilling the Transport Canberra workforce. This Group includes representatives from Canberra Institute of Technology as the local training partner, depot and workshop staff and Transport Canberra officials. The Group developed an Action Plan to map out the different training and communication requirements of different workforce groups and is actively seeking cross jurisdictional information sharing with those who have ventured into zero-emission buses. — Several training courses have been made available to the Transport Canberra staff to support their ongoing training and upskilling. These courses include the Connect and Disconnect Safety training, the Certificate III Diagnose and Repair certification at the Canberra Institute of Technology and the electrical vehicle familiarisation training facilitated by an internal Transport Canberra training team. 	
The next 5 years	<ul style="list-style-type: none"> — We will continue to partner with CIT and other providers to offer relevant battery electric bus training and accreditation for Transport Canberra staff to facilitate the fleet transition, with a key objective to ensure national recognition for Transport Canberra accreditations. — The new centre of excellence to be established at CIT Fyshwick as part of the National Skills Agreement would expand CIT's nation leading Electric Vehicle Training Centre to train more EV automotive technicians and support the electrification of the economy. This centre will also support the feasibility of a broader Future Energy Skills Hub at CIT which will incorporate the centre of excellence, and support expansion of training in electrotechnology. 	

Action 4.4		Support the sustainable repurposing and recycling of bus batteries.
Status	New action	
Action update since 2020	— N/A	
The next five years	<ul style="list-style-type: none"> — Work with ACT Government agencies and other jurisdictions to monitor and investigate sustainable transition practices including developments in repurposing and recycling of bus batteries to implement a circular economy approach for our batteries. — Transport Canberra will investigate including sustainability elements in bus procurement processes. — Look for opportunities to support development of local initiatives in battery repurpose, reuse, and recycling. 	

Strategic priority 5 – Increasing public transport use through better buses and a better service



A key priority for transport under the 2019-2025 Climate Change Strategy is to support higher uptake of public transport by continuing to improve services to meet community travel needs. Zero-emission buses provide a range of benefits to our community including improved amenity of our streets, better quality bus services including a newer bus fleet and of course environmental benefits.

Better buses and better services provide a range of additional advantages including supporting a reduction in private vehicle use, access to crucial services, improved liveability of our communities and improved health. Improved services also help us to support a Territory which is equitable for all our residents and visitors.

Encouraging public transport use will enable the reduction of transport emissions. This is achieved by encouraging a shift to a lower emission transport mode. When considering all the options available to move around, walking, cycling or catching the bus have the lowest carbon emissions. Transport Canberra is committed to supporting the priority of these modes to improve the health and liveability of our community.

Action 5.1		Co-design technology advancements with the introduction of new fleet that enhance service and performance.	
Status	In progress		
Action update since 2020	— Transport Canberra have started investigations into co-design technology advancements, which could include co-location with other Transport Canberra vehicle fleets, other operator’s fleets, or providing charging opportunities to the community. These investigations will continue, and further opportunities are likely to arise as the fleet transitions.		
The next 5 years	— Transport Canberra will examine the feasibility of transitioning the Territory’s special needs transport fleet to zero-emission technology.		
Action 5.2		Consider place-based initiatives that showcase the benefit of zero-emission vehicles in the urban environment.	
Status	In progress		
Action update since 2020	— Benefits of battery electric buses have been communicated. Transport Canberra have started to consider initiatives for implementation. This will continue to be the case as the transition accelerates.		
The next 5 years	<ul style="list-style-type: none"> — Look for opportunities to better integrate zero-emission bus services with Canberra’s town, group or local centres and other key destinations to ensure benefits of zero-emission buses are realised. — Work to deliver bus stop infrastructure improvements and initiatives to support the integration of zero-emission buses into our streetscape. 		

Action 5.3	Develop bus stop infrastructure improvements and initiatives to encourage public transport use.
Status	New action
Action update since 2020	— N/A
The next 5 years	— Transport Canberra will develop bus stop infrastructure improvements and initiatives to integrate zero-emission buses within Canberra’s town, group and local centres. Initiatives should focus on integration with other sustainable transport modes, such as walking and cycling, to support seamless interchange and facilitate multi-modal journeys. This work leverages the environmental benefits of zero-emission buses compared to diesel buses to support vibrant places, such as reduced air and noise pollution.

Action 5.4	Deliver bus network optimisation to leverage new infrastructure.
Status	New action
Action update since 2020	— N/A
The next 5 years	— Conduct a bus network review in conjunction with the opening of Woden depot.



TRANSPORT CANBERRA NOW VS THE FUTURE

Table 5.1 Transport Canberra future vision

	Now	Future
Customer experience	A small number of the fleet are older vehicles that may be noisy, produce particulates and impact on health.	All members of the community can access a bus. Buses are quiet, attractive and meet contemporary access and service standards. People see buses as modern, sophisticated transit.
Fuel supply	Diesel is transported to depots using diesel powered vehicles and stored on-site. Vehicles are fuelled manually, and fuel emissions contribute over 50% of government emissions. Natural gas is compressed on-site and vehicles fuelled manually.	Electricity for zero-emission battery electric vehicles is supplied predominantly by the energy grid as well as behind the meter solutions such as solar power voltage. Supply of power is connected to a local, regional, and national network which needs to be managed to maintain capacity throughout the day. Vehicles are charged via manual charging points or automated pantograph systems and the charging program is key to optimising whole of life costs of the battery and energy supply. In the future hydrogen may be provided via on-site processing or pipeline network.
Workforce	The maintenance workforce model is built around the purchase and ownership of diesel buses, with strong skills and depth of knowledge keeping older fleet on the road for longer. Bus drivers can be driving a 30-year-old bus one day and a brand new one the next. Maintenance is largely scheduled.	The workforce is more agile to manage the new models presented through zero-emissions. Workshop staff are skilled across multiple areas and technologies. Bus drivers are driving newer, safer buses which are better for them and the customers. Maintenance is largely diagnostic, with less maintenance work required overall, though with a substantially larger fleet
Systems management	Systems management is focused mainly on passenger information and crew scheduling.	Zero-emission buses will require more complex systems management to manage the on-board storage systems and manage vehicle and service performance. Depots will be network control centres that deliver a smooth, reliable service to customers. Passengers experience a reliable, integrated journey across modes.
Interchanges and streets	Diesel and compressed natural gas buses are considered incompatible to adjacent land uses and inhibit place activation, healthy streets and quieter neighbourhoods.	Buses are a positive part of the urban environment because they are quieter, smoother, and non-polluting. Interchanges can be better integrated with surrounding land uses without negative impacts and our streets, neighbourhoods and places are cleaner, healthier and more accessible by public transport.
Vehicle purchases	Vehicles are purchased outright and driven to the point of irreparable mechanical failure. Staff use spare parts from retired buses to extend their useful life.	Vehicles are procured as a service asset through a range of procurement approaches including leasing. Adapting to technology change and managing obsolescence is factored into the initial procurement and the Territory can achieve better value for money and a better share of risk.

TRANSITION PRINCIPLES

Sustainable

The Territory is fuelled by 100% renewable energy, demonstrating our commitment to a sustainable zero-emissions future. The transition will continue to focus on delivering sustainable outcomes that benefit the community, environment and economy.

The transition to zero-emissions presents a large fiscal and community investment through various project areas.

The ACT Government will consider each of these investment decisions in terms of its direct and wider benefits and will strive to enhance these benefits through integrated approaches to solutions and delivery.

A particular focus for the ACT Government is the sustainability procedures around batteries including the reuse, repurpose and recycling of bus batteries once they reach the end of their useful life (at present, this is expected to be after about 8 years of operation – less than half the life of the bus).

Battery reuse, repurpose and recycling is an emerging area which will continue to develop over coming years. We will continue to investigate advancements in this area and leverage national and global learnings to ensure the ACT's transition to zero-emission buses are sustainable.

Figure 6.1 ACT Transition principles

Collaborative

New supply chains will present a range of commercial models. The zero-emission industry is already organising in new ways to provide effective solutions that meet the need of governments and operators with the changing nature of energy and renewables markets.

Bus manufacturers are already recognising that the useful life of a battery can be a key operational risk and barrier to entry for bus operators. Accordingly, many have determined to provide assurance over battery life and take the risk of the battery's value and performance over time.

The ACT Government has a number of important roles to play to facilitate this collaboration, including as a participant in a number of industries in the region, as a regulator or through specifically designed interventions and initiatives that drive a shared approach to learning and progression. Others have recognised that the supply of energy from the grid to electric buses can represent a major upfront cost to a transition.

Through careful site selection, discussions with energy suppliers and with manufacturers, the transport industry can work hand in hand with other critical service sectors to deliver a co-optimised solution that shares, reduces and/or avoids the costs and benefits of the transition to a zero-emission future.

Innovative

The ACT has been a leader in demonstrating how these interests can be leveraged to accelerate change, and the Transport Canberra transition will follow a similar lead.

The transition will aim to optimise the opportunities presented by the smaller scale of the Territory to facilitate innovative solutions that can be shared with other jurisdictions, that enhance the service offering and that promote the ACT Government's commitment to a diverse, knowledge-based economy.



Source: Zero-Emission Transition Plan for Transport Canberra

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ZERO-EMISSION
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