



ACT
Government

ZERO-EMISSION TRANSITION PLAN FOR TRANSPORT CANBERRA



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MINISTER'S FOREWORD

The ACT is leading the country in taking a responsible approach to managing climate change and our environment.

In 2020 we became the first jurisdiction outside Europe to reach 100% renewable electricity. Now we need to tackle the largest source of emissions, transport, which makes up over 60% of the ACT's net emissions, including emissions from public transport.

The Zero-Emission Transition Plan for Transport Canberra outlines the pathway to achieve the ACT Government's ambition of zero-emission public transport system by 2040.

This has started with the introduction of light rail to Canberra which has seen 20% of trips powered by 100% renewable electricity. However we also need to tackle the emissions produced by buses currently powered by fossil fuels.

With this Plan the ACT Government is taking nation leading action to transition our city's bus fleet to zero-emissions, including the infrastructure, investment and skills needed to make the transition operationally successful.

A transition of this scale requires detailed planning and preparation, and this work has been informed by our ongoing trials of battery electric and hybrid buses in Transport Canberra's fleet since 2017.

This plan has also been developed with the expert advice provided by the Zero-emissions Transport Plan Steering Committee and informed by advice from WSP.

They have helped define the steps needed to transition our bus fleet to zero-emissions, with consideration of the technology, timing and potential collaborations with energy providers.

As a result, this Plan will see the Government replace ageing diesel and CNG buses with battery electric buses powered with the ACT's 100% renewable electricity. This will be timed with plans for new bus depots with electric charging infrastructure to support the growing fleet of zero-emissions buses.

Modern, clean, accessible buses will help to make our transport interchanges cleaner and quieter, enabling more Canberrans to live close to public transport.

The Plan also takes into account the wider commitments and objectives of the ACT Government around public transport. It isn't enough to reduce emissions from our bus fleet. Key to addressing climate change is work to expand and improve our public transport network to encourage more Canberrans to use public transport, to move people efficiently around our city, and make it a better place to live.

Finally this plan supports a just transition for workers, with diesel mechanics supported with the skills they need to work on the new electric fleet, and power our transport system forward to a more sustainable future.



Chris Steel MLA

Minister for Transport

EXECUTIVE SUMMARY

A zero-emission public transport system is a critical step in achieving a sustainable, resilient future for our city and environment. It will deliver a smoother ride, healthier streets and reinforce the Territory's reputation for leadership in taking action on climate change.

Achieving a zero-emission fleet is more than putting new buses on the road. It requires a refocus from traditional fuel supply chains, service planning and procurement.

The *Zero-Emission Transition Plan for Transport Canberra* outlines the key drivers, opportunities and constraints of this transition. The Plan maps out a practical pathway to start the transition away from fossil fuels combined with a strategic approach to achieving a complete zero-emissions fleet by 2040. It considers opportunities to establish resilient supply chains and build local capability as the economy transitions to an emissions-free future.

The Plan identifies key interventions that will position the Territory to achieve that future while optimising value for money and establishing Transport Canberra as a leader in its field.

The plan responds to the emissions targets set out in the 2019-2025 Climate Change Strategy to achieve zero-government emissions by 2040 and an interim target of 33 per cent reduction by 2025. With the recent achievement of 100 per cent renewable sources for the ACT electricity supply, the transport sector is now the largest source of emissions in the Territory, comprising 62 per cent.

The move to zero-emissions transport is part of a broader global transition to cleaner energy, resilient communities and technological advancements. The Plan explores how these transitions might intersect in the future and how we might coordinate those individual pathways to optimise our resources, efforts and outcomes.

At the centre of the Plan is the Zero-Emission Transition Roadmap comprising five *Strategic Priorities* to embrace the unique advantages of the ACT and drive forward the journey to zero-emissions. These Priorities are supported by an Action Plan to guide the implementation. All actions and investments will be subject to consideration in future ACT Government investment decisions and will require periodic review to ensure our actions keep pace with the accelerated rate of technological change.

Lastly, the Plan describes how we will implement and deliver these and other supporting actions to build a zero-emissions fleet.

- 1. Building the infrastructure we need** 
- 2. Procuring zero-emission buses** 
- 3. Partnering with the energy sector** 
- 4. New skills, protecting jobs and growing the economy** 
- 5. Increasing public transport use through better buses and a better service** 



SUMMARY ACTION PLAN

Strategic Priority 1 – Building the infrastructure we need

- | | |
|------------|---|
| Action 1.1 | Deliver an interim infrastructure solution for a first tranche of zero-emission vehicles. |
| Action 1.2 | Undertake a Depot Feasibility Study to identify the timing and scope of future needs. |
| Action 1.3 | Upgrade Woden Depot to support zero-emissions buses. |
| Action 1.4 | Build a new zero-emissions depot, by 2026. |
| Action 1.5 | Convert remaining existing depots to zero-emissions. |

Strategic Priority 2 – Procuring a zero-emissions fleet

- | | |
|------------|---|
| Action 2.1 | Procure a first tranche of battery electric buses which are supported by a temporary infrastructure solution. |
| Action 2.2 | Continue to monitor changing commercial models, technology developments and power advances. |

Strategic Priority 3 – Partnering with the energy sector

- | | |
|------------|--|
| Action 3.1 | Engage early with different service providers and the energy market. |
| Action 3.2 | Participate and partner with the energy sector. |
| Action 3.3 | Monitor discussions on future power technologies and advances. |
| Action 3.4 | Work with other jurisdictions to identify shared solutions to shared problems. |

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

- | | |
|------------|---|
| Action 4.1 | Engage with workforce to deliver a just and fair transition. |
| Action 4.2 | Expand transition benefits to the ACT local market, involving businesses and organisations across the zero-emission supply chain. |
| Action 4.3 | Train and upskill workers and expand these to regional and nationally recognised certifications. |

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. |
| Action 5.2 | Consider place-based initiatives that showcase the benefit of zero-emission vehicles in the urban environment. |



GLOBAL CHALLENGES, LOCAL OPPORTUNITY

The world is moving towards a zero-emissions future. It is widely recognised that the time for talk about climate change is over and urgent action is needed.

At a global level, the United Nations is leading efforts to address climate change and limit global warming. To achieve this, the United Nations has called on nations everywhere to commit to net zero-emissions by 2050.

As an inclusive, progressive city, Canberra is leading the field in the journey to a sustainable future.

Last year, the Government released the *ACT Climate Change Strategy 2019-2025*, which sets a target of net-zero-emissions by 2045 and identifies key actions to success. Central to this success is reducing emissions from the transport sector, which now account for more than 60% of the Territory's emissions.

Figure 1 – 2020 Projected Emissions Sources - Source ACT Climate Change Strategy

| CATEGORY | % | kt CO ₂ -e* |
|---------------------------------|-----|------------------------|
| Transport Canberra buses | 52% | 33 |
| Natural Gas (other facilities) | 13% | 8 |
| Natural Gas (health facilities) | 13% | 8 |
| Fleet Vehicles | 11% | 7 |
| Natural Gas (schools) | 11% | 7 |

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

While the majority of transport emissions come from private vehicles, government has a particular responsibility for leading with its own emission reductions.

The 2019 *ACT Climate Change Strategy* sets a target for zero Government-emissions by 2040 with an interim target to reduce emissions by 33 per cent by 2025. While comprising around 3 per cent of total Territory emissions, the current Transport Canberra fleet of diesel and gas buses

comprise over half of government emissions. Reducing public transport emissions is therefore critical to reducing government emissions overall.

A frequent, reliable public transport system powered by renewable energy is essential to reducing both public and private emissions. The ACT Transport Strategy outlines how Canberra's integrated transport system will support our ambitions for a sustainable, resilient city in facilitating a more compact, connected urban form. At its core lies a high-quality, reliable public transport service.

With public transport one of the most efficient means of moving people over distances, our focus is to increase the use of public transport for a greater variety of trips, by improving our service reliability, accessibility, simplicity and overall attractiveness.

Transport Canberra's vision is for public transport to contribute to the positive urban experience for all Canberrans. In the future, our public transport network will facilitate fast, reliable movements across our city and be complemented by high quality transfers, interchanges and integrated end of trip facilities.

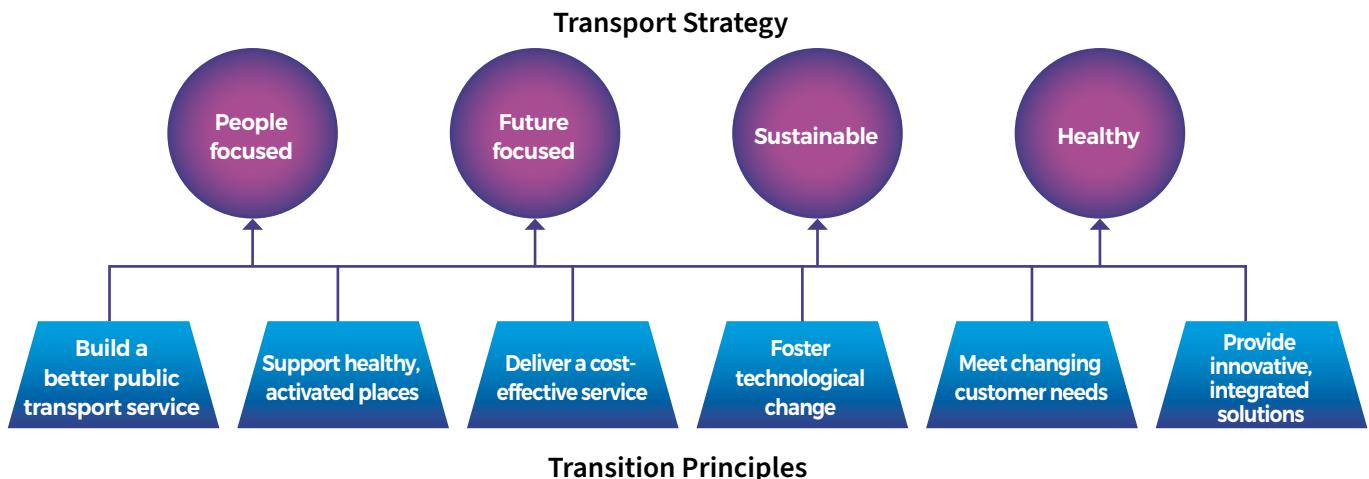
Through transitioning to a zero-emissions bus fleet, the ACT Government can deliver a modern public transport system that drives positive change for all Canberrans.

“For the long-term health benefit of all Canberrans, we will make a healthy transport transition to a new normal that puts walking, cycling and public transport at the centre of a connected city.”

2020 ACT Transport Strategy

Transition objectives

Figure 2 – Alignment with Transport Strategy



The Zero-Emission Transition Plan is guided by six objectives that deliver on all of the Territory's transport objectives. These objectives will guide future investment and decision making to ensure the decisions we make at the local level contribute to city and global outcomes.

ACT emissions targets

Emissions from transport are expected to create over 60% of the ACT's emissions by 2020, with the majority created by the use of private cars.

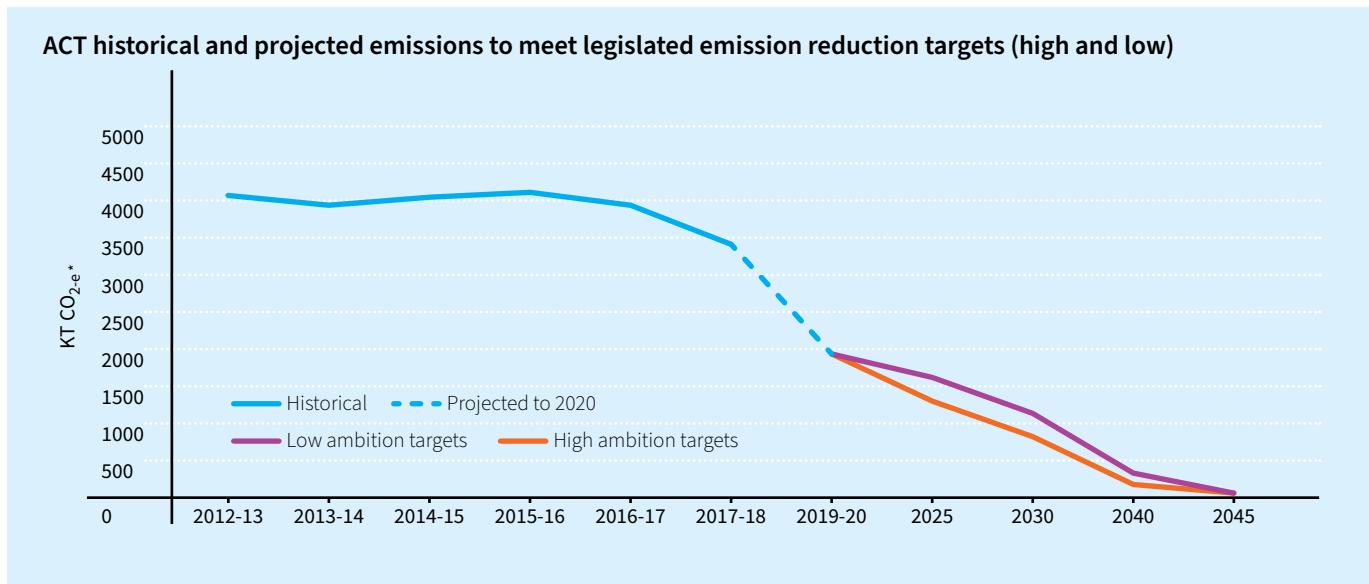
Emissions from Transport Canberra buses account for 2-3% of these emissions but over 50% of ACT Government emissions.

The ACT has committed to reducing emissions by 50-60% by 2025 from 1990 levels in order to reach its ultimate goal of 100% zero-emissions by 2045. This equates to a 17 per cent to 25 per cent reduction in emissions between 2020 and 2025.

The Climate Change Strategy sets a zero-government emissions target of 2040 with an interim 2025 target of 33 per cent on 2020 (which represents the higher end of the 17-33 per cent reduction target).

Figure 3 shows the projected emissions reductions between 2020 and 2045.

Figure 3 – Emission reduction - Source ACT Climate Change Strategy



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

TRANSPORT CANBERRA

The Transport Canberra public transport network is at the core of Canberra's integrated transport system. Every day, 1.3 million trips are made across the city with public transport accounting for approximately 85,000 of them. As our city grows, the role of public transport in delivering social, economic and environmental outcomes for our city will become critical.

In 2019, the ACT Government introduced a new public transport network to drive the step change needed to deliver a high-quality, modern and sustainable public transport service.

The network is based on connected, frequent and integrated design principles and comprises a 3-tier service hierarchy:

- * **Rapid**
- * **Feeder and Local**
- * **Flexible**

Figure 5 – Transport Canberra Key Facts

Operations

Transport Canberra buses are publicly owned, operated, managed and maintained.

This is in contrast to many other Australian cities which feature some or all services franchised to the private sector, mostly through periodic competitive tendering.

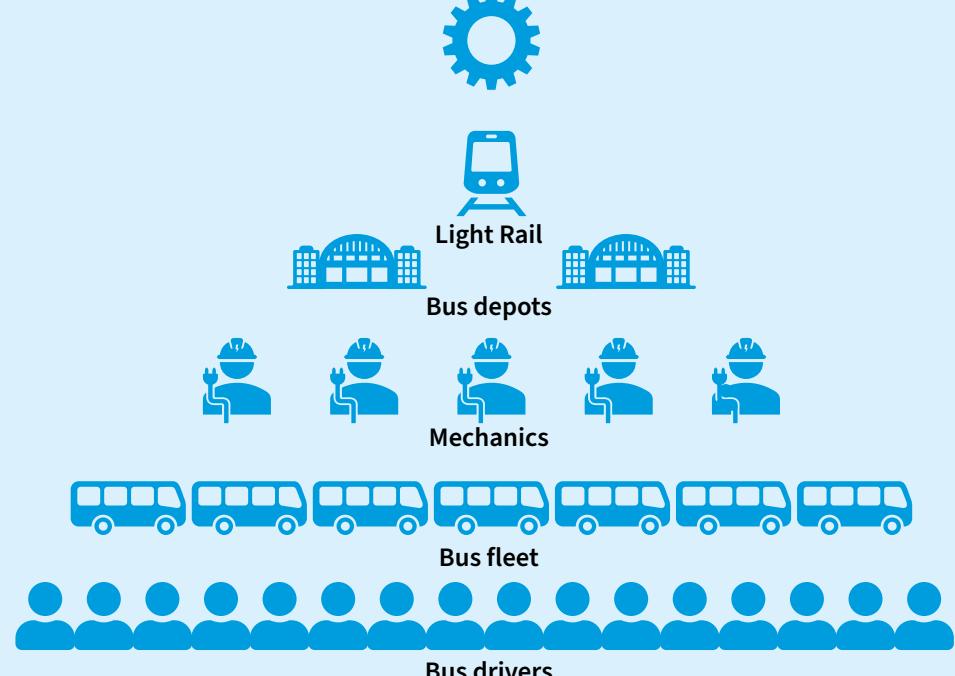
The ACT Government owns the bus fleet and bus depots (in Tuggeranong and Belconnen with Woden currently under development) and is responsible for delivering public transport infrastructure including terminals and layovers.

Transport Canberra directly employs all executive, administrative staff, bus drivers, transport officers and workshop mechanics in its bus operations.

Transport Canberra not only sets policy for the transport network, it is responsible for strategic network and operational planning, management of network operations, service monitoring, maintenance and reporting. City to Gungahlin Light Rail is the first stage of Canberra's light rail network. It is maintained and operated for Transport Canberra by Canberra Metro.

The network also comprises dedicated school bus services, a smaller number of Peak Express services and special needs transport. Transport Canberra buses travel nearly 22 million service kms per annum. The majority of service kilometres are generated by the rapid network and the local/feeder network.

| Service type (buses only) | 2019/20 service kms |
|------------------------------|---------------------|
| Rapids | 9,739,740 |
| Regular local and feeder | 11,280,373 |
| Dedicated school services | 589,366 |
| Peak | 153,967 |
| Total | 21,763,446 |



Fleet

A reliable, efficient and comfortable fleet is essential to providing a public transport service that is attractive to the customer, meets network requirements and is sustainable. As buses age they become more expensive to maintain and less reliable, leading to poorer customer satisfaction for existing customers and less likely to attract new customers.

The Transport Canberra fleet, summarised in Table 1 below, comprises 451 vehicles housed across two depots. The fleet is powered by a combination of diesel and compressed natural gas (CNG) buses with one electric bus also in service.

The current fleet contains high capacity rigid and articulated buses, as well as standard 12.5 metre single-deck rigid buses.

A substantial proportion of the fleet is facing retirement in the next decade and will require replacement. This includes 34 Renault buses. These vehicles pre-date euro-emissions

standards and do not meet the *Disability Discrimination Act* standards due to be enforced at the end of 2022. Approaching 30 years in age, these buses place an increasing service risk to Transport Canberra.

As the network and population expand, so too must the fleet. Transport Canberra will need to grow the total number of fleet, as well as its infrastructure and workforce, to keep up with both population growth and a forecast increase in mode share overtime.

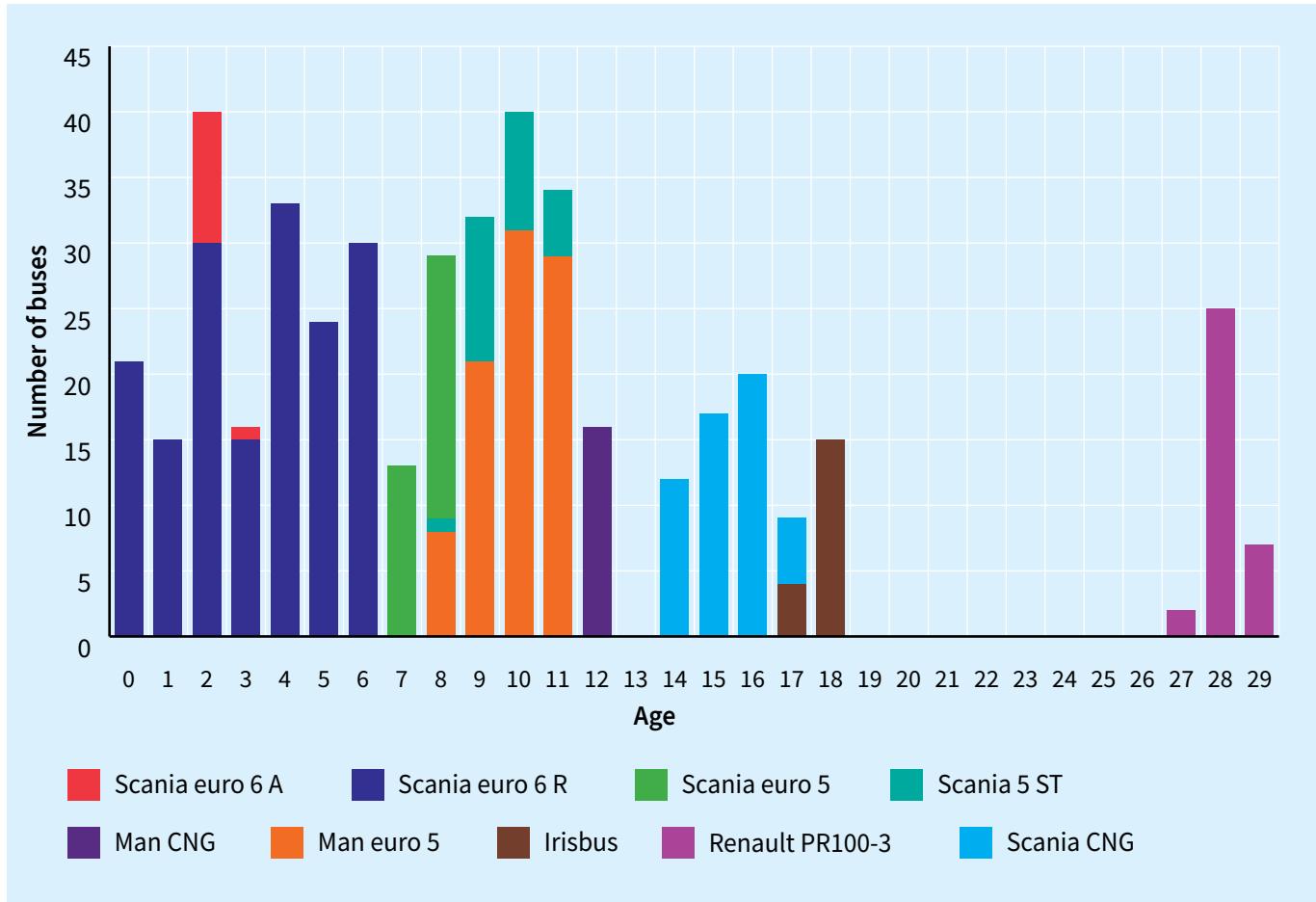
As Canberra city matures and travel behaviours change, we can make better use of the fleet we do have. The total fleet size is dictated by the number of vehicles needed in the peak period. Where a city has a very high peak and no demand during the day, a large number of vehicles will sit unused. By providing more frequency throughout the day, Transport Canberra can provide more transport choice, more services and reduce peak crowding without an increase in overall fleet numbers.

Table 1 – Fleet Composition

| Bus Type | Count | Average Age | Fuel | | | DDA | Euro-emissions standard | | | | | |
|--------------------|-------|-------------|------|--------|-----|-----|-------------------------|----|----|----|-----|-----|
| | | | EV | Diesel | Gas | | No | 2 | 3 | 4 | 5 | 6 |
| Renault PR100-2 | 34 | 28.5 | | | | No | 34 | | | | | |
| Irisbus AGORALINE | 19 | 18 | | | | Yes | | 19 | | | | |
| SCANIA CNG | 54 | 15.5 | | | | Yes | | | 54 | | | |
| MAN CNG | 16 | 12 | | | | Yes | | | | 16 | | |
| MAN DIESEL | 89 | 10 | | | | Yes | | | | 2 | 87 | |
| SCANIA 14.5m | 26 | 9.5 | | | | Yes | | | | | 26 | |
| SCANIA Articulated | 44 | 6 | | | | Yes | | | | 33 | 11 | |
| Scania Euro VI | 168 | 3 | | | | Yes | | | | | | 168 |
| Yutong E12 | 1 | 0 | | | | Yes | | | | | | |
| Total | 451 | 11 | 1 | 380 | 70 | | 34 | 19 | 54 | 18 | 146 | 179 |



Figure 6 – Fleet Age by Vehicle Type



Depot and infrastructure

Transport Canberra currently operates from two depots at Belconnen Town Centre and Tuggeranong Town centre. Depots provide a place for bus maintenance, bus storage, midday and overnight layover as well as driver break facilities. Both depots are currently operating over their design capacity.

To address these capacity issues and maximise operational efficiencies, Transport Canberra is planning to construct a new Woden bus depot. This depot, located at the site of the previous depot, is due for completion in 2022.

More depot space will be needed however to accommodate further fleet and service growth in the future.

Workforce

Transport Canberra employs over 1000 staff. Bus drivers comprise the majority of the workforce, with some 800 employees. They are often the public face of our organisation and supported behind the scenes by our Transport Officers, workshop staff, fuelers, starters, depot

managers and administration.

Transport Canberra also employs a small team of service schedulers, planners, communications staff, policy makers, finance, procurement and system leads to manage day to day operations as well as long term service needs.

Together this workforce contributes to the delivery of a reliable, safe and efficient public transport journey for Canberrans every day.

Emissions

Transport Canberra buses comprise around 3 per cent of total emissions in the ACT but over 50% of ACT Government emissions. Total vehicle emissions have reduced over time, with heavy particulate matter reducing most significantly between non-euro and euro standard vehicles. Table 2 outlines the changing emissions factors over different generation euro-emission standard vehicles. The latest technology, Euro VI, emit lower greenhouse gas emissions and lower particulate matter. Since achieving 100% renewable electricity, electric vehicles produce no emissions from the tailpipe.

Table 2 – Emission factors from various fleet types and emissions standards.

| | Emission factor g/kWh | | | Particulate Matter mg/kWh |
|-----------------------|-----------------------|------|-----|---------------------------|
| | CO2 | HC | NOx | |
| Euro III | 1.5. | 1 | 5.0 | 20 |
| Euro IV | 1.5 | 0.06 | 3.5 | 20 |
| Euro V | 1.5 | 0.06 | 2.0 | 20 |
| Euro VI | 1.5 | 0.06 | 0.4 | 10 |
| CNG euro III | 3.0 | 2.5 | 2.0 | - |
| Biodiesel | 0.0 | 0.7 | 1.9 | - |
| Electricity post-2020 | 0 | 0 | 0 | 0 |

Source: European Union Heavy Duty Vehicle Emissions Standards

CO2 - Carbon Dioxide

HC - Hydrocarbons

NOx - Nitrogen Oxide

tCO2e/MWh

g/Kwh - grams of relevant emission per kilowatt-hour of energy used

mg/kWh - milligrams per kilowatt-hour of energy used

1 litre of diesel fuel is equivalent to 10.6kWh of energy (NSW DPI,

2016).

Health impacts of older diesel buses

Canberrans recently experienced the effect of high levels of particulate matter, when catastrophic bushfires across our region caused our city to have some of the worst air quality in the world.

Transport Canberra currently has 34 Renault PR100.2 buses in service. These buses pre-date modern EURO emissions standards and compared with a modern diesel bus burning the same fuel, emit more than:

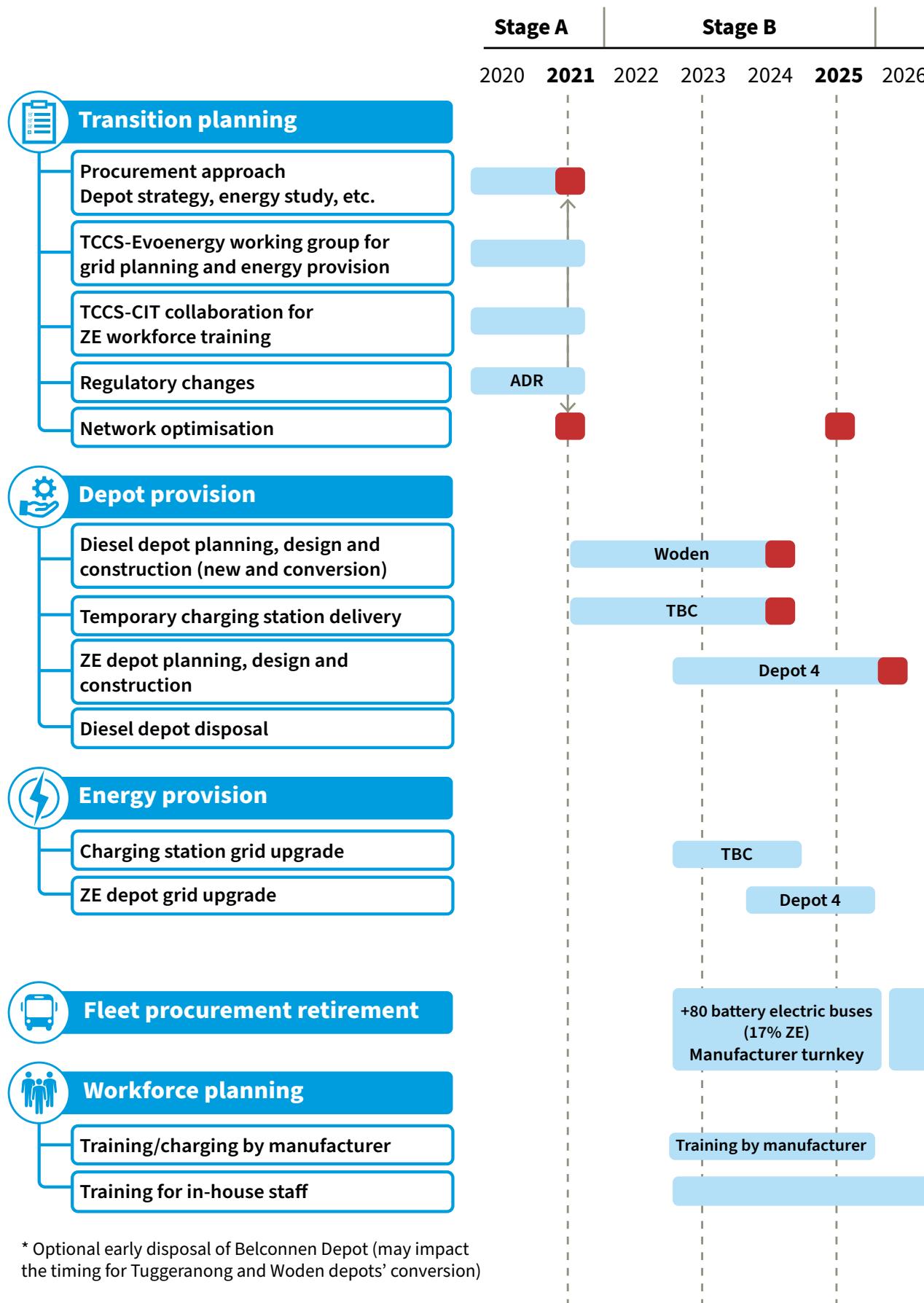
- 18 times the volume of hydrocarbons;
- 20 times the volume of nitrogen oxide; and
- 36 times the volume of particulate matter.

Noxious emissions from vehicles—including oxides of nitrogen and sulfur (NOx and SOx), particulate matter (PM), hydrocarbons (HC), and carbon monoxide (CO)—impact on the quality of the air we breathe, leading to harmful health effects such as respiratory illness, cardiovascular disease and cancer.

A 2013 study into the public risk of exposure to air pollutants found that long term population exposure to particulate matter alone is attributable to nine per cent of all deaths due to ischemic heart disease in Australia's four largest cities. (Department of Infrastructure 2016).



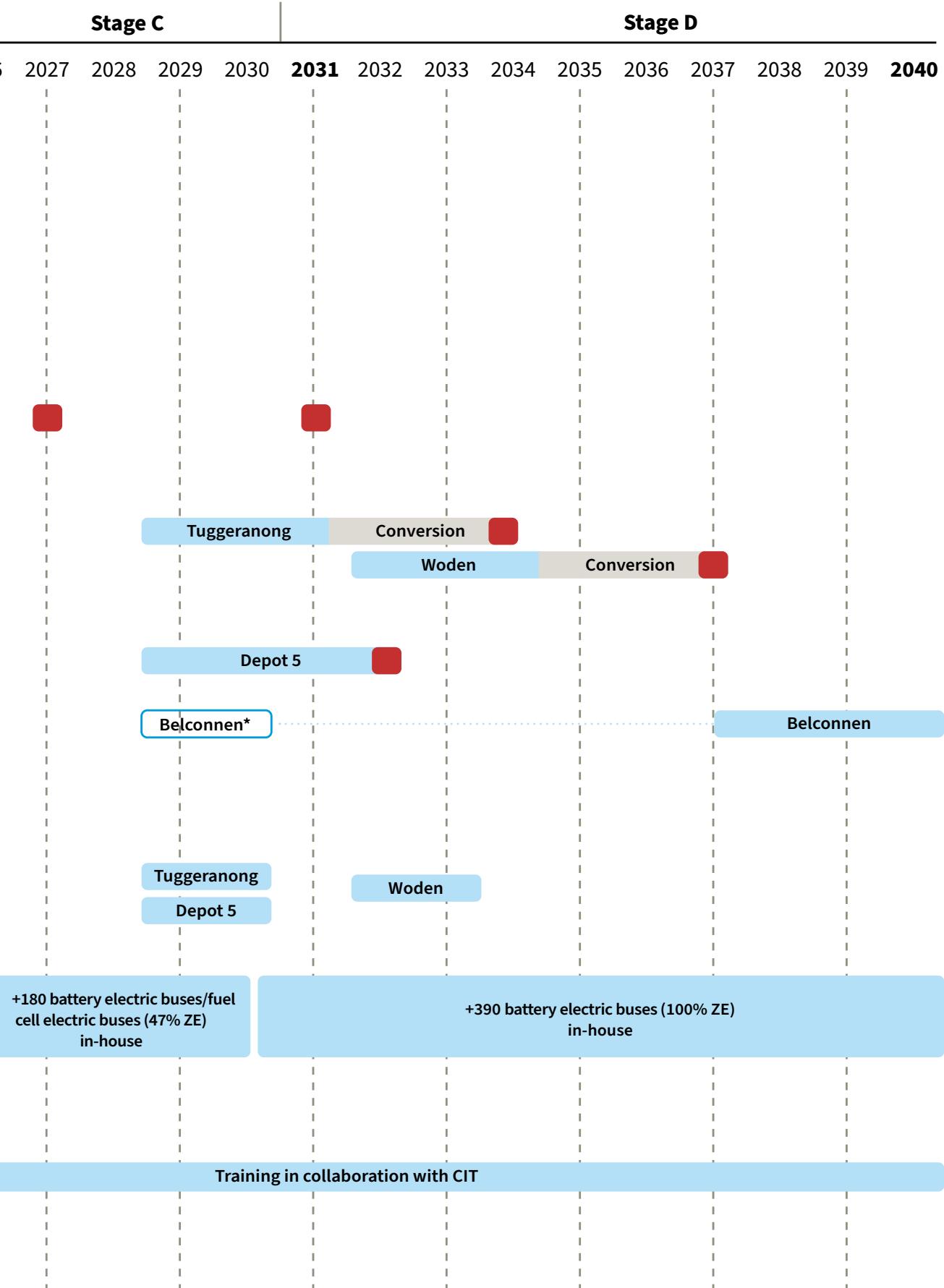
PREFERRED TRANSITION P



PATHWAY



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TRANSITION PATHWAY

How we get to zero-emissions

The Transition Pathway outlines the major steps in Transport Canberra's journey toward zero-emissions.

The Pathway considers elements, risks, sensitivities and opportunities of the transition to identify the point at which intercepting the change curve maximises value and minimises risk.

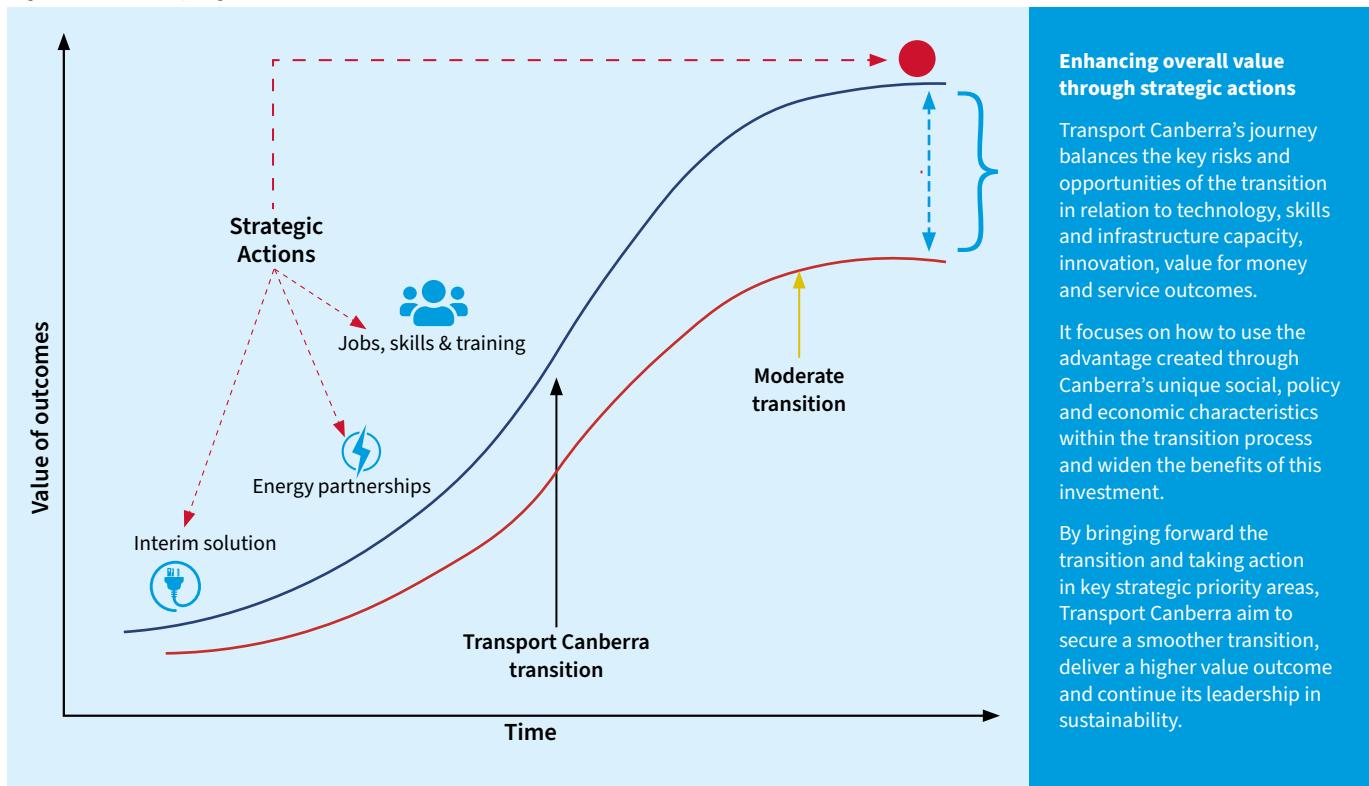
This means not starting too early or too late. The Pathway also gives opportunity for the Territory to lead and influence.

Reflecting on the Territory's comparative advantages, the Pathway identifies areas where accepting a higher level of risk is likely to optimise the outcome in the long term.

The Transition Plan is centred around five strategic priorities and actions to direct the zero-emission journey:

- 1. Building the infrastructure we need**
- 2. Procuring zero-emission buses**
- 3. Partnering with the energy sector**
- 4. New skills, protecting jobs and growing the economy**
- 5. Increasing public transport use through better buses and a better service**

Figure 7 – Identifying the optimal transition path



- Action 1. Deliver a temporary infrastructure solution for a first tranche of zero-emission vehicles.

- To enable the transition to commence as early as possible, Transport Canberra will deliver an interim infrastructure and service solution for zero-emission buses in the short term while scoping and designing the delivery of permanent solution in the medium term.
- This may include an off depot temporary bus stabling and charging site which makes the most of existing infrastructure and the energy network in the short term.
- The final solution will be determined through thorough consultation with a range of industry stakeholders.

- Action 2. Undertake a depot feasibility study to identify the timing and scope of future needs.

- In 2020-21 Transport Canberra will undertake a depot feasibility study to identify the mid to long term stabling, maintenance and operational needs for the future fleet.
- The study will consider the optimal location of future depots based on future service and network design, energy grid connections, future land use and zoning. As well as expanding and proofing designs for future technology, the study will also consider opportunities to integrate with the local electricity network and utilise the benefits that electric vehicles can provide in stabilising electricity supply.
- The study will consider opportunities to maximise the capacity of existing depots to ensure the asset is maximised while delivering a safe, accessible and efficient workplace.

- Action 3. Upgrade Woden Depot to support zero-emissions buses.

- As part of the building of the new Woden depot, which is planned for completion at the end of 2022, charging facilities and energy supply solutions will be added to the site to allow for the stabling and maintenance of electric vehicles.

- Action 4. Build a new zero-emissions depot, by 2026.

- A new zero-emission bus depot, will provide a home for the new zero-emissions fleet, while also reducing dead running and delivering a modern fleet management facility.
- The fourth depot is critical to providing capacity for future fleet growth and will deliver additional capacity in the short term to enable the transfer of vehicles between sites as existing depots are converted to zero-emission enabled.
- In accordance with the findings of the depot feasibility study, this facility will provide opportunities to leverage the electrical infrastructure and energy

storage to supplement the electricity network to assist with stabilising supply during the peak periods.

- Action 5. Convert remaining existing depots to zero-emissions by 2040.

- Over time as the existing diesel bus fleet reduces, the remaining CNG vehicles will be consolidated to a single depot to support more efficient maintenance and operations practices.
- This will allow existing depots to be progressively converted to support zero-emission vehicles as diesel and CNG numbers reduce.
- Where feasible, conversion of existing depots will give an opportunity to upgrade existing facilities to meet contemporary operational standards
- The Tuggeranong and Belconnen Depots will be subject to further detailed site assessments to determine the best site utilisation to support the ongoing delivery of sustainable public transport services.

Future depot needs

Zero-emissions depots will look markedly different from today's depots. Existing depots will need to be fitted out with charging points either in-ground or via roof-top pantograph systems. For hydrogen, on-site processing may be required with requisite safety considerations.

Future depot feasibility studies will need to consider the life and fit-for-purpose of existing depots as well as the need for new depots in accordance with the fleet retirement profile, vehicle technology, maintenance, operations needs and connectivity to the energy grid.

Future infrastructure will also need to meet changing technologies, systems and workplace practices to accommodate broader economic and social change.

Depot feasibility studies for future depot sites will account for the necessary depot infrastructure, grid requirements and site locations to meet these needs.

Depot conversion

Retrofitting existing depots for zero-emission infrastructure will reduce depot capacity and disrupt depot operations for long periods.

The transition will require alternative stabling of fleet, either off-site or at new facilities, to reduce direct operational interfaces while depots are being converted.

In the medium and long term, depots and infrastructure will need to accommodate a changing mix of fleet including diesel, compressed natural gas, electric and potentially hydrogen. Transitioning depots and facilities to meet the changing fleet profile over time will be a key driver in how to plan, manage and deliver infrastructure in a cost-effective and least disruptive manner.

Secure capacity beyond the depot

Infrastructure needs extend beyond the depot. Battery electric vehicles require high-voltage energy at a large scale to charge vehicles. This power need can be in-part met through on-site photo-voltaic solar panels and battery-storage but will inevitably require a supply from the main energy grid.

While a small number of vehicles can be charged under existing grid capacity at existing depots, any larger scale charging will place extra load on the network and require grid infrastructure upgrades. Future depot and fleet planning will ensure the energy grid network capacity to deliver the requisite energy needs while strategic charging, storage and demand management will help curtail unnecessary investment. Securing this energy supply infrastructure at a scalable and reliable level is fundamental to a successful transition.

Charging strategy

Transport Canberra will develop an indicative charging strategy to assess the future zero-emission fleet needs, and develop a charging regime that identifies where, when and how vehicles will be powered. This will be essential in scoping and designing the necessary on-route and in-depot infrastructure requirements.

While the range and capacity of battery-electric buses is improving at rapid rates, strategically located on-route charging infrastructure can help build system redundancy and optimise assets by extending their route length, keeping batteries optimised and reducing dead running for charging purposes.

Strategic Priority 2 – Procuring a zero-emissions fleet

The introduction of zero-emission fleet at a notable scale must be supported by the necessary infrastructure, workforce and systems.

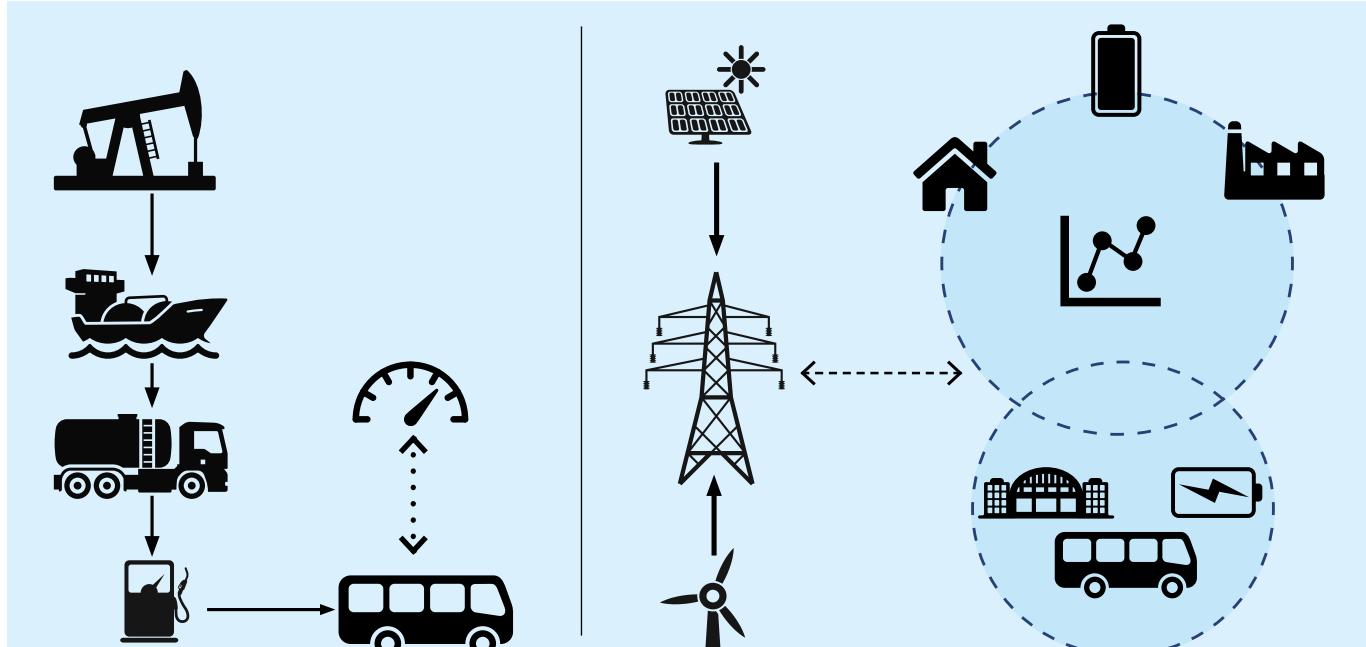
Transitioning a large number of fleet to zero-emissions too early will risk service reliability, infrastructure readiness and workforce capability. Starting too late will risk achieving service and Government targets and may present missed opportunity to benefit from early innovation, first mover advantage and influencing long term technology and commercial outcomes.

A first tranche of buses will accelerate the Territory's learnings in relation to commercial, operational and technical issues and inform later stages of the transition.

- Action 1. Procure a first tranche of battery electric buses which are supported by a temporary infrastructure solution.

- A procurement process seeking submissions from the transport industry will be prepared to supply zero-emissions buses over the forward years.
- Transport Canberra will commence initial marketing sounding in late 2020 followed by a formal request for Expressions of Interest in early 2021.
- The full procurement process to contract signing will extend 9-12 months. This request for tender will seek suitable applicants to supply battery electric buses that meet the specifications required to service the

Figure 8 – Traditional vs renewable fuel supply chains



Transport Canberra currently rely on fossil fuels as its main source of power its buses. These fuels are the result of long complex geological processes and complex supply chains, that are vulnerable in both price and supply.

Battery electric buses will use energy generated from renewable energy. They deliver more secure supply of energy, greater flexibility and, as part of an interconnected energy system, drive opportunities for multi-sector benefits.

Transport Canberra Network, delivered to align with infrastructure availability.

- This first tranche will focus on maximising existing infrastructure to reduce upfront capital costs associated with whether energy or depot infrastructure, batches as local depot infrastructure capacity is made available.
- A secondary procurement will seek a suitable partner for the ACT Government to design and deliver the energy and infrastructure solutions required to support the procured buses, as well as plan for the future growth of the zero-emissions fleet.
- Table 3 identifies the forward fleet procurement profile to deliver the fleet transition and growth in the medium term.

- Action 2. Continue to monitor changing commercial models, technology developments and power advances.

- Transport Canberra will continue to work with industry to monitor the improvements in technology that could benefit the ACT Government in meeting its climate change targets through the reduction of emissions in the public transport sector. This will also consider future partnership and procurement models that could provide accelerated progress on transitioning to a zero-emissions fleet.

Table 3 outlines the future fleet replacement profile.

In the short term, existing funding allocation will go toward managing the immediate service risks by replacing the 34 aged and non-DDA standard Renault buses.

This will provide a more immediate response to the compliance and reliability risks being managed by Transport Canberra, whilst also allowing for the industry to develop integrated and innovative responses to an interim zero-emission solution. Following their replacement, Transport Canberra will commence market sounding and procurement activities for the Territory's first major tranche of electric fleet of up to 80 vehicles and their supporting infrastructure.

This first tranche of electric buses will be housed outside of the existing depots to reduce disruption to existing services

Table 3 – Future fleet replacement profile

| Fuel | 2020-21 | 2021-22 | 2022-23 | 2023-24 | 2024-25 | Total |
|--|-----------------------------------|--------------------|--------------------|-----------------|-----------------|---------------|
| Diesel (via lease or similar) | up to 34 vehicles ¹ | | | | | Up to 34 |
| Zero emission Tranche One (including enabling infrastructure) | | 26 ⁽¹⁾² | 24 ⁽¹⁾² | 15 ² | 15 ² | Minimum 80 |

1. Funded under the Better Buses to support the new bus network

2. Includes provisional funding subject to future government funding decisions

and will be delivered as much as possible within the capacity of existing infrastructure. This first tranche will help up-skill staff, proof operating and commercial arrangements to inform and de-risk the delivery of the ACT's first 100 per cent zero emission depot in 2026.

Initial market soundings will be followed by a call for Expressions of Interest and Request for Tender process to engage the appropriate manufacturing and delivery industry partners. These procurement activities will be subject to consideration in future ACT Government investment decisions.

Why choose battery electric buses

- **Emission-free.** A battery-electric bus (BEB) functions using an on-board battery powering an electronic traction motor, which in turn powers the vehicle's drive axle, wheels and auxiliary components such as heating, air-condition and interior/exterior lighting. Regenerative braking systems recover energy from the vehicle's mechanical systems, which is then stored or used. Unlike diesel and gas buses, electric buses produce no tailpipe emissions.
- **100% renewable energy.** Earlier this year the ACT achieved 100 per cent renewable electricity meaning all power supplied to the grid is generated through renewable energy sources, such as wind and solar, which produce no emissions. This means that battery electric buses not only produce zero tailpipe emissions, the energy used to power them is also generated from zero-emission energy sources.
- **More mature technology.** Battery electric buses have experienced strong growth in recent decades and particularly the last few years in the Americas, Europe and China. The technology is well advanced and continues to improve rapidly overtime with manufacturers looking for ways to reduce battery size and weight, increase capacity and enhance the reliability of vehicles to support reliable and sustainable city wide fleets. The maturity and growth of the market means the ACT can make a firm commitment to this as the optimal technology in the short to long term, while not precluding the uptake of other technologies such as hydrogen in the future if they prove to be viable options.

Future fleet

A mixed fuel fleet is the optimal long-term fleet strategy for the Territory. Market analysis indicates that buses powered by electric batteries offer the most certainty in the immediate and short-term, yet the future uptake of hydrogen should not be precluded in the medium/long-term.

A mixed fleet provides flexibility for future changes in technology, while accessing and benefiting from a proven fuel in the short term.

Adapting to change

Zero-emission bus technology is rapidly changing. Concerns such as ‘range-anxiety’, reduced capacity and battery size are increasingly obsolete as technology improves and as industry and operators find different ways to manage new risks and ways of working.

Choosing the optimal timing, scale and technology is a difficult task.

The Territory has an advantage from other jurisdictions in owning and operating its fleet. There is opportunity to use this advantage to deliver innovative approaches in the short term while awaiting de-risking of investment in the medium to long term.

The transition will present a range of new procurement models, supply chains and componentry to consider as the technology improves over time and as the most effective commercial models for procuring fleet and components become apparent.

Total cost of operations

Although the price of zero-emission buses is expected to be higher than diesel buses in the immediate term, these prices are expected to fall. Analysis shows that relative operational costs associated with electric buses can be lower than diesel buses, including the costs of energy, maintenance and workforce training. Enhanced systems and technology and

"78% of Transport Canberra bus routes can be serviced by current BEB (Battery Electric Bus) technology"

ever improving diagnostics tools will help deliver operational efficiencies over time to complement what is expected to be a more competitive zero-emission vehicle manufacturing sector.

Operating and service planning

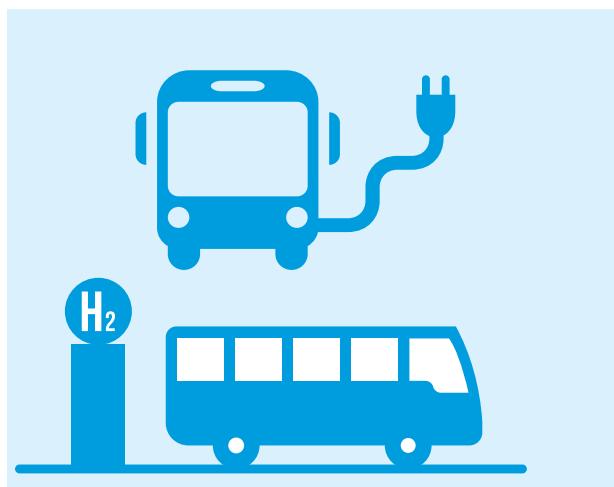
Zero-emission vehicles will be similar to operate for drivers, but without an internal combustion engine, will be quieter and smoother.

Battery use can vary depending on the outside temperature. Maintaining a high level of performance across an electric fleet requires more careful management than a diesel. Currently, most buses will service any route. Under the transition however, the allocation of the right bus to the right route will be important at least in the short term.

Strategic Priority 3 – Partnering with the energy sector

With transport and energy, the two largest sectors responsible for reducing emissions, there may also be opportunities to rethink the relationship between the provision of energy and a zero-emission transport sector. Battery electric vehicles will result in Transport Canberra being a major energy customer. This brings with it higher potential operating and capital costs but also opportunities to help manage the increasing loads on the energy grid, whether that is through on-site battery storage, co-located facilities, feed-in tariffs or other mechanism. The new relationships will present opportunities for Transport Canberra and the Territory to reduce costs, generate new sources of revenue, share solutions and better meet the energy needs of the future economy.

Figure 9 – Battery electric buses vs hydrogen fuel cell



Battery electric buses (BEBs) and hydrogen fuel cell buses (FCEBs) provide options that enable a dramatic reduction in the GHG and CACs emissions by the public transport sector. Both technologies offer zero tailpipe emissions (excluding any auxiliary diesel heater options), and their carbon footprint is directly proportional to the electrical grid or hydrogen plant they are connected to.

As the electrical energy sources and grids migrate to more renewable and carbon-neutral options in the future, this leads to the possibility of minimal to zero upstream carbon emissions. Battery electric buses are a more mature ZEB technology at present and will be the main ZE bus type to be procured initially.

- Action 1. Engage early with different service providers and the energy market.

- Transport Canberra will begin discussions with energy providers and network managers to seek opportunities to partner in the investment and in infrastructure that could provide co benefits for both parties. This could be through behind the meter electricity generation, providing access to batteries for off peak storage or locating new depots close to major electrical infrastructure.

- Action 2. Participate and partner with the energy sector.

- Look at partnerships with the energy sector to develop future proofing solutions for energy supply to the zero-emissions bus fleet which could also benefit the local communities.

- Action 3. Monitor discussions on future power technologies and advances.

- Transport Canberra will engage with emerging technology developers and the manufacturing industry to ensure opportunities to invest in alternative energy supply solutions for buses is taken up. This will include monitoring the development hydrogen powered buses and the supporting hydrogen generation.

- Action 4. Work with other jurisdictions to identify shared solutions to shared problems.

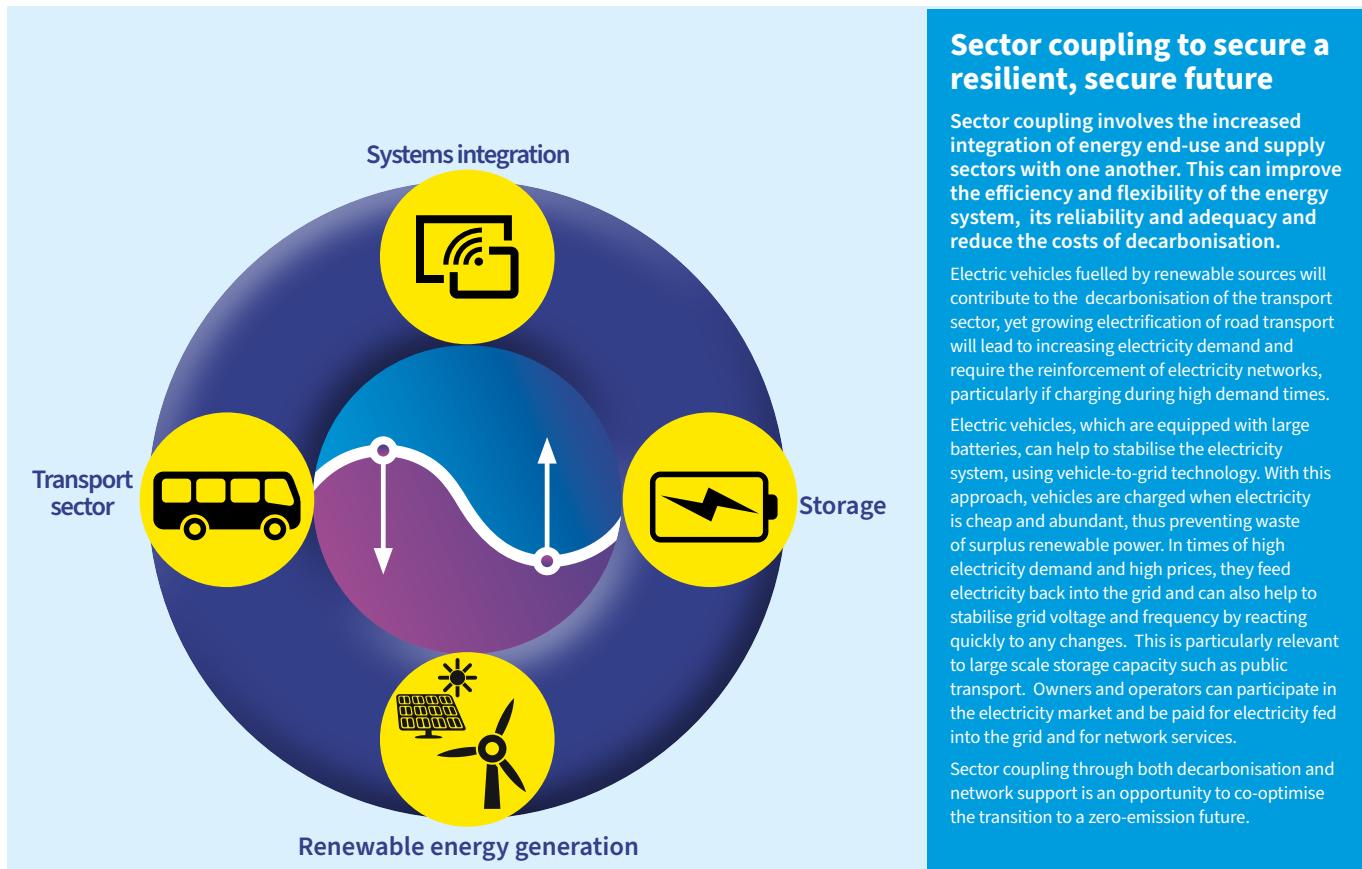
- Transport Canberra will continue to partner with larger jurisdictions as they explore solutions to addressing the impact of public transport on the environment in their regions. This could be through sharing information, partnering on investments and working at a national level to ensure consistency in compliance is achieved.

Transport Canberra has specific opportunities to play a role in energy demand management and grid network stabilisation in the future, and to better share associated infrastructure costs. This can help to deliver a range of benefits to the ACT community well beyond reducing emissions from the public transport system, such as reducing the need for costly upgrades of electricity network infrastructure that would ultimately be passed on to households and businesses through energy bills.

Currently bus routes that service Canberra are not all within the capabilities of current zero-emission buses. As a result, a mixed fleet of zero-emission buses needs to be considered into the future, while also adjusting the scheduling and routes that are currently utilised by Transport Canberra.

The Federal Government has identified that hydrogen production to support heavy vehicle usage is not expected before 2030. While there is strong interest in hydrogen as a zero-emission fuel with concertia already forming in region

Figure 10 – A joined-up transition



to consider its supply, all future usage of hydrogen in the ACT must be produced without emissions output. As a result, it would be difficult to purchase hydrogen from outside providers, as it may not meet the ACT's requirements.

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

Industry development, skills development and sustainable, resilient supply chains will be a key consideration in achieving value for money and autonomy in the future operations of Transport Canberra's bus network. This has never been more apparent than in 2020, with governments around the world looking at options to develop domestic industries to drive economic growth and better manage the impact future crises that may affect global travel and supply chains.

The transition will open opportunities to work with the education, skills and training sector as well as private industry to build and train the workforce, support the regional economy and allow the Territory to export learnings to other jurisdictions.

- Action 1. Engage with workforce to deliver a just and fair transition.

- To ensure that all workers have access to training that will allow them to transition into working on the future fleet, Transport Canberra will commence early and ongoing engagement to identify a suitable co-transition pathway.

- Action 2. Expand transition benefits to the ACT local market, involving businesses and organisations across the electric bus supply chain.

- Explore ways the commitment to a zero-emissions bus fleet could provide commercial opportunities for the local business sector, ranging from manufacturing to maintenance and supply across the bus fleet supporting infrastructure and service sectors.

- Action 3. Train and upskill workers and expand these to regional and nationally recognised certifications.

- Maintaining electric vehicles is an emerging challenge for the automotive sector. Transport Canberra will work closely with the local technology and training institutions, including CIT to develop appropriate educational solutions to meet this growing demand, in doing so supporting local industry to transition their employees to meet this shift in technology.

Existing fleet and workforce capacity

Zero-emission vehicles maintain much of the working componentry of a combustion-powered vehicle without the engine. Rather than an opposing skills set, zero-emission vehicles require both traditional and contemporary knowledge and skills. Transport Canberra will build upon the existing workforce skillset where possible to meet these needs.

Developing the skills to manage services and maintain vehicles will be critical to maintaining service reliability. The transition will focus on skills and training as an important enabling factor in the transition and one of the critical initial moves.

The opportunity to explore and develop these capabilities before implementing large scale change will de-risk the transition and build capacity and knowledge in the long term.

Workforce

An appropriately skilled and trained labour-force is critical to meeting the needs of current and future economy and driving growth in key engines of the economy. The ACT Government has an especially important role to play here, as both a major employer and as a major training provider through the Canberra Institute of Technology.

Training, upskilling and bringing the workforce on the journey will be key to optimising opportunities and delivering a just transition. Current and future employees will have an opportunity to up-skill, while continued use of diesels for at least the next decade will allow for other staff to adjust and transition in a just manner.

Central to this action will be an opportunity to learn on the go and to address issues in real time, while maintaining existing service levels and enhancing overall customer outcomes.

Jobs and economy

The transition to new technologies and new processes will drive new opportunities for industry, local jobs and skills both in the Transport Canberra workforce and the local economy.

Transport Canberra will concentrate on developing a flexible highly skilled workforce in its own operations as well as considering opportunities to drive skills and training as part of the Territory's broader ambition for a diverse, knowledge intensive economy, to ensure all sectors of the community can benefit from the renewables transition.

The Territory has an opportunity to leverage position through local skills development, operational pilots and being a first mover of technology. Coordinating the transition with other jurisdictions may help establish a nationally consistent approach to transitions and to commercial opportunities.

Resilient supply chains

A key benefit of zero-emissions buses is that the energy used to power them will be produced locally, either within the Canberra region or elsewhere in Australia. Australia has abundant resources for a renewable energy future, including sunshine and wind. Whether those resources are used to charge batteries or produce clean hydrogen, it will support local jobs in sustainable, growing industries and reduce the dependence on imported fossil fuels.

Partnering with the private sector or other public sector entities on infrastructure delivery will help to co-optimise positive outcomes. This approach will share the risk in the short term and de-risk investments in the long term.

All of these activities will be subject to consideration in future ACT Government investment decisions.

public space, Transport Canberra will explore ways to integrate public transport into the public realm that enhance a place in ways that diesel buses don't allow. This may result in improved accessibility, more opportunities for complementary business partnerships and demonstrations of the benefits of zero-emissions transport.

Transport Canberra has an opportunity to showcase the lived benefits of zero-emissions vehicles in the Australian urban environment at an operational scale. In time, this will mean not just trialling a few battery electric buses, but operating a depot exclusively with zero-emissions vehicles to test the feasibility of such an operation, identify where business practices may need to change to accommodate the new technology and make all the benefits of phasing out legacy diesel and gas buses clear.

Some opportunities include:

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

A key benefit of the transition will be improved service outcomes for customers and the community. By making use of the different features and advantages of both zero-emissions vehicles and the legacy diesel and gas fleets as well as thinking strategically about complementary investments in transport infrastructure, it is anticipated that there will be opportunities to deliver improvements to customer information, service frequency, travel times and comfort on-board buses.

- Action 1. Co-design technology advancements with the introduction of new fleet that enhance service and performance.

- With the opportunities of procuring a large number of new buses, Transport Canberra will explore through consultation with the community and bus manufacturers ways in which the users experience can be enhanced. This will involve all interactions across the public transport network from route planning to the cabin environment.

- Action 2. Consider place-based initiatives that showcase the benefit of zero-emission vehicles in the urban environment

- With the opportunities that zero-emissions buses provide in reducing the environmental impacts on a

- Better quality bus services for customers – transitioning to a modern, zero-emissions bus fleet can make catching a bus quieter and more comfortable. Enhanced technology will also present opportunities to fine-tune existing operations. Zero-emission vehicles will provide opportunity to align the back of house performance systems to better manage performance, range, battery levels and incidents.
- Lead broader change - transitioning to zero-emissions bus fleet will help to achieve the ACT government's zero-emission target. By playing a leading role in the space, the ACT Government will use 100% zero-emissions vehicles for bus operations and improve the uptake of zero-emission vehicles by the community, industry and commerce. Government has a role to play in taking risks that the private sector will not, in order to demonstrate the viability of new technologies and ways of doing things for the benefit of the whole community.
- Improved amenity and better places – one of the major drawbacks of diesel buses is that they are noisy, especially for those living near major bus corridors and interchanges. This can make it unappealing to serve key destinations effectively with buses, as they can make a place less attractive for pedestrians or commercial uses, such as outdoor dining. New zero-emissions vehicles such as the Yutong E12 battery electric bus currently being operated by Transport Canberra are quiet and will help to make Canberra's town centres and other key destinations more pleasant and attractive places.



TRANSPORT CANBERRA NOW VS THE FUTURE

| | Now | Future |
|--------------------------|--|--|
| Customer experience | A large number of the fleet do not meet disability standards and vehicles are noisy, produce heavy 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. |
| Fuel supply | <p>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.</p> <p>Natural gas is compressed on site and vehicles fuelled manually.</p> | <p>Electricity for zero-emission battery electric vehicles is supplied predominantly by the energy grid as well as behind the meter solutions. 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 pantograph systems and the charging program is key to optimising whole of life costs of the battery and energy supply.</p> <p>In the future hydrogen is provided via on-site processing or pipeline network.</p> |
| Workforce | <p>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.</p> <p>Bus drivers can be driving a 30 year-old bus one day and a brand new one the next.</p> | <p>The workforce is more agile to manage the new models presented through zero-emissions.</p> <p>Workshop staff are skilled across multiple areas and technologies.</p> <p>Bus drivers are driving newer, safer buses which are better for them and the customers.</p> |
| Systems management | Systems management is focused mainly on passenger information. | <p>Zero-emission buses will require more complex systems management to manage the on-board storage systems and manage vehicle and service performance.</p> <p>Depots will be network control centres that deliver a smooth, reliable service to customers.</p> <p>Passengers experience a reliable, integrated journey across modes.</p> |
| Interchanges and streets | Diesel and CNG 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. Interchanges can be integrated with surrounding land uses without the negative impacts and our streets, neighbourhoods and places are cleaner, healthier and more accessible by public transport. |
| Vehicle purchases | <p>Vehicles are purchased outright and driven to the point of irreparable mechanical failure.</p> <p>Staff use spare parts from retired buses to supplement the useful life.</p> | Vehicles are procured as a service asset through a range of procurement approaches. Adapting to technology change and managing obsolescence is factored into the initial procurement and the territory can achieve better value money and a better share of risk. |

TRANSITION PRINCIPLES

Sustainable

The transition will 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.

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 life of 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 overtime.

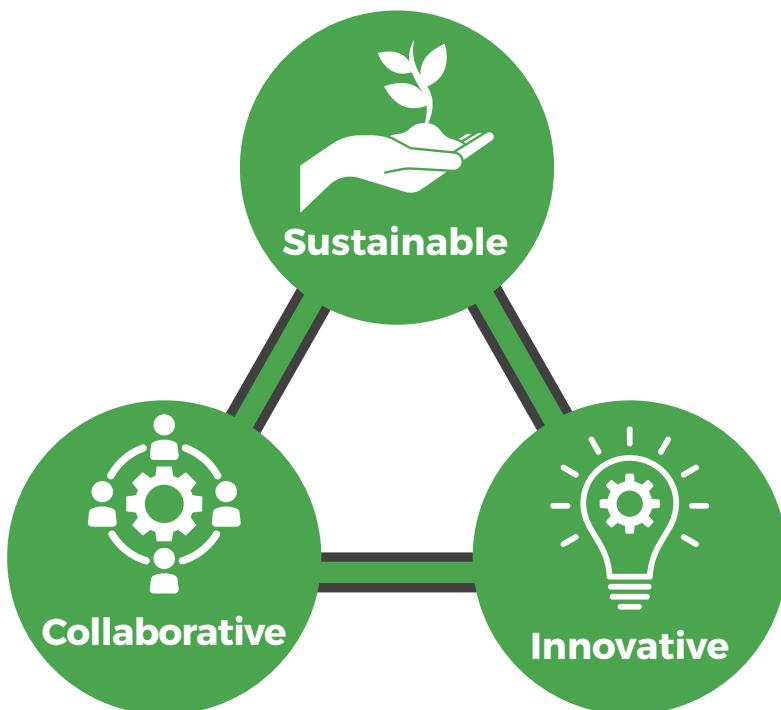
The ACT Government has a number of important roles to play to facilitate this collaboration, including as a participant in a number of industries in the region, as a regulator or through specifically designed interventions and initiatives that drive a shared approach to learning and progression.

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 delivered 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.



ZERO-EMISSION
TRANSITION PLAN
FOR TRANSPORT
CANBERRA

200784



Transport Canberra and
City Services

September 2020