



Taking Charge:

The role Auckland Transport is playing in transitioning buses from diesel to zero emission

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Auckland Transport's role as a transport provider is rapidly evolving to meet and anticipate fast-paced changes in how people want and need to travel. We play an active role in shaping a growing, vibrant Auckland with more sustainable and networked modes of transport, and in integrating the diverse new ways our customers will be more mobile.

Climate

A look at transportation emissions in Auckland.

Over 1.66 million people call Auckland home – a place rich in diversity where the energy and excitement of city life meets spectacular natural beauty in every direction. With the vision of being a world-class city, Auckland is challenged with balancing growth and prosperity with environmental stewardship, particularly around greenhouse gas emissions reduction and adapting to a changing climate.

The largest source of emissions in Auckland is road transportation, comprising 35% of the region's emissions profile according to Auckland Plan. There are three key aspects that influence transport emissions in Auckland; vehicle kilometres travelled, fuel type, and fuel efficiency.

Historically, Auckland's growing population resulted in a higher volume of vehicle kilometres travelled. With \$28 billion of investment in the transport system over the next 10 years, Auckland Transport expects a strong shift to public transport and active modes that will eventually decouple population growth and number of vehicle kilometres travelled. Creating this modal shift is an essential cornerstone in reducing emissions on the road network.

Fuel consumption is the other key element when it comes to transport emissions. Despite vehicle kilometres increasing in the past, overall fuel consumption has grown very little comparatively. This can be attributed to fuel efficiency improvements in vehicles and the more recent trend in electric vehicles.





light vehicle fleet is forecasted to reduce fuel consumption by 3%



heavy commercial vehicle fleet predicted to increase fuel consumption by 23%



heavy commercial vehicle fleet predicted to be accountable for 85% of the anticipated increase in road transport emissions

However, when comparing diesel with petrol consumption over the next ten years there is a significant increase in diesel consumption. While the light vehicle fleet is forecasted to reduce fuel consumption by 3%, it is expected that the heavy commercial vehicle fleet will increase fuel consumption by 23%. As such, the heavy commercial vehicle fleet will be accountable for 85% of the anticipated increase in road transport emissions.

Modelling and forecasting predicts that emissions will increase by 5% over the next decade because of a growing population and dominant heavy vehicle use. Reducing road transport emissions will require a multifaceted approach that addresses rapid mode shift and adopting zero emission technology solutions.

Commitment

Setting the direction for change.

A focus of Auckland Transport's 2017 Sustainability Framework is low emission transport choices to mitigate climate change, improve air quality, and reduce the city's reliance on fossil fuels. Developing a low emission bus roadmap was identified as one of Auckland Transport's priority actions in the 2017 Sustainability Framework.

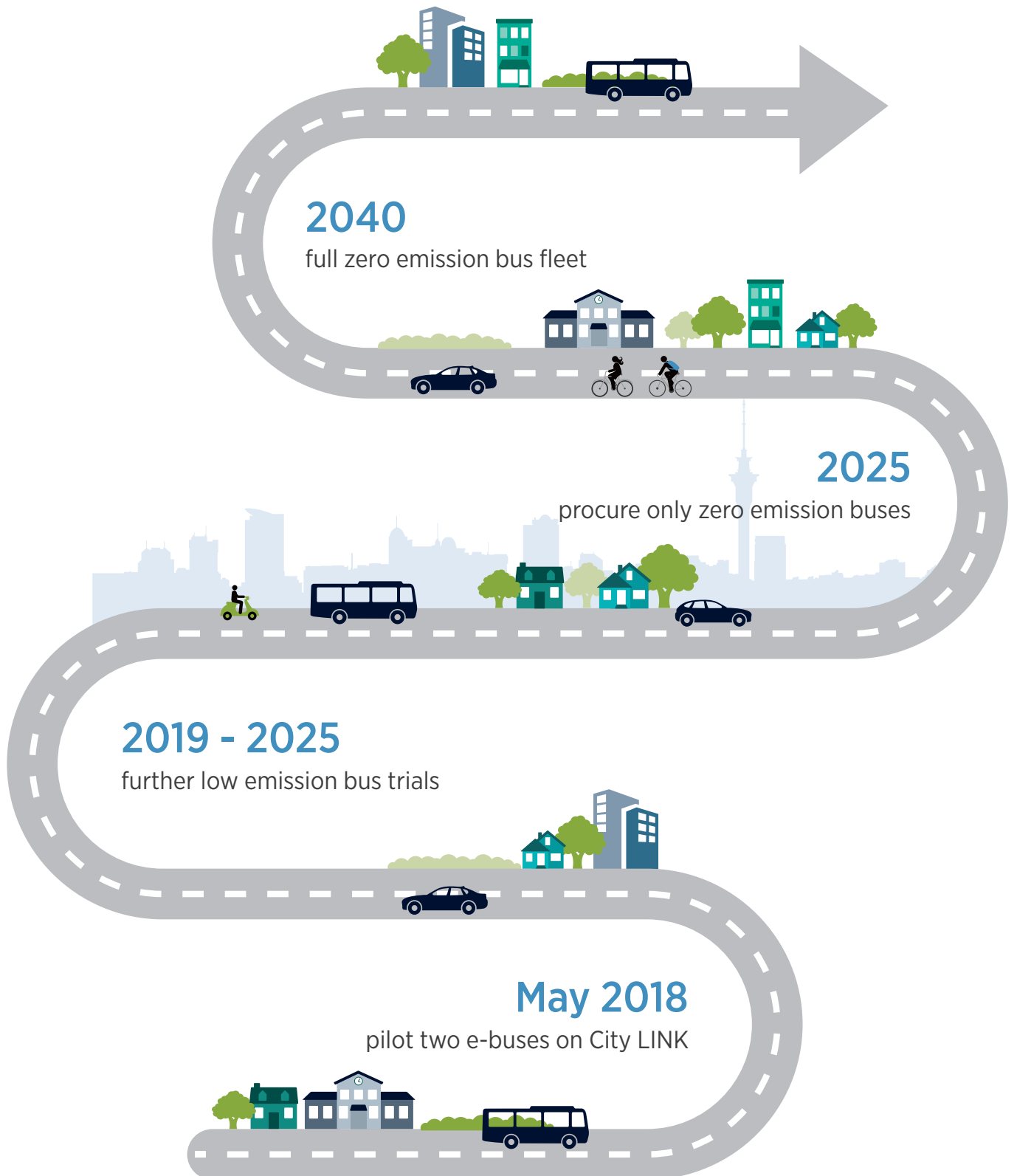
In 2017, Auckland signed the C40 Fossil-Fuel-Free-Streets Declaration at the "Together4Climate" event in Paris. C40 Cities is a network of the world's megacities committed to addressing climate change, of which Auckland is a member. The declaration commits Auckland to procuring only zero emission buses from 2025 and to ensure that

Auckland's city centre reaches zero emissions by 2030. At the time of signing the declaration, Mayor Phil Goff shared, "it is a defining issue of our time and setting ambitious zero emission targets is the only way we will make a serious impact on reducing our carbon emissions."

Since the signing of the declaration, Auckland Transport has worked diligently to create the region's first ever "Low Emission Bus Roadmap". This piece of work was completed in December 2018 and presents a baseline for transition of Auckland's bus fleet to a low emission fleet, with key milestones at 2020, 2025, and 2040. The roadmap takes into consideration relevant policy frameworks, technology and innovation, financial impacts, infrastructure challenges, and strategic options.



Low Emission Bus Roadmap. The pathway to cleaner air for Auckland by eliminating diesel buses from the city's roads.





Context

Understanding the operational challenges for transitioning to zero emission.



Auckland's buses are privately owned. Auckland Transport contracts all of its urban and school bus services to 10 bus operators. There are currently around 100 routes, using approximately 1,300 diesel buses. The fleet size varies considerably between operators. The largest fleet size operates over 500 buses, while some smaller operators have fewer than 100 buses each.

With a fully outsourced bus fleet, the Low Emission Bus Roadmap took into consideration several different strategic options for transition to a zero emission fleet. The preferred scenario recommends that the bus operators continue to purchase the vehicles, with Auckland Transport specifying that all contracts from 2025 onwards will require new buses purchased for end-of-life replacements or fleet growth to be zero emission. The vision is for the entire bus fleet to be zero emission by 2040.

The Low Emission Bus Roadmap and the recommendations within was well received by Auckland Transport's board of directors.



In fact, the board requested that staff explore modelling options to accelerate the programme of work.

Transitioning to a zero emission fleet will need to accommodate a variety of influencing factors. One of which is the timing of the contracts with the bus operators. Swapping diesel buses for zero emission ones will be orchestrated primarily through contract negotiations with operators, which are all due to be re-tendered at various stages throughout the 2020s. It is through these negotiations that Auckland Transport can stipulate the fleet specifications to be zero emission. Therefore, these contracts define the timescale over which requirements for new technologies can be procured. This process will require active engagement with fleet operators for effective implementation.

Another important consideration for the transition to zero emission is the impact of fleet electrification on Auckland's electricity grid. Each operator with electric vehicles will be

responsible for providing charging facilities for their fleet. To better understand these potential impacts, Auckland Transport worked with C40 Cities to engage experts to investigate the peak power demand and grid upgrade costs for 15 bus depots in Auckland, assuming they would operate a fully electric fleet. This study revealed that significant investment in the electricity grid (up to \$32 million NZD) is required for electrifying the bus fleet.

The upgrade costs will address substation upgrades to accommodate a higher peak load and cable costs to connect depots with substations. The study recommended that electrification would be more achievable for bus operators with multiple depots as this provides the flexibility to move buses between depots and electrify whole depots at a time. However, further investigation of each depot is required to better understand the specifications of the project, i.e. bus models, operating data, sizing bus chargers, and analysis of mitigation strategies such as opportunity charging.



Choices

Navigating the suite of zero emission solutions available.

In order to transition to a zero emission bus fleet, Auckland Transport needs to know what to migrate to, and by when. Low emission technology has come a long way with electric vehicles becoming more mainstream in the passenger-car market. However, when it comes to the bus fleet, how does the technology stack up?

First, the technology application must meet regulatory requirements for bus operations. For example, batteries for electric buses can affect the size and weight of the vehicle, which must align with the Ministry of Transport's Public Transport Operating Model. Secondly, not unlike the passenger car fleet, zero emission buses still face the pervasive issue of

“range anxiety” and supporting infrastructure costs.

Despite these challenges, major cities around the world are still embracing the technology as a means of slashing emissions, reducing operational costs, and delivering social benefits. Research shows that battery electric buses are the most commonly adopted technology, followed by plug-in hybrid and hybrid buses.

The Low Emission Bus Roadmap examined different low emission fuels and technologies based on life cycle analysis. Auckland Transport examined diesel hybrid, plug-in hybrid, battery electric, compressed natural gas, biodiesel, and hydrogen fuel cell options, assessing each for practical application in Auckland through a whole-of-life lens.

It was determined that battery electric buses offer the best all-round opportunities with

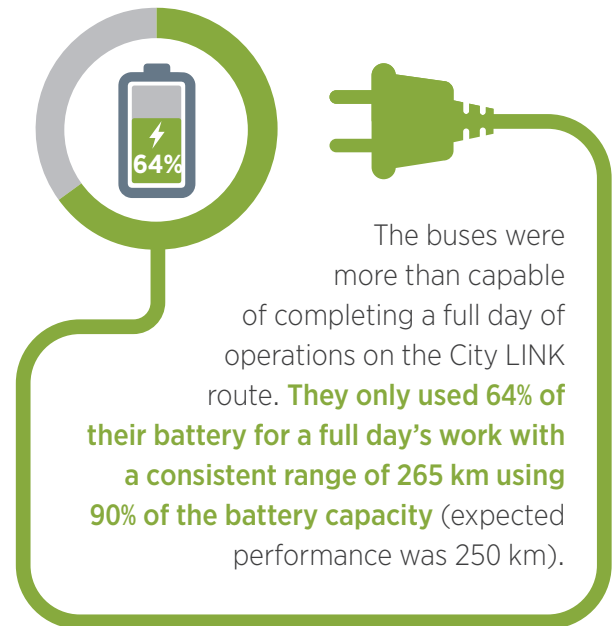
hydrogen fuel buses serving as a suitable option for large fleets travelling longer ranges. It was recently announced that Ports of Auckland have partnered with Auckland Transport, Auckland Council, and KiwiRail to procure a hydrogen fuel cell bus and three hydrogen fuel cell cars as part of a wider project to build a hydrogen fuel production plant. The project will be co-funded by EECA and present additional opportunities to work collaboratively with suppliers to test low emission technology in Auckland.

City LINK Trial

When rubber hits the road.

In May 2018, Auckland Transport worked in partnership with bus operator NZ Bus to launch what started as a six-month trial of two electric buses. The vehicles serviced the City LINK route and performed exceptionally well.

The City LINK route was selected because the length and topography of the route was appropriate, it was near a bus depot, and it travelled through poor air quality zones with high public exposure.



The buses were more than capable of completing a full day of operations on the City LINK route. **They only used 64% of their battery for a full day's work with a consistent range of 265 km using 90% of the battery capacity** (expected performance was 250 km).



City LINK Trial

The bus model is a Enviro200EV from Alexander Dennis and BYD. Both buses are battery electric.

Each bus and charger cost \$840,000 and were purchased by AT with funding support from Energy Efficiency and Conservation Authority (\$500,000).



There were operational savings of \$10,900 from the two buses, which travelled a combined 17,400 km over the trial period. It is expected that lower operating costs will reduce the total cost of ownership and offset high capital costs. Furthermore, the electric buses demonstrated an estimated emissions reduction of 160 tonnes of CO₂ over the course of six months.

With the success of the City LINK trial, Auckland Transport has begun experimenting with alternate routes to challenge the technology. In addition to the City LINK trial, a third electric bus (with slightly different technology) was acquired on loan from a manufacturer and is servicing the Airporter 380 route alongside one of the buses that operated on the City LINK. The remaining electric bus is now servicing the Inner LINK route. These additional trials allow us to gather more local

data on range and operating costs to inform future investment decisions.

The positive results of this trial indicate that the City LINK route is the perfect candidate for a transition to a zero emission fleet in 2020 when the operating contract comes up for renewal. This would be the first “electrified contract” and would target emissions reduction in the city centre.

Collaboration

Influencing the supply chain.

With a vision in place, Auckland Transport now must address the challenges to make a zero emission bus fleet a reality. The success of the roadmap relies on strong relationships with the entire supply chain, from bus operators to technology/infrastructure suppliers to manufacturers. Delivering a zero emission fleet by 2040 will require a coordinated approach, facilitated by Auckland Transport, where collaboration drives innovation and effective implementation.

With the bus fleet outsourced to operators, the contracts that Auckland Transport have with the bus operators dictate the speed at which the transition to zero emission buses can be made. The Low Emission Bus Roadmap identified that bus operators are sceptical of



Bus

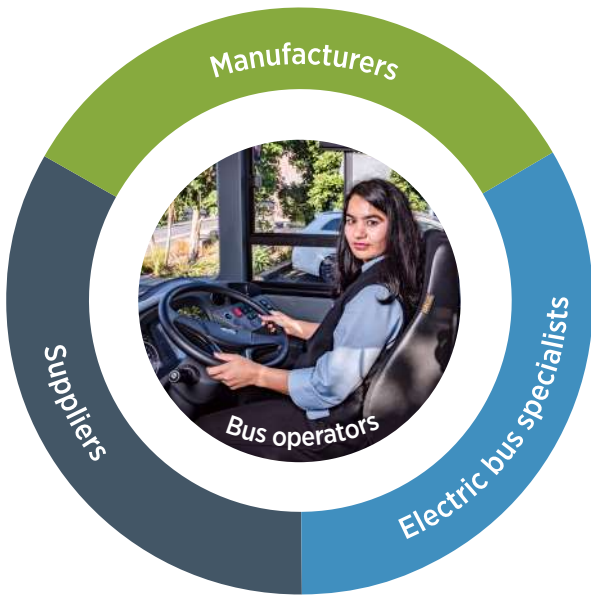
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Sched	Route	Destination	Platform	Due
11:55	321	HOSPITALS	C	17
12:00	351	HIGHBROOK	B	21
12:00	325	MANGERE	C	22
12:02	32	SYLVIA PARK	A	23
12:02	321	BRITOMART	A	23

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Bus Stops A & B





new technologies and their performance and many already have a relatively new diesel fleet. Auckland Transport has signalled to operators the objectives of the Roadmap, however, there is a delicate balance between sharing the vision and not spooking operators with high upfront capital costs, possibility of stranded assets, and completely new ways of doing business.

It is Auckland Transport's mandate to convene key players (manufacturers, suppliers, electric bus specialists) and familiarise them with the Auckland market, giving them an opportunity to share their expertise with the bus operators. Ensuring the bus operators are equipped with an understanding of the benefits and practical application methods will help provide the confidence for a smooth transition. Auckland Transport is planning to establish a national Low Emission Working Group that will engage industry stakeholders in policy decisions, creative fiscal incentives, growing the market, and facilitating supply chains.

Auckland Transport is looking to change the way public transport operates, transforming the entire system that enables passengers to get from A to B. Disruptive innovations can upset mature operations and alter the face of entire industries. As Auckland Transport continues to channel learnings into tangible outcomes, one thing is clear – bringing the supply chain along the journey is critical for success.



Conclusions

Auckland is a technology and innovation hub and is quickly becoming an emerging market for both local and international low emission bus technology. Auckland Transport is unique in that it has a strong strategic vision, which has incorporated deep-rooted thinking around industry impacts and realistic implementation mechanisms. Other distinct features of the Low Emission Bus Roadmap include the emphasis on life cycle analysis to ensure a sustainable transition and a continual thirst for knowledge from practical technology trials.

Although Auckland Transport is still embarking on the low emission journey, we have collected a few lessons along the way. Darek Koper, Manager of Bus Services, shares his top three tips for dealing with disruptive innovation:

1. Be Agile

When it comes to disruptive innovation and change management, the key to success is flexibility. Be prepared to modify the approach to adapt to developing technology and evolving markets. Do not let perceived risks prevent you from seizing opportunities.

2. Engage Early. Engage Often

Identify stakeholders early on and be proactive about sharing learnings, benefits, and industry research. Take a systems-based approach to ensure all layers of the supply chain are considered, including funders and regulatory bodies. Understand the challenges and work collaboratively to mitigate risks.

3. Collect Knowledge

With limited local market expertise, Auckland Transport depends on research from international markets. Collecting knowledge from industry experts is an effective way of determining what is required for successful application in Auckland. Asking the tough questions such as “what the challenges were” and “what didn’t go so well” are perhaps more helpful in sidestepping costly faults that others experienced first-hand.

As for next steps, Auckland Transport looks forward to undertaking additional zero emission vehicle trials while further investigating grid impacts for charging infrastructure. The Low Emission Bus Roadmap has set the direction to continue to collaborate with stakeholders to influence national policy while growing the low emission bus market in Auckland.





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