

# E- Bus Trial Update

## Recommendations

That the Board:

- i. Notes the update on the progress made on the electric bus (e-bus) trial;
- ii. Notes the Low Emission Bus Working Group will be established at an industry forum on 23 July 2019;
- iii. Notes the role Auckland Transport is playing in transitioning buses from diesel to zero emission (Attachment 1).

## Executive summary

1. AT is hosting an electric bus industry forum on the 23 July 2019 where the Low Emission Bus Working Group will be established.
2. Auckland Transport (AT) has three electric buses in operation for the purpose of trialling electric buses on Auckland urban roads. Two ADL/BYD e-buses were purchased in February 2018, with a third e-bus from Yutong introduced in February 2019 on a 12-month free loan.
3. The ADL/BYD e-buses have performed well on the CityLink route, demonstrating the ability to complete a day's scheduled operations on a single charge, with a significant reduction in operating costs of an average 77 percent. The limited in-operation availability at the start of the CityLink trial was due to electrical faults at the depot and was resolved. Feedback from bus drivers, as well as customers, has been positive.
4. The ADL/BYD e-buses on the InnerLink and 380 Airporter routes show up to 84 percent lower operating costs compared to diesel.
5. The Yutong e-bus is being trialled on the 380 Airporter and the 309 routes. It is of a similar size and weight to the two ADL/BYD buses but uses a different drive and charging technology and has higher capacity batteries to support the availability of air-conditioning. This bus is demonstrating 76 percent lower operating costs when compared to similar sized diesel buses.
6. A global search for suitable hydrogen fuel cell (HFC) electric buses has been completed. A procurement process is in its final stages to select preferred suppliers of three buses for HFC e-bus trials. Additionally, an extra-large three-axle electric bus is being procured.
7. The e-bus trials provide valuable insights to assess the potential challenges and barriers that will need to be overcome in order to enable faster adoption of zero emission fleet by AT's supply chain.
8. AT's approach to adopting a zero emission fleet and the results of the CityLink e-bus trial were presented to the Climate Leaders Coalition in May 2019 as a Case Study (Attachment 1).

## Previous deliberations

9. The Board endorsed at its December 2018 meeting the Low Emission Bus Roadmap Version 1:

- All new and end-of-life diesel fleet replacement buses are to be procured as low-emission vehicles (zero-emission at tail-pipe) from 2025 (latest), preferably earlier - subject to confirmed/refined benefit cost;
- Further uptake of low-emission (zero-emission at tail-pipe) bus trials including a hydrogen fuel cell trial in partnership with Ports of Auckland, and for the City LINK service to be full zero-emission at tail-pipe operation from November 2020 (new contract commencement), subject to further information provided to the Board on each trial and funding availability;
- The set up and running of a low-emission bus working group comprising NZTA, councils and bus operators.

## Strategic context

10. The Auckland Transport Alignment Project (ATAP) priorities include:

- Encouraging mode shift from cars to public transport, walking and cycling;
- The adoption of low emission vehicles;
- Meeting our wider environmental commitments such as the Paris Agreement and the C40 Fossil-Fuel-Free Streets Declaration.

11. A focus of AT's Sustainability Framework is low emission transport choices, which mitigate climate change, improve air quality and reduce the city's reliance on fossil fuels. One of the framework's key actions was to develop a Low Emission Bus Roadmap. AT's Statement of Intent 2019-2021 is committed to the development of this roadmap in the 2018/19 year. This Roadmap has now been adopted as a baseline transition, with continuing 12-18 month updates to the Roadmap's base level scenario.

## Background

12. In February 2018 AT purchased two ADL/BYD e-buses. Each bus and charger cost \$840,000 and were purchased by AT with funding support from Energy Efficiency and Conservation Authority (EECA).

13. In December 2018 the AT Board endorsed the Low Emission Bus Roadmap ("Roadmap") and endorsed further uptake of low emission bus trials including for the CityLink service to be full zero emission by November 2020 and hydrogen fuel cell (HFC) trial in partnership with Ports of Auckland Limited (POAL).

14. In February 2019 a third trial e-bus has been provided by Yutong China on a free 12-month demonstration of the vehicle and charging technology.

## Issues and options

15. Success of the Roadmap relies on strong relationships with the entire supply chain, from bus operators to technology/infrastructure suppliers and bus manufacturers. Delivering a zero emission (at tail-pipe) fleet, by 2040 requires a coordinated approach facilitated by AT; collaboration will drive innovation and effective implementation. The electric bus trials are key enablers to understand costs, benefits, challenges and barriers to adoption of zero emission fleet.
16. The six-month trial of two e-buses on the CityLink service has been completed in November 2018. The e-buses were more than capable of completing a full day of operations. They only used 64 percent of their battery for a full day's work with a consistent range of 265 kilometres using 90 percent of the battery capacity (expected performance was 250 kilometres). Operational performance showed average 77 percent lower operating costs compared to diesel buses on the CityLink circuit. The two electric buses demonstrated an estimated emissions reduction of 160 tonnes of CO<sub>2</sub> over the course of six months. The results of the CityLink trial were part of a case study presented to the Climate Leaders Coalition (Attachment 1).
17. Three e-buses are currently being trialled on the 380 Airporter, InnerLink and 309 routes. The ADL/BYD bus on the 380 Airporter shows 83 percent lower operating costs per trip compared to similar diesel bus. The other ADL/BYD bus on the InnerLink route shows similar savings with 84 percent less costs to operate. Regenerative braking on route and less challenging topography and passenger loadings on the 380 Airporter and InnerLink trips are attributed to greater savings compared to those achieved on the CityLink trial.
18. The Yutong e-bus used on the 380 Airporter and 309 routes achieves a theoretical driving range of up to 340 kilometres using 90 percent of battery capacity and up to 75 percent lower operating costs on the 380 Airporter and 309 service compared to a similar diesel bus. The Yutong bus has a fully electric air-conditioning / heating unit, with a higher capacity battery to sustain the additional function. The operating performance of this bus has attracted positive feedback from bus operators.
19. The e-bus trials inform AT of the operating cost component of contract rates with bus operators. They also provide bus operators with the opportunity to test operation of e-buses in order to build operator confidence, develop bus driver training, and assess their procedural needs in order to transition to an electric fleet.
20. The trials also enable testing of the bus charging technology. ADL/BYD uses a two-plug system of 40kW per plug enabling slow charge overnight at depot. The charging time takes up to six hours. The Yutong bus uses single plug design of 150kW charge enabling fast charging between 1.5 hours to 4 hours depending on the power supply.
21. The initial depot set up and the transfer of trial e-buses between operators and routes identified issues and opportunities to improve design and processes. These included:

- Initial charging software on the ADL/BYD buses caused tripping of Residual Current Devices (RCD) installed with the depot chargers. These issues have been overcome with a software change on-board the bus;
- Changing operation to route 380 Airporter required an increase in speed limit for an e-bus (NZTA permit limited the operating speed of ADL/BYD buses due to a calculated rollover limits). The review process identified the need to update the rollover testing in New Zealand for e-buses and higher capacity electric motors to enable driving on motorways at safe speeds of up to 80 km/hour;
- Software update to change the speed limit on the ADL/BYD bus after a permit was granted by NZTA (based on European rollover test standards), has caused issues with bus kneeling and prevented safe use of the e-bus in service and has been resolved;
- Concerns over lower speeds of the ADL/BYD bus on motorways and door issues had initially limited the dispatching of ADL/BYD bus to the 380 Airporter services. These issues have been resolved by a software fix and buses are well utilised;
- General bus driver shortage and limited training affected the utilisation of e-buses on InnerLink route. The driver numbers have improved, and the e-bus is regularly in service.

22. Progress has been made with the hydrogen demonstration project in partnership with Ports of Auckland Limited (POAL). This includes:

- Successful joint application to the Energy Efficiency and Conservation Authority (EECA) for funding towards purchase of a trial hydrogen fuel cell (HFC) fleet with \$160k of funds allocated to spend on an HFC bus to be purchased by AT;
- Route profiling to assess fleet and HFC technology options and specifying HFC buses for a trial;
- Developing new regulations for hydrogen as a fuel through collaboration with NZTA.

23. AT is assessing HFC e-bus fleet options and quotes from global bus suppliers. Up to three HFC trial e-buses (single and double deck), subject to approval, are expected to be delivered by mid-2020 (note, the hydrogen production plant and refuelling station is to be built by POAL in Q2 of 2020).

24. AT is in the final stages of a procurement process for an extra-large three-axle e-bus to expand the trials to test new large capacity bus designs previously not available on the global e-bus market.

25. Closer collaboration is underway with other key players in the low emission bus technology industry to establish and lead a national Low Emission Bus Working Group; The intention is to break down barriers to the adoption of low emission buses and address identified issues through regulatory change and e-bus design.

26. Remodelling the costs and benefits of earlier transition to electric buses is underway, with updated lower operating costs of e-buses based on learnings from the AT e-bus trials.

27. A Low Emission Bus Forum to be held on 23 July 2019 will bring together key players in AT's supply chain with bus operators, manufacturers, technology suppliers and academia to collaborate with NZTA and other government agencies. The Low Emission Bus Working Group will be established at this Forum.

## Next steps

28. Continue e-bus trials on different routes and with different bus operators. The Yutong e-bus will transition to the Onewa Road services from August 2019. One ADL/BYD bus will transition from 380 Airporter to the OuterLink route in December 2019.

29. Continue to undertake trials and demonstrations of zero emission buses and their associated infrastructure (subject to budget and availability) where possible maximising alternative funding streams such as from EECA and private capital. Proposed options include:

- Further electric bus trials from other manufacturers and extra-large three-axle e-buses from June 2020;
- Hydrogen electric bus trials (incorporating hydrogen supply) from June 2020;
- Assessment of 'opportunity' charging on route versus plug-in charging at depots and key stations/ layovers;
- Trial re-power of diesel extra-large three-axle and double decker buses to electric using proven technology.






30. Lead a national Low Emission Bus Working Group to break down identified barriers to the adoption of zero emission buses in Auckland and New Zealand.

31. Implementing a large-scale trial on the CityLink route with an all electric bus service from November 2020.

## Choose an item.

Attachment Number	Description
1	Taking Charge: The role Auckland Transport is playing in transitioning buses from diesel to zero emission

## Document ownership

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## Glossary

Acronym	Description
EECA	Energy Efficiency and Conservation Authority
HFC	Hydrogen fuel cell
e-bus	Electric bus
ADL	Alexander Dennis Limited (UK bus manufacturer)
BYD	Build Your Dreams (Chinese bus manufacturer)
RCD	Residual Current Device