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EMISSION FREE MODES OF PUBLIC TRANSPORT

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Committee on Transport and Infrastructure's Inquiry into Emission Free Modes of Public Transport

Response from University of Sydney Net Zero Initiative

Prepared by
Prof John Nelson,
Prof David Levinson,
Dr Geoffrey Clifton and
Dr Emily Moylan

School of Civil Engineering
Faculty of Engineering
Civil Engineering Building J05
The University of Sydney
NSW 2006 Australia

[redacted]

ABN 15 211 513 464
CRICOS 00026A

Introduction

It is our pleasure to provide information to the Committee on Transport and Infrastructure's Inquiry into Emission Free Modes of Public Transport. We are academic staff at the University of Sydney. John Nelson is Professor of Public Transport at the Institute of Transport and Logistics Studies (ITLS). David Levinson is Foundation Professor in Transport Engineering. Dr Geoffrey Clifton is a Senior Lecturer in ITLS. Dr. Emily Moylan is Lecturer in Transport in the School of Civil Engineering. We are part of the University of Sydney's Net Zero Initiative. While we cannot comment on specific investment decisions, which are usually context-specific, we can provide some general background and ways of thinking about the question.

Reducing the emissions of the transport sector is essential, as pollution has significant effects on human health,[1] and CO2 emissions are responsible for climate change. There are other co-benefits of electrification as well. Low noise from non-combustion engine vehicles creates a more pleasant street experience for travellers on that mode as well as travellers on other modes, as well as adjacent properties, thereby improving residential property values along highways[2] and train lines and improving the usability of footpath and shop front commercial properties along bus corridors.

Emission-free modes of public transport include buses, trams, trains and ferries with zero CO2 equivalent emissions from the vehicle. This includes electric vehicles or hydrogen fuel cell vehicles. However the life-cycle emissions may be non-zero if the electricity or hydrogen was generated in a process that produces CO2 equivalent emissions.

The most narrow definition of the problem is consideration of electrification of buses (as most rail public transport is already electric), and assuming that the electricity sector will decarbonise on its own. More broadly, there are steps that are required for the electricity sector to decarbonise, which though market conditions are already moving in that direction with the rapid uptake of renewable power sources, can be helped or hindered by

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[1] Dean, A., & Green, D. (2018). Climate change, air pollution and human health in Sydney, Australia: A review of the literature. *Environmental Research Letters*, *13*(5), 053003.

[2] McElveen, M. A., Brown, B. E., & Gibbons, C. M. (2020). Highway noise and elevation effects on nearby home prices: Spatial econometrics using LIDAR-derived data. *Real Estate Finance*, *37*(1), 3-13.

government policy. Finally we need to consider the entire trip of which public transport is an element.

We address the issues of Decarbonising Public Transport and of Public Transport Access in turn.

Decarbonising Public Transport

We need to focus on decarbonising the entire transport sector, of which public transport is a small share in most cities. Attention should be given to both technically transitioning the vehicle fleets to "emission free" (EF) and decarbonising the electricity generation mix (there is no point just focussing on emission free at the point of use).

Until renewable electricity technologies achieve widespread deployment in Australia, fossil fuels are still likely to comprise a significant share of the electricity mix. More rapid deployment of emission mitigation and renewable energy technologies will need to be accompanied by a substantial mode switch to electric (and perhaps hydrogen) trains and buses – i.e. we need to adopt new technologies and encourage a mode shift from the private car towards public transport (since emissions per person kilometre travelled is significantly lower for bus users).

Practical issues for depots will need to be considered (e.g., implications for design and location (including new build v retrofit) and access to the electricity grid). This implies the need for the public transport sector to be in dialogue with the energy sector.

Bear in mind the need for a state-wide response to meet the requirements of contrasting operating environments. Electric buses are more suited to urban areas due to their current range and the frequency to be charged. Hydrogen buses have a much larger range (and require more substantial infrastructure), making them more suited to more long-distance routes. Other alternatives include compressed natural gas (CNG) or liquified natural gas (LNG), although there are storage issues.

Electric trains produce the lowest levels of emissions when compared to conventionally fuelled trains and hydrogen trains. However, emissions remain dependent on the electricity generation mix. It is important to think in terms of rolling stock, as well as the tracks and platforms. Installing catenary to support train electrification in less well used corridors is expensive (and the construction equipment utilised is not itself necessarily electrically-powered) and will thus have a longer environmental payback time than other investments.

Other jurisdictions that have emission free modes of public transport

- Examples of country-level support for electric buses through the introduction of grants and subsidies include the Transportation Investment Generating Economic Recovery (TIGER) programme in the USA, the Green Bus Fund programme in the UK and the Ten Cities and Thousand Vehicle Programme in China (see Logan et al. 2022[3] for a compilation of international experience).
- The Bus2Grid project in London[4] is using 28 buses to demonstrate the potential for bi-directional charging.
- Hydrogen buses offer similar benefits to electric buses (low environmental emissions, energy conservation and generating minimal noise) but offer greater flexibility in deployment because they have a significantly larger range of ~ 450 km range, typically taking 7–10 min for a full charge. Although a relatively new technology, they have been introduced in Asia, Europe, North and South America (see Logan et al. 2022).
- Aberdeen, Scotland introduced an initial fleet of ten hydrogen buses in 2015, representing the largest deployment in Europe.[5] Subsequently, a small fleet of double deck buses have been deployed.[6] Refuelling infrastructure is shared with Council fleets.

We recommend that to achieve the highest co-benefits that:

- Electrification of the public transport sector be supported and encouraged. Buses in higher density urban corridors should be electrified first, as this will generate the greatest noise-reduction and pollution-intake reduction co-benefits.
- Decarbonisation of the electricity generation sector be supported concurrently.
- Policies that encourage use of public transport be supported, as this will result in less use of a higher polluting internal combustion engine private vehicles. These policies include permitting higher density development near train stations, pricing policies that ensure the out-of-pocket cost of public transport is lower than that by

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[3] Logan, K G, Hastings, A and Nelson, J D (2022) *Transportation in a Net Zero World: Transitioning Towards Low Carbon Public Transport*. Springer.

[4] https://www.sseenergysolutions.co.uk/distributed-energy-infrastructure/our-solutions/bus2grid

[5] https://www.ballard.com/docs/default-source/motive-modules-documents/aberdeen-bus-case-study-website.pdf?sfvrsn=6151c280_8#:~:text=City%20Council%20implemented%20the%20Aberdeen,streets%20with%20zero%2Demission%20buses.

[6] https://www.intelligenttransport.com/transport-news/116179/hydrogen-buses-aberdeen/

automobile for comparable trips, and public transport fare structures which don't penalise transfers between public transport modes.

Public Transport Access

The problem of accessing public transport stations is often referred to as the "last mile" or "first and last mile" problem. While having fast, direct, frequent, and reliable public transport service is important, being able to get to that service is also critical. The travel times involved in accessing transit stations at either end are often as long as the time spent moving aboard the transit vehicle.

More broadly still, we need to consider what we mean by public transport. Walking to a bus and taking the bus to a final destination is the simplest mental model. Public transport is thus supported by active travel modes (walking, cycling, etc) which have negligible emissions. But we might also consider driving to a commuter car park and taking a train or express bus. While the train is electrically powered, (and the bus might be) and that electricity may be purchased from renewable sources like Snowy Hydro, the car driven to the car park may not be. So a system that produces emission-free public transport must consider access (and egress) modes as well as the mainline transport.

New modes, especially micromobility, electrically-powered and tailpipe emission-free small vehicles like e-bikes and e-scooters, extend the range of the pedestrians (and themselves are accessed on foot), but require separate and protected lanes from both footpaths and automobile travel to be safe on all but the lowest speed roads. Micromobility is increasingly used to replace or supplement traditional public transport modes.

Recommendations:

- Separated and protected bike paths for both bikes and micromobility devices should be constructed supporting all public transport stations to enable more emissions-free access within a 4 km radius.
- Bike parking should be provided at all stations.
- Shared micromobility services should be permitted to have corrals at stations.
- All stops and stations should have footpath connections within a 1 km radius to enable people to safely walk to public transport stops and stations.

Sincerely,

Prof. David M. Levinson
[redacted]

Prof. John Nelson
[redacted]

Dr. Geoffrey Clifton
[redacted]

Dr. Emily Moylan
[redacted]