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Committee on Transport and Infrastructure
Legislative Assembly, Parliament of NSW
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To Whom It May Concern,

RE: ClimateWorks Australia submission to inquiry into *Electric buses in regional and metropolitan public transport networks in NSW*

ClimateWorks Australia welcomes the opportunity to respond to the Committee on Transport and Infrastructure inquiry into electric buses for regional and metropolitan public transport networks in New South Wales (NSW). Compared to traditional diesel vehicles, electric buses can reduce operating costs, noise and air pollution, while supporting the transition to an efficient, zero emissions transport system powered by renewable energy. We applaud the NSW Government for demonstrating leadership in the transition to a cleaner transport system and committing to transitioning Sydney's buses to a zero emissions fleet.

ClimateWorks Australia develops expert, independent solutions to assist the transition to net zero emissions for Australia, South-east Asia and the Pacific. A non-profit organisation, it was co-founded in 2009 by The Myer Foundation and Monash University and works within Monash Sustainable Development Institute.

The NSW Government Climate Change Policy framework sets an aspirational objective for NSW to achieve net zero emissions by 2050[1]. Transport currently contributes 21% of the state's annual greenhouse gas emissions[2]. Decarbonising transport systems is critical to achieving the NSW Government's net zero emissions objective. States can drive a rapid transition to reduce emissions by electrifying bus fleets and powering vehicles with 100%

[1] NSW Office of Environment and Heritage. 2018. NSW Climate Change Policy Framework. Viewed 6 December 2019: www.environment.nsw.gov.au/research-and-publications/publications-search/nsw-climate-change-policy-framework
[2] NSW Department of Planning, Industry and Environment. 2017. NSW Emissions. Viewed 6 December 2019: https://climatechange.environment.nsw.gov.au/About-climate-change-in-NSW/NSW-emissions

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Since ClimateWorks' launch in 2009 through a partnership between The Myer Foundation and Monash University, philanthropic support has been key to achieving our mission of catalysing Australia's transition to a prosperous, net zero emissions future. This support continues to allow us to remain truly independent, evidence-based and non-partisan.

renewable energy[3].

Electric bus trials already underway in NSW show the technology and industry are ready for policy to support electric bus rollout. *Transit Systems Leichhardt* depot is trialling electric buses on some of Sydney's busiest routes[4]. *Premier* is already trialling an electric bus from their Nowra depot, with reports that the bus can cover 290km per day across 15-hr shifts, returning with a 45% charged battery, and that the electric bus has reduced daily running costs 72% compared to diesel buses[5]. NSW has also demonstrated leadership in renewable powered electric public transport with the Beryl Solar Farm meeting all electricity needs of the Sydney Metro NorthWest.

There is an opportunity for NSW to build on these trials and rapidly expand its electric bus fleet to support its net zero emissions aspirations. Unpublished ClimateWorks analysis models future scenarios for Australia to transition to net zero emissions in line with the Paris Climate Agreement[6]. In NSW, increased uptake of electric vehicles and other zero emissions technologies (renewable hydrogen and biodiesel) play an important role in this transition: one of the scenarios shows the proportion of electric buses in NSW's bus fleet is 18% in 2030 (5,630 buses), 44% in 2040 (13,800 buses) and 60% in 2050 (18,640 buses). Under this scenario another 20% of buses are powered by either hydrogen or biodiesel in 2050. When combined with 100% renewable energy, 80% of the total bus fleet operates at net zero emissions. These figures are likely to be conservative as the modelling doesn't account for broader opportunities to improve the efficiency of bus networks, for example through optimised operational efficiency in bus routes and charging.

Cities globally are transitioning to electric bus fleets

Globally there were 460,000 electric buses operating in 2018, an increase of 25% on 2017 numbers[7]. Battery electric vehicles account for 93% of new electric bus registrations. China represents 99% of the global market for electric buses.

There were 157,000 chargers installed for buses in 2018. In Europe, the majority of charging infrastructure is located at depots for use overnight alongside some fast charging infrastructure along routes for use during operating hours[8]. Charging infrastructure choice depends on bus operations and cost, as well as the regulatory regime context. In Australia,

[3] Climate Council. 2018. Waiting for the Green Light: Transport Solutions to Climate Change. Viewed 6 December 2019: www.climatecouncil.org.au/wp-content/uploads/2018/10/CC_MVSA0154-Report-Transport_V6-FA_Low-Res_Single-Pages.pdf

[4] The Driven. 2019. Sydney eyes BYD electric buses to silence noisy inner west. Viewed 6 December 2019: https://thedriven.io/2019/06/28/sydney-eyes-byd-electric-buses-to-silence-noisy-inner-west/

[5] Truck and Bus. 2019. Electric Bus Trial Set to Start in Inner West of Sydney. Viewed 6 December 2019: https://www.truckandbus.net.au/electric-bus-trial-set-to-start-in-inner-west-of-sydney/

[6] The Paris Climate Agreement commits the global community to pursuing efforts to keep global temperature rise to 1.5 degrees Celsius above pre-industrial levels. UNFCCC. 2015. The Paris Agreement. Viewed 10 December 2019: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[7] International Energy Agency. 2019. Global EV Outlook 2019: Scaling-up the transition to electric mobility. Viewed 6 December 2019: https://webstore.iea.org/download/direct/2807?fileName=Global_EV_Outlook_2019.pdf

[8] ZeEUS. 2017. ZeEUS eBus Report #2. Viewed 6 December 2019: https://zeeus.eu/uploads/publications/documents/zeeus-ebus-report-2.pdf

buses could charge overnight using electricity generated during the day by rooftop solar and stored in batteries. This minimises interruptions to timetables, operation schedules, and driver procedures.

The Chinese city of Shenzhen, with a population of 12 million, transitioned to a fully electric bus fleet in 2017 with the support of national and municipal government subsidies, affordable leasing arrangements with manufacturers and optimised fleet charging to reduce operational costs[9]. Local manufacturer BYD delivered most of the 16,000 electric buses.

More than 34 cities around the world have pledged to only buy zero emissions buses from 2025. Combined, these cities represent 80 000 bus vehicles, sending a market signal for electric buses in the coming years[10]. Bloomberg projects electric buses will comprise half of the global fleet of buses by 2025[11]. In addition, many countries are planning an outright ban on fossil fuelled vehicles, including Norway (2025), Germany (2030), United Kingdom (2040) and France (2040).

Electric buses can reduce costs, improve air quality and support local industries

Fleet operators transitioning to electric buses are motivated not just by the emissions reduction benefits, but also cost reductions over the life of the vehicle, and the broader benefits presented to public health and the economy.

Electric buses are **cost competitive** with conventional buses over their operating lifetime[12]. Due to lower operation and maintenance costs, electric buses already offer a cost competitive total cost of ownership[13]. While upfront electric bus costs remain high, price parity is projected to be achieved in 2030[14]. As demand increases there is potential for this to be reached sooner, in particular due to falling battery prices.

Electric buses run **quietly and cleanly** leading to improved air quality and noise. Electric buses can address growing noise issues in urban environments, since they contribute less noise pollution than diesel or internal combustion engine vehicles[15]. Diesel buses also produce

[9] Lu, L., Lulu, X. and W. Zhou. 2018. How Did Shenzhen, China Build World's Largest Electric Bus Fleet? World Resources Institute. www.wri.org/blog/2018/04/how-did-shenzhen-china-build-world-s-largest-electric-bus-fleet
[10] C40. 2019. Network Overview C40 Cities. Viewed on 6 December 2019: www.c40.org/networks/zero-emission-vehicles
[11] Bloomberg. 2018. Electric Buses Will Take Over Half the World Fleet by 2025. Viewed 6 December 2019: www.bloomberg.com/news/articles/2018-02-01/electric-buses-will-take-over-half-the-world-by-2025
[12] Bloomberg New Energy Finance. 2018. Electric Buses in Cities: Driving Towards Cleaner Air and Lower CO_2. Viewed 6 December 2019: https://data.bloomberglp.com/professional/sites/24/2018/05/Electric-Buses-in-Cities-Report-BNEF-C40-Citi.pdf
[13] The total cost of ownership of an e-bus is very sensitive to fuel prices, electricity prices, average driving distances, charging configuration and financing costs - buses travelling longer distances and buses in larger cities have a stronger potential for long-term cost savings
[14] Bloomberg New Energy Finance. 2018.
[15] International Energy Agency. 2019.

harmful pollutants such as nitrogen oxide (NOx) emissions and particulate matter[16] which is bad for health and for climate change. In Sydney, motor vehicles (including buses) are responsible for 62% of harmful NOx emissions[17]. Diesel buses also produce black carbon emissions, a sooty black material harmful to human health and a powerful greenhouse gas[18]. New York City is transitioning its fleet of 5,700 buses from diesel to electric, with analysis predicting each bus will save $150,000 per year in reduced health care costs[19].

A local electric bus market also presents an opportunity to support a growing manufacturing sector and associated industries in Australia. Precision Buses in Adelaide is producing electric buses locally as part of contracts with South Australia, NSW, Queensland and Victoria[20]. Australia's largest bus body manufacturer, Volgren has begun production of electric buses at their headquarters in Dandenong, Melbourne[21].

Policy direction from the NSW Government can support electric bus uptake

Positive announcements from NSW demonstrate leadership and the potential for electric buses growth in Australia. In New Zealand, Auckland has developed a low emissions roadmap to transition their bus fleet by 2040[22] providing policy direction. The NSW Government has the opportunity to use its bus contracts and procurement processes to drive this change at the lowest cost and largest social and economic benefit.

Policy direction and certainly from government can help address the biggest barriers[23] affecting uptake of electric vehicles in Australia:

- Purchase cost: The NSW Government can leverage its significant fleet purchasing power to encourage electric vehicle manufacturers to bring more models and vehicles to Australia, bringing down the upfront cost due to the scale and the transition time period[24].

[16] Bloomberg New Energy Finance. 2018.
[17] NSW EPA. 2019. NSW State of the Environment - Air quality. Viewed 17 December 2019: https://www.soe.epa.nsw.gov.au/all-themes/climate-and-air/air-quality
[18] The World Bank. 2014. Reducing Black Carbon Emissions from Diesel Vehicles: Impacts, Control Strategies, and Cost-Benefit Analysis. Viewed 6 December 2019: http://documents.worldbank.org/curated/en/329901468151500078/pdf/864850WP00PUBL0l0report002April2014.pdf
[19] Aber, Judah. 2016. Electric Bus Analysis for New York City Transit. Columbia University. Viewed 6 December 2019: http://www.columbia.edu/~ja3041/Electric%20Bus%20Analysis%20for%20NYC%20Transit%20by%20J%20Aber%20Columbia%20University%20-%20May%202016.pdf
[20] Business Insider Australia. 2017. South Australia just built the nation's first electric bus. Viewed 6 December 2019: https://www.businessinsider.com.au/south-australia-just-built-the-nations-first-electric-bus-2017-6
[21] The Driven. 2019. Australia's largest bus maker steps into electric future. Viewed 6 December 2019: https://thedriven.io/2019/09/27/australias-largest-bus-maker-steps-into-electric-future/
[22] Auckland Transport. 2018. Auckland's Low Emission Bus Roadmap. Viewed 6 December 2019: https://at.govt.nz/media/1980070/low-emissions-bus-roadmap-dec-2018.pdf
[23] Purchase cost, range anxiety and lack of charging infrastructure are consistently highlighted as barriers to EV uptake. See *State of Electric Vehicles* ClimateWorks Australia. 2018.
[24] ClimateWorks Australia. 2019. Electric Vehicle Ready Local Government Fleets. Viewed 6 December 2019:

- Range anxiety: Targets and policy investment would encourage increased bus charging infrastructure across the state, particularly at depots and key interchanges. As buses return to depots for extended periods (overnight) they provide an ideal place for concentrating charging infrastructure.
- Responsibility for charging infrastructure: There is currently uncertainty about who is responsible for funding, building and operating charging infrastructure in Australia[25]. Through a coordinated electric buses transition, charging infrastructure gaps could be addressed across the state.

- Electricity grid impacts: There remains unknown impacts on the grid from transitioning to electric buses, and a local assessment should be undertaken for NSW. Recent analysis for the City of Auckland found it is possible to mitigate or avoid local grid stabilisation upgrades to meet increased grid demand[26]. Demand can be met through a portfolio approach of smart charging management, charge shifting, onsite depot energy storage and solar PVs, and opportunity charging[27].

Prospects for hydrogen and battery electric vehicles

Electric buses are a mature technology, ready to be deployed on a large scale in Australia. Electric bus driving range is growing - there are now models available that can drive up to 1,700 kilometres on a single charge - meaning buses can operate throughout the day without needing charging[28].

There is an undefined role for hydrogen in future transport systems. While suppliers are exploring options[29], it is important to consider the cost, complexity and timeframes for hydrogen, given the technology advances and infrastructure needed for production, transmission and distribution[30]. Hydrogen is more likely to suit transport applications that

https://www.climateworksaustralia.org/sites/default/files/documents/publications/ev_ready_local_government_fleets_report.pdf

[25] ClimateWorks Australia. 2019. Electric Vehicle Ready Local Government Fleets. Viewed 6 December 2019: www.climateworksaustralia.org/sites/default/files/documents/publications/ev_ready_local_government_fleets_report.pdf

[26] A Study of the Impact of Electrification of Auckland's Bus Depots on the Local Electricity Grid, June 2018. Viewed 10 December 2019: https://cff-prod.s3.amazonaws.com/storage/files/goYZtMAiNeyBnqOAapgYh4IzuGpDjlkK0XylzEyO.pdf

[27] See for example, Heliox fast-charging in Wellington NZ, Viewed 9 December 2019: https://www.heliox.nl/projects/first-double-deck-buses-in-the-world-in-wellington-new-zealand

[28] Quartz. 2017. An electric bus just snagged a world record by driving 1,100 miles on a single charge. Viewed 6 December 2019: https://qz.com/1078326/an-electric-bus-just-snagged-a-world-record-by-driving-1100-miles-on-a-single-charge/

[29] Transdev, is trialling six hydrogen fuel cell buses in the Netherlands and France. They also run Europe's largest electric buses fleet in Amsterdam with 100 vehicles. (Transdev. 2019. Transdev Zero Emission 'Living Lab' meets in Amsterdam for fourth edition: from battery to hydrogen-powered electric buses. Viewed 6 December 2019: https://www.transdev.com/wp-content/uploads/2019/06/PR_Transdev_Living-Lab_EN.pdf)

[30] Hydrogen Council. 2017. Hydrogen scaling up. Viewed on 9 December 2019: https://hydrogencouncil.com/wp-content/uploads/2017/11/Hydrogen-scaling-up-Hydrogen-Council.pdf

involve longer travel distances (400-600km in a single tank) and heavy payloads, which require rapid refuelling[31].

For both battery and hydrogen technology to align with net zero emissions, these technologies must be supplied by 100% renewable energy. A competitive tender process for a zero emissions bus fleet is likely to support a cost-effective mix of fuel sources.

On behalf of ClimateWorks, I thank you for the opportunity to provide input in response to the inquiry. Please do not hesitate to contact me if you have any further questions.

Yours sincerely,

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ClimateWorks Australia

[31] Refer to New Zealand's hydrogen green paper for a comparison of the strengths of hydrogen and battery electric applications. New Zealand Government. 2019. A vision for hydrogen in New Zealand.