

**Submission
No 35**

**ELECTRIC BUSES IN REGIONAL AND METROPOLITAN PUBLIC
TRANSPORT NETWORKS IN NSW**

Organisation: Australian Bus Corporation

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The Chair,
Legislative Assembly Committee on Transport and Infrastructure
Parliament House
Macquarie Street
Sydney NSW 2000

RE: Electric buses in regional and metropolitan public transport networks in NSW

The Australian Bus Corporation (**ABC**), owner of Precision Buses (SA) Pty Ltd (**Precision**) and Bustech Pty Ltd (**Bustech**), is a 100% Australian-owned bus manufacturer with advanced manufacturing facilities in multiple states. ABC is currently the 2nd largest bus manufacturer in Australia by volume, and in 2016 developed and manufactured Australia's first electric bus which has been on trial in Australia and the Middle-East. Through Bustech, ABC has delivered over 1200 buses into NSW operating networks for Government and private clients.

Zero-emissions buses form a key part of ABC's strategy. This has resulted in key partnerships with governments, bus operators and technology partners both in Australia and overseas.

ABC considers the transition to electric-drive buses and commitment to electric vehicle infrastructure to be imminent and fundamentally important, in the context of the current social climate, available and developing technology and trends in international markets. Furthermore, Sydney's population is forecast to pass 6 million by 2030 and this will directly increase the demand for high-quality public transport services and measures to meet the mobility needs of a growing metropolis.

ABC is well placed from a capability, experience and partnerships perspective to deliver best-in-class bus technology, manufactured and assembled in country.

In response to the Legislative Assembly Committee on Transport and Infrastructure's request for information, ABC provides the following responses:

Benefits of electric buses and factors that limit their wider uptake.

ABC views the current benefits of electric buses to be centred on the political requirements for the reduction of emissions and pollution, as well as the improved customer experience on board the electric bus services and the urban environment benefits created by zero local carbon emissions and reduced noise. Electric drivetrains can reduce noise pollution by 75% conservatively, and produce almost zero local air pollutants. In urban environments, this will prove essential for maintaining air quality. This benefit is quantifiable and can have a significant economic and social impact.

Improved customer experience and the resulting opportunity to increase both patronage and mode-share that public bus services currently deliver is a major benefit of electric-drive, zero-emissions buses. A common criticism of internal combustion engines is the noise and vibration caused by the engines through gear changes and idling, as well as the emissions from the buses (in particular diesel engines). Electric-drive buses will provide a significantly smoother ride during arrival and departure



from bus stops, as well as significantly reduced vibration throughout the journey. The ride experience will be comparable to light rail, which is consistently awarded with higher customer satisfaction results in customer surveys by Australian public transport authorities and departments. Driver satisfaction is also highly likely to improve, with cabin noise and vibration significantly reduced.

The emissions benefits of electric buses are obvious, but are likely to be dependent on the availability of renewable energy on any scale. Precision understands the current installed electricity generation capacity of NSW includes approximately 30% renewables. This would already provide a significant effective emissions benefit when used for an electric bus fleet. As an additional benefit, ABC sees the change to electric drive buses as a potential driver for increased renewables development and integration to provide a holistic infrastructure solution. Incentivising operators to minimise their effective emissions and maximise the economic benefits of the fleet transition will directly promote renewable energy development. The renewable portion of installed capacity in NSW is already forecast to grow to 50% by 2030, but electrification of the bus fleet could push this further and faster.

An electric bus fleet has an operating cost advantage over a traditional diesel or hybrid fleet through maintenance and fuel cost savings. Electric drivetrains typically require comparatively less frequent maintenance, thereby reducing bus downtime and required maintenance hours. The associated effect on operational availability would be dependent on the employed bus charging solution but decreased maintenance downtime will partially offset the additional fuelling/charging time required by an electric fleet.

Precision considers fuel cost savings to be a likely benefit as electricity has historically been cheaper than diesel when motor efficiencies are considered. The electricity cost would be highly dependent on the Australian electricity market but ABC believes that a commercial framework will be required to provide governments and bus operators with a method for managing this risk effectively and providing a level of certainty on electricity prices outside if electricity provided by renewables.

ABC views two of the major barriers to the wider uptake of electric buses to be higher upfront capital costs and comparative diesel bus operational performance. Upfront capital for bus procurement and infrastructure development is currently a significant hurdle to adoption, which makes bus fleet electrification challenging in a commercial environment built around diesel bus fleets. The cost disparity to traditional fleets is primarily related to battery and charging infrastructure cost, which ABC expects to continue to fall in the foreseeable future, akin to the reduction in renewable infrastructure over the last 15 years. According to Bloomberg New Energy Finance, the prices of lithium-ion batteries have fallen significantly since 2010. If this trend continues, ABC sees the cost disparity becoming less significant in the short-medium term. The total cost of ownership parity between electric and diesel buses is expected to either be reached shortly or have already been reached dependent on the use case. ABC understands that relative cost parity is, in contrast, not expected in the near future.

ABC sees range-per-tank, refuelling ease and current transport operations systems design as the primary operational benefits of traditional diesel-fuelled bus fleets. In locations such as Australia, with large distances and large secondary power requirements (HVAC), range can be a limiting factor. ABC believes however, that the current variety of charging solutions (such as fast-charge capability) and improvements to battery energy density and power, now make this barrier insignificant if the mix of charging solutions are deployed appropriately. Modern battery technology now provides a solution



for all operator requirements, with the market able to consider the appropriate solution to match that requirement.

Australia's current transport system is designed for traditional fuelled vehicles and there are likely to be inefficiencies to running electric vehicles on the system. For passenger vehicles this is most obvious in refuelling, where the current fuelling station system design facilitates practically limitless range on vehicles. Buses are less reliant on this portion of the transport system due to majority depot refuelling, but ABC still sees refuelling practicalities as a core benefit of traditional bus fleets. ABC understands the typical refuel time on a metro bus to be ~5 minutes and there are no current equivalent charging options for electric buses. Additional downtime and lower control over refuelling/recharging are, therefore, also viewed by ABC as a barrier to wider uptake. However, with appropriate planning between governments, operators, electric bus manufacturers and electricity utility providers the right solution is capable of being implemented with the appropriate collaboration.

Minimum energy and infrastructure requirements to power electric bus fleets.

Based on simple modelling of the NSW grid and the potential electric bus fleet, ABC sees the percentage of grid demand originating from electric buses as unlikely to exceed 4% of total current demand. ABC, therefore, believes this to mean it is unlikely that overall electricity generation capacity would require development with electrification of the bus fleet. The requirements are instead considered likely to focus on the development of infrastructure for electricity distribution and charging at a local level (both within the depot, and within the local grid infrastructure). The charging infrastructure requirements will be particularly important if charging time flexibility is needed to avoid peak market demand and prices.

Despite the relatively insignificant total demand as a percentage of overall grid demand, ABC sees the potential requirement for additional infrastructure to ensure adequate distribution and peak power. The electricity requirements of an electric bus grid are likely to be concentrated at depots and would be highly dependent on the charging solution employed. Infrastructure requirements would be highest with an opportunity charging model and lowest with overnight charging. These infrastructure differences would, however, likely be balanced by demand flexibility and operational benefits (such as a lower peak vehicle requirement and higher asset uptimes). ABC has to date invested in fast depot charging as a potential compromise option, which can provide the range flexibility and low downtime of opportunity charge without the associated distributed infrastructure, which ABC has demonstrated successfully in a test environment in Sydney.

The previously mentioned investment in renewable energy infrastructure is an important aspect of infrastructure requirement analysis. Emissions savings via an electrified fleet are entirely dependent on renewable power generation. ABC therefore sees renewable energy supply and growth as a priority for attaining core electric bus fleet emission benefits.

Other renewable, emissions neutral energy sources.

The primary focus of electric buses is currently battery electric operations; however, ABC also sees hydrogen fuel cell buses as a potential medium-term solution. Hydrogen fuel cell electric buses produce zero emissions, are not severely range limited, refuel quickly and require only a small battery



pack. Australia is also investing heavily in the hydrogen economy, with a focus on fuel exports. The potential to close this loop and create a fully domestic solution with production and usage is achievable, given a targeted policy framework. ABC possesses the ability to manufacture fuel cell buses now, through partnerships with international technology providers and there are bus operators that possess experience in international markets operating fuel cell buses. These skill sets should be leveraged to create trials and scale deployments of fuel cell buses as soon as possible.

Hydrogen fuel cell buses are growing in popularity, particularly in Europe. There is an opportunity to leverage international technology through domestic manufacture and fuel, thereby bringing fuel cell e-mobility to Australia on a large scale whilst developing domestic industry capability. Hydrogen fuel is currently not cost-competitive with electricity and diesel; however, significant price reductions are expected over the next 10 years as the industry matures. Electricity and diesel are in contrast forecast to experience real price increases. Globally high diesel and electricity costs in Australia mean hydrogen is already more cost-competitive relative to Europe and the USA. ABC estimates a ~50% reduction in hydrogen price is required over the next 5 years in Australia for cost-competitiveness with diesel on a \$ per km basis. This is in line with hydrogen fuel price reduction forecasts for the US.

Ways to support the manufacture and assembly of electric buses in NSW.

Australian bus manufacture consists primarily of bus body builders working with an imported chassis and drivetrain. Australia's only bus original equipment manufacturer (OEM) of scale is Bustech, which is part of ABC, through its integrated chassis bus range. Based on a common design platform, Bustech has delivered the XDi (light-weight diesel), CDi (double-decker), and ZDi (battery electric & fuel cell electric variants).

Australian bus body manufacturers are near capacity, with the current market supplying ~1200 buses per year. The market volume demand is expected to grow over the next 10 years in response to population growth in major cities and urban centres, and continued investment in public transport services. Transition to zero emissions buses may also increase volume demand over and above general replacement buses.

ABC has experience with electric buses and fully supports manufacture and/or assembly inside NSW. The NSW government can support in-state operations and the development of new facilities, jobs and capability in NSW through policy frameworks and funding models that support industry development in NSW. Allowing the market to forecast and commit production volumes beyond annual budget cycles is also a critical factor, as this allows long-term capital investment decisions, staff acquisition and training and strategic supply chain partnerships to be formed and sustained. With the demonstrated policy leadership from government, industry will invest and deliver against the objectives of those policies.

ABC has demonstrated the capability to form international technology partnerships, and to develop local engineering and advanced manufacturing capabilities as opposed to being simple importers of technology, facilitating the export of profits and taxes.

ABC's parent company, Fusion Capital, currently operates an Advanced Manufacturing Hub model in South Australia, where bus manufacture integrates with related advanced manufacturing operations. These further operations build from the bus manufacture platform creating a volume multiplier effect,



building and retaining engineering and advanced manufacturing employment opportunities that would otherwise be located overseas or interstate. This model can be rolled out to new locations, with volumes supported by the other operations within ABC, and from within the group's broader advanced manufacturing businesses including the following;

- Precision Components aftermarket supplies to GM Holden;
- Brabham Automotive, global supercar manufacturer;
- EVANT Electric Vehicles;
- Swagman Luxury Motorhomes;
- Heliostat & Fusion Renewables (solar energy solutions)

Fusion also leases a space in the Advanced Manufacturing Hub to an entity which supplies complex suspension systems to the motorsport and defence industries. This entity also works with a number of the Fusion entities as a collaboration partner including Precision Buses, a model that can be replicated in other states – that is a facility that houses advanced design, engineering and manufacturing entities working together to provide holistic solutions.

Experience with introducing electric bus fleets in other jurisdictions.

Electric bus fleets are not entirely new to Australia; however, there has been no introduction beyond trial formats and nothing on the scale proposed by the NSW government. ABC was the first company to design, engineer and manufacture electric buses and as a result has experience with trials in South Australia, New South Wales, Queensland and Dubai. ABC is currently manufacturing buses to fulfil Australia's largest ever electric bus order.

ABC has the ability to leverage its own Australian experience, as well as the experience of its key technology partners from jurisdictions all over the world. ABC has strategic partnerships with global electric vehicle technology leaders such as ZF, Toshiba and BYD. In terms of deployment and operations, ABC has existing supply partnerships with both Australian and international operators which have experience operating and maintaining electric buses in Australia and overseas. Through these partnerships, large scale manufacturing, supply, operations and maintenance of zero-emissions buses is achievable in NSW in the immediate term.

Opportunities and challenges of transitioning the entire metropolitan bus fleet to electric.

There are significant challenges associated with the proposed full fleet electrification. The capital cost, time frame and infrastructure capacity are considered by ABC to be particularly relevant.

High capital cost will potentially limit the potential for NSW to enact the desired transition. Even in the case of comparable total ownership cost, the upfront cost is a barrier and challenge and leasing options may have to be investigated. This has also been proposed to ABC in the form of charging infrastructure and battery leasing, where these assets can be leased while the base cost from interior, chassis and body remains. This means NSW could effectively fund an amortised infrastructure + battery capital cost separately to a historically consistent fleet capital purchase cost.



No fixed time frames or transition rates have been announced by NSW, however, the potential for a significant portion of the NSW fleet to be electrified in the short to medium term poses a potential production capacity issue. If the NSW government were to target a 50% electric bus fleet portion by 2030 then Precision expects a significant additional manufacturing volume above the natural replacement and growth rate to be required from industry. This effectively represents an acceleration of bus replacement to achieve fleet electrification targets. The current industry capacity is unlikely to cope with these additional volumes and development will be required. This is especially relevant when considered in combination with NSW's disability compliance decisions, which, if they are met, will require a significant number of metropolitan buses to be replaced before 2022. To alleviate this in part, NSW needs to commit to long term volumes to allow manufacturers to commit to a long term strategy to satisfy guaranteed volume requirements.

ABC sees the transition to an electric fleet as an opportunity. The global trend for buses is electrification, with China a dominant force, and Europe and the US accelerating. ABC believes that Australia and NSW have an opportunity to move proactively and establish an industry with real environmental and technical capability. There are distinct external cost savings in pollution, noise and emissions and likely medium-term financial benefits to the state and operators as technology develops.

A key potential benefit identified by ABC is the use of bus batteries as flexible energy storage during use-life and static energy storage post-use-life. Operators of electric buses would have the opportunity to leverage their fleets in the dynamic electricity market and use the buses and charging infrastructure as a two-way connection to the grid. This extends the traditional leverage opportunities of bus operators beyond charter services. Operators with significant scale will be able to operate in the dynamic spot electricity market and control their demand timing and price more accurately. Following the useful lifespan of bus batteries, recycling or reuse will be required. ABC sees the end-of-life case as an opportunity for repurposing in static applications, where capacity and charge rate requirements are lower. An opportunity also exists here for a closed-loop system, where batteries are repurposed for use balancing charging and grid demand, providing ongoing benefits to the operator.

Any other related matters.

As e-mobility and fuel cell technology remain relatively immature, ABC has the view that further significant technological change is likely over the medium term. As Australian buses are designed for a 25 year lifespan, ABC sees an opportunity for modular bus design during fleet electrification. A modular design could facilitate drivetrain changes and technological upgrades during the life of a bus. With accelerating hydrogen fuel cell development ABC considers there to be a high probability of fuel cell buses becoming operationally and economically viable in 5 to 10 years. With a modular design, NSW could begin investment in electrification without exposing itself to the risk of fleet technological obsolescence.

ABC sees an opportunity for the government to support designs such as this and technological adaptability through the upcoming bus operations contract tenders. ABC sees the future of e-mobility as uncertain and believes that NSW can reduce its investment risk with the support of modular power / drive train design.



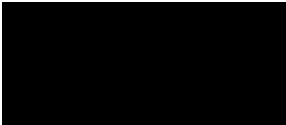
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Overall, ABC sees the electrification of the NSW fleet as a positive social, environmental, economic and political decision and encourages the committee to promote all forms of support for the transition.

Regards,



Christian Reynolds

Managing Director

Australian Bus Corporation