Submission No 26

ELECTRIC BUSES IN REGIONAL AND METROPOLITAN PUBLIC TRANSPORT NETWORKS IN NSW

Organisation: Nexport Pty Ltd

Date Received: 20 December 2019

Nexport's submission to the Legislative Assembly Committee on Transport and Infrastructure Inquiry into Electric buses in regional and metropolitan public transport networks in NSW

Contents

Submission made by: **Luke Todd, Managing Director of Nexport Pty Ltd**
Address: **4 161-165 Bunnerong Road, Kingsford NSW 2032**
Email: luke.todd@nexport.co
Contact: [redacted]

1. Overview

Nexport welcomes the invitation to make a submission to the Legislative Assembly Committee on Transport and Infrastructure's Inquiry into electric buses in metropolitan public transport networks in New South Wales (NSW).

Nexport is an Australian based company, registered and based in NSW. The Managing Director and Founder of Nexport, Mr Luke Todd, is a pioneer in the deployment of electric bus fleets and successfully:

- delivered and operated Australia's first electric airport bus fleet (6 vehicles) at Sydney Airport in August 2016[1]; and
- delivered and operated Australia's largest electric bus fleet at Brisbane Airport (11 vehicles) commencing July 2017[2];

The above airport deployment industry experience was gained through Carbridge Pty Ltd, the company he owned and managed as Chief Executive Officer for over 13 years.

Following the sale of Carbridge Pty Ltd to Swissport in November 2017, Mr Todd established Nexport, a new business with the sole focus of building and delivering to Australia, the world's leading-edge electric bus and transport products.

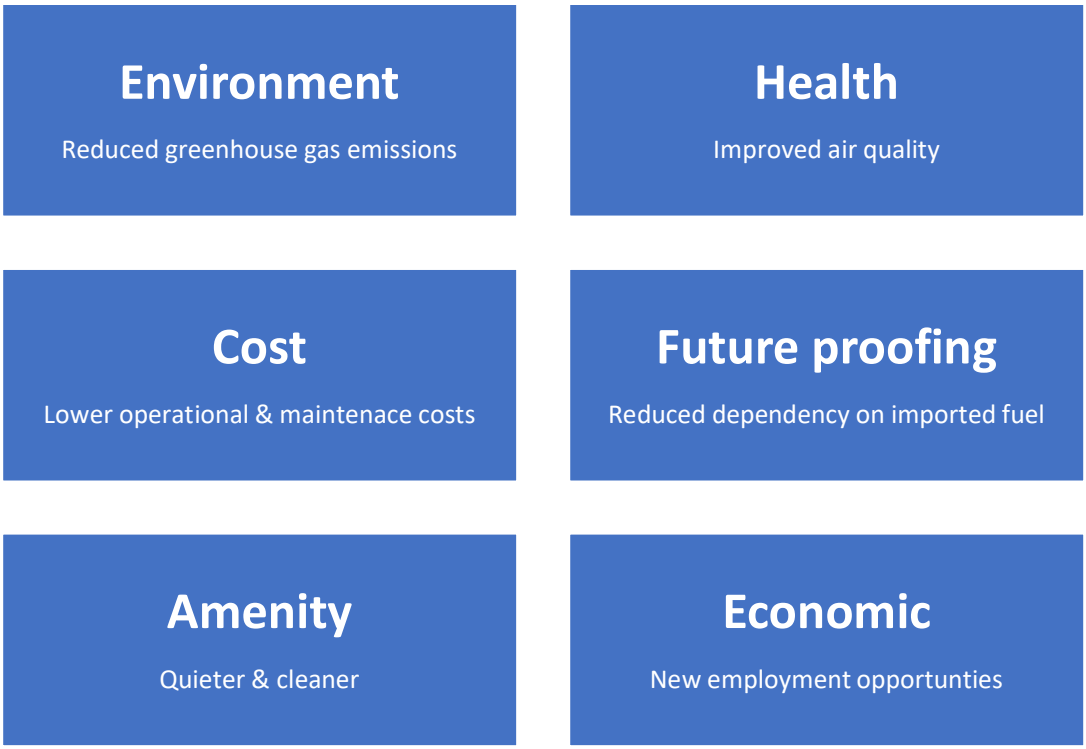
Most recently, Nexport was involved with the trial of four electric buses in Sydney's inner west, supporting the supply of the chassis for the trial[3]. Nexport are the official Australian chassis supplier for BYD, the world's largest electric bus manufacturer. BYD manufactured the first electric buses to meet Australian Design Rules in 2016.

Backed by valuable industry experience and knowledge, Nexport's submission responds to the Inquiry's Terms of Reference s detailed below:

- Benefits of electric buses and factors that limit their wider uptake (section 2).
- Minimum energy and infrastructure requirements to power electric bus fleets (section 3).
- Other renewable, emissions neutral energy sources (section 4).
- Ways to support manufacture and assembly of electric buses in NSW (section 5).
- Experience with introducing electric bus fleets in other jurisdictions (section 6).
- Opportunities and challenges of transitioning the entire metropolitan bus fleet to electric (section 7).
- Any other related matters (section 8).
- Rural Bus Services (Section 9)
- V2G (Section 10)
- Conclusions (section 11).

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

Cities around the world are recognising the benefits of electric vehicles.



- Environmental benefits: A key driver for Santiago, Chile to adopt electric buses was to meet the commitments the country had made under *The Paris Agreement* and *Atmospheric Decontamination Plan* to reduce GHG emissions to 30 per cent below 2007 levels by 2030[4].
- Health benefits: The City of Amsterdam has committed that the city centre will be an emission-free zone for buses and coaches by 2022, noting that the city's dirty air reduces the average life expectancy in Amsterdam by just over a year[5]. They also state that they anticipate that the measures in the *Clean Air Action Plan* will extend the life of the average resident of Amsterdam by three months.
- Cost benefits: The Australian Capital Territory (ACT) electric bus trial demonstrated that *"on a whole of life economic basis, the fully electric buses… fared favourably when factoring in the reduction in the cost of the energy used to power them in comparison to diesel buses"*[6].
- Future proofing: The NSW Government in the *NSW Electric and Hybrid Vehicle Plan* identified that the *"transition to EVs will also increase our fuel security by reducing the State's reliance on imported liquid fuels and vulnerability to fuel price variation and potential supply disruptions"*[7].
- Amenity benefits: Testing has shown an average of less than 45 dB for an electric bus compared with 72 dB for a diesel bus, reducing noise pollution and improving the amenity of cities[8].
- Economic benefits: The City of Shenzhen in China completed its transition of 16,000 buses to electric in 2017 and now operates the largest 100% electric bus fleet in the world. BYD, the

world's largest manufacturer of electric buses, is headquartered in Shenzhen and has over 220,000 employees globally, of which more than half are employed in the Asia Pacific Region demonstrating the jobs generation associated with the industry.

Despite the benefits, the introduction of electric buses is faced with significant barriers. The World Resources Institute's report on *Barriers to Adopting Electric Buses*[9] provides insights into the factors that have limited the wider uptake of electric buses, summarised below.

- Key technological barriers are created by:
  - the lack of relevant information for decision-making; and
  - the current operational limitations of e-buses and charging infrastructure.
- Key financial barriers emerge from:
  - the difficulties agencies face to make the necessary changes to rigid procurement structures; and
  - the lack of long-term, sustainable financing options.
- Key institutional barriers stem from:
  - the lack of political leadership and pragmatic public policy; and
  - the lack of institutional authority, funding, and physical real-estate.

		GENERAL BARRIERS		
		Technological	**Financial**	**Institutional**
E-BUS TRADESPACE ELEMENTS	**Vehicles and batteries**	■ Lack of information on the advantages and disadvantages of e-buses ■ Range and power limitations of e-buses ■ Design flaws in e-buses ■ Disjointed or limited e-bus marketplace	■ High up-front capital costs of e-buses ■ Lack of financing options	■ Difficulties for manufacturers in engaging with cities ■ Lack of a plan to remove current bus stock
	Agencies and operators	■ Lack of information on how to start ■ Lack of operational data	■ Rigid financial management and business models ■ Scaling investment past initial pilot programs	■ No enabling policies supporting adoption of e-buses ■ Negative public perception ■ Coordinating maintenance duties ■ Weak governmental coordination ■ Informal transit
	Grid and charging infrastructure	■ Lack of understanding of the requirements to upgrade infrastructure ■ Limitations of the charging ports and stations ■ Grid instability ■ Lack of standards and regulations on charging infrastructure	■ Large capital expenses for grid infrastructure ■ Difficult to determine grid infrastructure responsibilities	■ Lack of space and land to install infrastructure ■ Limited planning for long-term implications

Source: *World Resources Institute: Barriers to Adopting Electric Buses*[9].

Nexport further explores these barriers in the subsequent sections of this submission.

3. Minimum energy and infrastructure requirements to power electric bus fleets

As introduced in the previous section, there are current operational limitations of electric buses and charging infrastructure.

There are four choices when it comes to charging electric buses[10]:

1. Plug in charging at depots.
2. Plug in charging at depots with fast charging at terminus.
3. Plug in charging at depots with pantograph on routes.
4. Super-fast charging on route (pantograph/wireless).

All of these charging options require electricity supply, and network augmentation by way of a substation is often required. While charging stations with multiple charging ports can help minimise the space required within a depot, consideration of other required electrical equipment such as distribution transformers and substation is needed. An assessment of whether an existing depot can be adapted to support electric buses or whether new depot facilities are required is an important step in the planning to transition to electric buses[11].

We wish to notify the Committee that Nexport has made an offer and in early discussion with BusNSW via, Matt Threlkeld the Executive Director of BusNSW to undertake a State-wide 'depot energy review' of all bus depots operating Government contracts.

Nexport would undertake the following evaluation at each bus depot:

1) Initial onsite inspection with a licensed electrician experienced with EV technology;
2) Submit request on behalf of the depot owner to Ausgrid for an energy supply report;
3) Prepare a report of existing energy supply, scalability and capability for each site;
4) Provide a quote on upgrade costs for sites needing additional energy infrastructure.

Technology wise - Inverted Power, an Australian company, has teamed up with European based Heliox to address the problem of energy supply to depots and enable a fast charge outcome. This new technology combines electric bus chargers with depot-based battery storage to remove the need of a high draw of energy from the grid. Each charger trickle charges itself from either the grid or solar, or other forms of clean energy, and then the charge comes from the battery storage rather than directly from the grid when the bus connects for charging. Smart charging provides the ability to spread out the power demand over a longer period of time, lowering the amount of energy required at a particular time. Heliox and Inverted Power are now rolling out this technology globally. Further information on this technology can be viewed here: https://www.youtube.com/watch?v=QSQ5RpIE1_k&feature=youtu.be

The Heliox technology, especially when combined with renewable energy sources mitigates the operational risk of power outages. As identified in the World Resources Institute report *How to enable electric bus adoption in cities worldwide*, *"power outages can wreak havoc on city public transit systems when e-buses are widely deployed"*. They identify strategies to detect potential system failures, establishing demand reliability regulations at the national level and further applying smart charging technology and different charging patterns as the ways to reduce the impact of power outages[11].

In our experience, on site depot upgrades involving a new substation are generally in the order of $200,000 - $700,000 and facilitate charging for between 50 – 200 buses, subject to local factors. It will be important to work closely with distribution utility companies as large power switch gear is their speciality and 'charging as a service' models, if required, should be considered to help fund the transition to mass fleet electrification[12]. Many technology and financial institutions have a great interest in tackling this transition and the recognise the upside of the financial returns for the investment in infrastructure as an offset for a return on investment by way of a profit margin over time on the energy supply.

Innovative planning, smart use of emerging charging technology and industry partnerships will be required to minimise energy and infrastructure requirements to power electric bus fleets.

4. Other renewable, emissions neutral energy sources.

The key vehicle engine technologies are hybrid, fully battery electric or hydrogen, with full battery electric the most common choice[10].

Transport Canberra conducted a 12-month trial of buses with alternate fuel use on the ACTION bus network. The trial commenced in October 2017 with a Volvo Hybrid diesel/electric (Euro V) bus and one Carbridge Toro battery electric bus. An additional fully electric bus was added to the trial in March 2018. The buses were benchmarked against three Scania Euro VI low emissions diesel buses, which make up the majority of the local bus fleet[13]. The electric buses had the best environmental performance and on a whole-of-life economic basis, the fully electric buses were favourable when factoring in the reduction in the cost of energy used to power them. It is acknowledged that the zero emissions buses now available far exceed the technology and build quality of those evaluated in the ACT trial[14].

Hydrogen fuel cell (HFC) buses were not included in the ACT trial and are not currently broadly adopted. HFC buses and associated infrastructure is highly expensive. A quality HFC bus will currently cost in excess of $1.2M; and fit out of a depot to run 30 buses with a hydrogen electrolyser in excess of $15M[15].

The safety debate around HFC is also critical, especially in densely populated areas and will likely influence what will be acceptable long-term technology in suburban areas. Hydrogen is a highly volatile fuel type and safe transit of hydrogen to and from depots and in vehicle collisions is yet to be fully tested. Whereas with lithium electric buses, there is now more than a decade of high-volume deployment globally, with electric buses having far fewer thermal incidents than diesel or gas buses, and proven as safe technology.

Based on current trends, it is most likely that electric buses will end up dominating the suburban route market due to the mass take-up and head start electric technology has over hydrogen. In Nexport's opinion, hydrogen vehicles will find their place in ultra-long-haul services for interstate coaches and long-haul trucking. Companies such as Nikola Trucks are leading the way in HFC trucking as HFC enables running for very long ranges.

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

Nexport, supported by BYD, is seeking to bring electric bus chassis manufacturing to Australia, creating new jobs, new industry and strengthening the NSW economy.

The key ways to support establishment of this industry in NSW is through:

- A minimum order commitment of one bus per week over a 3-year period (150 buses). This would result in the ability to establish manufacturing and assembly in NSW and initially create between 20 and 30 jobs; and grow to upwards of 100 jobs.
- Assistance to navigate existing funding mechanisms such as grants.

Nexport are in current discussions with the NSW Government to build an advanced manufacturing site in partnership with BYD and the Government's Special Activation Precincts presents an opportunity to fast track planning for a manufacturing and assembly facility. Potential site requirements would include:

- Appropriately zoned land (Industrial or Heavy Industrial zoning).
- Serviced industrial land (power, water, internet/data).
- 6,000m² for plant footprint including testing track facilities.
- Digital connectivity to cater for Industry 4.0 advanced manufacturing.
- Capacity to receive container freight from port (inbound from overseas).
- Access to skilled workforce production.

It is anticipated that the localised chassis manufacturing site could be located in regional NSW and support upwards of 100 local jobs. The proposal would be for a streamlined manufacturing process using the might of BYD's global supply chain combined with localised resource and content resulting in a globally sourced, cutting edge technology product built in NSW using local skills and labour.

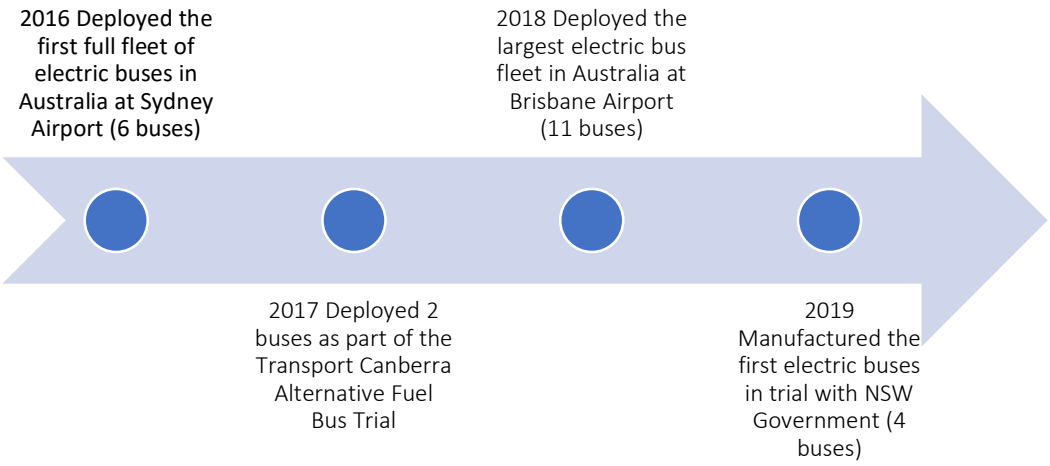
Nexport's partner, BYD is headquartered in Shenzhen within the Quangdong Province of China. Quangdong Province is the sister state to NSW and this offers a bridge between the most dynamic electric bus city in the world and NSW. Shenzhen was the first city in the world to remove all diesel buses and replace them with electric buses and also has the world's largest fleet of electric buses. This link provides opportunities for information sharing and co-development of products for the future, ensuring that NSW is at the cutting edge of electric bus fleet products.

Also relevant to the discussion on ways to support manufacturing and assembly of electric buses in NSW is the example of Campinas, Brazil, where the city government offers a reduced corporate tax for bus businesses located in the city. This attracted a bus manufacturer to establish a new factory, which largely advanced the development of electric buses in the city and provided on-site support for local bus operators. This example shows how potential enablers may not be self-evident from the outset but can prove helpful—in this case by helping to create a local market for e-buses coupled with technical capacity-building[15].

Nexport is committed to working through the various options around manufacturing and assembly with the NSW Government. We are focused on ensuring the delivery of world class electric buses in NSW, combining global knowledge and experience, with local skills and resources.

6. Experience with introducing electric bus fleets in other jurisdictions.

Nexport Management Team has proven local experience with the introduction of electric bus fleets. This is further detailed below.



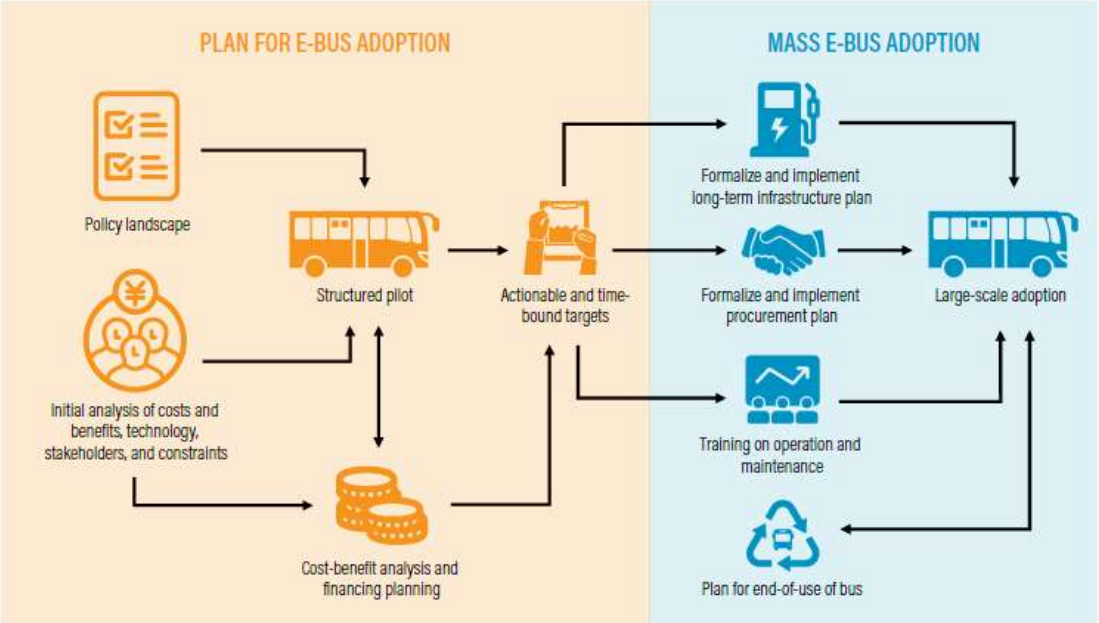
Nexport is backed by BYD which has extensive worldwide experience with the introduction of electric bus fleets, the most recent of which is detailed below:

- BYD delivered 10 new electric buses in Jerusalem in September 2019;
- BYD delivered 183 new electric buses for Santiago in August 2019;
- BYD ADL delivered 37 new electric double-decker buses in London in July 2019;
- BYD delivered 8 new electric buses in Portugal in June 2019.

The experience of Nexport and BYD also cover the World Resources Institute's[15] four components for consideration in the mass adoption of large-scale electric bus projects:

1. Formalising and implementing a long-term infrastructure plan for large scale electric bus fleets.
2. Formalising and implementing e-bus procurement plans adjusted to city conditions, and financial instruments to reduce costs and risks.
3. Providing training to bus operators based on internal best practice and local experiences.
4. Planning for the end-of-use of the buses, especially their batteries.

Figure ES-1 | Enabling Factors and Actions in the Planning and Scaled-Up Lifecycle of E-Bus Adoption

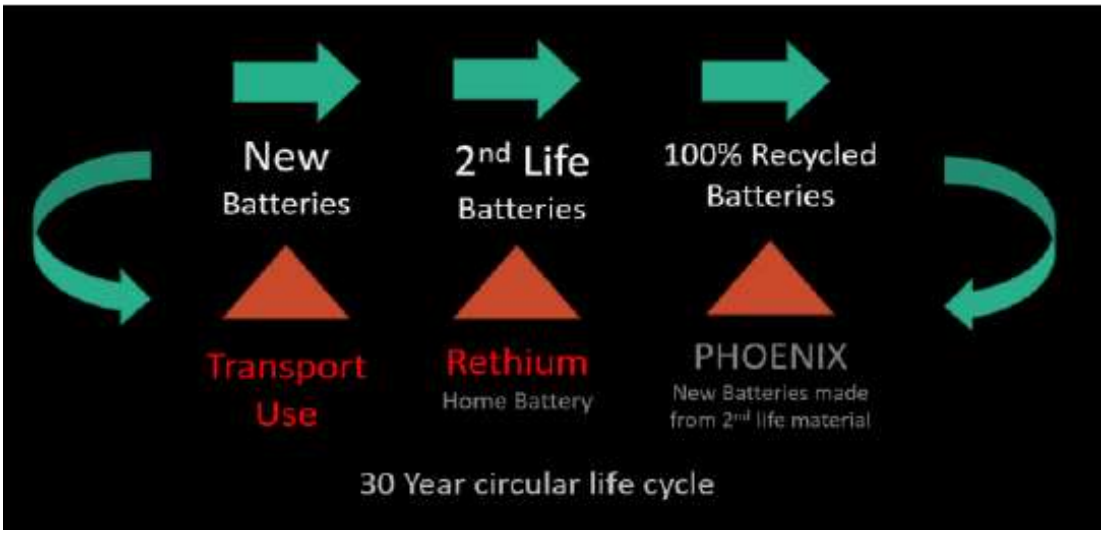


Source: Authors.

With regards to planning for the end-of-use of the buses, especially their batteries – Nexport, through one of its business interests, Rethium, has both engineered and now manufactured a home residential battery that uses end of life transport grade batteries, recycling them into residential battery storage units. With this process used batteries from electric buses can be completely recycled locally in NSW.

This highly innovative product not only solves the environmental concern for end of life lithium batteries, it also enables solar residential battery storage to be more affordable for a higher number of Australian homes. A Rethium solar home battery will cost around $6500, less than half the cost of a well-known 'Tesla Wall' battery storage unit and will deliver the same performance outcome. This product has been tested and is ready for market release in March 2020.

Rethium is now in development of a 'third phase' of Lithium battery use which will take the Rethium 2nd life batteries, and completely recycle the interior components, processing them back to a core powder, of which new lithium batteries can be made. This technology creates a 360-degree environmental circular life phase for lithium battery products. With the entire cycle producing a thirty-year productivity return – starting from initial phase of transport grade use, moving onto 2nd life residential use, and then third life for various usages with recycled batteries being made from the 2nd life transport batteries.



Nexport is the most experienced Australian company involved in the introduction of electric bus fleets and highly evolved in the planning and implementation of battery re-purposing.

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

Industry trends and technology advancements indicate that the time for change is now.

Any diesel bus purchased now by NSW will more than likely be in the system and in service for 20-25 years, embedding a fleet of old technology buses into the public transport system of NSW until 2045 or even longer. This would mean the government would be buying diesel fuel and maintaining diesel buses for another 25 years. These buses will become more expensive to run and maintain in the next 10-20 years.

Battery technology is improving as electric vehicles become more mainstream. Over the past five years the battery density ratio quality has improved by roughly 15% and this trend will most likely continue.

Future improvements in battery technology will occur but this is not a reason to delay implementing electric buses. The current technology is already at the point of being able to save significant amounts on fuel costs with the introduction of electric buses.

If NSW were to introduce 500 electric buses by 2020, the fuel savings across 10 years would be estimated at $409M. If NSW were to introduce 1000 electric buses by 2022, the fuel savings across 10 years would be estimated at $819M. The fuel savings in both 10-year scenarios pays for the entire bus purchase price of an electric fleet of buses.

The key challenge is how to transition the entire fleet of 8000 buses taking into consideration:

- High capital upfront costs – refer to section 8 which discusses financing options;
- Renewal costs for batteries – refer to section 8 which discusses battery leasing opportunities;
- Cost of grid upgrades – refer to section 3 which discusses depot-based battery storage and indicative costs of new substations;
- Existing bus fleet is diverse making retrofitting more expensive – to be considered in a detailed cost benefit analysis;
- Reduction in fuel and road tax – as per above challenge, to be considered in a detailed cost benefit analysis.

Furthermore - Nexport has the ability to convert diesel and CNG buses to electric buses, not just to supply new buses. This is an important consideration given the average age of the NSW bus fleet. The technology Nexport holds can remove the diesel or CNG running gear, the bus is then stripped back to facilitate insertion of electric componentry and batteries. The bus is then re-packaged and certified as an electric zero emission bus. This option in concert with new purchases of electric buses could allow a fleet wide transition to 100% zero emission buses for NSW more rapidly, and without needing to dispense of the entire diesel fleet.

Given the options available for transitioning the NSW bus fleet to electric buses, and the numerous potential benefits (including financial savings) it is Nexport's opinion that more detailed exploration of the opportunities and challenges of this endeavour is required. This next step should be undertaken as a matter of urgency in order to maximise any potential opportunities and long-term benefits of the transition.

Section 8 redacted

9. Rural Bus Services

To date, a large focus of electric bus adaption and focus has been centralised on city and metropolitan bus services. Nexport, wishes to draw attention that zero emission bus technology should also be considered for NSW rural services. In many ways, rural operations are ideally suited for the take-up of electric buses, especially on school services due to the relatively low volume of kilometers, and split services with morning and afternoon runs.

We draw to the attention of the Committee the following key points:

1) Nexport, within our NSW Bus Procurement Panel Submission (Submitted August 2019) submitted an ADR compliant Urban configuration bus. This bus is a low-floor chassis fitted with seat belted seats and is suitable for many rural school bus services. As this bus will be ADR complaint, there is no reason why an immediate trial could not commence for a rural operator. This would allow rural operators to experience and have exposure to trial data already availed to metropolitan operators.
2) By Q3 2020, Nexport and BYD will have an ADR approved school bus built and ready for sale in NSW. This will be built on the BYD C9 coach chassis and will offer a zero-emission school bus for rural and metro services.
3) In a rural area, Nexport wishes and hereby proposes to undertake, in partnership with the NSW Government a world first, 100% zero-emission, solar powered 'onsite' clean energy sourced bus service. Our proposal consists of installing a mini-solar farm at a rural bus depot, connected to battery storage system using our Patented Rethium remanufactured battery storage system. This 100% clean energy capture and storage would then be used to power a fleet of zero tail pipe emission electric urban configuration buses. This exciting pilot opportunity could be enacted as early as Q3 2020 and would lead the way to larger rollouts of similar 100% clean energy services, forming as a blueprint of how bus services can be 100% clean energy sourced and operated for ongoing future long-term sustainability.

10. Vehicle to Grid Battery Utility Support (V2G)

There have been considerable technology advancements of late relating to V2G energy grid support. Nexport encourages the Government to engage with energy suppliers and offers our expertise as vehicle suppliers to discuss V2G possibilities. V2G in simple terms creates an opportunity to harvest unused energy inside bus batteries when they are back at the depot and direct this dormant stored energy back into the grid during peak load periods, such as evenings

1800-2200. As an example, if a fleet of 100 electric buses return back to the depot with 50% battery capacity, if V2G technology is used, this 50% stored energy can be pushed back into the grid during peak to support the grid, and then the buses can be programmed to charge back from the grid during off-peak periods such as 2AM in the morning when grid pressure is low. With just 100 buses (@50%) this equates to 8,100kWh of energy that can be used for V2G grid support. If this is extrapolated across NSW's 8000 buses, the volume of energy becomes a potential significant support to grid supply.

11. Conclusion

The NSW Government should be congratulated on the public commitment to investigate the transition to an electric bus fleet. While it may seem like a mammoth task to transition the full NSW bus fleet, there are funding models which will lessen the upfront burden to government. Partnerships between government, financial institutions, bus operating companies and bus manufacturing companies will be key to the successful transition of the bus fleet.

Nexport is thankful for the opportunity to make this submission. For more information or to discuss the submission further please contact:

Luke Todd
Managing Director
Nexport Pty Ltd
luke.todd@nexport.co
Mb: [redacted]

12. References

1https://www.sydneyairport.com.au/corporate/media/corporate-newsroom/sydney-airport-unveils-australia-s-first-electric-airport-bus

2 https://newsroom.bne.com.au/new-electric-buses-at-brisbane-airport-a-winwin-for-travellers-and-the-environment/

3 https://www.transitsystems.com.au/electric-buses

4 https://wriorg.s3.amazonaws.com/s3fs-public/how-to-enable-electric-bus-adoption-cities-worldwide.pdf and Herrera, C. 2015. "Chile Commits to 30 Percent Reduction of Greenhouse Gas Emissions by 2030" (blog) May 3. Natural Resources Defence Council. https://www.nrdc.org/experts/carolina-herrera/chile-commits30-percent-reduction-greenhouse-gas-emissions-2030.

5 https://www.amsterdam.nl/en/policy/sustainability/clean-air/

6 https://www.transport.act.gov.au/__data/assets/pdf_file/0008/1427561/Alternative-Fuel-Bus-Trial-Summary-Assessment.pdf

7 https://future.transport.nsw.gov.au/plans/nsw-electric-and-hybrid-vehicle-plan

8 https://www.busworld.org/articles/detail/2497

9 https://wriorg.s3.amazonaws.com/s3fs-public/barriers-to-adopting-electric-buses.pdf

10 LEK Electric bus implementation and the market, delivered to UITP, November 2019

11 https://www.wri.org/publication/how-enable-electric-bus-adoption-cities-worldwide

12 Tritium Charging Infrastructure, the grid and interoperability, delivered to UITP, November 2019

13 https://www.transport.act.gov.au/__data/assets/pdf_file/0008/1427561/Alternative-Fuel-Bus-Trial-Summary-Assessment.pdf

14 https://www.linkedin.com/pulse/results-act-electric-bus-trial-chris-steel-mla/?trackingId=Pil66uXlKZqOUNG1vVVchQ%3D%3D

15 https://www.ocregister.com/2018/02/07/octa-to-purchase-10-hydrogen-fuel-electric-buses-at-cost-of-about-12-million/

Attachment A - Nexport Service Centre brochure

Delivered, stocked and ready to function within minutes.

Spare parts and inventory management system.

Vehicle diagnostic equipment.