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New South Wales Department of Planning and Environment
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Electric Vehicle Council Submission to
NSW Government's Going Circular in Clean Energy Issues Paper

The Electric Vehicle Council (EVC) welcomes the opportunity to provide feedback on New South Wales Government's Going Circular in Clean Energy Issues Paper.

The EVC is the national peak body for the electric vehicle (EV) industry in Australia. Our mission is to accelerate the electrification of transport for a sustainable and prosperous future. We represent members across the EV value chain, including car, bus and truck manufacturers, importers, operators, charging infrastructure suppliers, battery reuse and recycling companies, financiers, and network providers.

In this submission, we focus on the circular economy opportunities that exist for EVs in NSW, with a particular focus on the development of second life applications and the recycling of EV batteries to facilitate the re-use of critical minerals (see **Figure 1**).

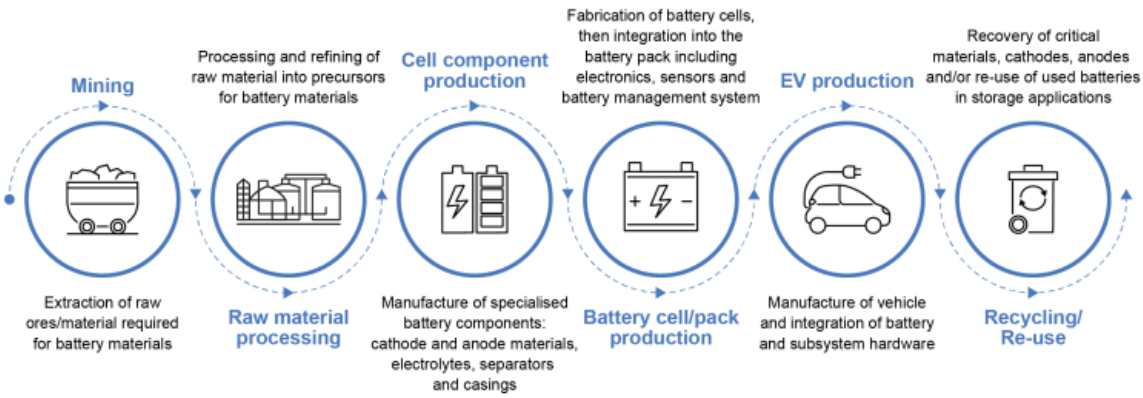

***Figure 1**. An overview of the EV battery value chain. IEA, Global EV Outlook 2022 (2022).*

Developing circularity in the clean energy sector will play an important role in achieving emissions reduction targets and environmental objectives, while increasing national energy security. Governments have a key role to play in working with industry to facilitate the development of onshore recycling capabilities for EV batteries, providing support for industry innovation to further reduce the life-cycle emissions of battery technology through second-life applications, and deliver additional employment opportunities for Australians through this emerging industry. This is particularly important as global efforts work towards

reducing the resource intensity of batteries and clean energy technology, increasing the need for recycled components to build more sustainable supply chains.[1]

EV batteries are generally expected to significantly outlast their usage in a vehicle (see **Figure 2**). Following average 10-to-15-year lifespan in a vehicle, EV batteries are expected to retain approximately 70-80% of their energy storage capacity, which makes them attractive for several secondary use cases prior to recycling.[2]

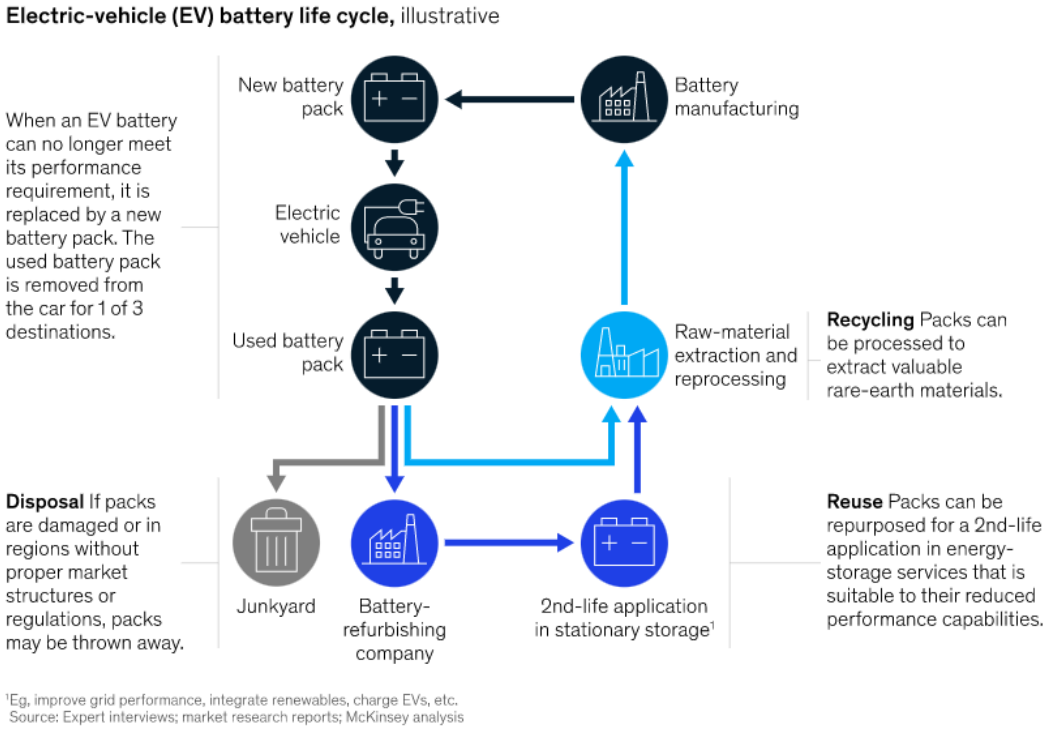

***Figure 2**. EV battery lifecycle including second-life and recycling (2019) McKinsey*

While no longer suitable to power a vehicle, second-life batteries remain useful until about 30% original capacity before the battery is spent and needs to be recycled (see **Figure 3**). Depending on the second use application, this can potentially provide an additional 10 to 15 years of use.

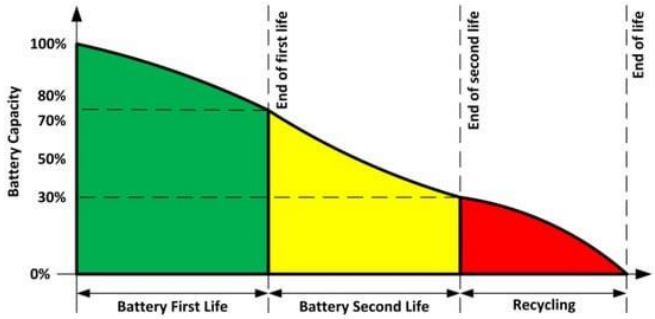

***Figure 3.** Plot of EV battery life range as function of battery capacity (2023) Font et al.*

[1] See, e.g., European Parliament (2020), Proposal concerning batteries and waste batteries, repealing Directive 2006/66/EC and amending Regulation (EU) No 2019/1020, https://eur-lex.europa.eu/legalcontent/EN/TXT/?uri=CELEX:52020PC0798.

[2] IEA (2022) World Energy Outlook, p. 48; ICCT (2023), *Scaling Up Reuse and Recycling of Electric Vehicle Batteries: Assessing Challenges and Policy Approaches*, https://theicct.org/wp-content/uploads/2023/02/recycling-electric-vehicle-batteries-feb-23.pdf

Question 1. What are the key barriers to a circular economy for clean energy in NSW? Are there any specific barriers in your industry?

The major barriers to adopting a circular economy for EV batteries in NSW (and Australia more broadly), are predominantly the same challenges that exist for developing downstream capabilities across clean energy and EV value chains.

With manufacturing supply chains dominated by major global economies that are investing heavily to capture the economic opportunities provided by the clean energy transition,[3] Australia risks being left behind given our relatively small market size and limited existing industry (see **Figure 4**). This further reduces the ability to directly embed circularity into every stage of production, as circular design and manufacturing is essential to developing truly sustainable supply chains.

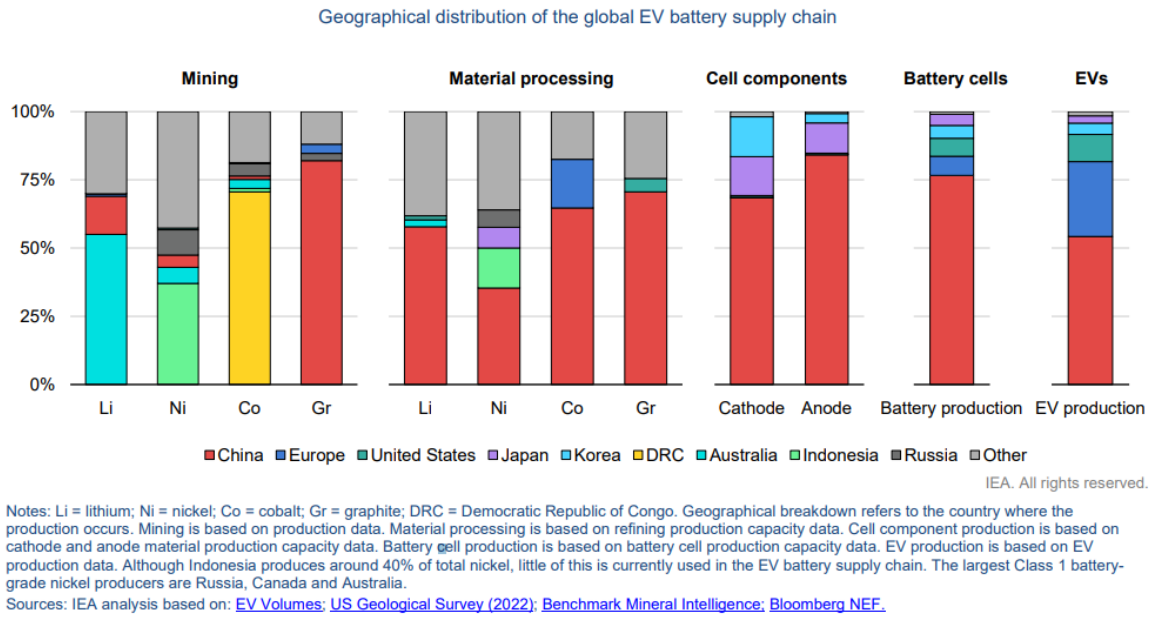

Figure 4. *Distribution of global EV battery supply chain. IEA (2022)*

Market size

The global capacity of end-of-life EV batteries will increase significantly in coming decades (see **Figure 4**). However, given Australia's current uptake of EVs and the size of our domestic vehicle fleet, the available supply of EV batteries for second-life applications and recycling is expected to be considerably lower than global averages. For battery recycling, there is a likelihood that higher volumes of spent EV batteries will not emerge until the 2040s, due to the average rate of vehicle retirement, and the potential for a further 10 to 15 years in second-life applications prior to recycling.

[3] See, US Government (2022), *Inflation Reduction Act* https://www.whitehouse.gov/cleanenergy/inflation-reduction-act-guidebook/

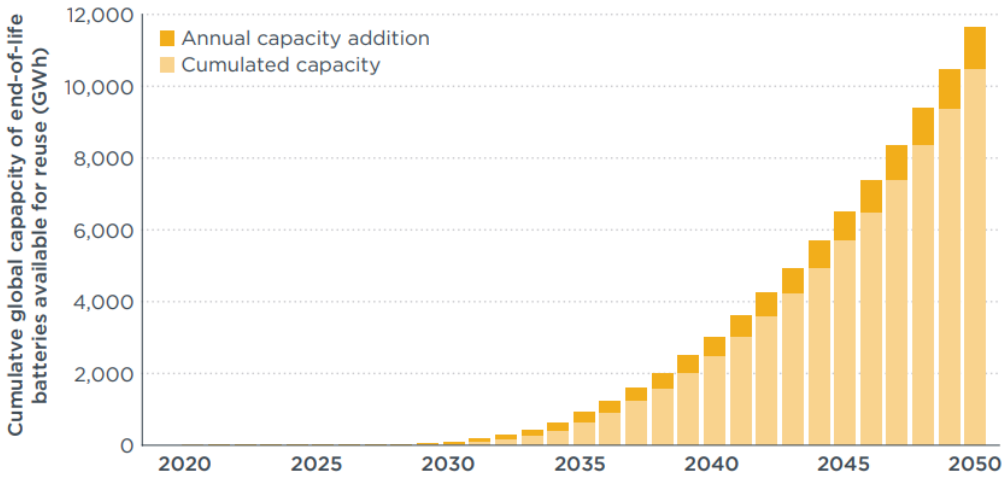

Figure 5. Global capacity for end of life EV batteries available for second-life applications. *ICCT (2023).*

Financial viability

Without substantial financial backing from both government and private investors to support R&D and commercialisation to scale onshore battery second-life applications and recycling, the energy intensity and high capital outlay required to establish and sustain a mature industry in Australia will continue to prove to be substantial barriers.

Scaling a domestic EV second-life and recycling industry faces challenges from limited volumes of EV batteries, high costs involved in battery disassembly, and regional collection difficulties. The changing spectrum of battery chemistries also needs to be accounted for, given the potential reduction in the economic viability of recycling lithium-iron-phosphate (LFP) batteries - due to the reduced value of recycled iron and phosphorous relative to nickel-based chemistries.[4]

Regulatory uncertainty

Regulatory uncertainty presents another barrier to adopting a circular economy for EV batteries in NSW. As regulatory frameworks take a considerable amount of time to evolve, the relative complexity and fragmentation across different jurisdictions can substantially increase costs of compliance and place a significant barrier to entry for businesses looking to set up and operate in the state, whether involved in battery repurposing or recycling.

When developing any novel regulations regarding second-life applications and battery recycling, there will be a need to distinguish between batteries incorporated into portable electronics such as laptops and mobile phones and batteries for e-mobility (such as e-bikes and e-scooters), from EV batteries. EV batteries have much longer lifespans – due to the more granular control of battery health through complex battery management systems, and provide for second-life applications for stationary energy storage.

While battery stewardship arrangements may be suitable to increase collection of household lithium-ion batteries to reduce the volume of smaller batteries entering landfill and address related safety concerns, the introduction of levies for EV batteries may result in unintended consequences that inhibit EV supply to Australian consumers by increasing

[4] Lander, L et al, "Financial Viability of Electric Vehicle Lithium-Ion Battery Recycling", *iScience,* 2021, 24(7):102787, https://www.sciencedirect.com/science/article/pii/S2589004221007550

upfront purchase costs. It is important no additional regulatory burden is introduced into the Australian market which further disadvantages our country with regards to the uptake of electric vehicles.

To provide further surety around product safety across the battery value chain, the NSW Government will need to work with the Federal Government and State and Territory counterparts to establish nationally consistent data collection initiatives, including fire and safety incident reporting to share learnings and support data analysis.

Question 2. What are the key opportunities to advance a circular economy for clean energy in NSW? Are there any specific opportunities in your industry?

Utilising EV batteries in second life applications

As previously mentioned, following the initial lifespan of an EV battery, there is still a significant amount of residual battery capacity which allows these batteries to be utilised in various second-life applications, including as stationary energy storage. A number of innovative projects are already underway in Australia to capitalise on the opportunities provided by refurbished EV batteries. In partnership with Relectrify, Nissan Australia has commenced a circular economy project in Victoria, with Nissan Casting Australia Plant (NCAP) using repurposed LEAF batteries to power part of its production. The battery storage project will use nine repurposed Gen 1 Nissan LEAF batteries which will also be charged from a solar array.

To develop a mature industry around second-life battery applications, a number of technical hurdles will need to be overcome, including establishing efficient processes for removing, testing and refurbishing batteries for new purposes.

Consider opportunities extend EV lifetime

While EV batteries are expected to have a useful life in a vehicle for 10 to 15 years, the other components of an EV, including the electric motors, are expected to have much longer lifespans. Extending the life of EVs through replacement batteries/battery cells after 10 to 15 years could provide benefits to consumers through the greater availability of second-hand EVs, and improve the lifecycle emissions of EVs. Further work is required to understand the scale of this potential opportunity as the market evolves.

Other components, such as the vehicle's suspension, air-conditioning systems, and interior fit out, may also require servicing or renewal, however, it is possible that at a relatively low cost, the life of an EV could be extended through the establishment of a domestic vehicle refurbishment industry, using Australian-made batteries. This could apply to electric cars, buses, trucks and other vehicles too.

Although it is not yet possible to determine the overall feasibility of this approach with great certainty, and at what scale it could be possible, the NSW Government should explore this potential opportunity for the creation of additional jobs as part of a future circular economy.

Development of domestic capacity for battery recycling

The recycling of EV batteries at end-of-life allows for the recovery of valuable critical minerals, which can then be utilised to make new batteries and reduce demand for minerals extraction. Australian recycled materials can also be used to meet minimum recycled

content requirements for battery production in other countries.[5] A significant level of investment is already being directed overseas towards establishing battery recycling capabilities and support supply chain diversification, including through direct partnerships between recyclers and the automotive manufacturing industry.[6]

At present, the dominant battery recycling method to recover key minerals like cobalt, copper and nickel involves pyrometallurgy, however, hydrometallurgy (or a combination of pyrometallurgy and hydrometallurgy) remains more effective for recovering lithium and aluminium. In order to improve material recovery, including graphite and plastics, the NSW Government can support industry development by funding innovation in recycling methods to increase material recovery rates, minimising waste and increasing efficiency to reduce costs. This could include supporting the commercialisation of direct recycling pathways to enable direct recovery of cathode and anode materials.[7]

Incentivising innovative software solutions

Developing a circular economy for EV batteries presents opportunities for innovative start-ups and researchers to develop new software applications, and improve battery management systems to assist with diagnostics, smart-charging and other optimisation and safety features to avoid battery degradation. This can extend battery life and reduce life-cycle emissions. Software solutions using artificial intelligence (AI) and data science can be integrated into a range of applications, providing real time monitoring of batteries, and sending alerts where a problem arises, allowing for timely maintenance and replacement.[8]

Question 3: What role can a circular economy play in building resilient and circular supply chains for clean energy technologies? What industries or areas should be a focus?

Building circular supply chains

Major economies are taking steps to increase supply chain resilience through the development of onshore capabilities in recycling and second-life applications.[9] Establishing a circular economy around EV batteries will allow for the provision of critical minerals to meet future needs for clean energy technologies, and achieve significant emissions reductions by reducing the use of raw materials in battery production.[10]

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[5] See, e.g., European Parliament (2020), *Proposal concerning batteries and waste batteries, repealing Directive 2006/66/EC and amending Regulation (EU) No 2019/1020,* https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020PC0798.

[6] US Department of Energy (2023), *LPO Offers Conditional Commitment to Redwood Materials to Produce Critical Electric Vehicle Battery Components From Recycled Materials*, https://www.energy.gov/lpo/articles/lpo-offers-conditional-commitment-redwood-materials-produce-critical-electric-vehicle; A Hawkins (2022), Redwood Materials announces $3.5 billion EV battery recycling plant in South Carolina, *The Verge*, https://www.theverge.com/2022/12/14/23509031/redwood-materials-ev-battery-recycling-factory.

[7] ICCT (2023), *Scaling Up Reuse and Recycling of Electric Vehicle Batteries: Assessing Challenges and Policy Approaches*, https://theicct.org/wp-content/uploads/2023/02/recycling-electric-vehicle-batteries-feb-23.pdf.

[8] See, e.g. K Bucharest (2021), 'The Czech startup helping us make better use of our batteries,' *Sifted (FT)* https://sifted.eu/articles/batterycheck-startup-czech/.

[9] European Commission (2020), *Green Deal: Sustainable batteries for a circular and climate neutral economy*, https://ec.europa.eu/commission/presscorner/detail/en/ip_20_2312.

[10] Chen, Q et al (2022), 'Investigating carbon footprint and carbon reduction potential using a cradle-to-cradle LCA approach on lithium-ion batteries for electric vehicles in China,' *Journal of Cleaner Production*, 369 (133342). https://www.sciencedirect.com/science/article/abs/pii/S0959652622029286.

Establishing a domestic battery recycling industry has the potential to significantly reduce the need for cobalt, which can assist to address the negative social and environmental impacts associated with some cobalt sourced from the Democratic Republic of Congo – the world's leading producer (refer back to **Figure 4**).

While battery recycling is expected to remain a nascent industry until significant volumes of spent EV batteries are available, establishing battery recycling at scale may also contribute to the domestic production of battery precursors and cell components. It will be important for NSW to work with industry to develop partnerships with battery producers (whether onshore or overseas), to ensure recycled minerals can be embedded into the manufacturing process.

Question 4: How can the NSW government facilitate a circular economy for clean energy? What policy options could the NSW government explore?

Attracting investment

Irrespective of whether Australia is able to facilitate a 'complete' circular economy for EV batteries domestically, there is a need to develop effective solutions for the end-of-life of EV batteries, including the development of second-life applications for stationary storage, and eventually recycling. At present it remains challenging to establish and sustain a mature industry in NSW (and elsewhere in Australia) due to the high capital outlay required at the outset, given the limited supply of EV batteries that require recycling or refurbishing at the current (early) stage of the EV market.

Funding provided through a range of NSW government programs, including the Low Carbon Product Manufacturing Fund and Renewable Manufacturing Fund, can play a key role in de-risking investment in battery second-life applications and recycling to enhance attractiveness of the industry to private investors. This will enable NSW industry participants to develop innovative solutions to enhance material recovery in recycling and build further capacity in second-life applications.

Further actions to accelerate the transition to EVs will assist in increasing the available supply of EV batteries for second-life applications and recycling over coming years.

Ensuring policy and regulatory certainty

Providing policy and regulatory certainty will play a significant role in enabling domestic battery recycling and second-life capabilities. The NSW Government can facilitate this by ensuring coordination between different jurisdictions, and NSW government agencies, to harmonise regulations to create clarity for industry. Accordingly, it will also be important for any rules to align with standards established in overseas markets, including the EU and China, to enable industry to develop globally consistent approaches to managing end-of-life batteries, ensuring better traceability and circularity.[11]

[11] See, e.g., European Parliament (2022), 'Batteries: deal on new EU rules for design, production and waste treatment', https://www.europarl.europa.eu/news/en/press-room/20221205IPR60614/batteries-deal-on-new-eu-rules-for-design-production-and-waste-treatment

Question 5. What are some additional issues in creating a circular clean energy sector (if any) that haven't been discussed in the issues paper?

The development of a circular economy for EV batteries in NSW provides a real opportunity for the NSW Government to work with industry to build local recycling capabilities and second-life applications, reducing the life-cycle emissions of battery technology while supporting innovation and delivering additional employment opportunities in a rapidly evolving sector.

The NSW Government should prioritise policy settings that can provide strategic direction and incentivise industry development, while supporting and not slowing down the necessary transition to an electrified vehicle fleet.[12]

In summary, the Electric Vehicle Council recommends that in progressing the development of a circular economy for EV batteries, the NSW Government should:

- First and foremost, continue to accelerate the uptake of electric vehicles of all shapes and sizes across New South Wales to increase the volume of future batteries for second-life applications and recycling, and help to build critical mass for this sector.
- Initially focus on supporting the development of second-life applications for EV batteries, after their initial 10-to-15-year lifespan in a vehicle; and underwrite demand for these used EV batteries through inclusion in future grid integration projects.
- In addition to second-life applications for EV batteries, explore opportunities to extend the life of EVs through the use of a replacement battery – after the first battery is removed. Given the long-life of other components of EVs, there is significant potential to extend vehicle life through the use of a replacement battery.
- Beyond supporting second-life applications, start to plan for the future development of a domestic EV battery recycling industry, with a focus on locally developed technology and innovative processes, noting that significant spent EV battery volumes are unlikely to emerge until the 2040s. That said, smaller-scale operations should be supported in the near-term, with the ability to expand over time.
- Reduce regulatory barriers and provide policy certainty to investors to de-risk early investment in both second-life applications (of EVs and EV batteries) as well as battery recycling. This includes offering short-term tax exemptions for businesses in this sector and reducing regulatory fragmentation with other States and Territories.
- Identify opportunities for public-private partnerships to increase job opportunities and generate a return on government investment. This will be critical for solidifying Australia's role in the global EV value chain. This could include supplying recycled battery materials to international partners, and strategic allies like the US, to produce batteries overseas.

[12] Zhao, Y et al (2021), *Australian Landscape for Lithium Ion Battery Recycling and Reuse in 2020,* CSIRO, Australia. https://publications.csiro.au/publications/publication/PIcsiro:EP208519.

If you have any questions on this submission, please do not hesitate to contact Natalie Thompson, Senior Policy Officer, or Umair Afzal, Programs and Insights Officer at: office@evc.org.au.

Thank you for your consideration of our submission.

Yours sincerely,

Behyad Jafari

Chief Executive Officer

Electric Vehicle Council