National Electric Vehicle Strategy submission

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ENGINEERS
AUSTRALIA

Contents

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About Engineers Australia

Engineers Australia is the peak body for the engineering profession in Australia. We are a professional association with over 110,000 individual members, constituted by Royal Charter to advance the science and practice of engineering for the benefit of the community. Our members represent every engineering discipline and work across all sectors of the economy impacting the lives of Australians every day.

We are pleased to have the opportunity to make a submission on the National Electric Vehicle Strategy. This is a critical strategy for all Australians' health and prosperity, and we congratulate the Government for progressing this journey.

Contact

Engineers Australia welcomes the opportunity to engage further with the Department of Climate Change, Energy, the Environment and Water. These are complex and contextual issues. Engineers Australia has significant expertise in our Learned Society Colleges and Technical Societies that can assist in addressing them. Please do not hesitate to reach out if you would like to discuss this further. You can contact us at policy@engineersaustralia.org.au.

Executive Summary

Electric vehicles are an example of a multifunctional platform that sits at the nexus of a smart grid supplying renewable energy, ICT, and intelligent transport. It sits within a system of systems encompassing technical, economic, social, legal and regulatory systems. Engineers Australia believes it is critical to view it in this way to ensure we anticipate the interactions between the systems to have a sustainable approach. This is particularly relevant to the National Electric Vehicle Strategy because there are a number of interacting systems (such as vehicle grid integration in the middle of a once-in-a-generation energy transition) that need to be aligned for sustainable progress. The emission reduction benefits from EVs will only be fully realised if the electricity supply for recharging is renewable. A comprehensive, holistic strategy that increases supply, stimulates demand, and plans for smooth integration with other aspects of the energy transition has the best chance of success. The adoption of EVs in Australia will likely reach a tipping point (typically 5 per cent) in the very near future, which increases the urgency of these actions if we are to avoid the downsides of disruptive transformation of the road transport sector (and affiliated industries/stakeholders).

Innovation and technology of all types continue to change every aspect of society and transport is not immune. Engineers will play a crucial role in both creating and integrating new technologies and software to improve efficiencies and tackle challenges. Autonomous vehicles, artificial intelligence, smart technologies, new fuel sources and propulsion systems, freight and transportation management systems, high-speed rail, e-mobility, and drones are just some of the advancements currently being discussed and implemented in Australia and worldwide. These developments can have numerous benefits, including increasing productivity and efficiency and reducing emissions; however, it is essential that regulations and policies relating to their use are developed to ensure unintended consequences are minimised.

Engineers Australia believes that high demand already exists for EVs and the low uptake in Australia is chiefly attributable to three supply factors. First is purchase price. There is a significant relationship between EVs' low market share and their high upfront cost relative to Internal Combustion Engine (ICE) alternatives. Low-priced EVs are not being offered to Australia, as the limited supply has been prioritised to those countries offering incentives or to meet emission standards. At present, the average premium associated with an EV, relative to an equivalent ICE, is well over $15,000. Australian consumers nominate high costs as their biggest purchase barrier. They are not expected to reach parity with ICE equivalents until the mid to late 2020s or beyond. Costs over the vehicle lifecycle are already competitive or better than ICEs, especially for lower priced EVs and highly utilised vehicles such as taxi fleets. However, this is unlikely to spur significantly increased uptake: Buyers only factor in operational costs over a short period when making a purchasing decision. Measures reducing the upfront cost of EVs, such as waivers on import duties and taxes, directly address the largest uptake barrier. They also encourage manufacturers to bring models to market by driving up demand. Such interventions are almost uniformly available in markets with high uptake.

While purchase price and low model availability are significant barriers, charging infrastructure is also seen as an important factor. EV adoption is correlated with the availability of public charging; nine in ten Australian consumers say this is important in encouraging them to buy an EV. Users are reluctant to use EVs until charging is available, but businesses will not invest in charging until EV uptake grows. While nearly all current EV owners charge mostly at home, there is a disconnect between users' perceived and actual charging needs. This is linked to 'charger anxiety' – a feeling that an EV may be stranded where recharging is unavailable (regardless of the vehicle's actual performance capabilities).

Consumer information will be key and should be spread across all media types. Many people do not have the capacity to develop a deep understanding of the EV market and so tend to use generalisations or assumptions. Government and industry must work to provide information on model choice, cost savings, emission reductions and charging networks, amongst other topics.

High cost is the greatest barrier for local Australian manufacturing, and mitigating this issue will help Australia emerge as a global leader in EV and specialised component and subsystem manufacturing such as batteries, chargers, etc. There are already some emerging success stories – see 15 below. Developing electric vehicle production onshore is not only economically productive but provides greater resilience for the long term in the face of unexpected challenges. Advanced manufacturing automation is required to bring costs down and attract global manufacturers to consider Australia as a feasible and cost-effective place for manufacturing.

Shifting the fleet towards EVs is a crucial element of transport decarbonisation. However, a like-for-like substitution would not represent an environmentally or economically optimal path to deep emissions abatement. Public transport and active transport are exceptionally efficient alternatives for many journeys currently taken by car. Roads absorb a much larger share of the Australian government's infrastructure expenditure than facilities used by other modes. This largesse reflects unsound project evaluation more than superior transport or cost outcomes. Major roads are often approved despite no benefit-cost analysis or business case being prepared, or when such analyses show little or no net benefit. Infrastructure that supports cycling, micro-mobility, rapid bus transit and rail infrastructure is also required.

As recommended in the Select Committee Report on Electric Vehicles in January 2019, addressing the "risks and challenges will require effective national standards and regulation in regards to charging infrastructure and electricity grid integration, building and construction, public safety, consumer protection, processes for disposal and/or reuse of batteries, and skills training."

It should be noted that many of the issues raised in the consultation paper and recommended in this submission were included in that 2019 Select Committee Report. Many organisations have provided well-researched and thoughtful contributions to these issues over the years. The issues and many of the solutions have previously been identified. Other countries have already accelerated EV uptake, and if Australia does not respond, the costs of doing so will only increase. We commend the Government for proceeding with developing and implementing this important strategy.

1. Do you agree with the objectives and do you think they will achieve our proposed goals? Are there other objectives we should consider?

The strategy design requires careful calculation of sectoral emissions reductions and trajectories in order to ensure national greenhouse gas emissions targets are achieved in an efficient manner. Calculations of trajectory need to factor in the lag time due to existing ICEs continuing in operation for their useful life. Having set these various targets for light vehicles, road transport, and the overall transport sector, then ensure that the actions in the EV strategy are sufficient to achieve the required pace and scale of uptake of EVs in Australia.

Objectives one and two should include built energy and full lifecycle costs from creation to disposal for owners and infrastructure. Waste product management from a future Australian EV fleet will require significant development that is integrated into the necessary infrastructure. Encouraging and supporting ongoing research and development is expected to assist in the process.

Fire safety is a key environmental consideration that does not appear to be included – see 19.3 below.

Add 'safe and effective' to the third goal, i.e. "Establish the systems and infrastructure to enable the rapid, safe, and effective uptake of EVs."

Further consideration could be given to objectives that:

- reflect the rapid uptake of EVs and the relationship to electricity systems and electricity infrastructure see - 19.2 below
- nests the proposed National EV strategy into broader national transport objectives such as improving our health and well-being.

2. What are the implications if other countries accelerate EV uptake faster than Australia?

Other countries have already accelerated EV uptake faster than Australia. Other comparable countries have plans to switch to EVs by 2030 or 2035. In response to this shift, many major car manufacturers will stop making petrol and diesel-powered cars by similar dates. As Australia no longer manufactures traditional cars locally and has limited assembly of trucks and buses, we rely on vehicles from the international market. Countries that are achieving high penetration of EVs have greater buying power and are getting lower EV pricing for the same cars. Australia is at risk of getting unsold ICE vehicle stock from manufacturers at a cheaper cost making EVs relatively more expensive and undesirable.

If Australia's uptake of these new technologies (and corresponding infrastructure) is not at pace with international markets, it will find itself unprepared, which will be costly in the medium to long term and may require large-scale government financial support or direct investment at both a federal and state level.

There are many additional implications, including many that are noted in the consultation paper, which we currently see in Australia:

- reliance on global fuel supply fluctuations with long supply lines and inadequate domestic reserves
- limited and expensive EV vehicle options available for sale
- lost opportunities to ensure EVs are integrated into an effective energy system designed to meet future needs
- increasing transport greenhouse gas (GHG) emissions undermining Australia's ability to reach a net zero emissions economy
- poor air quality and increasing exceedances of air quality goals, particularly in urban areas
- global supply chains for EV components may mature, and Australia will lose opportunities to create new manufacturing jobs in batteries, EV components or charging infrastructure technologies.

Therefore, there is an urgency to develop and execute the strategy.

3. What are suitable indicators to measure if we are on track to achieve our goals and objectives?

Countries with a net zero target by 2050 will need to phase out sales of new ICE cars by 2035 at the latest (considering cars have an average useful life of around 15 years). Aiming for 100 per cent of new car sales by 2030 could be the cost-effective strategy.

This will require us to set staged new car uptake goals along the lines of 5 per cent by 2023, 35 per cent by 2027 and 100 per cent at the latest by 2035.

Suitable indicators to track progress include:

- average emissions of new cars that are sold by each manufacturer
- tracking the types of ICE vehicles entering the country
- decommissioning of ICE vehicles
- number and type of recharging stations installed
- consumer surveys that cover charging/range anxiety for trips over 300 km
- use of EVs in high-productivity transport or the Performance Based Standards scheme
- recycling and wastage of EV components such as batteries
- lifecycle of EVs and total carbon footprint from production to recycling, waste or landfill
- real-time data on the use of chargers would inform where to place additional chargers.

To ensure accurate and independent data, vehicle manufacturers should report directly to Federal Government and/or state vehicle registration data could be used.

In addition, it is important to understand Australia's transport fleet subdivided to the lowest levels to create scenarios for the uptake of EVs and understand the impact on each. Fleet assessment has many variables and assumptions that may need alternate methods to the standard assessments.

4. Are there other measures by governments and industry that could increase affordability and accessibility of EVs to help drive demand?

There may be considerable merit in delivering additional purchase concessions. To maximise accessibility, the Commonwealth is best placed to deliver this support, potentially in the form of exemptions from taxes paid at purchase. Waivers on import duties and luxury car tax (LCT) could significantly reduce prices: LCT is levied at 33 per cent on all cars exceeding the cost threshold (currently $69,152 for most vehicles). Customs duty is generally levied at 5 per cent. These taxes are also dysfunctional. Customs duty is applied inconsistently; several free trade agreements offer concessions to manufacturers based in select countries. It also no longer serves to protect locally-made vehicles. The LCT is ill-suited to many EVs, whose high prices are chiefly attributable to manufacturing costs of core components rather than 'luxury' features.

While some suggest purchase subsidies are not cost-effective, they can be carefully calibrated to catalyse the rate of uptake required to achieve the transport sector's emissions reduction target. Subsidies can be scaled (inversely to vehicle purchase price) or means-tested to ensure they are provided mainly to cost-sensitive buyers, minimising additionality issues. Subsidies could be made available for a limited time or a set number of vehicles to quantify budget impacts.

Also of note is that business fleets make up 38 per cent of Australia's vehicle market. We should set increasing annual enforceable targets for government and large organisations to increase the uptake of EVs to meet their 2050 net zero carbon commitments, and boost supply to the second-hand EV market. Where fleet vehicles are made available to employees for private use, employers incur a substantial and ongoing fringe benefits tax (FBT) liability. Exempting electric vehicles from FBT could dramatically reduce lifecycle costs for fleet purchasers. As FBT is not paid on purchase, a concession does not serve to drive down EVs' upfront costs. However, businesses may be more responsive to reduced lifecycle costs, especially at large scale, than individual buyers. Equally, delivering an incentive only available to businesses may raise concerns about equity; the modelled environmental benefit would need to demonstrably outweigh the social impact prior to implementation. However, FBT is also relevant to salary packaged (novated lease) vehicles. Employers may pass on to the employee the FBT costs of salary

packaged vehicles, which has the impact of making salary packaging of EVs unattractive and therefore this slows uptake of EVs by making them less affordable.

Another approach would be to base registration costs on vehicle efficiency rather than weight.

4.1 Second-hand vehicles

We could adjust the taxation and other costs to allow large organisations and Governments to flip the vehicles after 20,000km or two years instead of 40,000km or four years to increase the supply of second-hand vehicles earlier until the overall uptake increases and prices fall.

Bringing in second-hand models has issues with meeting Australian standards, including the type of batteries and chargers used. In addition, Australia will compete with developing countries for this trade. However, late-model EVs from compatible RHD Countries (such as Japan) have been successful here and in New Zealand.

4.2 Left-hand-drive vehicles

Allow the direct import of left-hand-drive (LHD) EVs that are not currently produced in a right-hand-drive (RHD) version. There are already thousands of LHD historic vehicles in Australia under an "exemption" that applies to vehicles over thirty years old. A "new" exemption for EVs, perhaps for a limited time or a limited number, would allow the immediate import of speciality vehicles such as Utes.

5. Over what timeframe should we be incentivising low emission vehicles as we transition to zero emission vehicles?

Refuelling an EV from a coal-fired power system only saves a percentage of the emissions of an ICE vehicle running on petroleum depending on which state you are in, for example 20 percent in Victoria through to nearly 100 per cent in Tasmania. Consequently, whilst strengthening fuel emission standards would incentivise the uptake of EVs, it would not have a significant impact on emissions reductions or the carbon intensity of supply chains, etc. unless the electricity systems charging EVs are simultaneously decarbonised.

There is an urgency to the transition, and it would be preferable if ICE vehicles were phased out by 2030 rather than 2035, with some exceptions and mitigation measures in place for some users, such as those in rural areas.

Low emissions vehicles should be incentivised at least until the Australian market becomes self-sustaining and in line with our emission reduction targets. We could consider a sliding incentive scheme to accelerate the uptake and minimise the government costs to implement until the price point for the same vehicles in sub-sections approaches the global average. This requires input from many groups, including industry.

6. What information could help increase demand and is Government or industry best placed to inform Australians about EVs?

Messaging is key and should be spread across various media, including social media. Many people do not have the capacity to develop a deep understanding of the EV sector and so tend to generalise or make assumptions. Government, industry and non-government agencies should all work together to provide clear information that helps people to develop their understanding over time. Information on model choice, charging networks, range, cost savings, emissions, maintenance cost and the overall low cost of ownership must be highlighted.

Another opportunity is to develop an independent 'EV Owners Manual' that contains trusted and useful information that is not provided in the OEM's vehicle manual. Such a manual would alleviate much of the fear, uncertainty and doubt on social media platforms. The manual could include such topics as trip planning, charging tips, charging etiquette, accessories (such as charging leads/adapters) and so forth. The manual could be produced by motoring associations (such as the NRMA), the Electric Vehicle Council and Standards Australia (EM-001 Committee).

Government has the task of providing verified data on the current fleet and progress on the transition to EVs over time, setting the minimum design criteria for the supply and operation of EVs in Australia, and distributing the information openly, transparently, effectively, and efficiently.

Industry has the task of showing how their offerings meet and exceed the minimum requirements.

7. Are vehicle fuel efficiency standards an effective mechanism to reduce passenger and light commercial fleet emissions?

Fuel efficiency standards are critical and should be established as soon as possible. The Climate works Centre suggests the EU standard of 95g CO2/km by 2024 reducing to 0g by 2035 – see here https://www.climateworkscentre.org/resource/accelerating-ev-uptake-policies-to-realise-australias-electric-vehicle-potential/. The Federal Chamber of Automotive Industries recommends under 100g CO2 per kilometre and heavy SUVs and light commercial vehicles under 145 gC02per kilometre by 2030. The fine level would need to be high enough to drive behaviour. The penalty price could also rise each year.

The Government should adopt standards in line with international levels. This would encourage manufacturers to bring their most efficient internal combustion engine, flex-fuel and hybrid vehicles to Australia. Whilst Engineers Australia does not advocate for traditional fossil fuels being used long-term, there is a need to develop policy initiatives that can deliver quick emission reductions while this transition takes place. This will ensure a high pace of improvements in the availability of fuel-efficient ICE vehicles and availability of affordable battery electric vehicles (BEVs), which in turn will quickly help to reduce road transport emissions.

Requiring vehicle manufacturers to achieve an overall fuel efficiency target that can only be met by supplying a certain portion of EVs can be used to progressively induce manufacturers to supply a greater portion of EVs into the Australian market. The focus is on reducing overall emissions, and the limits should apply to the total fleet supplied by the manufacturer. This will drive the manufacturers to push the lower emission vehicles to meet this overall requirement. The EU policy sets a fleet vehicle emissions target for each manufacturer. If the fleet sold fails to meet the target, there is a substantial fine levied per vehicle on all the vehicles sold. The fleet emissions cap required in Europe is low by Australian standards - around 135 g/CO2 per car, reducing in future to 95 g/CO2 per car. (Australian average = 200 g/CO2 per car/LCV).

Consideration should be given to setting these fuel efficiency targets tiered by size/weight of vehicle, corresponding to different classes of vehicles (scooter; motorbike, hatchback; sedan; Utes, further tiered by load carrying capacity; light truck).

Adopt a testing procedure that is also aligned with international standards.

All mitigation efforts should be informed by the 'Avoid Shift Improve' framework. It has been used widely and to good effect internationally. 'Avoid' refers to the need to facilitate fewer and shorter journeys – improving the efficiency of the sector as a whole. 'Shift' refers to the need to increase the uptake of low-emissions modes – improving the efficiency of individual journeys. 'Improve' refers to the need to increase the efficiency of vehicles and the fuels they use.

8. Would vehicle fuel efficiency standards incentivise global manufacturers to send EVs and lower emission vehicles to Australia?

Fuel efficiency standards will incentivise global manufacturers to send EVs as the gap between the cost of petrol vehicles and EVs will become narrower.

Carbon fuels will cost more due to the increased processing to support lower emission vehicles. Note the fuel is available now from current suppliers, who supply the rest of the world with lower-emission fuel. It does, however, impact the whole fleet if we require all fuels to meet the standards.

9. In addition to vehicle fuel efficiency standards for passenger and light commercial vehicles, would vehicle fuel efficiency standards be an appropriate mechanism to increase the supply of heavy vehicle classes to Australia?

The requirement that trucks be 2 per cent narrower than global standards limits the range of trucks available in Australia, and this should be removed immediately.

When looking at heavy vehicles, the main barrier will be the limited options suitable for Australia's landscape and long haulage routes. Heavy vehicles are highly utilised with minimal downtime. Innovation and increased awareness are required to ensure decreased payloads due to the weight of rechargeable batteries, and increased downtime for electric charging are not barriers to the adoption of heavy electric vehicles.

Hydrogen may offer a better model for heavy vehicles due to fast refuelling and similar range to existing operations. However, some large vehicle vendors are moving away from hydrogen for long haulage.

For hydrogen to be viable for industry to adopt, there needs to be an extensive Australian network of hydrogen refuelling facilities backed by a secure, reliable supply of hydrogen. Fuel cell electric vehicles (FCEVs) are rapidly commercialising with applications in the heavy vehicle industry. Battery-powered vehicles do not offer the same payload capacity due to the weight of batteries, and this is a major consideration when choosing which vehicle to use.

Most heavy vehicles in Australia have a design life of 20 years which propels the second-hand market. There may be benefits to implementing fuel efficiency standards for heavy vehicles in the form of productivity. For example, the amount of fuel that is used to transpire 10t of payload. Performance Based Standards are a perfect example of this and promote the use of newer vehicles that are at least 30 per cent more fuel efficient as they can carry more payload.

City-based heavy vehicles, including buses and distribution trucks, are very ready for the transition to electric and will need significant local infrastructure and supply from the grid or local generation in the cities to achieve this. The newer ICE technologies also improve air quality that should not be ignored in cities and built-up areas.

Heavy vehicle class fuel efficiency is also required. At the moment, H2 fuel cell technology is appropriate for heavy long-distance vehicles due to the low energy density of Lithium batteries (250kWh/kg vs 33kWh/kg).

10. What design features should the Government consider in more detail for vehicle fuel efficiency standards, including level of ambition, who they should apply to, commencement date, penalties and enforcement?

The implementation of emission standards (and the fuel efficiency) of conventional internal combustion engines (ICEs) is likely to only go so far in achieving the Australian Government's greenhouse gas emissions reduction targets, air quality objectives, and improvements in energy productivity. Therefore, it is suggested that to meet the draft strategy objectives, a suite of policy and regulatory initiatives would be required.

The National Transport Commission (2021) reports that data from the Federal Chamber of Automotive Industries (FCAI) voluntary CO2 Emissions Standard shows that:

- the 2021 average emissions intensity for passenger cars and light SUVs (MA category) was 146.5 g/km. By contrast, the average emissions intensity of heavy SUVs and light commercial vehicles (MC+NA category) was 212.5 g/km
- if Australian consumers had purchased vehicles with best-in-class carbon dioxide emissions in 2021, the national average carbon dioxide emissions intensity from these new car sales would have been reduced by 91 per cent for the MA category and 47 per cent for the MC+NA category.

11. What policies and/or industry actions could complement vehicle fuel efficiency standards to help increase supply of EVs to Australia and electrify the Australian fleet?

An emissions trading scheme would also help bring Australia into line with trading partners that wish to decarbonise their economies and incentivise the decarbonisation of Australia's electricity generation sector.

Another approach could be the so-called 'feebate' systems that place a fee on higher-emitting vehicles and use the revenue to encourage zero or low-emissions vehicles to provide a continuous improvement incentive to manufacturers.

12. Do we need different measures to ensure all segments of the road transport sector are able to reduce emissions and, if so, what government and industry measures might well support the uptake of electric bikes, micro-mobility and motorbikes?

Micro-mobility will play a huge role in cutting down emissions and reducing electricity loads on developing grids. However, micro-mobility using e-bikes and e-scooters is still looked upon as unsafe due to the lack of protected bicycle lanes, especially while making a turn. Alternatively, people resort to using footpaths for their e-bikes, scooters, etc., where they can become a public nuisance.

Australia needs to look at models overseas, such as the Netherlands, where biking is often faster than driving and roads are designed to discourage the use of cars. There need to be fundamental shifts in the way road infrastructure is planned and developed.

The International Council on Clean Transportation (2021) reviewed the policies of the 25 largest electric passenger vehicle markets worldwide. Key policy initiatives, including many that have come up in this consultation, included:

- purchase and other financial incentives
- non-financial benefits such as road access and registration privileges
- zero-emission zones
- charging infrastructure
- building codes
- public fleet electrification
- private fleet electrification, e.g. taxis and car-sharing services, recycling old cars in exchange for grant funding to use on an electric car, an electric bike, public transit, and car-sharing services
- consumer awareness
- collaboration with all stakeholders.

Electrification of the whole transport market should go hand in hand with broader transport system policy and focus on cars and motorbikes, but also bring in scooters/bikes for shorter trips.

One way to reduce the cost and facilitate greater uptake of EVs, at least for light transport applications where the average trip is 30km, would be to have EVs available with smaller batteries - some such vehicles may be coming onto the Australian market in 2023. It would require the education of consumers to ensure they understand the trade-offs between the cost and range of EVs. There is also a trade-off in that such vehicles would require more frequent charging and hence more widely available charging infrastructure.

Need to focus on the charging safety standards for the lower cost vehicles, so we don't follow the trend in other countries of fires in homes when charging electric bikes and mobility scooters.

12.1 Infrastructure priorities and management

Cars dominate the Australian transport landscape. Private vehicles are used for around 80 per cent of all journeys – a figure that has remained relatively static for 40 years. Also virtually unchanged is the share attributed to public transport modes (under 15 per cent) and active transport (around 5 per cent).

While interrelated technological and socio-cultural forces support car use, mode choice is also strongly correlated with convenience and comfort. In essence, people prefer easier journeys. It follows that governments influence mode choice through their infrastructure investment priorities, management and policy decisions because this impacts the relative convenience and comfort of a particular mode.

While shifting the road fleet towards EVs is a crucial element of transport decarbonisation, a like-for-like substitution would not represent an environmentally or economically optimal path to deep emissions abatement. Public transport and active transport are exceptionally efficient alternatives for many journeys currently taken by car. A shift to these modes over the short and medium term could be supported through a modest reprioritisation of infrastructure investment, together with policy reform. Though major infrastructure provision and transformative approaches to urban planning are also powerful modes shift tools, they typically see results over the long term.

Roads absorb a much larger share of the Australian government's infrastructure expenditure than facilities used by other modes. This largesse reflects unsound project evaluation more than superior transport or cost outcomes. Major roads are often approved despite no benefit-cost analysis or business case being prepared, or when such analyses show little or no net benefit.

For instance, increasing kerb space fosters a safer, more attractive environment for walking and increases space for cycling. Inversely, the perceived value of kerbside parking for most drivers is low. Most localities can also accommodate parking off-street. The abolition of mandatory minimums for on-street parking, as well as kerb allocation supportive of pedestrians, can nudge users towards active transport.

Cycling is the fastest-growing mode of transport worldwide. COVID-19 triggered strong growth in bicycle uptake that is expected to be sustained in the longer term. Global popularity notwithstanding, cycling faces infrastructure barriers to large-scale uptake in many locations. Cycling-specific infrastructure is consistently identified as the single most important intervention to improve the safety of cycling and drive higher mode share for bicycles.

E-bikes, powered by a combination of pedalling and a small electric motor, may offer a further means of increasing cycling's mode share. Growth in e-bike sales has outpaced overall bicycle sales since the onset of COVID-19. They support mode shift to cycling for longer journeys, those involving more difficult terrain, and those requiring users to transport heavier goods. E-scooters also offer an efficient alternative for those uncomfortable with a bicycle. However, both e-bikes and e-scooters are relatively expensive. E-bikes in particular are much more expensive than most standard bicycles. This is likely to pose a major purchase barrier. Several European governments subsidise e-bike purchases; there may be merit in delivering similar in Australia.

Rail infrastructure of moderate scale can deliver much faster journey times over middle-distance. This supports mode shift from private vehicles by offering similar or shorter travel times by rail. Rail infrastructure discussion commonly turns to the potential construction of a high-speed rail network. In theory, such a network could shift demand from both private vehicles and domestic aviation routes.

Government should continue to support clean, reliable and efficient public transport that reduces demand for personal vehicles. Greater emphasis is needed on integrating nationally consistent digital approaches to public infrastructure planning and operations if Australia is going to be ready for the demands of the future.

13. How could we best increase the number of affordable second hand EVs?

Sales in the domestic second-hand market will initially reflect the low number of new EVs available. Adjust the taxation and other costs to allow large organisations and governments to flip the vehicles after 20,000km or two years, instead of 40,000km or four years to increase the supply of second-hand vehicles earlier and consistently until the overall uptake and lower vehicle price points are achieved.

14. Should the Government consider ways to increase the supply of second hand EVs independently imported to the Australian market? Could the safety and consumer risks of this approach be mitigated?

Overseas second-hand EVs can be left-hand-drive, but this needs state approval for domestic use. Alternatively, they can be modified to right-hand-drive if the frame allows. Overseas second-hand supply needs manufacturer support for accident repair, as well as maintenance and parts. However, it is unlikely that people buying cars will import second-hand EVs and get them modified to meet Australian Design Rules (ADRs). It is difficult to get the permits, modification plates and relevant approvals. Vehicle Type Approvals may help change this with certain EVs having modifications or no modifications approved or exempted from ADRs. Importing second-hand EVs may only benefit commercial buyers like heavy vehicle operators etc. Making the import approval process easier will help eliminate barriers to entry.

Bringing in second-hand models has issues with meeting Australian standards, including the type of chargers used. In addition, Australia will compete with developing countries for this trade. However, late-model EVs from compatible RHD Countries (such as Japan) have been successful here and in New Zealand.

The uncontrolled importation of second-hand EVs will result in the potential dumping of low-quality vehicles and a significant waste legacy that will require addressing. Importing second-hand EVs does not fully support the higher targets for safety and lower carbon content that exist in newer vehicles. This adds a level of risk if these vehicles garner bad publicity. The focus should be on getting a viable new car market going first and letting it organically grow into a second-hand market.

If second-hand EVs are imported, they should be less than three years old, have low km (less than 40,000), have a high safety rating (preferably 5 stars ANCAP equivalent), have Australian compatible charging ports (AC Type 2 and DC CCS2 or Chademo) and there should be a level of local support to recognise the vehicle warranty (generally five years) and battery warranty (8 years).

15. What actions can governments and industry take to strengthen our competitiveness and innovate across the full lifecycle of the EV value chain?

High potential exists for Australia to provide vendor specific battery grade material and assembled batteries to car, truck, motorcycle, aircraft, marine and space industries. Australia is already home to large lithium plants. Similar to iron ore or gold, Australia has the opportunity to capture value adds to these resources by providing completed energy systems. Battery material miners are investing in further downstream processing to provide raw materials for battery manufacture. A report published by the CSIRO finds that Australia is on the cusp of moving up the battery value chain due to our world-class mineral resources and strong technical competence. As the demand for batteries grows worldwide, expertise in this area will be highly beneficial to Australia's exports – see here *https://www.csiro.au/en/News/News-releases/2020/Study-provides-foundation-for-new-battery-industries-in-Australia*.

High manufacturing cost is the greatest barrier for local Australian manufacturing, and mitigating this issue will help Australia emerge as a global leader in Battery and EV manufacturing. There is already light truck and bus manufacturing in Australia. Engineers and technicians at The Australian Clean Energy Electric Vehicle (ACE-EV) Group have assembled their first prototype in a series of fully electric vehicles planned for light commercial and city living purposes. Developing technology and electric vehicle production onshore is not only economically productive but provides greater resilience for the long term in the face of unexpected challenges. These sectors need to be supported by targets for local products. Advanced manufacturing automation is required to bring costs down and attract global manufacturers to consider Australia as a feasible and cost-effective place for manufacturing.

There are already some emerging success stories:

- Light vehicles - https://www.ace-ev.com.au/; https://varleyelectricvehicles.com.au/
- Heavy vehicles - https://www.sea-electric.com/; https://www.arccaus.com.au/

- Charging and energy management - https://tritiumcharging.com/; https://www.redarc.com.au/; https://www.tmgtestequipment.com.au/Blog-Lumen-Regatron.

16. How can we expand our existing domestic heavy vehicle manufacturing and assembly capability?

Investments in Industry 4.0, lean manufacturing, and factory automation will play a major role in expanding heavy vehicle manufacturing and assembly capabilities. Consultations with not just manufacturers but heavy vehicle operators will be critical as they are the ones making the purchasing decision.

As mentioned above, 'buy local' targets and more financial support for local manufacturers will facilitate the next phase of vehicle development. Research and development will be critical.

17. Is it viable to extend Australian domestic manufacturing and assembly capability to other vehicle classes?

It is viable to expand domestic manufacturing to other vehicle classes provided the availability of advanced manufacturing automation and investments in smart factories.

Australia has many of the key resources and engineering expertise required for EV manufacture and operation, so the opportunity exists to mandate this opportunity to add value and not just squander it, as has been happening for many years. As the demand for EV batteries increases, particularly the vital metals involved, as well as cost fluctuations, supply chain pressures and the need to strengthen sovereign capability, securing access to and use of key metals such as lithium and nickel may prove vital and ensure Australia can proceed with the rollout of EVs at the pace it desires.

The US is encouraging EV manufacturers to build battery plants with subsidies for battery production and assembly. This has already had an impact on pushing legacy car manufacturers to build battery plants.

Additionally, the current generation of EV batteries are classed as dangerous goods, increasing the cost of international shipping – see here https://www.tnt.com/express/en_au/site/how-to/ship-lithium-batteries.html. Local manufacture and recycling may therefore be more cost-effective and would facilitate the development and manufacture of future battery technologies in Australia.

Component manufacturing is one way to extend manufacturing, but it will require financial support to establish and keep pace with international competition.

18. Are there other proposals that could help drive demand for EVs and provide a revenue source to help fund road infrastructure?

When considered from a system level, the root problem is traffic congestion rather than insufficient road network capacity, which requires a high level of funding to continue expanding – see 12.1 above. Measures to address traffic congestion include avoiding commuting (encouraging working from home; providing easy to engage with web-based government portals to avoid attending government service offices; urban design with shops and services either within walking distance or with excellent public transport connectivity) and providing highly convenient public transport which commuters would prefer to use rather than private vehicles.

Access to roads with developed EV networks should be made available free of charge to heavy electric vehicles that operate under the Performance Based Standards scheme. These vehicles are highly productive and can transport more payload per vehicle, thus reducing the effect on the road pavement, while keeping pollution low and productivity and profits high. These vehicles usually go through a rigorous process of safety simulations and road access permits which are chargeable.

Vehicle sharing and extending T2 lanes is one approach. It is fast to implement and low cost. It also has the highest opportunity to halve road transport in many locations. Revenue from fines could be directed.

18.1 Replacing fuel tax revenue

Pricing schemes address an imbalance in the relative costs of accessing transport infrastructure that favours private vehicles. High road construction and maintenance costs are mostly covered by the taxpayer. Users bear a higher proportion of the costs of utilising other transport infrastructure, such as the passenger rail network. Further, road use costs that are borne by users, such as through petrol excise, are often opaque, further distorting mode preference in favour of cars.

Road pricing is a powerful means of supporting mode shift away from cars to lower-emitting modes, as well as mitigating congestion, thereby improving the fuel efficiency of journeys that do take place by car. Pricing requires a shift from the approach employed in most jurisdictions of tolling a select number of busy main roads rather than support mode shift across the network and related objectives.

Governments need to replace the fuel tax revenue for the transition to proceed smoothly. Some State Governments have proposed a per/km tax on EVs, with Victoria already introducing theirs, which is now subject to a High Court challenge. The Transport Society of Australia (TSA), the NRMA and many other bodies have been calling for a debate on a 'fairer' model for Road Funding for years. One model could be a road funding formula that recognises:

a) 'how' much of the road network a vehicle uses each year, i.e. total km travelled
b) 'when' that vehicle is used – i.e. congestion charging in urban environments between 7-9 am and 4-6 pm
c) 'where' that vehicle is used – split between metro, regional, urban and rural usage (the current fuel excise penalises rural and regional vehicles that must travel more)
d) 'what' is the environmental impact of that vehicle, such as particulates, pollution (health impacts) and noise.

For item a) a 'connected' vehicle, this could be self-reported. Otherwise, the total annual km could be owner reported and is already captured on pink slips for vehicles over five years old.

For items b) and c), postcode could be used as a 'proxy' and verified/modified using data from average speed cameras and other number plate recognition cameras.

Item d could use the 'green vehicle guide'.

The funds raised from Item d above could be specifically directed to the funding (establishment and maintenance) of fast-charging infrastructure in remote parts of Australia. Large carports with solar panels and a storage battery could be built and expanded as the number of EVs increases.

19. What more needs to be done nationally to ensure we deliver a nationally comprehensive framework for EVs?

Undertake research and development as well as provide incentives for commercialisation of EV battery types suited for reuse in residential buildings (with negligible fire risk). This would greatly expand the opportunity to economically reuse batteries from EVs before they are recycled (and therefore provide higher value from their life cycle).

Ensuring consistency of standards and approaches across all states. Standardising of infrastructure and associated connection points and so forth. Standards will support unified access to infrastructure and lower prices over the longer term.

Because we have been slower than other countries to advance these issues, Australia can benefit from their learning.

19.1 Charging Infrastructure

Delivering the charging network required by a large electric road fleet is a challenge of considerable scale. One study suggests that to support EV uptake consistent with reaching net zero by 2050, Australia requires 100,000 public chargers by 2027 - a more than thirty-fold increase on today's network - see here https://theconversation.com/as-the-world-surges-ahead-on-electric-vehicle-policy-the-morrison-governments-new-strategy-leaves-australia-idling-in-the-garage-169824.

We have an opportunity to rethink and plan the ways we refuel/recharge EVs, scooters, bikes, and so forth. There is a need to provide appropriate charging for different purposes, including long-distance, medium-range, commuting and supporting activities closer to home, such as children's activities, grocery and other shopping. These different uses will require different rates of charging at relevant locations. We should consider universal chargers, chargers on power poles and anything else that makes charging EVs more accessible for everyone.

While charging in areas such as shopping centres and offices may become a commercial opportunity, the market's failure to deliver charging as needed is likely to be particularly acute where it promises lower returns, such as in regional areas. While charger costs vary according to a range of factors, capital and installation costs for a typical 'fast charger' site with multiple chargers often exceeds $200,000.

Several measures could support the increased provision of charging infrastructure. Increased investment is the most direct option. This could be provided solely by governments or in partnership with the private sector – ideally, focusing on areas neglected by the market. The NSW Government has suggested that a simple national charging infrastructure target may also catalyse increased private investment.

Building codes and planning regulations could also be used to drive investment. New builds or major renovations of apartments, large commercial sites, and/or buildings in areas with little public charging could be required to deliver charging or 'make ready' for later installation. The volume of chargers required varies according to the number of residents, floor space, local population density and/or grid capacity. Residential high-rise building parking lots need to be equipped with charging stations on each parking level. Bulk EV charging plans may be considered based on battery capacity, like bulk hot water charging schemes.

EV owners want to charge in the most convenient way possible, which generally means at home or the most convenient public charging when necessary. The vast majority of trips are fairly short, making charging at home the easy and accessible option for most current EV owners. Charging equipment in homes should have communication capability that is nationally consistent and aligned with international approaches. This does not mean it has to be externally controlled. The more onerous consumers find the requirements for vehicle chargers, the more likely they are to simply plug into the wall socket in the garage or outside power point. A mixture of controlled charging, time-of-use tariffs and owner education to avoid peak times will allow high penetration of EVs and lessen the need for grid upgrades.

According to the Electric Vehicle Council, currently most EV owners have solar on their roof and access to off-peak pricing at night, so they can cost-effectively self-manage their charging – see here https://electricvehiclecouncil.com.au/wp-content/uploads/2022/08/Home-EV-charging-2030.pdf This may change as the ownership profile changes bur consumer choice and control will remain critical.

There is a need for more ultra-fast and fast chargers. If you own a Tesla, then you are very well served with charging options and can go anywhere in Australia. If you don't own a Tesla, then fast charging options are more limited, as there are often inadequate backup options (Teslas can use non-Tesla chargers, but currently not vice versa), and usage is increasing to the point that it can be difficult to charge when and where needed, particularly on public holidays. Having said that, not all chargers have to be fast chargers, and a mix of chargers may be the best solution. The principle of 'N-1' should apply such that there are multiple chargers per site should any one unit be broken, busy or blocked.

As well as a general lack of chargers, reports indicate that many chargers are out of order and that it takes too long to get them repaired. Out-of-order chargers that are left for extended periods undermine public confidence in EVs – see here https://thedriven.io/2022/03/28/why-are-so-many-ev-charging-stations-out-of-order-are-they-reliable/.

Current remote locations would require additional infrastructure to address charger anxiety. Islanded sources may be possible but are even more expensive to install, maintain and turn a profit. Pushing these non-profitable charge locations to the government to address is effectively requiring network upgrades.

Chargers create localised demand which in turn creates more peak load demand. The DC multi-charger sites like Tesla Superchargers and some Chargefox sites have 'dynamic load management', which means that as the stalls fill, the charge allocation per vehicle is reduced to fit below the network capability, which

is generally the kiosk transformer size. This is sometimes called "throttling", and allocation per vehicle is typically 60 per cent to 80 per cent per vehicle if all stalls are occupied.

Even if the cost of the vehicles is accessible, if the charging network is inadequate it will put people off shifting to EVs. The EV Council's recent report indicates that charging infrastructure is growing at about 15 per cent, well behind the 60 per cent rate of growth in EV numbers in Australia in the last year, https://electricvehiclecouncil.com.au/state-of-evs-october2022/, so the development of public charging infrastructure needs to continue/accelerate in line with EV uptake.

19.2 Vehicle Grid Integration

Vehicle batteries can work synergistically with the grid, but the system needs to account for significant impact on the load profile. The impact of the overall load is likely to be much less than on peak load, which drives investment. With the right policies and technology in place, EVs could do much to assist the transition to renewable energy generation by providing the distributed storage needed to smooth variable supply (for example, by absorbing excess photovoltaic generation during the day and use of that stored energy through vehicle-to-home and vehicle-to-grid technology to supply peaks in load in the early evening), as well as providing significant customer savings.

There needs to be a framework or strategy on how we can ensure the grid remains balanced while we introduce variable energy resources and EV ownership steadily increases. The grid will need to balance daily fluctuations in generation and demand as well as seasonal variations. Bi-directional grids need to be strategised in a way that can relieve pressure from the grid during peak times. This could be achieved by smart demand management strategies.

The Australian Government has committed to working with States and Territories, industry, and other experts to ensure the grid is 'EV-ready'. In addition, the Commonwealth's Integrated Systems Plan (ISP) provides a roadmap for the long-term development of the National Energy Market (NEM). The current ISP accounts for EV support policies currently in place within the NEM. It also models EV uptake scenarios and the advent of vehicle-to-grid discharging from EVs. The ISP expects significant domestic investment in roof-top solar to support the plan and could be linked to EV ownership to reduce the impact on the power grid and local distribution issues. Nonetheless, the precise impacts of EVs on the grid remains difficult to model.

The emission reduction benefits from EVs will only be fully realised if the electricity supply for recharging is renewable. Australian electricity grid generation still uses in the order of 71 per cent fossil fuels. If vehicles are being charged at night, this reaches 90 per cent on the east coast of Australia. In addition, the competition for new renewable electricity assets to supply the growing green hydrogen market must be considered. As an example, the proposed Asia renewable energy hub is proposing to build 26 GW of solar and wind generation, substantially more than exists in Australia today (~21GW).

Strata systems in residential buildings can include hardware and demand management software that take time-of-use tariffs and response signals into account. The first few EVs can be accommodated without fuss and cost, however, as the number of EVs goes up, further support will often be needed to provide a 'spine' of cabling and load management equipment that individuals can connect to. Retro-fitting charging systems to strata residences is expensive, and the question of 'who pays' is a source of contention where not all residents have vehicles, let alone EVs.

While some large-scale urban development has indicated that consumer mains are not rated for the loads and require significant upgrades, a two-year study by the ENA and various Victorian Universities has concluded every home can accommodate an EV through a combination of managed charging, time-of-use tariffs and driver education. The cost of charge management hardware to better utilise infrastructure is likely to be cheaper than the cost of increasing capacity (upgrading 'poles and wires').

Smart grid applications for bi-directional energy flows require technical standards such as AS4777 to ensure the system is capable and compatible. Various Virtual Power Plant (VPP) trials are already underway where EVs can be called upon to charge (dispatchable load) or stop charging (load shed).

Small trials of V2G technology commenced relatively recently in Australia, however much has been learnt from many large-scale trials conducted overseas in the last several years (e.g.

https://innovation.ukpowernetworks.co.uk/wp-content/uploads/2018/12/V2G-Global-Roadtrip-Around-the-World-in-50-Projects.pdf)

Engineers Australia acknowledges the work of the Distributed Energy Integration Program EV Grid Integration Working Group. The work they are doing on charging interoperability, market integration and grid support will become even more vital over the coming years. This work must take a consumer perspective and remain aware of cost impacts.

19.3 Fire Safety

We need to develop harmonised and clear EV fire safety guidance for owners, facility managers and emergency services personnel. Passenger EV battery fires are very rare but significant when they occur. As the number of EVs in Australia ramps up significantly and the fleet ages, this will become a much greater concern. Engineers have formed a working group on the fire safety of alternative energy vehicles, including charging, storage, and a Task Group on EVs in carparks. These 40+ engineers have just begun the work, and there are some identified concerns. The plan is to develop a fire engineering practice guide and a guide for EV fire safety in new buildings that calls on learnings from countries with higher EV penetration.

19.4 Circular economy

While Battery Electric Vehicles and Plug-In Hybrid Vehicles have no tailpipe emissions, on a life cycle analysis, there is no such thing as a zero-emission vehicle.

Batteries differ in chemistry and construction, which makes it difficult to create efficient recycling processes. Regulation is needed to ensure battery manufacturers consider these issues from the design stage. Considering the ease of recycling at the design stage and clear labelling of batteries so recyclers know what they are dealing with, will make the process more efficient. Reducing complexity will encourage battery reuse. Regardless, recovering key battery minerals may prove vital and increasingly economically viable.

Disposal and recycling should only happen after reuse. A battery that is no longer capable in a vehicle may well be suitable for a stationary application, especially if the battery type/chemistry has low fire hazard. Battery recycling facilities are being developed in Australia – see here https://fbicrc.com.au/wp-content/uploads/2021/03/CSIRO-Report-Australian-landscape-for-lithium-ion-battery-recycling-and-reuse-in-2020.pdf.

Again, there is some urgency with these issues as we don't want to continue with battery manufacturing that is expensive and difficult to recycle.

20. How can we best make sure all Australians get access to the opportunities and benefits from the transition?

The installation of batteries is related to solving network configuration issues and increases the built energy costs specifically related to temporary storage. The strategy should enable the use of other forms of energy storage. With locations like the Nullarbor roadhouses, there are unique opportunities with land availability to consider options such as mixed generation sources and perhaps geothermal or even stack draft. Hydrogen storage may also be applicable. The solution should be best suited for each location.

Rural and Regional areas must be supported to handle an exponential increase in EVs. Large Carports with Solar panels and a storage battery (acting as a buffer) could be built and expanded as the number of EVs increases and subsidies paid to the Roadhouses that host them.

Charger sites that allow for a vehicle towing a caravan or trailer to 'drive through'.

Chargers need to allow wheelchair access for the charging ports on all vehicles. Chargers that can automate the process for drivers that cannot manipulate the charger cable are also important.

EVs cut across many different silos. This means in order to have an effective solution, collaboration across the whole EV value chain is essential. We need to have a whole-of-system approach to facilitate the integration of electric vehicles.


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