

# Submission to the Senate Select Committee on Electric Vehicles

## Terms of reference addressed by this submission:

- a. the potential economic, environmental and social benefits of widespread electric vehicle uptake in Australia;
- c. measures to support the acceleration of electric vehicle uptake;
- e. how federal, state and territory Governments could work together to support electric vehicle uptake

## Personal Details:

Name: Gail Helen Broadbent BSc, Dip Ed, MEM, MPhil

**Background Information:** I have worked as a transport policy advisor for more than ten years. I have recently qualified as a Master of Philosophy by Research at UNSW, Sydney submitting a thesis entitled: *Speeding the uptake of electric vehicles in Australia: social attitudes to electric vehicle purchase and recommendations for government intervention to address market failures*. I was awarded an A by each of two external reviewers for this original research. Based on this research I have published several papers in peer review journals. I have received considerable media exposure about the issue of EVs and I have advised a number of government organisations.

In particular the research focused on: 1. International best practice in countries with relatively high rates of EV uptake; and 2. Using surveys and experimental techniques, understanding Australian attitudes to electric cars, with a focus on understanding why even those motorists with a positive attitude to the environment were unable to make the transition away from internal combustion engine vehicles (ICEVs - conventional cars) towards purchase of Electric Vehicles. I focused on understanding barriers to uptake and incentives that could encourage purchase of EVs; and I also included an experimental component to test if providing information increases the likelihood of EV purchase, which it does.

Next year I will commence a PhD to further study uptake of EVs in an international context to better understand measures that have been successfully deployed.

## Relevant Publications:

Broadbent, G. H. (2017) 'Comment on "Consumer purchase intentions for electric vehicles: Is green more important than price and range?" K. Degirmenci, MH Breitner Transportation Research Part D 51 (2017) 250', *Transportation Research Part D: Transport and Environment*. doi: <http://dx.doi.org/10.1016/j.trd.2017.07.026>.

Broadbent GH, Drozdowski D, Metternicht G (2017) Electric vehicle adoption: An analysis of best practice and pitfalls for policy making from experiences of Europe and the US *Geography Compass*. 2018;12:e12358. <https://doi.org/10.1111/gec3.12358>



## Summary:

- Using fossil fuelled vehicles results in a wide range of negative externalities, which the market has failed to correct;
- There are numerous sustainability ie economic, social and environmental, benefits if there is a transition to electricity as the energy source for cars for personal transport (see Table 1);
- Even in Australia, with a low proportion of renewable energy involved in electricity production, use of EVs produces fewer emissions per kilometre of travel compared to ICEVs, and as the renewables proportion increases, emissions from EVs will decrease (see Appendix for calculations);
- International best practice has demonstrated that suitable government intervention increases the rate of EV uptake;
- Multiple actions produce better outcomes than single actions as each appeals to various market niches;
- As the price of EVs nears parity with similar model ICEVs (due to rapidly decreasing cost of the vehicle batteries) subsidising the purchase price of EVs should not be necessary
- The single most effective measure has been for governments to support and ensure that a necessary market co-condition ie an effective network of recharging infrastructure, is installed and that the network is open access ie the electricity can be paid for with a credit / debit card rather than requiring membership of a network. This measure is three times more effective for every dollar spent compared to vehicle subsidy. Australians are more concerned about running out of charge than they are about vehicle price. Even if a motorist can afford current model EVs they are reluctant to buy one because they worry about getting to their destination and they want reassurance that rechargers will be available to get them to their destination if they are going to consider an EV next time they buy a car.
- Australians are relatively unfamiliar with EVs and research demonstrates that increasing availability of information, especially online and in the print media, to motorists before they get to a car showroom increases the likelihood they will buy an EV. Also experiential information such as field days eg ride and drive events, increases the familiarity of motorists with EV as an innovative technology and reduces uncertainty in a non- threatening way. However, without an effective recharging network in place any money spent on communication strategies would be wasted.

## Details:

### **a. the potential economic, environmental and social benefits of widespread electric vehicle uptake in Australia;**

The following table summarises the primary externalities arising from the use of fossil fuels for transport and then outlines the benefits of transitioning to EVs for private motor vehicle transport rather than using fossil fuelled vehicles.



**Table 1 Negative externalities arising from fossil fuelled transportation in Australia and positive change effected by reducing fossil fuel consumption**

<b>Externality</b>	<b>Positive change and impacts of fossil fuel consumption</b>
<i>Greenhouse gas emissions (GHG)</i>	Reducing emissions: In 2013-14, transport generated 17% of Australia's total GHG emissions, 46% of which was from private road transport (DoE, 2015). The National Greenhouse Gas Inventory, 2014, showed domestic transport annual emissions increased from 32,112 Gg to 45,597 Gg (1990-2014) (AGEIS, 2015). These contribute to global warming and hence climate change, a significant global environmental problem with noticeable impact (Australian Academy of Science, 2015).
<i>Toxic air pollution</i>	Cleaning up the air reduces health impacts and medical costs: using fossil fuels increases air pollution especially particulate matter. Diesel produces Class 1 carcinogens (IARC 2012). Even low levels of air pollution result in health impacts ( e.g. Kjellstrom <i>et al.</i> 2002; Nawrot <i>et al.</i> 2011).
<i>Noise</i>	Reducing noise from internal combustion engines increases social amenity and reduces health costs: Noise results in significant but often unrecognised health impacts such as increased blood pressure; disturbed sleep patterns, which can affect cognitive functioning especially in children ( e.g. DenBoer & Schroten 2007; Passchier-Vermeer & Passchier 2000).
<i>Fuel security</i>	Reducing fossil fuelled transport reduces the risks associated with overseas sourced energy: Australia imports 90% of its oil, and is almost entirely dependent on imported oil for road transport resulting in very low fuel security as stockpiles are low (Blackburn, 2014) with only 23 day's supply in stock (DoEE, 2017, Table 7). The bulk of automotive gasoline is imported from South Korea and Singapore (DoEE, 2017, Table 4B), which has implications in a geopolitical context.
<i>Balance of trade</i>	Reducing Australia's balance of trade deficit - reducing business costs and increasing national prosperity: In 2016-7, Australia's fifth highest value import was Crude Petroleum (AUD 8.6 billion)(DFAT, 2017) while Refined Petroleum imports were in third place (AUD 17.4 billion). Combined they resulted in considerable balance of trade deficit (AUD26 billion in 2016-17) which is far higher than the current receipt of about AUD18 billion per year, from fuel sales tax revenue (about 4% of Federal government income), despite the tax's low level in Australia. While not all the imported fuel is used for road transport, the national good of lower business costs, improved health etc, needs to be weighed up when considering if government tax receipts are more important than a higher balance of trade deficit.
<i>Loss of jobs</i>	Generating renewable energy locally for transport would create Australian jobs -transport energy sourced from overseas means employment is outsourced.
<i>Waste heat</i>	Reducing the heat generated by inefficient internal combustion engines: Waste heat from EVs is less than 20% of that generated by conventional cars, which are extremely inefficient (for every litre of fuel only about 18-25% of its energy is converted into forward propulsion for a car (University of Calgary, 2015). This heat contributes to the heat island effect in urban areas thus increasing the use of air conditioning in buildings in summer (Li <i>et al.</i> , 2015). Buildings located near heavily trafficked roads have high air and noise pollution levels, reducing the use of windows for building ventilation and placing additional demand on air conditioning and electricity use.



<i>Financial leakage</i>	Due to repatriation of funds by foreign owned oil and electricity providers, financial leakage could be reduced if individuals use home generated renewable electricity to charge their EVs.
--------------------------	--

**c. measures to support the acceleration of electric vehicle uptake;**

The following table summarises recommendations based on my research over the past three years.

**Table 2 Recommendations for policy makers**

<b>Recommendation</b>	<b>Action</b>
<i>Acknowledge that transport related fossil fuel consumption results in a wide range of negative externalities.</i>	<ul style="list-style-type: none"> <li>• Set goals and targets to effect a transition to EVs as an effective way to reduce negative externalities including:             <ul style="list-style-type: none"> <li>○ Reducing GHG emissions, and toxic air pollution and noise, thus reducing associated health costs;</li> <li>○ Improving fuel security;</li> <li>○ Improving Australia's balance of trade;</li> <li>○ Reducing job losses resulting from outsourcing of transport energy supply;</li> <li>○ Reducing heat island effect in major urban centres, which in turn increases use of air conditioning and energy use in summer; and indirectly,</li> <li>○ Reducing financial leakage due to repatriation of funds by foreign owned oil suppliers.</li> </ul> </li> </ul>
<i>Deploy a comprehensive and effective network of publicly accessible rechargers.</i>	<ul style="list-style-type: none"> <li>• Install fast chargers every 50-100 km on main intercity routes as these are the most frequently used when recharging away from home, and in country towns,</li> <li>• Encourage the deployment of recharge stations at public places such as shopping centres, to enable recharging while motorists are parked in one place for a length of time</li> <li>• Ensure the network is in place as EV prices drop and motorists become increasingly familiar with the technology.</li> <li>• Support those householders with no off-street parking by providing on street rechargers near their homes, with sufficient points to avoid queues at popular spots;</li> <li>• Ensure an adequate maintenance regime with prompt repair of public rechargers;</li> <li>• Ensure public recharge stations are well signposted with standardised signage; improves accessibility for customers and maximises network value;</li> <li>• Ensure easy access regardless of time of day;</li> <li>• Maintain centralised and up-to-date data collection and dissemination for recharger location and status to aid availability of information to everyone, including motorists, and assists network planning; and</li> <li>• Encourage installation of workplace rechargers; while this is not as important compared to at home charging, it is important for people with long commutes to be able to recharge during worktime, and it increases visibility of EVs and rechargers.</li> </ul>



<p><i>Introduce legislation /regulation to increase consumer convenience.</i></p>	<ul style="list-style-type: none"> <li>• Legislate to ensure open access to rechargers, that there is interoperability and no need to join a private recharge network provider for recharging away from home, and that recharging can be paid for by credit/debit card. See California's legislation ;</li> <li>• Introduce standards for recharger hardware to maximise customer convenience when recharging and to maximise efficacy of the network, ideally one size fits all cars, to increase network utility and reduce negative feedback to intending customers;</li> <li>• Ensure availability of rechargers in multi-occupant carparks, whether residential or commercial;</li> <li>• New buildings with car parking must have capacity for recharger installation, including adequate electricity supply and parking space availability;</li> <li>• Compel building managers to allow retrofitting of rechargers in car parking spaces; as cities densify and people move into multi-dwelling buildings this will be a critical measure; and</li> <li>• Investigate a range of soft incentives to encourage uptake of EVs, for example, free access to toll ways, access to high occupancy vehicle lanes regardless of passenger numbers.</li> </ul>
<p><i>Increase the flow and availability of information for existing and future drivers.</i></p>	<ul style="list-style-type: none"> <li>• Support / introduce websites and smartphone apps to enable drivers to access to public recharger maps that have accurate up to date data; this reduces negative informational conformity due to frustrated users who tell their friends, and helps with planning for future locations of recharger sites;</li> <li>• Support and promote field days to help expose car customers to the technology, this would need to be in tandem with recharge network deployment, otherwise field days would be wasted. EV owners are far less concerned about technology limitations than non-owners so there is a need to familiarise non-owners with capability of the technology;</li> <li>• Support Formula e racing and/or other events; to further highlight developments in the EV field, it is good for tourism and information dissemination; and</li> <li>• Provide cost calculators for total ownership costs; for example, re-label the <i>Green Vehicle Guide</i> website as a fuel cost-calculator and guide to cheaper motoring, to promote the money saving aspects of EV ownership, thus appealing to a wider audience than might be attracted to the 'green' aspects of EVs; ensure monthly fuel bill is displayed for every vehicle when sold; such measures would appeal to peoples' concerns about personal budgets, allowing direct comparison of EV's 'fuel' saving aspects.</li> </ul>
<p><i>Implement procurement strategies, encourage fleet purchasing to prioritise EVs over ICEVs.</i></p>	<ul style="list-style-type: none"> <li>• Implement government EV procurement strategies;</li> <li>• Encourage fleet purchasing, and hence increase the availability of second-hand EVs due to rapid turnover; and</li> <li>• Facilitate workshops for businesses and government departments to determine good operating practices, for example, to produce in-car user instructions and troubleshooting manuals to maximise EV use and output and to enhance user experiences. This also</li> </ul>



	increases positive feedback rather than negative – an important influence on diffusion of innovation.
<i>Encourage car manufacturers and dealerships to prioritise EV sales.</i>	<ul style="list-style-type: none"> <li>• Introduce long term fleet emissions targets for vehicle manufacturers importing to Australia to encourage greater use of EVs to reduce overall emissions from cars;</li> <li>• Support importation of a greater variety of EV models to Australia at the cheaper end of the car market; and</li> <li>• Provide support, such as training and workshops for sales staff to be positive and reliable sources of EV information, thus increasing positive experiences for customers.</li> </ul>

#### **e. how federal, state and territory Governments could work together to support electric vehicle uptake and manufacturing, supply, and value chain activities**

1. A critical factor to ensure the introduction of EVs is as smooth as possible will be to ensure any legislation / regulations are Australia wide eg the use of standardised fittings on recharger hardware – there is only one plug shape for example; or the signage for rechargers is the same nationally. That is, ensure all States and the Commonwealth have legislation that is national. This measure will ensure investment is not wasted. For example by disadvantaging early adopters who chose one type of hardware, that was discontinued and now the investors must pay for upgrades. While it is possible for an EV owner to buy adaptors to suit different plug types, with more than six different plug shapes on the market, it is expensive and inconvenient to have to carry that many adaptors in the car.
2. Implement legislation that ensures motorists have open access to publically available rechargers. That is a motorist does not need to join a network to recharge a car away from home. By increasing convenience to motorists it will speed up the introduction of EVs and increase the potential custom for infrastructure providers.
3. Support the introduction of lithium battery recycling in Australia. This measure is poorly addressed internationally and it is an industry that will become increasingly important for all countries as we transition to more electric vehicles and increasing levels of battery storage for electricity supplies.

## **References**

AGEIS (2015) *National Greenhouse Gas Inventory by Economic Sector*. Available at: <http://ageis.climatechange.gov.au/ANZSIC.aspx> (Accessed: 18 August 2016).

Australian Academy of Science (2015) *The Science of Climate Change: questions and answers*. Canberra. Available at: <https://www.science.org.au/files/userfiles/learning/documents/climate-change-r.pdf>.

Blackburn, J. (2014) *Australia 's Liquid Fuel Security Part 2*. Sydney. Available at: [http://www.aie.org.au/AIE/Documents/NRMA\\_Fuel\\_Security\\_Report\\_Pt2.pdf](http://www.aie.org.au/AIE/Documents/NRMA_Fuel_Security_Report_Pt2.pdf).

California Assembly (2014) *AB 2565, Muratsuchi. Rental property: electric vehicle charging stations*. USA. Available at: [https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill\\_id=201320140AB2565](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB2565).



California Senate (2013) *Electric Vehicle Charging Stations Open Access Act*. Available at: [http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill\\_id=201320140SB454](http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB454).

DenBoer, L. C. (Eelco) and Schroten, A. (Arno) (2007) *Traffic noise reduction in Europe*. Delft. Available at: [http://www.transportenvironment.org/sites/te/files/media/2008-02\\_traffic\\_noise\\_ce\\_delft\\_report.pdf](http://www.transportenvironment.org/sites/te/files/media/2008-02_traffic_noise_ce_delft_report.pdf).

DFAT (2017) 'AUSTRALIA ' S TOP 25 GOODS & SERVICES EXPORTS ( a )', 4(c), p. 5429. Available at: <http://dfat.gov.au/about-us/publications/trade-investment/australias-trade-in-goods-and-services/Documents/australias-goods-services-by-top-25-imports-2016-17.pdf>.

DoE (2015) *Australia ' s emissions projections 2014-15*. Canberra, ACT. Available at: <https://www.environment.gov.au/system/files/resources/f4bdfc0e-9a05-4c0b-bb04-e628ba4b12fd/files/australias-emissions-projections-2014-15.pdf>.

DoEE (2017) *Australian Petroleum Statistics, Issue 251, June 2017*. Canberra. Available at: <https://www.energy.gov.au/government-priorities/energy-data/australian-petroleum-statistics>.

IARC (2012) *IARC: Diesel Engine Exhaust Carcinogenic, International Agency for Research on Cancer, World Health Organisation*. Available at: [http://www.iarc.fr/en/media-centre/pr/2012/pdfs/pr213\\_E.pdf](http://www.iarc.fr/en/media-centre/pr/2012/pdfs/pr213_E.pdf) (Accessed: 4 May 2016).

Kjellstrom, T. E., Neller, A. and Simpson, R. W. (2002) 'Air pollution and its health impacts: the changing panorama.', *The Medical journal of Australia*, 177(11–12), pp. 604–8. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/12463977>.

Li, C. *et al.* (2015) 'Hidden Benefits of Electric Vehicles for Addressing Climate Change', *Scientific Reports*, 5, p. 9213. doi: 10.1038/srep09213.

Nawrot, T. S. *et al.* (2011) 'Public health importance of triggers of myocardial infarction: A comparative risk assessment', *The Lancet*. Elsevier Ltd, 377(9767), pp. 732–740. doi: 10.1016/S0140-6736(10)62296-9.

Passchier-Vermeer, W. and Passchier, W. F. (2000) 'Noise exposure and public health.', *Environmental health perspectives*, 108 Suppl(6), pp. 123–131. doi: 10.2307/3454637.

University of Calgary (2015) *Energy Education: energy lost in vehicles* Available at: [https://energyeducation.ca/encyclopedia/Energy\\_loss](https://energyeducation.ca/encyclopedia/Energy_loss) (Accessed: 21 July 2017)

## Appendix

Please refer to the attached documents for further information about EVs, in particular the paper from Transportation Research Part D provides evidence that in Australia, even with the electricity production we had in 2013, that it is worthwhile substituting EVs for ICEVs whereby fewer emissions are produced per kilometre driven. It was not possible to transfer the tables from a PDF format into this submission without the tables changing from their original format.