Transport Emission Energy Research

Committee Secretary
Standing Committee on Climate Change, Energy, Environment and Water
PO Box 6021
Canberra ACT 2600

11 March 2024

Dear Sir, Madam,

The Committee invited me to make a written submission, providing recommendations on the on the inquiry terms of reference by Friday, 22 March 2024.

This letter contains my input on a number of topics listed in the Terms of Reference.

If there are any further questions, please do not hesitate to contact me.

Kind regards,

[redacted]

Transport Energy/Emission Research (TER)
Dr Robin Smit
Director and Principal Research Consultant
https://www.transport-e-research.com/

Adjunct Professor
University of Technology Sydney, Australia
Faculty of Engineering and Information Technology
School of Civil & Environmental Engineering

Transport Emission Energy Research

*1) Terms of Reference - the impact of moving from internal combustion engine vehicles, including fuel excise loss, existing auto industry component manufacturers and the environment*

In collaboration with international experts, Transport Energy/Emission Research (TER) has conducted recent research (2022-24) into the impacts of the energy transition in the Australian road transport sector on greenhouse gas emissions. This research work was done using a holistic life-cycle assessment approach, which accounts for both fuel-cycle emissions (on-road driving, maintenance, upstream fuel and energy extraction and production) and vehicle-cycle emissions (vehicle manufacturing as well as end of life, recycling or scrapping). These studies are available as open access papers with full transparency regarding methods, assumptions and results. Some key points are listed below, and more details can be found following the web links.

- Australian passenger vehicles:[1]
  - For the 2018 Australian electricity mix, which was still largely fossil fuels based, the weight of evidence suggests that (battery) electric vehicles will reduce life-cycle greenhouse gas emission rates by 29% to 41%.
  - The emissions performance of (battery) electric vehicles varied substantially between States/Territories in 2018, which reflects the differences in fuel mix for electricity generation in the different states and territories (See Figure 1).
  - Large reductions between 74% and 80% are estimated for a future more decarbonised Australian situation (90% renewables in electricity generation).
- Australian trucks:[2]
  - Diesel trucks had lower life-cycle GHG emissions in 2019 than electric trucks (battery, hydrogen fuel cell), mainly due - at the time - to the high carbon-emission intensity of the Australian electricity grid (mainly coal) and hydrogen production (mainly through steam–methane reforming).
  - In a future more decarbonised Australian situation (90% renewables), battery electric trucks are estimated to provide deep reductions (about 75–85%) in life-cycle GHG emissions.
  - Fuel-cell electric (hydrogen) trucks provide substantial reductions (about 50–70%), but not as deep as those for battery electric trucks. Hydrogen trucks are expected to emit about twice the amount of life-cycle emissions per kilometre compared to battery electric trucks. The latter's extra reduction in emissions will be vital for getting road transport closer to the net-zero target in 2050.
  - Moreover, hydrogen trucks exhibit the largest uncertainty in emissions performance, which reflects the uncertainty and general lack of information for this technology. They therefore carry an elevated risk of not achieving the expected emission reductions.

---

[1] International peer-reviewed scientific journal paper (open access): https://www.mdpi.com/2071-1050/14/6/3444. Short read in *The Conversation*: https://theconversation.com/how-climate-friendly-is-an-electric-car-it-all-comes-down-to-where-you-live-179003.

[2] International peer-reviewed scientific journal paper (open access): https://www.mdpi.com/2071-1050/16/2/762. Short read in *The Conversation*: https://theconversation.com/why-electric-trucks-are-our-best-bet-to-cut-road-transport-emissions-219960.

Transport Emission Energy Research

From an emission reductions perspective, these studies suggest that policy efforts to boost the share of battery electric vehicles in the Australian fleet needs to be stepped up urgently, at scale, alongside a rapid decarbonisation of the electricity grid and hydrogen production.

A relevant factor that may be overlooked, is that fleet turnover is a slow process (in the absence of specific policy interventions such as scrappage programs). The Australian Motor Vehicle Census reports that the average age of Australian cars is about ten years, with an average attrition rate of only about 4% each year. This means even if all vehicles sold today were battery electric, it would take more than ten years for the Australian road fleet to be fully electric.

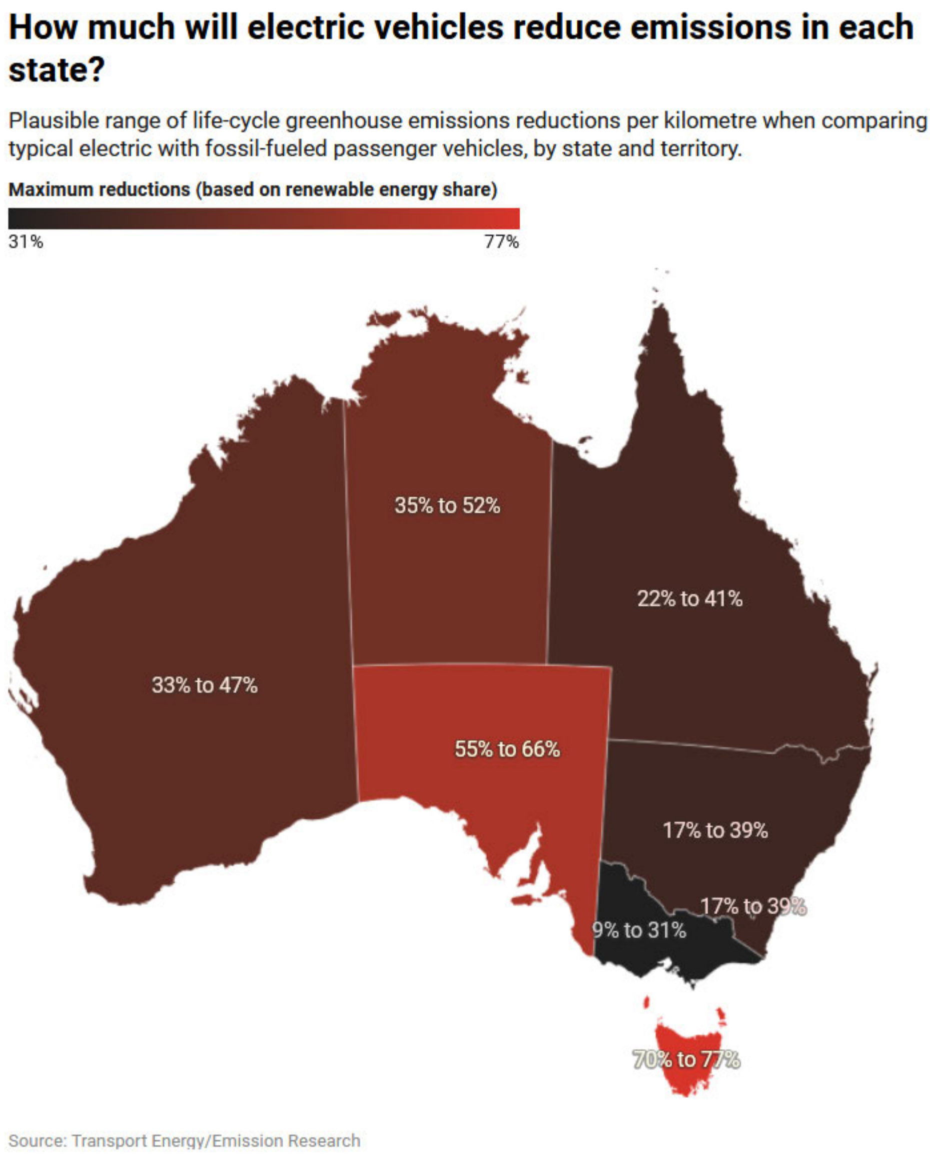


Figure 1 - Regional variability in emission reduction potential of electric vehicles in 2018.[3]

---

[3] https://theconversation.com/how-climate-friendly-is-an-electric-car-it-all-comes-down-to-where-you-live-179003.

*2) Terms of Reference - the impact on electricity consumption and demand.*

Last year, Transport Energy/Emission Research (TER) conducted a detailed and independent modelling study into greenhouse gas emissions, fuel consumption, electricity and energy use from Australian road transport in 2019 and 2050, using state-of-the art and Australia-specific software tools and methods.[4] The study assumed that Australia will follow an ambitious EU scenario, albeit delayed, whilst taking into consideration critical aspects of Australia's unique on-road fleet.

The study predicts a substantial shift in the use of different energy sources in road transport. Whereas practically all transport energy use in 2019 was fossil fuels (petrol, diesel, LPG, CNG), with a negligible portion of electricity (0.01%), the situation is expected to be different in 2050 with 62% of transport energy coming from fossil fuels, 26% from hydrogen and 12% from electricity. In addition, due to efficiency improvements for all vehicle technologies, total on-road energy use by road transport is forecasted to be reduced with 25% in 2050, despite the estimated 54% increase in total travel in the period 2019 – 2050.

However, the picture is significantly richer and more complex than that. First, there are significant differences in energy efficiency between technology types. For instance, battery electric vehicles are roughly twice as energy efficient on the road (tank-to-wheel) as fuel cell electric (hydrogen) vehicles and roughly three times as energy efficient as internal combustion engine (ICE, fossil-fuelled) vehicles of similar type. This is reflected in the modelling results. In 2050, BEVs account for approximately a 70% of total travel, but only 25% of total (on-road) energy use. In contrast, fossil-fuelled vehicles account for about 25% of total travel, but consume 60% of total energy, despite the expected efficiency improvements for ICEVs, which were simulated out to 2060. In 2050, hydrogen vehicles make up only a few percent of total travel, but it was assumed that the bulk will be driven by large trucks. As a consequence, FCEVs use a little over 10% of total on-road energy.

The Australian on-road fleet is predicted to require 216 PJ of electricity and 103 PJ of hydrogen in 2050, which corresponds to 60 TWh of electricity and 861 ktonne of hydrogen per annum, respectively. To put this in context, total electricity generation in Australia was 265 TWh in 2019. So the forecasted electricity required for electrified road transport in 2050 is estimated to be relatively modest, with a share of 23% of current electricity production.

This is an estimate of total annual electricity demand for Australian road transport in 2050, alongside the use of other transport fuels, which does not yet consider other factors that are relevant for electricity generation, such as the spatial and temporal distribution of electricity demand (e.g. peak demand over the day, week, months), the use of home charging with solar panels, the uptake of V2G technology, etc.

---

[4] Peer-reviewed scientific journal paper (open access): Publication 2023c, https://www.transport-e-research.com/publications. Short read in *The Conversation*: https://theconversation.com/too-big-too-heavy-and-too-slow-to-change-road-transport-is-way-off-track-for-net-zero-208655.

Transport Emission Energy Research

The analysis suggests that Australia will fall short of the net zero 2050 target. This is still the case with a significant penetration of electric vehicles in the on-road fleet and approximately 70% of total kilometres travelled by battery electric vehicles in 2050. The study suggests that electrification and the use of hydrogen alone are not going to be enough. This means that significantly more intensified and far-reaching policies need to be developed and implemented if net zero is to be achieved in 2050.

In terms of possible solutions, a combination of electrification and lightweighting of road transport appears to be the most effective and robust way forward. The simulation suggests that an on-road passenger vehicle fleet in 2050 that is dominated by small and light battery electric vehicles may get Australia close to achieving the net zero target. Green hydrogen should be deployed where electrification faces unsurmountable barriers, but based on the current evidence, it is expected there will not be many cases in the road transport sector.

*3) Terms of Reference - any other relevant matters.*

To provide further context around the Australian New Vehicle Emission Standards (NVES) Transport Energy/Emission Research (TER) and The International Council on Clean Transportation (ICCT) produced a collaborative and independent piece of research on 20 February 2024.[5] The study provides a brief history of greenhouse gas emission and fuel efficiency standards in Australia and analyses the emissions performance of Australian Australian cars, SUVs, utes and vans from an international perspective. The results of this study support a strong NVES, as part of an overall strategy to catch up with major jurisdictions (EU, USA, Japan, China) and reach net zero in 2050.

We would also like to draw your attention to an older but detailed study into the real-world $CO_2$ emissions performance of new Australian passenger vehicles in the period 2008-2018, with a (statistical) analysis of underlying vehicle characteristics that affect (and increase) fleet average emission rates (g/km) of our newly sold passenger vehicles.[6]

[5] Briefing paper (open access): https://theicct.org/publication/australian-ldv-co2-emissions-compare-to-the-rest-of-the-world-feb24/. Short read in *The Conversation*: https://theconversation.com/australian-passenger-vehicle-emission-rates-are-50-higher-than-the-rest-of-the-world-and-its-getting-worse-222398.
[6] TER, 2019. Real-World $CO_2$ Emissions Performance of the Australian New Passenger Vehicle Fleet 2008-2018 – Impacts of Trends in Vehicle/Engine Design, Transport Energy/Emission Research (TER), 14 September 2019 (open access): Publication 2019a, https://www.transport-e-research.com/publications. Short read in *The Conversation*: https://theconversation.com/we-thought-australian-cars-were-using-less-fuel-new-research-shows-we-were-wrong-122378.