Australian National University

Submission: Response to Transport and Infrastructure Net Zero Consultation Roadmap

ANU Institute for Climate, Energy & Disaster Solutions

This submission is the collated perspective of independent researchers that work at The Australian National University. The views and opinions expressed in this submission reflect those of the authors and contributors.

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TEQSA Provider ID: PRV12002 (Australian University)
CRICOS Provider Code: 00120C

23rd July 2024

The Hon Catherine King
Department of Infrastructure, Transport, Regional Development, Communications and the Arts
GPO Box 594
Canberra
ACT 2601

Re: Transport and Infrastructure Net Zero Consultation Roadmap

Dear The Hon Catherine King,

Please find enclosed a submission by the ANU Institute for Climate, Energy and Disaster Solutions (ICEDS) in response to Transport and Infrastructure Net Zero Consultation Roadmap.

Based in the ACT, ICEDS connects industry, governments and communities with climate, energy & disaster-risk research from the Australian National University. Our goal is to advance innovative solutions to address climate change, energy system transitions and disasters. We facilitate integrated research, teaching and policy engagement across disciplines. The enclosed submission contains contributions from experts in sustainable transport, renewable energy, grid integration of distributed energy resources and electric vehicles: Dr Bjorn Sturmberg, Dr Bin Lu, Kate Lawrence and Natali Heil Koerbel.

Our network of ANU researchers will gladly provide further consultation and modelling support if requested.

Sincerely,

Professor Mark Howden
Director, Institute for Climate, Energy and Disaster Solutions

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Executive Summary

The Australian National University (ANU) Institute for Climate, Energy and Disaster Solutions (ICEDS) welcomes the opportunity to provide feedback on the Department of Infrastructure, Transport, Regional Development, Communications and the Arts' *Transport and Infrastructure Net Zero Consultation Roadmap*.

This submission focuses on accelerating the phase out of internal combustion engine vehicles through policy and taxation measures, the data needed to design optimised integration of electric vehicles into Australia's electricity grid, alternative solutions for the decarbonisation of the aviation sector and available mechanisms for electrification of buses and bus networks.

The ANU ICEDS submission makes the following recommendations:

- *1.1 Draw upon existing resources, including FACTS: A Framework for an Australian Clean Transport Strategy, to inform Australia's transport and infrastructure net zero roadmap.*
- *2.1 Accelerate electric vehicle adoption, learning from the successful growth of solar photovoltaics.*
- *2.2 Prepare standards, regulations and behaviours for a net zero transport system.*
- *2.3 Introduce early scrapping policies for Internal Combustion Engine vehicles to accelerate the transition of Australia's light passenger vehicles.*
- *2.4 Deploy infrastructure supporting electric vehicles equitably in regional and remote Australia.*
- *2.5 Remove tax arrangements that encourage the purchase of light commercial Internal Combustion Engine vehicles for passenger use.*
- *3.1 Invest in thorough data collection efforts to support the design of smart charging strategies that enable large-scale electric vehicle integration. Particular focus on under-represented users including apartment dwellers is necessary.*
- *3.2 Develop and deploy capabilities for all electric vehicles to contribute to power system stability and security.*
- *3.3 Educate electric vehicle users to the impacts of charging behaviours on the stability and security of the power system and their own energy costs.*
- *4.1 Invest in the increased prevalence of drop-in alternative fuels, such as electrofuels, for aviation.*
- *4.2 Include the production of alternative aviation fuels in any forecasting of electricity demand.*
- *5.1 Engage with available tools such as RouteZero to support the electrification of bus services and depots.*
- *5.2 Provide local and state governments with coordination and low-cost financing for bus electrification.*

The transition to net zero of Australia's transport and associated infrastructure is highly complex and will require the use of policy, technology and financial levers. It is key that the Department works not only to progress the development of low-and no-emissions transport technologies but gives due attention to eliminating existing high-emissions transport modes in a timely manner, consistent with Australia's commitments under the Paris Agreement to keep global temperature increases to well under 2°C and if possible, to 1.5°C.

1. FACTS: A Framework for an Australian Clean Transport Strategy

Recommendation 1.1: Draw upon existing resources, including FACTS: A Framework for an Australian Clean Transport Strategy, to inform Australia's transport and infrastructure net zero roadmap.

Three ANU experts contributed to the development of FACTS: A Framework for an Australian Clean Transport Strategy.[1] The framework contains advice for a holistic approach to decarbonisation, setting near and long-term transport targets, consideration of a broad range of decarbonisation strategies and technology options, differing responsibilities across levels of government and industry, and capturing the economic, social and environmental benefits of clean transport.[2, 3]

While some elements of FACTS can be found in the consultation roadmap (for example, the '*avoid, shift, improve*' hierarchy), Australia's transport and infrastructure net zero roadmap can increasingly draw upon FACTS for evidence-based policy support.

2. Road Transport Electrification

2.1 Rapid transition to electric vehicles

Recommendation 2.1: Accelerate electric vehicle adoption, learning from the successful growth of solar photovoltaics.

Australia's rollout of rooftop solar power systems has been incredibly effective, with rooftop solar accounting for 11.2% of Australia's electricity supply in April 2024.[4] To encourage similar success in the rollout of electric vehicles (EVs), which has thus far been slow,[5] the Australian government can helpfully apply lessons from the rapid increase in solar photovoltaics in the EV context.

Policy solutions can account for:[6]

- Price and non-price motivators for uptake (including climate concerns)
- The likely exponential rates of increased EV penetration (including the power demand implications)
- Charging times and behaviours and their impacts on infrastructure (for example, availability of highway chargers)
- Whether road user charges will be necessary in the absence of fuel excise tax
- The potential for uptake of electric private passenger vehicles to increase congestion when targeted over public transit options
- The potential to entrench disadvantage among those unable to meet the costs of purchasing EVs.

Recommendation 2.2: Prepare standards, regulations and behaviours for a net zero transport system.

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[1] Dr Bjorn Sturmberg welcomes further engagement relating to FACTS via email at bjorn.sturmberg@anu.edu.au.
[2] Whitehead et al. (2022)
[3] Whitehead et al. (2022)
[4] Clean Energy Council (2024)
[5] Commonwealth of Australia (2019)
[6] Stumberg et al. (2021)

The Australian government can also learn from the complications and contentions that have arisen from the progressive waves of rooftop solar uptake to pre-emptively prepare standards, regulations and behaviours to be fit for purpose in a net zero transport system.[7]

It is reasonable to expect that technology learning effects of price reduction and continued adoption throughout the supply chain will continue to drive an exponential growth in EVs share of vehicle sales in Australia – as has been observed in other vehicle markets[8]. It is also reasonable to expect that international ambitions and policies will continue to accelerate the transition to EVs. ANU ICEDS members have developed models that incorporate both learning effects and the impacts of policy targets, such as the United States (US) Inflation Reduction Act and the European Union (EU) ban on sales of ICE vehicles. Figure 1 and Figure 2 show how continued global learning effects, combined with policy ambitions including the US Inflation Reduction Act and EU ban on sales of ICE vehicles, drive the exponential uptake of EVs. This uptake is faster than current forecasts from CSIRO's and AEMO's Step Change scenarios, which have not incorporated the effects of increasingly ambitious policies internationally, indicating that almost all new car sales are likely to be electric in the early 2030s. The consultation roadmap points out that the Federal government is already targeting light vehicles through its National Electric Vehicles Strategy. However, the strategy largely focuses on uptake of new EVs through accessibility and availability, rather than addressing the prevalence of Internal Combustion Engine (ICE) vehicles.[9] The continuing uptake of new, and operation of existing, ICE vehicles pose a threat to Australia's transition to net zero emissions in a timely fashion consistent with the country's obligations under the Paris Agreement. In fact, the Climate Change Authority stated that, in order to achieve net zero transport emissions by 2050, the sale of new ICE vehicles must cease by 2035.[10] Hence, this can be considered an urgent policy option.[11]

Early scrapping of ICE vehicles does not necessitate a costly rebate system such as the 2009 US Car Allowance Rebate System.[12] Policy options including regulations on vehicle age, pricing emissions into registration fees, and establishing carbon pricing can all contribute. However, policy impact on all communities can be considered, with appropriate supports in place to ensure that those relying on aging or high emissions ICE vehicles due to an inability to afford a replacement are not disproportionately disadvantaged by pricing mechanisms.

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[7] Sturmberg et al. (2021)
[8] International Energy Agency (2024)
[9] DCCEEW (2023)
[10] The Climate Change Authority (2024), p25
[11] Please contact Dr Bjorn Sturmberg (bjorn.sturmberg@anu.edu.au) for further information about the modelling approaches used, or to engage in collaboration to explore the capabilities of the model.
[12] United States Public Law 111-32 (2009)

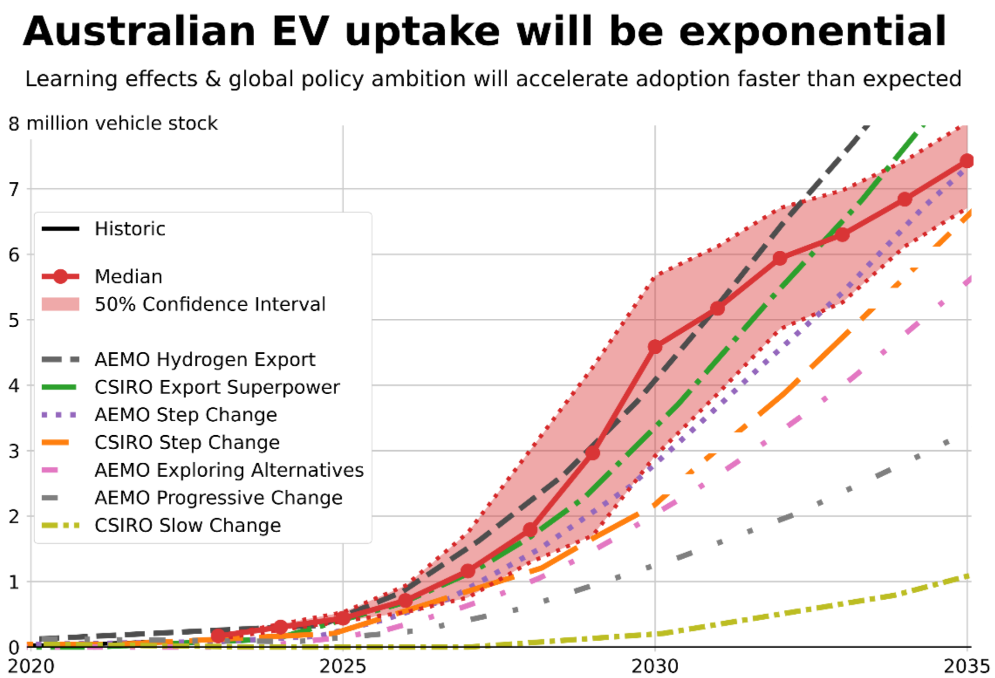

Figure 1: Exponential uptake of electric vehicles in Australia. The median represents output from a model that includes international policy targets.

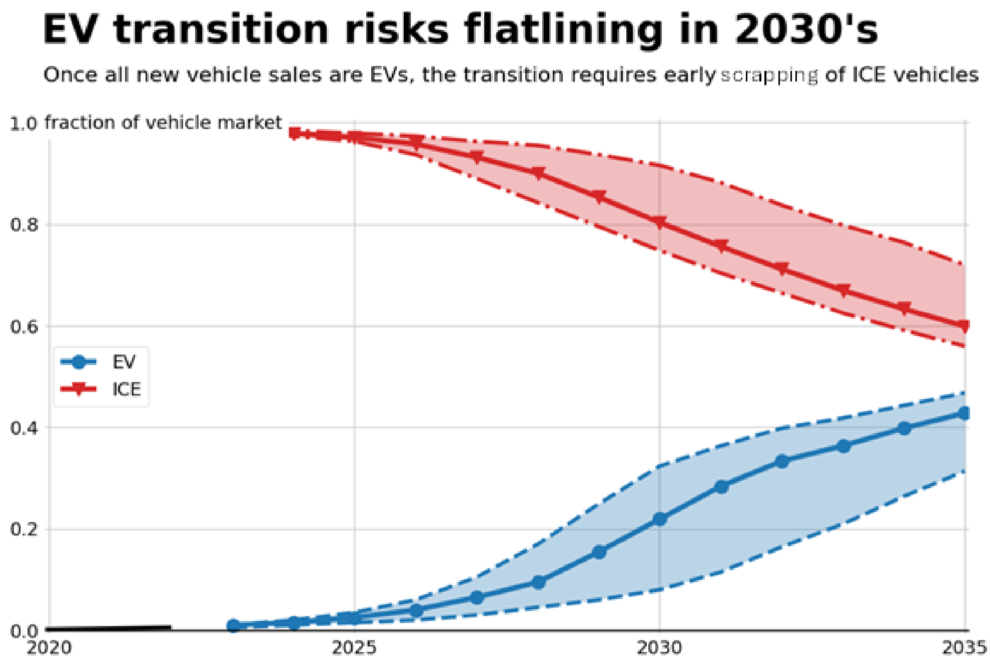

Figure 2: ICE vehicles will continue to make up a significant proportion of Australia's fleet unless early scrapping policies are introduced.

Recommendation 2.3: Deploy infrastructure supporting electric vehicles equitably in regional and remote Australia.

This modelling focuses on EV production volumes and prices. For EVs, such a transition depends critically on the provision of charging infrastructure. This must be a high priority for an accelerated EV transition, complementing incentives for vehicle purchases. The deployment of this infrastructure must not only be fast, it must also be fair. Particularly, government support can be geared towards regional Australia so that regional Australians are given an opportunity to benefit from EVs. Our research shows that the 500km+ range of modern EVs is making long distance travel throughout regional, and even remote, Australia feasible. However, there is as yet little charging infrastructure to service these communities, leaving them outside of the transition and risking a 'rural vs urban' divide. Charging infrastructure installed in regional Australia tends to be ultra-fast charging on highways, serving through-traffic. In contrast, rural communities often require more modest power chargers located in towns to service drivers spending a few hours utilising local services like shopping and healthcare.[13]

2.2 Taxation of Light Commercial Vehicles

Recommendation 2.4: Remove tax arrangements that encourage the purchase of light commercial Internal Combustion Engine vehicles for passenger use.

The consultation roadmap notes the fastest growing vehicle segment in the Australian market are bigger and heavier cars, such as SUVs. These vehicles are stated to potentially offset any emissions reductions gained from fuel efficiency improvements and increased adoption of EVs.[14] In 2024 so far, 56% of new vehicles purchased in Australia have been SUVs, 23% have been Light Commercial Vehicles and 18% have been passenger vehicles.[15] The most popular new car in Australia in June 2024 was the Ford Ranger, with tailpipe emissions of 230g/km of CO_2.[16] Tailpipe emissions account for 83% (82 Mt CO_2-e) of Australia's transport emissions.[17]

A key driver of increased uptake of large, emissions-intensive ICE vehicles including utes and SUVs, which make up five of the top ten most popular new vehicles in Australia, is a series of complementary tax incentives that apply to businesses. For instance, in most cases where an employee uses a business vehicle for private purposes, their employer will need to pay Fringe Benefit Tax (FBT).[18] However, exemptions apply for dual cab utes and four-wheel drives with a payload of over one tonne, which means large, heavily emitting commercial vehicles can be used privately without incurring FBT liabilities.[19] FBT exemptions encourage the use of such vehicles for travel between home and work, incidental travel or non-work-related use where the size and capacity is unnecessary.[20] Businesses also receive tax credits for fuel used in heavy vehicles.[21]

While the FBT exemptions encourage businesses to purchase larger-than-necessary vehicles, Australia's Luxury Car Tax (LCT) subsidises consumer purchases of expensive and inefficient commercial vehicles such as dual cab utes or four-wheel drives by classifying them as "designed mainly for carrying goods and not passengers." The LCT applies to any new car that costs over AUD80,576 (unless it meets fuel efficiency requirements, where the threshold is AUD91,387). The relevant exemption applies where the vehicle can carry twice the weight in payload than it can carry in people, which describes most dual-cab utes available in 2024.[22] Consumers that are able to buy cars that cost over the LCT threshold are thus incentivized to choose models that do not incur the 33% tax. Even with the higher cost threshold in place for fuel efficient vehicles, in many cases it is still cheaper, at least at point of sale, to purchase a

[13] Demaria et al. (2022)
[14] DITRDCA (2024), p34
[15] Federal Chamber of Automotive Industries (2024)
[16] Green Vehicle Guide (2024)
[17] Climate Change Authority (2023)
[18] Australian Taxation Office (2023a)
[19] Australian Taxation Office (2023b)
[20] Australian Taxation Office (2023b)
[21] Australian Taxation Office (2021)
[22] The Australia Institute (2024) p2

"commercial" vehicle.[23] The Australia Institute estimates the cost of the LCT ute exemption to be AUD250 million in lost revenue for 2023 alone.

These tax structures encourage the purchase of large, inefficient, non-passenger vehicles in the name of a business purpose, where the primary use is actually passenger journeys. Given the lifespan of a new light commercial ICE vehicle is 10–15 years, and that achieving net zero transport emissions by 2050 requires no new ICE vehicles by 2035, urgent taxation reform is required.[24]

3. Grid Integration of Electric Vehicles

Electric vehicles cut carbon emissions by 50-60% compared to fossil fuel vehicles when accounting for the current energy mix,[25] but increase household electricity use by 50%.[26] This extra electricity demand could be a major strain on the grid at times unless the charging of vehicles is managed. The large batteries in electric vehicles could be enlisted to discharge power to the power grid when needed. The average electric vehicle battery stores more than two days' worth of electricity demand for the average Australian household,[27] so this could have a significant effect.

Large-scale electric vehicle integration poses significant challenges to current power grid operation and network capacity. Studies estimate that completely electrifying road and rail transport in Australia would increase current electric loads in the National Electricity Market by 38%, with about half of the increase attributed to electrifying passenger vehicles.[28] New peak loads resulted from large-scale electric vehicle integration may exceed the capacity limits of existing power grids. To best accommodate this new electricity demand, flexible and responsive charging options (smart charging) must be implemented.

Although the consultation roadmap makes passing reference to innovations in bi-directional charging, smart (dis)charging will not happen without coordinated efforts in data collection and research investment in charging patterns, behaviour change and vehicle-to-grid technology.

3.1 Data Collection and Charging Strategies

Recommendation 3.1: Invest in thorough data collection efforts to support the design of smart charging strategies that enable large-scale electric vehicle integration. Particular focus on under-represented users including apartment dwellers is necessary.

A comprehensive understanding of electric vehicle travel patterns and charging profiles is crucial for developing effective smart charging strategies. By conducting various types of transportation surveys at state and city levels, the travel and charging patterns of electric vehicles can be better comprehended, enabling the design of effective charging strategies to manage the impact of large-scale electric vehicle integration into power grids.

Conventional transportation surveys include regional resident travel surveys by collecting trip information from residents and electric vehicle trials conducted by utilities and network operators. However, the sample sizes of these surveys are usually small, limiting their ability to accurately reflect diverse travel and vehicle charging patterns amongst various traveller groups. Current vehicle charging data primarily come from early electric vehicle adopters, who

[23] The Australia Institute (2024) p3
[24] The Climate Change Authority (2024), p25
[25] Sheng et al. (2021)
[26] Electric Vehicle Council (2024)
[27] Sturmberg, Bjorn (2024)
[28] Nadolny et al. (2022)

typically have higher incomes and live in detached homes.[29] In Australia, a detached home is more likely to have solar panels than any other type of dwelling,[30] which also may influence EV charging patterns. In contrast, there is insufficient data on electric vehicle charging for apartment dwellers, and thus existing trials cannot well represent the charging behaviours of these residents. New survey methods can help collect rapidly large amounts of vehicle travel and charging data at city, state and national levels, facilitating the establishment of a constantly updated database of the vehicle travel and charging patterns.

For instance, information from mobile phone calls and electric vehicle charging equipment can be triangulated to develop extensive datasets on electric vehicle travel patterns and charging profiles. Studies simulated residential travel patterns based on data from 200 million calls (call times and location of cell towers) from 1.39 million residents in the San Francisco Bay Area, collected over a 6-week period. The travel patterns generated from their modelling showed a dual-peak pattern, with the afternoon peak (between 3 pm and 5 pm) 25% higher than the morning peak before 8 pm.[31] The study also analysed vehicle charging data from 580,000 charging sessions on charging equipment, including vehicle arrival and departure times. The arrival times showed a single-peak pattern in the morning between 8 am and 10 am, while the departure times showed a dual-peak pattern with peaks occurring at midday between 11 am and 1 pm and in the evening from 5 pm to 7 pm. Replicating similar innovative data collection processes in the Australian context can better inform pathways to fully integrate EVs into the power grid and optimise charging infrastructure.

While the ability to discharge power from vehicles remains limited to a small number of vehicles and EV Supply Equipment (EVSE), the immediate opportunities to integrate EVs into the electricity grid are in managing the charging of vehicles. The goal for day-to-day EV charging is to align EV charging with times of day where the electricity system is lightly loaded. This is typically overnight and during sunshine hours when solar power is produced. During these times, the electricity network is operating far below its rated capacity and many generators are not being used.

3.2 Grid Contingencies and Vehicle-to-Grid Technology

Recommendation 3.2: Develop and deploy capabilities for all electric vehicles to contribute to power system stability and security.

Recommendation 3.3: Educate electric vehicle users to the impacts of charging behaviours on the stability and security of the power system and their own energy costs.

The potential interactions of EVs and the electricity grid can best be considered as two key elements:

- Power grid conditions: the grid can either be experiencing normal, everyday conditions, or grid contingencies (the loss or failure of a component within the power system).
- Charging possibilities: vehicles can be disconnected, charging, or discharging power.

During grid contingencies there is a tremendous opportunity for EVs to contribute to grid stability by ceasing to charge. For example, if 60,000 EVs were charging at 5kW, stopping them from charging would be equivalent to cutting power to the 90,000 customers disconnected during the contingency in Victoria on February 13, 2024 (where 300MW was involuntarily disconnected).[32] The capability to preferentially stop EV charging before disconnecting households does not currently exist in Australia but is something can be considered for development. It would be advisable for this to occur ahead of the mass adoption of EVs so that

[29] Powell et al. (2022)
[30] Australian Bureau of Statistics (2016)
[31] Xu et al. (2018)
[32] DEECA (2024)

drivers are aware of this when they purchase an EV. Such a scheme can function well through communication direct to vehicles via the small number of EV manufacturers with vehicles on Australian roads. All drivers could be sent a notification and those with immediate charging needs could be allowed to override the default cessation of charging.

There is a great potential for EVs to contribute further to electricity system stability by discharging power from their batteries. The energy storage capacity of a fully electrified Australian vehicle fleet would exceed that of the Snowy 2.0 hydropower station five times over.[33]

Australia recently witnessed a landmark 16 EVs successfully use vehicle-to-grid (V2G) capabilities to respond to a contingency in the national grid.[34] If 105,000 vehicles provided such a response, it would match the typical power capacity held in reserve to balance supply and demand in NSW/ACT when unexpected events occur. For context, Australians bought 98,436 new electric vehicles last year.[35] This V2G experiment is the culmination of the REVS project, in which ANU collaborated with six partners to move V2G towards being a commercial service in Australia. All our project reports are available online, including our comprehensive introduction to vehicle-to-grid.[36],[37]

It is expected that V2G will become increasingly widely available from 2025 onwards as new charging protocols are adopted and more vehicle manufacturers enable V2G in their vehicles.

Crucially, if this was to work EV drivers would need to habitually plug EVs into chargers more frequently and for longer durations than would otherwise be the case to meet their charging needs. Otherwise, EVs provide limited opportunities for grid integration. A recent study for the ACT Government found that vehicles that are plugged into chargers around 25% of the time (for example, six hours a day or over the weekend) is sufficient to realise most of the benefits of flexible EV charging for drivers and the electricity system.[38] An education program targeting EV drivers and the benefits of intentionally charging to provide grid stability and security can be combined with information around electricity tariffs and cost minimisation to incentivise users to better understand the multifaceted benefits of their vehicles.

4. Air Transport

Direct electrification of aviation is highly challenging due to the low volumetric energy densities of lithium-ion batteries and hydrogen – only about 5% and 25% that of conventional jet fuels, respectively.[39, 40] However, the field is rapidly developing.

4.1 Electrofuels

Recommendation 4.1: Invest in the increased prevalence of drop-in alternative fuels, such as electrofuels, for aviation.

Recommendation 4.2: Include the production of alternative aviation fuels in any forecasting of electricity demand.

Electrofuels are produced by combining carbon dioxide and hydrogen via fuel synthesis. The carbon dioxide can be sourced from direct air capture powered by renewable energy, while the

[33] Sturmberg, Bjorn (2020)
[34] Sturmberg, Bjorn (2024a)
[35] Electric Vehicle Council (2023)
[36] ARENA (2023)
[37] Jones et al. (2021)
[38] Sturmberg, Bjorn (2024b)
[39] Yusuf et al. (2024)
[40] Vehicle Technologies Office (2022)

hydrogen is obtained through water electrolysis, also driven by renewable energy. Since both carbon dioxide and hydrogen used in the fuel synthesis are produced using renewable energy resources, electrofuels can achieve carbon neutrality over their lifecycle.

Electrofuels enable the indirect electrification of aircraft, thus facilitating a transition to net-zero direct GHG emissions for the aviation industry (note there would still be global warming arising from indirect effects, including the emissions of water vapour at altitude or the leakage of hydrogen during fuel production) and delivering long-term environmental benefits.[41] Similar to biomass-based sustainable aviation fuels, electrofuels can be used as drop-in alternative fuels either mixed with or replacing conventional fossil jet fuels. Therefore, they can serve as an immediate substitute without the need for new designs or major modifications to existing aircraft, unlike the pathways using batteries and hydrogen fuel cells. Furthermore, unlike sustainable aviation fuels derived from biogenic feedstocks, electrofuels are not limited by land resource availability.

In Australia, the manufacture of electrofuels could support the decarbonisation of domestic and international air transport, while also facilitating the development of new green fuel export industries, contributing to Australia's transition to a renewable energy superpower. Manufacturing technologies for electrofuels are advancing rapidly, and these alternative aviation fuels have been used in commercial aviation markets. Shell plc reported a Boeing 737 loaded with 500 L of electrofuels (mixed with regular jet fuel) flew from Amsterdam to Madrid in 2021, marking the world's first flight with electrofuels.[42] Considering declining costs of green hydrogen production and direct air capture along with economies of scale, electrofuel prices are expected to decrease over the coming decades.

The manufacture of aviation electrofuels would significantly increase the electricity consumption in the National Electricity Market. This impact needs to be factored into the Australian Energy Market Operator (AEMO)'s planning and forecast. Decarbonising aviation using electrofuels could double the current electricity demand in the National Electricity Market. This significant potential increase in electricity consumption needs to be incorporated into the future AEMO Integrated System Plans.

As technologies advance, drastic increases in electrolysis efficiency, direct air capture efficiency and fuel synthesis efficiency are expected. Decarbonising air transport in Australia would require about 250 TWh p.a. of electricity (as an input in the carbon capture and hydrogen production) and 4 Mt p.a. of hydrogen (as a feedstock in the fuel synthesis) in place of the pre-COVID jet fuel consumption of 349 PJ in Australia in 2018-19 for both domestic and international air transport.

5. Public Transport

The consultation roadmap speaks to the value of increased mode share of public transport including buses, trains, trams and ferries and also active transport such as walking, biking, skating, scooting and use of electric micromobility. Amongst these public transport modes, buses have the largest potential to benefit from investments in enhancing existing infrastructure.

5.1 Bus Electrification

Recommendation 5.1: Engage with available tools such as RouteZero to support the electrification of bus services and depots.

[41] Lu et al. (2021)
[42] Shell plc (2021)

Recommendation 5.2: Provide local and state governments with coordination and low-cost financing for bus electrification.

Buses are inherently a more sustainable form of transport than passenger vehicles due to their smaller material, GHG and space footprint per passenger.[43,44] The electrification of buses further enhances their sustainability by greatly reducing the emission of greenhouse gas, air pollution and noise pollution compared with internal combustion engine buses.[45,46,47,48] The electrification of buses could therefore be a high priority.

A major barrier to bus electrification is the cost, complexity and uncertainty of electrifying bus depots.[49] The ANU Battery Storage and Grid Integration Program has developed a free-to-use, open-source model called RouteZero that quantifies the energy requirements and optimised charging loads of electric scheduled bus services and depots.[50] We encourage the Department to explore the implications of electrification through the online tool[51] and would welcome the opportunity to apply this model to more detailed studies of local, regional and state level impacts.

Governments (particularly local and state) contract many bus services and are responsible for the cost of electrifying bus operations. The federal government can play a valuable role in coordinating and standardising this process, as well as providing low-cost financing for electrification. Appropriate financial arrangements are required, reflecting the radical shift in cost structure for operators from fuel costs to upfront capital costs of buses, charging infrastructure and grid connections.

Conclusion

The transition to net zero in Australia's transport and infrastructure sector requires comprehensive strategies and coordinated efforts. ANU ICEDS has identified key areas where immediate action and investment can significantly accelerate this transition. These include policies that encourage the early scrapping of internal combustion engine vehicles, reforming taxation policies to discourage the purchase of high-emission vehicles, optimizing the integration of electric vehicles into the electricity grid, advancing the use of electrofuels in aviation and using available tools to design and implement bus electrification.

The recommendations outlined in this submission emphasize the importance of data-driven approaches and innovative technologies to manage the increased electricity demand from electric vehicles and alternative fuel production.

Collaboration with researchers, industry stakeholders and local governments will be essential to implement these recommendations effectively and ensure a sustainable, adaptive and fit-for-purpose transport infrastructure for the future.

ANU ICEDS remains committed to supporting this transition through continued research, policy engagement and collaboration. We look forward to further contributing to the development and implementation of strategies that drive Australia towards a net zero future.

[43] Manzolli et al. (2020)
[44] Stojanovski (2019)
[45] Holland et al. (2021)
[46] Varga et al. (2020)
[47] Tsoi et al. (2023)
[48] Sunitiyoso et al. (2022)
[49] Sclar et al. (2019)
[50] Sturmberg & Hendriks (2024)
[51] Battery Storage and Grid Integration Program (2024)

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