ENGINEERS
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Future Fuels Strategy

Response to the Australian Government Discussion Paper

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1. About this submission

1.1 Introduction

Engineers Australia welcomes the opportunity to provide feedback on the Australian Government's Future Fuels Strategy: Discussion Paper.

Engineers Australia is a strong supporter of initiatives to reduce emissions, grow Australian industry, workforce and strengthen our domestic fuel security. Engineering expertise is critical to the success of a variety of emerging technologies, including battery technology for electric vehicles, the use of hydrogen for energy, and ensuring corresponding infrastructure can be supported and sustainable. In addition to this expertise, engineers can also provide guidance on alternatives to commercial and bulk transport which will have a benefit not only on emissions reductions but also on the productivity of the sector.

It is understood the purpose of the future fuels strategy is to set out the Australian Government's direction whilst providing actions that will enable the private sector to commercially deploy low emissions road transport technologies at scale. It goes on further to explain the increased availability of new vehicle technologies and refuelling infrastructure will give consumers more choice, provide additional productivity, reduce emissions, provide fuel security, and have air quality benefits.

Effective policy needs to be clear in its objectives. The Future Fuels Strategy could be improved by having a clear statement of the objective. In providing clarity the following should be considered:

- To what extent is the strategy targeted at giving consumers more choice?
- To what extent is the strategy designed to reduce emissions?
- To what extent is the strategy to support lowering reliance on traditional fuel sources providing more fuel security?
- To what extent is the strategy designed to reduce transport and fuel import costs to industry and the nation?
- To what extent is it to cultivate technology, support productivity and make Australia a provider of green energy in the future?
- How quickly is the speed of transition to occur?
- How does the objective fit into and contribute to the Australian Government's greater strategic intent for a transition to renewables and green energy?

All these are valuable, and are inherently interlinked, success in one will lead to success in the others. The overarching benefit of moving to green fuels in the transport sector is the reduction in greenhouse gas emissions. This will contribute to the goal of by 2030 a 26-28% reduction on emissions from 2005 levels. Clarity of the objective will assist in providing outcomes for the priority areas and provide a measure for the success of the strategy.

This submission provides general comments as well as specific answers to the questions posed under the priority initiatives. If you wish to discuss this further please contact Jonathan Russell, General Manager, Policy and Advocacy on 02 6270 6565 or jrussell@engineersaustralia.org.au.

1.2 About Engineers Australia

Engineers Australia is the peak body for the engineering profession in Australia. With around 100,000 individual members across Australia, we represent individuals from a wide range of disciplines and branches of engineering. Engineers Australia is constituted by Royal Charter to advance the science and practice of engineering for the benefit of the community. This response is guided by our Charter and Code of Ethics which states engineers act in the interest of the community, ahead of sectional or personal interests, towards a sustainable future. The submission provided has been informed by our members.

2. General Comments

Engineers Australia acknowledges there are many challenges facing any strategy for the future of road transport fuels in Australia. The discussion paper notes in the short to medium term, conventional vehicles that use petrol and diesel will continue to be the most widely available vehicles in Australia. Consideration needs to be given to developing a transition or staged process providing stability in the transport sector while moving towards the 2030 emission reduction goals and achieving the objectives set out in the discussion paper.

The 2018 Australian Renewable Energy Agency / Clean Energy Finance Corporation Australian Electric Vehicle Market Study predicts early adoption of electric vehicles will primarily be in passenger vehicles. By 2040, the report predicts electric vehicles will grow to comprise 30% of the passenger vehicle fleet with no government intervention, 55% with moderate intervention and 70% with accelerated government intervention.[1] The uptake rate under the no government intervention scenario is insufficient to meet 2050 emission reduction targets under the Paris convention. Engineers Australia members believe electric vehicle uptake will have the lowest cost due to compatibility with electricity supply networks meaning infrastructure is already largely in place. A lack of hydrogen fuel cell electric vehicle re-fuelling infrastructure will slow the uptake of these vehicles and require more investment.

In order to achieve significant emission reductions across the transport sector, particularly in the short to medium term, the future fuels strategy should be broader and look at supporting investment in already available low emission technologies used for transport, such as clean liquid fuels, electric vehicle uptake and clean biofuels. For example, the production of biofuels is expected to increase 10-fold by 2060 and is identified by the International Energy Agency as a major player in efforts to reduce our reliance on high carbon emitting fuels.[2]

The strategy should further consider a global trend of fast paced adoption of electric vehicles in other countries. The British Prime Minister has stated by 2030 cars powered wholly by petrol and diesel will no longer be sold in Britain. The United States has outlined plans to have Americans switch to electric vehicles by 2035. The European Union is committing to a minimum of 30 million electric cars by 2030. 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 are reliant on vehicles from the international market and are subject to its trends. 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.

To assist in the reduction of emissions in the transport sector an emissions reduction trajectory could be set to help guide the transition. As an immediate action, the following should be explored:

- The Government should adopt more stringent fuel standards (such as the European fuel standard). 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 reduction results while this transition takes place.
- Calculating how many of Australia's fossil-fuelled vehicles will need to be replaced by electric vehicles at certain stages as part of an emissions reduction trajectory. This should include age profiling of existing vehicles to determine how they contribute to emissions combined with policy to reflect requirements of suppliers to meet reduction targets through their supply of emission free or emission reduced vehicle types.
- Consider how different sub-sectors contribute to the reduction of emissions and which of these sectors will have the biggest impact on meeting reduction targets.
- Educate and promote zero emission and high efficiency transport solutions that assist in providing consumers with informed choices.
- Promoting infrastructure and investment to align with global suppliers of emission free transport fuel technologies.

[1] 'Australian Electric Vehicle Market Study' *Energia* (May 2018) <https://arena.gov.au/assets/2018/06/australian-ev-market-study-report.pdf>
[2] 'Biofuels and Transport: An Australian Opportunity' *ARENA / CEFC* (Web Page 22 March 2021) <https://arena.gov.au/knowledge-bank/biofuels-and-transport-an-australian-opportunity/>

2.1 Greater Operational Environment Considerations

It will be essential to consider the operational environment within which these initiatives are introduced to identify the entire set of impacted systems, including enabling support systems and supply chains. The following points are suggested for consideration:

- Systems thinking and causal analysis be applied to confirm and/or establish the greater context within which these initiatives are being considered, identifying all associated systems, relationships and dependencies so interrelated factors are properly addressed, and unintended consequences mitigated as far as reasonably practical.
- Any new future fuels infrastructure systems will need to integrate with existing infrastructure and the impact of this integration understood and considered in design, delivery, transition and support.
- The responsibilities of stakeholders need to be considered throughout the transition (i.e., who are the developers, owners, maintainers) to establish and subsequently ensure ongoing utility of future fuels infrastructure.
- Pacing will be an important factor and what measures may be appropriate from Government to help catalyse the innovation.
- Ensure safety and fuel security during the transition through specification and regulation.

The above aspects will inform how these initiatives are introduced and contribute to their successful uptake. This will also provide the Government with a reference that may be used and extended for similar or related future initiatives.

2.2 Societal Considerations

For the majority of motorists, the use of electric vehicles requires limited change in the mindset of drivers due to range, speed and safety being similar to current vehicles. However, those undertaking regular long journeys will need to consider proximity and availability of charging stations. Uptake of electric vehicles will likely be slower for this subgroup of drivers without direct investment in infrastructure networks.

Whilst the report recognises the future may have a range of different fuel types, it should provide a roadmap on which existing and emerging technologies suit different types of motorists and their individual requirements. The roadmap should identify what technologies could be adopted now to minimise emission and how this choice could change over the next 10 years. Currently all technologies have refuelling/charging requirements, similar to current cars. The availability of refuelling/recharging and the price of electricity and hydrogen may impact purchasing decision in the short term. This could cause low utilisation of infrastructure and result in higher operation costs. A roadmap defines potential pathways and is not a defined map for the future, this would assist businesses and individuals with making smarter investment decisions.

Whilst exploring this issue the Government is also developing strategies to replace aging electricity generation plants with renewable energy solutions. To avoid the risk of policy decisions being made in isolation of interdependent systems, it is recommended that any future fuels strategy also considers the future of electricity generation, storage and consumer behaviour. Part of this should include how the energy generated is used to charge electric vehicles or the electricity required to produce hydrogen. The increase in power demand to charge battery electric vehicles (particularly during peak times) and produce hydrogen for hydrogen fuel cell electric vehicles may pose problems to the grid. Working with power generation organisations may incentivise synergistic investment in the power and energy industry.

2.3 Infrastructure Considerations

The transition to future fuels-based infrastructure systems is a component of a greater multi-faceted challenge of transitioning to green energy. This problem requires consideration of multiple stakeholder perspectives across a set of diverse and interrelated systems. Understanding these inter-relationships will be crucial to achieve the desired goals and minimise unintended (negative) consequences. To fully understand the implications of specific initiatives, a holistic systems approach is required that considers not just each individual initiative, but also its operational environment across all impacted systems, their associated support systems, as well as the impact on society, whole of life emissions up and downstream, economic efficiency, infrastructure in general and the broader economy.

As for specific infrastructure, a large proportion of charging will happen at home and by businesses. The future fuels discussion paper notes a lack of publicly available chargers may be a barrier to consumer and business confidence in buying battery electric vehicles and that charging will not be an option where off-street parking is not available. Consideration should be given to how on street parking locations can be equipped with charging options. Some commuters may benefit from on street charging parking at both ends of their commute such as residence to work or residence to shops. If on street charging is unavailable, a recharging station would have to be used, similar to current refuelling stations. A working model for this could be converting local government parking meters into meters/charging stations. This would not have to be at every on-street parking bay but by utilising dedicated bays and charging motorists more for parking in these bays (if not using the charging station) could provide a solution. For this to be effective, guidelines will need to be provided to developers in urban areas as to how their current car parking provisions will need to be reconfigured. Guidance will also be needed as to what percentage of charging infrastructure needs to be in place.

There is potential to consider battery-electric vehicles for temporary electricity storage during times of high solar-feedback into the grid for load balancing. This initiative must be considered in a greater renewables context as an opt in from consumers and include government initiatives geared to innovation in energy storage technology, safer grid infrastructure and consideration of end users from both consumer and producer perspectives.

2.4 Economic Considerations

Adoption of battery electric vehicles and hydrogen fuel cell electric vehicles to replace Australia's light vehicle fleet will have macro-economic impacts. The majority of Australia's refined fuel is either imported or refined from imported crude oil.[3] Whilst reducing the required oil imports for fuel refinement will have a significant economic benefit, there may be other unforeseen impacts. Engineers Australia recommends the strategy looks to identify these impacts to ensure Australia is prepared for these changes and consideration is given to how some industries can transition. For example:

- Workforce transitioning for those employed in oil and gas to emission free fuels/energies or other industries.
- Requirements for decommissioning and cleaning up existing oil and gas infrastructure and waste.
- Conversion to storage industries rather than extraction and refining industries.
- Managing Australian vulnerability to oil price shocks and increasing prices prior to cost effective alternatives being rolled out.
- Oil price fluctuations negatively affecting legacy oil consumers who may find transitioning impractical (for example, small agriculture operators who rely on second hand machines).

Engineers Australia further recommends reconsidering the discussion paper's position on subsidies closing the total cost of ownership gap. The discussion paper mentions battery electric vehicle subsidies would not represent value for money with analysis showing it would cost the taxpayer $195-$747 per tonne of carbon dioxide equivalent. To assist in the uptake of these vehicles, particularly in fleets, tax incentives could be extended to battery electric vehicles, similar to those currently existing for four-wheeled drives (off road) and utility (load carrying) petrol and diesel vehicles. If these incentives were contained to business vehicle purchases the net tax revenue impact would be neutral. Tax concessions/incentives could also be provided to help with the conversion of infrastructure to support these vehicles.

In Norway, a country considered a leader in adopting electric vehicles, part of their success is due to providing incentives (including reductions in taxes) for buying and driving electric vehicles.[4] Through this policy 61.5% of the cars sold in September 2020 were electric.[5] Whilst these types of incentives may not be cost effective here, it is worth reviewing how the adoption of these vehicles could be supported further, particularly for businesses. These types of tax incentives have an added environmental benefit and would reduce business costs since the operating costs of electric vehicles are lower than traditional fuelled vehicles.

[3] Dr Hunter Laidlaw 'Australian oil refineries and fuel security' *Parliament of Australia* (Web Page 17 December 2020) <https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/FlagPost/2020/December/Oil_refineries_and_fuel_security>
[4] '60% of cars sold in Norway last month were electric' *World Economic Forum* (2020) Website accessed 24 February 2021) <https://www.weforum.org/agenda/2020/10/norway-electric-cars-majority-sales/>
[5] '60% of cars sold in Norway last month were electric' *World Economic Forum* (2020) Website accessed 24 February 2021) <https://www.weforum.org/agenda/2020/10/norway-electric-cars-majority-sales/>

From an individual economic perspective, the strategy looks at the total cost of ownership, however, the conclusions drawn from Table 1 in the strategy should be reviewed as the total cost of ownership is based on battery electric vehicle prices in 2020, not once they reach price parity by roughly 2023 – 2025.[6] To improve the data the table could be split into three sections: 2021 pricing, predicted 2025 pricing and predicted 2030 pricing; to enable investment decisions, support emerging technology development and uptake. This will assist in providing a 10 year phased transition from internal combustion engine vehicles to lower carbon footprint vehicles. As a result of increasing uptake of renewable energy sources, the emissions intensity of the grid is forecast to reduce with time, which will cause the cost to abate to decline (whereas Table 1 only states current cost to abate). The total economics of future fuels should also be considered to prevent over investment and promote efficient use of resources. This will allow Australia to identify and use the lowest cost methods to comply with emissions standards and remain internationally competitive.

The difference between capital costs and operation costs for battery electric vehicles compared to internal combustion engine vehicles and hybrid vehicles is not explored. The operating cost of battery electric vehicles is lower than hydrogen, internal combustion and hybrid vehicles, resulting in battery electric vehicles potentially being a more cost effective solution for operators using fleet vehicles for higher-than-average driving per year.

2.5 Energy security during transition

Engineers Australia wrote extensively on energy security in 2014 calling for a wider systems definition of the energy ecosystem, and the need for an ongoing analysis of process supporting the National Energy Security Assessment (NESA).[7] The NESA has not been updated since 2011, and the 2018 Liquid Fuels Security review was never completed. Engineers Australia believes a future fuel strategy needs to consider the key requirement of energy security as transition occurs and make plans to manage existing conditions and future shocks as new fuel types become available, not simply identify the new fuel implementation.

The strategy notes "the Government has developed a comprehensive fuel security package….by increasing our domestic stockholdings and supporting a sovereign refining capability that meets our needs during an emergency, and into the future." Unfortunately, since the 2020 Fuel Security Package was announced on 14 Sep 2020, Australia's liquid fuel supply has become more vulnerable with two confirmed refinery closures since the announcement.[8] There is no description in the strategy of how Australia will reverse the exposure to increasing liquid fuel supply chain vulnerabilities with liquid fuels before the transition to future fuel types is complete. Engineers Australia is concerned that the strategy implies the security situation is robust when, instead, significant vulnerabilities remain.

Engineers Australia recommends the future fuel strategy consider the legislative requirements for fuel emergencies which may occur during the energy transition and should make recommendations to update the Liquid Fuel Emergency Act 1984. This Act provides the legislative basis for contingency planning and the management of liquid fuel emergencies and stocks. The Act needs updating because it is at risk of becoming inconsistent with how Commonwealth and state governments work in the modern day. Additionally, there needs to be better transparency of government planning in the event of a liquid fuel stock emergency. There needs to be greater public visibility and open feedback options to scenario testing and scenario modelling as we are reliant on increasingly fragile maritime supply chains as geopolitical tensions rise.

[6] Scott Collie 'Price parity between electric and internal combustion cars is close – Volkswagen' Car Advice (Web Page 9 August 2019) <https://www.caradvice.com.au/782597/price-parity-electric-vehicle/>
[7] Athol Yates and Neil Greet, *Energy Security for Australia: Crafting a comprehensive energy security policy* (2014) Engineers Australia <https://www.engineersaustralia.org.au/sites/default/files/resources/Public%20Affairs/Energy%20Security%20for%20Australia%20-%20Crafting%20a%20Comprehensive%20Energy%20Security%20Policy.pdf>
[8] 'Australia's Fuel security package' *Department of Industry, Science, Energy and Resources* (Web Page 23 March 2021) <https://www.energy.gov.au/government-priorities/energy-security/australias-fuel-security-package>

3. Feedback to priority initiatives and questions

3.1 Electric vehicle charging and hydrogen refuelling infrastructure where it is needed.

1. **What are the highest priority charging and refuelling blackspots that should be considered under the ARENA administered Future Fuels Fund?**

A priority focus should be given to service stations in remote areas. Charging and refuelling infrastructure will have a higher utilisation rate in the metropolitan areas which will make the upgrade more appealing, remote areas will struggle to get the same benefit so may be slower to adopt this change.

Further investigation is required to see which emerging technologies are going to suit which drivers as is investigation to see which low emission technologies will be more readily available and imported. For example, hydrogen fuel cell electric vehicles may be better suited for heavy haulage vehicles traveling long distances, however, if the vast majority of imports are electric vehicles, benefits from economies of scale may be better spent in closing shortfalls in electric vehicle ranges via hot-swap battery standardisation and fast charge networks rather than establishing two competing transport fuel markets. Conversely if hydrogen fuel cell vehicles are adopted, then consideration for current limitations in storage, transport, combustibility, limited planned vehicle manufactures, safety, cost and range would need to be addressed.

Engaging with industry to gauge the appetite for different technologies would be beneficial. Widespread adoption of both battery electric vehicles and hydrogen fuel cell electric vehicles will require substantial industry commitment and investment which is detrimental to overall economic efficiency. The question of whether industry is willing to support two differing technologies is not canvassed nor which one results in the lowest overall economic cost and highest emissions reduction. Once this is established, priority can be assessed based on technology adoption and requirements.

2. What technical issues remain for rolling out recharging and refuelling in both metropolitan and regional blackspots?

Clear criteria are required to ascertain what qualifies as a black spot. There will be a marked difference in demand (both in terms of uptake of future fuel based vehicles, as well as ongoing demand) between metropolitan and regional areas due to density of population and transport links. There would also be nuanced differences between some regional areas which are closer to metropolitan areas, and some regional areas that may be more rural or geographically dispersed.

In rolling out recharging and refuelling infrastructure, careful consideration should be given to the availability of this infrastructure. The requirements, impacts and in particular costs of rolling out and supporting electric vehicle charging stations and hydrogen refuelling stations are vastly different in scope, location and timing. A transition to parallel alternatives offers consumers choice and opens the markets for the whole supply chain, however this incurs parallel infrastructure costs. Having too many alternative choices will dilute the demand across the different markets. Further consultation should be undertaken to ensure the resources allocated are appropriate based on the benefit. If, for example, hydrogen vehicles are intended for niche applications where long range is essential, then the supporting infrastructure rollout should be targeted accordingly.

Another risk is while technically there could be enough charging or refuelling stations, the reality may be these are not appropriately placed particularly in rural areas. In Australia, some inland routes currently have limited traditional fuel stations, which can lead motorists to run out of fuel. When reviewing recharging and refuelling stations, thought should be given to how new infrastructure could be implemented in areas with limited traditional fuel stations. Limited availability of recharging or refuelling stations raises the risk a driver may not know which service stations offer the desired charging or hydrogen fuel facilities and thus may run out of charge or fuel. There need to be ample locations with charging and refuelling services so consumers can be confident they will not get caught short.

A great amount of effort has been placed in the development of hydrogen fuel cell and hydrogen production technologies. This effort is essential in reaching the net zero emission goals. However, from a complete lifecycle point of view, there are some topics worthy of further development.

Production of hydrogen as a fuel is most likely to occur in regional areas where substantial solar and wind power production is available. Critically, hydrogen is much more expensive to transport than liquid fuels. Even when transported under high pressure (200 bar), hydrogen has a density 47 times less per cubic metre than petrol. In addition, the risk profile of above ground high pressure hydrogen storage is very different to the risk profile of existing underground liquid fuel storage.

Viable options for the on-site production of hydrogen at filling stations include (i) electrolysis and (ii) steam methane reforming (SMR). Electrolysis is an expensive option due to the use of rare earth metal as catalyst and expensive polymer electrolyte. Scaling up may reduce production costs (present day) but sustainability of this technology demands development of catalysts from non-noble materials as well as alternative polymer electrolyte candidates. Noise pollution is one of the major issues for any on-site SMR facility. It will be difficult to run the facility below the World Health Organisation defined 50dB noise pollution limit with current technologies. Secondly, carbon capture will incur another cost and space burden if it has to be captured in gaseous form.

In terms of hydrogen storage, attention should be paid towards the development of solid state and liquid options to see what solutions will be feasible. Furthermore, reliability of components for a hydrogen refuelling facility such as compressor, dispenser, etc. need to be engineered and developed for their use in hydrogen handling. Engineers Australia members have observed the components at their current stages require significantly higher maintenance. Components specifically designed and developed for the purpose of hydrogen can reduce the high maintenance and safety issues. Investment in their maturity is crucial for successful rollout of hydrogen refuelling stations.

There will be a need for standards to address conformity of design such that supply and receiving technologies will be compatible (in terms of physical dimensions, nozzle flow rates and compression) from all manufacturers and suppliers. Safety issues will be a key concern for refuelling of hydrogen and hazard analysis for public consumers is essential.

Other technical issues include the rapid development of charging technology which may cause existing optimisations and investment decisions to become obsolete quickly. Use of outdated or obsolete infrastructure will need to be phased out, and eventually repurposed or decommissioned which will incur costs and may increase the risks of contamination/damage to surrounding infrastructure.

3. What are the biggest commercial barriers to installing new charging or refuelling infrastructure?

Commercial barriers to installing new charging or refuelling infrastructure include:

- How to bill for charging of vehicles, including peak charging costs. Further information will be needed so business knows if/how much tax the Government will place on charging.
- Interface between AMEO and state energy networks for integrated model to network balancing, interface and costings.
- Limited initial patronage of this new infrastructure due to small number of vehicles requiring these services will be a barrier in the short term. This could be addressed with tax incentives sufficient enough to overcome opportunity cost where the service station allocates space at their premises to an electric charging station that cannot then be used for other purposes.

4. What barriers are there to co-locating charging with existing infrastructure (for example carparks or service stations) compared to standalone charging stations?

It is unlikely all fuel stations can be reconfigured in the short term. Fuel station switchboards and power supplies are not designed to accommodate electric vehicle fast chargers. In many cases street power infrastructure may need upgrading in addition to onsite switchboards to permit installation of such facilities. This will require investment by government or electrical distribution companies in addition to site modifications for this to be practical. The significant question is who will pay for such infrastructure investment.

Fuel stations are also not designed to accommodate vehicles staying longer than five minutes and have limited space to park multiple vehicles whilst they recharge. Car parks are ideal from a space perspective as vehicles are parked for long periods of time. The challenge will be to provide electrical infrastructure and substantially larger power supplies to support multiple vehicles charging. This will also require availability of sufficient capacity in the power grid to meet demand at charging locations.

Unforeseen regulatory barriers may also exist. When establishing charging infrastructure in carparks, care needs to be taken with regulation of the carpark operator e.g., they may then be regarded as an electricity retailer, which potentially may involve onerous regulations that were not designed for circumstances such as ad hoc vehicle charging at the retailer's premises, rather than utility-provided electricity supply to premises.

For fuel cell electric vehicles refuelling infrastructure will need to meet safety standards and town planning guidelines which have yet to be created. Clear risk assessment of hydrogen refuel stations and associated liabilities are required to be established, especially if rollout is undertaken by the Australian Government. Co-location of charging / refuelling will need to be explored to deem if safe due to potentially increased risks involved with hydrogen refuelling facilities.

5. What information do businesses need to ensure an integrated charging network can be delivered across Australia?

Operators of charging stations in locations such as carparks will be able to provide charging slow enough that they have an opportunity to optimise their power draw from the electricity grid by balancing the available power supply with the power demand of their charging network. This will have benefits for grid stability while achieving the most efficient/economic use of intermittent sources of renewable energy. Information required to do this will come from:

- The power utility - the charging network operators will require information on the instantaneous electricity price, and triggers from the power utility to request load shedding; and
- The vehicle owners - each customer can input the amount of power they would like to purchase (or state of charge they would like to achieve) and the target completion time. There may be some advantage if the Apps/interfaces at charging stations are relatively standard.

3.2 Early focus on commercial fleets.

1. What are the main barriers to adding new vehicle technology into light and heavy duty vehicle fleets?

In regard to light vehicles, the upfront purchase price is the primary barrier to rapid uptake of battery electric vehicles. Action is required to ensure Australia has access to suitable mass-produced battery electric vehicles. Tax and depreciation rules for businesses purchasing battery electric vehicles should be the primary focus to manage affordability.

Light vehicle hydrogen fleet uptake's main barriers are limited mass production of overseas vendors and very high vehicle costs relative to internal combustion and electric vehicles. Similar to battery electric vehicles, tax and depreciation rules for businesses purchasing hydrogen vehicles should be the primary focus to manage affordability.

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 is 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 electric heavy 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. Scania has announced battery electric vehicles will be the main tool to shift to decarbonised transport after reporting the use of hydrogen moving forward will be limited for two main reasons. Firstly, hydrogen trucks require three times the electricity per mile to haul freight. Secondly, the systems required for hydrogen trucks are highly complex relative to electric vehicle haulage adding to the overall cost of ownership.[9]

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.

2. How could the Future Fuels Fund help address these barriers?

The focus of addressing these barriers should be:

[9] 'Scania's commitment to battery electric vehicles' *Scania* (Web Page 19 January 2021) <https://www.scania.com/group/en/home/newsroom/news/2021/Scanias-commitment-to-battery-electric-vehicles.html>

- Tax and depreciation rules for businesses purchasing emission free vehicles should be the primary focus to manage affordability.
- Funding of independent research into the economics of emission free technologies in the transport industry as current understandings of available technologies and market forces and directions is limited.
- Coordinated rollout of emission free, whole of life vehicles with incentives to fleets based on economics and emissions on tender assessments.
- For heavy vehicles, a suggestion would be more research and investment in clean liquid fuels from biomass or waste feedstocks with a focus on targeting zero or minimal emissions in the short to medium term. It is recommended the soon to be released Bioenergy Roadmap is reviewed to assist in implementing viable solutions that work with existing infrastructure and vehicles that can make a difference over the next 20 years.

3. In what ways (other than direct funding) could the Government assist business to increase uptake of new vehicle technologies in their fleets?

Education about the total emission and net present value costs of ownership of specific fleets based on transport studies would be beneficial. Vehicle suppliers should provide detailed ownership costs of vehicles based on known metrics as well as emissions data for the full life of vehicle.

It will be essential to consider all the stakeholders to understand their requirements and decision making factors for uptake of new technologies for fleets if incentives are to be attractive. Building a supportive ecosystem consisting of industry, researchers, manufacturers, customers and infrastructure operators will encourage joint efforts towards the common goal. An understanding of fleet renewal cycles is needed to ensure technologies and infrastructure are available at the right time and seen as a viable option.

As mentioned previously tax incentives for installation of charging stations and also for any consequential site electricity capacity upgrades should be provided. An example of these incentives could be instant or rapid depreciation. These incentives should also be included on any self-provided renewable energy used primarily for charging stations. These incentives could be in lieu of current incentives for petrol and diesel vehicle purchases, keeping them revenue neutral. The number of purchases these incentives apply to needs to be sufficient to create a viable zero emission vehicle market.

Further intangible options could also be explored such as:

- Reassuring businesses of scalability of solutions in order to provide confidence in the roll out.
- Encourage partnerships between fleet owners (demand) and infrastructure operators (suppliers).
- Making existing fuel sources unattractive through education, communication and regulation may be options?

4. What specific cost effective vehicle technologies should be trialled under the Freight Energy Productivity Program?

This requires detailed consultation as needs vary by industry and location. In the short term battery electric vehicles for short range (urban) freight distribution and deliveries are likely to be the zero emission technology closest to commercial competitiveness. The cost effectiveness of trials with fuel cell freight vehicles should be explored further.

3.3 Improving information for motorists and fleets.

1. What is the most important information to provide to motorists and fleets about new vehicle technologies and future fuels?

Whilst it is noted in the discussion paper fleet purchasing could stimulate the second-hand market for new vehicle technologies as these vehicles are generally replaced more regularly, consideration should be given to the whole of life costs. Whilst it may be cheaper to purchase the vehicle second hand, for consumer confidence, the long term warranty implications should be provided. Subsidised fleet trials may be required in early stage implementation to establish (and publish) cost benchmarks.

Other relevant information includes greenhouse gas emissions; whole-of-life cost (for example refuel, servicing, battery replacement if required) and total emissions up and downstream (including various scenarios e.g., grid charging versus using own solar system); vehicle range, recharging/refuelling time, fuel consumption, fuel/charging

station availability now and proposed rollout plans; access to break down maintenance and spares, tax treatment (e.g., whether accelerated depreciation available). Updating and expanding the Green Vehicle Guide is supported.

For fleets, vehicle life and ongoing maintenance costs will be critical. Hydrogen refuelling and servicing costs vs battery replacement costs (if required) over life of asset. Consumers need to be assured of predictable ongoing costs and reliability of these new vehicles.

2. What are the highest priority knowledge sharing areas to be targeted in future fleet trials?

Battery electric vehicles are already an established technology, and although still advancing, are ready for roll-out in fleets now, with information already available. Testing of electric vehicle fleets to understand total cost of ownership and total emissions upstream and downstream of electricity generation would be beneficial to help decision makers.

Hydrogen fuel cell electric vehicles is the area where there is the largest knowledge gap which should be addressed. Tests of hydrogen fleets to understand total cost of ownership and total emissions profile for life of vehicle upstream hydrogen generation and downstream CO2 capture costs to offset gas production.

3. What additional guidance do businesses need on technical or taxation matters in relation to new vehicle purchases?

The Government should be clear on what incentives will be offered to assist business in the transition. Taxation matters are important in assessing financial aspects of converting a light vehicle fleet to zero emission fleets. It would be ideal if accelerated depreciation were available, and then promoted as part of the Government's action on mitigating climate change and on supporting establishment of a zero emission transport industry.

Individual states are now proposing their own policies in the absence of a national policy. Given most long-distance freight businesses operate across state borders the risk of inconsistency between states may be detrimental to revenue collection and individuals. In the case of large freight operators this could impact employment in some border regions. The need for a consistent and agreed national policy on road charging for zero emission vehicles (whether battery electric or fuel cell) is unavoidable and urgent.

3.4 Integrating battery electric vehicles into the electricity grid.

1. What are the highest priority issues to consider when integrating large numbers of battery electric vehicles into the electricity grid?

Integrating battery electric vehicles into the grid cannot be explored in isolation. Collaboration is needed between the owners of the network infrastructure, energy providers and government to ensure integration is possible and done as part of a larger effort to integrate and stabilise renewable energy into the network.

One way to assist with this is developing smart charging solutions with the requirements being similar for both private charging and networks of charging stations. Smart chargers would optimise charging based on a user-input for when charging is to be completed; the instantaneous electricity price; and request for load shedding (from the power utility).

It is critical any policy position adopted is holistic, considering other initiatives outside of electric vehicles and is adaptable, low risk, and workable many decades into the future. Detailed modelling of potential demand for electric vehicle grid charging and capacity to supply is required to resolve this issue. Government will require access to the results of such modelling to make effective policy.

2. What further action is needed to ensure consumers and the electricity grid can benefit from bidirectional charging technology?

Smart charging systems are required that have capability for vehicle-to-grid or vehicle-to-home once the smart charger has achieved a minimum state of charge in the battery system. It is worth noting this technology for vehicle battery-to-grid supply could also be applied to home battery-to-grid supply, which will provide further benefits to grid stability as well as enabling greater uptake of renewable energy while minimising expenditure on additional grid energy storage systems.

It is important integration provides an economic incentive to vehicle owners and the benefit is equitably distributed. It is worth noting, bidirectional charging technology may have negative impacts which should be considered. For example, the reverse power flows may be small and the power quality un-regulated if not implemented correctly. The end consumer may also be negatively affected as the more cycles a battery goes through the shorter the life expectancy.

3. What are the opportunities for tariff innovation or reform to support the rollout of public charging infrastructure?

As the cost of day-time energy falls, a higher percentage of the energy price will be driven by consumer convenience. Tariffs could be based on instantaneous electricity prices and a discount provided if the customer sheds the charging load on request. Barriers to swapping between networks should also be minimised for effective competition.

4. How could motorists be incentivised to charge their battery electric vehicles outside periods of high electricity demand to help keep prices low?

The desired change in behaviour has to be to the motorists' economic benefit with minimal disruption. Trip planning, forecasting and cost-reflective pricing may be enough. To achieve this, the electricity utility could continuously communicate the instantaneous electricity price to the smart charging systems, which would allow optimisation of charging to be biased towards when the electricity price is lowest. This will provide efficient operation of the electricity grid, and by charging when electricity is most abundant (and lowest price) this will assist maximising uptake of intermittent renewable energy by biasing demand (from battery electric vehicle chargers) to respond to supply (from intermittent renewables).

Subsidisation or adoption of home storage solutions that store charge to be used for the vehicles outside of high peak demand times is required.

3.5 Supporting Australian innovation and manufacturing.

1. What are Australia's market niches in future fuels to maximise high-value domestic export outcomes?

There is an abundance of opportunities to maximise high-value domestic export outcomes. Whilst Australia has limited existing production of electric vehicles and no production of hydrogen fuel cell electric vehicles, we are extremely well placed to create regional jobs and investment in battery energy storage systems and hydrogen production and biofuels. Australia contains all the natural resources necessary for production of both electric and hydrogen energy storage solutions.

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 opportunity to capture value adds to these resources by providing completed energy systems. 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.[10] As the demand for batteries grow world-wide expertise in this area will be highly beneficial to Australia's exports.

A thriving battery industry could also open up opportunities to revive car manufacturing in Australia leading to the potential for exports. 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.[11] Developing technology and electric vehicle production onshore is not only economically productive but provides for greater resilience for the long term in the face of unexpected challenges.

Australian exports could benefit from looking at the development of biofuels in other countries and seeing what Australian industries could receive further support to help progress their efforts. This presents two opportunities, the export of biofuels or the materials for biofuels and the export of technology. There are a number of biofuels

[10] "Study provides foundation for new battery industries in Australia' *CSIRO* (Web Page 20 October 2020) <https://www.csiro.au/en/News/News-releases/2020/Study-provides-foundation-for-new-battery-industries-in-Australia>
[11] "ACE Electric Vehicles" ACE-EV (Web Page accessed 25 March 2021) <https://www.ace-ev.com.au/>

technologies being demonstrated in Australia with some already being exported overseas.[12] Engineers Australia recommends the report Biofuels and Transport: An Australian Opportunity be reviewed in conjunction with any strategy to see how biofuels can contribute to this conversation.[13]

Another opportunity is to establish a market niche in green hydrogen production. We already have expertise in oil & gas production and export. An abundance of solar and wind resources has also given Australia experience with large scale solar photovoltaic systems and wind farms This provides a competitive advantage for developing a green hydrogen industry with a starting place being locations where both solar and wind resources are abundant.

The large-scale energy generation could partly be used for de-carbonising the domestic power grid as well as for production of hydrogen. Export outcomes would be further enhanced by downstream processing such as "green metals" so that instead of exporting metal ores, they could be refined locally using renewable hydrogen as the reducing agent (together with direct use of the renewable energy for other aspects of the metal production process). This local refining of metals will further reduce energy intensity because the refined metals have less mass than the unrefined metal ore, which means export volumes/weight would be lower.

12 'Biofuels and Transport: An Australian Opportunity' ARENA / CEFC (Web Page 22 March 2021) <https://arena.gov.au/knowledge-bank/biofuels-and-transport-an-australian-opportunity/>
13 ibid

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