



7 December 2018

Mr Bill Pender
Inquiry Secretary
Standing Committee on Infrastructure, Transport and Cities
PO Box 6021
Parliament House
CANBERRA
Canberra ACT 2600

Dear Mr Pender

**RE: INQUIRY INTO AUTOMATED MASS TRANSIT – HYDROGEN MOBILITY AUSTRALIA
SUBMISSION**

Hydrogen Mobility Australia (HMA) welcomes the opportunity to contribute to the Standing Committee on Infrastructure, Transport and Cities Inquiry into Automated Mass Transit. The inquiry is a timely initiative given the transformations taking place in the mobility sector globally related to connectivity and alternative fuels, and the opportunity for Australia to take advantage of the environmental, economic and social benefits this transition will deliver.

While the central focus of this Inquiry is automated mass transit, HMA commends the Committee for incorporating consideration of alternative fuels within its terms of reference. Automation and connectivity as well as electric drivetrains represent the most significant trends facing the automotive sector and are inextricably linked in that they are complementary technologies which can work together to minimise the environmental footprint of transport through reduced congestion and vehicle emissions. The full benefits of automation can only be realised with a zero-emission drivetrain and therefore it is HMA's position that both technologies be considered in parallel.

HMA is a membership-based industry association with a mission to realise a hydrogen society for Australia. We do this through government advocacy, education and industry engagement for the purposes of facilitating the introduction of hydrogen and fuel cell technologies, including zero emission transport to Australia. Our members comprise vehicle and component manufacturers, energy and technology companies and infrastructure providers with interests across the hydrogen value chain, including hydrogen production, storage, export, power-to-gas, distribution and mobility. Together we recognise the significant opportunity the economy-wide application of hydrogen presents for Australia to decarbonise, diversify our energy mix and create jobs, investment and innovation.

HMA participates in this inquiry as a representative of organisations with interests in hydrogen fuel cell electric vehicles otherwise known as FCEVs and their infrastructure. As the name implies, an FCEV is an electric vehicle. However, unlike a battery electric vehicle (BEV), which stores its electricity in a battery, an FCEV produces its own electricity on-board and on-demand in a fuel cell. Both technologies, that is BEV and FCEV, are zero emissions technologies, and are equally expected to play significant roles in the decarbonisation of the transport sector.

Together with our members, HMA is focussed on accelerating the introduction of FCEVs to Australia, from light to heavy vehicles, and the establishment of a nationwide hydrogen refuelling infrastructure to support them. The specific benefits of FCEVs are broad ranging and include:

- Long travel range – Similar range delivered to an internal combustion engine (ICE) and a greater range than a BEV (i.e. up to 800km for a FCEV which is two to three times the range of a BEV)
- Fast refuelling time – Similar refuelling process and time to a petrol or diesel vehicle (i.e. 3-5 minutes for a passenger car)

- Smooth and quiet operation – Electric drivetrains make significantly less noise than ICE
- Heavy payload capability – Hydrogen storage and fuel cell technology is easily scalable meaning its suitable for heavier vehicles and loads
- Reduced maintenance costs – Due to the smaller number of moving parts versus ICE
- Zero harmful emissions while driving – No damaging pollutants or carbon dioxide is emitted by the vehicle when in use

From a mass transit perspective, the opportunity to improve air pollution is a particularly important one with fine particulate matter found to shorten human lives by more than a year.¹ Citizens in the UK for instance have taken legal action against the UK Government in connection with levels of air pollution which has been found to cause 40,000 early deaths per year.² The phasing out of diesel buses is one mechanism the City of London is employing to reduce air pollution levels.³

Due to the characteristics of FCEVs, particularly range, refuelling time and payload capability, hydrogen is being recognised as having the potential to play a significant role in heavier and long-range transport segments. The Hydrogen Council for instance, the global industry advocate for the hydrogen sector, has identified that 5 million trucks (~30%), and more than 15 million buses (~25%) will be running on hydrogen in the year 2050.⁴ In addition, the Council forecasts that 20 per cent of today's diesel trains will be replaced with hydrogen-powered trains also in 2050.⁵

In Australia, the Chief Scientist's *Hydrogen for Australia's Future* briefing paper to the COAG Energy Council forecasts future domestic demand for hydrogen powered long-haul heavy transport such as buses, trucks, trains and ships due to the above characteristics.⁶

The Chief Scientist's report also finds that the greater range and quicker refuelling times of FCEVs will translate to higher vehicle availability and productivity compared to BEVs.⁷ It is expected these advantages will make FCEVs of more value to fleet operators through lower idle time for refuelling and higher utilisation of vehicles therefore reducing the number of vehicles required in the total fleet. This could be significant in the longer-term where car ownership declines and individuals and businesses subscribe to mobility services provided by fleets. Further, autonomous vehicle fleets can be programmed to return to a single refuelling base, reducing the need for refuelling infrastructure.

FCEVs also have the potential to be more suitable for autonomous driving than BEVs due to their ability to provide the computing power required to process significant amounts of data, particularly for higher levels of automation i.e. level 4 and 5 due to greater energy storage on board.⁸ Hyundai's recently released NEXO FCEV is the first hydrogen-powered vehicle to demonstrate this technology, with a small fleet of vehicles offering Level 4 autonomous driving.⁹ The application of self-driving technology to the NEXO demonstrates Hyundai's direction towards focussing on fuel cell technology for autonomous driving.

The integration of hydrogen fuel cell vehicles into Australian mass transit also presents opportunities for local manufacturing of both vehicles and supportive infrastructure. This potential is being seen through examples such as the recently announced SEA Electric EV factory in the Latrobe Valley. The facility is

¹ Acsorg. 2018. Acsorg. [Online]. [7 December 2018]. Available from: <https://pubs.acs.org/doi/10.1021/acs.estlett.8b00360>

² RCP London. (2018). Every breath we take: the lifelong impact of air pollution. [online] Available at: <https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution> [Accessed 7 Dec. 2018].

³ London City Hall. (2018). How we're cleaning up London's air. [online] Available at: <https://www.london.gov.uk/what-we-do/environment/pollution-and-air-quality/how-were-cleaning-londons-air> [Accessed 7 Dec. 2018].

⁴ Hydrogencouncil.com. (2017). [online] Available at: <http://hydrogencouncil.com/wp-content/uploads/2017/11/Hydrogen-scaling-up-Hydrogen-Council.pdf> [Accessed 3 Dec. 2018].

⁵ Ibid.

⁶ Chiefscientist.gov.au. (2018). [online] Available at: https://www.chiefscientist.gov.au/wp-content/uploads/HydrogenCOAGWhitePaper_WEB.pdf [Accessed 7 Dec. 2018].

⁷ Ibid.

⁸ CarAdvice.com. (2018). Autonomous driving better suited to hydrogen fuel-cell EVs: Hyundai | CarAdvice. [online] Available at: <https://www.caradvice.com.au/613545/autonomous-driving-better-suited-to-hydrogen-fuel-cell-evs-hyundai/> [Accessed 3 Dec. 2018]

⁹ Hyundai.com.au. (2018). Hyundai Showcases World First Self Driven Fuel Cell Electric Vehicle | 2018 | Hyundai News | Hyundai Australia. [online] Available at: <https://www.hyundai.com.au/hyundai-info/news/2018/february/hyundai-showcases-world-first-self-driven-fuel-cell-electric-vehicle> [Accessed 3 Dec. 2018].

expected to create 500 jobs and assemble 2,400 vehicles a year – specialising in the production of electric delivery vans and minibuses.

The application of hydrogen to mass transit will also require a range of enabling technologies which will include areas such as injecting hydrogen into existing gas networks. By enabling hydrogen to be transported through existing gas infrastructure, it can be moved throughout our cities to where it is most needed for refuelling trucks, trains and buses, as well as for use within homes and businesses. This again represents the development of a new sector with subsequent jobs and investment opportunities.

Given the terms of reference of this inquiry, HMA's submission focuses on the opportunities for hydrogen-powered land-based mass transit vehicles, in particular buses and trains, and their accompanying infrastructure. These transport types are the leading modes for urban public transport in Australia with 62 per cent of all trips comprising rail and 34 per cent by bus.¹⁰

The suitability of hydrogen fuel cell technology to both buses and trains is evidenced by their deployment in fleets around the world including the UK, US, China, Korea and Japan and it is expected that this technology will enable an effective platform to support increased connectivity and future autonomous driving capability.

Hydrogen in mobility however presents opportunities across all transport modes, including passenger cars, light commercial vehicles, trucks, material handling equipment and marine applications. For a more detailed overview of these transport types and the opportunities they present for Australia's environmental, economic and social objectives please refer to our submission to the Senate Select Committee on Electric Vehicles.

Vehicle opportunities

Hydrogen fuel cell buses

Hydrogen-powered buses are one of the most mature fuel cell technologies with bus fleets currently operating throughout the European Union, Asia and the United States supporting city emission reduction objectives (CO₂ and NO_x) and Paris accord commitments.

European Union fleets alone have travelled almost 10 million kilometres and refuelled with more than 1.1 million kilograms of hydrogen since introduction.¹¹ In London for instance, eight fuel cell buses have been operating on the RV1 - Covent Garden to Tower Gateway station line since 2010 travelling over one million kilometres to date with a reliability of 98 per cent.¹²

Hydrogen fuel cell buses represent a direct one for one replacement with diesel and CNG buses. Other important benefits include:

- Operating performance and refuelling time comparable to diesel and CNG buses
- Climbing and cold weather performance similar to diesel and CNG buses
- No additional curb weight to maximise passenger capacity
- Long-range up to 450 kilometres between refuelling
- Route flexibility (depot refuelling means there is no need for en-route charging infrastructure)
- Reduced maintenance and repair costs due to fewer moving parts versus their ICE counterparts

As fuel cell buses have been proven in real-world conditions and are a fully commercialised technology, they present a tried and tested platform for the integration of connectivity features to support automation including communications to other vehicles and infrastructure.

¹⁰ National Transport Commission. (2016). [online] Available at: [https://www.ntc.gov.au/Media/Reports/\(D62E6EFC-36C7-48B1-66A7-DDEF3B04CCAE\).pdf](https://www.ntc.gov.au/Media/Reports/(D62E6EFC-36C7-48B1-66A7-DDEF3B04CCAE).pdf) [Accessed 3 Dec. 2018].

¹¹ European Commission. 2017. *Horizon 2020*. [ONLINE] Available at: <https://ec.europa.eu/programmes/horizon2020/en/newsroom-item-type/achievements?page=1>. [Accessed 27 July 2018].

¹² London City Hall. (2018). Cleaner buses. [online] Available at: <https://www.london.gov.uk/what-we-do/environment/pollution-and-air-quality/cleaner-buses> [Accessed 3 Dec. 2018].

The ABS Census of motor vehicles (2014) identified 79,686 buses were registered in Australia.¹³ While the market share of urban trips via bus is less than rail as noted above, urban bus passenger-kilometres surpassed rail passenger-kilometres in 1981 due to the expansion of the urban bus network, while rail usage has remained relatively unchanged.¹⁴ As the majority of these buses operate on diesel, hydrogen presents an immediate and significant opportunity for emissions reductions, and air and noise quality improvements through the introduction of fuel cell technology.

A number of HMA members are actively exploring the opportunity for the deployment of hydrogen fuel cell bus fleets and infrastructure in Australia. HMA would be happy to connect interested parties with these organisations to discuss this opportunity further.

Hydrogen fuel cell trains

The application of hydrogen to trains is regarded as a cost-effective pathway for the decarbonisation of the sector, particularly as, similar to buses, hydrogen trains represent a direct replacement for diesel rolling stock. Specifically, they require significantly less infrastructure investment than electric trains where the electrification of existing train lines is needed to enable their introduction.

The first hydrogen fuel cell trains, manufactured by French company Alstom, went into commercial service in September 2018 in Lower Saxony, Germany. Currently operating on a 100-kilometre route that typically operates diesel trains, these trains provide zero emission and lower noise than their diesel counterparts. Similar to diesel trains however they have a top speed of 140 kilometres per hour and a range of 1,000 kilometres.

Other countries expressing interest in hydrogen trains include the United Kingdom, the Netherlands, Denmark, Norway, Italy and Canada. In France, the government has indicated it is planning for the first hydrogen train to be operational in the country by 2022. The United Kingdom has also announced plans to introduce hydrogen trains as part of the government's ambitions to remove all diesel rolling stock by 2040.

Similar to buses, hydrogen trains represent a standout technology for the introduction of clean mobility in public transit, with no sacrifice to operability or performance while delivering an enhanced customer experience through improved air quality and noise reduction. HMA would welcome an opportunity to discuss this technology further with the Committee or other interested stakeholders as part of the transition to a connected vehicle fleet.

Hydrogen infrastructure

Hydrogen refuelling stations can be integrated onto the forecourt of petrol stations adjacent to other fuel bowsers or alternatively can be installed at the premises of fleet operators for the purposes of back to base refuelling. The hydrogen itself can either be generated on site through electrolysis or delivered via tube trailer or gas pipelines. Refuelling equipment is consistent across transport modes, for instance a single refuelling station can supply hydrogen to a car, a truck or a bus from any vehicle manufacturer.

There are currently around 300 private and public hydrogen refuelling stations globally. While Australia is yet to have a commercial station at this stage, projects are currently in progress in the ACT, New South Wales and Victoria. Both Hyundai and Toyota also have their own private hydrogen refuelling stations to service their vehicles in Australia in Sydney and Melbourne respectively.

Globally, a number of countries have already announced they will build some 2,800 hydrogen refuelling stations by 2025, which would be sufficient to cover the leading markets for hydrogen vehicles. Germany for instance has set a target of 400 stations by 2023, and California and Japan are aiming for 200 and 320 stations respectively by 2025.

¹³ National Transport Commission. (2016). [online] Available at: [https://www.ntc.gov.au/Media/Reports/\(D62E6EFC-36C7-48B1-66A7-DDEF3B04CCAE\).pdf](https://www.ntc.gov.au/Media/Reports/(D62E6EFC-36C7-48B1-66A7-DDEF3B04CCAE).pdf) [Accessed 3 Dec. 2018].

¹⁴ Ibid.

Hydrogen refuelling is still an early, developing market however scaling up of infrastructure deployment is bringing station costs down. The costs for building a midsize station in Germany for instance has already reduced by 50 per cent compared to five years ago, but further decreases will be needed to support broader rollout into the mass market.¹⁵ These decreases will be achieved through scale, which in particular, can be supported by the introduction of hydrogen vehicles into the mass transit segment given the greater production of hydrogen required to support buses for instance.

The consistent routes of mass transit vehicles make them suitable for back to base refuelling with infrastructure investment thereby minimised through the utilisation of a single refuelling site. HMA has been engaging with all levels of government on the opportunities for the introduction of hydrogen across all transport modes, including mass transit, and it is clear that improved coordination and support both within and across all levels of government will better support the roll out of this technology. HMA's recommendations pertaining to this are outlined below.

HMA recommendations

Due to the interconnected nature of autonomy and electric drivetrains, it is our recommendation that both vehicle technologies be given equal consideration in government decision making and policy development. For instance, the Office of Future Transport Technologies was recently established by the Australian Government for autonomous and connected vehicles, however its scope precludes zero emission technologies.

Due to the national benefits of the zero-emission vehicle sector and the level of coordination and planning required to enable its growth, HMA has been calling for a similar dedicated group or alternatively an expansion of the Office of the Future Transport Technologies to take carriage of this space.

There are a number of specific opportunities for governments to support and coordinate zero emission vehicles and their infrastructure that will complement the work occurring across government to prepare for the advent of autonomy. The areas we believe require focus by the Commonwealth Government in close collaboration with state and territory governments are as follows:

Private and public fleet procurement policies

- Federal Government coordination of joint procurement activities across public and private mass transit operators to enable cost savings through mass purchase and stimulate demand for refuelling infrastructure
- Review and redesign of government mass transit contracting and procurement policies to promote the integration of zero emission vehicles and infrastructure into fleets
- Introduction of zero emission vehicle targets for public operated or contracted mass transit fleet to support development of an initial customer base

Vehicle emissions policy

- Commencement of a national light and heavy vehicle CO₂ emission standard to encourage zero-emission technology purchase and accelerate the supply of these vehicles to Australia

Vehicle incentive measures

- Introduction of financial support measures to stimulate the uptake of zero emission vehicles including income tax credits on vehicle purchase, stamp duty exemptions and registration discounts
- Consideration of road user charging as the Australian fleet's fuel usage evolves, while ensuring that hydrogen powered vehicles are not unfairly penalised versus battery electric vehicles through any additional charges, such as the application of excise tax

¹⁵ McKinsey. 2017. Hydrogen: The next wave for electric vehicles? [ONLINE] Available at: <https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/hydrogen-the-next-wave-for-electric-vehicles>. [Accessed 27 July 2018].

Infrastructure support measures

- Development of a zero-emission vehicle infrastructure strategy and development of suitable funding models, including approaches for the deployment of hydrogen refuelling stations to support back to base mass transit operators
- Initial co-investment with industry to support capital and operational costs associated with hydrogen refuelling infrastructure

Consistent regulations, codes and standards

- Introduction of consistent regulations, codes of standards both internationally and between Australian jurisdictions to enable streamlined introduction of technologies to support innovation and change in the supply chain and associated infrastructure
- Undertaking of a review into existing Australian Design Rules to remove unnecessary barriers to entry for international vehicles, including a focus on buses and trucks in particular where prescriptive rules regarding dimensions and weight can inhibit the entry of product manufactured overseas

Information and education

- Government delivery of targeted education campaigns in collaboration with industry to increase consumer understanding and acceptance of zero-emission technology in fleets
- Government support for zero-emission vehicle trials and demonstrations to demonstrate the suitability of the technology, its potential applications and benefits with mass transit fleet operators

The Chief Scientist's *Hydrogen for Australia's Future* briefing paper recommends as a critical first step the development of an overarching national hydrogen strategy, which will define the role for government and industry in:

- International agreements and regulations, including shipping, to position Australia as the world's leading hydrogen exporter
- Standards to ensure safety in all aspects of the hydrogen sector
- Regulations to enable the addition of hydrogen to existing domestic gas supplies
- Refuelling infrastructure and regulations for hydrogen vehicles

A national hydrogen strategy will be considered by the COAG Energy Council in December 2018. HMA recommends the Committee monitor the progress of this work and consider the opportunities for it to complement the focus and recommendation of this inquiry.

In conclusion, we are very confident in the important role that FCEVs will play in the mass transit sector. We therefore strongly encourage the inquiry to focus on the integration of hydrogen mobility in mass transit fleets across Australia and develop plans to support this transition.

Thank you for the opportunity to participate in the Inquiry into Automated Mass Transit. Should you wish to discuss our submission further please do not hesitate to contact me

Yours sincerely

HYDROGEN MOBILITY AUSTRALIA

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