24 October 2019

Ministry of Business, Innovation and Employment
15 Stout Street
Wellington 6011
New Zealand

By email: hydrogen@mbie.govt.nz

To whom it may concern

Re: Auckland Council, Auckland Transport and Watercare's submission to "A vision for hydrogen in New Zealand" green paper

Please find attached Auckland Council, Auckland Transport and Watercare's submission on the Ministry of Business, Innovation and Employment's green paper "A vision for hydrogen in New Zealand".

The submission does not have input from local boards due to the timeframes and proximity of the local government elections.

Stephen Town, the Chief Executive of Auckland Council, is the designated signatory of this submission.

Auckland Council, Auckland Transport and Watercare support the green paper. We would welcome the opportunity to discuss the matters raised in this submission.

Ngā mihi

Stephen Town
Chief Executive

Auckland Council
Te Kaunihera o Tāmaki Makaurau

Auckland Transport
An Auckland Council Organisation

Watercare
An Auckland Council Organisation

Submission

A vision for hydrogen in New Zealand

October 2019

Mihi

Ka mihi ake ai ki ngā here kōrero,
Ki ngā pari whakarongo tai,
Ki ngā awa tuku kiri o ōna manawhenua,
Ōna mana ā-iwi taketake mai, tauiwi atu.
Tāmaki – makau a te rau, mūrau a te tini,
Wenerau a te mano.
Kāhore tō rite i te ao.

I greet the mountains, repository of all that has been said of this place,
there I greet the cliffs that have heard the ebb and flow of the tides of time,
and the rivers that cleansed the forebears of all who came those born of this land and the newcomers among us all.
Auckland – beloved of hundred, famed among the multitude, envy of thousands.
You are unique in the world.

Introduction

1. Auckland Council and its Council-Controlled Organisations (CCOs), Auckland Transport and Watercare, thank the Ministry of Business, Innovation and Employment (MBIE) for the opportunity to provide feedback on the green paper, "A vision for hydrogen in New Zealand". This response is a submission from Auckland Council, Auckland Transport and Watercare (CCOs), jointly referred to in this submission as Auckland Council.

2. In November 2018, Auckland Council committed the Auckland region to limiting global heating to no more than 1.5 degrees Celsius above pre-industrial levels. Auckland Council also declared a Climate Emergency in June 2019, in response to the call for greater urgency in Auckland's transition to a net zero carbon future. Both these actions demonstrate Auckland's commitment to climate action and an alignment with the overarching purpose of the green paper.

3. To deliver on Auckland's climate action commitments, Auckland Council is currently developing Te Tāruke-ā-Tāwhiri: Auckland's Climate Action Framework (ACAF), which outlines climate change mitigation and adaptation actions in line with a 1.5 degrees Celsius commitment, while ensuring the region is resilient to the impacts of climate change. Auckland Council, partnering with mana whenua of Tāmaki Makaurau, has worked with the Ministry for the Environment in the development of the framework and aims to secure long-term commitment and leadership across public, private and voluntary sectors.

4. The draft framework has 11 key moves which speak to Auckland's needs and address the future challenges. A key focus of the foundational key move is upholding Te Tiriti o Waitangi/Treaty of Waitangi in climate change decision making, and ensuring that custodianship of matauranga Māori knowledge systems, practices and teaching inform and underpin climate response, actions and decisions. It is important for matauranga Māori to be reflected in New Zealand's vision for hydrogen. Within ACAF there is an action on identifying additional opportunities for hydrogen use to lower emissions, using learnings from Auckland's first hydrogen fuel production plant at Ports of Auckland. There are additional areas of interest for Auckland Council, Auckland Transport and Watercare in hydrogen.

5. Auckland Council has an interest in relation to local and national resilience, as outlined in our Auckland Civil Defence and Emergency Management Group Plan "*Working together to build a resilient Auckland*". This plan meets the statutory requirements of the Civil Defence and

Emergency Management (CDEM) group plan for Auckland, and has specific goals for Auckland: reduction, readiness, response, recovery and resilience. Hydrogen could impact on Auckland's resilience, which is addressed in this submission.

6. Auckland Transport's role as a transport provider is rapidly evolving to deliver transport choices for a growing, vibrant Auckland. The operation of the bus fleet contributes to 85 per cent of Auckland Transport's greenhouse gas emissions.

7. As part of Auckland Transport's sustainability agenda, the Low Emission Bus Roadmap was developed and endorsed by the Auckland Transport board in December 2018. The roadmap sets the direction for achieving a zero-emission bus fleet by 2040, and its implementation is instrumental to reducing these emissions. To achieve this Auckland Transport is exploring both battery electric and hydrogen options. Auckland Transport has trialled battery electric buses on various routes across the region, with noted success in reducing operating costs and greenhouse gas emissions. Auckland Transport will be trialling hydrogen buses in partnership with bus operators and Ports of Auckland. Trials are expected to commence in September 2020. This will provide Auckland Transport, along with its operators and stakeholders, evidence of real-world application of low emission technologies in addition to battery electric.

8. Watercare's primary role is delivering safe, reliable water and wastewater services for Auckland, and has an objective of being an industry leader in multiple fields. Watercare's "*Climate Change Mitigation and Adaptation Strategy*" was released in January 2019 and was developed in accordance with its "Fully Sustainable" strategic priority and the United Nations Sustainable Development Goal 13 –"Climate Action". The release of this strategy marks a significant milestone in Watercare's climate change mitigation and adaptation journey.

9. Watercare has a well-established energy efficiency programme, which started in 2016. Current and future projects are anticipated to deliver annual efficiency gains of 8 GWh per year. Watercare is planning to achieve energy neutrality at Watercare's two largest wastewater treatment plants by 2025 while also investigating initiatives to improve pumping efficiencies.

10. Auckland is actively investing in a sustainable future, with the Ports of Auckland currently applying for a consent to construct Auckland's first hydrogen production refuelling facility. The plant is planned to be operational by mid to late 2020 and will support the use of hydrogen fuel vehicles (e.g. buses, port equipment, cars). The pilot plant provides an opportunity to better understand the potential for hydrogen to support low carbon solutions, such as zero emission buses.

11. The resource consent application for this facility is currently being processed. Due to this first-hand experience, Auckland Council can provide insights and feedback on the current challenges of processing a resource consent for a hydrogen facility.

12. Auckland Transport has recently procured hydrogen buses and is able to provide feedback on specific procurement issues relevant to a New Zealand context. Feedback from Auckland Council and Auckland Transport on these issues is outlined below, including emergency management considerations.

Summary of submission key points

General points

13. The Auckland Council **supports MBIE's vision for hydrogen**. It covers a wide range of hydrogen applications and addresses the complementary role for hydrogen and electricity in achieving a net zero carbon future. Our submission addresses the questions outlined in the green paper and highlights additional key points relevant to an Auckland context.

14. We see a critical role for government to guide the transition to a low emissions economy in order to improve New Zealand's productivity and environmental sustainability. This role should include the **adoption of best-practice industry standards regarding the production, transportation and storage of hydrogen** as well as the use of policy tools (including incentives and disincentives) that **accelerate the adoption of sustainable energy and transport technologies**.

15. We support the development of hydrogen in New Zealand and the transition to green hydrogen generation. Currently the total global emissions from hydrogen production are 830 $MtCO_2eq$. per year, with only 2 per cent produced via electrolysis[1]. It is essential that the emissions associated with hydrogen production are transparent and certified, otherwise the highly energy-intensive production and storage of hydrogen will negate New Zealand's natural advantages in renewable electricity generation. This may undermine efforts to achieve net zero emissions by 2050, with no material economic or environmental gain over the existing use of fossil fuels. We recommend that **green hydrogen is prioritised, and brown hydrogen only used during a transition phase.** The phase out of brown hydrogen should be set over a clear timeline. The vison paper focuses on the end use of hydrogen, but there is limited focus on hydrogen generation.

16. We agree with the emphasis placed on the complementary role of electricity and hydrogen. We consider that a **diversified energy network will be beneficial in the transition to a net zero carbon future**. In particular, there are good opportunities for hydrogen and electricity to complement each other in transport, emergency management and industrial processes.

Opportunities and concerns of hydrogen use to Māori

17. We support Māori representation on all decision-making authorities related to the vision for hydrogen in New Zealand in respect of the treaty relationship between the Crown and Māori. We also support a dual process (based on the Treaty of Waitangi) to give national direction to local government authorities regarding hydrogen. This includes mapping and identifying processes and the use of cultural indicators and monitoring.

18. We express concern regarding the impacts on water, its usage and allocation for the generation of hydrogen. The Māori World view and Treaty of Waitangi is incorporated within the vision paper, however requires further consideration, specifically regarding the use and allocation of water. Māori are kaitiaki, stewards to safeguard the use and quality of Aotearoa's water. **It is essential that water allocations and any potential discharges from the production and use of hydrogen are aligned with the Māori World view.** We recommend that Government partner with Tangata

[1] IEA, "Hydrogen - Production of hydrogen today," IEA, 2019. [Online]. Available: https://www.iea.org/topics/hydrogen/production/. [Accessed October 2019].

Whenua to address these issues. Auckland Council has relationships and commitments under the Treaty of Waitangi/Te Tiriti o Waitangi and our legislative obligations to the 19 mana whenua groups in the area that Auckland Council covers.

19. There are potential economic and social opportunities for Māori businesses and investments in hydrogen, if the concerns outlined above (and within the Safety & Resilience section below) are adequately resolved and align with the Māori World view. These opportunities are highlighted through projects such as the Tuaropaki Trust pilot project. It is important that these opportunities are supported with clear direction and partnership between the crown and Māori, to enable Māori communities to benefit from growth in hydrogen generation and use.

Operational Considerations

20. There is concern around investing in a technology that may lead to stranded assets through future technology development. Hydrogen and electric vehicles both use an electric motor, with different power methods (e.g. battery or fuel cell) to propel the vehicles. Therefore, if a specific technology was to outweigh another, it would be possible to replace a vehicle's power source and reduce the likelihood of stranded ineffective assets. Hydrogen is an important consideration at an operational level for the Auckland Council.

21. Auckland Transport procured a hydrogen bus for 2020, to test hydrogen's role and capability in the public transport fleet. Barriers and opportunities from the hydrogen bus procurement are outlined further in the transport section, with a key barrier being lack of legislation or standards that reflect the use of hydrogen as a fuel.

22. Watercare is interested in the potential of hydrogen as a low emissions energy source. It is a generator of renewable energy and a potential supplier of treated water and wastewater for use in electrolysis. In 2018 to 2019, Watercare generated 46 GWh from hydroelectricity, solar photovoltaics and cogeneration using methane biogas from wastewater treatment. There are opportunities to increase energy production, with initial estimations that 1.3 tonnes of hydrogen could be produced per day from the Mangere Wastewater Treatment Plant. This could be sold to domestic transport users or exported overseas. Hydrogen has significant potential to provide clean energy for Watercare to help reduce its net emissions, advance a 'circular economy' approach to resource use and provide a source of revenue to help reduce costs to customers.

Safety & Resilience

23. A major concern with hydrogen is the real and perceived safety hazards associated with its use. Mana whenua are kaitiaki (stewards) of Tāmaki Makaurau, and it is important that safe hydrogen use reflects this role. Hydrogen technology has existed for a long period, however safety control measures for hydrogen are not as advanced as other flammable liquids, such as liquefied petroleum gas (LPG). An invisible flame to the naked eye and difficulties odourising hydrogen increase the challenges for safe handling. However, other flammable fuels have proven that these risks can be safely mitigated and accepted by the general public. It is therefore important to demonstrate safe use and application, to increase user confidence. Education and safety awareness projects are important for the general public to be aware of the dangers and to help reduce their safety concerns.

24. In addition to safety concerns, the emergency provisions around hydrogen storage, in terms of security, safe zones and evacuation zones need to be articulated. This could include evacuation plans, such as those required for large dams, and appropriate security measures. Such requirements would ideally be legislated for, which in the future will likely come into MBIE's purview as lead agency for energy emergencies.

25. Hydrogen, if it can be stored and distributed safely, can also aid Auckland's resilience in emergency situations as an alternative fuel source during shortages. Hydrogen powered generators could provide an alternative to diesel generators for decentralised energy during an outage on the national network without the carbon monoxide poisoning risk that diesel generators can pose if misused. However, hydrogen powered generators may introduce other risks that would need to be further assessed.

26. If hydrogen fuel becomes an important part of the fuel supply system, it is important for hydrogen suppliers and distributors to be listed as lifeline utilities under the Civil Defence and Emergency Management Act to ensure these resources can be managed during an emergency.

Resource Consenting

27. Auckland Council is currently processing a resource consent application for the Ports of Auckland demonstration hydrogen production and refuelling plant. The plant is the first of its type in Auckland and highlighted the consenting challenges under the current resource management framework of the Auckland Unitary Plan. This resulted in an extended resource consent application process.

28. The risks associated with hydrogen generation and storage facilities need to be adequately controlled. We recommend for the Government to develop a National Environment Standard for the production and storage of hydrogen, with specific standards, rules and consenting triggers. For example, this could include rules relating to proximity to occupied dwellings and risk management measures for storage, so that risks are appropriately controlled in a consistent manner across the country.

29. Hydrogen fuel stations could benefit from a template design to control risks and support efficient consenting. Establishing the risk and resource management framework for these facilities could avoid the inconsistent management and adverse effects experienced with petroleum facilities. Since the 2017 Resource Management Act (RMA) amendments, the obligation to regulate hazardous substances was removed from local and regional councils and WorkSafe NZ now has greater oversight through the *Health and Safety at Work (Hazardous Substances) Regulations 2017*. It would be appropriate for the WorkSafe programme to control the majority of risks associated with hydrogen generation and storage facilities.

Storage and distribution

1a. What is the role of Government in developing hydrogen for storage and distribution?

30. We recommend that the Government develops regulations for the use of hydrogen as a fuel. Currently, hydrogen is controlled by different jurisdictions depending on its application. Hydrogen in its gaseous state falls under the Gas Act and the purview of MBIE, however as a transport fuel it falls under the jurisdiction of New Zealand Transport Agency (NZTA) and the Ministry of

Transport (MoT). It is important that suitable standards are adopted for hydrogen's use as a fuel, as a special case adoption of the international standard EC79[2] was required for Auckland Transport's hydrogen bus procurement. It is important for a future standard for hydrogen fuel to specify the required quality of hydrogen production. A standardised and consistent quality of hydrogen produced throughout New Zealand would increase the resilience of a future hydrogen network, with the ability to refuel hydrogen vehicles in emergency and civil defence situations from any source. The purity of hydrogen required for transport use is higher than for industrial use.

31. Auckland Council's recommendation, from our experience of processing a resource consent for a hydrogen plant, is for the Government to develop a National Environment Standard (refer to paragraph 28) which outlines specific standards, rules and consenting triggers. Currently, it is difficult to understand how a hydrogen facility fits within the policies and definitions of the Auckland Unitary Plan, or how it might be managed as a potential hazard under the Resource Management Act. This is a result of the Auckland Unitary Plan being developed without consideration for hydrogen facilities.

32. Hydrogen could play a role in the future of New Zealand's resilience and emergency management. It is important that this vision for hydrogen is linked to the National Resilience Strategy and it is recommended that hydrogen suppliers are listed as lifeline utilities to be managed in emergencies. This would enable access to energy when electricity may be unavailable and increase resilience during an emergency event.

1b. What are the challenges for using hydrogen for storage and distribution?

33. Batteries are currently a preferred solution over hydrogen for short-term energy storage due to lower energy losses and cost with easier storage ability. Hydrogen is potentially a better solution for long-term storage capacity. Hydrogen has low energy density and needs to be stored at high pressures. It is important for storage facilities to be adequately designed for these high pressures, although hydrogen dissipates quickly in unconfined spaces which reduces its explosion risk.

34. We are concerned about the potential use of toluene for long-distance transport. The vision paper does not address the hazards associated with the application of toluene to bond with hydrogen to create methylcyclohexane for transportation. The environmental risks of transporting methylcyclohexane require further analysis, such as toluene discharges into the natural environment if incorrectly handled which poses a risk to human health and ecosystems. It is essential that the application and use of toluene reflects the Māori worldview. The separation of toluene from hydrogen should follow legislation related to hazardous substances and discharges from industrial processes in the RMA. Current hazardous substance frameworks should be applicable to the separation process, but it is important to consider the use of toluene for transportation carefully.

35. As noted above, the land use implications for developments around such facilities, and the safety and security implications associated with such facilities should be considered.

[2] European Union, "REGULATION (EC) No 79/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on type-approval of hydrogen-powered motor vehicles and amending Directive 2007/46/EC," Offical Journal of the European Union, 14 January 2019.

1c. What are the opportunities for using hydrogen for storage and distribution?

36. Hydrogen is a potential substitute for coal and gas to deal with intermittent renewable energy generation and could be used as long-term seasonal energy storage. With the 2035 target for 100 per cent renewable energy in New Zealand, this will need to be met with intermittent energy generation methods such as wind and solar. It is important to identify storage solutions for intermittent energy generation to meet peak power demands. Batteries and hydrogen can play a complementary role in this solution, with batteries providing short-term storage and hydrogen providing long-term storage (e.g. seasonal usage). Hydrogen should only be generated when renewable energy is in surplus, as it is more efficient to store energy in a hydro system than convert it to hydrogen.

37. Hydrogen offers a potential opportunity to increase national resilience in response to a large natural disaster that could damage the HVDC Inter-Island cable. A significant seismic event could damage the HVDC cable, and the ability to transfer electricity between the South and North Island plays an important role in managing security of electricity supply. A storage of hydrogen, produced to a standardised quality during surplus energy supply, could increase resilience during a national emergency.

38. Hydrogen is a hazardous and explosive substance, like many commonly used fuels such as LPG. These fuels have successful risk mitigation measures to ensure they can be safely handled, and there are numerous existing regulations and safety measures for flammable/explosive gases. We acknowledge that hydrogen has a transparent flame and is difficult to odourise, but it is possible to work with existing frameworks for hazardous substances to mitigate the risks associated with hydrogen.

Complementary role of electricity and hydrogen

39. We consider the complementary role of electricity and hydrogen as essential for the future vision for hydrogen. Electricity and hydrogen have complementary strengths in multiple areas, including storage, transport and industrial processes. Currently, hydrogen vehicles are suitable for heavy, long-distance travel while battery electric technology is well suited to light vehicles and standard buses travelling shorter distances. The same complementary role is applicable to process heat, where low temperatures (<200°C) can be transitioned to electricity, and hydrogen is potentially suitable for high temperature process heat (>200°C).

2a. What is the role of Government in developing the complementary role of electricity and hydrogen?

40. We commend the Government for its vision paper on hydrogen and the recent progress towards incentivising low emission vehicles. Any government approach to promote hydrogen should not hinder or delay electrification (or other low carbon technologies), for example as a result of waiting for technology to develop around hydrogen. This includes avoiding deferment of investment in distribution networks and charging points for electric vehicles; particularly light passenger vehicles and standard buses. We believe there is a strong complementary role for both forms of energy but emphasise that it is critical that the promotion of one form of technology does not hinder another's progress.

2b. What are the challenges for achieving this complementary role of electricity and hydrogen?

41. It is important to have a clear, long-term view of the transition to a net zero carbon future, and to provide the emissions budgets and implementation plans as defined within the Climate Change Response (Zero Carbon) Amendment Bill. A lack of future direction could lead companies to deter procurement of zero emission solutions, for example, bus operators holding off investing in hydrogen or electric buses due to a lack of market certainty. It is important that there is a clear, visible timeline, which could be accompanied (and aided) by additional incentive schemes.

2c. What are the opportunities for this complementary role of electricity and hydrogen?

42. Hydrogen offers an alternative energy supply for generators. This could enable remote communities to have a clean energy supply option and offer Auckland a resilient alternative to provide power to priority facilities during power shortages. Currently there is a reliance on fossil fuel generators to provide a back-up energy, and it is important to find a suitable transition fuel for this application.

43. A key barrier to adopt zero emission buses, specifically battery electric, is the current vehicle dimension and mass (VDAM) regulations. These regulations have a tight limit on allowable weight for axles, due to the capability of New Zealand's roading network and the impact of heavy vehicles on this infrastructure. The lower weight of hydrogen buses (and trucks) provide a zero-emission solution without cargo loss within the current regulations, which is an advantage over electric buses.

44. Refuelling depots for buses, trains and trucks are currently distributed across the region. This land could be adapted to provide low emissions charging depots and/or hydrogen refuelling stations. Converting the depots will reduce disruption to the freight systems and enable a phase-in approach for a zero-emission fleet. It is important to keep this opportunity open.

45. Over the past few years, Auckland Council has focussed on increasing the energy efficiency of its building profile. The programme was successful, and some buildings are operating with a 22 per cent reduction in energy demand. This enables spare capacity within the building assets, which can be utilised for charging infrastructure or hydrogen refuelling stations.

Transport

3a. What is the role of Government in supporting hydrogen use for the transport sector?

46. We support the preference for multiple clean technology solutions in the transport sector, as highlighted in MoT's recent Green Freight report[3]. It is important that MBIE's vision for hydrogen, MoT's Green Freight project and MfE's Climate Change Response (Zero Carbon) Amendment Bill are strongly linked to optimise the transition towards a net zero carbon future. It is also important that these papers promote a complementary role for clean technology solutions in the transport sector, and do not create competition for funding or prioritisation. This means policy and investment should focus on areas of relative strength for each technology.

[3] https://www.transport.govt.nz/multi-modal/climatechange/green-freight-project/

47. We see the development of a hydrogen economy in the transport sector, where it is used to power heavy vehicles such as trucks, trains, light commercial vehicles and forklifts. Government should avoid choosing between Battery Electric Vehicles (BEVs) and Fuel Cell Electric Vehicles (FCEVs), with the former already proving to be suitable for private transportation and recharging at home using existing electrical infrastructure. FCEVs will likely have weight and cargo-carrying advantages over BEVs in the heavy vehicle space. Therefore, a complementary approach is necessary, and we support MoT's position that no single alternative fuel can address emissions for the freight sector, including rail and shipping.

48. Alternative fuels such as hydrogen will not be subject to excise tax; accordingly, it is anticipated that low emission vehicles will eventually become subject to road-user charges. We recommend that generalised costs of transport and their potential associated effects on demand travel are studied. If travel is cheaper using hydrogen or other alternative lower-emission fuels, road-based vehicles kilometres travelled may increase, which may have unintended negative externalities.

3b. What are the challenges when using hydrogen for mobility and transport?

49. Auckland Transport's procurement of a hydrogen bus provides insight into the challenges of procuring hydrogen vehicles. Hydrogen buses currently available internationally are not built to suitable standards and set up for an Auckland context. They are designed for a UK context, with an average speed of 30 km/h in the urban environment. Auckland buses reach travel speeds of up to 80 km/h on some busways, and modelling performance of hydrogen buses at higher speeds shows it would be uneconomical due to a high consumption rate. Auckland's steep topography is another challenge. The purpose of the hydrogen bus trial is to identify a suitable application of hydrogen buses in an Auckland specific context and inform design changes to be fit for purpose in New Zealand.

50. Hydrogen fuel cell buses are not classified as electric vehicles under the Road User Charges (RUC) Rule due to the wording of the relevant exemption and are therefore not automatically exempt from RUC until December 2025. Hydrogen and electric vehicles both use an electric motor to propel the vehicle and should therefore both be exempt from RUC. The lack of exemption for hydrogen buses creates unintended behaviours from designers and operators. For example, to meet the criteria of the exemption, a hydrogen bus requires a plug-in system to charge a battery from an external power source. Modifying bus specification in this way results in unnecessary additional costs to manufacture hydrogen buses. We recommend that the RUC exemption criteria is reviewed to address these issues and allow for the inclusion of hydrogen vehicles. There is also an opportunity to review and update other regulations to promote the uptake of hydrogen vehicles.

51. Another challenge is the required refuelling process for vehicles. Hydrogen is a new fuel and will require safety measures for its use. We request clarification whether the refuelling process can be performed by vehicle drivers or only by a certified refueller. This will require workforce upskilling in maintaining, operating and servicing hydrogen vehicles.

3c. What are the opportunities for using hydrogen for mobility and transport?

52. Co-benefits, such as public health and climate mitigation, are neither consistently evaluated nor fully accounted for in business or economic cases. Clean transport modes will result in a reduction in particulate matter and nitrous oxide emissions, which are linked to increased morbidity and

mortality. This will have a positive impact on the health of our region, specifically for vulnerable communities. Green transport will improve air quality, specifically in the Auckland's city centre, and reduce Auckland's emissions. These co-benefits reduce costs on society (e.g. reduced morbidity) and reinforce the value of investment and prioritisation of low emission transport modes.

53. We support a diverse, low emission public transport fleet. The combination of hydrogen and electrical modes in the system increases its resilience to system shocks. It is important that the public transport network is safe and reliable to increase its usage, and a blended fleet has lower risk for major disruption to the network.

54. Hydrogen ferries are an additional mode of transport to be considered. Auckland has an extensive coastline and multiple islands that can only be accessed via ferries. The length of ferry trips varies across the region, highlighting the potential complementary role of hydrogen and electrification. Due to the weight of electric ferries they have a restricted travel distance range and could be a viable option for shorter routes with hydrogen used to access more remote areas. A challenge for hydrogen ferries however is the feasibility of refuelling (with green hydrogen) in remote communities. This requires further investigation.

Industrial processes

4a. What is the role of Government in encouraging the use of hydrogen for industrial processes including process heat supply?

55. We recommend that Government provides investment or incentivisation schemes into research and development for the application of hydrogen in the industrial process space. While transport is being actively investigated for hydrogen applications, the use of hydrogen as a low carbon fuel for industrial processes, including process heat supply, is essential for New Zealand's transition to a net zero carbon future.

4b. What are the challenges for using hydrogen in industrial processes?

56. Industrial processes and product use, as well as process heat, are a significant part of Auckland's greenhouse gas inventory, contributing to approximately 39 per cent of the region's emissions. While there are currently technologies available to transition low temperature process heat to electric heat pumps, there are challenges for high temperature process heat. High temperature process heat accounts for approximately 62 per cent of Auckland's process heat demand (19.6 PJ[4]) and emits a total of 1,259 $ktCO_{eq}$ annually. These mainly come from industries connected to the reticulated gas network or using coal for metal production.

57. Auckland Council uses process heat, in some of its buildings such as swimming pools and leisure centres. Most of the Auckland Council specific process heat can be converted to electric heat pump systems, but there are challenges with facilities such as crematoriums.

[4] 2018 Auckland council report "Process Heat Emissions & Energy Use in the Auckland Region"

4c. What are the opportunities for the use of hydrogen in industrial processes?

58. While some industrial processes have current technologies available to transition, other areas (such as high temperature process heat) do not have commercially available low carbon solutions. Using a blended reticulated gas network of 20 per cent hydrogen would be a way to reduce natural gas use while investing into research and development to identify viable, long-term solutions that are 100 per cent renewable.

Decarbonisation of natural gas

5a. What is the role of Government in encouraging hydrogen uptake for decarbonisation of our natural gas users?

59. We are not responding to this question.

5b. What are the challenges for hydrogen to decarbonise the applications using natural gas?

60. It is important to clarify if MBIE's future intention is to replace only 20 per cent of the reticulated gas network for hydrogen or the long-term goal of 100 percent hydrogen in a reticulated gas network. While both scenarios are beneficial, they have specific challenges that would need to be addressed.

61. To upgrade the network to 100 percent hydrogen requires large investment in extensive infrastructure. Most of Auckland's major gas pipes are steel, which is incompatible with hydrogen and will require replacement. The embodied carbon of the infrastructure would need to be accounted for. A reticulated network would be an important solution for industrial processes, however it would be more appropriate to electrify residential gas usage. A reticulated hydrogen network for residential use poses safety risks as people's use or understanding of the dangers associated with hydrogen is difficult to control. We emphasise that a cautious approach should be taken, and have outlined additional risks of a 100 percent reticulated gas network:
    - Increase in usage due to a lack of associated emissions
    - Safety concerns during an emergency event, such as an earthquake
    - Additional education and behaviour change required for safe use

62. If the intention is to only implement 20 per cent hydrogen into the reticulated gas network, then it is important to prevent locking in new and future development with a reticulated gas network and a fossil fuel dependent future, when other low carbon alternatives are available.

63. An additional challenge is Auckland's large industrial sector, which manufactures a wide range of products from steel to sugar. It is essential for these businesses to have a secure and consistent quality of gas supply for their operational functions. Any shortages or inconsistent quality in supply could be detrimental to their operations. It is essential that if hydrogen is to be injected into the reticulated gas network, it will be of a consistent quality and adequate supply to meet demand.

5c. What are the opportunities for hydrogen to decarbonise our gas demand?

64. Auckland has a reticulated gas network and a large proportion of New Zealand industry is located here; it would be a suitable location to test and apply a blended hydrogen and natural gas mix.

Auckland's gas network fuels most of the medium and high temperature heat applications in the region, so a blended mix could produce a reduction in natural gas use of up to 20 per cent from those applications in the transition to net zero carbon future.

Export

6a. What is the role of Government in producing hydrogen in sufficient volumes for export?

65. Large-scale hydrogen production could be beneficial to New Zealand's economic future in a low emission global economy. However, it is important that the Government regulates hydrogen stocks to ensure adequate capacity is maintained within New Zealand. The global market may present attractive prices for exporting green hydrogen, but higher national resiliency to market shocks and natural disasters should be prioritised. Government will need to reduce the risk of limited availability within New Zealand due to competitive international pricing.

6b. What are the challenges for hydrogen if produced for export?

66. The purpose of exporting green hydrogen, aside from the financial gains, is to address global greenhouse gas emissions. It is important to consider the entire lifecycle impacts of green hydrogen, including transportation to its points of use. A lifecycle analysis would be required to determine if exporting hydrogen by shipping it long distances is a suitable approach for reducing global emissions, or if generating hydrogen from renewable energy close to its point of use should be prioritised.

6c. What are the opportunities for hydrogen if produced for export?

67. We recognise there are potentially significant opportunities for exporting green hydrogen. Ports of Auckland are currently trialling a hydrogen production plant, which will build the capability, expertise and experience of storing and working with hydrogen. This presents an opportunity for Ports of Auckland to be a viable export port for green hydrogen in the future.

68. Investment into hydrogen production could also have additional benefits to encourage more renewable energy generation capacity as the over-supply would be utilised for hydrogen production. This would increase the resilience of New Zealand's energy network and support New Zealand's commitment to the Paris Agreement[5].

69. Hydrogen offers businesses and utilities the opportunity to produce hydrogen as a fuel and earn revenue from domestic sales to hydrogen users and/or for export. Water utilities already produce low-cost inputs for hydrogen fuel cells from wastewater treatment (e.g. methane and water).

[5] UNFCC, "Paris Agreement," United Nations, 2015.