1 November 2019

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Energy and Resources Markets Branch
Ministry of Business Innovation and Enterprise

By email: hydrogen@mbie.govt.nz

RE: A vision for hydrogen in New Zealand

Refining NZ appreciates the opportunity to make this submission on the discussion document, 'A vision for hydrogen in New Zealand'.

1. Refining NZ - an essential part of our transport fuels future

1.1 Refining NZ's facility at Marsden Point is New Zealand's only oil refinery and the largest producer of pure hydrogen in the country (around 130 tonnes per day).

1.2 We agree with the assertion set out in the discussion document, that there is "*greater opportunity for New Zealand in exploring the use of our renewable energy to produce green hydrogen as an alternative fuel for domestic use and for export.*"[1]

1.3 Meeting the challenge of decarbonising the New Zealand economy requires authentically low carbon solutions. The greatest contribution to decarbonising transports fuels in New Zealand comes from green hydrogen, not alternatives such as blue or brown hydrogen. Sourcing the electricity needed for electrolysis from an entirely renewable source, instead of from grid electricity which has a carbon footprint (0.12 tCO_2/MWh), is the only environmentally credible means to produce green hydrogen.

1.4 Hydrogen is an essential part of the refining process used to produce petrol, diesel and jet fuel and is currently made in the Refinery's Hydrogen Manufacturing Unit. Replacing the brown hydrogen made by this unit with green hydrogen produced via electrolysis, would remove 500,000 tonnes of CO_2 from New Zealand's transport fuels. That is the emissions equivalent of 250,000 Toyota Corolla sized vehicles, or around 8 % of the 6 million tonne reduction target recommended by the Interim Climate Change Committee (ICCC) in its report, 'Accelerated Electrification'. [2]

1.5 New transport and other energy technologies will take time to develop. As an interim step, Refining NZ sees real benefit in using green hydrogen to replace some (not all) of the brown hydrogen in the refining process to make **'greener'** transport fuels.

1.6 Our answers to specific questions raised in the paper are set out under key headings.

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[1] Ministry of Business Innovation and Employment (2019). A vision for hydrogen in New Zealand. P.11. Available from www.mbie.govt.nz

[2] Interim Climate Change Committee (2019). Accelerated Electrification. P.7. Available from www.iccc.mfe.govt.nz

2. Hydrogen for storage and distribution (Questions 1b, 1c)

2.1 High-pressure natural gas pipelines can store significant quantities of green hydrogen manufactured with low-priced electricity. Injecting hydrogen into natural gas pipelines is well known in Western Europe.

2.2 The challenge in the New Zealand context is the need to give careful consideration to pipeline integrity and imperfect mixing in the pipeline, before this opportunity could be pursued.

2.3 The development of green hydrogen has enormous potential for New Zealand's future low carbon economy. However, developing a domestic hydrogen industry will require more production facilities, the development of a national distribution network, and the technical expertise and experience with hydrogen manufacturing, handling and distribution.

2.4 Refining NZ believes that the best way forward for the development of a hydrogen economy is to leverage existing energy infrastructure that is closely connected with other infrastructure.

The Refinery at Marsden Point provides a good example of existing energy infrastructure that could be adapted in the future to support a hydrogen industry. Features include:

- a deep technical capability and experience of handling hydrogen;
- a connection to the northern natural gas pipeline;
- shipping infrastructure at a deep water port;
- renewable electricity from a solar farm to be developed by the Refinery;
- connection to a sizeable (457MVA) 220 kV grid connection which is currently under-utilized; and
- existing access to sizeable quantities of demineralized water.

3. Electricity and hydrogen (Questions 2b, 2c)

3.1 The production of green hydrogen offers demand response/ voltage support flexibility to the grid. In the event of a power shortage, electrolysers can be turned off in seconds to free up electrical power and maintain the integrity of New Zealand's electricity grid.

3.2 The challenge for the complementarity of electricity and hydrogen is the cost of hydrogen manufacture. The current grid electricity price (around $100/ MWh) means that green hydrogen is more expensive to make than brown hydrogen, yet is well within the generation price associated with other renewable electricity projects and can be expected to reach parity with brown hydrogen in the foreseeable future.

3.3 Storing enough hydrogen to generate sufficient power is a challenge, given its low energy density on a volume basis.

3.4 Economic incentives are not available – so for example, negative electricity pricing in Western Europe actively supports the production of green hydrogen.

4. Hydrogen for transport uses (Questions 3b, 3c)

4.1 Green hydrogen produced with renewable electricity is a carbon neutral alternative fuel for New Zealand's long haul, heavy-duty trucking fleet that currently has no viable alternative to conventional fuels, or biofuels.

4.2 While this technology is nascent there is an opportunity to convert New Zealand's heavy transport fleet to a hybrid model that uses both diesel and green hydrogen. This hybrid technology is being developed in the U.S. and elsewhere (e.g. Ulemco in the UK), and would prove a viable transition

for heavy duty truck operators as it would require less capital than a full hydrogen model and provide additional range with a reduction in emissions.

4.3 The use of hydrogen in other transport such as rail, is currently challenged by inadequate torque ratios – i.e. the ability to produce sufficient motive power to move heavy loads.

4.4 We believe that green hydrogen is also a key ingredient for authentic biofuels. In the short term green hydrogen could be used to produce the country's existing fuels portfolio. On that basis, Refining NZ is an essential 'vehicle' for the transition to new, low carbon fuels.

5. Hydrogen for industrial processes (Question 4c)

5.1 Industry and policy makers need to give greater recognition to the decarbonising potential of green oxygen, a by-product of electrolysis produced at the same time as green hydrogen.

5.2 The use of green oxygen in refining and other energy intensive industry processes, such as process heat furnaces and glass smelting, would improve fuel consumption and contribute to reducing carbon emissions from industrial heat - the challenge of which is recognised by the ICCC. [3]

6. Hydrogen volume for export (Questions 6b, 6c)

6.1 In 2018 New Zealand signed a memorandum of co-operation for the development of green hydrogen technology with Japan which lacks the renewable energy supply to manufacture green hydrogen. If we are to harness the potential for export hydrogen there needs to be sufficient production capacity in New Zealand both at the Refinery and elsewhere in the country.

6.2 Hydrogen being the lightest element is difficult to store. Export would require hydrogen to have a carrier, such as toluene, or liquification either via an onshore facility or on board ship. Such challenges are not insurmountable and Refining NZ is in discussion with Japanese and Korean technology owners on a viable carrier solution for green hydrogen.

7. The role of Government (Questions 1a, 2a, 3a, 4a, 5a, 6a)

7.1 The economics of green hydrogen is recognized as challenging, costing around 30% more to produce than brown hydrogen derived from hydrocarbons. There is a role for Government to provide financial support to enable early large-scale implementation of green hydrogen technology.

7.2 Given the potential for green hydrogen as an alternative fuel for heavy transport we believe that there is also a role for the National New Energy Development Centre to lead research and development of green hydrogen as a fuel for long haul, heavy-duty trucking.

7.3 The development a hydrogen economy needs a regulatory framework that is specific to hydrogen. A host of changes to existing regulations will be needed to enable the early uptake of hydrogen technology:

7.3.1 The Resource Management Act would require changes to allow hydrogen storage facilities to be developed;

3 Interim Climate Change Committee (2019). Accelerated Electrification. P.13 Available from www.iccc.mfe.govt.nz

7.3.2 Electricity regulations and the Gas Act would need amending to support the complementarity of electricity and hydrogen – e.g. electricity regulations are largely centred on large rotating machines not solar farms, batteries or hydrogen fuel cells.

7.3.3 Health and safety legislation would need to be amended to govern the safe production, handling and distribution of hydrogen as its use becomes more widespread.

7.3.4 Hydrogen vehicles are not classified as EV's and as such, do not enjoy the same benefits designed to incentive use.

8. Concluding comments

8.1 As the major producer of pure hydrogen in the country we believe that Refining NZ has an essential role to play as New Zealand transitions to a low carbon economy.

8.2 Refining NZ firmly believes that if the country is to make substantive inroads towards the target of net zero carbon emissions by 2050, then this must come from manufacturing environmentally credible, green hydrogen and not other hues of hydrogen.

8.3 There is real potential for green hydrogen to make a significant contribution to reducing CO_2 emissions from transport, and from industrial processes in energy intensive industries including refining. Furthermore, the level of renewable electricity generation available in New Zealand provides the ready platform needed to manufacture green hydrogen in the near future. Caution is required given the carbon footprint associated with the marginal mega-watt hour generated in New Zealand.

8.4 The Government has a critical role to make a domestic hydrogen industry a reality. Policy frameworks will need to be developed and given the current cost of manufacturing green hydrogen, financial support will be needed to allow for early investment in hydrogen technology.

8.5 Finally, we commend the Government for facilitating the hydrogen discussion and setting out a vision for what we believe will be an essential component for New Zealand's low carbon energy future. However, if New Zealand is to realise the clean energy potential of hydrogen then we need to progress from debating the merits to meaningful action as quickly as possible.

For Refining NZ

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