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Subject: Hydrogen green paper - submission

Submission on Hydrogen green paper recevied:

Introduction
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Is this an individual submission or on behalf of a group or organisation?

Behalf of group or organisation

Please give the name of the group or organisation this submission is on behalf of.

Transpower New Zealand Limited

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

Before answering this specific question, we make some general comments.

Transpower is the State Owned Enterprise that owns and operates the National Grid – or high voltage transmission network – that carries electricity around the country. The National Grid is made up of over 12,000 km of transmission lines and more than 170 substations. Electricity is transmitted over the grid at high voltages (up to 220,000 volts) from power stations to local lines companies and major industries. Transpower is also the system operator and manages the wholesale electricity market that schedules and dispatches electricity in real time. Our assets cover the country and we have an overview of the national electricity system. We devote a significant effort to understanding future electricity demand and supply opportunities, as well as the challenges of changing energy production and consumption patterns and technologies.

Transpower welcomes the government's Vision for Hydrogen paper. Hydrogen has the potential to play a role in a net zero carbon future by decarbonising hard-to-abate areas of the economy that are difficult to electrify. These areas potentially include long distance shipping, aviation and chemical feedstocks.

Transpower supports a market led evolution of the hydrogen market. There are likely to be a number of different options to decarbonise New Zealand's economy and numerous technologies are advancing quickly. We recommend that the Government ensures a level playing field for technologies to provide the necessary conditions for a market led development.

Government has the key role of removing regulatory barriers and constraints to the development of infrastructure required for hydrogen. This infrastructure could include hydrogen storage and distribution infrastructure, renewable energy infrastructure and electricity network infrastructure to connect hydrogen electrolysers and equipment.

Regarding this specific question, Transpower considers that the role of Government is to ensure the required regulations and standards are in place to enable hydrogen to be manufactured, stored, transported and accessed.

What are the challenges for using hydrogen for storage and distribution?

Hydrogen is already used as a feedstock within New Zealand and some of the required regulations and standards already exist. It will be important to ensure that these regulations and standards are updated or expanded to reflect different types of hydrogen supply and use.

A key challenge to developing hydrogen for storage and distribution will be enabling the necessary infrastructure, including supporting infrastructure such as refuelling stations for hydrogen-enabled transport, to be built and consented efficiently.

There are regulatory barriers in New Zealand to allowing infrastructure to be built in a timely and efficient manner, and these barriers are increasing. The increasing number of strong and directive policies to protect the environment (including the coast, indigenous biodiversity, freshwater, highly productive land, and outstanding natural landscapes and features) will make it difficult to establish infrastructure that can impact on the environments being protected. Few of these regulatory barriers recognise the operational, technical or functional constraints on where infrastructure can establish.

As an example, hydrogen infrastructure may need to be in close proximity to Ports, a water source, gas pipelines, and/or near a National Grid connection. Storage and distribution infrastructure required for hydrogen will also have land use and environmental impacts.

The King Salmon and Davidson line of cases have established the legal interpretation of the term 'avoid'. The Interim Climate Change Committee states, "these judgements have now made it substantially more challenging to consent renewable electricity generation because they effectively mean that if an adverse effect cannot be entirely avoided, it should not be consented… This is of particular relevance to wind (and transmission infrastructure)" (ICCC (2019) Accelerated Electrification, page 72). This line of cases has recently been extended in Environmental Defence Society v Otago Regional Council [2019] NZHC 2278. It provides that a specific and unqualified policy is prescriptive and binding on decision-makers – general enabling policies could not overcome them and adverse effects were required to be avoided. The case went further, and provided that consent may not even be able to be applied for in some protected environments. These cases have implications for the interpretation of all National Policy Statements (NPSs).

The impact of these cases is amplified, due to the number of existing and proposed NPSs which Councils need to consider when establishing regional policy statements and plans, and ultimately consenting infrastructure. In many instances there could be competing objectives and policies between these NPSs. For example, if hydrogen storage and distribution assets need to built near a Port, the New Zealand Coastal Policy Statement may inhibit this, depending on its interpretation. Similarly, if a water take is required for hydrogen production, the draft NPS-Freshwater Management may prevent consent being granted, or even able to be applied for. Furthermore, the same regulatory barriers that exist for hydrogen storage and distribution, also impact renewable generation and transmission infrastructure which may be required for low carbon hydrogen production.

Without enabling policy settings, and a pathway through "protectionist/avoidance" policies, it may be difficult to consent this infrastructure within the timeframes needed to capitalise on the opportunities hydrogen presents. As recognised by the Interim Climate Change Committee (ICCC):

"The RMA and its current suite of national policy statements do little to assist decision-makers to reconcile or trade-off competing national objectives. Such ambiguities or gaps do not simply affect existing hydropower … but increase legal uncertainty for many potential renewable electricity generation opportunities" (ICCC, 2019, Accelerated Electrification, at p82).

There are opportunities available through the Resource Management Act 1991 (RMA) reforms to remove some of these regulatory barriers. Again, the ICCC notes:
"Such a reform process is a major opportunity to not just remove barriers to emissions reducing activities, but to fully enable resource management legislation to actively support needed mitigation efforts. Alignment of policy efforts is a fundamental mechanism to address climate change. Resource management legislation and associated regulation should complement, rather than dampen the effect of, core climate change policies ..." (at 82)
It is Transpower's view that more value should be placed on the climate change benefits of renewable energy, transmission and hydrogen infrastructure through:

- a revised and strengthened National Policy Statement for Renewable Energy Generation (NPSREG) and the National Policy Statement for Electricity Transmission (NPSET). These documents need to address and overcome the protectionist policies in other competing NPSs;
- Reconciling tensions between NPSs in the documents themselves, consistent with EDS v ORC;
- A strengthened section 6 of the RMA, to provide for the benefits of renewable generation and associated infrastructure, such as transmission and hydrogen distribution and storage, in mitigating climate change effects;
- A strengthened rule framework for renewable electricity (and associated Grid connections), either through a new national environmental standard or directive spatial planning coupled with concept-level designations.

What are the opportunities for using hydrogen for storage and distribution?

No comment.

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

Hydrogen could be used in various forms to backup and support the electricity system when renewable sources such as hydro, solar, or wind are insufficient, if it proves economic do to so.

The Government has a role in removing barriers to the development of new renewable energy and transmission infrastructure (e.g. transmission line connections to renewable generation or hydrogen gas lines or storage tanks), as such infrastructure relates to both electricity and hydrogen.

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

As mentioned above (in relation to challenges of distribution and storage, as well as renewable generation and transmission infrastructure which may be required for low carbon hydrogen production) there are significant consenting challenges with the existing policy framework, and these challenges are increasing through the combination of increased NPSs and recent case law. Transpower considers that a number of steps are required in order to streamline (or even provide for) consenting and therefore better enable the infrastructure required to support a low carbon economy – these steps involve:

- a revised and strengthened National Policy Statement for Renewable Energy Generation (NPSREG) and the National Policy Statement for Electricity Transmission (NPSET). These documents would provide a stronger case for renewable electricity and hydrogen infrastructure where there are competing NPS objectives;
- Reconciling tensions between NPSs in the documents themselves, consistent with EDS v ORC;
- A strengthened section 6 of the RMA, to provide for the benefits of renewable generation and associated infrastructure in mitigating climate change effects;
- A strengthened rule framework for renewable electricity (and associated Grid connections), either

through a new national environmental standard or directive spatial planning coupled with concept-level designations.

RMA regulatory issues aside, the most challenging aspect of using hydrogen for electricity is the economics. The Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) notes that in the context of using hydrogen for electricity the "key factors affecting the economics of (hydrogen) storage are the round-trip efficiency and the capital costs of the initial conversion, storage and electricity production components". While the CSIRO estimates that the round-trip efficiency of batteries and pumped hydro are 90% and 75% respectively, the round-trip efficiency of hydrogen is estimated to be 35%. (This challenge is discussed in "Hydrogen for Australia's Future, Commonwealth of Australia, 2018. This report is available at: https://www.chiefscientist.gov.au/wp-content/uploads/HydrogenCOAGWhitePaper_WEB.pdf).

For this reason, it may be unlikely that hydrogen is used routinely in the electricity sector, except for certain applications and in certain countries. For example, hydrogen may be applicable for peaking seasonal demand in Japan and South Korea. As noted in a Boston Consulting Group (BCG) report: "Hydrogen is arguably one of the least cost-effective power-generating options available today. This is true even if one were to take the often-touted approach of setting up an electrolyser to run only when there is excess renewable—and therefore free—power". (This report is available at the following link: https://www.bcg.com/publications/2019/real-promise-of-hydrogen.aspx).

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

Stored hydrogen sources could be used for firming electricity production during normal and dry winter years when there is a reduction in renewable electricity generation production. Due to challenging economics, it is difficult to determine how substantial the role of hydrogen will be in this context. For example, the ICCC forecast that the marginal abatement cost of a hydrogen dry year solution would be $1,500/tCO2-e, which is considerably higher than the $250/tCO2-e estimated for a pumped hydro energy storage solution. (See Interim Climate Change Committee (2019). Accelerated Electrification, at pp 66-67. This report is available at the following link https://www.iccc.mfe.govt.nz/assets/PDF_Library/daed426432/FINAL-ICCC-Electricity-report.pdf).

There are a number of competing technologies and applications that could also provide firming to support intra-year/inter-year renewable electricity production variability. The solution to intra-year/inter-year renewable electricity production variability is likely to comprise a combination of some, but not necessarily all, of the following:

- Energy efficiency
- Load shifting and demand response, including electric vehicle smart charging and smart appliances
- Utility scale and distributed batteries
- Pumped hydro energy storage
- Gas generation
- Biomass
- Hydrogen.

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

The Government should have a role in identifying and creating the necessary environment to support market led development of hydrogen use in the transport sector. The Government will need to reduce regulatory barriers and may need to promote small-scale demonstration projects where sensible.

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

The lack of suitable refuelling or fuel source infrastructure is a barrier to hydrogen vehicle uptake. There is also a shortage of knowledge within organisations on the possibilities and economics of hydrogen use for transport.

What are the opportunities for using hydrogen for mobility and transport?

The application of hydrogen in mobility and transport will be where the advantages of hydrogen's high energy density outweigh the disadvantages of increased fuel cost and relative inefficiency of the energy to wheel pathway when compared to battery electric vehicles (BEVs).

According to BCG "thanks to their higher round-trip energy efficiency and their ability to leverage established infrastructure, battery electric cars have developed a cost advantage in individual mobility, which fuel cell vehicles are unlikely to achieve". As lightweight BEVs are already moving to mass scale, costs are considerably more competitive than equivalent Fuel Cell Vehicles (FCV) and the charging infrastructure is more advanced. BEVs may also be used in medium and heavy transport applications where there is sufficient time to recharge batteries. Examples include delivery vehicles, buses and rubbish trucks. For example, Amazon is planning to purchase 100,000 electric vehicle trucks by 2030. (The following link contains are report on Amazon's announcement: https://qz.com/1712151/amazon-orders-100000-electric-delivery-trucks/).

For these reasons, it is most likely that hydrogen will be suited in niche transport applications where payload, utilisation and long distance between fuelling is valued. Examples include long-distance trucking and shipping. Over time, as battery performance improves, BEVs may begin to also compete in these niche areas.

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

No comment.

What are the challenges for using hydrogen in industrial processes?

The cost of producing green hydrogen as a feedstock into industrial process compared to existing hydrogen sources from natural gas.

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

Hydrogen is unlikely to be economic for low temperature process heat (<100 ^{0}C) applications due to round trip energy efficiency economics compared to electricity alternatives. However, low carbon hydrogen could have applications in some high temperature process heat applications or as a chemical feedstock. (The following link refers to a BCG report on the opportunities for hydrogen: https://www.bcg.com/publications/2019/real-promise-of-hydrogen.aspx).

What is the role of Government in encouraging hydrogen uptake for decarbonisation of our natural gas uses?

The role of the Government in encouraging hydrogen uptake for decarbonisation of New Zealand's natural gas use is to ensure there are regulations and standards which allow its uptake in this application. This regulation includes policies that allow for existing infrastructure to be reused for hydrogen production/storage.

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

The challenges associated with easily decarbonising the natural gas network are both technical and economic.

A technical challenge is the ability of existing gas consuming appliances to operate with an increased hydrogen gas content. The Government's paper outlines that boilers and cooking appliances may be able to tolerate natural gas with hydrogen blend up to 30%.

An economic issue is that many electric domestic appliances will likely be cheaper and more energy efficient than hydrogen domestic appliances. As BGC states: "in space heating and warm water generation, a wide range of potentially low-carbon technologies, such as electric heaters, heat pumps, solar thermal, biomass, and green district heating, will most likely remain much cheaper than low-carbon hydrogen."

When combining both the technical and economic issues, electric appliances are likely to be both more economic and lower carbon than natural gas blended with hydrogen.

There are likely to be technical issues related to the ability of the existing gas transmission and distribution network to accommodate increased hydrogen gas content. Gas transmission and distribution companies will be best placed to advise on this.

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

No comment.

What is the role of Government in producing hydrogen in sufficient volume for export?

No comment.

What are the challenges for hydrogen if produced for export?

New Zealand may struggle to compete globally for the cost-effective production of hydrogen. Australia, South American and Middle Eastern countries may be able to produce hydrogen at lower costs due to lower cost renewable energy potential. There are already projects in these regions where the delivered energy cost is being struck at NZD$25-45/MWh compared with costs of over $60/MWh in New Zealand. New Zealand may only have a niche position as an exporter and it may therefore be more cost effective to import hydrogen for domestic needs. (The following links refer to costs for renewable energy production in overseas countries:
https://www.researchgate.net/publication/328147444_Evaluating_the_factors_that_led_to_low-priced_solar_electricity_projects_in_the_Middle_East ,
https://www.energyforgrowth.org/memo/competitive-auctions-and-ultra-low-solar-bids/
https://www.pv-magazine.com/2019/10/10/dubais-900-mw-solar-tender-sees-lowest-bid-of-0-0169-kwh/
https://www.pv-magazine.com/2019/07/31/portuguese-auction-attracts-world-record-bid-of-e14-8-mwh-for-solar/)

Another challenge is that significant renewable generation will be required to provide electricity to achieve decarbonisation of New Zealand's energy sector, due to increased electrification of transport and process heat. It is important that renewable energy to produce hydrogen for export does not compromise New Zealand's ability to supply renewable electricity for domestic consumption.

In addition, we welcome your feedback about the opportunities of hydrogen to Māori and how this will support their aspirations for social and economic development.

No comment.

What are the opportunities for hydrogen if produced for export?

No comment.

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