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**From:** no-reply@mbie.govt.nz
**Sent:** Friday, 25 October 2019 11:57 a.m.
**To:** [redacted]; Hydrogen
**Subject:** Hydrogen green paper - submission
**Attachments:** [redacted]

Submission on Hydrogen green paper recevied:

**Introduction**
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**Business name or organisation (if applicable):**

GNS Science

**Position title (if applicable):**

General Manager Strategy & Chief Scientist

**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.**

GNS Science

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

Since the hydrogen industry is very much in its infancy, Government has an important role right across the value chain.

Appropriate policy settings will help overcome barriers to market. These should act to reduce risk and help achieve economies of scale. Regulation should also embed appropriate safety and environmental standards for the design, construction and operation of hydrogen-related assets. In addition, Government can set standards for infrastructure that will avoid fragmentation in the sector.

An appropriate and effective policy framework could be a "market pull" for hydrogen. But if regulations are too onerous, they will discourage investment.

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

Work is needed to identify the most appropriate and economical options for storing hydrogen. This could involve compression of a hydrogen gas, large-scale underground storage at a lower pressure, liquefaction or blending with another energy vector.

Storage options must be compatible with distribution options to reduce any energy required to transfer the hydrogen from one platform to the next.

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

Hydrogen could play a role in the distribution of energy from renewable sources for which connection to the power grid would be prohibitively expensive. If we can achieve a high enough storage density of hydrogen, this could provide an economic way of transporting energy in remote parts of New Zealand and servicing the energy needs of those remote communities.

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

Hydrogen can be used for energy storage, for periods where the electricity sector cannot supply energy. However, the cost of providing storage will be constant – while the income from it will be infrequent. The government can play a role in providing incentives for companies to invest in such storage.

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

Other energy sources can also be used for peak supply such as natural gas or coal. The principal challenge for hydrogen will be developing a competitive advantage over these non-renewable sources.

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

New Zealand's electricity supply is largely based on renewable, weather-dependent sources such as hydro and wind generation. These systems are likely to face increasing intermittency as the climate changes (for example, less reliable rainfall). Hydrogen could provide a grid stabilising function in our electricity system. This will be of increasing importance as we move closer to the target of 100% renewable electricity by 2035.

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

Several EU countries, the United Kingdom and Japan have identified transport as a key application for hydrogen fuel technology. Some governments have announced plans to encourage the development of vital infrastructure such as hydrogen re-fuelling stations to facilitate its uptake as a transport option. Government support of a pilot programme, possibly involving government or local council fleet vehicles as demonstration models, would be useful.

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

In order for hydrogen to gain widespread use as a transport fuel, the public must have confidence in its safety. Consumers must be comfortable travelling in a vehicle carrying a compressed hydrogen tank. A widespread educational effort and a robust safety regime will play a crucial part.

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

Hydrogen has long been identified as a low-emission fuel option for heavy transport, rail, marine and some specialised "round-trip" transport functions such as container cranes and forklifts in the freight handling sector which require high utilisation time.

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

Any large-scale transition to the use of hydrogen in industrial processes would require considerable research and development. This would likely require some form of Government support, including funding projects which demonstrate clear benefits over traditional approaches.

**What are the challenges for using hydrogen in industrial processes?**

Depending on the required heating and flame requirements, there could be significant challenges in converting commercial and industrial infrastructure to hydrogen use. In some cases entire plants may need to be reconfigured.

Industries wanting to use green hydrogen for process heat would need confidence that their supply is reliable. A number of factors may influence this – including the intermittency of our largely renewable electricity supply.

Upgrading industrial equipment is technically complex, and it is difficult to envisage a coordinated roll out of hydrogen combustion systems on industrial sites. Any transitions are likely to be site specific and ad hoc, and would benefit from clear directions.

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

There are many opportunities to use hydrogen in industrial processes. Apart from its use as a fuel or in the production of fuels, hydrogen can be used in food production, glass manufacturing, metals processing and potentially as a replacement for coking coal in the steel manufacturing process.

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

In the near to medium term, direct combustion of hydrogen to generate heat will struggle to compete with the mature natural gas sector. This form of utilisation would therefore need a clear policy signal from government and a statement that gas network decarbonisation is a priority.

Companies will need certain access to a secure source of hydrogen at a stable price. Planning and coordination by central government will be required to ensure supply is available.

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

Using the natural gas network to transport hydrogen may be difficult due to the impact that hydrogen gas can have on the network materials.

Hydrogen enrichment of the natural gas network provides an early market for hydrogen and a shorter-term option for reducing the sector's carbon emissions without significant upgrade of existing infrastructure. However, due to different burner properties and characteristics of the gases, only a modest level of enrichment may be practical without upgrading equipment and pipelines.

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

As a new fuel with materials issues and without economies of scale, hydrogen will struggle to replace natural gas as a low-emissions source of heat in the short to medium term.

The greatest opportunity here is in the production of ammonia. As hydrogen production can be decentralised, ammonia can be produced closer to the point of consumption which could result in overall reduced use of gas.

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

"Green" hydrogen production needs electricity for electrolysis, and this requires sufficient renewable electricity generation. However, projects such as windfarms or hydro are typically difficult, contentious, expensive and time-consuming to consent. Streamlining the consenting process would be of assistance here. This applies whether the hydrogen is destined for domestic consumption or for export.

Exporting hydrogen will require facilities for transport that are compatible with overseas countries. The government should take a lead in drawing up international agreements on infrastructure standards, as these will be important for a successful export sector.

**What are the challenges for hydrogen if produced for export?**

The major challenge will be cost. If demand for hydrogen increases there could be an increase in blue or brown hydrogen produced in overseas markets that could make it difficult for green hydrogen to compete.

Also see above regarding suitable environment for consenting new renewable generation projects.

**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.**

Māori land trusts are involved in many renewable energy projects, particularly in the central North Island. These projects could link with hydrogen production. One early example is the partnership between Tuaropaki and Obayashi Corporation of Japan at the Mokai geothermal power station. As key partners in other geothermal power facilities, iwi are well-placed to benefit should the early work at Mokai prove fruitful.

**What are the opportunities for hydrogen if produced for export?**

By 2030, potential demand for imported hydrogen in the big Asian economies such as Japan, China and South Korea is expected to total nearly 4m tonnes. Japan has signalled a need for specified hydrogen import targets, which will increase over the coming decades. As green hydrogen will be particularly desirable, New Zealand would be well-placed to participate in a global hydrogen export market.

If the Tiwai Point aluminium smelter ceases operations, the renewable output of Manapouri power station (approx. 800 MW) could be used to electrolyse water for large-scale green hydrogen production. Port facilities exist at Bluff to enable export.

**If you wish to, you can attach a document to this submission.**

[redacted]

**Use and release of information**
**We intend to upload submissions to our website at www.mbie.govt.nz. Can we include your submission on the website?**

Yes

**Can we include your name?**

Yes

**Can we include your email address?**

No

**Can we include your business name or organisation?**

Yes

**Can we include your position title?**

Yes

**Can we include the group or organisation your submission represents (if submitting on behalf of a group or organisation)?**

Yes

**If there are any other parts to your submission that you do not want public on the website please note them below:**
**OIA warning**
**If there is information in your submission that you wish to remain confidential, please note them below:**

25 October 2019

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To whom it may concern

GNS Science welcomes the Government's Green Paper on Hydrogen "A Vision for Hydrogen in New Zealand". We believe a national strategy for hydrogen is a vital part of this country's efforts to shift to a low-emission economy and to achieve net Carbon Zero by 2050. The Green Paper is an important step towards that strategy.

Although green hydrogen production is currently possible, more R&D is needed for it to become a viable energy vector for New Zealand. We need new technology across the value chain, including production, storage and transport.

Examples of these R&D activities include:

- new materials for electrolyser electrodes and membranes
- materials for storing hydrogen that have low cost and energy requirements
- new methods to produce high pressure hydrogen and reduce cost and energy requirements of compression
- underground storage of hydrogen
- direct use of renewable energy without requiring conversion to electricity

For New Zealand, we believe that the latter point has the greatest potential. Current industrial methods for producing and exporting green hydrogen rely on first generating electricity from a renewable source, often with a significant loss of energy (for example wind turbines typically have efficiencies 35-45%, geothermal turbines have efficiencies of less than 20%). This brings additional energy and cost barriers as each conversion step adds inefficiencies.

Previous research has shown the potential for directly converting solar energy and geothermal steam to hydrogen. We can leverage our knowledge and capabilities to develop technologies for direct conversion of a renewable energy source to a hydrogen export medium (high pressure hydrogen, ammonia, or other carbon base media (e.g. methyl cyclohexane)). New Zealand's expertise in materials science, nanotechnology and geothermal science is recognised worldwide and we are well-placed to be a leader in the development of these solutions.

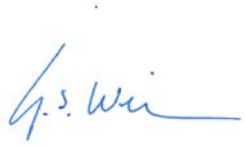
In our view, the government needs to encourage and support research which will encourage innovation and investment partnerships – both nationally and internationally, with a focus on the private sector. This should not be limited to export of a green energy vector but should include the associated high-value add products and services.

New Zealand needs a unified view on the obstacles to developing a hydrogen economy, and what we need to do to overcome them. If we are to make the most of the combined talents, strengths and expertise of our research and engineering communities and realise the benefits green hydrogen may have for de-carbonising our energy mix, this is crucial. A national strategy with a research focus is central to achieving this.

New Zealand is not alone in working on these challenges. Internationally, billions of dollars are being invested in hydrogen research and development – and this should lend considerable impetus to our research efforts. We will need New Zealand-specific research activities to develop a viable hydrogen industry our country.

A national strategy on hydrogen would send a strong signal to governments and to the research and investment communities worldwide. It would show New Zealand takes green hydrogen seriously – and that we are keen to be part of the international research and scientific response to the challenge of climate change.

Kind regards,



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