SUBMISSION
GREEN PAPER: A VISION FOR HYDROGEN

Engineering New Zealand (formerly IPENZ) is New Zealand's professional home for engineers. We are New Zealand's strongest and most influential voice on engineering issues, with more than 22,000 members who want to help shape the public policy agenda and engineer better lives for New Zealanders.

Thank you for the opportunity to provide comment on the Green Paper *A Vision for Hydrogen*.

In forming this submission, we consulted with our membership on their views of the Green Paper. Many of Engineering New Zealand's members will submit individually, or on behalf of other organisations. This submission is intended to be high level and raise common considerations expressed by members. Engineers are central to the provision of New Zealand's energy needs and will be central in New Zealand's transition to a low emissions economy.

We acknowledge the Green Paper is intended to frame the discussion for a national strategy on hydrogen. We also acknowledge the work of the Interim Climate Change Committee (ICCC), Transpower, the Ministry for the Environment and the Productivity Commission who, among others, are working with the Government as it develops policy settings to support a low emission economy. We support the **Government's Climate Change Response (Zero Carbon) Bill 2019** and we welcome the Government's on-going consideration of its role in supporting New Zealand to carbon neutrality.

As Hon Megan Woods outlined in her introduction to the Green Paper, "achieving a low emissions economy based around greater electrification and next generation fuels such as hydrogen is a formidable challenge". We agree and consider the size of the challenge unprecedented in history, as fossil fuels have powered the economy since the industrial revolution. This submission outlines our feedback on this challenge as it relates to hydrogen.

Structure of this submission and key considerations

The Ministry of Business, Innovation & Employment (MBIE) has requested submitters answer a series of questions about the challenges and opportunities related to the storage, distribution, industrial processes, complementary role of electricity and hydrogen and the decarbonisation of our natural gas uses, among others. This submission will not answer each of those questions in depth because we consider there are key

technical and economic concerns for the Government's overall consideration of hydrogen. In this submission we wish to convey the following key themes:

- We support the drive to a zero-carbon economy, recognising the challenges
- The use of hydrogen for storage and transmission of energy has technical engineering challenges that include inefficiencies, material sciences and health and safety considerations, as such engineers need to be actively involved in the Government's direction
- Renewable energy is a valuable resource and must be utilised well for maximum efficiency
- We support a regulatory environment that encourages the use of New Zealand's science, technology, engineering and mathematics sectors to drive innovations in energy generation, storage and transmission

WE ADVISE CAUTION

The use of hydrogen for energy storage and fuel has been considered for decades. There is a substantial body of research and development undertaken to explore hydrogen's role in low emission economies. Several Engineering New Zealand members have been involved in research and development relating to hydrogen for many years. The use of hydrogen for the storage and transmission of energy has several technical engineering challenges. We support the Government's on-going engagement with industry and academia to build on lessons learned throughout the last decades. We advise caution when considering future hydrogen economies.

Our members advise there is no one solution that solves the problem of New Zealand's emissions. There is a lot of work to be done as we transition. Our engineering and science facilities, together with industry, have a fundamental role to play in this transition.

Hydrogen is an energy carrier that must first be produced using primary energy sources, which have poor conversion efficiencies and, in the case of natural gas, produce CO_2 as a by-product. To produce green hydrogen through electrolysis, renewable energy of work is used for the reaction, leading to a significant amount of energy lost in the process. We take the view that renewable energy in New Zealand, which currently only accounts for 40%[1]of our total energy consumed, is a valuable resource and must be utilised for maximum efficiency.

NEW ZEALAND NEEDS MORE RENEWABLE ENERGY

The recent ICCC Accelerated Energy publication stated that, at present, 82% of New Zealand's electrical energy is renewable. The paper highlighted that significant work is needed to meet the majority of New Zealand's current electricity demands through renewable energy (hydroelectric, wind, solar and geothermal, among others). With continued electrification of New Zealand's vehicle fleet, demand for electricity will continue to rise. Renewable electricity is pivotal for New Zealand to transition to a low emissions economy and there is ongoing need to strength electrical distribution

[1] Ministry of Business, Innovation & Employment. *Energy in New Zealand 2019*. https://www.mbie.govt.nz/dmsdocument/7040-energy-in-new-zealand-2019

We recognise New Zealand's renewable energy generation is not the primary focus of the Green Paper. However, as we have already stated, this energy is a valuable and scarce resource and consideration on the return on investment is needed.

System efficiency

The consideration of hydrogen to support renewable energy 'storage', or for that matter any possible energy 'storage' opportunities, requires consideration of the economics involved. Simply, consideration of the *energy return* for *energy invested* is vital. The generation of green hydrogen from water (electrolysis) requires electricity, much of which is lost in the process of conversion.

Societal considerations

The economy, and indeed society, are dependent on a reliable, low-cost supply of energy. The cost of energy (whether that be the cost of electricity or carbon-based energy sources) has considerable impact on industry and individual consumers. It goes without saying that the ability to afford energy to run a business or heat a home affects the wealth and health of New Zealand. Transitions to alternative energy processes and systems must consider these implications and their flow-on effects for industry and individual consumers.

REGULATORY FRAMEWORKS

We consider one of the Government's key roles in the country's transition to a low emissions economy is to provide a supportive regulatory environment for innovation and the adoption of new technology. As such, we support the Government's electricity price review, Gas Act review and Resource Management Act review, as outlined in the Green Paper. We also support research and development tax credits.

Health and Safety

MBIE recently consulted on proposed changes to the health and safety regulatory system (particularly pertaining to plant). Engineering New Zealand was involved in this process. There are health and safety risks associated with pressurised systems and flammable gas. In the case of hydrogen, it must be compressed to between 300 and 700 atmospheres for use.[1] For reference, compressed natural gas, when used as a vehicle fuel is stored at 200 atmospheres. We consider health and safety regulation should enable a framework that addresses future plant in the energy field. As previously advised, **we support MBIE's direction** with regard to changes to health and safety regulation.

CONCLUSION

Thank you again for the opportunity to provide comment on the Green Paper *A Vision for Hydrogen*. As this submission highlights, the question of the role of hydrogen in New Zealand's energy economy must be considered in parallel with New Zealand's ability to produce enough renewable electricity. This energy needs to be affordable, reliable and maximise decarbonisation. It is also critical that New Zealand's ability to compete globally is not negatively affected by energy choices that increase costs.

We advise caution when considering future hydrogen economies. Commercial viability and minimisation of waste must be key considerations.

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[1] Etienne, R., Trudeau, M., and Zaghib, K. (2019). *Hydrogen Storage for Mobility: A Review*. Materials (Basel). Published online. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6630991/

Engineers are at the forefront of the work needed to support New Zealand to transition to a low-emissions economy. We support the Government's ongoing engagement with industry and academia as the pursuit of the low-emissions economy continues, and momentum builds. We recognise the scale of the job ahead but also point out that engineers are in the business of finding solutions.