2 November 2023

Hydrogen Team
Energy Resources Markets Branch
Ministry of Business, Innovation and Employment
15 Stout Street
PO Box 1473, Wellington 6140

Attention: Interim Hydrogen Roadmap Submissions
hydrogen@mbie.govt.nz

RE: Submission on the *Interim Hydrogen Roadmap*

Introduction to Major Gas Users Group Inc

1. This submission is on behalf of the Major Gas Users Group Inc (MGUG). Nothing in this submission is confidential and members may choose to make their own submissions.
2. MGUG was established in 2010 as a consumer voice for the interests of a number of industrials who are major consumers of natural gas.
3. Membership of MGUG includes:
    - Ballance Agri-Nutrients Ltd
    - Oji Fibre Solutions (NZ) Ltd
    - Fonterra Co-operative Group
    - New Zealand Steel Ltd
4. These industries are a significant part of New Zealand's economy, including; the primary industry export sector, and through import substitution assisting New Zealand's balance of payments. The industry contributes to the overall resilience of the New Zealand economy through the creation of economic diversity and direct and indirect contribution to enhancement of social, financial, human, and natural capital. Collectively our members have invested significant long-term capital in manufacturing facilities that consume about 23 PJ per annum of natural gas, or about 15% of the gas supplied to the market in New Zealand.
5. Our members use natural gas as a feedstock and/or, as process heat. As the technical paper produced by MBIE and EECA in January 2019, *Process Heat in New Zealand: Opportunities and barriers to lowering emissions* points out, large users such as our members, have in-built technologies reliant on gas supply for the life of the plant[1]. Specific mention of these industries in the paper include; petrochemicals[2], and steel[3]. Industries with globally traded

[1] EECA, MBIE – *Process Heat in New Zealand: Opportunities and barriers to lowering emissions,* 2019 – p10
[2] This includes from our membership, Ballance
[3] New Zealand Steel

commodities[4] are also considered at risk of emissions leakage under the New Zealand Emissions Trading Scheme (NZETS). We are therefore concerned to ensure that energy transition remains orderly, and policies do not create outcomes that shuts down domestic export and import substitution industries and incur broader economic and social welfare costs.

6. MGUG members support all efforts to reduce emissions and are already executing or advancing projects for this purpose.;

    a. **NZ Steel** - $300 million[5] electric arc furnace to replace the existing steelmaking furnace and two of four coal fired kilns by 2027. This will cut coal use at Glenbrook by about 400,000 tonnes annually, and reduce scope 1 and 2 emissions by 800,000 tonnes per year (45% reduction).

    b. **Ballance** - $50 million[6] investment in green hydrogen production in partnership with Hiringa Energy. During 2022 and 2023, Ballance is investing significant additional moneys to define its '*Te Ata*' decarbonisation project for Kapuni. The decarbonisation pathway being proposed by Ballance for the Kapuni plant looks to abate approximately 190,000 tonnes per annum, or approximately 90 per cent of the plant's manufacturing emissions[7] over two phases[8].

    c. **Fonterra** started its decarbonisation journey in 2003. This included a commitment made in 2017 to be net zero by 2050 and to a 30% reduction in GHG manufacturing emissions by 2030 with the priority to phase out coal use by 2037.

    d. **OJI Fibre Solutions** is already around 70% renewable. An upgrade at the Kinleith facility (costing hundreds of millions of dollars) would increase this further. The upgrade would reduce Oiji's reliance on natural gas and could also facilitate a regional biohub. An initial feasibility study was completed in 2023, this was in partnership with Te Uru Raakau.

7. We believe it's in everyone's interest to find more sustainable ways to produce the goods and services New Zealand need to advance as a society. However, while we acknowledge that current policy settings are designed to move away from natural gas to progressively decline towards 2050, our members will still need reliable, affordable gas for many years as they transition to alternative fuels and feedstocks.

8. This transition is open to the opportunities that <u>**clean**</u> hydrogen[9] may present to decarbonise our industries, but such opportunities will only be selected on rational economic grounds.

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[4] All of our members
[5] Includes $140 million GIDI funding
[6] Includes $19.9 million from the Regional Economic Development and Investment Unit
[7]compared to the 2022 baseline
[8] The first phase involves reducing emissions from Kapuni utilities and ammonia manufacturing. The second phase would reduce emissions from hydrogen production.
[9] We expand on this in this submission, clean hydrogen are all forms of hydrogen that reduce or remove emissions associated with unabated fossil fuel use, not just green (water electrolysis) hydrogen

Summary of Submission Points

9. Our summary observations and preferences are provided below. Answers to specific questions that expand on our summary points are also provided in **APPENDIX - Consultation Questions**.

10. Our key points are:

    a. A hydrogen road map should focus on **clean hydrogen** – not just green hydrogen. Over the time frame to 2050 we consider that blue hydrogen offers a lower cost transition pathway that can keep our industries in New Zealand, and that gold (naturally occurring) hydrogen is the potentially lowest cost hydrogen source for which we should be identifying the resource potential. There are also current sub commercial developments around methane pyrolysis (turquoise hydrogen) that are encouraging.

    b. Even in use cases where hydrogen has no alternative, such as ammonia/urea production, analysis indicates that in New Zealand, green hydrogen appears unlikely to offer a competitive solution compared to unabated grey hydrogen production without substantial and ongoing public subsidy, and/or substantial reduction in electricity pricing.

    c. While there appears to be significant official optimism around green hydrogen as an *energy carrier* and a solution for industrial decarbonisation, we are less convinced. We caution that economic, market, and supply chain realities will ultimately determine the extent of application and uptake, which may be few. As such, we support an ongoing approach to hydrogen in New Zealand that is considered and objective, and regularly recalibrates the still evolving assumptions around the use cases where clean hydrogen is being promoted.

    d. We consider that the main role of government is in addressing legislative and regulatory frictions and gaps that are closing pathways or stopping private investment. In particular we would advocate for immediate measures that remove the regulatory barriers:

        i. Adopt a regulatory framework for enabling CCUS (blue hydrogen option)[10]
        ii. Use the Regulatory Systems Amendment Bill (RSB) to revise the definition of gas pipelines under Part 4 of the Commerce Act to explicitly allow for regulation of blended fuels in gas networks.
        iii. Update health and safety regulations for gas pipelines, gas appliances, and gas fitting.
        iv. Update the Crown Mineral Act to bring in "natural hydrogen" as a separate resource that can be explored and mined for.

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[10] Eg Barton B., 2023, Centre for Environmental, Resources and Energy Law Te Piringa Faculty of Law University of Waikato – "*Carbon Capture and Storage: Taking Action under the Present Law*" – including recommendations

v. Fund GNS (or similar institutions) to provide basic geological data to parties interested in exploring for natural hydrogen.

APPENDIX - Consultation Questions

SECTION 1
Are there other issues we should be considering in our assessment of the strategic landscape for hydrogen in New Zealand?
The section traverses the current (green) hydrogen landscape well. However, while the opportunities for green hydrogen are described, there are also limitations embedded in the immutable fundamentals of physics and chemistry of hydrogen that are material to the discussion: 1. *Hydrogen is a high-density energy carrier*[11]" – This is only true on a gravimetric basis, not a volumetric basis. Compared to natural gas, the volumetric energy density of hydrogen is less than one-third that of natural gas. This relative volumetric density doesn't change with compression or liquification. 2. "*Zero emissions at the point of use*[12]" – This ignores the global warming potential of the hydrogen gas itself when it escapes into the atmosphere. According to a recent report by the UK government[13], hydrogen is about 11 times more powerful a greenhouse gas than CO_2 over a 100-year period — or 33 times more powerful over 20 years. A further report[14] notes electrolysis production of H_2 would result in 9.2% of the hydrogen produced making its way into the atmosphere through venting and purging, tanker transport of liquid hydrogen (13.2% of its cargo leaking into the air), above-ground compressed-gas storage (6.52%), fuel cells (2.64%) and refuelling stations (0.89%). As hydrogen is scaled, so will the quantities escaping to atmosphere. 3. Globally, plans for green hydrogen development rely on significant amounts of public subsidies and funding. While the cost of manufacturing green hydrogen is expected to fall over time, there is a growing body of informed commentary that the rate and quantum of the decline will be far less than predicted just 12 months ago[15]. Keeping subsidies over an extended time period, may not be politically sustainable. Interest in clean hydrogen can be distinguished between a clear use case for decarbonising current grey hydrogen manufacture **where there is no alternative for hydrogen production**[16], and clean hydrogen **as an energy carrier** use where other technologies compete for the same end use. In the former, characterised by grey hydrogen production for manufacturing ammonia, methanol, and hydrogen peroxide, clean hydrogen has no competing alternatives, because the molecule

[11] MBIE - Interim Hydrogen Roadmap, p8
[12] Ibid, p14
[13] April 2022 -Nicola Warwick, Paul Griffiths, James Keeble, Alexander Archibald, John Pyle, University of Cambridge and NCAS and Keith Shine, University of Reading - *Atmospheric implications of increased Hydrogen use*
[14] March 2022 Frazer-Nash Consultancy - *Fugitive Hydrogen Emissions in a Future Hydrogen Economy*
[15] Green hydrogen price in Europe unlikely to fall below €5/kg by 2030, putting off potential offtakers: analyst | Hydrogen news and intelligence (hydrogeninsight.com); (October 2023)
[16] Hydrogen Ladder | Seven H2 applications relegated in updated use-case analysis, but three promoted | Hydrogen news and intelligence (hydrogeninsight.com)

itself is needed. Where clean hydrogen is intended to be a competing energy carrier, there is an increasing realisation that the case for hydrogen may not be compelling[17].

An effective energy strategy that includes hydrogen should be agnostic on the hydrogen technology. We would encourage a widening of focus on solutions by referencing **clean hydrogen**, rather than just green hydrogen. Green hydrogen is not the only technological pathway to clean hydrogen for achieving New Zealand's national emissions target, creating or supporting economic activity and employment, and contributing to New Zealand's energy security and resilience. While green hydrogen can achieve all these (notwithstanding that hydrogen is also a greenhouse gas), other pathways to hydrogen can achieve the same outcomes at a potentially lower cost (and risk). These include blue hydrogen (grey hydrogen with CCS), turquoise hydrogen (methane pyrolysis), and gold (naturally occurring) hydrogen.

SECTION 2 - The role for hydrogen in New Zealand's energy transition

Do you agree with our assessment of the most viable use cases of hydrogen in New Zealand's energy transition?

We agree that existing demand for hydrogen present an early opportunity to decarbonise activities such as ammonia, methanol, and hydrogen peroxide production. However, whether clean hydrogen is also economically viable for these use cases is likely to depend on the clean hydrogen technology selected.

In New Zealand, ammonia, methanol, and hydrogen peroxide (bleaching chemical for paper manufacture) compete in a global commodity market place where these products are historically derived from unabated grey hydrogen. The IEA reports[18] that depending on regional gas prices, the levelised cost of hydrogen production from natural gas ranges from USD 0.5 to USD 1.7 per kg. Using CCUS technologies to reduce the CO_2 emissions from hydrogen production increases the levelised cost of production to around USD 1 to USD 2 per kg. Using renewable electricity to produce hydrogen costs USD 3 to USD 8 per kg. If ammonia/ urea production in New Zealand was to use green hydrogen it would be uncompetitive relative to importing more product from the Middle East or Indonesia[19] and the New Zealand plant would be economically stranded without significant government support[20]. Currently there is no market premium for "green urea" in New Zealand. A business case could be made for blue hydrogen as a transition from grey to green hydrogen (for so long as there is an available natural gas supply), but this requires legislation and regulation that would allow CCS to be an option in New Zealand[21]. If natural hydrogen was discovered and mined in New Zealand the economics has the potential to outcompete other forms of clean energy. For example, Helios Aragón, an Anglo-Spanish company says it could

[17] https://www.hydrogeninsight.com/policy/liebreich-it-will-take-until-2030-to-rein-in-the-current-bout-of-hydrogen-mania-cult-deprogramming-takes-time/2-1-1408504

[18] https://www.iea.org/reports/global-hydrogen-review-2021/executive-summary

[19] New Zealand domestic manufacture of Urea is approximately 260,000 t per year, but demand is 700,000 t per year. The balance is imported through established infrastructure meaning that adding another 260,000 t of imports would not present any major challenges.

[20] carbon tariff at border, minimum renewable energy requirements, investment subsidies, or subsidised energy costs

[21] https://www.hydrogeninsight.com/industrial/fertiliser-production-is-an-obvious-use-case-for-green-hydrogen-so-why-are-producers-more-likely-to-want-blue-/2-1-1533395

produce naturally occurring hydrogen from a giant underground reservoir in the foothills of the Pyrenees for €0.75 ($0.82) per kilogram — about half the current cost of producing grey H_2 from unabated fossil gas[22].

DRI (direct reduction of iron) also has potential although alternatives like molten oxide electrolysis (MOE)[23] could out-compete it.

We consider that the other use cases presented as opportunities will prove to be uncompetitive unless the cost of hydrogen production can be significantly reduced. This is one key reason for emphasising that the focus needs to broaden to include all forms of clean hydrogen, not just green hydrogen.

In particular we discount the idea of creating a green hydrogen export industry in New Zealand. While the private sector might be willing to take the risk, we consider that to export scarce renewable energy resources while continuing to rely on imported non-renewable energy would undermine/ delay national policy objectives for energy security and affordability. We expand on other reasons why green hydrogen export shouldn't be a priority for New Zealand, under Section 3.

Do you support some of these uses more than others?

As discussed above, the best use case is where clean hydrogen displaces current grey hydrogen production in ammonia/ urea manufacture, methanol, and hydrogen peroxide. However, if the technology was restricted to green hydrogen, the risk is that these industries will be uncompetitive relative to imports and would lead to closure of these industries in New Zealand.

What other factors should we be considering when assessing the right roles for hydrogen in New Zealand's energy transition?

Assessing the right roles for hydrogen in New Zealand's energy transition should be framed around a wide definition of clean hydrogen, and not solely focused on green hydrogen. The technologies and economics of hydrogen are co-evolving rapidly, as are the markets for its use. New Zealand's policy environment should recognise that the relative merits of competing technologies (including other renewables) are still volatile and not settled.

As with most strategic opportunities in an uncertain world with a range of futures, what is also important is recognising when windows of opportunity open and when they close. Broadly this suggests two main priorities for government [24]:

1. No regret moves. (A payoff exists in all scenarios)
2. Creating options (reserving the right to play).

[22] https://www.hydrogeninsight.com/innovation/massive-underground-reservoir-of-natural-hydrogen-in-spain-could-deliver-the-cheapest-h2-in-the-world/2-1-1431515

[23] molten oxide electrolysis uses electric current to separate oxygen from iron ore, and avoids the by the green-hydrogen step. It is similar to the way that aluminium is produced, but at a higher temperature (1,600 deg C vs 1,000 deg C)

[24] Courtney H., Kirkland J., Viguerie S., McKinsey "*Strategy under uncertainty*"

No Regret Moves
Within the context of discussion on opportunities for hydrogen in New Zealand, no regret moves can be grouped into immediate legislative and regulatory amendments that remove barriers to clean hydrogen development and implementation in New Zealand. These include:

1. A regulatory framework for enabling CCUS (blue hydrogen option)[25]
2. The Regulatory Systems Amendment Bill (RSB) could be used to revise the definition of gas pipelines under Part 4 of the Commerce Act to explicitly allow for regulation of blended fuels in gas networks.
3. Update health and safety regulations for gas pipelines, gas appliances, and gas fitting.
4. Update the Crown Mineral Act to bring in "natural hydrogen" as a separate substance that can be explored and mined for.
5. Fund GNS (or similar institutions) to provide basic geological data to parties interested in exploring for natural hydrogen

Creating Options
The government co-investment in various proof of concept projects, including the trial funding case study examples, is helpful in bridging the investment gap between pilot scale work and full commercialisation.

THE PATHWAY TO 2050

Do you agree with this assessment of the potential for hydrogen supply and demand in New Zealand?

If by "potential" the question asks whether it is "possible" the answer is yes. Scenarios are not forecasts. All scenario work relies on making assumptions and projecting this forward, on some rule basis that could be exogeneous or endogenous to the modelling work. Scenarios don't assign probabilities to the likelihood of the outcome.

In the given case, the scenarios work backwards from an assumed end level of demand in 2050 and then explores what the resource implications are based on current technology and economics.

In our view, the robustness of the assessment would be enhanced if it were to consider and allow for external drivers such as the rate of change in technology, policy adaptions, and economics. The assessment also appears predicated on an assumption that only green hydrogen matters and that it wins in all of the use cases put for it. We are doubtful on both these propositions.

Do you agree with the key factors we have set out that are likely to determine how hydrogen deployment could play out?

The key factors are focused on one technology (water electrolysis) and ignores other possible technology pathways that could outcompete green hydrogen production.

[25] Eg Barton B., 2023, Centre for Environmental, Resources and Energy Law Te Piringa Faculty of Law University of Waikato – "*Carbon Capture and Storage: Taking Action under the Present Law*" – including recommendations

Missing therefore are technology factors (existing and emerging) for e.g. blue, turquoise, and gold hydrogen, the capital and input costs for these, and also competing clean technologies that achieve the same economic, emission, energy security outcomes.
What do you think needs to happen to address these factors?
Broaden the narrative to talk about clean hydrogen rather than just green hydrogen and also assess these against other competing clean technologies.
Do you have any evidence to help us build a clearer picture?
The evidence is in following the public policy, techno-economic evaluation, commercial testing and technology competition, and real investments being made (and why). A good central resource to start with is www.hydrogeninsight.com
SECTION 3: Government position and actions
Do you agree with our policy objectives?
No, we don't agree with the policy objectives. First and foremost, the policy objectives all hinge around an assumption of green, rather than just clean hydrogen. For reasons already outlined, this seems unnecessarily restrictive, especially given that green hydrogen is one of the more expensive pathways for clean hydrogen production. This is without including the opportunity cost, of infrastructure investments to build and use renewable electricity to generate green hydrogen. We would consider blue hydrogen offers a plausible lower cost alternative, provided that the regulatory settings for CCS can be established and the ETS scheme creates the appropriate incentives for investment. Equally opening up the Crown mineral and petroleum estate to the opportunity of natural hydrogen exploration and mining has the potential to change the economics for all use cases. It is also important to distinguish New Zealand hydrogen markets in the discussion. New Zealand has a long-established market for hydrogen in chemical use cases (ammonia, methanol, hydrogen peroxide, and until recently, refining). In 2022, this amounted to approximately 182,000 tonnes of grey hydrogen produced from natural gas. These industries represent the most viable use cases within New Zealand's energy system. They already contribute to the economic and social wellbeing of New Zealand. The aim of government hydrogen policy should be to keep these industries operating in New Zealand. For these industries switching from unabated grey hydrogen to clean hydrogen when their international competition is staying with unabated grey hydrogen will be economically challenging. For example, there is no premium for green urea in New Zealand, and switching to importing urea instead of producing it domestically is relatively straightforward, given that New Zealand already imports most of its urea needs[26]. Government support will need to focus on keeping these industries viable in New Zealand. This includes keeping the EITE scheme in place, opening up clean hydrogen solutions beyond just green

[26] https://www.hydrogeninsight.com/industrial/fertiliser-production-is-an-obvious-use-case-for-green-hydrogen-so-why-are-producers-more-likely-to-want-blue-/2-1-1533395

hydrogen (for example, blue hydrogen), and requiring imports to meet the same emission standards at the border as domestic producers. Outside of the existing hydrogen market for chemicals, the other use cases presume that hydrogen should be used as an energy carrier. The evidence on that today, weighs against green hydrogen, with better alternatives available to achieve the same outcome. The government should exercise more caution and objectivity in backing hydrogen as a suitable clean energy carrier.
Do you agree with our positioning on hydrogen's renewable electricity impacts and export sector?
The positioning is based on a narrow definition of clean hydrogen as being green hydrogen. Furthermore, the idea of creating a hydrogen export sector from New Zealand carries enormous project and strategic risks for New Zealand. Most commentary pans exporting green hydrogen in most forms, including if shipped as ammonia for energy use[27][28]. New Zealand is also not seen as having any competitive advantage in the production of green hydrogen that would make it a serious competitor against other jurisdictions like Australia, North Africa, Spain, or Chile which have abundant and cheap renewable sources and are closer to markets. The current anticipated export market opportunities are yet to materialise, if they ever will. Most of the assumed investments are yet to reach Final Investment Decision (FID)[29][30] indicating a significant gap between rhetoric and reality.
Do you agree with the proposed actions and considerations we have made under each focus area?
We agree with the government committing to regulatory work to support use cases. We would note that this needs to go beyond green hydrogen and consider **all clean hydrogen** technologies, but particularly blue hydrogen and enabling exploration for natural (gold) hydrogen. We also support the government working with other countries to support the development of emissions-intensity standards and guarantee of origin schemes that allow for trading and certification hydrogen production sources, to support not just the development of a market for green hydrogen, but **for all clean hydrogen.** We support further work on consenting regimes and education of consenting authorities to streamline and speed up consenting processes. We partially support the government working with industry training providers for workforce planning but consider that in a mixed economic system that New Zealand operates in, this needs to be industry led. Overlaying another government coordinating layer on top of a coordinating

[27] https://www.hydrogeninsight.com/power/opinion-does-it-make-financial-sense-to-export-green-hydrogen-derived-ammonia-around-the-world-/2-1-1325725
[28] https://www.linkedin.com/pulse/myth-hydrogen-export-spitfire-research-inc/
[29] https://www.hydrogeninsight.com/production/exclusive-how-many-international-clean-hydrogen-offtake-contracts-have-actually-been-signed-/2-1-1369233
[30] https://www.hydrogeninsight.com/production/impossible-dreams-the-11-biggest-green-hydrogen-projects-announced-around-the-world-so-far/2-1-1517618

layer with more government officials who aren't direct employers of future skills is a recipe for public spending waste. We don't support the $100 million regional hydrogen transition consumption rebate scheme to support regional transitions: 1. Hydrogen has no clear use cases where it wins against every other clean energy alternative. Subsidies eventually stop, and this leaves the investments that relied on them economically stranded. This would be a huge opportunity cost for the regions. 2. Within the hydrogen production world, green hydrogen is most likely to slow down decarbonisation because of the low efficiency of converting from renewable electricity generation to hydrogen – particularly also if the renewable energy needed to displace coal, oil, and gas is instead being exported at very low round trip efficiencies.[31]
Is there any evidence we should be considering to better target actions in the final Hydrogen Roadmap?
The transition pathway towards a 'net zero' future is complex, uncertain and will require many trade-off decisions. Multiple influences, be they technological, geopolitical, economic, and/or policy, are impacting, and will continue to impact on the direction of travel. Clean hydrogen, provides one of many levers to enable the transition. However, there is mounting evidence that green hydrogen may not be the silver bullet that proponents believe it to be. We would urge government to broaden the perspective of New Zealand's potential hydrogen landscape by addressing opportunities for clean hydrogen (vs just green hydrogen). The evidence for doing this widely and readily available, including through tracking of technology, market, and policy development through (free) subscriptions such as www.hydrogeninsight.com . This should give sufficient insight into the volatility of the topic to indicate that use cases for hydrogen are far from settled, and increasingly challenged on the role of green hydrogen as a solution for emission reduction, energy security, and affordability.

[31] The reasons green hydrogen can slow down decarbonisation relates to the energy losses, and the way it competes for resources, both in terms of inputs (water, renewable generation, land, rare metals), and capex related to infrastructure development. The high cost against grey hydrogen also acts as an economic deterrent.