Interim Hydrogen Roadmap: Public Consultation Submissions Summary

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MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
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Purpose

This report summarises key themes from the submissions received on the Interim Hydrogen Roadmap 2023 public consultation, as well as submissions on the broader *Advancing New Zealand's Energy Transition* consultation package that commented on hydrogen.

Background

The Ministry of Business, Innovation, and Employment (MBIE) published an Interim Hydrogen Roadmap (the Interim Roadmap) on 9 August 2023 to test initial positions and proposed actions, on the role of hydrogen as part of New Zealand's energy transition. The Interim Roadmap was informed by regional stakeholder workshops in late 2022 and early 2023. The Interim Roadmap outlined:

- strategic opportunities within New Zealand's energy system for hydrogen to support emissions reductions (particularly for hard-to-electrify applications), economic development and contribute to New Zealand's energy security and resilience.

- scenario modelling commissioned to inform development of the Interim Roadmap. This modelling estimated that hydrogen production using renewable electricity could require significant additional generation capacity above the amounts estimated in electricity forecasts to date.

- an initial position on the potential for the export of hydrogen or derivatives from New Zealand, and the possible implications and trade-offs for the electricity system.

- signalled government actions to address the identified barriers to hydrogen deployment in New Zealand. Proposals included establishing a government and sector body, undertaking a regulatory work programme to enable safe use of common infrastructure and enable near-term use cases and exploring the need for certification of emissions content. It also highlighted the two hydrogen-related initiatives announced as part of Budget 2023 – the Regional Hydrogen Transition consumer rebate scheme and the Clean Heavy Vehicle Grant scheme.

- areas meriting further consideration for developing a final Hydrogen Roadmap. This included work to:

    - test our estimates of the supply and demand of hydrogen when considering the wider energy system and potential alternatives to hydrogen

    - better understand the implications of hydrogen production on the electricity system

    - further explore challenges to commercial viability, particularly in the next decade.

Navigating this document

This document provides a high-level summary of the feedback received on the Interim Roadmap. The Interim Roadmap included 15 discussion questions to guide submissions (refer **Annex Two** for a full list of questions). For the purposes of this summary, we have used common terminology throughout for the numbers of submissions that shared a similar view, as set out in **Table 1**.

Table 1: Definitions of numerical terminology used in this document

Terminology	Number of responses
One / single / a	1
Two	2
Some / several	3 to 10
Many / large proportion	Up to 50 per cent of responses
Most / a majority	Over 50 per cent of responses
Unanimously	All responses

Throughout this document we refer to groups of submitters in the categories outlined in **Table 2** and a full list of submitter groups and organisations is included in **Annex One**.

Table 2: Categories of submitters used in this document

Submitter category	Number of submissions	Submitter category	Number of submissions
Unions	1	Environmental groups	5
Industrial hydrogen users	3	Electricity generators and retailers	7
Iwi and Māori organisations	4	Central and local government organisations	7
Academia	6	Active or potential hydrogen suppliers and/or producers	9
Private sector organisations or joint ventures	5	Industry organisations	11
Transport hydrogen users	5	Private individuals	16

We have also coded statements made in submissions into theme areas. These theme areas are outlined in **Table 3** and broadly track the structure of the Interim Roadmap document. We have taken this approach to quantifying submissions and coding statements into themes as:

- submitters did not always answer every question and in some cases they provided general or overarching commentary on the Interim Roadmap
- many submissions included information in one question that had statements relevant to other/multiple questions
- some submissions include the views of multiple organisations or individuals (e.g. a collective or industry organisation).

Table 3: Themes used in this document

Theme	Description of how submissions were tagged to the theme
Key messages and strategic case	Overarching or contextual comments within a submission that are not directly addressed at one of the theme areas below.
Hydrogen use cases	Commentary on the different potential use cases for hydrogen.
Hydrogen's impact on emissions reduction, economic development and energy security and resilience outcomes	Comments on the objectives hydrogen could contribute to. This included objectives highlighted in the Interim Roadmap, and additional objective areas.
Production and storage methods	Commentary on different methods for making and storing hydrogen.
Electricity system interfaces	Views on the implications of hydrogen production for required electricity generation and supporting infrastructure, and potential effects on electricity prices.
Exporting hydrogen	Comments relating to potential future export of hydrogen from New Zealand, and possible implications.
The role of government	General comments about the role of government, that are not specifically in relation to one of the other theme areas.
Modelling and scenarios	Comments on the scenario modelling prepared to inform the Interim Roadmap.
Commercial viability of hydrogen and policy implications	Comments relating to barriers to commercial viability. Includes specific commentary on the Regional Hydrogen Transition and Clean Heavy Vehicle Grant Scheme.
Governance and monitoring	Comments relating to the role of government in coordinating activity relating to hydrogen, and feedback on the proposed government and sector body.
Research, development and deployment	Commentary on research, development and deployment issues.
Workforce availability and capability	Comments relating to the required workforce for hydrogen deployment.
Infrastructure and planning	Feedback on infrastructure needs and implications relating to hydrogen, and commentary on the general consenting environment for this infrastructure.
Health and safety regulations and standards	Feedback on health and safety matters relating to hydrogen, and the regulatory work programme.
Certification	Certification of the emissions intensity of hydrogen production, and role for government.
International partnerships	Commentary on the role of international partnerships in hydrogen deployment in New Zealand.
Public perception	Comments relating to public perception of hydrogen and social licence.
Next steps and final hydrogen roadmap	Commentary on current thinking on the opportunities for hydrogen and the Government's role to help realise these, as well as plans to release a final hydrogen roadmap alongside the New Zealand Energy Strategy.

Overview of submissions

MBIE received 79 written submissions to the Interim Roadmap public consultation. In addition, MBIE received feedback on the Interim Roadmap through a series of meetings with key stakeholders. The Interim Hydrogen Roadmap was well-received by most submitters. Support indicated for hydrogen use cases was mostly for hard-to-electrify applications, and where hydrogen could contribute to lowering hard-to-abate industry emissions. While most submitters covered a wide range of issues and themes in their feedback, they broadly fitted into three groups in terms of their main areas of focus:

- **Environmental groups and a number of private submitters** voiced strong concerns, particularly around hydrogen leakage, greenhouse gas emissions during production processes, safety concerns, efficiency, resource use and environmental implications (e.g. water use). They also had concerns about electricity implications, including the impact of additional demand for electricity on prices.

- **The hydrogen sector and electricity generators** see a strong role for government and want more clarity, drive and clear signalling. This includes regulatory frameworks, a position on certification, financial supports and clearer direction on the path to scaling up in the 2020s.

- Other submitters supported consideration of alternative production methods or further analysis of alternative technologies. Some submitters (mainly from the **gas sector**) supported consideration of other hydrogen production methods including grey hydrogen and blue hydrogen as transitional pathway towards green hydrogen. Some **research groups** considered further analysis is needed on alternative fuels and energy options before committing to technology-specific approaches. These submitters also supported a government energy strategy before finalising a hydrogen roadmap.

Summary of submissions by theme

KEY MESSAGES AND STRATEGIC CASE

Submitters that expressed support for the Interim Roadmap, whether in part or overall, indicated a final hydrogen roadmap should provide **clear direction and certainty** to existing and potential suppliers and consumers of hydrogen. This certainty would guide or underpin investment decisions in the private sector. For example:

- Hiringa Energy advocated for a strong, clear pathway for hydrogen deployment to attract investment, and for in-depth industry consultation on any future demand modelling.

- Taranaki Offshore Partnership indicated that the final Hydrogen Roadmap needs to contain enough detail to give clarity to industry participants, increase investor confidence, identify opportunities and ideally highlight timelines for developing the renewable electricity generation needed to produce hydrogen.

Submitters who supported the Interim Roadmap generally made positive statements regarding coverage of the strategic issues relating to hydrogen within New Zealand's energy transition and the presentation of the current hydrogen industry landscape internationally and in New Zealand.

Several submitters, including private individuals, environmental groups and an academic organisation, thought that the positioning and statements in the Interim Roadmap were too closely aligned with industry views and that the Interim Roadmap needed to be more balanced in its consideration of both **benefits and disbenefits** of supporting a developing hydrogen economy. Some of the concerns raised included:

- the **global warming potential** of hydrogen itself due to emerging research about how it interacts with other gases in the atmosphere, and potential risks around leakage of hydrogen to the atmosphere through equipment during production, storage and distribution

- concerns about the **safety** of compressed and liquefied hydrogen, particularly in transport uses

- **water usage** implications of producing green hydrogen, when many existing freshwater sources are already under pressure and may be to a greater extent in the future from the effects of climate change

- the **energy efficiency** of hydrogen production from renewable electricity, compared to using electricity directly in other applications (like battery electric vehicles and electric building heating), due to the energy losses associated with production, storage and transportation/distribution

- the potential for hydrogen production to place upward pressure on **electricity prices** from being an additional source of demand

- whether ambitions around green hydrogen, and in some cases renewable energy, are compatible with a need to reduce demand for energy, consumption and change patterns of behaviour in order to effectively **reduce emissions and address climate change**.

Several submissions questioned the **sequencing of the Interim Roadmap** ahead of other work signalled at the same time, like the New Zealand Energy Strategy. Many submitters supported an initial technology-neutral approach, with consideration of all types of alternative fuels before signalling support for hydrogen in particular.

Others set out proposed priority areas for how the Government should consider potential uses for hydrogen, starting with replacing existing emissions-intensive hydrogen produced from natural gas with hydrogen produced using **100 per cent renewable energy**.

HYDROGEN USE CASES

61 submitters commented directly on one or more hydrogen use cases outlined in the Interim Roadmap or discussed the appropriateness of hydrogen for particular uses. The majority of submitters agreed with the Interim Roadmap's focus on **hard-to-electrify applications** in heavy transport, heavy industry and power generation, noting the technological and economic uncertainty around whether all of these use cases will eventuate.

Heavy industry applications were most commonly supported. Some submitters (predominantly private individuals and environmental groups) supported hydrogen use only where there is little or no alternative, such as replacing grey hydrogen feedstocks and in steelmaking. Two environmental groups explicitly opposed using green hydrogen to produce urea-based fertilisers due to concerns it would be used to 'greenwash' other environmental effects of fertiliser use. Some submitters viewed the production of synthetic fuels favourably, recognising the strategic importance of domestic fuel security.

Heavy transport applications attracted divided opinion. Some submitters considered that hydrogen was unviable or even wasteful in heavy land transport applications. These submitters mentioned hydrogen's low energy efficiency, high space requirements for storage, the wide variety of alternatives to hydrogen in clean fuel applications and ongoing improvements to battery technologies which they suggested posed better alternatives.

Z Energy and the National Energy Research Institute noted that most road transport will be electrified in New Zealand, and that only 3 to 5 per cent of heavy vehicle kilometres travelled in New Zealand are long-haul (much less than Australia, Europe and North America).

Air New Zealand and the New Zealand Hydrogen Aviation Consortium commented on the potential for **hydrogen aviation applications** to grow faster than our modelling suggested. Environmental groups signalled a preference for alternatives to aviation, such as passenger rail and coastal shipping. One private submitter suggested that while hydrogen may not play a significant role in the overall rail network, there may be opportunities in pollutant-heavy parts of the network, starting with hydrogen shunting engines at primary freight terminals, similar to the Polish Rail Network.

Support for **power and energy system applications** was also divided. Some submitters advocated for hydrogen's use as energy storage, particularly when renewables are over-producing, while others considered this impractical. Some submitters suggested hydrogen may have an important role in providing back-up power generation for an emergency response, particularly in light of the disruptions caused by Cyclone Gabrielle.

Most submitters who commented explicitly on **gas blending** opposed it, considering it technically or economically unviable, or opposing its potential role to perpetuate gas production, or both.

HYDROGEN'S IMPACT ON EMISSIONS REDUCTION, ECONOMIC DEVELOPMENT AND ENERGY SECURITY AND RESILIENCE OUTCOMES

45 submitters commented directly on one or more of the outcome areas discussed in the Interim Roadmap, and many made a point of raising broader environmental issues associated with hydrogen production beyond direct emissions reduction.

Submitters had mixed views on hydrogen's likely **decarbonisation or emissions reduction** outcomes. In general, these aligned with their views on likely use cases, with commercial entities in the hydrogen economy the most positive versus environmental groups and private individuals expressing more negative views. Some indicated decarbonisation benefits are disproportionately important in some industries. For example, Horticulture New Zealand noted that only six per cent of kiwifruit lifecycle emissions occur on the orchard, while 43 per cent come from shipping.

Some submitters also noted the indirect warming potential of hydrogen from **atmospheric leakage** (particularly when transported and stored). These submitters suggested that government has a role in outlining how **greenhouse gas emissions** from leakage should be accounted for and how this relates to the Emissions Trading Scheme, as well as investigating the risk and extent of leakage. Some expressed a view that there may be emissions reductions opportunities available at lower economic, environmental and social costs than those offered by hydrogen use cases.

Submitters generally supported a focus on **energy security and resilience**. For example, Auckland Transport noted the risks of relying too heavily on one source of energy across the economy as we electrify more applications, and noted a potential solution is a mixed fleet of electric and hydrogen buses. Some submitters noted hydrogen's potential regional back-up power benefits. Submitters placed a high degree of importance on ensuring the electricity grid can meet the demands of both electrification and hydrogen deployment, particularly in relation to hydrogen production for export. Some submitters saw a role for hydrogen in short and/or long-term energy storage to balance

intermittent renewables and address dry-year risk (i.e. one submitter proposed a hydrogen strategic reserve), while others considered hydrogen unviable or wasteful in these applications.

Most submitters saw **economic benefits for a hydrogen economy**. Some submitters mentioned opportunities for economic growth, particularly through export, as well as job creation and diversification. Some submitters noted there may be economic disbenefits if hydrogen increases electricity bills.

Submitters considered the Roadmap should more clearly articulate hydrogen's **environmental impacts**, particularly around water use. Submitters noted impacts would need to be managed from both water demand (which is limited at national level but may be more significant at local levels, and is under pressure from climate change impacts) and wastewater disposal (i.e. if toxic and corrosive chlorine ions are discharged into the sea or if water is treated with alkali or acid). Some submitters supported exploration of non-freshwater sources like process water or grey water to manage pressures on freshwater.

FEEDBACK CONCERNING IWI AND MĀORI PERSPECTIVES

Several submitters commented that the Interim Roadmap lacked a **te āo Māori perspective**, with one submitter expressing concern that it did not go far enough to demonstrate either commitment to Te Tiriti o Waitangi or regular/enduring consultation with tangata whenua.

Ngā Iwi o Taranaki and Post Settlement Governance Entities voiced strong concerns around water usage for hydrogen production processes and water pollution (discharge to water bodies) from post-hydrogen production processes. This was in particular reference to surface water bodies in Taranaki which they said were already under pressure for other uses.

Arup considered that Māori and iwi partners would play an important role in raising public awareness, understanding and acceptance of hydrogen in New Zealand's energy system, and **Māori participation** in the opportunities that a future hydrogen sector might offer.

Arup recommended ensuring **Māori representation** in working groups and in governance settings under forums focused on regulatory settings, standards, workforce/skills and training and planning. They considered that iwi and hapū could provide useful **input and guidance** on how to stand up a partnership that could be both meaningful and impactful. The Taranaki Offshore Partnership recommended that the final Hydrogen Roadmap include a formal objective to further enable Māori participation.

PRODUCTION AND STORAGE METHODS

14 submitters commented directly on different hydrogen production and storage methods. The University of Auckland and Hyundai supported a core focus on **green hydrogen** due to New Zealand's strong comparative advantage in this area and its sustainability attributes. BEC stated that the economics of green hydrogen are expected to improve as the price for electrolysis and fuel cells falls. GNS recommended supporting research that progresses green hydrogen production from a range of non-freshwater sources given potential future pressures on freshwater (i.e. waste water and sea water).

Several submitters from the sector argued for a **technology-agnostic approach** (maintaining openness to **blue, turquoise and gold/natural hydrogen**) to keep the focus on emissions reductions, promote lowest-cost decarbonisation and/or enable incremental steps toward an at-scale hydrogen market. These submitters suggested government could enable these approaches by ensuring regulations took these technologies into account (i.e. through safety regulations and by clearly regulating carbon capture, utilisation and storage technologies).

Major Gas Users Group noted **naturally-occurring hydrogen** has the potential to outcompete other forms of clean energy, referencing Helios Aragón's claim that it could produce naturally occurring hydrogen from a large underground reservoir in the foothills of the Pyrenees for €0.75 ($0.82) per kilogram — about half the current cost of producing grey hydrogen from unabated natural gas. Major Gas Users Group advocated for government to fund GNS (or another organisation) to provide basic geological data to parties interested in exploring for natural hydrogen.

Kakariki said **biomass-derived hydrogen** is a lower priority use of biomass than uses such as e-fuels and sustainable building materials. The Environment and Conservation Organisation submitted that **liquid hydrogen** is impractical because of the energy required to make it and because of losses due to boil-off when stored. A private submitter suggested the government take note of a patent filed by start-up Novacium SAS for a hydrogen production system using a chemical process to liberate hydrogen from low-cost alloys, without the need for electricity, extensive storage, or complex transportation infrastructure. Clarus and GNS discussed the potential for **underground hydrogen storage** in depleted gas wells, noting previous research on this by Clarus, the University of Canterbury and EnergyLink.

ELECTRICITY SYSTEM INTERFACES

24 submitters commented on issues and considerations relating to the interface between hydrogen production and the electricity system. Several submitters, including academia, transport, industry and energy provider organisations, highlighted the importance of planning for **grid capacity** given the significant renewable electricity required, particularly in export-heavy scenarios. Some submitters considered hydrogen's risks to grid stability too large to justify going ahead, while others claimed that grid impacts could be managed with effective planning and forward-signalling. Hiringa set out that hydrogen production does not compete for scarce green electrons. The flexible nature of electrolyser production allows for greater utilisation of variable renewable generation (otherwise spilled, curtailed, or sold at zero or negative prices), with less overbuild of transmission, storage and firming infrastructure than would need to be built in a 'no-hydrogen' scenario.

Some submitters, including offshore wind developers, noted the potential synergies between hydrogen and **offshore wind** to meet capacity – notably, the ability to develop projects at scale, proximity to demand, high-capacity factors and the ability for hydrogen to soak up **'energy spillage'**[1].

Several environmental groups plus an individual submitter expressed concern that hydrogen demand could increase **electricity prices** if the market is unable to meet demand for both increased electrification and production of green hydrogen. These submitters expressed a view that higher electricity prices are likely because hydrogen will involve construction of increasingly marginal electricity generation projects, and the 80 to 90 per cent capacity factors for electrolysers will necessitate grid baseload power. These submitters also expressed doubt that additional renewable electricity generation to support hydrogen demand would lead to lower electricity prices, due to the way the electricity wholesale market is structured. They also noted the risk of a demand response market for hydrogen producers being paid via higher wholesale electricity prices for consumers.

Meridian Energy disputed the claim that the Southern Green Hydrogen project may lead to increased electricity prices, because of the strong pipeline of renewables projects in Southland that have been historically underinvested in, and that the project may help to unlock. They also said it is incorrect to claim that export would more directly link New Zealand electricity prices to a global commodity market, because the long-term contractual arrangements such as **offtake agreements and Power Purchase Agreements (PPAs)** would mean international prices do not flow through to wholesale electricity prices. They pointed to evidence from the Boston Consulting Group, MBIE and the

[1] Energy spillage is when excess solar or wind energy, for example, is allowed to dissipate unused.

Electricity Authority indicating a healthy pipeline of affordable renewable electricity development opportunities. They also highlighted historical increases in electricity and renewable generation capacity, citing an increase of 20,000 GWh of new electricity generation since 1996, and the increase over the last decade in the share of renewable electricity generation from 65 per cent to 85 per cent.

Some environmental groups plus an industry body and academic submitter noted that New Zealand is depending on ample supply of renewable electricity at low prices but **build-out of renewable generation** requires rising power prices. These submitters considered it was unclear how prices would fall sufficiently to achieve prices of $2 per kg of hydrogen, particularly if electricity has higher returns elsewhere. Ballance Agri-Nutrients considered electricity price relief would be needed to support early adoption.

Some electricity generators, suppliers and producers advocated the **demand response benefits** of large-scale hydrogen projects and view flexibility as one of the key benefits of their projects. They noted demand response would need to be adequately compensated to allow for loss of production. The group submission from J Haas et al. noted hydrogen's benefits from capturing energy spillage, and noted that projected hydrogen integration in South America has been shown to lower the average cost of electricity by enabling greater use of flexible generation.

EXPORTING HYDROGEN

A diverse group of 22 submitters commented directly on hydrogen export considerations. Their positions were mixed. Export was mostly favoured by commercial submitters as well as regional entities. Export was seen by these submitters to bring direct **economic benefits** as well as provide the scale necessary for wider hydrogen. Some submitters including Meridian, Bluefloat, Parkwind and BECA also claimed export could provide demand response and seasonal balancing. As above, Meridian disputed claims that export would impact electricity prices either through requiring increasingly marginal electricity projects or through linkages to **international markets**. J Haas et al. noted that the largest export scenarios discussed in the Interim Roadmap equate to around 0.1-0.2 per cent of the projected global hydrogen demand by 2050, and given this small proportion, export could be flexible to seasonality.

Submitters across several different categories (Academia, Transport, Industrial suppliers/producers for example) supported a **domestic focus in the near term** until it is clearer that we will have sufficient renewable electricity, or with export growing in line with grid constraints. NZ Steel considered it too early to tell whether exporting hydrogen would support or detract from our domestic hydrogen and electricity markets.

Export was most likely to be opposed by individual submitters and environmental groups. These submitters expressed concern over **energy security**, environmental impacts, possible impacts on electrification if electricity capacity is diverted and possible **impacts on electricity prices**.

Some industry bodies and energy providers expressed doubt that New Zealand will be commercially competitive in the **global market for green hydrogen**, given our geographic distance from markets and higher renewable electricity costs. Bluefloat and Meridian Energy considered that New Zealand does not need to be the lowest cost producer to have a role in a diversified market, while J Haas el al. noted that while New Zealand does not have periods near-zero marginal electricity cost like Australia and Chile, we do have very cheap electricity prices at night, no significant space constraints for deploying renewable generation and an already highly renewable electricity sector.

THE ROLE OF GOVERNMENT

26 submitters made general comments on the role of government in addressing the issues to hydrogen uptake in New Zealand. Views varied across submissions, largely depending on the level of support for hydrogen in general.

Submitters with commercial or regional interests in hydrogen, such as Murihiku Regeneration, Parkwind, Hyundai, West Coast Regional Council and Ballance Agri-Nutrients, generally supported **ambitious and decisive action** from Government, including fiscal support, concrete targets, supporting early demonstration and use, procurement tools, diplomatic relationships, reducing investment uncertainty and facilitating connections across the value chain. These submitters noted the competitive global landscape for hydrogen projects, e.g. the financial incentives for hydrogen production introduced by the Inflation Reduction Act in the United States of America.

Several submitters (both with and without particular commercial interests in hydrogen) supported a **technology-neutral approach** focused on addressing legislative, regulatory, information and other system-level barriers to private investment, so that markets can allocate to the least-cost emissions reduction technology. These submitters often supported government intervention only where there are identified market failures.

Submitters with concerns about hydrogen's safety, energy efficiency, or environmental characteristics (mainly environmental groups and individual submitters) called for the Government to **limit activity relating to hydrogen**, either to sectors with no other option (i.e. industrial uses), to later in time when likely safety and emissions impacts are better understood, or indefinitely.

MODELLING/SCENARIOS

Nine submitters commented directly on the hydrogen economic modelling and scenarios. These comments covered views on the **accuracy, realism or completeness** of the assumptions and scenarios presented in the Interim Roadmap. Some noted the complexity of estimating hydrogen production costs and the limitations of modelling cost estimates in an emerging and technologically evolving sector.

Some submitters considered that the assumptions and scenarios appeared reasonable, while others noted that scenarios ultimately rely on the **underlying assumptions** used, making it difficult to judge the scenarios in this context. Feedback included statements around:

- Whether the Interim Roadmap represented the full range of potential scenarios, noting some 'relatively narrow' differences between the five scenarios (J Haas et al.).
- The 'base case' being the most likely scenario, with the accelerated uptake scenario giving an upper bound (National Energy Research Institute).
- Suggestions that the modelling exercise would be improved by including consideration of **external drivers of change** such as the rate of technology change, policy adaptations and economics that will ultimately influence the uptake of each scenario. This included the effects of the potential exit of the New Zealand Aluminium Smelter on wholesale electricity prices (University of Auckland).
- Support for consideration of **alternative scenarios**, such as one that includes using hydrogen for value-added products like steel and chemicals, but without direct export of hydrogen and/or derivative carrier chemicals - noting that the value-add scenario modelled included both (Taranaki Offshore Partnership and Arup).

- **Comparisons** to similar exercises undertaken in other jurisdictions or other modelling undertaken in New Zealand. Two submitters noted that the estimated wholesale levelised production cost for green hydrogen was lower than other modelling undertaken in New Zealand and estimates carried out in Europe (Arup and Major Gas Users Group).

- A need to consider **demand side implications** of hydrogen uptake - namely the willingness to pay for green hydrogen across different use cases and sectors (Arup).

- The implications of the model results compared to other energy modelling products that are widely used or relied upon in the New Zealand energy system, namely the Electricity Demand and Generation Scenarios published by MBIE (Transpower).

Focus areas

COMMERCIAL VIABILITY OF HYDROGEN AND POLICY IMPLICATIONS

44 submissions commented directly on commercial viability for hydrogen. There were a wide range of comments and views on the current commercial viability of green hydrogen, in particular what might be needed for green hydrogen to become commercially-feasible, and what role government could or should play in support of this. These comments ranged from those in support of a greater role for government to help stimulate **investment confidence and certainty**, to those that either do not support a role for government in hydrogen deployment and those that consider further analysis and assessment would be needed first.

Among submitters that expressed support for a commercial market for hydrogen, there was general agreement with the issues set out in the Interim Roadmap, such as high **upfront costs** for capital equipment, the current higher cost of hydrogen compared to fossil fuels and the 'chicken-and-egg' issue around first mover investment risk and certainty of future supply to ensure confidence in investment decisions.

Infrastructure availability was raised as a common issue, particularly by submitters active in or considering transport use cases. These submitters noted the need for an accessible and reliable supply of hydrogen and refuelling infrastructure to underpin a wider rollout of hydrogen fuel cell and diesel-hydrogen combustion vehicles than the existing demonstration vehicles currently operating in New Zealand.

Comments that saw a role for government in this space included:

- clear government signals to underpin investment decisions

- streamlined and fit-for-purpose regulatory and consenting mechanisms

- ensuring electricity prices are compatible with hydrogen production costs and user willingness to pay

- government investment or ownership of core hydrogen infrastructure

- financial support mechanisms similar to those being implemented in other countries

- promoting regional hydrogen hubs

- using government procurement to enter into long-term offtake contracts

- reflecting the true cost of climate change in existing fuel pricing to make it closer in true cost to hydrogen production.

Comments that either did not support hydrogen deployment and/or a role for government in enabling it, or considered further technical analysis was needed included:

- general comments about the versatility, practicality and cost of hydrogen
- questions around assumptions in the hydrogen economic scenario modelling around electricity prices, declining capital costs for electrolysers and related equipment, whether hydrogen producers will actually curtail production when demand for electricity is high, and the need for green hydrogen production to be supported by at least some firmed grid capacity
- the view that hydrogen not being currently commercially viable is a market signal of how viable it is likely to be into the future.

Several other submitters saw the need for further assessment before coming to conclusions about whether to support or encourage a commercial hydrogen market. This included more robust **technological and cost assessment analysis** of the benefits of hydrogen alongside potential alternative fuel options.

REGIONAL HYDROGEN TRANSITION REBATE

11 submissions commented directly on the Regional Hydrogen Transition (RHT) rebate scheme. There were a range of perspectives on support for the scheme, its design and other considerations.

Several of these submitters supported the scheme as a way to **bridge the current price gap** between green hydrogen and fossil fuels that would be displaced using hydrogen. These submitters saw the scheme as a key measure to **de-risk investment** and provide confidence for the sector to scale up. Some commented that the announcement of the RHT had already generated considerable interest in hydrogen infrastructure investment.

Others either did not support the scheme, or suggested design changes. The main reason given for not supporting the scheme was that it would support hydrogen use cases that would not be otherwise viable, and lead to economically stranded assets once support ended.

Suggested design changes included **expanding its core focus** beyond the Taranaki and Southland regions given that reducing emissions is required nationally. Several submitters thought that the scheme should be open to consumption of **other types of hydrogen** production beyond green hydrogen. This was seen as a transitional measure to help build scale and demand in hydrogen use cases, while green hydrogen remained an expensive production method.

CLEAN HEAVY VEHICLE GRANT SCHEME

Six submitters commented directly on the Clean Heavy Vehicle Grant Scheme, which was also announced in Budget 2023. These submissions were **evenly split** in their agreement or disagreement for the scheme for similar reasons as the Regional Hydrogen Transition. One submitter suggested scope changes to allow dual hydrogen-diesel combustion vehicles as well as hydrogen fuel cell heavy vehicles.

GOVERNANCE AND MONITORING

16 submitters commented directly on matters relating to the coordination of government activity in hydrogen, and the action to establish a government and sector body to guide activity.

Submitters that were generally supportive of hydrogen deployment considered that it was important for the government to set **clear targets, milestones and timeframes** relating to the actions signalled in the Interim Roadmap, to give greater confidence to early movers and investors. There was general support for a **coordinated approach** from government to consider the views and input of a broad range of stakeholders who have quite specific but interconnected interests and areas of focus relating to hydrogen.

The action to establish a government and sector body was generally supported by submitters who had a commercial or operational interest in hydrogen production and use. Hiringa Energy suggested it be made a 'taskforce', with **clear accountabilities and a responsibility** to report to the Minister directly on progress. The National Energy Research Institute considered that a government and sector body based on a technology like hydrogen was less suited to this approach, compared to a sector-specific group like Sustainable Aviation Aotearoa. Some submitters who generally did not support hydrogen deployment considered the proposed structure was too focused on industry views. There was also support from some submitters (GNS, University of Auckland) to include **representatives** from research and academic backgrounds in the membership of such a body, along with sector representatives.

RESEARCH, DEVELOPMENT AND DEPLOYMENT

14 submitters across several different submitter categories commented directly on research, development and deployment (RD&D). These submitters said it would be important for building in-country skills and learning curves, reducing costs, addressing global supply chain risks by building domestic capability to produce and use equipment and the opportunity for New Zealand to become a **technology exporter**.

In terms of the focus of research, Arup noted that the capital cost of hydrogen production technology is likely to be driven by **global developments** and therefore RD&D efforts should be specifically targeted to a **New Zealand context**. Research into hydrogen conversion, storage, and transportation had support from academia. with two submitters commenting on the value of research that can clarify hydrogen's role and integration into the future energy system (J Haas et al., National Energy Research Institute).

Commercial submitters suggested there was a role for government to **stimulate investment in RD&D** (whether public or private). Kakariki advocated for the creation of a dedicated fund (more than $1 billion) supporting both research and deployment of energy technologies at commercial scale. One submitter recommended a "top down" investment approach which first considers New Zealand's energy sector priorities and the RD&D supports needed for those, in place of the current competitive funding system which can leave **gaps in comprehensive coverage of research**.

WORKFORCE AVAILABILITY AND CAPABILITY

13 submitters from across the submitter categories commented directly on workforce and skill needs to support hydrogen deployment. Among these submitters, there was broad recognition of the need for a suitably skilled workforce to enable hydrogen deployment, the opportunities to utilise **transferrable skills** within existing workforces and the need to understand potential workforce and skill gaps.

There were differing views among submitters on how and when to address these issues, and what the role of government should be. Hydrogen project leaders generally supported the proposed government and sector body helping to lead a **coordinated approach** to workforce needs. One suggested surveying the sector and training providers on industry workforce requirements. There was also recognition that the transferability of skills from the oil and gas sector, with complementary training to 'top up' **existing qualifications**, could be well suited to hydrogen workforce needs. Other submitters preferred a more industry-led approach. Energy Resources Aotearoa highlighting the work it had done in this area to date. The National Energy Research Institute considered a more realistic assessment of the need for hydrogen was required before considering workforce and skills needs.

Several submitters commented on the international dynamics of hydrogen workforce requirements, noting both the potential to source suitably skilled workers from other countries and enabling this through the **immigration system**, as well as the risks of losing skilled workers to other countries with ambitious hydrogen plans such as Australia. Some submitters noted risks in relying on internationally sourced workers, on the basis that this would be much more expensive than training or upskilling domestic workers.

INFRASTRUCTURE AND PLANNING

32 submitters commented directly on infrastructure and planning issues. Several submitters commented on the need for infrastructure deployment ahead of demand to underpin investment decisions. Some submitters highlighted the network effects needed for infrastructure like hydrogen refuelling stations before potential users could commit to using hydrogen.

There was support from several industry/sector submitters with a direct interest in hydrogen deployment in establishing **regional hydrogen hubs**. Reasons stated included the ability to share costs by aggregating production and consumption across different use cases, attracting investors, acting as a test bed for viability and deployment, and focusing effort to understand and resolve health and safety matters. The hub model was seen by these submitters as a practical way to overcome challenges. Several industry submitters with an interest in developing New Zealand's hydrogen sector also highlighted or drew comparisons to **renewable energy zones** (REZs) and other spatial planning tools, where renewable generation builders coordinate to sequence and co-locate generation to share network connection costs.

Submitters commented on other infrastructure requirements, including the desirability of locating hydrogen production close to renewable electricity generation and points of use to minimise the need to transport hydrogen. These submitters also mentioned **coordinating development of infrastructure** that would enable lower cost hydrogen transport, such as newly-built or repurposed pipelines to carry hydrogen-natural gas blends or 100 per cent hydrogen.

There were a range of comments on the role of the **resource management planning system**, what the government could do to speed up planning consideration of hydrogen projects and how environmental effects of hydrogen infrastructure should be considered and mitigated. Those leading hydrogen projects or with an indirect interest in hydrogen deployment generally supported the government taking action to reduce the time, cost and level of complexity involved in **consenting** for hydrogen projects. Suggestions for government action included considering hydrogen infrastructure in any fast-track rules for renewable energy infrastructure and developing a national policy statement for hydrogen.

Three submitters highlighted the significant infrastructure build-out that would be required, based on the estimates provided by the scenario modelling. These submitters either did not support hydrogen deployment to this extent for that reason or noted further considerations or actions for

government. GNS supported more consideration of the additional critical minerals that would be required for the electricity generation needed to support this, while Transpower noted the need to allow investment test rules to enable anticipatory investment in infrastructure.

HEALTH AND SAFETY REGULATIONS AND STANDARDS

24 submitters commented directly on health and safety regulatory settings and standards. Submitters with a direct interest in hydrogen activities considered that addressing or removing **regulatory barriers** now would enable faster development of the hydrogen sector and provide increased transparency and greater certainty for investors. However, some of these submitters had differing opinions on which uses should be prioritised over others in a **regulatory work programme**.

Several submitters, including environmental groups, considered that the Interim Roadmap did not go far enough to discuss and address the **health and safety risks** relating to hydrogen, including flammability, high storage pressures and inadequacy of existing regulatory regimes. These concerns included the unique risks an emerging hydrogen industry posed to **emergency responders**, particularly in transport settings. Some of these submitters called for the development of industry-specific training as a mitigation. There were also concerns shared by several submitters that hydrogen refuelling stations could pose dangers to surrounding **communities**. Most of these submitters supported urgently prioritising work to develop or update health and safety regulations and greater clarity over what the work programme would entail.

CERTIFICATION

11 submitters commented directly on certification for green hydrogen, almost all of which were from organisations with an interest in hydrogen deployment. There was general agreement on the need to certify the emissions intensity of hydrogen production. The reasons given were: to ensure **consumer trust and confidence** in hydrogen; allow producers to capture the **'green premium'** associated with green hydrogen production; and enable **compatibility and recognition** with certification schemes in other jurisdictions, to support future international hydrogen or derivative trade.

Some submitters noted that governments have typically developed or endorsed certification schemes, which provides a level of credibility to **underpin trading markets**. Certified Energy highlighted its New Zealand Energy Certificate Scheme, which is already in operation, and considered it **could be endorsed** by the Government rather than creating a new scheme. Hiringa Energy supported a certification approach based on the average renewable electricity generation share per annum. It considered that more complex approaches that tracked the emissions intensity of the electricity system at time-based intervals and limiting certification of renewable hydrogen to electricity from new renewable generation would add unnecessary cost and complexity.

INTERNATIONAL PARTNERSHIPS

13 submitters made comments directly relating to the role of international partnerships in hydrogen activities. These were primarily submitters with a direct role in hydrogen production and use.

There was general agreement on the importance of international partnerships and relationships for New Zealand. Reasons given included: connecting to countries that are likely to be future importers of hydrogen such as Japan; **staying connected** to international developments that could see cost reductions in key equipment; **collaborating** with and learning from other countries that are further ahead in their hydrogen strategies; and **sharing information** on common issues such as establishing safety rules and regulations. Some submitters noted that New Zealand is likely to draw on technology from other countries in many parts of the hydrogen supply chain, which will make international connections important.

Hyundai New Zealand noted Australia's positioning to become a major hydrogen exporter, and that New Zealand might import hydrogen from Australia in some capacity. Hyundai saw this as having potential energy security benefits that differed from those set out in the Interim Roadmap, which largely assumed energy security through domestic production.

PUBLIC PERCEPTION

Ten submitters made statements relating to public perception of hydrogen, noting that the inclusion of hydrogen as part of New Zealand's energy mix ultimately depended on **community acceptance**, understanding and support.

Submitters who generally supported hydrogen deployment considered that public acceptance of hydrogen deployment is crucial. These submitters noted the similar considerations with public consent across many parts of the energy transition, including offshore wind and increased transmission and distribution infrastructure to support electrification. Some submitters also noted that projects might not be commercially viable without public acceptance, due to the costs that **challenges and objections** in the resource management system could add.

Some submitters saw a **role for government** in building greater understanding and acceptance of hydrogen uses by setting clear strategies, leading public education campaigns and carrying out consumer perception studies to better understand levels of community concern. Fortescue Future Industries suggested that benefit-sharing arrangements need to be a central part of hydrogen deployment, either directly through **community participation** in projects, or indirectly through **compensation or recognition**. One example given was to lower electricity prices for communities directly impacted by the resulting infrastructure required to support hydrogen production, such as electricity transmission lines.

Submitters who were generally less supportive of hydrogen deployment considered that communities would object to refuelling stations or production/storage facilities, due to **safety concerns** around high storage pressures, explosion risk and flammability. There were also concerns about potential wider **social, economic and environmental effects** on communities that would affect public support. This included affordability challenges from increased electricity prices for other users due to hydrogen production, the environmental effects of water intake requirements and water discharge.

Annex One

LIST OF SUBMITTER GROUPS AND ORGANISATIONS[2]

Air New Zealand*	Major Gas Users Group
Arup	Manawatu District Council
Auckland Transport	Mercury
Ballance Agrinutrients	Meridian Energy
BECA	Mitsui
BECA Practitioners*	Murihiku Regeneration
Bluefloat	National Energy Research Institute
BOC New Zealand & BOC Pacific Islands	New Zealand Green Building Council
BusinessNZ Energy Council	New Zealand Hydrogen Council
Carbon and Energy Professionals New Zealand	New Zealand Steel
Certified energy	New Zealand Wine
Clarus*	Ngā iwi o Taranaki
Climate Justice Taranaki	NZ Post
Coal Action Network Aotearoa Incorporated	OMV
Dunedin City Council*	Parkwind Incorporated
Energy Resources Aotearoa	Public Service Association
Environment and Conservation Organisations of New Zealand Ltd	Taranaki Energy Watch
Fortescue Future Industries	Taranaki Mayoral Forum
Genesis Energy*	Taranaki Offshore Partnership
GNS Science*	Te Rūnanga o Ngāti Mutunga
GoEco*	Te Waka*
Hiringa Energy	Toitu Envirocare
Horticulture NZ	Transpower
How Energy	Tūaropaki Trust/Halcyon Energy
HW Richardson	University of Auckland
Hyundai New Zealand	Venture Taranaki
Independent Electricity Generators Association	Waikato Tainui Energy Transition
Infrastructure New Zealand	West Coast Regional Council
Jannik Haas et al.	Western Bay of Plenty District Council*
Kakariki*	Z Energy
Komanawa Solutions Ltd	

*These organisations submitted separately to the overarching Advancing New Zealand's Energy Transition document, rather than directly to the Interim Roadmap. However, these submissions may either include commentary on the Interim Roadmap, or discuss some of the core issues raised and have been counted as submissions.

[2] Private individuals have not been named

Annex Two

INTERIM HYDROGEN ROADMAP PUBLIC CONSULTATION DISCUSSION QUESTIONS

Question number	Discussion Question
1	Are there other issues we should be considering in our assessment of the strategic landscape for hydrogen in New Zealand?
2	Do you agree with our assessment of the most viable use cases of hydrogen in New Zealand's energy transition?
3	Do you support some of these uses more than others?
4	What other factors should we be considering when assessing the right roles for hydrogen in New Zealand's energy transition?
5	Do you agree with this assessment of the potential for hydrogen supply and demand in New Zealand?
6	Do you agree with the key factors we have set out that are likely to determine how hydrogen deployment could play out?
7	What do you think needs to happen to address these factors?
8	Do you have any evidence to help us build a clearer picture?
9	Do you agree with our findings on the potential for hydrogen to contribute to New Zealand's emissions reduction, energy security and resilience and economic outcomes?
10	Do you have any insights we should consider on what is needed to make hydrogen commercially viable?
11	Is there any further evidence you think we should be considering?
12	Do you agree with our policy objectives?
13	Do you agree with our positioning on hydrogen's renewable electricity impacts and export sector?
14	Do you agree with the proposed actions and considerations we have made under each focus area?
15	Is there any evidence we should be considering to better target actions in the final Hydrogen Roadmap?

Te Kāwanatanga o Aotearoa
New Zealand Government