



BRIEFING

Update on hydrogen policy developments – January 2020

Date:	20 February 2020	Priority:	High
Security classification:	In Confidence	Tracking number:	2167 19-20

Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	<p>Note the updates to hydrogen policy developments outlined in this briefing.</p> <p>Agree to MBIE publishing the Hydrogen Vision submission analysis.</p>	28 February 2020

Contact for telephone discussion (if required)			
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Minister's office to complete:

- | | |
|---|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Declined |
| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments



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Purpose

This briefing provides an update on the state of play with the hydrogen policy work that the Ministry of Business, Innovation and Employment (MBIE) is engaged in, and seeks your agreement to publish the analysis on the submissions received on the green paper – *A vision for hydrogen in New Zealand*.

Recommended action

The Ministry of Business, Innovation and Employment (MBIE) recommends that you:

a **Note** the updates to hydrogen policy developments outlined in this briefing.

Noted

b **Agree** to MBIE publishing the Hydrogen Vision submission analysis.

Agree / Disagree

Justine Cannon
Manager, Energy Markets Policy
Building, Resources and Markets, MBIE

20 / 2 / 2020

Hon Dr Megan Woods
Minister of Energy and Resources

..... / /

Hydrogen Work Underway

Hydrogen Vision Submissions

1. The green paper – *A vision for hydrogen in New Zealand* - (the Vision) was launched on 2 September 2019. The Green Paper looked at the scope of New Zealand's hydrogen potential to frame discussions for a national strategy.
2. Consultation for the Vision ended on 25 October 2019. We received 79 submissions from the public, industry, research institutions, local government agencies, and private sector organisations. MBIE has published the submissions received on the Vision on its website.
3. In general, the majority of submissions supported the Vision. As would be expected, there was strong support from parties already engaged, in one form or another, in the hydrogen industry.
4. A common theme among those working already in the hydrogen area was that government financial support is required to advance investment and achieve economies of scale. The contrary argument from those who supported hydrogen, but not government investment is that the role of government should be limited to removing regulatory barriers and that the market should decide on technologies viability.
5. A majority submitters supported green hydrogen, particularly those who valued its potential for emissions reduction. However, a number of submitters argued strongly for fossil fuel based hydrogen as a transition fuel, especially if CCS is utilised.
6. This view was balanced though by other submitters, who argued that adoption of fossil fuel based hydrogen must be avoided as it will prolong emissions and support for the fossil fuel industry, which they believe should end. In addition, a number of submitters rejected CCS as being unsafe and unproven while others asserted the opposite.
7. Some submitters argued strongly against the use of any form of hydrogen, as they claim its production is inefficient relative to the direct use of electricity. A number of submitters argued that emphasis and support for hydrogen should be shifted to other renewable options such as marine energy, bioenergy or compressed air.
8. Safety was a concern of many submitters. A common observation was the need to ensure standards and regulatory control of hydrogen production, storage, and transport are sufficient and to ensure public safety. Some submitters however claimed that hydrogen is in their view so dangerous that it should never be deployed in New Zealand.
9. MBIE has prepared a summary of submissions, from which the above comments are drawn. With your agreement, we propose to publish this summary on our web page. A copy of this analysis is attached as Annex Two.
10. The pertinent comments and recommendations from submissions will form part of the advice when the roadmap or strategy is developed later this year.

Hydrogen Roadmap or Strategy

11. The next stage of work after the Vision is the development of a hydrogen roadmap or strategy.
12. Both MBIE and stakeholders have been using the words roadmap and strategy interchangeably, as do many international documents.
13. We will work with you to find a suitable title for the document when we establish its scope, noting that a roadmap often contains more concrete steps to reach a specific goal than a strategy does.

14. Budget funding has been sought to develop the roadmap or strategy in the 2020/21 budget. If this funding is obtained MBIE will seek consultants in mid-2020 to assist with this work.
15. MBIE has yet to develop the scope and implementation process for this work. However, we expect to follow a similar process as the Vision, which produced a well-received and respected document.
16. This would likely involve a joint working arrangement between MBIE and one or more consultants, with peer review of draft work by a stakeholder group, and consultation on draft work through a wider stakeholder/public/iwi group as required.
17. In preparation for this project, MBIE currently has a tender out for modelling work on hydrogen.
18. The purpose of this tender is to address a small number of numeric questions on New Zealand's hydrogen capability before June 2020, in order to provide information that will help inform the initial development of the hydrogen roadmap or strategy.
19. The final scope of the questions to be addressed will be agreed with contractors when the tender is awarded. However, in this work, we hope to address such questions as, what volume of hydrogen can be produced in New Zealand and what effect this may have on the electricity market and prices.

Association of East Asian Nations (ASEAN) Hydrogen Working Group

20. New Zealand was invited late last year to join a working group on the supply and demand of hydrogen in ASEAN nations. The group has produced a study entitled "Demand and Supply Potential of Hydrogen Energy in East Asia - Phase 1".
21. This work and attendance at meetings is jointly funded by ASEAN and the Institute of Energy Economics Japan (IEEJ).
22. MBIE Energy and Resource Markets has not traditionally engaged with ASEAN over energy issues, except for visiting delegations from ASEAN members. However, ASEAN countries are important trade partners for New Zealand and New Zealand established a dedicated ambassador to ASEAN in Jakarta in 2014.
23. MBIE attended the inaugural working group meeting in Jakarta in mid-December, where the first phase of ASEAN's hydrogen study was presented. This phase analysed potential hydrogen supply from exporting countries such as Australia, Indonesia and New Zealand, and demand from importing countries such as South Korea and Japan. It also contained an analysis of hydrogen use in countries that are likely to satisfy demand internally, such as Vietnam and Laos.

6(a)

27. Given the alignment between this ASEAN work, the export aspect of our hydrogen roadmap/strategy and the work being undertaken by the Clean Energy Ministerial (CEM) hydrogen initiative (described later), MBIE will assess attending future ASEAN hydrogen working groups.

APEC 2021 and green hydrogen initiative

28. New Zealand is the host of APEC 2021.
29. Within the theme of “inclusive and sustainable growth”, the Minister for Trade and Export Growth has identified cooperation on hydrogen supply chains as a potential fruitful area for cooperation within APEC. To facilitate APEC 2021 discussion on hydrogen, the Ministry of Foreign Affairs and Trade (MFAT) proposes that New Zealand undertakes an APEC project on this topic and bids for APEC funding for this project.
30. MBIE and MFAT officials identified that a project on green hydrogen certification, standards or guidelines would be of strategic interest to New Zealand.
31. MFAT has provided MBIE \$50,000 funding for an initial scoping work on a green hydrogen project that will consider the value of green hydrogen certification in the APEC region. MBIE is currently tendering for a consultant to carry out this work.
32. Budget funding has been sought in the 2020/21 budget for the full APEC green hydrogen certification project. If this money does not become available, then alternatively funds will be sought through APEC’s funding application process in mid-2020.

Clean Energy Ministerial and its Hydrogen Initiative

33. The PRE or preparatory meeting of the CEM was held in Riyadh in the first week of February 2020. The purpose of this meeting was for senior officials from member countries to firm up the agenda and topics for the June CEM meeting to be held in Chile this year.
34. MBIE did not attend this PRE meeting and instead discussed our position over relevant issues with the CEM secretariat by phone.
35. One of the issues that the CEM secretariat asked New Zealand to confirm was an indication on which parts of the Hydrogen initiative workplan New Zealand could contribute to:
36. A copy of the initiatives from the draft hydrogen workplan is attached as Annex One.
37. After reviewing CEMs proposed hydrogen program, we tentatively indicated that New Zealand could engage in the following areas:
 - Activity 3 – Global aspirational goals for hydrogen by providing information on New Zealand hydrogen aspirations, goals and long-term plans
 - Activity 7 – Roundtable on North Sea collaboration and developing a new regional energy system backbone of electricity and hydrogen – CEM asked if we could participate in this event as a potential hydrogen exporter. We indicated that MBIE may be able to attend if roundtable is coincident with other planned MBIE travel
 - Activity 9– Launch of Biannual Hydrogen Report – New Zealand will provide information and peer reviewers if required, and
 - Activity 10 – Other projects, actions, webinars and workshops – New Zealand may be able to run a regional workshop on hydrogen in cooperation with APEC or ASEAN.
38. MBIE’s indication of New Zealand’s potential to take part in these CEM activities was tentative, as due to the CEM PRE meeting being the first week in February we had to provide an indication ahead of any discussion with you.

39. Involvement in the first three activities would largely be business as usual for MBIE. The later activity, of a regional workshop, would require significantly more work and we would suggest it only if a hydrogen project is undertaken for APEC21, as described above, where we can leverage off that project.
40. We have also confirmed with the CEM secretariat the steps that need to be undertaken for New Zealand to become a full member of CEM. Note you attended CEM last year as an observer.
41. The CEM secretariat will write with further details on what New Zealand needs to do to become a full member of CEM after it ratifies our application. Our understanding is that this will require a New Zealand Minister to endorse the CEM framework in writing and to confirm what activities and policies New Zealand intends to undertake that will help further CEM goals.
42. MBIE will work with the CEM secretariat to complete this process before the June CEM meeting so the New Zealand delegation can participate as a full member and sign its acceptance in a ceremony at CEM if necessary.
43. The CEM secretariat has provided a short report on the outcome of the PRE meeting in Riyadh.
44. The theme for CEM11 in Chile will be *“Driving action towards secure and sustainable energy”*, with four principles (Transform; Collaborate; Think Big; and Make Sense) to guide the overall design and outcomes of the meeting.
45. The CEM Ministerial will take place in Viña del Mar on 2-4 June 2020 in the Sheraton Miramar Hotel, a venue previously successfully used by Chile for international meetings.
46. The Chilean team is currently liaising with the President’s office in the hopes of having the Chilean President open the meeting.

Hydrogen Standards

47. Standards New Zealand is developing the New Zealand Hydrogen Standards Draft Framework and a Hydrogen Standards Implementation Strategy that sets out a proposed roadmap for the next three years to enable the integration of hydrogen as an alternative fuel source within New Zealand’s energy landscape.
48. MBIE is participating in this work and its associated forums, the first of which was held on 17 December 2019. This forum was well attended by stakeholders in hydrogen development.
49. We are also liaising with Hiringa and Ports of Auckland who have committed to providing us with information on the regulatory barriers their projects have faced.
50. This work will provide an input into the hydrogen roadmap when it is commissioned.

Next steps

51. Subject to your agreement, we will publish the analysis of the submissions on the Hydrogen Vision on MBIE’s website.
52. MBIE will work the CEM secretariat to complete the steps required to confirm New Zealand as a full member of CEM.

Annexes

Annex One: Draft CEM hydrogen workplan

Annex Two: Draft hydrogen vision submission analysis

Annex One: Draft CEM hydrogen workplan

1. The items below are taken from the draft CEM hydrogen workplan. The response provided by MBIE to potential New Zealand interest to each activity is indented.

Activity 1 - Establishing CEM H2I in the international hydrogen landscape

2. The IEA, as the Coordinator of the H2I, will collaborate with other international initiatives to improve the overall coordination of activities in the international hydrogen landscape. That dialogue will involve HEM, IPHE, MI, Hydrogen TCP and the Hydrogen Council. This activity includes ensuring H2I's complementarity to other initiatives and answer how the H2I could work as a platform to help leveraging other initiatives work. The IEA will report back to the Advisory Group regularly on these coordination activities and before June 2020 on how the H2I can become a cornerstone of global hydrogen activity.
 - a. MBIE did not indicate any potential for New Zealand involvement in this issue.

Activity 2 - Developing a web presence

3. The IEA, as the Coordinator of the H2I, will develop a website with relevant information on hydrogen deployment and activities undertaken by H2I. The IEA will keep the Advisory Group informed about the progress of the website. At the December 2019 Advisory Group meeting IEA can present its proposed design and timelines to launch.
 - a. MBIE did not indicate any potential for New Zealand involvement in this issue.

Activity 3 – Global aspirational goals for hydrogen

4. H2I member [to be decided] will lead the work on preparing a survey of all existing country goals/targets and other approaches to integrate hydrogen in long-term plans. The analysis includes an assessment of the potential for clean hydrogen production; and specific end-use sectors such as transportation and industry. This assessment will be the foundation for a possible first voluntary H2I Campaign (presented below). This work builds on results of the Hydrogen Energy Ministerial in Japan on 25 September 2019.
5. H2I member [to be decided] will lead the development of a CEM Campaign that delivers the ambition expressed at the Hydrogen Energy Ministerial in Japan on global aspirational goals for hydrogen. These goals are aimed to help incentivising and mobilising the private sector and investment community. Participation in the Campaign is non-mandatory and H2I members may select other approaches to integrate hydrogen in long-term plans. Under the campaign, countries will be encouraged to highlight ongoing and intended actions, including development of national or regional roadmaps and/or strategies. The Campaign will help the understanding of the global potential for hydrogen to contribute to clean energy and low carbon economy objectives. The CEM campaign will be discussed at the first Advisory Group with a view to launching it at CEM 11 or HEM in 2020 (TBC). A strong public/ private strategic partnerships will be essential for determining and realizing these objective/targets.
 - a. MBIE indicated that New Zealand is happy to participate in the campaign by updating on local hydrogen projects and its roadmap and to provide updates on any work it may commit to on hydrogen as the host of APEC2021
 - b. MBIE indicated that New Zealand is happy to take part in survey. NZ suggests coordination with ASEAN be added which has formed a working group on hydrogen supply and demand in ASEAN region.

Activity 4– Launch of Twin City Program

6. H2I member [to be decided] will lead on developing the Twin Cities program under H2I. The program will identify and showcase cities and communities that are well positioned to become global leaders on clean hydrogen. A draft program proposal can be

presented/discussed at the next H2I Advisory Group meeting with the aim to inform other CEM members at the CEM11 preparatory meeting in February 2020. If approved, the program could be formally launched at CEM11 in June 2020, or alternatively at HEM 2020.

- a. MBIE did not indicate any potential for New Zealand involvement in this issue.

Activity 5 - Hydrogen to Fuel

7. The European Commission (tbc) will identify and launch a project focusing on a selected energy intensive industry that is interested to develop a pathway for using clean Hydrogen in the energy transition, and that would support scaling up clean hydrogen production and use across many H2I members.

- a. MBIE did not indicate any potential for New Zealand involvement in this issue.

Activity 6 – Strategic Project Canada-Brazil Bus Deployment

8. Canada and Brazil will work together on a large-scale bus deployment project, where fuel cell buses would be deployed to fully meet the transit needs of a smaller Brazilian Municipality.

- a. MBIE did not indicate any potential for New Zealand involvement in this issue.

Activity 7 – Roundtable on North Sea collaboration and developing a new regional energy system backbone of electricity and hydrogen

9. The Netherlands will lead the preparations of a regional workshop with governments and key stakeholders around the North Sea to explore the potential of developing a liquid regional hydrogen market. The workshop will discuss the potential benefits of cooperation in implementing existing plans, with a view of scaling up faster and accelerating the reduction of the cost of clean hydrogen by joint investment projects in the next 10 years.

- a. MBIE indicated that New Zealand depending on timing and staff availability NZ may be able to attend if we have suitable staff in Europe around this time for other purposes.

Activity 8 – Webinar on linkage between Hydrogen and Nuclear

10. Canada will lead the preparation of a webinar focused on the linkages between large-scale clean hydrogen production and nuclear energy/ processes. This webinar will be developed and presented in collaboration with the Nuclear Innovation: Clean Energy Future initiative, under the Clean Energy Ministerial (NICE-Future).

- a. MBIE did not indicate any potential for New Zealand involvement in this issue.

Activity 9– Launch of Biannual Hydrogen Report

11. The IEA, as the Coordinator of the H2I, will on a biannual basis present insights to H2I members on global hydrogen deployment. The work will build upon IEA's Future of Hydrogen report launch in June 2019. H2I members will contribute toward compiling latest data on global development and deployment, and highlight upcoming projects and joint initiatives. The report will also summarize progress on technological developments and the work of H2I and feature next-steps and key achievements. The IEA will keep the Advisory Group updated on a regular basis.

- a. MBIE indicated that New Zealand will contribute as required, and provide peer reviewers if needed.

Activity 10 – Other projects, actions, webinars and workshops

12. Member countries can propose ideas and concepts for new projects, webinars, activities and workshops, for consideration at anytime, on and as needed/ required basis, to further advance the objectives of the Initiative.
 - a. MBIE indicated that New Zealand could consider a regional workshop, depending on how joint work on hydrogen with ASEAN and APEC countries develops. We would seek to do this in partnership with one or more of our APEC or ASEAN partners.

Annex Two: Draft hydrogen vision submission analysis

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Summary

A total of 79 submissions from the public, industry, research institutions, local government agencies, and private sector organisations. 44 of the submissions were from organisations, the rest were from individuals.

In general, the majority of submissions support the government's hydrogen vision (The Vision). As would be expected, there was strong support from parties already engaged, in one form or another, in the hydrogen industry.

A majority of submitters supported green hydrogen, particularly those who valued its potential for emissions reduction. However, a number of submitters argued strongly for fossil fuel based hydrogen as a transition fuel, especially if CCS is utilised. This view was balanced though by other submitters who argued that adoption of fossil fuel based hydrogen must be avoided as it will prolong emissions and support for the fossil fuel industry, which they believe should end. In addition, a number of submitters rejected CCS as being unsafe and unproven while others asserted the opposite.

A number of submitters were supportive of hydrogen but only if the economic case is proven. This sentiment was expressed in the following from the Major Electricity Users Group (MEUG):

we do not assume that hydrogen is necessarily complementary with electricity unless it is demonstrated that it is an economically efficient alternative to other solutions and technologies that achieve the same broader public policy outcomes. E.g. on H2 competitiveness with increased electrification (e.g. EVs, electric process heat, residential/commercial heat pumps) (MEUG)

Some submitters argued strongly against the use of any form of hydrogen, as they claim its production is inefficient relative to the direct use of electricity. A number of submitters argued that

emphasis and support for hydrogen should be shifted to other renewable options such as marine energy, bioenergy or compressed air.

Some common arguments against the hydrogen included:

- a. other technologies should be pursued instead e.g. bio-fuels, tidal, compressed air
- b. hydrogen is uneconomic, energy inefficient and a waste of energy
- c. the technology is immature and we should not commit to it
- d. hydrogen is a serious safety public risk, the safety aspects cannot be mitigated and the public will never accept it
- e. New Zealand should concentrate on electrification and cannot afford a new or parallel refuelling infrastructure, and
- f. The vision contained a low level of detail compared to the Australian roadmap and did not provide a clear path and direction forward.

Some submitters claimed hydrogen is a scam because of recent advertisements that fish can swim in Fuel Cell Vehicle (FCV) exhaust, while others argued it is a scam promoted by the fossil fuel industry to prolong the use of coal using Carbon Capture and Storage (CCS) and gas for steam methane reforming of hydrogen.

CCS doesn't work. Any claims that it is 'almost ready' ought to be ignored since such claims are common among techs that are so tantalising. They've been saying the same about fusion for decades. (Kieran Martin)

Some submitters were opposed to the need for a Vision:

why is the government asking the general public these things? Is it a test to see if the vision document caused a vision in the general reader? (Susan Krumdieck)

A common theme among those working already in the hydrogen area was that government financial support is required to advance investment and achieve economies of scale. The contrary argument from those who supported hydrogen, but not government investment is that the role of government should be limited to removing regulatory barriers and that the market should decide on technologies viability.

Several submitters acknowledged the energy loss in hydrogen production but argued that despite this disadvantage hydrogen has certain attractions in niche areas:

- as a long distance and 24/7 transport fuel, and
- as a local store to compliment renewable electricity.

A number of submitters commented on the potential for distributed and longer-term hydrogen storage to improve resilience, and with scale reduce fossil fuel imports. Some argued there is a national defence or resilience aspect such that in the event of a break down in international trade, or competition for resources, New Zealand would not be wholly reliant on Lithium and other components of Battery Electric vehicles if we have access to hydrogen. The argument presented here was that we can produce hydrogen as a transport fuel from local resources improving our reliance.

Some recognised the potential for hydrogen to assist in process heat, but there was a strong argument from many submitters that the direct use of electricity would be more efficient.

Safety was a concern of many submitters. A common observation was the need to ensure standards and regulatory control of hydrogen production, storage and transport are sufficient and to ensure public safety. Some submitters however claimed that hydrogen is in their view so dangerous that it should never be deployed in New Zealand. Other submitters noted that many fossil fuels have similar safety issues and concerns, and several submitters observed that fuels such as LPG, petrol and diesel, if introduced today, would face significant safety acceptance issues. Several submitters identified the need for public education over hydrogen's role and safety.

The role for hydrogen export from New Zealand received mixed support. Some submitters argued that exports would improve the economy of scale for hydrogen development in New Zealand by providing access to technology that may otherwise prove more difficult or costly to obtain. A lesser number identified that helping other countries reduce emissions will have a net overall benefit for New Zealand by helping reduce global emissions. A few submitters argued against hydrogen export either because; they believe it would take valuable water from New Zealand and/or it would have a detrimental effect on future electricity prices in New Zealand.

A number of submitters raised the issue of water use in hydrogen production, its environmental effects, and any potential interaction with Maori/Iwi rights and values as a concern. Several stressed the paramount importance of meaningful engagement with Maori/Iwi on this issue going forward.

The role of submissions

The main purpose of the submissions is to provide additional information and knowledge for the policy development process; either by supporting or reinforcing ideas expressed in the Vision document, or by exposing issues that have been neglected, overlooked, under-analysed or expressed wrongly or poorly.

The next stage of the hydrogen strategy is the development of a roadmap or strategy. The key findings and observations from the submissions to the Vision will be used in shaping the work that the roadmap will undertake.

Approach to submissions analysis and expert status

As the summary indicates, in analysing the submissions on the hydrogen vision, it became apparent that some submitters hold strong views either for, or against, the development of hydrogen in the New Zealand economy. Some arguments raised in support or against hydrogen were countered by opposite arguments from other submitters. In addition, some submitters claimed 'expert' status in all or part of their submissions, while with others an 'expert' status could be inferred on the basis of their current position and experience. No attempt in this analysis has been made to categorise submissions as having a greater lesser value depending on their claimed or inferred expert status or otherwise.

The following sections outline the issues addressed by submitters in more detail. Where quotations have been used they are attributed to organisations where possible, rather than to individuals. Given the number of submissions, this document does not incorporate quotations from every submission, but does endeavour to capture the broad intent of all submissions.

Government Role

Of those who support the Vision a large number requested further government direction through a roadmap or strategy, involving advisory or expert groups as appropriate. Several submitters claimed that government's role was simply to ensure that there were no regulatory barriers and not to back any one technology. Submitters opposed to hydrogen development, supporters of alternative fuels and others argued that either no government support should be given for hydrogen development or that hydrogen development is a decision that should be left to the private sector; the government should not pick winners.

The role of government should be to remove barriers to the uptake of hydrogen to make the energy sector "hydrogen ready" (MEUG)

Some submitters called for active government support in order to overcome scale economy issues and to enable the development and deployment of a new technology to enable a sustainable hydrogen economy to be achieved.

Some submitters argued the government should prioritise funding and regulatory support for demonstration projects, noting that the Provincial Growth Fund (PGF) does not fund activities in main centres which is where the best scale for initial hydrogen development may be found (in particular Auckland as a major freight and transport economy).

New applications for hydrogen stand at the riskiest point of the deployment curve and require significant investment. Investment risk mitigation should be a priority consideration for the Government. The most effective investment risk mitigation to deliver the hydrogen vision is the provision of Government incentives and grants. This will ensure that this important technology is deployed and that New Zealand is able to be regionally competitive in the development of the hydrogen industry. It might also include other financial tools such as loans and risk guarantee. (Ports of Auckland).

Support for active government intervention was not confined to only supporters of green hydrogen,

Given the high cost of hydrogen production acting as a barrier to development and usage, BP believes the fastest way to drive production and uptake is for the government to create a pathway by supporting of all types of hydrogen production, i.e. brown, blue, grey and green. Once scale is achieved, subsequent transition to green hydrogen could be facilitated through policy development around carbon capture, use and storage (CCUS). (BP New Zealand)

Some submitters made the point that climate mitigation strategies requires early investment and active government support for hydrogen, largely because the private sector may or will not act fast enough. That is, in their view the economic approach that created the problem will not necessarily provide the solution to transition the New Zealand economy away from fossil fuel dependence without some form of intervention.

... in terms of transitioning the New Zealand economy away from fossil fuel dependence in a timely fashion we cannot expect the same economic approach that has created the problems of deteriorating ecological sustainability to provide a solution. (If it did, it would have already occurred). The current liberalised economic framework is the barrier to rational and timely action being taken.

The role of the State is to ensure that public welfare is maximised over the long term. If private sector investment is avoided because public benefits (or costs) are not accounted for in the investment accounting, then public welfare is likely to sub-optimal. (Arete Consulting Ltd).

Some submitters claimed the vision lacked a clear desired direction or roadmap for hydrogen's development in New Zealand. We note, the vision was intended as an education document for stakeholders and the public to set out the opportunities, and challenges, for hydrogen in the New Zealand economy. Although the Vision does endorse green hydrogen from renewable energy as the preferred approach, a work programme that will develop a roadmap or pathway for hydrogens development in New Zealand will follow the vision.

the Government needs to commission a national roadmap for the country-wide implementation of hydrogen infrastructure and technologies - with the same level of detail as the Australian National Hydrogen Roadmap (Levi Farnum)

Some argued that greater cross reference and coordination should have been undertaken with the Australian 2018 hydrogen roadmap, claiming that suppliers will take an Oceania view, therefore in these submitters view New Zealand needs to closely follow what Australia does, as it is the larger market.

One submitter called for a restructuring of government departments to ensure better clarity around hydrogen's development. This submission argued that the existing separately governed electricity and fossil fuel infrastructures are likely a substantial barrier to the development of a complementary role for hydrogen; calling for the for consideration to be given to combining the energy jurisdictions of the various government agencies (e.g. MBIE, EA, NZTA) into one entity, i.e. a Ministry of Energy.

Safety

Many submitters commented on the importance of addressing hydrogen safety and risk.

Safety concerns must be the first priority (Carbon Neutral New Zealand Trust)

While only a few made reference to the Hindenburg airship disaster of the late 1930's, several raised the recent accident in a Norwegian hydrogen refuelling station, with some citing this as a reason not to proceed with hydrogen.

.. in June 2019 a car Hydrogen refuelling station exploded in Sandvika, Norway which prompted Toyota and Hyundai to freeze sales of its hydrogen fuel cell vehicles (WSP)

One submitter claimed the high pressure of FCEV tanks posed an unacceptable public safety risk.

A number of submitters acknowledged hydrogen safety issues but then observed that other liquid and gaseous fuels also have associated safety risks, which are accepted and managed. Several submitters noted that if fuels such as LPG, petrol or diesel were to be introduced today, their explosive and flammability concerns would raise a similar or greater public concerns as hydrogen may do. This observation was not to diminish genuine concerns about hydrogens safety, only to note that all fuels, even batteries, can be dangerous if misused.

The general theme of submissions on safety was that hydrogen safety issues exist but can be managed, and that public education and understanding is important.

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

Based on the experience of other countries, once hydrogen is being used safely in a public manner e.g. public buses with "hydrogen powered" on the side of them (as in Aberdeen and other cities), then hydrogen becomes quickly accepted. (Venture Taranaki)

Although as one submitter noted, there are some problems that may be difficult to resolve:

Hydrogen vehicles in tunnels is a thorny issue, discussed at length at the recent International Conference for Hydrogen Safety. Capture of escaped hydrogen within a tunnel is a problem to be avoided (Gallagher Fuel Systems Limited)

Regulation and Standards

Several supporters of hydrogen noted the lack of a clear regulatory framework for hydrogen; raising issues about uncertainty with regulatory coverage, regulatory boundaries, consenting under the RMA and what standards are relevant. A National Environment Standard (NES) to cover hydrogen was recommended by some submitters that would facilitate consistent rules and guidelines for hydrogen use across different territorial authorities.

Auckland Council's recommendation, from our experience of processing a resource consent for a hydrogen plant, is for the Government to develop a National Environment Standard (refer to paragraph 28 in the attached submission) which outlines specific standards, rules and consenting triggers. Currently, it is difficult to understand how a hydrogen facility fits within the policies and definitions of the Auckland Unitary Plan, or how it might be managed as a potential hazard under the Resource Management Act. (Auckland Council, Auckland Transport and Watercare)

Other submitters highlighted other regulatory changes needed:

The development a hydrogen economy needs a regulatory framework that is specific to hydrogen. The Resource Management Act would require changes to allow hydrogen storage facilities to be developed; Electricity regulations and the Gas Act would need amending to support the complementarity of electricity and hydrogen – e.g. electricity regulations are largely centred on large rotating machines not solar farms, batteries or hydrogen fuel cells. (Refining NZ)

There was strong support, especially with submitters currently involved in fossil fuel industries, for government endorsement and a regulatory environment for blue or grey hydrogen and CCS or CCUIS. These submitters argued CCS is a mature and economic technology with many working

examples and should be endorsed and supported by government as it will be difficult, if not impossible under existing law.

CCS is, contrary to the apparent view in the Green Paper, already technically and financially viable. Large scale CCS is a reality today, with at least 18 large scale CCS facilities operating with five under construction and 20 in various stages of development. This includes the major CCS project at the Gorgon natural gas field in Western Australia.

We recommend that, to promote a level playing field, the Green Paper notes the regulatory barriers to CCS and recommends these be remedied. (PEPANZ)

Other submitters took a contrary view arguing that CCS is unproven and only green hydrogen should be supported, with some claiming that fossil fuel based hydrogen essentially prolongs the life of an industry they believe should close.

In relation to carbon capture, use and storage (CCUS) on which blue hydrogen relies for its justification, evidence overseas shows that it fails to effectively remove GHG and is largely a dissembling tactic used by fossil fuel companies to prolong their operations.

Research overseas and within our GNS indicates that CCUS is a risky, immature and as yet unreliable technology (Climate Justice Taranaki Inc.).

Many submitters stressed the importance of alignment with international hydrogen standards.

Alignment to international standards is crucial. Allied to that qualified inspectors and regulatory management. (Gallagher Fuel Systems Limited)

From supporters of green hydrogen there was strong support for certification internationally for a green hydrogen standard, to ensure hydrogen promotes a legitimate carbon reduction.

Lastly, Utilities Disputes commented that when hydrogen becomes a widespread consumer commodity it will be important that Utilities Disputes has jurisdiction.

Transport

Transport was one area where many submitters saw and supported the potential of hydrogen, noting in particular the emissions reduction that hydrogen may provide:

There is real potential for green hydrogen to make a significant contribution to reducing CO2 emissions from transport, and from industrial processes in energy intensive industries including refining (Refining NZ)

It is well acknowledged that hydrogen and HFC technology will be more suited to the heavy transport sector (John Hill)

Hydrogen has a high energy density and therefore is best suited to long-range, high payload and/or utilization applications like commercial logistics, heavy freight, buses, and material handling equipment (Hiringa Energy Ltd)

opportunity to convert New Zealand's heavy transport fleet to a hybrid model that uses both diesel and green hydrogen. This hybrid technology is being developed in the U.S. and elsewhere (e.g. Ulemco in the UK), and would prove a viable transition for heavy duty truck operators as it would require less capital than a full hydrogen model and provide additional range with a reduction in emissions (Refining NZ)

The BEC TIMES-NZ energy scenarios did not see hydrogen as an economic option for transport or industrial heat applications. However, we know from sensitivity analysis that the assumed purchase cost of hydrogen fuel-cell trucks only needs to drop by less than 5% for them to be preferable to electric trucks, (BECC)

However, several submitters noted the advantages and established position of EVs in the market over hydrogen vehicles:

There is already a battery electric technology solution developed and growing in this light passenger transport segment which challenges the feasibility of having hydrogen powered light passenger

vehicles. This also relates to light commercial vehicles, for example delivery vans, where there is increased availability of fit for purpose battery electric vans.

Hydrogen powered light passenger vehicles will potentially find it hard to compete in this vehicle market segment. (Ellen Cavanagh)

There is no rational argument for the promotion of hydrogen fuel cell light vehicles over light battery electric vehicles (BEV). (- Climate Justice Taranaki Inc.)

There may be a role for hydrogen fuel cell for heavy, long-haul freight, maritime transport or port and warehousing facilities. (Climate Justice Taranaki Inc.)

Several submitters stressed that the higher energy efficiency of electric vehicles argued against hydrogen vehicles now and in the future.

BEV solutions would not require same level of investment and are currently more energy and cost efficient, this may be competing technology (WSP)

Although others pointed out what they saw as some of the drawbacks of EVs relative to FEV:

Widespread deployment of FCEV's reduces New Zealand's reliance on importing and managing the disposal infrastructure, costs and obligations associated with hazardous end of life batteries (e.g. lithium ion) Current FCEV technology provides the equivalent range and convenience of diesel fuel for heavy vehicles and is therefore the logical zero emission replacement fuel if commercially viable.. (New Zealand Hydrogen Association)

The cost of the infrastructure required to enable fleet-wide implementation of fuel-cell vehicles is likely less than the cost of the infrastructure for fleet-wide implementation of battery-powered vehicles (Venture Taranaki Trust and New Plymouth District Council)

Some submitters argued that New Zealand cannot afford to adopt another transport fuel option

We already have a partly developed EV charging network so there is no point in having a hydrogen network that only delivers 30% of the electrical energy that you started with. I.e. just use the electricity directly ...

... it would be ridiculously expensive to add a third vehicle refuelling system alongside petrol/diesel and EV chargers. (Scott Rabone Individual submitter - mechanical engineer)

Some submitters went further and opposed entirely the use of hydrogen for transport

The government should pass regulations against use of green hydrogen as a fuel for light vehicles. This is because it is wasteful of New Zealand renewable energy resources to have to have to support the inefficiencies of green hydrogen creation and conversion back to green electricity as created from fuel cells. Much less renewable generating capacity would need to be constructed if the electricity is used directly to charge EV batteries. (Earl Bardsley, University of Waikato)

Other submitters argued the government should take a more neutral stance, for example:

The government should stay neutral on policies that drive the uptake towards decarbonizing the transport sector. The rationale for this is that it is impossible to predict what the winners of tomorrow's technologies will be given that I believe the technologies of tomorrow have not yet been identified. (Rob Kirkpatrick)

Or alternatively that it should provide more direction

currently no national strategy with regards to how hydrogen should be used to contribute to the reduction of emission across the transport sector. Real Journeys Ltd

One submitter argued that rather than supporting hydrogen, the government should be seizing the opportunity to decrease the role of private motor vehicles instead of just shifting from one fuel to another.

it is nonsensical for New Zealand to switch its light vehicle fleet from fossil fuel to green hydrogen. The time is now for redesigning our cities, transport modes, highway networks and fuel supplies to new configurations not just shifting from one fuel to another. (Carbon Neutral New Zealand Trust)

Balancing these negative views, many submitters supported the idea that hydrogen from renewable electricity may be most economical and effective way to electrify certain parts of the transport sector, such as commercial and heavy freight, buses and material handling equipment.

Hydrogen is a real option to meet the needs of transport operators for certain use-cases, but it will take some time for cost-effective hydrogen fuelled vehicles to grow to material volume. (Z Energy)

And National Energy Research Institute (NERI) noted

Green Hydrogen is virtually unique in its ability to service high duty cycle industrial vehicles where emissions are an issue. (NERI)

Hiringa Energy Ltd, who is currently engaged in the commercial development of hydrogen transport infrastructure for heavy vehicles noted:

Hydrogen from renewable electricity is the most economical and effective way to electrify certain parts of the transport sector, such as commercial and heavy freight, buses and material handling equipment. (Hiringa)

The New Zealand Hydrogen Association (the Association) identified that it will take 25 years to turnover our existing internal combustion engine car fleet at the current new vehicle entry rate. In the Association's (and others) view this indicates the need for a regulatory framework that supports and speeds up the transition to a zero emission vehicles; using fiscal incentives and mechanisms targeted at such as emission limit on vehicle sales), carbon tax and fuel excise relief for zero emission fuels to incentivise new vehicle uptake.

Z Energy recommended the consideration of the Californian Low Carbon Fuel Standard as a way to promote and incentivises low carbon energy in transport, where the lower the carbon intensity of the fuel or energy source, the higher the incentive.

In a similar vein, Hiringa for example noted the potential for disincentive regulation;

For example preventing use of fossil fuel buses in public transit by 2025 in Europe has created a large market for zero emission alternatives that is driving greater uptake of FCEV solution. A similar program sends strong signals to operators and technology vendors that NZ committed changing its fleet make up. (Hiringa)

Such policies are not of course specific to the promotion of hydrogen and would equally benefit other low emissions technologies.

Lastly, several submitters noted that hydrogen low emissions vehicles do not enjoy the same incentives as battery electric vehicles in New Zealand, with some calling for this to change.

Hydrogen vehicles are not classified as EV's and as such, do not enjoy the same benefits designed to incentive use. (Refining NZ)

Auckland Council noted that hydrogen and electric vehicles both use an electric motor to propel the vehicle and therefore should therefore both be exempt from Road User Charges (RUC). However, the

Energy Innovation (Electric Vehicles and Other Matters) Amendment Act 2017, which in section 21 (2, b) talks about the definition for an heavy EV as one that derives "...motive power wholly or partly from an external source of electricity." (Auckland International Airport Ltd.)

In general those who argued for support for hydrogen vehicles argued for a change to RUC provisions to put hydrogen vehicles on the same footing as EVs.

Rail

Submitters were generally supportive of the potential for hydrogen in rail and marine systems.

the government owns Kiwi Rail and can certainly invest in hydrogen powered train engines and ferries (Pat Wall)

Venture Taranaki noted potential interlinkages between these applications commenting that a relatively modest level of infrastructure at ports would have potential to support use by both the rail and trucking industries.

The Carbon Neutral New Zealand Trust stated it believed that green hydrogen has a role to play in the rail and marine transport sectors.

Several submitters supported the consideration of hydrogen by KiwiRail, though one noted:

We understand that KiwiRail presented solutions for improving services in the Golden Triangle, with no consideration for Fuel Cell locomotives at that time. Perhaps this needs revisiting. (Gallagher Fuel Systems Limited)

KiwiRail commented it is committed to supporting New Zealand's goal of achieving a net carbon zero economy by 2050. KiwiRail however commented that in its view:

At present, the only viable zero-emissions technology for heavy freight rail is through electrification, which is worth considering on the heavily utilised routes of the North Island Main Trunk (NIMT) between Auckland and Wellington, and the East Coast Main Trunk (ECMT) between Auckland and Tauranga. The section of the NIMT between Hamilton and Palmerston North is already electrified. (KiwiRail)

Kiwirail stated that outside of these areas, it will move towards alternative zero-emissions propulsion systems as the technology and necessary infrastructure develops, where the final solutions are likely to be a mix of battery and hydrogen fuel-cell technology. However, KiwiRail also noted that in its view hydrogen freight locomotives are a long while off as

While the technology required to operate a freight locomotive is all theoretically in place and available, no-one has yet synthesised this into a viable product. Until this happens, it is difficult to forecast a timeframe for adoption of this technology in New Zealand. At present KiwiRail believes it likely to be beyond 2040 before we see a commercially available product that is relevant to our operating environment.

Marine

Hydrogen use in marine settings has a large potential for emissions reduction; both for ships at sea and for power supply when ships are stationary in port. NERI commented on this potential:

Emissions from New Zealand bunkered marine fuels come from international shipping (2/3rds), with coastal freight, the fishing fleet, and Cook Strait most of the remainder. Cruise liners/ferries where emissions and noise are an issue could eventually move to all-electric systems using FCs with hydrogen carriers, and in the interim adopt lower emission auxiliary power. However, for most applications it is likely that alternative renewables e.g. drop-in bio-marine fuel oils will be cheaper.

One of the likely early uses of hydrogen in New Zealand is in continuous or 24/7 transport applications such as container cranes and forklifts. The Ports of Auckland project is an active example of this sort of development to deploy hydrogen technologies in port facilities.

Aviation

Some submitters noted the potential for hydrogen application at airports in similar manner as at ports in providing energy for airport transport operations that have similar continuous or 24/7 requirements. Other submitters noted that the application of hydrogen technologies within aircraft whether as motive power, or as fuel cell batteries is likely to be a long way off.

Refuelling infrastructure

Many submitters who commented on hydrogens potential, or otherwise, in transportation discussed the issues and concerns around refuelling infrastructure. These submitters recognised that lack of a refuelling infrastructure is a significant barrier to the deployment of FCEVs.

However, submitters response to this problem varied. Many opposed to hydrogen cited this lack and the advantage of EV's being able to be charged "anywhere" e.g. at home as reasons why hydrogen should not be supported. Others, argued the similarity between hydrogen and traditional petroleum refuelling meant that less infrastructure was needed to a hydrogen fleet, citing this as an advantage.

Refuelling stations to support the uptake of heavy transport switching to hydrogen present less of a problem compared to recharging infrastructure required to stimulate the mass uptake of EVs in the light vehicle fleet. The existing network of truck stops for traditional hydrocarbon refuelling could be extended to provide hydrogen refuelling at locations to support the use of hydrogen fuelled heavy transport. What will be needed for any investment to be made in the building of hydrogen refuelling stations is a strong signal from Government that the use of hydrogen within the road transport sector is not a short-lived policy that saw CNG come and go within a relatively short period of time. (Stephanie Gregor)

As noted above, heavy vehicle transport is one niche where hydrogen may be adopted earlier in New Zealand, and is the focus of many of the currently active hydrogen projects such as Hiringa. Some submitters noted that this focus on the commercial heavy vehicle market, rather than the general public and light vehicles, will at least initially, reduce the size of the infrastructure problem:

Refuelling networks and supporting infrastructure must be designed around the needs of the target end users. In BP's case, and in the establishment of the supply chain, we believe that hydrogen infrastructure is at first best targeted to commercial ecosystems for heavy transport, in both off road (marine and rail) and on road (long haul trucks, bus fleets) uses. (BP New Zealand)

A large network of refilling stations will not be required to start with, but a commercial model will take time to develop due to small scale operations to start the transition. On that basis, it may be beneficial to look at incentives and support to create a basic network of refuelling stations to get to some sort of scale. (BP New Zealand)

Given this initial concentration on commercial vehicles, there is unlikely to be the same imperative to create a nationwide and dense hydrogen refuelling network. This would by itself act to constrain the extent to which such vehicles may become attractive as light passenger vehicles, if they ever do. As Todd Corporation noted:

Given New Zealand's geography and population density, Todd does not consider it economic to invest in development of a sufficiently dense national re-fuelling network that would be required for hydrogen-fuelled light vehicles. (Todd Corporation)

Submitters also recognised the implications of hydrogen for training:

The service sector for hydrogen vehicles needs to also be considered, particularly around training and safety regulations. For example, training and apprenticeship programme, retrofitting or developing specialist hydrogen workshops, on-site fuelling procedures and HSNO regulations. (Z Energy)

Availability of suitable hydrogen vehicles

Several submitters noted access to suitable FCEVs was a limiting factor as well:

Another barrier for the roll-out of hydrogen is the availability of technology and infrastructure. For example, transport, where New Zealand's market size might limit access to heavy trucks (left-hand-drive). (BEC)

There is limited availability of buses and heavy-duty vehicles, with long lead times (one year to 18 months) for delivery to smaller and more distant markets such as New Zealand as larger orders may be prioritised over smaller orders. (BEC)

Auckland Transport's procurement of a hydrogen bus for its trial highlighted some of the challenges of procuring hydrogen vehicles. In particular it noted that:

Hydrogen buses currently available internationally are not built to suitable standards and set up for an Auckland context. They are designed for a UK context. (Auckland Council, Auckland Transport and Watercare)

Industrial use of hydrogen

Submitters were generally supportive of government developing hydrogens potential for industry,

Govt needs to lead production of a road map for industrial process uptake of green hydrogen (Alister Gardiner)

The role of Government in encouraging the use of hydrogen for industrial processes, including process heat supply (New Zealand Hydrogen Association)

Government support will be required for early projects that substitute existing fossil fuel feedstocks for industry, (Hiringa Energy Ltd)

predominantly green transport system will be an asset for tourism. Further, active promotion of the use of green hydrogen for rental vehicles and rental motor homes, widens this to the NZ tourist base. (Arnim Littek)

Some submitters in particular noted its ability to reduce the carbon footprint of some industrial processes:

green hydrogen is also a key ingredient for authentic biofuels (Refining NZ)

There is real potential for green hydrogen to make a significant contribution to reducing CO2 emissions from transport, and from industrial processes in energy intensive industries including refining (Refining NZ)

green hydrogen to offset ammonia imports and NG usage in fertiliser production. (Alister Gardiner)

(Swedish example:) Steel production with hydrogen instead of coal. The project is called Hydrogen Breakthrough Ironmaking Technology or "HYBRIT (Les Pepper)

biorefining appears likely to be a significant area of growth in New Zealand with implications for Green Hydrogen production (and other biofuels), and its use as a reducing agent.

Another area of potential growth for Green Hydrogen could be in synthetic fuels. (National Energy Research Institute)

Tiwai Point and Glenbrook, generate CO2 by using carbon to reduce their feedstocks. In the latter case hydrogen is being explored to replace the carbon as the reducing agent (National Energy Research Institute)

there may be opportunities for hydrogen production to decarbonise emissions-intensive processes, such as for ammonia/urea and steel production The key opportunity in New Zealand appears to be using green hydrogen as an industrial feedstock to replace hydrogen currently produced from natural gas. (Todd Corporation)

Some submitters recognised that hydrogen could create resource issues as well as benefits:

A potential challenge for industrial scale hydrogen is that electricity and water are required – both of which are key process inputs for Fonterra’s operations. Depending on the location of hydrogen processing plants, this could create resource competition for Fonterra, particularly in water constrained regions. (Fonterra Co-operative Group Limited)

However, some submitters noted, other technologies may provide a more versatile and efficient path than the use of hydrogen in some industrial processes:

the suggestion of expanding our renewable energy capacity to produce green hydrogen for ‘low-carbon oil refining’ or drying milk (without coal) for export borders on the farcical. On the latter, burning waste wood or producing biogas from farm wastes for heating and electricity are proven and much more economical than hydrogen. (BP New Zealand)

no point in using hydrogen for industrial processes in place of using electricity (Scott Rabone)

Hydrogen is unlikely to be economic for low temperature process heat (<100 ° C) applications due to round trip energy efficiency economics compared to electricity alternatives (Transpower)

The increasingly popular electric heat pumps and induction cook-tops are energy efficient and climate friendly when the electricity is generated from renewable sources. Hence, there is no reason or advantage to switch domestic heating or cooking from electric to hydrogen (20% concentration) supplied through existing gas network. (Climate Justice Taranaki Inc.)

Fonterra noted that while hydrogen may be interesting at this stage, technical limitations make it difficult to fit with their current business operations:

there are currently no technically feasible options for hydrogen tankers that would suit New Zealand conditions. (Fonterra Co-operative Group Limited)

compared to other low emission options. This makes it difficult to provide a useful assessment of the potential of hydrogen as a fuel for our tanker fleet. (Fonterra Co-operative Group Limited)

Additionally, our manufacturing sites are largely based in rural locations, so building and maintaining infrastructure for hydrogen re-fuelling could be costly. These factors will influence the technical feasibility and economics of hydrogen (Additionally, our manufacturing sites are largely based in rural locations, so building and maintaining infrastructure for hydrogen re-fuelling could be costly (Fonterra Co-operative Group Limited)

Several submitters supported the exploration of hydrogen in gas reticulation:

Using a blended reticulated gas network of 20 per cent hydrogen would be a way to reduce natural gas use while investing into research and development to identify viable, long-term solutions that are 100 per cent renewable. (Auckland Council, Auckland Transport and Watercare)

There are many new local polymer pipe based low pressure LPG distribution networks in the South Island and elsewhere which might be more amenable to hydrogen injection. It may be worthwhile undertaking a study and if feasible support pilot trials on LPG distribution networks in association with suitable green hydrogen production projects. (Alister Gardiner)

Acknowledging though limitations such as:

a need to replace our gas transmission network if the hydrogen concentration is to be above 20% (Bryan Leyland)

due to different burner properties and characteristics of the gases, only a modest level of enrichment may be practical without upgrading equipment and pipelines. (Gary Wilson)

Industries wanting to use green hydrogen for process heat would need confidence that their supply is reliable (Gary Wilson)

Hydrogen Export

Submitters recognised the future potential of an international hydrogen market:

By 2030, potential demand for imported hydrogen in the big Asian economies such as Japan, China and South Korea is expected to total nearly 4m tonnes (Gary Wilson)

Germany would have a strong interest in importing green hydrogen from New Zealand, showing a willingness to pay the additional cost of producing green, instead of brown or grey, hydrogen (Tina Schirr)

But the possibility of hydrogen export from New Zealand was another issue that divided submitters.

Some submitters argued against hydrogen exports because they believe it would be detrimental to New Zealand's interests; either by consuming excessive levels of renewable electricity, raising electricity prices (because the price being paid to all generation needed to meet demand for hydrogen production will drive up the price for consumers) or potentially strain fresh water resources.

Some submitters were strongly opposed to hydrogen exports, for example

Producing hydrogen for export makes absolutely no sense environmentally or economically when there are existing storage technologies that are cheap, proven and environmentally friendly. (Dr Stuart Jeanne Bramhall)

It is ludicrous to think that we can or should develop a hydrogen export commodity market with Japan or anywhere else. It makes no energy or economic sense, when we realise that we must ensure our own energy, water and food security, reduce our emissions to zero, stop overshooting the known planetary boundaries and have capacity to sustain not only our own populations but climate refugees (Climate Justice Taranaki Inc.)

Export cannot be even considered at this stage. You do have to learn to walk before you run. The technology is not available, the electricity is not available and hydrogen tankers do not exist. (Bryan Leyland)

The government should firstly look to New Zealand's requirements for transportation and industrial requirements before participating in international trading. (Evonik Peroxide Limited)

This is totally ridiculous. We don't have any surplus renewable electricity in the first place and exporting requires port facilities and ships with massive cryogenic vessels to handle liquid hydrogen. Think massive cost for no gain. (Scott Rabone)

Role of govt for export - None. If it was economical the private sector would do it. (Luke Schneider)

There is no certainty that we could produce green hydrogen at lower cost than competing brown hydrogen in a global hydrogen market, should such a market ever happen. If we wish to contribute toward global decarbonisation from our gas sales, it would be more

logical to seek to discover and develop major offshore gas fields, selling the gas to China for power generation there in place of coal. (Earl Bardsley)

Some submitters claimed that New Zealand is unlikely to be cost competitive for hydrogen exports:

NZ does not offer a natural competitive advantage to produce renewable hydrogen. There are better wind (e.g. Chile) and solar (e.g. Australia) resources elsewhere (Rob Kirkpatrick)

New Zealand's Green Hydrogen exports won't compete in markets where the margin for Green Hydrogen (renewable) over Blue (low emissions) is small. (National Energy Research Institute)

New Zealand's green hydrogen will also have to compete with countries where green hydrogen might be produced more cheaply, such as Australia and those closer to market (BEC Tina Schirr)

New Zealand may struggle to compete globally for the cost-effective production of hydrogen. Australia, South American and Middle Eastern countries may be able to produce hydrogen at lower costs due to lower cost renewable energy potential. There are already projects in these regions where the delivered energy cost is being struck at NZD\$25-45/MWh compared with costs of over \$60/MWh in New Zealand. New Zealand may only have a niche position as an exporter and it may therefore be more cost effective to import hydrogen for domestic needs (Transpower)

main challenge is New Zealand's cost competitiveness with other countries with green hydrogen supply strategies. The utilisation of solar power is currently the cheapest way to produce green hydrogen, and countries like Australia, Chile and the UAE have a natural advantage which means NZ could struggle to compete on cost. (Sheena Thomas)

However, other submitters recognised that hydrogen exports may bring scale to the development of infrastructure which could bring local benefits:

Recognizing that export of hydrogen can pay for New Zealand's hydrogen infrastructure build must be a key starting point (Gallagher Fuel Systems Limited)

A side benefit is that production at export scale would drive investment in renewable generation, and reduce the overall cost of hydrogen production in New Zealand. (Alister Gardiner)

Revenue generated from exporting hydrogen made from excess renewable energy may support the business case for increased and faster build of renewable electricity capacity in New Zealand, as it would allow greater utilisation of capital. (Fonterra Co-operative Group Limited)

Presently, there are a number of countries evaluating the role of future hydrogen imports to supplement their own limited renewable energy resources. New Zealand is only one possible source, and as some submitters observed may not be as cost competitive as other potential locations. Submitters were concerned that any goal to export does not affect local supply, or should give priority to local supply.

The paper states that exporting hydrogen is an aspirational goal and is based on New Zealand's abundant renewable resources. We believe the government has a key role in ensuring that this aspiration is balanced with the demands of the domestic energy market. Policy and infrastructure must be developed to support the growth of this market without sacrificing domestic energy sovereignty, security or price. (Fonterra Co-operative Group Limited)

There is no role for Government to ensure sufficient volume of hydrogen for export. The primary concern for Government is in ensuring domestic energy security consistent with also meeting international obligations to reduce net carbon emissions. (Major Gas Users Group)

Some submitters were concerned that international hydrogen prices could feedback into domestic prices:

should we begin exporting hydrogen we could face international market prices for hydrogen, and potential price volatility. (Fonterra Co-operative Group Limited)

Once green hydrogen is produced for export it becomes an international commodity. This will have flow-on effects on the local price of hydrogen. In turn this will impact on the potential local uses of hydrogen and on the local price of renewable electricity. (Venture Taranaki Trust and New Plymouth District Council)

a major challenge and risk is to ensure both hydrogen and indirectly, renewable electricity, are not priced to an international market at the disadvantage of domestic consumers. We note this occurred on the east coast of Australia in 2016 when the LNG market was developed for export. (Fonterra Co-operative Group Limited)

or that a balance is needed between local and international use

it is important that the Government regulates hydrogen stocks to ensure adequate capacity is maintained within New Zealand. (Auckland Council, Auckland Transport and Watercare)

there needs to be a balance between the use of hydrogen in NZ so that only excess production volumes are exported (Stephanie Gregor)

ensure New Zealand balances green hydrogen export opportunities alongside energy requirements for hydrogen use domestically (Rob Kirkpatrick)

May be in the "greater good" not to export energy since energy is wasted used in transport and may be more viable assist and support nations to building their own capabilities. (Les Pepper)

Should hydrogen exports develop, some submitters recognised the central role that government can play to help ensure its success:

Extend the 100% pure NZ brand to include Green NZ Hydrogen Help to develop a premium Green Hydrogen product to assist marketing this internationally (Les Pepper)

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

Support and facilitate government to government cooperation with potential hydrogen importing countries to advance hydrogen export opportunities and also with countries that are advancing hydrogen export technologies. (New Zealand Hydrogen Association)

Some submitters recognised that the value of hydrogen exports was also in global energy and emissions reduction, not just a local benefit:

The purpose of exporting green hydrogen, aside from the financial gains, is to address global greenhouse gas emissions. It is important to consider the entire lifecycle impacts of green hydrogen, (Auckland Council, Auckland Transport and Watercare)

New Zealand has the best wind resource in the world, but wind by nature is very unstable and difficult to store. If the energy can be harvested and converted to hydrogen products which can be shipped and exported to other countries such as pacific island countries, it will tighten the strength between the links to the people and culture and their economy growth. (Koru Consultants)

Overall, the general submitter view on exports is best summed up in the statement:

The role of Government is in being realistic about the benefits of exporting hydrogen. (Daniel Lister)

Security of Supply

Several submitters saw the value of hydrogen in improving our security of supply.

Distributed storage of hydrogen (both stationary and on board) provides an inherent and enhanced disaster and crisis ride-through capability greater than that currently available through the fossil fuel infrastructures. (Alister Gardiner)

For civil defence emergencies, a fuel cell locomotive can provide power in the event of longer term loss of electrical connections to outlying communities. Fuel cell powered ships/ferries can provide emergency power to towns and even cities (Gallagher Fuel Systems Limited)

Also by facilitating more renewable electricity development:

Green Hydrogen will accelerate the deployment of renewable generation and increase security of supply, enabling New Zealand to meet its ambitious climate targets without compromising the energy system. (Hiringa)

By facilitating greater decentralisation of energy production:

De-centralised power generation would be the best way to build a resilient energy network, paying a fair price to citizen-generators will increase the energy available to hydrogen generators. Especially in locations where networks were not designed for a high load from a hydrogen plant, the network of citizen-generators would ease the load. (Daniel Lister)

Government may need to fund and incentivise regions to manufacture hydrogen from electricity (electrolysis), gas (SMR) and coal (gasification) to allow regional microgrids (John Hill)

Some submitters saw how this use of hydrogen could be particularly advantageous in supporting disadvantaged and remote regions

disadvantaged regions present an opportunity for pop up microgrids and hydrogen production and storage to provide process heating at competitive prices and support regional economic development. (Arnim Littek)

Hydrogen could open up many more opportunities for groups and communities, especially in more remote areas of NZ, as Green Hydrogen can be produced locally (using geothermal and wind generation) and then stored and/or used for process heat for applications like glasshouses, timber drying and food processing etc. (Les Pepper)

Social license and water use

Several submitters commented on the need for water as a resource to create hydrogen:

One of the key challenges for creating high volumes of hydrogen for export will be to create a viable, scalable, cost-efficient way to break down seawater instead of requiring the masses of high quality fresh water. (Gallagher Fuel Systems Limited)

And also how this use of resources may create social license or acceptability levels, particularly if it involves exports

Large scale onshore and potentially offshore wind development will require public acceptance which may be challenging, especially if these resources were developed only for energy export. (Z Energy)

There is also a social licence challenge. There is the opportunity for international demand to drive significant investment in renewable energy generation. There may be local concern about the impacts of some forms of renewable generation e.g. the landscape impacts of additional wind generation. These concerns may be heightened if the electricity produced is being used for producing green hydrogen for export rather than for local supply. (Venture Taranaki Trust and New Plymouth District Council)

We express concern regarding the impacts on water, its usage and allocation for the generation of hydrogen. The Māori World view and Treaty of Waitangi is incorporated within the vision paper, however requires further consideration, specifically regarding the use and allocation of water. (Auckland Council, Auckland Transport and Watercare)

Maori Issues

The Vision attempted to outline how the renewable aspects of the use and concept of green hydrogen is broadly compatible with Maori values. Some submitters noted how hydrogens development may be of benefit to Maori.

Many Māori groups now have access to large capital funds which they could use to develop and partner with investors for Green Hydrogen production, storage and distribution network developments. (Les Pepper)

Development of hydrogen facilities on Iwi land using Iwi resources represents a real opportunity for young Māori to gain experience, education, and training in the technology and to directly participate in building NZ's energy future. (Les Pepper)

Hydrogen could open up many more opportunities for Māori groups and communities, especially in more remote areas of NZ. There are potential economic and social

opportunities for Māori businesses and investments in hydrogen, if the concerns outlined above (and within the Safety & Resilience section below) are adequately resolved and align with the Māori World view. (Auckland Council, Auckland Transport and Watercare)

Māori land trusts are involved in many renewable energy projects, particularly in the central North Island. These projects could link with hydrogen production. (Gary Wilson)

The introduction of hydrogen into Maori's life through pipeline transportation can effectively solve the problem of energy supply and increase the local employment rate to a certain extent (Koru Consultants)

The development of green hydrogen production in New Zealand provides a range of opportunities which Māori may choose to take advantage of. (Venture Taranaki Trust and New Plymouth District Council)

Opportunities to utilise Māori geothermal resources to produce green hydrogen for use in Iwi owned business enterprises and for potential export. (New Zealand Hydrogen Association)

Submitters commented on the importance of involving Maori in the development of this policy

Maori are incredibly important stakeholders in this decision on energy policy, especially as renewable energy takes over - they will be and should be leading this effort (John Gorman)

Maori are incredibly important stakeholders in this decision on energy policy, especially as renewable energy takes over - they will be and should be leading this effort (John Gorman)

However, some submitters did not feel the Vision went far enough, or did not represent Maori interest correctly:

This document does not illustrate a true partnership between Crown & Māori. In the next round (and especially the Renewable Energy Strategy) I hope to see a marked improvement in building meaningful, sustainable relationships. (Kingi Gilbert)

Think of Māori organisations and communities as being co-authors of the paper. I'm afraid that while tokenistic engagement practices are adopted we will continue to see the widening gap instead of bridging a transition to a new NZ. (Kingi Gilbert)

In reality the Crown has never honoured Te Tiriti o Waitangi properly and Māori has not had the ability to outright refuse oil and gas well drilling on their whenua. We do not see how hydrogen development would be different. How would it "assist whānau, hapū and iwi to thrive" rather than negatively impact them, (Climate Justice Taranaki Inc.)

The infographics used are offensive as they try to incorporate capitalist ideas into our traditions and tikanga that do not sit within the exploitative ideology of capitalism (Climate Justice Taranaki Inc.)



EVENT BRIEFING

Launch of the Hydrogen Green Paper – A vision for hydrogen in New Zealand

Date:	30 August 2019	Priority:	High
Security classification:	In Confidence	Tracking number:	BR 0681 19-20

Action sought		
	Action sought	Deadline
Hon Dr. Megan Woods Minister of Energy and Resources	Note the contents of this briefing.	30 August 2019

Contact for telephone discussion (if required)			
Name	Position	Telephone	1st contact
Justine Cannon	Manager, Energy Markets Policy	04 901 8597	9(2)(a) [Redacted] ✓
Mark Pickup	Principal Policy Advisor, Energy Markets Policy	04 474 2628	[Redacted]

The following departments/agencies have been consulted

Minister's office to complete:

- | | |
|---|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Declined |
| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments



EVENT BRIEFING

Launch of the Hydrogen Green Paper – A vision for hydrogen in New Zealand

Date:	30 August 2019	Priority:	High
Security classification:	In Confidence	Tracking number:	BR 0681 19-20

Purpose

You are launching the Hydrogen Green paper - *A vision for hydrogen in New Zealand* at 9 a.m. on Monday 2 September, in Function room, Level 2, The Beehive.

This briefing provides logistical details about the event. You have agreed to deliver a five minute speech at the event. A speech / talking points have been forwarded to your office separately.

Recommendations

The Ministry of Business, Innovation and Employment (MBIE) recommends that you:

- a **Note** the contents of this briefing.

Noted

Justine Cannon
Manager, Energy Markets Policy
Buildings, Resources and Markets,
MBIE

30/8/19

Hon Dr. Megan Woods
Minister of Energy and Resources

..... / /

Background

1. The Hydrogen Green paper - *A vision for hydrogen in New Zealand* is a part of the Government's renewable energy strategy work programme to achieve an affordable, secure and sustainable energy system
2. The vision has been developed by an external consultancy, Arup, working closely with MBIE officials and key stakeholders, including the members of the New Zealand Hydrogen Association.
3. Submissions on the vision will close on Friday 25 October.
4. MBIE will then use the feedback from the vision in developing a roadmap or strategy for hydrogen.

About the audience

5. The function room holds around 40 people.
6. We are expecting 30 to 50 people; depending on whether some organisations bring more than two representatives.

Risks and mitigations

7. No material risks are expected from this launch.
8. This is because the green paper does not contain specific policy decisions or targets, which could be open to challenge, as these aspects will be a part of subsequent work.
9. Instead, the paper sets out a vision for green hydrogen to help decarbonise parts of the New Zealand economy which will be hard to electrify.
10. The paper provides a view of the future and seeks opinions.

Logistics

11. The programme for the event is:

08.30am	Access to Level 2, The Beehive function room – press packs (<i>Copies of Green Paper and media release</i>) available
08.45am	Guests arrive Level 2, The Beehive. Refreshments for media/guests
08.50am	Ministerial groups arrives; 5-10 minute mingle
09.00am	You welcome everyone, acknowledge those in attendance and give a short speech to launch the Green Paper
09.05am	Dr Linda Wright, Hydrogen Association of NZ chief executive will give a short speech to welcome release of Green Paper
09.10am	Dr Ralph Sims speaks - to be confirmed
09.15am	Photo/media opportunity
09.30am	Official event closes

Communications / Media

12. Media, including those who specialise in energy matters have been invited.
13. A press release will be issued by your office.
14. MBIE will publish the paper on its website on the morning of Monday 2 September.
15. Arup will also release the paper in Europe on its website after it has been released in New Zealand.

Annexes

Annex One: Invitation List

Annex One: Invitation List

INVITE LIST

Crown invitees

Status

Ministers

All Ministers have been invited, however it is yet to be confirmed which Ministers will attend.

NZ Hydrogen Association

Dr Linda Wright CE NZ Hydrogen Association

Angela Ogier First Gas

Simon Calvert BOC

Jim Hinkley Victoria University

Shane Gowan Beca

Jace Carson Canterbury University

Alan Brent Victoria University

Michael Fulton Fulton Hogan

Andrew Clennett Hiringa

Alan Keogh Aurecon Group

Stephen Canny Venture Southland

ARUP

Dr Ralph Sims Reviewer of paper

Elizabeth Halstead

MBIE

Carolyn Tremain CE

Chris Bunny DCE, BRM

Phillippa Fox GM, ERM

Andy Hume Policy Director, ERM

Justine Cannon Manager, ERM

Mark Pickup Principal Policy Advisor

Suzannah Toulmin Principal Investment Advisor

Companies

Neal Barclay Meridian CE

Dennis Barnes Contact Energy CE

Marc England Genesis Energy CE

Fraser Whineray Mercury CE

James Stevenson Wallace EA CE

Andrew Caseley EECA CE

Catherine Thompson Contact

Louise Griffin Genesis

Nick Wilson Mercury

Keith Turner ICCC Adviser

John Carnegie Business NZ Energy Council

Stuart Marshall PowerCo

Andrew Kerr PowerCo

Mike Bennetts Z Energy CE

Alison Andrew Transpower CE

David Knight Transpower

David Prentice ICCC Chair

Simon Upton Parliamentary Commissioner for the Environment

Ralph Matthes MEUG

Adam Williams KiwiRail

Andrew Cooper GWRC

Ministry for Environment

Matt Smith

Ministry of Transport

Freddie Holmes

Dave Hadley

Treasury

Scott Russell

MFAT

Leon Grice

Nikki Taylor Cameron

Rachel Crump

Rodney Harris

Others

Kathy Errington Helen Clark Foundation

John Hancock

David Hunt Concept Consulting

Simon Coates

MEDIA

Press Gallery

Energy News Matt Ritchie - Editor

Business Desk Gavin Evans – Journalist/GM



BRIEFING

Cabinet paper – Release of the Green hydrogen strategy: a vision for hydrogen in New Zealand

Date:	22 February 2019	Priority:	High
Security classification:	In Confidence	Tracking number:	2593 18-19

Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	<p>Agree to provide feedback at the weekly meeting with officials scheduled for 27 February.</p> <p>Agree, subject to your feedback, to lodge the attached Cabinet paper with Cabinet Office by 28 March for submission to the Cabinet Economic Development Committee.</p> <p>Agree to forward a copy of this briefing to the Minister for Economic Development.</p>	27 February 2019

Contact for telephone discussion (if required)				
Name	Position	Telephone		1st contact
Andrew Hume	Manager, Energy Markets Policy	04 901 1474	9(2)(a)	✓
Miranda Birchler	Policy Advisor	04 896 5854		
Vidushi Challapali	Graduate Policy Advisor	04 897 5432		

The following departments/agencies have been consulted

Minister's office to complete:

- | | |
|---|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Declined |
| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments



BRIEFING

Cabinet paper – Release of Green hydrogen strategy: a vision for hydrogen in New Zealand

Date:	22 February 2019	Priority:	High
Security classification:	In Confidence	Tracking number:	2593 18-19

Purpose

To provide you with a draft Cabinet paper to consider for submission to the Cabinet Economic Development Committee on the release of the green hydrogen paper: a vision for hydrogen in New Zealand, including a proposed outline.

If you agree to this paper, it should be lodged by 28 March 2019.

Recommended action

The Ministry of Business, Innovation and Employment recommends that you:

- a. **Agree** to provide feedback at the weekly meeting with officials scheduled for 27 February.
Agree / Disagree
- b. **Agree**, subject to your feedback, to lodge the attached Cabinet paper with Cabinet Office by 28 March for submission to the Cabinet Economic Development Committee.
Agree / Disagree
- c. **Agree** to forward a copy of this briefing to the Minister for Economic Development.
Agree / Disagree

Andrew Hume
Manager, Energy Markets Policy
Energy & Resource Markets, MBIE

..... / /

Hon Dr Megan Woods
Minister of Energy and Resources

..... / /

Background

1. You have asked MBIE to develop a green hydrogen vision for New Zealand.
2. You have agreed to seek Cabinet's approval to delegate authority to you in consultation with the Minister for Economic Development, to release the final green hydrogen vision paper at the Just Transitions Summit in New Plymouth on 9 and 10 May 2019.

Draft Cabinet paper

3. We have attached a draft Cabinet paper for your consideration. The Cabinet paper provides background context on hydrogen in NZ, the approach taken to develop the green hydrogen vision paper, recommendations, next steps and it attaches a proposed outline of the vision paper.

Green hydrogen vision paper

4. The vision paper will provide a broad vision that covers the scope of hydrogen's potential in New Zealand, framing the discussion for its integration into a subsequent wider renewable energy strategy. The paper will also seek feedback from stakeholders about the challenges and opportunities for building a hydrogen economy in New Zealand to ensure any Government action is well supported and consistent with market direction.
5. We have asked your office to organise a meeting in April with the Minister for Economic Development to discuss the draft green hydrogen vision paper.

Communications with stakeholders

6. In accordance with our previous briefing to you [2140 18-19 refers], we have posted some high-level information for stakeholders on MBIE's website about the vision paper, including their opportunities to participate in the work.
7. MBIE will also be holding three workshops with key stakeholders to help inform the development of the vision paper. The first workshop will be held in Wellington on 6 March, the second in Auckland on 7 March and the third in Christchurch on 8 March. The key stakeholders we have identified comprise of energy-sector businesses, research institutions, government agencies, local government and some iwi involved in hydrogen.
8. MBIE's communications advisors will prepare a full communication plan, key messages, reactive Q&As and other material, as required, for your release of the vision paper at the Just Transition Summit on 9 and 10 May in New Plymouth.

Next steps

9. Following your review and finalisation of the attached Cabinet paper, it will need to be submitted to Cabinet Office on 28 March to be considered by the Cabinet Economic Development Committee at its meeting on 3 April, and by Cabinet on 8 April before the April recess begins.
10. We will continue to work with the interagency working group and ARUP to complete the vision paper in time for the Just Transitions Summit and we will keep you updated on our progress in our weekly Energy Resource Markets branch report.

Annex

Annex One: Draft Cabinet Paper on Green Hydrogen Paper: a vision for hydrogen in New Zealand, including an outline of the vision paper

Annex Two: Cabinet Paper Timeline

Annex One: Draft Cabinet Paper on Green Hydrogen Strategy: a vision for hydrogen in New Zealand

Annex Two: Cabinet Paper Timeline

Monday	Tuesday	Wednesday	Thursday	Friday
			21	22 Agency provides draft paper
25	26	27 Feedback at officials meeting	28 Agency makes amendments	1Mar
4	5 Second draft provided by 12pm	6 Formal consultation with other Ministers and Parties	7	8
11	12	13	14 Feedback from other Ministers, and support parties by COP	15 Amendments following consultation
18	19	20	21	22

25 Final provided Monday 3pm	26	27 Final approved by Minister	28 Lodge 10am	29
1Apr	2	3 Cabinet Economic Development Committee	4	5
8 Cabinet	9	10	11	12
15 Cabinet Recess	16	17	18	19
22	23	24	25	26
29	30	1May	2	3
6	7	8	9 Just Transition Summit	10 Just Transition Summit



BRIEFING

New Zealand Hydrogen Scenarios Report 2022

Date:	14 April 2022	Priority:	Medium
Security classification:	In Confidence	Tracking number:	2122-3398

Action sought		
	Action sought	Deadline
Hon Dr. Megan Woods Minister of Energy and Resources	Note the contents of this briefing on modelled hydrogen scenarios for New Zealand	21 April 2022

Contact for telephone discussion (if required)			
Name	Position	Telephone	1st contact
Suzannah Toulmin	Acting Manager, Energy Markets Policy	9(2)(a)	✓
Mark Pickup	Principal Advisor		

The following departments/agencies have been consulted

Minister's office to complete:

- | | |
|---|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Declined |
| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments



BRIEFING

New Zealand Hydrogen Scenarios Report 2022

Date:	14 April 2022	Priority:	Medium
Security classification:	In Confidence	Tracking number:	2122-3398

Purpose

This briefing presents the results of a report by Castalia on potential scenarios for hydrogen development in New Zealand, which was commissioned by the Ministry of Business, Innovation and Employment (MBIE).

Recommended action

The Ministry of Business, Innovation and Employment recommends that you:

- a **Note** MBIE commissioned Castalia in late 2021 to undertake a modelling exercise to explore potential scenarios for hydrogen development in New Zealand.

Noted

- b **Note** that this modelling work examines the potential for private sector led hydrogen development under a business-as-usual scenario and undertakes a preliminary investigation of the effects of government intervention to hasten hydrogen development.

Noted

- c **Note** the modelling is not intended as the final product to inform hydrogen policy, rather it provides an indicative starting point to inform the roadmap when it commences.

Noted

Suzannah Toulmin
Acting Manager, Energy Markets Policy
Building, Resources and Markets, MBIE

.14... / .04. / .22...

Hon Dr. Megan Woods
Minister of Energy and Resources

..... / /

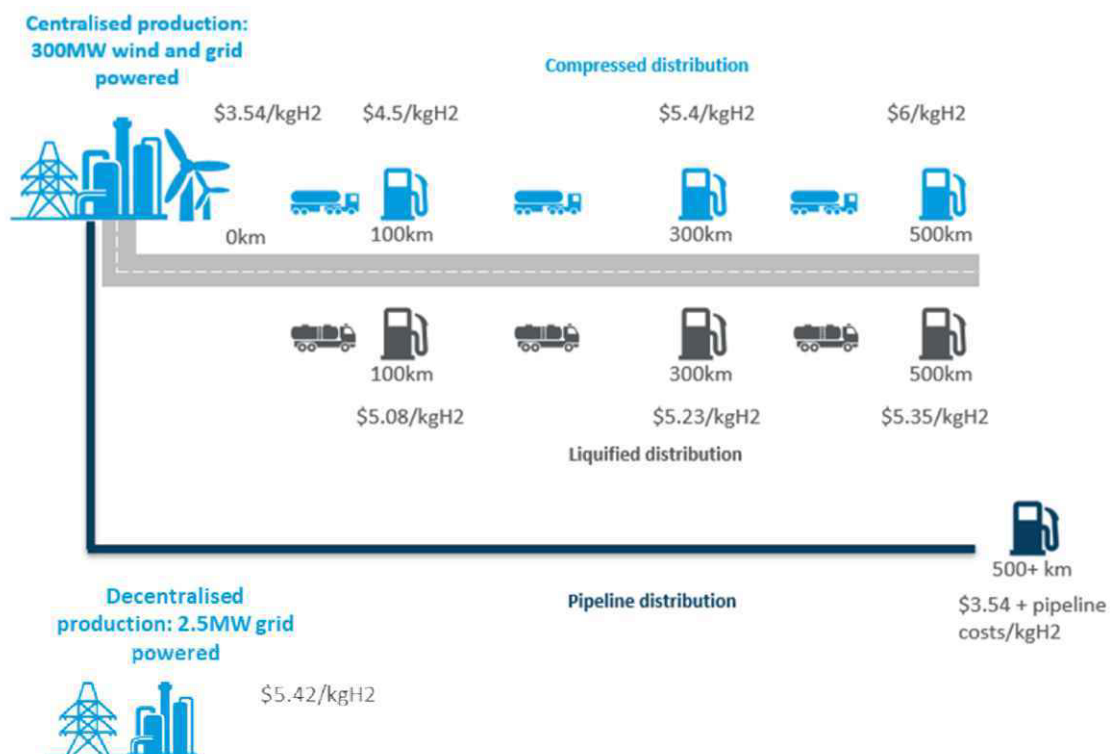
Background

1. In late 2021 MBIE tendered for contractors to undertake modelling on potential hydrogen scenarios for New Zealand. The purpose of this work was to undertake analysis that could provide a useful input into the hydrogen roadmap when its development commences.
2. The contract was awarded to Castalia, working with Zen Energy Solutions of Canada, who carried out modelling for MBIE on hydrogen in 2021. A report, along with its supporting model was delivered to MBIE in late March 2022.
3. This paper provides a summary of key results from the report. The full report is attached as Annex One.

Castalia's analysis of New Zealand hydrogen costs

4. This Castalia report explores possible use cases of green hydrogen under a business-as-usual (BAU) in 2050 pathway and looks at New Zealand's possible hydrogen economy in 2050 under specific intervention scenarios.
5. The BAU scenario modelling suggests that around eight percent of New Zealand's energy demand could be met by green hydrogen as an energy vector in 2050.
6. The report finds that New Zealand's domestic delivered hydrogen costs are comparable to global forecast benchmarks, noting that the advantages of scale production can be outweighed by distance from the point of use.

Figure 1: Illustration of centralised vs decentralised hydrogen production in 2035 under BAU (USD)



7. Figure 1 (above) illustrates the difference in delivered hydrogen prices in the modelled business as usual (BAU scenario). While large-scale centralised bulk production costs are lower (US\$3.54/kg = \$5.20/kg NZD) compared to smaller-scale decentralised production (US\$5.42/kg = \$7.96/kg NZD)), once delivery costs as either compressed gas or liquid are

considered, the cost at the point of use is very similar. Distribution via pipelines is likely to be cost-competitive, but distribution costs are difficult to estimate.

8. The modelling in the report explores potential hydrogen use in four sectors.

Hydrogen in the transport sector

9. According to Castalia, heavy vehicle demand is the largest source of estimated demand, that is not dependent on the emergence of new technologies. Hydrogen is likely to be used in aviation applications; however, it is not clear at this stage whether hydrogen will be combusted, in a hybrid Hydrogen Fuel Cell (HFC)-combustion aircraft or used as an input to Synthetic-Sustainable Aviation Fuel (SAF).
10. Castalia estimates the tipping point for demand for hydrogen in heavy vehicles will start around 2030, with demand for high frequency users and specific use cases prior to this. Transport demand is modelled to grow to around 265,000 tonnes of hydrogen by 2050.
11. It is important to note that this modelling is highly sensitive to technological developments and assumptions in the future price of electricity and alternative fuels.
12. For example, the tipping point in Castalia's model for heavy hydrogen vehicles is 2030 which is based on earlier forecasts of domestic electricity and international oil prices. However, if the recent oil price of around \$110-120 USD a barrel of crude is used, then the tipping point for heavy vehicles moves significantly closer to 2025.
13. The demand in both rail and marine sectors is difficult to assess. Marine applications using hydrogen are possible for small vessels and some larger vessels using HFCs, or as a fuel (including via green ammonia) in combustion engines for deep-sea and larger fleets. Rail may possibly utilise HFC trains in applications that require long-range, low service frequency, fast refuelling times and have high-power demands. For rail, the use of HFC trains in New Zealand will depend on the cost of electrifying remaining sectors of the network.

Hydrogen for energy and electricity system services

14. Castalia note that hydrogen could be used to store electricity from renewable energy sources over various time horizons, which could help improve the resilience of the electricity system. Hydrogen produced during periods of low electricity demand could be stored and used to support intra-day and inter-seasonal security of supply.
15. However, electric batteries are likely to be more viable for daily peak demand requirements, whereas hydrogen storage may become more viable for longer duration storage, and where multiple uses for hydrogen are possible. Electrolysers that would normally produce hydrogen could also provide an option for rapid demand response in electricity systems, making supply available for other uses in times of high need.
16. MBIE notes these are options that are also being explored in the NZ Battery project.

Hydrogen in industry and as a heat source

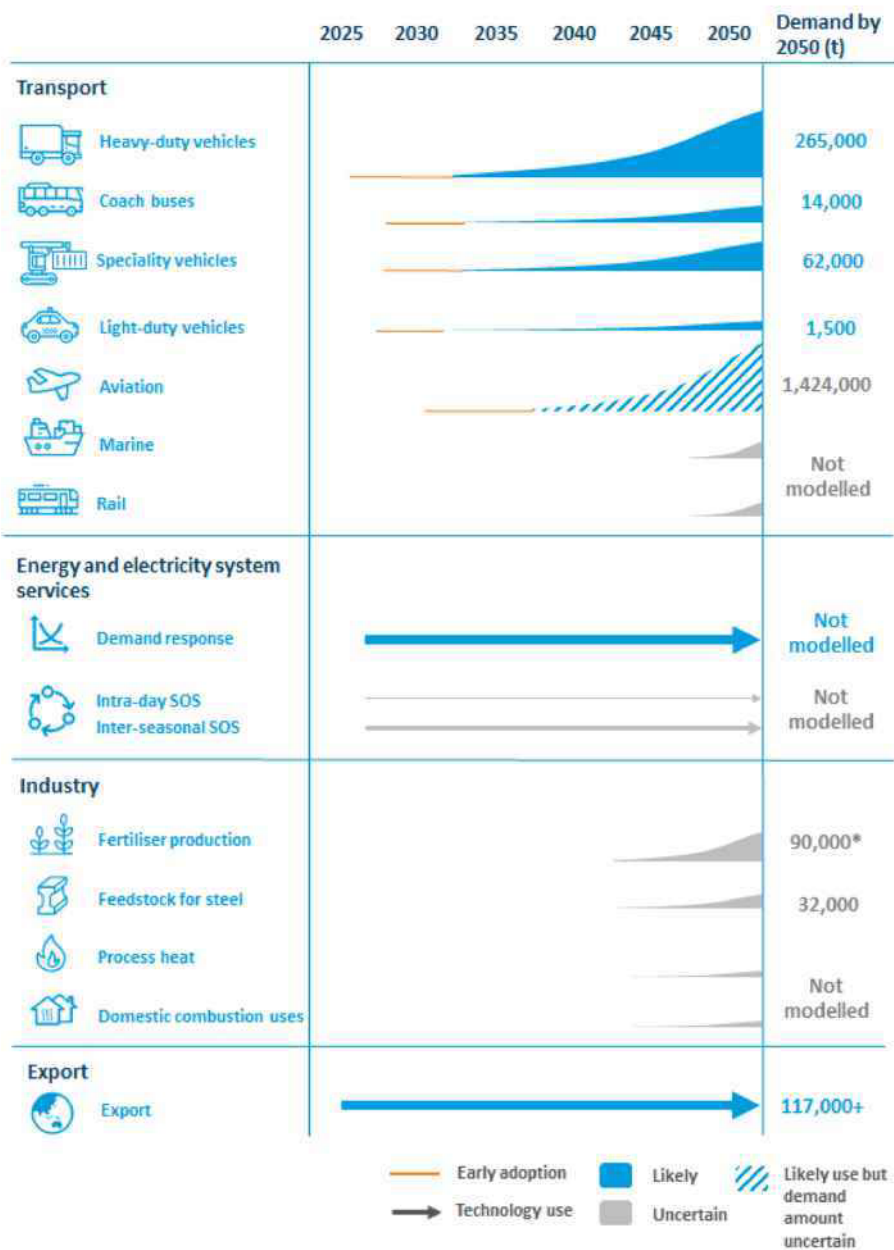
17. Castalia observe that there is currently only limited scope to replace industrial feedstocks with hydrogen. Fertiliser production may utilise hydrogen as a feedstock if costs come down and technological processes improve, for example, the Balance-Hiringa urea project.
18. Hydrogen could be used in steelmaking, but demand will be modest relative to transport use and the technology to do this at scale is still in development. If a steel mill could convert its entire production process, potential demand for hydrogen in steelmaking would be between 30-35 kilotonnes per year. Although this demand for hydrogen is relatively low compared to other use cases such as transport, the emissions reduction impact is still significant.

- High-temperature process heat could use hydrogen as a combusted heat source. Electricity and biomass are effective heat sources, but only for low and medium-temperature process heat. Domestic and commercial combustion may utilise hydrogen as a combusted heat source for heating and cooking, but hydrogen use in this application is likely to be small, due to electricity and biogas as strong competing energy sources for heat pumps and stoves.

Hydrogen to support decarbonisation through export markets

- Hydrogen produced in New Zealand could help meet global demand, particularly in countries like Japan, Korea, and Singapore. New Zealand’s abundant renewable energy sources mean that hydrogen could be cost-competitive with other likely exporters in the Pacific region.
- Figure 2 (following) illustrates the tipping point and uptake timeframes for each use of hydrogen in the BAU case and an assessment of the likelihood of development. It also shows the approximate hydrogen demand by 2050 in the BAU case.

Figure 2: Illustration of hydrogen uptake in BAU scenario



The potential for policy interventions

22. Castalia were requested to model the potential effects of government interventions that could advance or bring forward in time hydrogen development in New Zealand.
23. Castalia's conclusion based on this initial modelling is that typical demand-side policy interventions would not make a significant difference to hydrogen uptake. This is because their analysis assumes subsidies (or tariffs) on capital equipment or inputs have a relatively modest impact on the total cost of ownership of an asset, largely because the additional cost of tariff increase is spread over an asset such as a vehicle's useful life. For example, Castalia's modelling suggests the change in demand for hydrogen would be very small from a 20 percent increase in tax on diesel vehicles, as this tax has only a minor effect on the total cost of ownership of the vehicle compared to its capital cost.
24. Castalia conclude that support for scale production, production subsidies, emissions taxes or emissions trading scheme (ETS) prices, and low carbon fuel standards (LCFS) could reduce the cost of hydrogen fuel relative to other technologies, energy sources, or energy carriers and accelerate the pace of hydrogen uptake. However, their modelling suggests that large subsidies for the capex cost of building a plant (25-45 percent subsidy) would have only a modest impact on timing of hydrogen demand, although such subsidies on plant capex would have a larger impact after 2040 compared to BAU. This arises because their modelling assumes that hydrogen trucks below 12,000 kgs become viable earlier due to the cheaper cost of producing hydrogen.
25. This analysis provides an indicative illustration of the potential outcomes of the types of interventions that are not current Government policy but could be examined in a future hydrogen roadmap in greater detail. It does not provide a cost benefit analysis of options or consider alignment with the emerging Emissions Reduction Plan, though it notes hydrogen's potential for facilitating decarbonisation.
26. What the analysis does show however, is that supply-side or demand-side interventions need to be considered together. That is, creation of new supply does not necessarily bring forward new demand, unless there is an incentive to also accelerate demand to utilise that new supply. This aspect of the interlinkage between supply side and demand side interventions can be explored more extensively in the hydrogen roadmap.

Next steps

27. MBIE will utilise the work from this report, and its underlying model to establish the scope of the subsequent hydrogen roadmap and to inform the initial development of the roadmap.

Risks and mitigation

28. The report does not contain any confidential information and is within the scope of several recent OIA requests once it is finalised. Accordingly, MBIE intends to proactively release this report on its web site to extend public understanding of the potential role of hydrogen in New Zealand.

Communications

29. The upcoming H2Zero conference provides an opportunity for you to release the report.

Annexes

30. Annex One: New Zealand Hydrogen Scenarios Report April 2022

Annex One: New Zealand Hydrogen Scenarios Report April 2022

80. This information will enable a decision about which option or options (if any) should proceed to the detailed business case stage of the NZ Battery Project. At this stage, a detailed business case is likely to take 18 months to two years depending on the option selected, at which point a final investment decision could be made.
81. There may also be a range of non-infrastructure related initiatives that could be progressed as part of – or separately to – the NZ Battery Project, such as supporting a local New Zealand biomass industry.
82. If Cabinet decides in December 2022 to progress more than one option to Phase 2 of the project, this will have implications for the scope and scale of the project. It may also have associated implications for timeframes, depending on available resource.

Next steps

83. On 11 April, the Ministers of Energy and Resources, Environment and Conservation will meet to discuss the matters outlined in this briefing. Consideration of these early findings will help to assess whether further or additional work is required.
84. In early May you will receive a draft Cabinet paper providing the latest update on the NZ Battery Project and seeking some high-level decisions.



BRIEFING

Gas Act 1992: Report Back and Final Policy Decisions

Date:	10 October 2019	Priority:	High
Security classification:	In Confidence	Tracking number:	1069 19-20

Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	<p>Agree to amend the Gas Act 1992 to address issues around information disclosure and penalties.</p> <p>Agree to lodge the draft Cabinet Paper provided at Annex One, pending cross-party consultation.</p>	14 October 2019

Contact for telephone discussion (if required)			
Name	Position	Telephone	1st contact
Andrew McLoughlin	Acting Manager, Resource Markets Policy	9(2)(a)	✓
Andrew Marriott	Senior Policy Advisor		

The following departments/agencies have been consulted
The Treasury, Te Puni Kōkiri, Ministry for the Environment, Ministry of Justice, the Gas Industry Company, the Electricity Authority, the Commerce Commission, Te Arawhiti, the Environmental Protection Authority, the Ministry for Primary Industries, the Parliamentary Council Office (PCO), Worksafe New Zealand, and the Ministry of Transport.
The Department of Prime Minister and Cabinet has been informed.

- Minister's office to complete:**
- | | |
|---|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Declined |
| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments



BRIEFING

Gas Act 1992: Report Back and Final Policy Decisions

Date:	10 October 2019	Priority:	High
Security classification:	In Confidence	Tracking number:	1069 19-20

Purpose

This briefing seeks your agreement to final policy decisions for amending the Gas Act 1992 (the Act), including:

- Providing for greater information disclosure in the gas market;
- Improvements to the penalty regime; and
- Other changes to the Act to address minor issues.

A draft Cabinet Committee Paper seeking Cabinet agreement to these changes has been provided at Annex One.

Executive Summary

1. The Act plays a key role in the regulation of the natural gas industry in New Zealand. Part 4A of the Act sets out the Government's co-regulatory approach for governance of the industry where an approved industry body, the Gas Industry Company (GIC), co-regulates the industry alongside the Government.
2. On 1 May 2019, the Cabinet Economic Development Committee (DEV) agreed that the Ministry of Business, Innovation and Employment (MBIE) release a discussion document entitled '*Options for amending the Gas Act 1992*' for public consultation [DEV-19-MIN-0096 refers]. This consultation document sought the views of stakeholders on:
 - a. Potential regulatory issues posed by emerging technologies and alternative fuels (such as hydrogen) for the Act;

Out of scope

3. Consultation has not revealed any issues in the Act around the facilitation of emerging technology and alternative fuels that are required to be addressed immediately. However, consultation did reveal that some regulations made under the Act may need to be reviewed to enable further uptake of hydrogen as an alternative fuel source. MBIE will report back in the first half of 2020 on potential timings and scope of these changes.

Out of scope

Out of scope

Recommended action

The Ministry of Business, Innovation and Employment recommends that you:

- a **Note** that officials consider that no immediate changes are required to be made to the Gas Act 1992 to facilitate the uptake of emerging technology and fuels, but some regulations may need to be reviewed.

Noted

Out of scope

Out of scope



Andrew McLoughlin
Acting Manager, Resource Markets Policy
Building, Resources and Markets, MBIE

10 / 10 / 2019

Hon Dr Megan Woods
Minister of Energy and Resources

..... / /

Out of scope

We released a consultation document on Gas Act 1992 changes earlier this year

20. On 1 May 2019, the Cabinet Economic Development Committee (DEV) agreed to the release of a discussion document entitled '*Options for amending the Gas Act 1992*' for public consultation [DEV-19-MIN-0096 refers]. This consultation document sought the views of stakeholders on:
 - a. Potential regulatory issues posed by emerging technologies and alternative fuels (such as hydrogen) for the Act;

⁴ Gas governance arrangements are secondary legislation that relate to a number of different matters, for example, regulations relating to the setting of the industry levy that funds the GIC which are made annually.

Out of scope

21. Consultation closed on 12 June 2019 and we received 24 submissions from a range of industry stakeholders.
22. In relation to emerging technologies and alternative fuels, no issues were identified with the legislation that would require amendment in the short-term to address barriers to their uptake. While no major issues were identified through consultation, a range of minor issues were identified by submitters. These related to some regulations made under the Act, and some New Zealand technical standards. We will work with the GIC and Worksafe New Zealand around what changes may be desirable and on the potential timing of any changes.
23. The remainder of this briefing discusses legislative amendments to the Act relating to information disclosure, penalties, and a number of minor changes to the Act.

Out of scope

Out of scope

⁵ These are currently set out in the Government Policy Statement on Gas Governance 2008.

Out of scope

Out of scope

⁶ The Gas Governance (Critical Contingency Management) Regulations 2008.

Out of scope

Out of scope

Out of scope

Out of scope

Out of scope

Annex One: Draft Cabinet Economic Development Committee Cabinet Paper

**Annex two: Draft Regulatory Impact Assessment: Gas Act 1992
Amendment Bill 2019**



BRIEFING

Determining the scope of changes to the Gas Act 1992

Date:	30 October 2018	Priority:	Medium
Security classification:	In Confidence	Tracking number:	1229 18-19

Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	Agree to a preferred approach to amending the Gas Act 1992.	5 November 2018

Contact for telephone discussion (if required)			
Name	Position	Telephone	1st contact
Sarah Stevenson	Manager, Resource Markets Policy	9(2)(a)	✓
Andrew Marriott	Policy Advisor, Resource Markets Policy		

The following departments/agencies have been consulted
N/A

Minister's office to complete:

- | | |
|---|--|
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| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments



BRIEFING

Determining the scope of changes to the Gas Act 1992

Date:	31 October 2018	Priority:	Medium
Security classification:	In Confidence	Tracking number:	1229 18-19

Purpose

To provide you advice on potential approaches you may wish to take to ensure the Gas Act 1992 (the Act) is future proofed, and remains fit-for-purpose.

This advice follows on from previous engagements with officials and industry where you have expressed interest in possible amendments to the Act.

Executive Summary

The Act regulates the use of any gas as a fuel in New Zealand. It provides for the regulation of the gas industry, the supply of, and the use of gas. It also protects the health and safety of the public in connection with gas supply.

You have previously expressed interest in amending the Act to address two key issues that relate to:

- the low level of penalties able to be applied to industry participants during gas critical contingencies, and
- improving information disclosure from the industry, in the context of the ongoing Pohokura outages.

We have engaged with the Gas Industry Company (GIC) and MBIE's legal team on these issues, and have identified areas where legislative change will be required.

We also consider there is a need to make broader, more substantive, changes to the Act to better align with changes in technology and current approaches to health and safety. In addition, the Act has a number of areas that depart from modern legislative design principles.

An emerging issue is around how the Act could regulate the use of hydrogen as a fuel more effectively. At this stage, it is not clear that the Act allows New Zealand to capitalise on the opportunities presented by hydrogen as a low-emissions fuel source.

There are two approaches that could be taken to address the above issues; both of which require legislative change:

- **Option One** (preferred option) proposes targeted changes to the Act to address the penalty and information disclosure issues, while foreshadowing future larger changes to the Act in future. This would address important issues, while MBIE would also engage with stakeholders on barriers to emerging technologies, with an emphasis on hydrogen and on other legislative issues.
- **Option Two** proposes comprehensive review of the Act with a view to make substantial changes. This option could take up to two years to introduce a Bill. We do not consider the broader issues with the Act urgent enough to warrant undertaking this large piece of work now, in light of other Government energy policy priorities.

This briefing seeks your guidance on your preferred option.


Recommended action

The Ministry of Business, Innovation and Employment recommends you:

- a **Note** that changes are required to the Act to ensure that the legislative framework remains fit-for-purpose. *Noted*
- b **Note** that the Act regulates the use of any gas as a fuel in New Zealand including hydrogen. *Noted*
- c **Note** that we will need to undertake further engagement with stakeholders to understand if the Act presents any regulatory barriers to the uptake of hydrogen technologies in New Zealand. *Noted*
- d **Agree** to:
 - a. Make targeted changes to the Act in the 2019 legislative programme, addressing issues with information disclosure and the penalties contained in the Act, while signalling that a wider review will be undertaken in future (**MBIE's preferred option**). *Agree / Disagree*

OR

- b. A comprehensive review of the Act, with a particular view to ensure the regime is fit-for-purpose and future-proofed. *Agree / Disagree*
- e **Note** that officials are available to discuss this briefing. *Noted*



Sarah Stevenson
Manager, Resource Markets Policy
Building, Resources and Markets, MBIE

..... / /

Hon Dr Megan Woods
Minister of Energy and Resources

..... / /

The Gas Act 1992

1. The Gas Act 1992 (the Act) regulates the use of any gas as a fuel in New Zealand. It provides for the regulation of the gas industry (the industry), and for the supply and use of gas. It also protects the health and safety of the public in connection with the supply of gas and prevents damage to property in connection to the supply and use of gas.
2. The Act sets out the Government's co-regulatory approach for governance of the industry, where an approved industry body co-regulates the industry alongside the Government. This body has been the Gas Industry Company (GIC) since December 2004. Alongside the GIC, the Act provides Worksafe New Zealand (Worksafe) with roles and responsibilities associated with energy safety and health and safety.
3. The Act was first introduced in 1992 and has been substantially amended several times. The section which sets out the Government's approach to gas industry governance was added in 2004, and substantive areas were changed when Worksafe was created in 2013.
4. The Act has not undergone any substantial revisions in this time, but it has been included on the Parliamentary Counsel Office (PCO) Energy Revision Bill programme which was agreed to earlier this year (briefing 1604 17-18 refers). The aim of the revision bill programme is to make law more accessible to people; however policy changes to bills cannot be implemented through the programme.

Context

1. Following discussions at your weekly meeting with officials on 26 March 2018, you expressed interest in progressing changes to the Act. This was driven by the low maximum penalty able to be imposed by the Gas Rulings Panel in situations where an industry participant breaches the directions of the Critical Contingency Operator during a critical contingency event.
2. You have also indicated interest in the ability of the Act to require greater information disclosure from the gas industry. This was in the context of limited information disclosure to the gas market during the Pohokura outages. Subsequent to your meeting with Andy Knight, Chief Executive of the GIC on 21 April 2018, you wrote to the GIC directing them to investigate whether the current information disclosure requirements as provided for by legislation and regulation are sufficient.
3. We consider there is merit in pursuing changes to address these two issues, as well as the need to make broader, more substantial, changes to the Act as a whole. There are two approaches that could be taken to pursue these changes, both involving a legislative change process. We seek your guidance on how officials should proceed.

There are opportunities to improve the Act

4. MBIE considers that the Act needs to be amended to better align with changes in technology and current approaches to health and safety. In addition, the Act has a growing number of issues that need addressing and areas that depart from modern legislative design principles.
5. One of the immediate issues, for example, is that the Act regulates the use of hydrogen as a fuel, which makes the Act a key piece of legislation for enabling the development and deployment of hydrogen as a fuel in New Zealand. However, the Act was originally designed to regulate the use of LPG and natural gas. The use of hydrogen departs from the original policy intent and as such the Act may present some regulatory barriers for hydrogen's adoption as a fuel. MBIE's current understanding of these regulatory barriers is limited, and more work will be required to improve understanding.
6. One known regulatory barrier that we are aware of is the odourisation requirements for fuel

gas under the gas quality regulations. We understand that this is because mercaptan cannot be chemically added to hydrogen for odourisation purposes as it can be for natural gas. We also understand that, from a health and safety perspective, Worksafe could use exemption making powers under the Act to allow the use of hydrogen in some applications, however these powers are not suitable for use in the medium-term.

7. It is not clear at this stage that the Act is sufficient for allowing New Zealand to capitalise on the opportunities presented by hydrogen as a low-emissions fuel source. Given the significant period of change New Zealand faces as it transitions to a low carbon economy and the role that hydrogen can play in supporting this transition in all sectors of the economy, it will become increasingly important to ensure there are no unnecessary regulatory barriers for the uptake of hydrogen.

Options

8. In light of the issues raised above, we consider that two approaches could be taken to improve the Act:

Out of scope

Out of scope

16. This is our preferred option as it allows for in-depth consultation with stakeholders in regards to the deployment of hydrogen as a fuel in New Zealand, as well as on other legislative and regulatory issues with the Act. This option also mitigates the risk of policy decisions being made which may result in new legislative barriers in future. It also allows two relatively important but small in scope issues to be addressed in the short-term, rather than in a longer time period which would be in the case for a full Act review option.
17. If you agree to this approach, we will develop a discussion document by the end of 2018 and seek your approval on this. This would inform the development of an Amendment Bill for the 2019 legislative programme.

Option Two: A comprehensive review of the Act

This option would be a substantial piece of work and would result in comprehensive changes to the Act...

18. Option Two would initiate a work programme that would likely result in substantial changes to the Act. This process would start with engagement with stakeholders with the view to develop an issues paper. We estimate that the full policy process could take up to two years to complete. This option would require substantially more resourcing from MBIE, Worksafe and the GIC to deliver compared with Option One.
19. This would modernise the Act and likely result in substantive changes to existing legislation and subsequently regulations made under the Act. Stakeholders would be likely to be highly engaged and there will likely be commercial impacts for some companies involved.
20. This option would also likely lead to a longer-term work stream to update regulations made under the Act. Comprehensive changes to the Act would likely also necessitate a change to the GPS, last updated in 2008.
21. Given the interest in hydrogen as a low-emissions fuel source, a comprehensive review with an emphasis on hydrogen could provide investment certainty to interested parties, and signal the Government's intentions about the future of hydrogen in New Zealand.

... but needs to be considered alongside the Government's priority projects

22. Given Government priority projects such as the Zero Carbon Bill development, the Auckland Fuel Supply Disruption Inquiry, the tranche two Crown Minerals Act Review, and the Electricity Pricing Review, it may be desirable for these to be completed before undertaking another programme of energy policy change. This will enable Act changes to reflect the outcomes of these pieces of work, and to minimise 'consultation-fatigue' from stakeholders who are involved in multiple current priority energy policy projects.
23. We do not recommend this option. We consider that the present issues with the Act are important to address in the medium-term, but not substantive enough to warrant an immediate programme of work to address. There may be a risk that if policy decisions are taken regarding treatment of hydrogen and other emerging technologies too soon, it may result in unintended regulatory barriers.

Next steps

24. We seek your guidance on how you wish to proceed with making changes to the Act. If you agree to proceeding with either option, we will seek to remove the Act from the PCO revision bill programme as both of the potential approaches require policy changes.
25. Subject to your approval, MBIE will continue policy work on your preferred approach. We will report back to you on likely timeframes and milestones. We will begin work on developing a document for public feedback in consultation with the GIC.

Annexes

Annex one: Further information on penalties and information disclosure

Out of scope

Out of scope

Out of scope



BRIEFING

Final Report: New Zealand's Regulatory Pathway for Hydrogen

Date:	29 September 2022	Priority:	Medium
Security classification:	In Confidence	Tracking number:	2223-1181

Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	<p>Note PwC's final report on New Zealand's regulatory pathway for hydrogen;</p> <p>Note that the Ministry of Business, Innovation and Employment intends to publicly release the report on its website; and</p> <p>Forward this briefing to the Minister for Workplace Relations and Safety for their information.</p>	5 October 2022

Contact for telephone discussion (if required)			
Name	Position	Telephone	1st contact
Ayesha Myra Amin	Acting Manager, Offshore Renewable Energy and Hydrogen	9(2)(a)	✓
Ron Beatty	Policy Advisor, Energy Markets Policy		
Steve James	Principal Policy Advisor	(04) 830 7239	

The following departments/agencies have been consulted
MBIE Health and Safety Policy, MBIE Innovation Policy, Standards New Zealand, WorkSafe

Minister's office to complete:

- | | |
|---|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Declined |
| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments



BRIEFING

Final Report: New Zealand's Regulatory Pathway for Hydrogen

Date:	29 September 2022	Priority:	Medium
Security classification:	In Confidence	Tracking number:	2223-1181

Purpose

To provide you with the final report prepared by PricewaterhouseCoopers (PwC) on New Zealand's hydrogen regulatory pathway and outline next steps on the development of a regulatory work programme for novel uses of hydrogen.

Recommended action

The Ministry of Business, Innovation and Employment (MBIE) recommends that you:

- a **Note** that in early 2022, MBIE commissioned PwC to produce an independent report on whether legislation and regulation in New Zealand is fit-for-purpose for novel uses of hydrogen, as part of the broader hydrogen regulatory settings project commissioned by you and the Minister for Workplace Relations and Safety in late 2021; *Noted*
- b **Note** that PwC's broad findings in the attached report were that they considered existing legislative and regulatory regimes were not flexible for novel uses of hydrogen, but the issues were currently minor or not immediately urgent to resolve. They noted this could become more pressing depending on the pace of a hydrogen industry developing in New Zealand; *Noted*
- c **Note** that the report summarises a high-level assessment of relevant legislation and regulatory regimes, and there is a need for more detailed examination by responsible agencies; *Noted*
- d **Note** that part of the broader regulatory settings project, MBIE intends to reconvene the hydrogen regulatory settings working group to develop a forward work programme to carry out further regulatory examination in line with the group's broader terms of reference, and to inform a report back to relevant portfolio Ministers; *Noted*
- e **Note** that MBIE intends to publish the attached report on its website to extend public and sector understanding of the current legislative and regulatory environment for hydrogen in New Zealand, and signal the proposed next steps on the regulatory settings project; and *Noted*

f **Forward** this briefing to the Minister for Workplace Relations and Safety for their information.

Yes / No



Ayesha Myra Amin
**Acting Manager, Offshore Renewable Energy
and Hydrogen**
Buildings, Resources and Markets, MBIE

29 / 09 / 2022



Hon Dr Megan Woods
Minister of Energy and Resources

9 / 11 / 22

Background

New Zealand's existing regulatory regimes were not developed with novel hydrogen applications in mind, which may be a barrier to developing a hydrogen economy

1. Hydrogen is mostly used and regulated in New Zealand as an industrial chemical. However, it is regarded, both in New Zealand and internationally, as having the potential to be a key green fuel source that will enable decarbonisation of areas of the economy that may be difficult, impractical, or costly to electrify.
2. Hydrogen used in this way at scale has the potential to more substantially integrate electricity, gas, water, transportation infrastructure, and markets, and increase the level of interdependence between these infrastructure systems. Current legislation and regulations fall across six separate portfolios including Energy and Resources, Environment, Building and Construction, Workplace Relations and Safety, Transport, and Commerce and Consumer Affairs.
3. There is uncertainty around whether existing legislation and regulations are fit for purpose, where the gaps are, what might need to be changed and by when. These gaps may become more significant as the hydrogen economy evolves. If the hydrogen economy develops rapidly, these gaps could quickly become barriers to ongoing adoption and rollout.

In 2021, you commissioned a programme of work to examine the readiness of existing regulatory regimes for novel uses of hydrogen

4. In August 2021, officials briefed you on the existing regulatory environment and its suitability for novel uses of hydrogen [briefing 2122-0583 refers], noting that the relevant regulatory regimes fall across multiple portfolios.
5. You agreed to jointly commission the work with the Minister for Workplace Relations and Safety, and report back to the Minister for the Environment, Minister for Building and Construction, Minister of Transport, and Minister of Commerce and Consumer Affairs by April 2022 on the following issues:
 - a. identification of all the relevant Acts, regulations and standards that impact the regulation of hydrogen in New Zealand, organised into categories (e.g., transport, commercial, and health and safety),
 - b. a definition of "fit-for-purpose" and criteria to evaluate how fit-for-purpose the current regulatory settings are for hydrogen,
 - c. an evaluation of how fit-for-purpose the current regulatory settings are for hydrogen, including identification of current regulatory gaps, and barriers that need to be considered as the industry matures,
 - d. a systems-approach analysis of the impacts (short, medium, and long-term) of the current regulatory system on the hydrogen industry, the economy, iwi, international relations, the environment etc., based on different potential future scenarios outlined by the modelling completed in the Hydrogen Roadmap,
 - e. consideration of the alignment with international standards and best practice in order to ensure the settings support trade in hydrogen and hydrogen technology,
 - f. clarification and confirmation of the roles and responsibilities of the different government departments, agencies and co-regulators in the regulation of hydrogen, and

- g. high-level advice on any regulatory changes that need to be made (outlined by priority) and their corresponding timelines, including how they might align with any broader regulatory reviews that are being undertaken (e.g., in the Health and Safety portfolio).

MBIE commissioned PwC to independently review the current state of hydrogen regulatory settings

- 6. To inform this work, in March 2022 MBIE commissioned PwC to provide a high-level, fit-for-purpose independent review of the current regulatory settings for hydrogen to advance the hydrogen industry and support New Zealand's climate change response. The review was intended to:
 - h. indicate areas where existing legislation and regulation are a potential barrier or a shortcoming to the development of a hydrogen industry,
 - i. provide a starting point for agencies to consider legislative and regulatory changes in their respective areas if the removal of the barrier or shortcoming advances the hydrogen industry and supports New Zealand's climate change response, and
 - j. inform the development of the Hydrogen Roadmap.

MBIE established a Regulatory Settings Working Group to inform the independent review

- 7. Membership of the Working Group comprised the Commerce Commission, the Energy Efficiency and Conservation Authority, the Environmental Protection Authority, Fire and Emergency New Zealand, Gas Industry Company, Maritime NZ, Ministry for the Environment, Ministry of Transport, NZ Customs Service, Standards NZ, Waka Kotahi, WorkSafe NZ, MBIE Health and Safety Policy, MBIE Energy Policy, MBIE Building System Performance, and MBIE Trade and International. New Zealand Trade and Enterprise and GNS were also non-regulatory members of the Working Group.
- 8. The specific role of the Working Group was to:
 - a. co-ordinate interested parties within government to share information on work that has already been done in the hydrogen regulatory space, and review relevant legislation and regulations to determine whether or not they are fit-for-purpose to facilitate a hydrogen economy; and
 - b. review PwC's report on New Zealand's hydrogen regulatory pathway when completed.

New Zealand's hydrogen regulatory pathway report

- 9. PwC's report 'New Zealand's Hydrogen Regulatory Pathway' is attached as **Annex One**.
- 10. The report provides a starting point for agencies to consider work programme items to examine in more detail legislative and regulatory changes in their respective areas that will advance the hydrogen industry and support New Zealand's climate change response.

PwC's assessment approach

- 11. PwC interviewed 22 stakeholders, including regulators, industry bodies and suppliers to canvass views on the appropriateness of current legislation and priority order for any changes that need to be made.
- 12. The process PwC followed to determine if the current legislative and regulatory frameworks are fit-for-purpose was as follows:
 - a. applying individual legislation to an aspect of the future hydrogen value chain to assess if there were gaps or crossovers;

- b. assessing the interpretations in individual legislation for relevance to green hydrogen, its production and its novel uses; and
 - c. matching industry issues from the stakeholder discussions with the regulatory frameworks.
13. During the interviews and production of the report, PwC also provided an update and had open discussions at each Working Group meeting. MBIE also held feedback sessions with the Working Group on the draft report.

PwC made a number of findings and recommendations

14. Due to the complexity of interdependent legislation, regulation and standards, the report does not set out what needs to be changed, or a hard timeframe, apart from highlighting issues they considered need immediate attention.
15. The main findings of the report were as follows:
- a. The New Zealand hydrogen sector is currently small but the pace of investment is growing as investors realise its potential and the competitive advantage New Zealand has in renewable energy.
 - b. The Government should develop a clear national policy strategy for how New Zealand will navigate the hydrogen opportunity. Aligning incentives and policy support for hydrogen with other decarbonising options would help to level the playing field for renewable solutions and provide confidence to investors and underpin future regulatory reforms.
 - c. The economics, timing, and uptake of hydrogen in New Zealand are uncertain. But the sizeable investments being made and the policy direction of our closest trading partners in the Asia-Pacific region is undeniable.
 - d. Similar to the United Kingdom, New Zealand has very little legislation that specifically considers hydrogen. Instead, hydrogen projects must navigate the existing legislative landscape that applies to gases more generally. While this is acceptable in the short term, technology advances or fuel shortages could rapidly develop, and legislation could form a significant barrier.
 - e. The final form of the hydrogen landscape and how it integrates within New Zealand's legislative framework is not yet known. This will become clearer as technology and applications evolve and this will help inform requirements for legislative and regulatory change. Agencies will need budget, resource and work programme flexibility to amend regulation to provide clarity and certainty for hydrogen.
 - f. There are several pressing issues, particularly in the Gas Act 1992, with how legislation is aligned due to the definitions or absence of definitions for (fossil) gas and (engine) fuel in particular. As time progresses, these issues will become more urgent if they are not resolved.
 - g. The Gas Act and Hazardous Substances and New Organisms Act also do not appear to cover liquid hydrogen, as hydrogen is a liquid at the stated conditions for what constitutes a gas under the Gas Act, and classification of a substance under HSNO requires designation by the Environmental Protection Authority. PwC noted this could potentially impede local and export distribution of hydrogen if transported in liquid form.
 - h. The prescriptive nature of New Zealand's safety regulations is creating a lack of flexibility for novel uses of hydrogen. While there is some urgency in progressing some areas of reform, there is time to monitor and consider other changes in response to

market developments. Collaboration between the Government, regulators, business, and iwi will be important going forward.

- i. At the tertiary level, standards are currently barriers to very basic operation, an issue that is causing delays in implementation right now. The report noted Standards New Zealand's current work programme on reviewing standards for novel uses of hydrogen, and suggested the process could be quicker if existing international standards were adopted.
- j. There is a need for ongoing monitoring of regulatory issues across the future hydrogen value chain. PwC considered that the Working Group is a useful forum to co-ordinate this activity going forward, and should continue to operate.

Outstanding issues identified in the report

- 16. The independent review was high-level and did not assess the regulatory regimes in detail, as the requirements will become clearer as the hydrogen industry evolves. However, there is already a need for a programme of work to further examine the current issues highlighted.
- 17. We consider that detailed investigation of the issues set out in the report is necessary to determine the form that any amendment to legislation, regulation or standards will take. Leaving amendments or adoption of international standards too late could be costly in terms of development of the hydrogen industry, as the time required to carry out complex changes to legislation and regulation can be extended. This may require budget and resource set aside by regulators and agencies.

9(2)(f)(iv)

9(2)(f)(iv)

Agency views on PwC's assessment

9(2)(g)(i)

Next steps

25. We recommend you forward this briefing and the attached report to the Minister for Workplace Relations and Safety, for their information.

We intend to proactively publish the final report on the MBIE website in due course

26. We plan to accompany the report with supporting text on the website to be clear that the PwC report is an initial assessment of the regulatory readiness of current regulatory systems for hydrogen and does not represent an official government position on the applicability of legislation to novel hydrogen uses. We will also signal next steps in the wider regulatory settings project.



Annexes

Annex One: New Zealand's hydrogen regulatory pathway report

Annex One: New Zealand's hydrogen regulatory pathway report



BRIEFING

Development of a roadmap for hydrogen in New Zealand

Date:	2 September 2022	Priority:	Medium
Security classification:	In Confidence	Tracking number:	2223-0866

Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	<p>Note that officials plan to carry out preliminary engagement with key stakeholders, including iwi, on the development of a hydrogen roadmap</p> <p>Note that we intend to report back to you in November on the overarching objectives and ongoing approach to the development of a hydrogen roadmap.</p>	7 September 2022

Contact for telephone discussion (if required)				
Name	Position	Telephone		1st contact
Ayesha Myra Amin	Acting Manager, Offshore Renewable Energy and Hydrogen	04 490 18585	9(2)(a)	✓
Steve James	Principal Policy Advisor	04 839 7239		
Mark Pickup	Principal Policy Advisor		9(2)(a)	

The following departments/agencies have been consulted
Ministry of Transport, Energy Efficiency and Conservation Authority, Ministry for the Environment MBIE Just Transitions Unit, MBIE NZ Battery Project, MBIE Resource Markets Policy, MBIE Innovation Policy, MBIE Industry Policy

Minister's office to complete:

- | | |
|---|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Declined |
| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments



BRIEFING

Development of a roadmap for hydrogen in New Zealand

Date:	2 September 2022	Priority:	Medium
Security classification:	In Confidence	Tracking number:	2223-0866

Purpose

To update you on our proposed approach to developing a hydrogen roadmap for New Zealand, which was announced as part of the Emissions Reduction Plan and received funding in Budget 2022.

Executive summary

As part of the Emissions Reduction Plan (ERP), the Government has committed to develop a hydrogen roadmap (the Roadmap) to set a strategy to guide investment in hydrogen, reducing emissions and maximising economic benefits. The Roadmap builds on previous work on hydrogen, including the 2019 Vision for Hydrogen in New Zealand, the scenario modelling project report and modelling tool published by the Ministry of Business, Innovation and Employment (MBIE) in May 2022, and the review of regulatory settings to support novel uses of hydrogen.

Stakeholders in New Zealand's nascent hydrogen sector are seeking a roadmap to provide greater certainty about government views and direction on hydrogen, in order to encourage greater investment as projects look to scale up beyond initial testing and demonstration in the coming years.

Over 40 countries have released, are planning to release or are currently developing national strategies and roadmaps to support the development and uptake of hydrogen. Most focus around four key objectives, with varying approaches based on country-specific circumstances and goals:

- Meeting decarbonisation goals
- Diversifying energy supply
- Economic development
- Integration of renewables into electricity networks.

There are trade-offs and considerations to make when determining what role hydrogen should play in New Zealand's future, and how these objectives (or other objectives) may apply to New Zealand-specific circumstances.

Our initial view is that green hydrogen, that is, hydrogen produced through low-emission methods such as electrolysis using electricity generated from renewable sources, has a likely role in the decarbonisation of hard-to-abate sectors, such as steel production. What is less clear is the extent to which hydrogen is useful in decarbonisation relative to other technologies such as electricity, and whether hydrogen will have a broad or niche role in relation to the other three common objectives, or other objectives.

The role of the Roadmap will be to test and quantify the benefit of government intervention to extend or accelerate hydrogen's role in decarbonisation of the New Zealand economy, and clearly signal the Government's subsequent objectives in this space.

We consider that engagement is needed to help further refine what stakeholders think the most pressing issues are, to manage expectations on the timing and content of the Roadmap and make progress on the most pressing barriers to the development of hydrogen projects.

We intend to develop the roadmap across two main phases:

- Phase One would involve engagement with iwi and other key stakeholders on objectives and relative priority and possible interventions to support the development of hydrogen. We may augment stakeholder discussions with further modelling on specific hydrogen scenarios. We would look to publish an interim Roadmap in mid-2023.
- Phase Two would consider what measures the government might choose to adopt to support the development and use of hydrogen, based on the findings of engagement with the sector, chosen scenarios and ongoing regulatory work. This analysis would consider the relative costs and benefits of these interventions.

We will keep you updated on this work as it progresses and are engaging with stakeholders across government on related workstreams under the Energy Strategy, as well as related work in the Environment and Transport portfolios.

Recommended action

The Ministry of Business, Innovation and Employment (MBIE) recommends that you:

- Note** that as part of the Emissions Reduction Plan, the Government has committed to develop a roadmap for hydrogen (the Roadmap), which was funded in Budget 2022 as part of the initiative to develop an Energy Strategy and related plans;
Noted
- Note** that the development of the Roadmap is a continuation of earlier work, including the Vision for Hydrogen in New Zealand Green Paper, which was released and publicly consulted on in 2019, modelling on a 'business as usual' future scenario for hydrogen in New Zealand, and a review of the compatibility of existing regulatory regimes for novel uses of hydrogen;
Noted
- Note** that we have reviewed hydrogen roadmaps and strategies in other jurisdictions with objectives that commonly include hydrogen's role in decarbonisation, diversifying energy supply, economic development and integration of renewables in electricity networks;
Noted
- Note** that it is likely that not all of these international objectives are applicable to New Zealand, and to explore this issue we propose a two-phase development cycle for the Roadmap:
 - Phase One will test scenarios of the most applicable objectives to the New Zealand economy for hydrogen through a combination of stakeholder engagement and economic modelling, which would result in an interim Roadmap being published in mid-2023;
 - Phase Two will explore what, if any, government interventions should be considered to achieve the agreed objectives;
Noted
- Note** that MBIE officials plan to carry out preliminary engagement with iwi and key stakeholders to test objectives for the Roadmap, how they might apply in a New Zealand context and whether other objectives should be assessed;
Noted

f **Note** that we intend to report back to you in November on the outcomes of this engagement, and the overarching objectives and ongoing approach to the development of a hydrogen roadmap; and

Noted

g **Note** that we will provide you with a separate briefing in September, outlining the report produced for MBIE by PwC New Zealand and proposed next steps as part of the hydrogen regulation review.

Noted



Ayesha Myra Amin
**Acting Manager, Offshore Renewable Energy
and Hydrogen**
Building, Resources, Markets, MBIE

2 / 9 / 2022



Hon Dr Megan Woods
Minister of Energy and Resources

B. 9. 22
...../...../.....

Background

The Government has committed to develop a hydrogen roadmap

1. As part of the Emissions Reduction Plan (ERP), the Government has committed to develop a hydrogen roadmap (the Roadmap) to guide investment in hydrogen, reducing emissions and maximising economic benefits. The Roadmap would build on the Vision for Hydrogen in New Zealand Green Paper, released in 2019, which sought public input on a broad range of opportunities for hydrogen. The development of the Roadmap was funded in Budget 2022.
2. The Government has funded a number of hydrogen-based projects through the Covid-19 Response and Recovery Fund, the Provincial Growth Fund and the EECA's Low Carbon Transport Fund. Over the last two years we have also seen strong private sector interest in developing hydrogen supply and use cases for hydrogen demand.
3. In addition, a number of international companies have expressed an interest in developing hydrogen in New Zealand. For example, Japanese companies Mitsui and Obayashi Corporation have partnered with New Zealand companies and iwi in hydrogen production, refuelling and industry applications in the North Island, while Australian companies Woodside Energy and Fortescue Future Industries are finalists as potential partners in the Southern Green Hydrogen project. New Zealand has also entered into agreements with Japan (2018) and Singapore (2021) to facilitate greater co-operation on hydrogen.

A number of other countries have released strategies and roadmaps on hydrogen

4. Over 40 countries have released strategies or roadmaps on hydrogen or have announced an intention to do so. Most focus around four key objectives:
 - a. **Meeting decarbonisation goals** – through utilising hydrogen as an alternative fuel in a range of emissions-intensive applications, including as a fuel for electricity generation, in transport and as a replacement feedstock in industrial and chemical processes.
 - b. **Diversifying energy supply** – hydrogen offers potential both as an alternative import fuel to fossil fuels, and as a way to ensure security of supply through localised production where renewable energy and water resources can be utilised to provide on-site and distributed supplies of hydrogen.
 - c. **Economic development** – realising local economic benefits and utilising existing skills and assets in the transition from emissions intensive industries to alternatives and developing export opportunities to countries with limited capacity to produce hydrogen from local renewable resources and realising local economic benefits to developing a hydrogen industry.
 - d. **Integration of renewables into electricity networks** – by utilising hydrogen as a renewable energy carrier, coupling hydrogen production with times where renewable generation is in excess of demand, and acting as a storage medium for use in electricity generation when demand for electricity exceeds renewable supply.
5. **Annex One** provides summaries of these objectives across hydrogen strategies in Europe, the Americas and Asia-Pacific, and the relative level of priority countries have placed on these objectives. Some strategies include specific targets for hydrogen and timeframes for achieving the targets. Others set more general goals and lack specific details about how they will be achieved. Common targets include:
 - a. volume of hydrogen production
 - b. installed electrolyser capacity

- c. target prices for hydrogen
- d. volume of hydrogen exports.

Governments are also seeking to put in place measures to encourage a market for hydrogen to emerge

6. Internationally, many governments have announced a range of incentives and support as part of their hydrogen strategies. Most are aimed at addressing the 'missing market' problem, where parties are reluctant to invest in the production of hydrogen for supply without certainty of demand, while potential users are reluctant to invest in applications that make use of hydrogen without certainty of supply. Their general assessment is that without intervention, a market for hydrogen may either fail to develop, emerge sub-optimally, or will take longer to develop than envisaged by their governments' targets for hydrogen adoption.
7. Such incentives and other support options include:
 - a. Direct subsidies, grants and financing instruments for the capital costs of hydrogen production and associated equipment on the supply side, and for vehicles and other equipment on the demand side.
 - b. Market instruments to reduce the relative cost of hydrogen compared to alternatives, such as contracts for difference (CfDs), where governments subsidise the difference between a strike price (the price paid) and the cost of production or purchase.
 - c. Using government procurement to provide a reliable baseline of hydrogen demand, such as vehicle fleet purchasing.
 - d. Legislative and regulatory instruments, such as planning rules explicitly designed to enable and encourage hydrogen development.
 - e. Grants and other support for research and development activities to help reduce the associated costs of hydrogen through the development of cheaper and/or more efficient technologies.

Developing the Roadmap

We have been carrying out preliminary work to scope the Roadmap

8. Work to progress the development of the Roadmap has been underway since mid-2021. The Ministry of Business, Innovation and Employment (MBIE) commissioned three main pieces of consultancy work to inform the scope.

Hydrogen Vision

9. As previously mentioned, MBIE commissioned Arup to develop the Vision for Hydrogen in New Zealand, which involved input from stakeholders through in-person workshops, as well as a public consultation process on a draft green paper. Of the 79 submissions on the Vision, the majority were generally supportive, particularly of the use of green hydrogen. However, this support was countenanced by concerns about the economic case for hydrogen over direct electricity use, safety, and water use considerations.

Hydrogen Scenario Modelling

10. In mid-2021, MBIE engaged Castalia to carry out modelling work on a likely 'business as usual' (BAU) future scenario for the production, use and export of hydrogen. Castalia's report followed on from some earlier more limited work in 2020 and was publicly released in May 2022. It estimates that in a BAU scenario, hydrogen could make up around eight per cent of

energy use in New Zealand by 2050. A breakdown of the modelled demand for hydrogen by use is provided in **Annex Two**.

11. The report considered that heavy transport, long-distance coaches and specialty vehicles would be the most likely use cases of hydrogen in New Zealand, particularly in the near-to-medium term while industrial applications and use as an aviation fuel were also possible significant sources of hydrogen demand in the future depending on technological developments. The modelling also estimated that New Zealand could be competitive in an export market for hydrogen in the Asia-Pacific region out to 2030. Some use cases were also considered but not modelled, including rail, maritime, and electricity service applications.
12. Castalia also provided a limited assessment of possible government interventions to speed up the development of hydrogen, preserve infrastructure options and reduce the likelihood of import path dependency. However, these interventions, and the differing scenarios they would create, were not evaluated comprehensively, as this was intended only as an initial outline of the sorts of interventions that could be developed more fully as part of the Roadmap.

Hydrogen Regulatory Settings Review

13. In early 2022, MBIE engaged PricewaterhouseCoopers (PwC) to undertake a review of whether existing regulatory frameworks were fit for purpose to support a future hydrogen economy in New Zealand. The report, which was completed in June 2022, provided a view on likely pathways, the readiness of existing regulations across multiple frameworks, and what regulatory changes are likely the highest priority based on these considerations.
14. We will brief you in September on the details of the final PwC report, and possible next steps for progressing a programme of work to update the regulatory regime for new hydrogen uses.

The Roadmap could have a range of objectives and desired outcomes

15. The Hydrogen Vision of 2019 and subsequent statements by Ministers have endorsed green hydrogen (produced through low-emission methods) as a likely contributor to decarbonisation of hard-to-abate sectors, which is consistent with the focus of hydrogen strategies and roadmaps in other jurisdictions. However, it is less clear is the extent to which hydrogen is useful in decarbonisation relative to other technologies such as electricity.
16. The role of the Roadmap will be to test and quantify the benefit of government intervention to extend or accelerate hydrogen's role in decarbonising the New Zealand economy. It is less clear whether hydrogen will have a niche role or broader application in New Zealand across the other three objectives common in international strategies and roadmaps (diversifying energy supply, economic development and integration of renewables into the electricity network).

Diversifying energy supply

17. Diversifying energy supply is a key hydrogen objective for countries such as South Korea and Japan, who lack alternative renewable fuels and generation sources. It is also increasing in prominence as an objective in Europe as a long-term solution to the Ukraine conflict.
18. It is less clear that this is an important objective for New Zealand, unless decarbonisation modelling indicates that very significant volumes of hydrogen are required in New Zealand. If this is the case, then a key consideration will be whether it is desirable to create this hydrogen domestically to avoid the risk of tying New Zealand to international import pricing for hydrogen.
19. In general, where hydrogen has a niche role, distributed production through electrolysis close to its use may be favoured compared to large scale production which requires subsequent

pipeline, rail, ship, or trucking transport. However, we note that Castalia's recent modelling indicates that the most likely scenario requiring significant hydrogen volumes is if hydrogen becomes a primary input into synthetic aviation fuel (SAF) in the next decade, and if technology develops to use hydrogen in New Zealand steel production. Both of these uses will require very large hydrogen volumes. The implications of these steel and SAF scenarios would be explored in modelling for the Roadmap.

Economic development

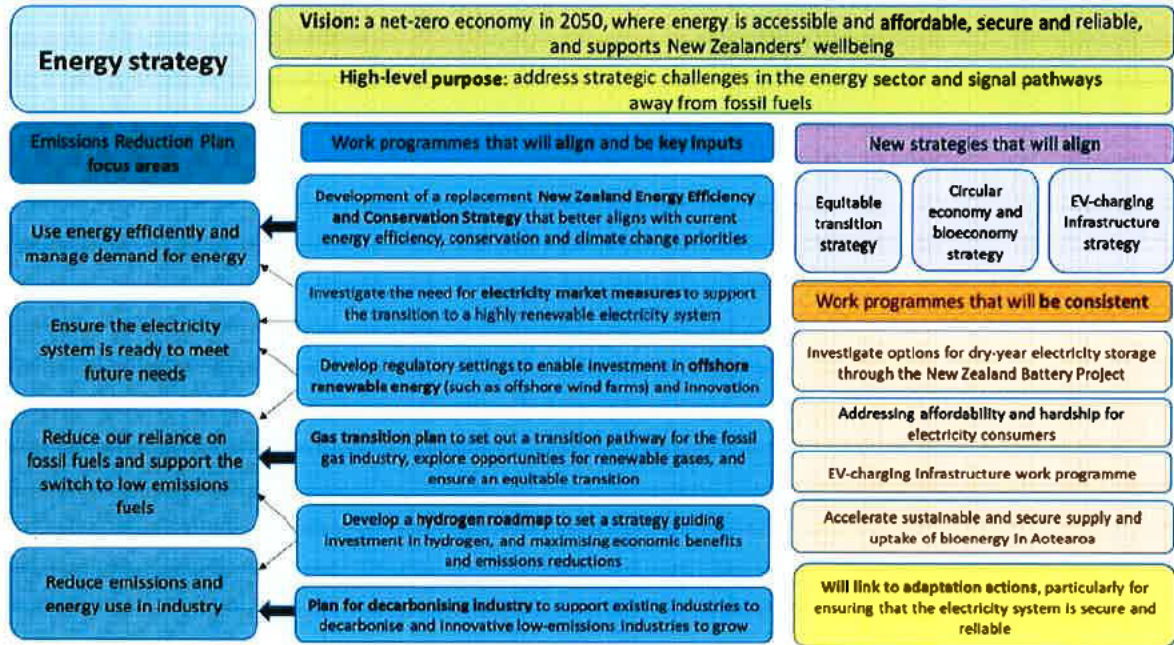
20. Economic development is a key objective of countries such as Australia who plan for the development of a large hydrogen export market. While there are private sector interests in New Zealand evaluating the feasibility of hydrogen export, it is less clear that large scale export is a valuable objective for New Zealand, compared to concentrating on domestic hydrogen production for decarbonisation, or direct electrification. However, it is likely that there is value for New Zealand in the R&D and innovation space and also in the economic transformation that may take place in fulfilling the other objectives such as decarbonisation.
21. Hydrogen also presents potential opportunities to contribute to a just transition for communities and workforces that are likely to be the most disrupted in a transition to a low-carbon economy. Hydrogen has the potential to utilise existing assets, skills, and workforces in key areas such as Taranaki and Southland, where Just Transition initiatives are currently underway.

Integration of renewables

22. Considering renewables integration, work is underway through the NZ Battery project to understand the potential for hydrogen as a dry year security measure. The outcome of this work will be integrated into the Roadmap work, as will similar work that will consider the transition of the electricity system to 100 per cent renewable electricity by 2030.
23. Alongside high-level objectives, other desired outcomes from a successful Roadmap could include:
 - a. Providing certainty and signalling to potential parties and investors to a hydrogen market in New Zealand that gives market participants confidence to invest in the production, use, distribution and import/export of hydrogen. Stakeholders consider that the uncertainty risk can be managed in the near-term as many projects are smaller-scale, focused on demonstration and managed on a case-by-case exemptions basis with regulators, but investment may be dampened as projects look to scale up.
 - b. Providing flexibility to allow New Zealand's hydrogen pathway to adapt to new use cases and technologies as they develop.
 - c. Helping to avoid stranded assets or missed opportunities to redeploy existing infrastructure, workforces and expertise from complementary activities and industries (i.e., fossil gas).
 - d. Setting out a programme of work to adapt the regulatory environment to better enable the production, distribution and use of hydrogen in New Zealand, with sequencing that takes into account the likely pathway of future uses and the current suitability of existing regulations to these uses to determine the priority of regulatory work.
 - e. Helping to guide decisions in research, science and innovation to unlock opportunities around hydrogen, especially where new technologies are needed to fully realise these opportunities, such as in industrial processes and aviation.
 - f. Strengthening co-operation on hydrogen with key international partners.

The development of the Roadmap will have implications for related work

- 24. There are a number of workstreams across the Energy and Resources portfolio and other portfolios administered by MBIE that will have implications for the Roadmap. The extent of the interaction with the Roadmap, and the timeline of any interdependencies will be determined as the Roadmap and related workstreams progress through regular engagement and co-ordination. Further detail on these projects and their relation to the roadmap is attached as **Annex Three**.
- 25. The figure below shows the relationship between the Roadmap and the broader Energy Strategy and its related plans.



- 26. We will also look to co-ordinate with workstreams across government that are likely to have implications for the development of a hydrogen industry in New Zealand. This includes the Ministry of Transport's Freight and Supply Chain Strategy, the proposed Natural and Built Environments Act being developed by the Ministry for the Environment and hydrogen-related work being carried out by EECA.

9(2)(f)(iv)

We are planning to develop the Roadmap in two phases

29. Given the interactions with other in-development workstreams as above, we consider a phased approach to the Roadmap's development is the most appropriate and beneficial way forward. This would allow exploration of different objectives before the more detailed costs and benefits of potential government measures to support hydrogen are considered.
30. The table below provides a high-level indicative timetable for the two-phase approach to the development of the Roadmap. We propose completing the first phase of development by mid-2023, with the completion of the second phase in 2024 prior to the finalisation of the Energy Strategy.

Phase	Major Steps	Indicative Date
Phase One: Sector engagement and commissioning further modelling work	Undertake early engagement with iwi, the energy sector and other interested stakeholders on their priorities for the Roadmap	September / October 2022
	Update you on objectives and approach to the Roadmap	November 2022
	Further detailed engagement	November 2022 – mid-2023.
	Commission further modelling to examine specific future scenarios	From September 2022 – early to mid-2023
	Report back to Ministers	Mid-2023
	Publish interim Roadmap	Mid-2023
Phase Two: Further work to assess a package of measures to support the development and use of hydrogen in New Zealand.		From mid-2023
Roadmap finalised and integrated with Energy Strategy		2024

Phase One of the roadmap would involve engagement with the energy and related sectors and iwi, followed by detailed scenario modelling

31. Engagement with the sector, iwi, and other stakeholders in Phase One would include:
- initial engagement about what would be useful in a hydrogen roadmap, their assessment of the relative priority of the objectives outlined above, their views on the BAU pathway and regulatory assessment outlined in the Castalia and PwC reports, and what interventions they think are necessary to support the development of hydrogen. We will update you following this initial engagement.
 - more in-depth engagement/workshops with a wider group of stakeholders, building on the results of the initial engagement.

32. Partnership with iwi will also be important in the development of the Roadmap. A number of iwi, hapū and rūnanga are already involved in hydrogen projects across the country, including Tūaropaki Trust in Taupō, Paranihinihi ki Waiotara in Taranaki and Murihiku Regeneration in Southland. It is also likely that iwi in Taranaki will have a strong general interest in the Roadmap given its links with the Just Transition work programme in the area and the concentration of energy-related industries in that region.

33. 9(2)(g)(i)

9(2)(g)(i)

Additionally, we will use existing channels, like the Energy and Resource Markets Pānui, to begin engagement and communication with other iwi and Māori across the country to communicate the opportunity for engagement on the Roadmap. We understand there are a number of policy and other engagements with iwi in the energy and resources sectors underway, and we will work to align these engagements where possible.

34. 9(2)(g)(i)

We would look to supplement this work with further modelling on specific hydrogen scenarios and outcomes

35. Following early engagement, we would look to augment stakeholder discussions with further modelling on specific hydrogen scenarios to inform the Roadmap. This could include modelling of:

9(2)(f)(iv)

36. At the end of Phase One we would report back to Ministers on the outcomes of the modelling and stakeholder feedback with recommendations on the primary objectives for roadmap development and seek to publish an interim Roadmap by mid-2023.

Phase Two of the Roadmap would involve detailed analysis of measures to enable further development and use of hydrogen

37. Phase Two would consider what measures the government might choose to adopt to support the development and use of hydrogen so that the objectives identified in Phase One are more likely to be achieved in a timely fashion. This analysis would consider the relative costs and benefits of these interventions. Feedback from Ministers on the Phase One objectives analysis would enable work on the development of interventions to be more focused.

9(2)(f)(iv)

Risks and mitigations

40. We have identified the following key risks and mitigations in the initial scoping of the Roadmap:

9(2)(g)(i)

9(2)(f)(iv)

Next steps

41. We will keep you updated throughout the development of the Roadmap.
42. We plan to publish a page on the MBIE website outlining the work to date on the Roadmap and the planned approach and timeframes for its development. This page will be kept updated as the work progresses.
43. We intend to begin initial engagement with iwi, the energy sector, other interested parties on what would be valuable to include in a hydrogen roadmap. We intend to seek specific views from stakeholders on the following matters:
- the relative merits of the four common objectives in hydrogen strategies and roadmaps developed internationally;
 - whether there are other objectives for the Roadmap that should be evaluated based on New Zealand-specific circumstances;

- c. the findings of the hydrogen scenario modelling and hydrogen regulation study reports; and
- d. the most pressing barriers to the development of a hydrogen industry in New Zealand and possible mitigations.

Annexes

Annex One: National Hydrogen strategy objectives

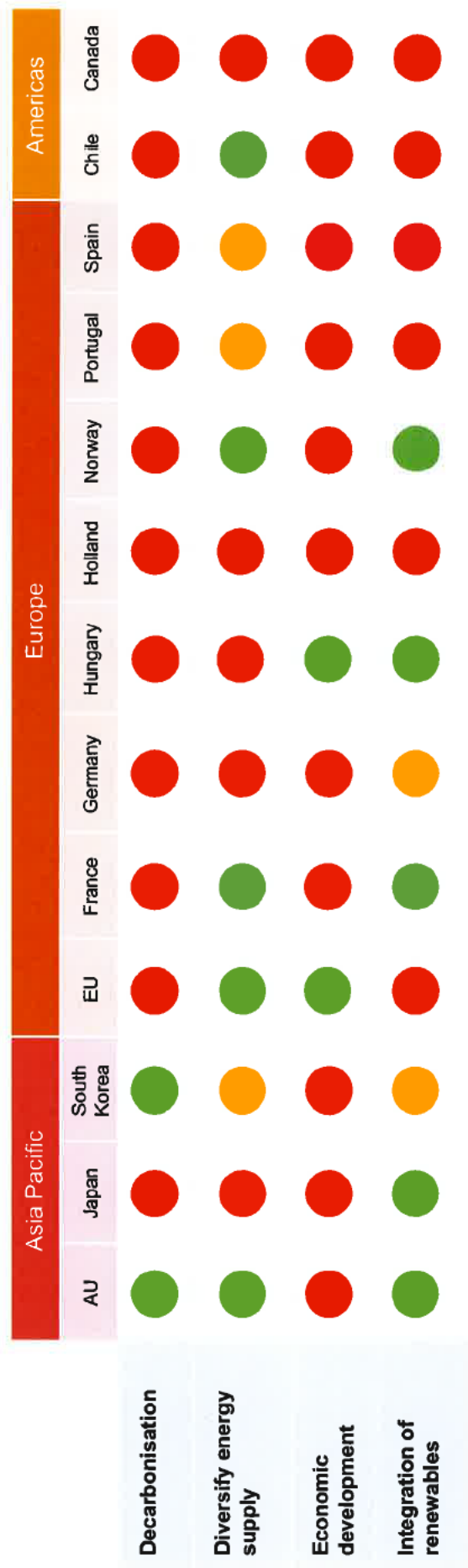
Annex Two: Modelled hydrogen demand in a BAU scenario

Annex Three: Related Energy and Resource portfolio and MBIE work

Annex One: National Hydrogen Strategies

National hydrogen strategies are being prioritised across four key objectives: **decarbonisation** as a pathway to meet national climate commitments; **diversification of the energy supply chain** away from fossil fuels and from reliance on electricity; **economic development** associated with the sizeable investment opportunities in hydrogen; and **integration of renewables** into existing networks.

New Zealand will also need to consider these objectives in its national strategy, to provide guidance to regulators and business. The absence of strategic policy objective(s) is creating uncertainty for regulators and investors on how to respond to the hydrogen opportunity.



Source: New Zealand's Hydrogen Regulatory Pathway (PwC)

The table 2 below aims to summarize the differing objectives and sectoral priorities of the published national hydrogen strategies.

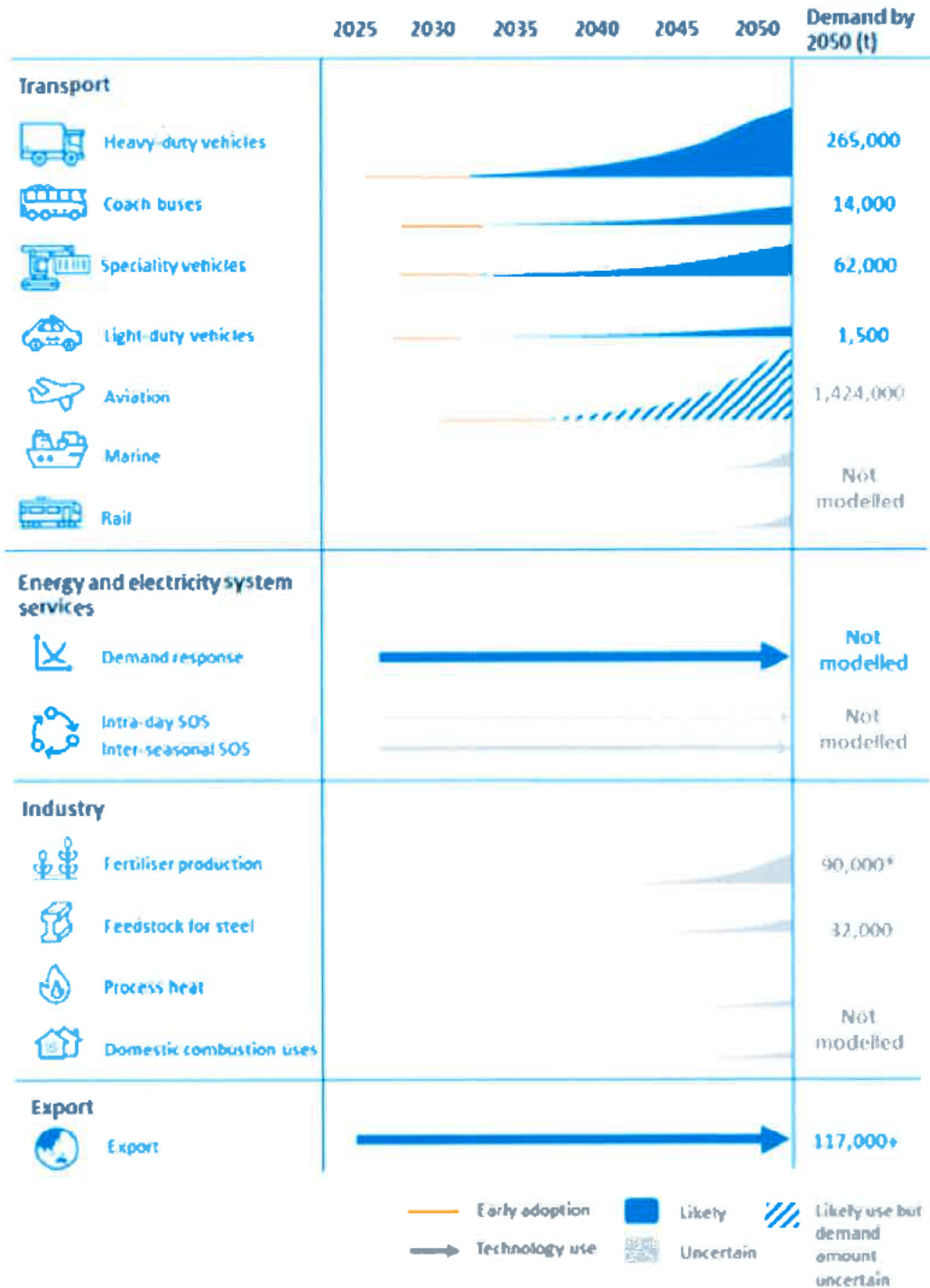
CATEGORY	ASIA			EUROPE						LAC	NORTH AMERICA		
	Australia	Japan	South Korea	EU	France	Germany	Hungary	Netherlands	Norway	Portugal	Spain	Chile	Canada
Strategy contains timeline for market development with targets	●	●	●	○	●	●	●	○	○	●	●	●	●
Strategy contains hydrogen cost targets	●	●	●	○	○	○	○	○	○	○	○	○	○
Strategy includes measures to support H2 development	●	●	●	●	●	●	●	●	●	●	●	●	●
Direct investments	●	●	●	●	●	●	●	●	●	●	●	●	●
Other economic and financial mechanisms	●	●	●	●	●	●	●	●	●	●	●	●	●
Legislative and regulatory measures	●	●	●	●	●	●	●	●	●	●	●	●	●
Standardisation strategy and priorities	●	●	●	●	●	●	●	●	●	●	●	●	●
Research & development initiatives	●	●	●	●	●	●	●	●	●	●	●	●	●
International strategy	●	●	●	●	●	●	●	●	●	●	●	●	●
Strategy addresses social issues for H2 development	●	○	○	○	○	○	○	○	○	○	○	○	○
Strategy includes review and update	○	○	○	○	○	○	○	○	○	○	○	○	○
Strategy H2 target source by 2030	○	○	○	○	○	○	○	○	○	○	○	○	○
Strategy H2 target source by 2050	○	○	○	○	○	○	○	○	○	○	○	○	○
Import / Self-reliance / Export	○	○	○	○	○	○	○	○	○	○	○	○	○
MAIN GOALS / SERVICES													
Decarbonisation	Lower	Immediate	Lower	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate
Diversify energy supply	Lower	Immediate	Long term	Lower	Lower	Immediate	Immediate	Immediate	Lower	Immediate	Immediate	Lower	Immediate
Foster economic growth	Immediate	Immediate	Immediate	Lower	Immediate	Immediate	Lower	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate
Integration of renewables	Lower	Lower	Long term	Immediate	Lower	Immediate	Lower	Immediate	Lower	Immediate	Immediate	Immediate	Immediate
SECTORAL PRIORITIES													
Manufacturing	Immediate	Immediate	Lower	Lower	Lower	Lower	Immediate	Immediate	Lower	Immediate	Lower	Immediate	Immediate
Industry	Immediate	Immediate	Lower	Lower	Lower	Lower	Immediate	Immediate	Lower	Immediate	Lower	Immediate	Immediate
Iron and Steel	Long term	Lower	Lower	Long term	Immediate	Immediate	Long term	Immediate	Lower	Immediate	Lower	Not seen	Immediate
Chemical Feedstock	Immediate	Lower	Not seen	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate
Refining	Not seen	Lower	Not seen	Immediate	Immediate	Immediate	Immediate	Immediate	Lower	Immediate	Immediate	Immediate	Immediate
Others (ammonia, etc.)	Not seen	Not seen	Not seen	Not seen	Immediate	Lower	Long term	Lower	Not seen	Immediate	Lower	Not seen	Immediate
Power	Lower	Immediate	Immediate	Lower	Not seen	Not seen	Lower	Lower	Not seen	Lower	Lower	Not seen	Lower
Power generation	Lower	Lower	Lower	Lower	Not seen	Not seen	Lower	Lower	Not seen	Lower	Lower	Not seen	Lower
Back up services	Lower	Lower	Lower	Lower	Not seen	Not seen	Lower	Lower	Not seen	Lower	Lower	Not seen	Lower
Transport	Lower	Immediate	Immediate	Lower	Lower	Lower	Long term	Immediate	Lower	Lower	Lower	Long term	Immediate
Passenger vehicles	Immediate	Long term	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate	Lower	Immediate	Lower	Long term	Immediate
Medium and heavy duty	Immediate	Long term	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate	Lower	Immediate	Lower	Long term	Immediate
Buses	Immediate	Long term	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate	Not seen	Immediate	Lower	Long term	Immediate
Rail	Lower	Lower	Lower	Long term	Lower	Long term	Lower	Lower	Immediate	Long term	Lower	Long term	Long term
Maritime	Long term	Lower	Lower	Long term	Lower	Long term	Lower	Lower	Immediate	Long term	Lower	Long term	Long term
Aircraft	Lower	Lower	Not seen	Long term	Immediate	Long term	Not seen	Lower	Lower	Lower	Lower	Long term	Long term

Source: World Energy Council
 Legend: ● Detected, ○ Mentioned, ○ Not seen
 Color coding: Immediate priority (dark blue), Long term priority (medium blue), Lower priority (light blue), Not seen (white)

Source: World Energy Council Working Paper May 2021: National Hydrogen Strategies

Annex Two: Modelled hydrogen demand in a BAU scenario

Figure 0.2: Illustration of hydrogen uptake in BAU scenario



Note: Figures are rounded.

*For fertiliser production, around 1 percent of annual demand will be produced in the short-term using green hydrogen from wind-powered hydrogen production at Kapuni.

Source: Castalia – New Zealand Hydrogen Scenarios Report: June 2022

Annex Three: Related Energy and Resource portfolio and MBIE work

Energy and Resources portfolio work	Relation to the Roadmap
Energy Strategy (end 2024)	Overarching strategy that includes the Roadmap and other energy-related work programmes to meet commitments in the ERP.
Offshore renewables regulatory framework (2023)	There is strong interest in the development of offshore renewable generation resources to meet the electricity demands of hydrogen production from electrolysis.
Gas Transition Plan (2023)	The Gas Transition Plan is being developed by MBIE and the Gas Industry Company. There are strong links to hydrogen as it is a potential supplement or replacement to fossil gas. There is also the potential for existing gas assets, such as storage and distribution assets, to be repurposed for hydrogen or its derivatives.
Electricity market measures to support the energy transition	Electricity is a key input in the production of green hydrogen through electrolysis. Where production is grid-tied, electricity costs and network capacity are expected to be a significant factor in the economic and practical case for hydrogen. There are also significant implications for the electricity market and wider consumers if a large-scale hydrogen production industry develops in New Zealand, and if exports come to play a key role.
Decarbonising industry action plan	Hydrogen may play a key role in supporting the decarbonisation of some hard-to-abate sectors, namely steel production, but also potentially other applications where high-temperature (>300C) process heat is required.
NZ Battery Project	As part of its alternative technologies workstream, the NZ Battery Project is considering hydrogen and has engaged engineering consultancy WSP to carry out analysis.
Southland just transition	The development of a high-value, domestic hydrogen ecosystem in Southland is a major focus of the clean energy work stream of the just transition process. The Just Transitions Partnership team have been working closely with Ngāi Tahu to develop a mechanism which will deliver on both Government and iwi ambitions for the sector.

Energy and Resources portfolio work	Relation to the Roadmap
MBIE Innovative Partnerships airport hydrogen hub study (Research, Science and Innovation Portfolio)	<p style="font-size: 2em; color: red; margin: 0;">9(2)(f)(iv)</p>
Standards New Zealand - Reviewing standards for the future integration of hydrogen	Standards New Zealand is leading a comprehensive review of hydrogen standards on behalf of WorkSafe-Energy Safety. A draft report outlining a suite of standards solution recommendations for the regulator to consider is currently being finalised. This workstream is being undertaken in conjunction with the Hydrogen Regulatory Settings Working Group.



BRIEFING

Update on hydrogen policy developments – June 2020

Date:	3 June 2020	Priority:	High
Security classification:	In Confidence	Tracking number:	3569 19-20

Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	<p>Note the updates to hydrogen policy developments outlined in this briefing and the implications for a future hydrogen strategy and the relationship to electricity price.</p> <p>Agree to MBIE publishing the Hydrogen supply and demand model on our web page.</p> <p>Agree to forward this briefing to the Minister for the Environment and the Minister for Climate Change.</p>	3 June 2020

Contact for telephone discussion (if required)			
Name	Position	Telephone	1st contact
Justine Cannon	Manager, Energy Markets Policy, MBIE	04 901 8597	9(2)(a)
Mark Pickup	Principal Policy Advisor, Energy Markets Policy, MBIE	04 474 2628	✓

Minister's office to complete:

- | | |
|---|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Declined |
| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments



BRIEFING

Update on hydrogen policy developments – June 2020

Date:	3 June 2020	Priority:	High
Security classification:	In Confidence	Tracking number:	3569 19-20

Purpose

This briefing covers the results of the modelling that Castalia has produced for MBIE on hydrogen supply and demand and explores implications for our hydrogen roadmap or strategy.

Recommended action

The Ministry of Business, Innovation and Employment (MBIE) recommends that you:

- a **Note** the updates to hydrogen policy developments outlined in this briefing and the implications for a future hydrogen strategy and the relationship to electricity price.

Noted

- b **Agree** to MBIE publishing the Hydrogen supply and demand model on our web page.

Agree / Disagree

- c **Agree** to forward this briefing to the Minister for the Environment and the Minister for Climate Change.

Agree / Disagree

Justine Cannon
Manager, Energy Markets Policy
Building, Resources and Markets, MBIE

..... / /

Hon Dr Megan Woods
Minister of Energy and Resources

..... / /

Preliminary modelling for the Hydrogen Roadmap/Strategy

Background

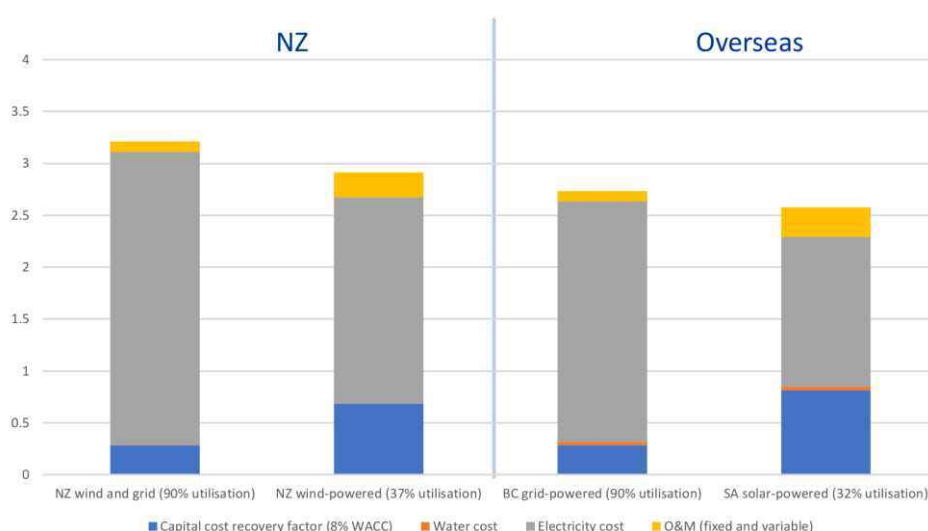
1. In September 2019 the Government released the Hydrogen Vision (the Vision). This document outlined plausible pathways for the development of hydrogen in New Zealand, but did not undertake any quantitative or numeric analysis on the issues concerning hydrogens future use.
2. Following the Vison, the Government intends to develop a hydrogen roadmap or strategy. Hereafter, referred to as the Roadmap.
3. The Roadmap will require a considerable amount of modelling and analysis in order to evaluate the potential scenarios for hydrogens future in New Zealand and to identify the scenario or pathway that fits most closely with the Government's post COVID-19 development priorities to ensure a low carbon economy.
4. To help guide the Roadmap's initial development, in April 2020 MBIE commissioned Castalia to undertake modelling of hydrogen supply and demand pathways in New Zealand. Castalia has now delivered this modelling work to MBIE.
5. The purpose of this work was to help inform the design of the upcoming Roadmap by carrying out a preliminary investigation of the expected costs of New Zealand produced hydrogen in order to gain an understanding how the economy may benefit from the introduction of hydrogen and at what cost.
6. Interpretation of the model findings will help direct the scope of the upcoming Roadmap by highlighting the areas where hydrogen use and development should be focused on in the New Zealand economy.

Castalia's main conclusions

7. Castalia's main conclusions from their modelling are:
 - Economic, large scale green hydrogen production in New Zealand is possible, but is highly dependent on the electricity price path here and overseas.
 - When compared to locally produced hydrogen, imported hydrogen is likely to be more cost competitive at the point of use (e.g. into a major port city like Auckland or Tauranga).
 - Heavy vehicles will be the main driver of hydrogen demand in New Zealand. Other uses are less likely to be economic compared to alternative energy.
8. Officials agree with Castalia's observation on the effect of the price of electricity on hydrogen production costs, and from this it follows logically that imported hydrogen maybe cheaper than internally produced hydrogen in some circumstances. However, we note there is a lot of uncertainty over future electricity prices and hydrogens transport costs for both shipping and by land, making this conclusion somewhat tentative.
9. We agree with Castalia's conclusion that heavy vehicles likely have the largest demand internally for hydrogen and note this conclusion also aligns with the views expressed in the Government's Green Freight Strategy.
10. However, we do not necessarily agree that other uses are likely to be uneconomic. The Vison noted that there are a number of industries actively exploring hydrogen electrolysis to provide zero carbon hydrogen for industrial uses. For example, the Government has already provided \$20 million in support to a Hiringa/Balance project to produce green hydrogen for industrial purposes.

Discussion of Model Findings

11. The Castalia model (The Model) findings represent a study at a point in time for a technology that is advancing rapidly with falling costs. While Castalia have endeavoured to forecast expected technology and other cost assumptions in their model, any prediction is time limited, and therefore we would expect to revisit many of these predictions as part of the Roadmap's development.
12. The Model evaluates a number of options for hydrogen production in New Zealand, from large to small electrolysers, both grid connected and standalone wind powered operations. Predicted costs are compared to similar options in South Australia and British Columbia and the current IRENA benchmark for hydrogen cost per kg.
13. A key observation of the modelling is that the cost of hydrogen production depends more on the electricity price and utilisation of the electrolyser than its capital cost, although there is a scale efficiency for capital cost making smaller units much more expensive. This is illustrated below.

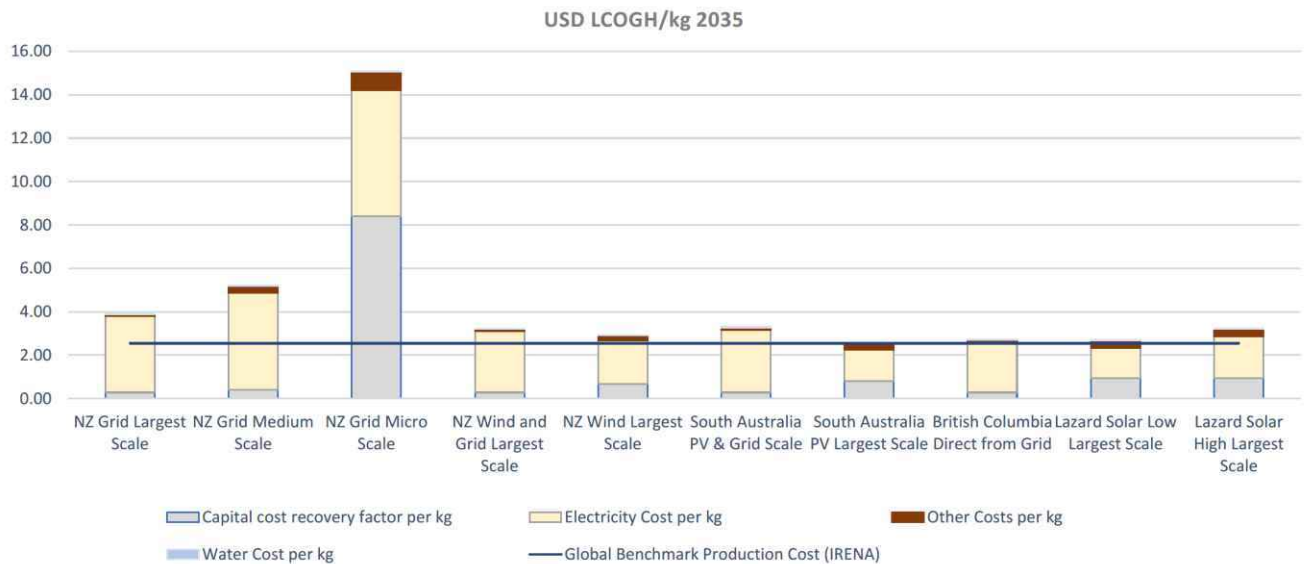


14. The initial conclusion from this work is that Australian and Canadian costs are likely to be below New Zealand costs over time. Whether they remain so, largely reflects the predicted future price path of electricity in each country. Castalia has assumed a uniform 0.25 per cent decrease in each country per year due to declining renewable energy capital costs. Sensitivity analysis provided by Castalia indicates that variance in electricity price can significantly alter this conclusion, changing the relative of each country.
15. In New Zealand our forecasted wholesale electricity price and electricity futures price remains stubbornly above the cost of new renewable investment, with the forward price still predicted to rise slightly while new investment costs of wind decline. This issue will be explored later as it also has bearing on how the hydrogen Roadmap integrates with other renewable energy policy developments and potential energy investments.

Expected hydrogen price in New Zealand

16. The figure below presents the Model results for New Zealand hydrogen production costs based on Castalia's predictions on future technology and electricity price changes compared to Australia, Canada, and an IRENA benchmark and Lazard¹ industry LCOE calculation.

¹ Lazard is an asset management and financial advisory firm that publishes annually a world recognised study on the Levelised Cost of Electricity Generation. Its latest report (LCOE 12.0) shows a continued



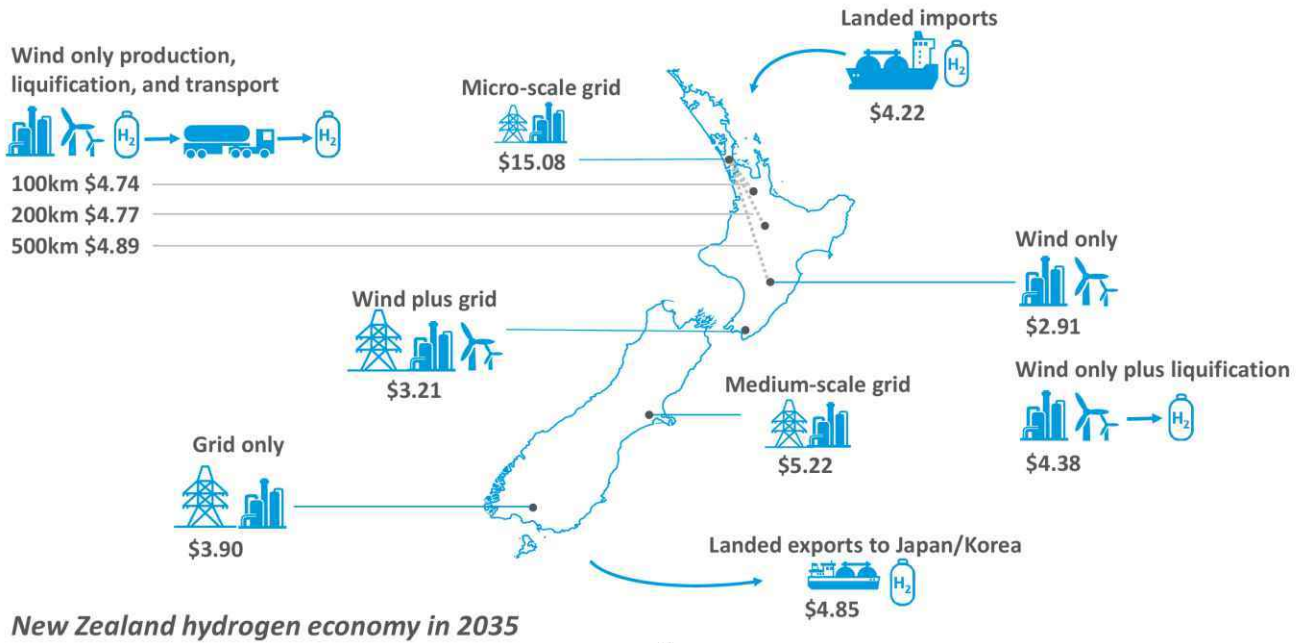
17. The tallest bar is for a small micro grid hydrogen installation. Such installations are not very cost efficient, mainly due to their high capital cost. However, as plant size increases the capital cost per kg of hydrogen decreases.
18. The predicted lower cost options are to the right hand side and for both Australia and New Zealand are for standalone solar and wind generation respectively. Similar scale operations with grid connections have a slightly higher price.
19. In contrast a grid connected electrolyser in British Colombia, with its large hydro capacity, has one of the lowest predicted prices.
20. These cost trends reflect both expected technology costs and also the cost structures in contemporary electricity markets, which must price in security, reliability, voltage and frequency support and transmission costs. Standalone operations avoid some of these additional costs, but if reliant on intermittent generation, will have less reliable operation, threatening hydrogen production schedules.
21. Hence, the most likely stable operation for a large export hydrolyser is a grid connected solar or wind farm where it can use its own generation when available and grid based electricity when not. Castalia comment that the modelling “assumes that the hydrogen producer would either build its own windfarm or purchase from a windfarm under a long-term supply agreement (basically at cost). This archetype is relevant because we are wanting to answer the high-level question whether NZ could competitively supply world markets at scale.”
22. A real world hydrogen producer will optimise its production decisions by making a trade-off between producing (and recovering capital costs) and the cost of power. At times such a wind generator may make more money selling power to the grid than making hydrogen, and at other times (such as when there is peak wind or hydro spill) grid purchased electricity will be cheaper.

Distribution of hydrogen production

23. Castalia’s analysis of the economics of hydrogen lead it to the following conclusions about where hydrogen is likely to be produced or used in New Zealand.

decline in the cost of generating electricity from alternative energy technologies, especially utility-scale solar and wind.

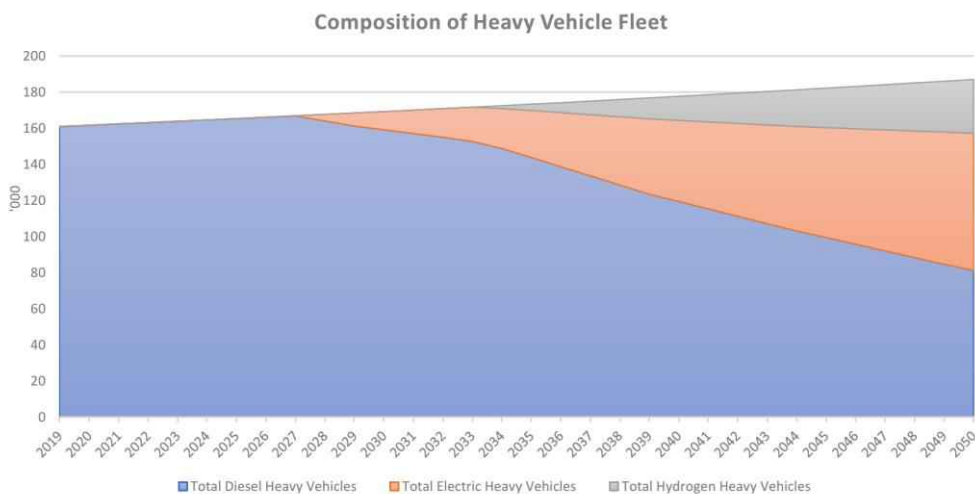
Where in New Zealand will GH2 be produced?



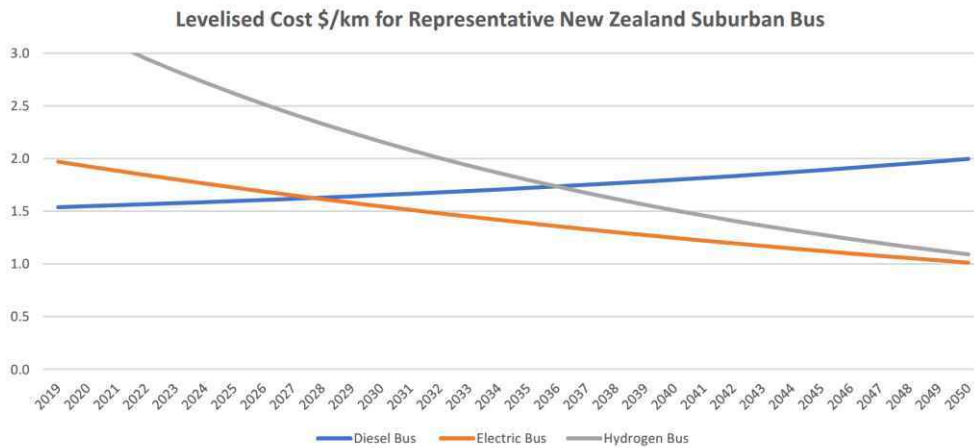
24. This diagram illustrates Castalia's different predictions around hydrogen production cost, indicating that hydrogen produced in some locations will be cheaper than imports and in other cases more expensive. The difference largely depends on the cost of input energy and transport costs. These conclusions will be revisited as part of the Roadmap, but do make sense in terms of Castalia's analysis of future electricity prices.

The use of hydrogen in transport

25. Castalia predict that the largest use of hydrogen will be in heavy transport, as illustrated in the following diagram, where hydrogen reaches an economic tipping point relative to alternatives in the mid 2030's for heavy trucks. Electric vehicles (EVs) remain more cost effective for light vehicles. These predictions are consistent with international views, such as those of the IEA, although viewpoints differ on when the tipping point favouring hydrogen will be, with some expecting earlier than 2030.



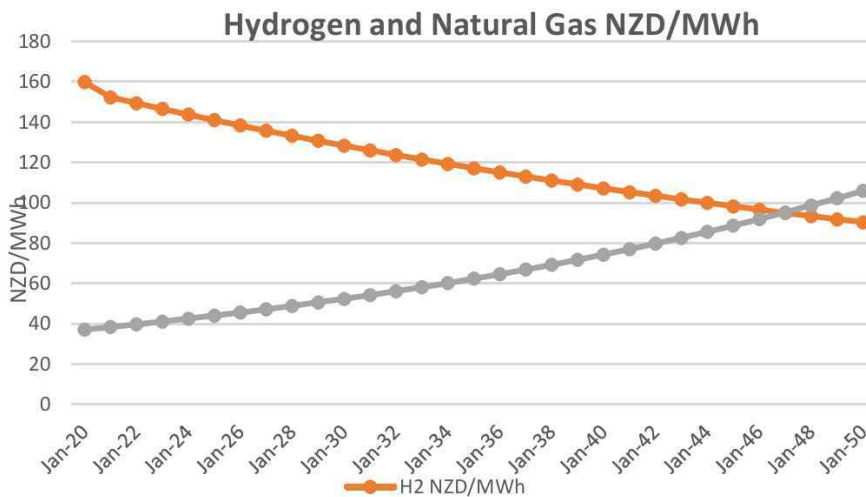
26. Buses are another potential market for hydrogen. Castalia's prediction is that both EV's and hydrogen batteries will become more cost efficient than diesel buses, although they predict that EV buses will remain a better option than hydrogen, as indicated below.



27. This prediction, of EV superiority for suburban buses, is consistent with other international predictions. However, we note that hydrogen buses have an acknowledged advantage for longer distance bus travel and also in hilly cities such as Wellington and Dunedin, where the higher weight of a batteries will limit performance and passenger capacity on hills.

Blending hydrogen into gas networks

- 28. There are a number of international trials underway to investigate hydrogen injection into reticulated gas networks. Firstgas, in New Zealand, is currently undertaking one such trail, with support from the Provincial Growth Fund (PGF).
- 29. Castalia’s concluded that blending hydrogen into natural gas is not competitive at the moment, and will only be economic when hydrogen production costs fall below natural gas costs (allowing for emissions pricing).



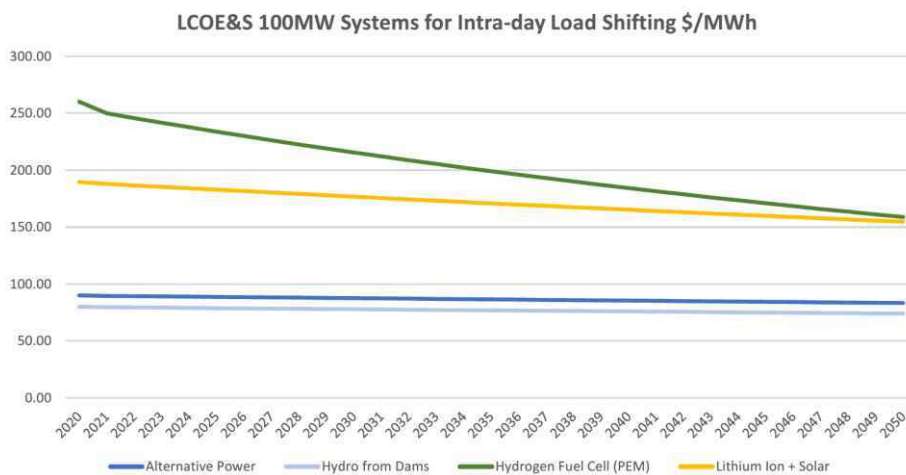
30. However, hydrogen is much more cost competitive compared with imported Liquefied Natural Gas (which is currently around twice the cost of New Zealand natural gas). This comparison has implications for any consideration of future LNG imports should this ever be proposed by a future government or private party.

Hydrogen use to support intermittent renewable generation

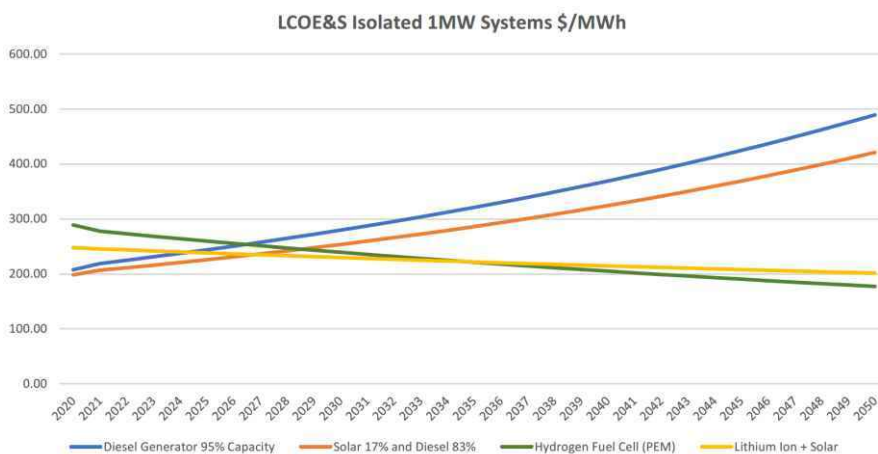
31. Castalia also considered hydrogen as support for intermittent renewables over time.



- 32. Castalia concluded that for the shortest time frame (minutes) existing hydro generators provide adequate frequency control, and that batteries will increasingly provide such services in future. Castalia also agreed with the ICCC that hydrogen was less suitable for longer inter seasonal storage.
- 33. Hydrogen may however, become more economic for intraday load shifting, where longer storage volumes are required than would be cost effective with batteries. Furthermore, the greater energy storage density of compressed hydrogen provides advantages over batteries in the amount of energy that can be stored for a given infrastructure footprint.



- 34. Castalia also identified that hydrogen fuel cells may be well suited to grid isolated communities such as the Chatham and Stewart Islands compared to diesel and solar alternatives with comparable characteristics to battery storage.



Water use in hydrogen production

- 35. Electricity is not the only input into green hydrogen production. Water is the other main ingredient.

36. The Vision discussed water use in hydrogen production and noted that green hydrogen is a cycle from water to energy and back to water and that the volume of water used is not large. Castalia was asked to quantify this water use to verify the assumptions expressed in the Vision.
37. The diagram below illustrates that a large scale grid connected hydrogen export plant that will be producing millions of dollars of export hydrogen per annum, uses around as much water as a large dairy farm.



38. Castalia's analysis assumed no water costs in New Zealand, apart from a small infrastructure costs for delivery. Water pricing is an issue that could affect hydrogen production, but is likely to be a very minor effect as the volumes of water used are very small compared to other industries that use water, meaning that hydrogen production extracts a much larger value per litre of water compared to a dairy farm for instance.

Implications for Renewable Energy Strategy

39. The major finding of the work by Castalia is confirmation of the significance of electricity price in the different scenarios for hydrogen production in New Zealand.
40. This work confirmed that hydrogen produced from grid based electricity in New Zealand is unlikely to be cost competitive with grid based electricity in very low cost highly renewable counties and regions such as British Columbia, using price projections based on our current electricity market operation.
41. New Zealand's new renewable generation investment costs continue to fall. Castalia modelling uses a starting Levelised Cost of Energy (LCOE) of \$61/MWh for wind and \$43/MWh for Australian solar. This LCOE of \$61/MWh is consistent with MBIE's recently commissioned study on updating wind production and costs data, 9(2)(ba)(i)
42. Castalia's modelling indicates that standalone solar in Australia and wind in New Zealand provides the cheapest hydrogen. But such generation is intermittent, making hydrogen production less stable, and so the minimal cost model in both countries for large scale hydrogen production is likely to be a standalone renewable energy plant supplemented with a grid connection.
43. Both Australia and New Zealand have similar cost structures in this scenario, though Australia solar plus grid is predicted to be slightly cheaper. This observation highlights the importance of future reforms that will act to reduce overall electricity market price.

44. Castalia modelled forward electricity prices across all countries dropping by a steady amount which reflected technology change. While in New Zealand the investment cost of new renewables continues to fall, our forward electricity price does not appear to date to be declining. For example the September 2023 quarterly Otahuhu futures price as of 29 May was \$94.75/MWh.
45. New Zealand electricity market prices take into account market expectations on future gas price and dry year supply risk. While new renewable costs may be declining, these other effects tend to mitigate that fall as the market prices in the risk of higher costs from thermal generation that will be needed when wind or hydro are not available.
46. Of the different budget bids that are being developed, the Onslow storage proposal, named "The New Zealand Battery", is the one intended to directly address this issue. This project, once completed, should provide sufficient water storage to bridge any future dry year shortage and also add support for much higher levels of renewable electricity. As a consequence, post Onslow completion around 2030, future electricity prices should more closely follow the downward trend of new renewable investment.
47. This should, all things being equal, reduce the small gap that will exist between Australian and New Zealand for the scenario of an electrolysis plant powered by the combination of grid plus standalone renewable energy.

Next Steps and Conclusions

48. Currently MBIE officials are reviewing the Castalia model.
49. The data contained in the Model and the data itself will be valuable to the wider hydrogen community in New Zealand.
50. Once we have reviewed the Model to our satisfaction we propose to make the Model available on MBIE's website. Castalia has reviewed the Model to ensure it contains no commercial or proprietary information.
51. The purpose of this modelling work was to provide indicators for the subsequent Roadmap.
52. Modelling indicates that there is a viable future for New Zealand as both a hydrogen user and hydrogen exporter, though the balance will depend heavily on future electricity prices.
53. Modelling indicates that the Roadmap should include a focus on:
 - a. How standalone and grid based electricity can best be integrated at a favourable price for electrolysis for large scale export use
 - b. The optimal way to extend hydrogen use into heavy transport
 - c. The use of hydrogen to support remote communities
54. MBIE has a current (small) budget bid to support the development of the Roadmap. If this budget is successful, we anticipate engaging external contractors from July 2020 and completing the Roadmap in Q1 2021.
55. If we are unsuccessful with this budget bid, we will engage with you to assess priorities and next steps. MBIE's ability to deliver the Roadmap solely from internal resources will depend heavily on other work commitments and its priority.



BRIEFING

Green hydrogen strategy: a vision for hydrogen in New Zealand

Date:	8 February 2019	Priority:	High
Security classification:	In Confidence	Tracking number:	2140 18-19

Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	<p>Agree with our proposed approach for developing a green hydrogen paper for New Zealand.</p> <p>Agree to direct MBIE to prepare a Cabinet paper seeking approval to delegate responsibility to release the paper to you in consultation with the Minister for Economic Development.</p> <p>Agree to forward this briefing to the Minister for Economic Development.</p>	11 February 2019

Contact for telephone discussion (if required)			
Name	Position	Telephone	1st contact
Andrew Hume	Manager, Energy Markets Policy	04 901 1474	9(2)(a) ✓
Miranda Birchler	Policy Advisor	04 896 5854	
Vidushi Challapali	Graduate Policy Advisor	04 897 5432	

The following departments/agencies have been consulted

- Minister's office to complete:**
- | | |
|---|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Declined |
| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments



BRIEFING

Green hydrogen strategy: a vision for hydrogen in New Zealand

Date:	8 February 2019	Priority:	High
Security classification:	In Confidence	Tracking number:	2140 18-19

Purpose

This briefing provides advice on our proposed approach for developing a green hydrogen paper for you to release at the Just Transitions Summit in New Plymouth on 9 and 10 May 2019 or at a later date of your choice. It also recommends that you direct the Ministry of Business, Innovation and Employment to prepare a Cabinet paper seeking approval to delegate responsibility for releasing the paper to you in consultation with the Minister of Economic Development, because of his Economic Development and Trade responsibilities.

Recommended action

The Ministry of Business, Innovation and Employment (MBIE) recommends that you:

a **Agree** with our proposed approach for developing a green hydrogen paper for New Zealand.

Agree / Disagree

b **Agree** to direct MBIE to prepare a Cabinet paper seeking approval to delegate responsibility to release the green paper to you in consultation with the Minister for Economic Development.

Agree / Disagree

c **Agree** to forward this briefing to the Minister for Economic Development.

Agree / Disagree

Andrew Hume
Manager, Energy Markets Policy
Energy & Resource Markets, MBIE

81.2.19

Hon Dr Megan Woods
Minister of Energy and Resources

101.2.19

Background

1. You have asked MBIE to develop a green hydrogen strategy for New Zealand for release in the first half of 2019.
2. MBIE has contracted ARUP (www.arup.com), a multinational professional services firm which provides engineering, design, planning, project management and consulting services to explore the current and future economic opportunities for hydrogen.
3. We have had an initial project scoping meeting with ARUP, where we discussed our vision, objectives, risks and opportunities, stakeholders, methodology and key deliverables. ARUP is currently working on a draft programme plan, methodology and literature review.
4. At the interagency level, we have established a working group with representatives from the Ministry of Foreign Affairs and Trade and the Ministry of Transport. From within MBIE there are representatives from the Science and Innovation, Energy Markets and Just Transitions policy teams. Its purpose is to provide input and feedback on work that ARUP and MBIE produce.
5. A steering group of senior MBIE leaders has also been established to oversee and provide guidance for the developmental process.

Approach for developing a green hydrogen strategy

6. We believe that hydrogen has the potential to play a significant role in New Zealand's energy system. Hydrogen offers a flexible and clean approach to energy for New Zealand. In the domestic market, hydrogen could potentially heat our buildings, power our vehicles, supply our industrial processes and increase energy system resilience. These applications represent opportunities to create jobs while lowering our CO₂ emissions and enhancing our energy system.
7. Internationally, demand for hydrogen is set to increase substantially over the coming decades. Countries like Japan that import most of their energy in the form of coal, oil and natural gas need cleaner energy to meet their CO₂ emissions reduction targets. Therefore, Japan, South Korea, United Kingdom, Germany, France and China have invested heavily in hydrogen research, development and demonstration projects, and in some cases, national strategies.
8. Organisations in the New Zealand domestic market are investing in hydrogen. For example, Ports of Auckland has committed to building a hydrogen production and refuelling facility. The company, along with its project partners Auckland Council, KiwiRail and Auckland Transport have invested in hydrogen fuel cell vehicles as part of the project. Similarly, Tuaropaki Trust has partnered with Japanese multinational Obayashi to construct a pilot hydrogen production facility using geothermal electricity. This indicates that New Zealand firms are seeing the potential and opportunities for hydrogen in our future economy.
9. With that said, the market ecosystem for production and use of hydrogen is in its infancy, and the New Zealand specific evidence base for policy making is not yet well developed. Therefore, we believe that it would be beneficial for the Government to engage New Zealanders in a conversation about the potential for building a hydrogen economy and about exploring the opportunities for hydrogen in our energy system.
10. We recommend that you agree to us developing a vision for hydrogen in New Zealand, in the form of a green paper with questions seeking stakeholder feedback. The paper would provide a broad vision that covers the scope of its potential and frames the discussion for its integration into a subsequent wider renewable energy strategy. The paper would also

provide a solid platform for seeking feedback from stakeholders about the challenges and opportunities for building a hydrogen economy in New Zealand.

11. This work could feed into a more fulsome strategy, which could be stand alone or integrated into a wider view of renewable energy or energy more generally. A two-stage process like this would enable stakeholders to engage in the process, and ensure any Government action is well supported and consistent with market direction.
12. This process is also consistent with the approach taken by Australia, who published a white paper in August 2018 called *Hydrogen for Australia's future*. The contents pages of this document are attached as Annex One. The paper concluded that Australia is well-positioned to benefit from the growth of hydrogen industries and markets. Australia has subsequently budgeted AU\$1.1 million to develop their full hydrogen strategy over the course of this year.
13. In addition, the Interim Climate Change Committee is due to complete its report at the end of April and we would like to align our wider renewable energy strategy work as much as possible with their report, while at the same time incorporating the outcome of the hydrogen green paper.
14. We are currently designing the outline or framework of the proposed paper. We have in mind a scope similar to the Australian white paper, though less extensive as it was a 60 page document. Another example of the type of document we envision is a short paper called *Energy Systems: A view from 2035* that was produced by ARUP for the UK. This document is attached as Annex Two.
15. A draft outline for the green paper representing the working and steering groups' thinking to date is attached as Annex Three.

Linkage with investment processes

16. The Provincial Growth Fund has received 43 energy related applications to date, several of these are hydrogen related. As a result of this, MBIE is developing a set of criteria for the assessment of energy projects to guide the Provincial Development Unit in its deliberations. The green hydrogen vision, as it develops, and the renewable strategy that will follow, will extend and develop these guidelines for the assessment of energy project funding.

Timing of release

17. We understand that you may wish to release the document at the Just Transitions Summit in May.
18. To achieve the May release date for the paper, we recommend that you direct us to draft a Cabinet paper seeking Cabinet's authority to delegate approval of the green paper's release to you, in consultation with Minister Parker, because of his Economic Development and Trade responsibilities.
19. We think that you will need to have delegated authority from Cabinet to release the final document because of the limited time available. This is illustrated in the two timelines, attached as Annex Four to this note.
20. This timeline diagram indicates that if full approval is required by Cabinet (option B), there may be insufficient time before the Just Transitions Summit, due to the parliamentary recess in April.
21. As such, we recommend that you forward this briefing to the Minister for Economic Development.

Communications with stakeholders

22. We have been made aware of concern amongst some stakeholders that a green hydrogen strategy is being developed without consulting them, as there have been no further announcements since the contract award to ARUP was made public. While you may choose to make an announcement about the green paper at the Summit in May, MBIE would like to inform stakeholders about the work before then.
23. Accordingly, we recommend that as part of our proposed approach, you agree to:
- issue a brief press release soon about the green paper being developed
 - MBIE publishing on our website some high-level information for stakeholders, including their opportunities to participate in the work, and
 - MBIE holding two workshops with key stakeholders, one in Christchurch and one in Auckland, to help inform the development of the green paper. ARUP in conjunction with the working group has developed a draft list of key stakeholders, which is attached as Annex Five.
24. An MBIE official (Mark Pickup) will also be presenting at an IEA public forum on hydrogen in Rotorua on February 20th. It would be useful to have an agreed position on the strategy/vision before then.

Communications plan

25. MBIE's communications advisors will prepare a full communication plan, including a draft speech and press release, key messages, reactive Q&As and other material, as required, for the release of the vision paper at the Just Transition Summit or at a later event.

Risks

26. The risks as assessed by MBIE and ARUP at this stage are outlined in the table below:

Risk	Description	Mitigation
Timeframes	As we are time constrained, we may not be able to develop the green paper within the timeframe.	MBIE to prepare a Cabinet paper seeking approval to delegate responsibility for releasing the paper to you in consultation with the Minister for Economic Development.
Stakeholder Response	There is concern amongst some stakeholders that a green hydrogen strategy is being developed without consulting them.	MBIE recommends you issue a brief press release soon on the green paper. MBIE will also publish some high-level information for stakeholders on the MBIE website. The information will outline the opportunities that stakeholders have to participate and contribute to the work. We will conduct two workshops with key stakeholders, one in Christchurch and one in Auckland, to help inform them about the development of the green paper.
Objective	There is a risk that some stakeholders may view the strategy as "picking winners", without a strong evidence base.	We will develop a vision for hydrogen in New Zealand, in the form of a green paper seeking feedback from stakeholders. There will be strong emphasis on stakeholder engagement, and we will collaborate and consult with all key stakeholders.

27. ARUP is developing a detailed risk register, which will outline the risks of this project and the suggested mitigation techniques.

Next steps

28. Once we have received your feedback on our proposed approach to developing the green paper for green hydrogen in New Zealand, we will begin drafting a paper for you to take to Cabinet, seeking approval for your approach. Attached to your Cabinet paper would be an early draft version of the green paper, or an outline to illustrate what the final document will look like.
29. We will then work with ARUP to complete the green paper in time for the Just Transitions Summit on 9 and 10 May 2019 in New Plymouth, if needed.
30. We will keep you updated you on our progress in our weekly Energy Resource Markets branch report.

Annexes

Annex One: Australian government example document contents

Annex Two: ARUP example document

Annex Three: Draft outline for the green paper to date

Annex Four: Timelines for approval of green paper

Annex Five: Draft list of key stakeholders

Annex One: Australian government example document contents

Annex Three: Draft outline for the green paper to date

New Zealand Hydrogen Future: A Green Paper

Executive Summary

- 0.1 Why hydrogen?
- 0.2 Why hydrogen now?
- 0.3 Why New Zealand?
- 0.4 What do we need to do?

1. Introduction

- 1.1 Aim and objectives of the green paper
- 1.2 Drivers of government, industry and key stakeholders

2. Hydrogen: a technical primer

- 2.1 Some properties of hydrogen (technical advantages and disadvantages)
- 2.2 Hydrogen production
- 2.3 Hydrogen storage and distribution
- 2.4 Hydrogen technical comparison/innovation cycle

3. The hydrogen opportunity

- 3.1 Opportunities for the domestic economy
- 3.2 A new export industry for New Zealand
- 3.3 A resilient energy system
- 3.4 Current challenges

4. Draft Green Paper

- 4.1 The hydrogen vision
- 4.2 The economic, environmental, social and cultural business case
- 4.3 Timeline for export and domestic applications
- 4.4 Government and industry actions/implementation

5. Next Steps

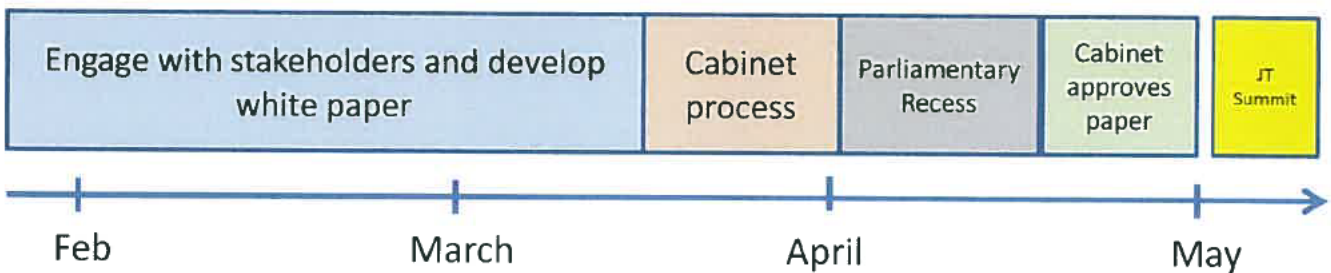
- 5.1 Potential program or policy actions
- 5.2 Potential industry/stakeholder actions
- 5.3 Further enabling research, development, demonstration and pre-commercial deployment
- 5.4 Feedback and finalisation process

Annex Four: Timelines for approval of green paper

Option A: Approval of paper by delegated Ministers



Option B: Approval of paper by Cabinet



If full approval is required by Cabinet, as shown in option B, there may be insufficient time before the Just Transitions Summit, due to the parliamentary recess in April.

Annex Five: Draft list of key stakeholders

Stakeholder Group	Examples of Stakeholders	Key Names & Contacts	Roles and Responsibilities	Paper Development Phase
1st Tier	MBIE, MoT, MFAT and MfE Reviewers Arup	Steering Group and Working Group and 1-1s with Consultants Alan Thomson, Linda Wright and Professor Ralph Sims Elizabeth Halsted and Kellie Charlesworth and Arup team		Workshop (1 in south island and 1 in north island) and invitation to feed back on the green paper
2nd Tier	Politicians	<i>Key Ministers</i> Min. Energy and Resources, Min. for Economic Development <i>Others Ministers?</i> Min. Regional Economic Development, Parliamentary Under-Secretary Foreign Affairs, Regional Economic Development, Min. Climate Change, Min. Transport, Ass. Min. Transport	Decision-Makers	
3rd Tier	Suppliers Other Key Stakeholders E.g.: Ministry Departments, CCO's WorkSafe NZ Mana whenua	Hydrogen Plant: Siemens, Obayashi, Tuaropaki Trust, Tauhara North No.2 Trust Vehicle Manufactures: Toyota; Mitsui; Audi; Mitsubishi; Honda Electricity: Vector; Transpower, Contact Energy, Genesis, Mercury Energy, Might River Power Kiwirail, Local Government NZ, EECA, ATEED, Callaghan Innovation, IEA, Unitech, World Hydrogen Forum, NZ H2 Association Iwi	Informers & Suppliers Suppliers & Potential Lobby Group Regulator Treaty partners	Workshop (1 in south island and 1 in north island) and invitation to feed back on the green paper

4th Tier	<p>Energy Advocates/ Key Lobby Groups</p> <p>Submitters around Hydrogen to draft Productivity Commission Report on Low Emissions Economy</p>	<p>The Petroleum Exploration and Production Association of New Zealand Business NZ Energy Council Sustainable Energy Association New Zealand Drive Electric Pure Advantage Greater Auckland Infrastructure NZ Sustainable Business Council Gas Industry Company</p> <p>Venture Taranaki Venture Southland RefiningNZ SpindleTop Law First Gas National Energy Research Institute PEPANZ Taranaki Regional Council Hiringa</p>	Advocates/Lobby Groups	Workshop (1 in south island and 1 in north island) and invitation to feed back on the green paper
5th Tier	General Public			Invitation to feedback on the green paper



BRIEFING

Travel options for Japan s 6(a) in October 2022

Date:	25 May 2022	Priority:	Medium
Security classification:	In Confidence	Tracking number:	2122-4476

Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	Indicate which opportunities you wish to prioritise for travel to Japan s 6(a) in the column provided	8 June 2022

Contact for telephone discussion (if required)				
Name	Position	Telephone		1st contact
Suzannah Toulmin	Acting Manager, Energy Markets Policy	04 901 3879	9(2)(a)	✓
Georgia Banks	Senior Policy Advisor, Energy Markets Policy	04 896 5882		

The following departments/agencies have been consulted
MBIE Research, Science and Innovation, Ministry of Foreign Affairs and Trade, Kāinga Ora – Homes and Communities, Te Tūāpapa Kura Kāinga – Ministry of Housing and Urban Development.

Minister's office to complete:

- | | |
|---|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Declined |
| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments



BRIEFING

Travel options for Japan s 6(a) in October 2022

Date:	25 May 2022	Priority:	Medium
Security classification:	In Confidence	Tracking number:	2122-4476

Purpose

You have requested a briefing on options for meetings and engagements for a trip to Japan s 6(a) in October 2022. Engagements are centred around your attendance at the Hydrogen Energy Ministerial in Japan. The briefing also includes options from your Research, Science and Innovation, and Housing portfolios.

Executive summary

The 5th Japan Hydrogen Energy Ministerial (HEM) provides an opportunity to attend a high-level global forum to promote cooperation on research, development and deployment of hydrogen technologies. It will also provide an opportunity for pull-aside bilaterals with many of your counterparts. No information is available yet on the dates for the conference, or the themes for discussion. Previous HEMs have included presentations by Japan and the International Energy Agency (IEA), round-table interventions by Ministers, and a separate industry conference.

s 6(a)

The Ministry of Foreign Affairs and Trade (MFAT) support travel to Japan s 6(a) in October, noting the significance of both the HEM s 6(a)

Recommended action

The Ministry of Business, Innovation and Employment recommends that you:

- a **Indicate** which opportunities you wish to prioritise for travel to Japan s 6(a) in the column provided

Noted

Suzannah Toulmin
Acting Manager, Energy Markets Policy
Buildings, Resources and Markets, MBIE

25 / 05 / 2022

Hon Dr Megan Woods
Minister of Energy and Resources

..... / /


Background

1. We briefed you on options for international travel in 2022 relevant to your Energy and Resources and Research, Science and Innovation portfolios in April [BR 2122-2753 refers], which included opportunities in Japan s 6(a) .
2. You have indicated that you are interested in travel to Japan s 6(a) in October 2022. This briefing explores potential options for engagement, building on previous advice. The options provided in April are included, as are some new opportunities.
3. We have not tested availability of any of the options detailed, we intend to contact overseas parties once your preferences are confirmed. We seek your feedback as to which visits or meetings you would like to progress.

Anchor event: Hydrogen Energy Ministerial, Japan

Event type	Person or Organisation	Purpose	Objective	Portfolio	Yes/No/Comments
Anchor event	5 th Japan Hydrogen Energy Ministerial (HEM)	Attend the HEM. No information is available yet on the dates for the HEM.	<p>The purpose of the event is to promote cooperation on research, development and deployment of hydrogen technologies between the attending countries.</p> <p>At this point the theme of the conference is not known, however attendance would be an excellent opportunity to engage with other member states on hydrogen work in their countries.</p> <p>We expect the format to be similar to the 1st HEM you attended in 2018, that of presentations followed by interventions from Ministers seated around the large U-shaped table. Note, you delivered a speech to the 4th HEM in 2021 via video-link.</p>	Energy and Resources	

Opportunities in Japan

Event type	Person or Organisation	Purpose	Objective	Portfolio	Yes/No/Comments
					
Visit to site or organisation	Mitsui	<p>Acknowledge Mitsui's interest and current investments in New Zealand, including its partnership with Hiringa Energy's Kapuni green hydrogen urea plant, and refuelling station networks, and interest in the Southern Green Hydrogen project, as a potential opportunity to export green hydrogen to Japan.</p> <p>Mitsui's and interests also extend into geothermal energy generation, methane reduction in agriculture, and bio-plastics from organic waste.</p>	Links to clean energy priorities, emissions reductions, hydrogen strategy, aerospace strategy. Mitsui has a small presence in New Zealand as an investor in projects such as Hydrogen.	Energy and Resources; Research, Science and Innovation	

Visit to site or organisation

s 6(a)

Visit to site or organisation

s 6(a)

			s 6(a)		
Ministerial Bilateral	Hagiuda Koichi, Minister of Economy, Trade and Industry (METI)	As above	<p>As above.</p> <p>New Zealand has a hydrogen cooperation agreement with the Japanese Ministry of Economy, Trade and Industry. This meeting would provide an opportunity to strengthen the relationship at Ministerial level.</p> <p>While Research, Science and Innovation engagement is primarily MEXT and the Japan Ministry of Foreign Affairs, MBIE sees value in lifting engagement with METI and a Ministerial meeting could support this.</p>	Research, Science and Innovation; Energy and Resources	
s 6(a)					

s 6(a)

s 6(a)

s 6(a)

s 6(a)

s 6(a)

Next steps

4. We seek your feedback as to which opportunities you are interested in pursuing during travel in October 2022.
5. Following this, we will work with your office to plan a more in-depth itinerary and engage with relevant overseas counterparts to secure arrangements. We will provide further details on the 5th HEM in Japan as they become available, including scheduling, and any key themes for the event.



MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
HĪKONA WHAKATŪTURI



BRIEFING

Comments and draft letter to the Minister for Infrastructure on the draft New Zealand Infrastructure Strategy, Rautaki Hanganga o Aotearoa

Date:	19 October 2021	Priority:	Medium
Security classification:	In Confidence	Tracking number:	2122-1255

Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	Provide feedback on the draft letter providing comments to the Minister for Infrastructure on the draft New Zealand Infrastructure Strategy, Rautaki Hanganga o Aotearoa, by 22 October 2021; OR Sign and send the attached letter at Annex Three to the Minister for Infrastructure by 31 October 2021.	22 October 2021

Contact for telephone discussion (if required)			
Name	Position	Telephone	1st contact
Michelle Schulz	Manager, Resource Markets Policy	9(2)(a)	✓
Nayana Islam	Senior Policy Advisor, Resource Markets Policy		

The following departments/agencies have been consulted
N / A

Minister's office to complete:

<input type="checkbox"/> Approved	<input type="checkbox"/> Declined
<input type="checkbox"/> Noted	<input type="checkbox"/> Needs change
<input type="checkbox"/> Seen	<input type="checkbox"/> Overtaken by Events
<input type="checkbox"/> See Minister's Notes	<input type="checkbox"/> Withdrawn

Comments

Briefing

27. We consider the draft Infrastructure Strategy may benefit from also including discussion on the opportunities for renewable gases (e.g. hydrogen and biogas) as an alternative to natural gas for these industrial processes. This discussion could also be linked to recommendations under **achieve net-zero carbon emissions at minimum cost** to ensure the existing gas infrastructure can be redeployed when new alternatives become viable.

Annex Three: Letter providing comments on the draft New Zealand Infrastructure Strategy, Rautaki Hanganā o Aotearoa

I consider the Strategy may benefit from also including some discussion on the opportunities for renewable gases (e.g. hydrogen and biogas) as an alternative to natural gas for these industrial processes. This discussion could also be linked to the recommendations to achieve net-zero carbon emissions at minimum cost, to ensure the existing gas infrastructure can be redeployed when new alternatives become viable.

Energy and Resources	Gas	Page 44, Section 6.1.1	The second to last paragraph mentions there are industrial processes that would be very costly to switch to electricity, and in these cases we may need to explore options to offset these, such as planting more trees or buying emissions units from offshore. Hydrogen and biogas could also be mentioned as alternatives to natural gas for these industrial processes.
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Energy and Resources	Gas	Page 51, Recommendation S1.2	<p>The recommendation around ensuring existing gas infrastructure can be redeployed is important for ensuring that costs can be minimised for consumers and for avoiding the costs of new electricity infrastructure to make up for energy demand from gas consumers that have electrified. This is well aligned with the overall strategic direction to get better use out of existing infrastructure.</p> <p>This recommendation is not mentioned in the body of the report, only in the recommendations section. Some discussion of renewable gases (such as hydrogen and biogas) and opportunities to leverage infrastructure could be added. There are likely to be other considerations, such as mechanisms around decommissioning parts of the pipeline (similar to the shutdown of copper networks) that will need to be considered.</p>
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BRIEFING

Consultation on customer service lines and update on other energy safety issues

Date:	14 June 2018	Priority:	Medium
Security classification:	In Confidence	Tracking number:	2270 17-18



Action sought		
	Action sought	Deadline
Hon Megan Woods Minister of Energy and Resources	<p>Agree to officials developing a Cabinet paper and consultation document on the risks posed by ageing customer service lines and power poles and a range of possible options to address them</p> <p>Agree to the work programme and timetable proposed in this paper</p> <p>Agree to the Minister for Workplace Relations and Safety's consultation on a review of the Health and Safety at Work (Mining Operations and Quarrying Operations) Regulations 2016 including questions about aligned provisions of the Electricity (Safety) Regulations 2010</p>	22 June 2018
Copied to: Hon Iain Lees-Galloway Minister for Workplace Relations and Safety	Note the contents of this briefing	N/A



Contact for telephone discussion (if required)				
Name	Position	Telephone		1st contact
Saskia Patton	Manager, Health and Safety Policy	04 901 8569	9(2)(a)	✓
Susan Hall	Principal Policy Advisor, Health and Safety Policy	04 898 5304	N/A	
Myles Brennan	Senior Policy Advisor, Health and Safety Policy	04 901 8837	N/A	

The following departments/agencies have been consulted
MBIE (Energy Markets Policy), MBIE (Service Design Policy), MBIE (Competition and Consumer Policy), WorkSafe, Commerce Commission

We propose to defer the development of proposals to deal with the production and use of hydrogen as a fuel until we have a better understanding of the potential mid-term uses of hydrogen and the role it could play in a low carbon economy.

2. Since these meetings we have worked closely with WorkSafe's Energy Safety team and have confirmed that there are a number of energy safety issues that need further work. The issues relate to:
 - Growing domestic and international interest in the **production and use of hydrogen as a fuel**. We need to ensure that regulatory settings are appropriate to ensure the safe production and use of hydrogen as a fuel and there are no unnecessary regulatory barriers that might prevent investment and innovation in this area.

Our January briefing also referred to the safe production and use of hydrogen as a fuel

71. We noted the need to ensure:
 - there are no unnecessary regulatory barriers that might prevent investment and innovation in this area
 - regulatory settings are appropriate to ensure the safe production, transport, storage and use of hydrogen as a fuel.
72. We have met with stakeholders and are continuing to develop our understanding of the nature of the risks posed by hydrogen and the ways in which it may be produced, stored and used in the mid-term. The range of possible uses of hydrogen is the subject of ongoing development. In addition to production and use as a transport fuel, it may have a role to play in the existing gas transmission and distribution network as part of a low carbon economy. It may also be used as a complementary fuel to electricity. The regulatory barriers and gaps will differ for these different uses.
73. We want to ensure our assessment of any regulatory barriers or gaps is properly informed by an understanding of the full breadth of the potential mid-term uses of hydrogen and the role it could play in a low carbon economy. Accordingly, we are working with MBIE's Just Transitions unit and the Resource Markets policy team on our timing and approach to consultation on how to address the barriers and gaps. We will report back to you as that work advances.



BRIEFING

Ministers' meeting on ministerial responsibilities for the regulation of energy safety and related issues

Date:	25 January 2018	Priority:	Low
Security classification:	In Confidence	Tracking number:	1738 17-18

Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	Note that there are areas of interface and common interest between the Energy and Resources and Workplace Relations and Safety portfolios as they relate to energy safety Discuss how you would like to work together and receive advice from officials on areas of interface and common interest in energy safety	31 January 2018
Hon Iain Lees-Galloway Minister for Workplace Relations and Safety		

Contact for telephone discussion (if required)			
Name	Position	Telephone	1st contact
Saskia Patton	Manager, Health and Safety Policy	04 474 8569	9(2)(a) ✓
Susan Hall	Principal Policy Advisor, Health and Safety Policy	04 896 5304	
Gareth Wilson	Principal Policy Advisor, Energy Markets Policy	04 460 1375	

The following departments/agencies have been consulted
N/A

Minister's office to complete:

- | | |
|---|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Declined |
| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments

Current issues and policy development

Energy and Resources portfolio

Hydrogen as a fuel

26. Hydrogen is a promising alternative clean energy source to fossil fuels in transport and stationary energy production.

27. There is international and domestic interest in New Zealand-based development and testing of hydrogen production installations and technology, with a view to increasing the use of hydrogen as a fuel source.
28. Several large Japanese corporations have recently investigated New Zealand as a potential site for the commercial scale production of hydrogen for export back to Japan. There is also some emerging interest from other Japanese corporations in establishing a market in New Zealand for hydrogen fuel cell vehicles and associated hydrogen refuelling stations. There is also some small scale production and use of hydrogen as a fuel gas within New Zealand.
29. The unique physical characteristics of hydrogen may require safety precautions and techniques that are sufficiently different from those applied to conventional fuel gases such that applying the normal precautions may not be sufficient to give confidence that tolerable levels of safety would be achieved.
30. Significant production or use of hydrogen as a fuel in New Zealand will necessitate a review of the appropriate safety standards and regulations. These fall under both of your portfolios:
 - a. The supply and utilisation of hydrogen as a fuel gas falls within the scope of the Gas Act 1992 and the GSMR
 - b. The transportation, storage and handling of hydrogen falls within the scope of the Health and Safety at Work (Hazardous Substances) Regulations made under the HSW Act
 - c. The Health and Safety in Employment (Pressure Equipment, Cranes, and Passenger Ropeways) Regulations 1999 are likely to apply to hydrogen production and use and will also require review. These also sit under the HSW Act
 - d. Depending on the size of a hydrogen installation, it is possible that the Health and Safety (Major Hazard Facilities) Regulations may also apply.
31. MBIE is investigating the potential opportunities and issues associated with this fuel. This work will include the policy options that may be necessary to remove any barriers to commercialising this innovation and ensure that the risks associated with the production, storage, handling, transport, supply, and use of hydrogen are adequately managed.

Workplace Relations and Safety portfolio

HSW Act regulatory reform programme

34. MBIE is undertaking a regulatory reform programme to ensure the regulatory framework under the HSW Act is effective, clear, certain, and working as intended.
35. The reform programme includes the following regulatory topics that will have an interface with the Energy and Resources portfolio:
 - a. *Hazardous Substances* – the transportation, storage, and handling of hydrogen, petrol, diesel, and gas fall within the scope of the Health and Safety at Work (Hazardous Substances) Regulations 2017.
 - b. *Pressure equipment, cranes, and passenger ropeways* – the Health and Safety in Employment (Pressure Equipment, Cranes, and Passenger Ropeways)

Regulations 1999 are likely to apply to hydrogen production and use, and pressure equipment is used in geothermal energy production.



BRIEFING

Work to address emerging energy safety issues

Date:	26 January 2018	Priority:	Medium
Security classification:	In Confidence	Tracking number:	1739 17-18



Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	<p>Note that the emerging issues outlined in this briefing suggest the need for a closer look at the energy safety regulatory framework to ensure that it continues to be fit for purpose</p> <p>Note that officials will be engaging with key industry stakeholders in February to develop a better understanding of the scale and materiality of the emerging issues and to identify and assess preliminary options</p> <p>Note that officials will report back to you in March on an approach and timeframe for resolving the emerging issues and the scope of any review of the regulatory framework that may be required</p> <p>Note that work may be required to ensure the energy safety and workplace health and safety settings are appropriate to facilitate the introduction of hydrogen production facilities, hydrogen fuel cell vehicles and hydrogen refuelling stations in advance of work on the other emerging issues.</p>	29 January 2018

Contact for telephone discussion (if required)				
Name	Position	Telephone		1st contact
Saskia Patton	Manager, Health and Safety Policy	04 901 8569	9(2)(a)	✓
Myles Brennan	Senior Policy Advisor, Health and Safety Policy	04 901 8637	N/A	

There is growing interest in ensuring that the New Zealand regulatory environment is appropriate to facilitate the introduction of hydrogen production facilities, hydrogen fuel cell vehicles and hydrogen refuelling stations. There may be a case for this topic to be addressed in advance of any work on the other emerging issues.

Summary of emerging issues

36. Pressures on the existing regulatory framework are becoming evident and stakeholder concern is starting to increase due to:
 - a. emerging risks associated with new technologies and processes. For example, we need to ensure that:
 - i. risks associated with emerging hydrogen production facilities and hydrogen refuelling station technologies are adequately managed, while not constraining the commercialisation of these innovations; and

Emerging risks from new technologies

Ensuring risks associated with production and use of hydrogen are effectively managed

15. Hydrogen is a promising alternative clean energy source to overcome our reliance on fossil fuels in transport and stationary energy production.
16. Several large Japanese corporations have recently investigated New Zealand as a potential site for the commercial scale production of hydrogen for export back to Japan. You have recently met with the New Zealand partner for a new joint venture that intends to build a large-scale hydrogen production plant in New Zealand. There is also some emerging interest from other Japanese corporations in establishing a market in New Zealand for hydrogen fuel cell vehicles and associated hydrogen refuelling stations. There is also some small scale production and use of hydrogen as a fuel gas within New Zealand.
17. The unique physical characteristics of hydrogen may require safety precautions and techniques that are sufficiently different from those applied to conventional fuel gases such that the application of the normal precautions on their own is not sufficient to give confidence that tolerable levels of safety would be achieved.
18. Significant production or use of hydrogen as a fuel in New Zealand will necessitate a review of the appropriate safety standards and regulations.

Annex Two: Proposed meeting agenda

Meeting on work to address emerging energy safety issues

Meeting date: Tuesday, 30 January 2018, 9.00am – 9.30am

Item
Should work to address hydrogen fuel be prioritised?



BRIEFING

Preliminary work on a Just Transition for Taranaki's Energy Sector

Date:	23 May 2018	Priority:	High
Security classification:	In Confidence	Tracking number:	3452 17-18

Action sought		
	Action sought	Deadline
Rt Hon Jacinda Ardern Prime Minister	Note MBIEs preliminary advice on an approach to a <i>Just Transition</i> for Taranaki's energy sector. This advice also provides our initial thinking on the broader approach to a Just Transition. Agree to forward to Minister Jones and Under Secretary Tabuteau .	25 May 2018
Hon Dr Megan Woods Minister of Energy and Resources	Note MBIEs preliminary advice on an approach to a <i>Just Transition</i> for Taranaki's energy sector. This advice also provides our initial thinking on the broader approach to a Just Transition.	25 May 2018

Contact for telephone discussion (if required)			
Name	Position	Telephone	1st contact
David Darby	Manager, Commercial Analysis & Investment	04 901 4987	9(2)(a) ✓
Suzannah Toulmin	Principal Investment Advisor	04 901 3879	

The following departments/agencies have been consulted
Provincial Development Unit, Just Transitions Unit, Labour, Science and Enterprise, Tertiary Education Committee

- Minister's office to complete:
- | | |
|---|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Declined |
| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments

The just transitions work will build on policies and programmes that the Government already has underway. Work is already being done in Taranaki to prepare for the transition, including a collaborative planning exercise (Tapuae Roa: Make Way for Taranaki); establishment of a New Energy Development Centre; and an initiative to establish a hydrogen-based energy ecosystem for the demonstration of zero emission transport solutions.

- f **Note** that work is already being done in Taranaki to prepare for the transition, including a collaborative planning exercise (Tapuae Roa: Make Way for Taranaki); establishment of a New Energy Development Centre; and an initiative to establish a hydrogen-based energy ecosystem for the demonstration of zero emission transport solutions;

Noted

What is already being done in Taranaki to prepare for the transition

H2 Taranaki – Hydrogen Technology

37. The H2 Taranaki initiative aims to establish a hydrogen-based energy ecosystem for the demonstration of zero emission transport solutions for heavy transport, renewable energy storage solutions, industrial feedstock and heating, and the export of renewable energy.
38. The H2 Taranaki initiative has potential to seed new hydrogen projects, create new jobs and attract technology investment in the region. Similar initiatives overseas have led to private sector investment of four times the public funds committed, creation of new IP, and enabling those regions to participate in the developing international supply chain.
39. The initiative seeks to enable aggregation of demand, and development of public infrastructure, that will provide a platform for scaling and participation in international supply chains. The initial focus would be on the development of refuelling infrastructure and piloting of hydrogen transport solutions. The initiative includes provision of initial infrastructure to connect the region to other planned hydrogen projects and demonstration of a rail transport solution.
40. Taranaki is unique in that it has all hydrogen market applications for demonstration projects in one close geographic area. Taranaki has world class industrial and technical capability across engineering, fabrication, manufacturing, construction, logistics, operations, maintenance, and health and safety. New Zealand's largest current hydrogen producers are also based in the Taranaki region.
41. Taranaki has a large freight industry served by diesel powered trucks. Hydrogen powered fuel cell vehicles are competitors to battery electric vehicles. Contemporary thought is that battery electric vehicles will be the dominant light passenger vehicle in coming decades. However, for heavy vehicle use the situation is less clear. Hydrogen heavy transport (bus and truck) vehicles have significant weight, carrying capacity and refuelling time advantages over contemporary battery electric alternatives; although this advantage may diminish with future improvements in battery technology
42. The long-term commercial viability of a hydrogen economy in New Zealand is high-risk, and the economics for many applications are marginal at present. However, the cost competitiveness of hydrogen is expected to improve over the next decade. The development of a hydrogen industry will depend on the relative economics of hydrogen compared to other renewable options.
43. The Provincial Growth Fund has provided \$50,000 towards helping advance the take-up of hydrogen technologies in the Taranaki region.

Steps towards a transition made by local businesses

Hiringa Energy

57. Hiringa Energy is a New Plymouth-based company focused on developing a hydrogen economy. Hiringa Energy has been established by ex-oil and gas sector and is an example of a business seeking to leverage energy sector skills to capitalise on opportunities arising from the transition to a low carbon economy. You will be meeting with Hiringa Energy on Friday May 25th, and more detail is provided in a separate briefing (briefing 3312 17-18 refers).

A transitioning Taranaki economy has opportunities and risks for the workforce

74. There may be opportunities for these specialist skill sets in future applications such as:
- Out of scope
 - Hydrogen, which will be investigated as part of the H2 Hydrogen Road map; and
 - Out of scope
75. Out of scope the commercial viability of Out of scope hydrogen in New Zealand is not certain. We have expanded on the opportunity of these applications in Annex One.

Annex One: New industries may provide opportunities for the specialised workforce

Hydrogen economy

9. New Zealand has the capability to produce hydrogen for domestic and international use. There is considerable potential for the development of hydrogen in New Zealand as a zero emissions fuel source for heavy transport vehicles, electricity generation and process heat.
10. Multiple Japanese corporations have expressed interest in either developing hydrogen facilities in New Zealand for bulk export to Japan or for testing and deploying hydrogen utilising equipment in New Zealand. The furthest advanced (in a commercial sense) of these interests is Obayashi Corporation, which is currently working on a joint venture with the New Zealand based Tuaropaki Trust to develop a pilot hydrogen production facility at the Mokai geothermal field.
11. Development of Japanese interest in hydrogen development in New Zealand, if it becomes established, will help to facilitate local development and research, by providing proof of concept and scale.
12. Local initiatives underway in Taranaki to establish a hydrogen economy, in particular hydrogen based transport for heavy vehicle fleets (refer paras 37-43 and 57) could provide some opportunities for engineers, petroleum geoscientists and reservoir engineers. If a hydrogen export economy develops, Port Taranaki is one port that may

be able to accommodate export vessels, providing opportunities for both port and maritime workers.

13. The full potential for hydrogen in New Zealand is unknown. In particular the degree to which it could replace other fuels for transport use and, perhaps more importantly, what the production limit may be given other competing demands for our renewable electricity.
14. A comprehensive study of its potential applications and commercial limitations is needed, which may develop into a roadmap or strategy document. In the meantime, Contact Energy, along with PowerCo, FirstGas, MBIE and EECA has engaged a consultant to develop a strategic paper on the potential for hydrogen to New Zealand.
15. This industry-led initiative will build on a study commissioned by MFAT in 2017 into the supply and demand for renewable hydrogen in New Zealand, and could complement subsequent work that MBIE may undertake to develop a hydrogen strategy, or roadmap, for New Zealand.



BRIEFING

Transitioning to more affordable and renewable energy: the energy markets work programme for 2019

Date:	22 May 2019	Priority:	High
Security classification:	In Confidence	Tracking number:	3628 18-19

Action sought		
	Action sought	Deadline
Hon Megan Woods Minister of Energy and Resources	<p>Note the attached draft Cabinet paper and its recommendations.</p> <p><i>Noted</i></p> <p>Advise any required changes to the attached Cabinet paper and circulate it for consultation before submission to Cabinet Office by 10am, Thursday 6 June, for consideration at Cabinet Environment, Energy and Climate Committee (ENV) meeting on 13 June.</p> <p><i>Agree / Disagree</i></p>	6 June 2019

Contact for telephone discussion (if required)				
Name	Position	Telephone		1st contact
Andrew Hume	Policy Director, Energy & Resource Markets	04 901 1474	9(2)(a)	✓
Janet Humphris	Team Leader, energy & Resources Markets	04 470 2314		
Oshan Jayawardena	Senior Policy Advisor, Energy & resource Markets	04 897 6432		

The following departments/agencies have been consulted

- Minister's office to complete:
- | | |
|---|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Declined |
| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments

Work-programme context to support affordable and renewable energy

16. The Cabinet paper gives an overview to your Cabinet colleagues of your current work programme, and how it is informing and supporting your vision for the Government's Affordable and Renewable Energy Strategy. It comprises the following aspects of your work programme:

- I. An Electricity Price Review investigating whether the electricity market, as it exists at present and into the future, is and will be delivering a fair and equitable price to end-consumers, taking into account the need to maintain energy security and environmental sustainability.
- II. Options to accelerate the deployment of renewable electricity generation to help to achieve the goal of 100 percent renewable electricity by 2035.
- III. Options to encourage energy efficiency in industrial sector use of energy and to decarbonise process heat through uptake of renewable fuels (e.g. electrification and biofuels).
- IV. Driving energy sector research and innovation through a range of initiatives such as an Advanced Energy Platform, incentives for research through the Taxation (Research and Development Tax Credits), Innovative partnerships programme, the National New Energy Development Centre (NNEDC) and the Provincial Growth Fund (PGF) supporting clean energy.
- V. Ensuring a just transition by partnering with the Taranaki region to create a transition plan and holding a National Just Transition Summit in Taranaki.
- VI. Supporting the development of future fuels such as hydrogen through a Memorandum of Cooperation with Japan's Economy, Trade and Industry Minister on the development of hydrogen technology and a green hydrogen paper.
- VII. Development of a Petroleum and Minerals Resource Strategy to support the transition to a carbon neutral economy.
- VIII. Gas Act review to assess whether the Gas Act 1992 (the Gas Act) is fit-for-purpose in regulating the uptake of future fuels such as hydrogen and biogas.

BRIEFING

Process Heat in New Zealand: Summary of submissions and new insights on opportunities to reduce emissions

Date:	25 March 2019	Priority:	Medium
Security classification:	In Confidence	Tracking number:	2888 18-19

Action sought		
	Action sought	Deadline
Hon Megan Woods Minister of Energy and Resources	For your information.	8 April 2019

Contact for telephone discussion (if required)				
Name	Position	Telephone		1st contact
Justine Cannon	Team Leader, Energy Markets Policy	04 901 8597	9(2)(a)	✓
Andrew Caseley	Chief Executive, Energy Efficiency and Conservation Authority	04 470 2201		
Amelie Goldberg	Senior Policy Advisor, Energy Markets Policy	04 897 5313		
Tal Yochay	Policy Advisor, Energy Markets Policy	04 898 5883		

The following departments/agencies have been consulted
Energy Efficiency and Conservation Authority

Minister's office to complete:	<input type="checkbox"/> Approved	<input type="checkbox"/> Declined
	<input type="checkbox"/> Noted	<input type="checkbox"/> Needs change
	<input type="checkbox"/> Seen	<input type="checkbox"/> Overtaken by Events
	<input type="checkbox"/> See Minister's Notes	<input type="checkbox"/> Withdrawn

Comments

Annex One: Detailed submissions analysis

Hydrogen

17. Ballance and Refining New Zealand believes that hydrogen generated from electrolysis is an opportunity for their business. First Gas suggested that investments in gas infrastructure could open up opportunities for the future deployment of hydrogen for industry.
18. The Coal Action Network Aotearoa and several individual submitters believe that if hydrogen is used as an energy source for process heat, it must be generated by renewable means, not derived from fossil fuels.



BRIEFING

Energy Markets Policy work programme for 2019

Date:	28 February 2019	Priority:	Medium
Security classification:	In Confidence	Tracking number:	2495 18-19

Action sought		
	Action sought	Deadline
Hon Megan Woods Minister of Energy and Resources	Note the high-level work programme for energy policy for 2019 and the indicative timeframes set out in this briefing.	22 February 2019

Contact for telephone discussion (if required)				
Name	Position	Telephone		1st contact
Andrew Hume	Manager, Energy Markets Policy	04 901 1474	9(2)(a)	✓
Justine Cannon	Team Leader, Energy Markets Policy	04 901 8597		
Tal Yochay	Policy Advisor, Energy Market Policy	04 896 5883		

The following departments/agencies have been consulted

Minister's office to complete:

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| <input type="checkbox"/> Approved | <input type="checkbox"/> Declined |
| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments

The policy work being undertaken regarding energy markets will progress this preparatory work and advance the pathway

19. Officials have been undertaking work to understand what regulatory and other barriers exist that may impede the energy transition, and options to address these. This work includes:
 - moving toward 100 per cent renewable electricity, including regulatory barriers, and incentives to increasing renewable generation build
 - moving the industrial heat sector to lower emissions and renewable energy
 - undertaking the Electricity Price Review, and
 - looking at the role green hydrogen could play in the transition.

This work is complementary to the work underway or completed in your Energy and Resources more broadly, and in your other portfolios

9. This includes a review of the Gas Act 1992 to consider:

- a. potential regulatory issues posed by emerging technology and alternative fuels (such as hydrogen) for the Act
- b. the release of information during situations where the gas supply is constrained, and
- c. improvements to the penalties able to be applied in regulations that govern the gas industry.

Just Transition Summit in Taranaki – 9-10 May

24. We are currently preparing a green hydrogen vision paper so you have the option to release it at the Just Transition Summit in Taranaki on 9-10 May. This paper will seek stakeholder feedback on the Government's long-term vision for hydrogen in New Zealand.



BRIEFING

Government response to the Taranaki Regional Economic Action Plan

Date:	8 February 2018	Priority:	High
Security Classification:	In Confidence	Tracking number:	1758 17-18

Action sought		
Minister	Action sought	Deadline
Hon Shane Jones Minister for Regional Economic Development	<p>Endorse the proposed Government response to the 'Tapuae Roa – Make Way for Taranaki' Action Plan</p> <p>Endorse the Regional Growth Initiatives proposals that form part of the Government response to the 'Tapuae Roa – Make Way for Taranaki' Action Plan prior to Cabinet approval</p> <p>Note Senior Regional Officials have reviewed the Government response to the Tapuae Roa – Make Way for Taranaki' Action Plan and recommend investment for the proposals</p> <p>Note that a briefing will follow that will include a draft Cabinet Paper including approval of all requests for Regional Growth Initiative Multi-Year Appropriations as a package.</p> <p>Forward this briefing for any comment to the Minister of/for:</p> <ul style="list-style-type: none"> • Arts, Culture and Heritage • Tourism • Transport • Energy and Resources • Economic Development • Māori Development • Agriculture • Conservation • Parliamentary Under-Secretary for Regional Economic Development 	14 February 2018

Contact for telephone discussion (if required)

Name	Position	Telephone	1st contact
Al Morrison	Deputy Commissioner, State Services Commission	9(2)(a)	✓
Stephanie Weller	Regional Economic Development Implementation Manager	04 901 3898	
Mark Patterson	Senior Advisor	04 916 6064	

The following departments/agencies have been consulted

<input type="checkbox"/> Treasury	<input checked="" type="checkbox"/> MoA	<input type="checkbox"/> NZTE	<input type="checkbox"/> MSD	<input type="checkbox"/> TEC	<input checked="" type="checkbox"/> MoE
<input type="checkbox"/> MFAT	<input type="checkbox"/> MPI	<input type="checkbox"/> MfE	<input type="checkbox"/> DIA	<input type="checkbox"/> TPK	<input checked="" type="checkbox"/> MoH
<input checked="" type="checkbox"/> Other:		Agencies have been consulted on the Action Plan			

Annex One: Proposed central government response to the 'Tapuae Roa – Make Way for Taranaki' Action Plan

Annex Three: Eight work streams described

Energy Futures												
The energy sector is a key part of Taranaki's economic prosperity. The region has world class capabilities in existing energy technologies, engineering, operations and maintenance. Maintaining this prosperity and capability will be dependent on future-proofing the region's existing industry and developing new capabilities and energy industries as the world transitions to a low-carbon future.												
Priority area	Recommended actions	Contributing parties	Indicative timeframe (estimated only)	Regional Contribution	Central Government Contribution REQUESTED	Comment	Central Government Contribution Available	Government agency	Structure/Team Responsible in Central Govt	Government response: A) Support? Yes/No B) Can it be met by: 1) Existing funding? 2) Reconstituted funding? 3) Reprorated funding? 4) New funding?		
Information provided by Region for Government response							GOVERNMENT RESPONSE					
Energy Futures	<p>Clean Energy Development Centre:</p> <ul style="list-style-type: none"> • Leverage strengths to actively contribute to the energy transition • Future proof the existing industry • Create new energy job opportunities and exports • Develop and attract new clean technology businesses. 	<p>Markets will include leveraging university research grants, Collierian grants and international demonstration funding. Projects will require private sector partners to access funds. Private sector will also be provided in-kind support via facilities and expertise.</p>	<p>Planning: 6 months from Feb 2018 (RD Funding) Establish: Oct 2018 Operational: Q3 2019</p>	<p>Planning: \$50k each and \$100k in-kind</p> <p>Establishment: \$100k each (plus additional in-kind)</p> <p>Operations: including practical government matching funding for demonstration projects</p>	<p>Planning: \$50k</p> <p>Establishment: \$100k</p> <p>Operations: Estimated \$200,000 per year for first 5 years plus matching funds to be leveraged for key projects meeting agreed criteria to attract additional private sector or international funding</p>	<p>Establish a Clean Energy Development Centre to develop, demonstrate, test and pilot clean technologies.</p> <ul style="list-style-type: none"> • Build an international reputation for development, demonstration, piloting, testing and commercialisation of clean energy technologies and models. • Create a focal point for clean energy projects in the region and overseas "Taranaki as a Hub" • Attract new clean energy projects and investment to the region. • Foster commercialisation through the capability to quickly and efficiently develop, evaluate and demonstrate products and services. • Link for small companies to leading national and international research capability and funding sources. • Identify and resource regional competence gaps for development projects. • Plan, fund and deliver an integrated technology development program to mature experimental technology into pilot-scale development. • Leverage existing skills, capabilities, installed infrastructure and existing industry facilities to develop and demonstrate new clean technologies and support new clean technology companies. 	\$	100,000.00	MBIE	RD	<p>MBIE: How have we interest in this area more detail is confirmed and closer to operationalising of project.</p> <p>MBIE: Support from RD / SDC funding appropriate for planning stage. Further funding from RD / PDP to be known after the outcome of planning and feasibility.</p> <p>MBIE: Science Policy: Support for project, however the project team need to consider existing work in this space within New Zealand.</p>	
	<p>H2 Taranaki (Hydrogen production development)</p> <ul style="list-style-type: none"> • promote market development and infrastructure equipment to build an integrated producing and zero emission transport solutions enabling transition to 100% renewable electricity • major reduction of industrial emissions of greenhouse gases • renewable energy export products 	<p>Private and public sector providing funds for industrial projects – e.g. Bus, council demonstration projects, public refuelling</p>	<p>Planning to July 2018 RD action Q3 2018</p>	<p>Planning and Roadmap: \$50k MPEC cash SNA, MPEC, VTT, TRC, industry in-kind</p> <p>Establishment: in-kind MPEC, VTT, TRC to be confirmed</p> <p>Operations: \$300k per annum MPEC, TRC, VTT towards H2 Taranaki demonstration project</p> <p>Industry and local government matching funding for public sector infrastructure and transport projects</p>	<p>Planning and Roadmap: \$50k</p> <p>Establishment: \$50k</p> <p>Operations: Critical mass of zero emission transport and infrastructure projects expanded projects including regional and overseas aviation</p> <p>\$200k over 5 years</p>	<p>Attract investment in the region</p> <ul style="list-style-type: none"> • Increase industry awareness, collaboration, and cross-pollination of ideas • Encourage the development of the hydrogen economy supply chain in the region 	\$	50,000.00	MBIE	RD	<p>MBIE: Support from RD / SDC funding appropriate for planning stage. Further funding from RD / PDP to be known after the outcome of planning and feasibility.</p> <p>MBIE: Science Policy: Support for project, however the project team need to consider existing work in this space within New Zealand.</p>	
	<p>Support action – branding, marketing, community, industry and public sector engagement</p>	<p>TALA, VTT, MBIE</p>	<p>Once funding secured for key initiatives</p>	<p>VTT in-kind support \$100k per annum to be confirmed</p>	<p>\$100k to support establishment - then \$5k per annum</p>	<p>Attract investment in the region</p> <ul style="list-style-type: none"> • Increase industry awareness, collaboration, and cross-pollination of ideas • Encourage the development of the hydrogen economy supply chain in the region 	\$	-	MBIE	PDP	<p>MBIE: Contestable Funding. Likely to come from the Provincial Growth Fund</p>	
Information provided by Region for Government response							GOVERNMENT RESPONSE					
Support action – industry and public sector engagement	TALA, VTT, MBIE	Once funding secured for key initiatives	VTT cash and in-kind support \$100k per annum to be confirmed	\$100k per annum	\$150k per annum	<ul style="list-style-type: none"> • Development of advertising campaigns and public information for the Centre and H2 Taranaki • Organising community events that encourage participation and interaction with clean technologies development • Promoting the use of clean technologies at major events held in Taranaki • School educational visits • Providing free advice on how to increase community engagement with the Centre and H2 Taranaki hydrogen projects • Creating connections and involve artists and creative professionals to improve the aesthetics and therefore community perception of clean energy technology and projects • Running art and design competitions that build on the Laney Centre and create art installations in the region 	\$	-	MBIE	TAC	<p>All require further investigation on funding potential. Linked to Collierian / other MBIE funding options.</p>	
Government commitment using regional estimates							Total				\$150,000	
Confirmed Funding (government and regional)							Total					\$630,000

Annex Two: Central Government Funding Requested and government agency Feedback

Annex Two: Taranaki Action Plan – Government Funding Requests to MBIE

Proposal from the Taranaki Lead Team	Estimated Cost of Proposal	Government Funding Sought	Regional contribution	Proposed Government Funding	Funding source (SRO)	Funding source (RGI)	Funding source (other)
Out of scope							
4. H2 Taranaki Hydrogen Ecosystem – business case and planning	\$190,000	\$50,000	\$140,000	\$50,000	Ministry of Business, Innovation and Employment - Dept Funding (Vote B5&I)		

Annex Two: Taranaki Action Plan – Government Funding Requests to MBIE

Proposal	Work Stream	Brief Description	Timeframe	Estimated Cost of Proposal	Government Funding Sought	Regional Contribution	Agency Comments
Out of scope							
4. H2 Taranaki Hydrogen Ecosystem – business case and planning	Energy Futures	<p>The proposal represents the key activities required to support the establishment of H2 Taranaki. H2 Taranaki is envisaged as an organisation consisting of key public and private sector members with the aim of stimulating innovative hydrogen projects and advancing the take-up of hydrogen technologies in Taranaki.</p> <p>Key outcomes:</p> <ul style="list-style-type: none"> Establish feasibility for public sector H2 projects in the region to secure regional and district council support Complete planning and roadmap to underpin central government support for proposed H2 Taranaki transport and infrastructure projects Secure formation partners for H2 Taranaki initiative 	Planning completed by July 2018.	190,000	50,000	140,000	<p>TRK support.</p> <p>MSD may have an interest in this once more detail is confirmed and closer to operationalizing of project.</p> <p>MBIE (Energy and Resource Markets) As a business case development risk is low at this point so the document looks appropriate. One thing I would note is that you reference the Business Growth Agenda alignment. This is the previous government's agenda so may not be appropriate now. You may also like to note that MBIE funds alternative energy R&D.</p>



BRIEFING

Update on the Taranaki just transition workshop and next steps

Date:	18 July 2018	Priority:	Medium
Security classification:	In Confidence	Tracking number:	0195 18-19

Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	Discuss the contents of this briefing and next steps with MBIE's Just Transitions Unit Refer this briefing to the Minister for Regional Economic Development and the Parliamentary Undersecretary for Regional Economic Development	23 July 2018
Hon Shane Jones Minister for Regional Economic Development	Note the contents of this report	None
Fletcher Tabuteau Tabuteau Parliamentary Undersecretary for Regional Economic Development	Note the contents of this report	None

Contact for telephone discussion (if required)			
Name	Position	Telephone	1st contact
Gus Charteris	General Manager, Just Transitions Unit	04 479 2839	9(2)(a) ✓
Kerryn Fowle	Policy Director, Just Transitions Unit	04 901 2022	

The following departments/agencies have been consulted

Minister's office to complete:

- | | |
|---|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Declined |
| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments:

Annex Two: Taranaki Energy opportunity set

Project	Description	New Energy Category	2018	2019	2020	2021
Hydrogen Supply Infrastructure	Establishment of initial hydrogen supply infrastructure including generation, distribution and refuelling	Hydrogen	\$1.5-\$2m for FEED & planning \$950k application submitted to PGF	\$28m execution		
Hydrogen Mobility Projects	Initial establishment of pilot Fuel Cell vehicle fleets (regional buses, council vehicles, material handling, heavy truck trial)	Hydrogen	Business Case & Roadmap \$500k for vehicle selection	\$14m execution		
Low emission Ammonia production pilot	Renewable energy to "green" ammonia via hydrogen - possibly coupled with hydrogen supply for mobility	Hydrogen / Low emission industrial processes	\$400k - feasibility study & FEED	\$20 - \$30m		
Carbon capture Methanol production	Carbon capture and use initiatives within plants.	Carbon capture / Low emission industrial processes	?	?		
Out of scope						
Gas pipeline hydrogen blending/conversion trial	Trial pipeline conversion to hydrogen blended mix enabling power to gas projects	Hydrogen	Screening	\$400k - feasibility study	?\$2m	
Direct connect renewables for hydrogen electrolysis	Couple hydrogen electrolyser with renewable project to enhance economics (eg stand-alone project or Waverley wind farm)	Renewable energy technologies	\$200k feasibility study	\$10-\$20m - dependant on scope		
Pilot integration of hydrogen refuelling into existing retail infrastructure	Initial hydrogen projects will be based around large commercial/public sector vehicle fleets. Full roll-out of technology into retail markets will require modifications of existing service stations.	Hydrogen		\$200k feasibility study	\$6m for pilot	
Out of scope						

Out of scope

Low emission hydrogen from Natural Gas	Methane cracking pilot for low emission hydrogen and grapbhte from Natural Gas for industrial feedstock	Carbon capture / Low emission industrial processes		\$200k Feasibility study	\$800k FEED	TBC (2021+)
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Out of scope

Renewable energy to Synfuels	Pilot plant for generating synfuel from renewable hydrogen and CO2 capture	Reduced emission fuels		\$400k - feasibility study		TBC (2021+)
Waste to Energy	Biogas to biomethane / hydrogen	Waste to energy				

Out of scope



AIDE MEMOIRE

Ahuroa gas storage facility and its contribution to energy security

Date:	6 August 2018	Priority:	Urgent
Security classification:	In Confidence	Tracking number:	0454 18-19

Information for Minister
Hon Dr Megan Woods Minister of Energy & Resources

Contact for telephone discussion (if required)			
Name	Position	Telephone	1st contact
David Darby	Acting Manager, Resource Markets	04 901 4987	9(2)(a) ✓
David Buckrell	Principal Policy Advisor	04 460 1361	

The following departments/agencies have been consulted
Inland Revenue

- Minister's office to complete:
- | | |
|---|--|
| <input type="checkbox"/> Approved | <input type="checkbox"/> Declined |
| <input type="checkbox"/> Noted | <input type="checkbox"/> Needs change |
| <input type="checkbox"/> Seen | <input type="checkbox"/> Overtaken by Events |
| <input type="checkbox"/> See Minister's Notes | <input type="checkbox"/> Withdrawn |

Comments

Surrounding policy considerations such as the Zero Carbon Bill and the 100 per cent renewable generation target (in a normal hydrological year)

35. The Government's stated objectives to decarbonise New Zealand's energy sector will likely result in an increasing proportion of renewable generation in future. Given the unique characteristics of New Zealand's energy system, managing winter and dry-year energy shortages is one of the most fundamental issues to be addressed.
36. Under Transpower's base case scenario, New Zealand's exposure to supply shortages in winter and dry years is expected to grow from 4 TWh today, which is comfortably covered by hydro storage and thermal generation capacity, to 9 TWh by 2030 and 12 TWh by 2050. The winter supply gap is largely driven by expected growth of intermittent supply, especially solar, and is partly offset by a modest flattening of the seasonal demand profile. Closure of coal- and gas-fired generation is anticipated in Transpower's

base case scenario, and that contributes about half of the growth of the seasonal supply shortage.

37. Subject to rainfall, hydro generation has the most flexibility. However, this flexibility is already used to meet current demand.
38. Several potential technical solutions have been identified, but none appears definitely feasible and economically attractive. These include:

Out of scope

- b. *Hydrogen ammonia - generating and storing hydrogen as ammonia seems feasible. Hydrogen currently provides a more effective means for inter-seasonal storage than other forms of storage, such as batteries. Hydrogen production and storage is scalable, modular, and some ammonia could be stored in existing facilities. However, the hydrogen solution is still rudimentary but there are several other solutions that might prove feasible.*

Out of scope



BRIEFING

Key Design Features of the Energy and Resources Initiatives for Budget 2019

Date:	22 November 2018	Priority:	High
Security classification:	Budget - Sensitive	Tracking number:	1740 18-19

Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	Discuss the Energy and Resources Budget initiatives at the officials meeting on 26 November 2018	26 November 2018

Contact for telephone discussion (if required)			
Name	Position	Telephone	1st contact
Phillippa Fox	General Manager, Energy and Resource Markets	04 474 2612	9(2)(a)
Andrew Hume	Manager, Energy Markets Policy	04 901 1474	✓
Amir Mehta	Policy Advisor	04 896 5745	

The following departments/agencies have been consulted
Energy Efficiency and Conservation Authority, Te Puni Kōkiri, Ministry of Health, Oranga Tamariki, Ministry of Social Development, Ministry of Housing and Urban Development, Ministry for the Environment, Just Transitions Unit (MBIE), Research, Science and Innovation (MBIE)

Minister's office to complete:

<input type="checkbox"/> Approved	<input type="checkbox"/> Declined
<input type="checkbox"/> Noted	<input type="checkbox"/> Needs change
<input type="checkbox"/> Seen	<input type="checkbox"/> Overtaken by Events
<input type="checkbox"/> See Minister's Notes	<input type="checkbox"/> Withdrawn

Comments

Initiative one – Facilitating the move towards 100 per cent renewable electricity

This initiative is seeking 9(2)(f)(iv) over four years. It will create a contestable fund that will aim to bring forward investment that would not otherwise occur to investigate solutions to accelerate the move to 100 per cent renewable electricity. MBIE will manage the fund.

The contestable fund will support projects that will facilitate the transition to 100 per cent renewable electricity, either through full or partial funding to private or public entities (such as councils). The projects may include feasibility studies to evaluate new energy storage proposals, or pilot programmes for new technology. This could include the use of hydrogen as a stored fuel Out of scope

The fund will support projects that would not have otherwise occurred, but is not intended to support technologies that are still in a research and development or prototype stage.

Out of scope

Out of scope

We recommend that regardless of whether the contestable fund is scaled, it should focus on facilitating the transition to 100 per cent renewable electricity through testing and piloting renewable technology. This allows the greatest funding flexibility and will cover hydrogen proof of concept projects and renewable generation projects for small isolated communities, which improve resilience in the move towards 100 per cent renewable electricity generation.

Out of scope

This new fund will complement and not duplicate other government funding mechanisms.

Initiative one: Facilitating the move towards 100 per cent renewable electricity

This initiative will facilitate the evaluation and testing of technology, and the implementation of pilot programmes that will create opportunities to accelerate the transition to 100 per cent renewable electricity

6. This initiative is seeking 9(2)(f)(iv) over four years. It will provide new funding, either full, or co-funding via a contestable fund, to private or public entities (such as councils) for projects that will facilitate the transition to 100 per cent renewable electricity that would not have otherwise occurred at this time.
7. Projects may include feasibility studies to evaluate new energy storage proposals, or pilot programmes for new technology. These may be joint ventures between industry and Government to develop new storage proposals, or wholly government funded initiatives, if that is appropriate. Examples of technologies or projects that could be within the scope of this initiative include:
 - Out of scope
 - the use of hydrogen derived from electrolysis as a stored fuel
 - Out of scope
 - investigation of alternatives to fossil-fuelled gas peaking plant, e.g. hydrogen or geothermal
 - Out of scope

8. Out of scope

Design of the Contestable Fund

The objective of the contestable fund is to bring forward investment that would not otherwise occur to investigate solutions to accelerate the move to 100 per cent renewable electricity

9. In the short term, the outcomes we expect to see are:
 - f. the improved knowledge of the options and cost of available solutions to assist with accelerating the move to 100 per cent renewable electricity
 - g. allowing industry stakeholders to see real world application of low emissions technologies or options
 - h. higher engagement from industry in considering relevant technologies that are on the cusp of becoming commercially viable (such as hydrogen).
10. The medium- and long-term outcomes are that ultimately the fund will stimulate private and public companies to invest in technologies that will enable New Zealand to reach a goal of 100 per cent renewable electricity, with a corresponding decrease in electricity-related emissions.

Scaling option one: facilitating the transition to 100 per cent renewable electricity through testing and piloting renewable technology

11. This is the preferred option, as it allows the greatest funding flexibility. It is wide enough to include applications such as for hydrogen proof of concept projects which involve proving the use and demand for hydrogen infrastructure, and renewable generation projects for small isolated (not grid connected) communities, which improve resilience in the move towards 100 per cent renewable electricity generation.



BRIEFING

Updated Proposed Energy and Resources Portfolio Budget Bids

Date:	17 October 2018	Priority:	High
Security classification:	Budget - Sensitive	Tracking number:	1363 18-19

Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	Agree that we submit the high level information contained in the briefing below to the Treasury by 23 October 2018.	22 October 2018

Contact for telephone discussion (if required)				
Name	Position	Telephone		1st contact
Anna Clark	Acting General Manager, Energy and Resource Markets	04 901 3925	9(2)(a)	✓
Andrew Hume	Manager, Energy Markets Policy	04 901 1474		
Alexandra Seton	Senior Policy Advisor	04 901 2489		

The following departments/agencies have been consulted
Energy Efficiency and Conservation Authority, Ministry of Health, Ministry of Housing and Urban Development, Te Puni Kōwhiri, Just Transitions Unit in MBIE

Minister's office to complete:

<input type="checkbox"/> Approved	<input type="checkbox"/> Declined
<input type="checkbox"/> Noted	<input type="checkbox"/> Needs change
<input type="checkbox"/> Seen	<input type="checkbox"/> Overtaken by Events
<input type="checkbox"/> See Minister's Notes	<input type="checkbox"/> Withdrawn


Comments

Initiative 3 – Supporting the energy sector to transition to high renewables

28. The objective of this proposed initiative is to increase New Zealand's overall energy security and resilience in a low emissions world, utilising renewable energy and other low carbon technologies.
29. A particular focus will be technologies and processes that can help to reduce New Zealand's dry year security risk through increasing energy storage. By addressing dry year risk, this programme should enable a greater percentage of intermittent renewable electricity to be deployed.
30. The components of the initiative could consist of studies to evaluate new energy storage proposals, pilot programmes for new technology, or joint ventures between industry and Government to develop new storage proposals.

31. Applicable technologies, include, but are not limited to:
 - a. the use of hydrogen from electrolysis as a stored fuel

Out of scope



32. Additional benefits from this work are the strong links to sector/industry development (such as hydrogen) and reducing sectoral emissions e.g. heavy transport. For example, the development of hydrogen as a dry year storage fuel for electricity generation would also provide quantities of hydrogen for use as a low emissions transport fuel. Reducing fossil fuel use in this sector will not only reduce dependency on imported fuel and improve security; it will also significantly lower emissions.
33. This work strongly supports the Just Transition Unit's work with the Taranaki region. It will enable the Government to bring appropriate resourcing to the table that can contribute to the region's efforts to realise its vision as a leader in new energy development.



BRIEFING

Clean energy funding landscape

Date:	27 February 2019	Priority:	Medium
Security classification:	Budget - Sensitive	Tracking number:	2387 18-19

Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	<p>Note a number of energy-related projects are being considered by the Provincial Growth Fund.</p> <p>Note there is an opportunity to provide Ministers with advice on:</p> <ul style="list-style-type: none"> • how these energy projects contribute to a range of government objectives; and • the most appropriate funding or support mechanisms for energy projects where government intervention is appropriate. <p>Agree for officials to carry out further work to develop a framework for decision making on clean energy projects.</p>	4 March 2019

Contact for telephone discussion (if required)			
Name	Position	Telephone	1st contact
Gus Charteris	General Manager, Just Transitions Unit	04 474 2839	9(2)(a) ✓
Grace Smart	Policy Advisor	04 897 7662	

The following departments/agencies have been consulted

Minister's office to complete:

<input type="checkbox"/> Approved	<input type="checkbox"/> Declined
<input type="checkbox"/> Noted	<input type="checkbox"/> Needs change
<input type="checkbox"/> Seen	<input type="checkbox"/> Overtaken by Events
<input type="checkbox"/> See Minister's Notes	<input type="checkbox"/> Withdrawn

Comments

This briefing relates to 'clean energy' projects

- Clean energy is energy that produces zero or low emissions when produced and used, and the technology and infrastructure to support and enable this. Solar, wind and geothermal are all clean energy types that are already used in New Zealand, and other new clean energy technologies may be developed and commercialised in future, including green hydrogen.
- Initiatives such as waste to energy, switching from coal to natural gas, and blue hydrogen production with carbon capture and storage are not considered 'clean energy' but may have value as a step in the transition to a low emissions economy.


These initiatives should therefore be considered as part of a discussion on New Zealand's clean energy future.

The emerging hydrogen economy is an example where clean energy projects can contribute to multiple government objectives

14. A number of hydrogen energy projects are currently underway, particularly in the Taranaki region. We recently provided you with a briefing updating you on the H2 Taranaki Roadmap report (the Report) and related hydrogen energy projects in the region [briefing 2374 18-19 refers].
15. The PGF funded \$50,000 to support the development of the Report, which focuses on the application of hydrogen technologies in Taranaki and in wider New Zealand. Officials understand that several of the projects proposed in the Report will soon be put forward as individual applications to the PGF. This includes a proposed Hiringa Energy and Ballance Agri-nutrients renewable hydrogen and green ammonia project at Kapuni (the Kapuni project).
16. Hydrogen energy projects can contribute to multiple government objectives. For example, the Kapuni Project is mapped against various government objectives in Annex Two, showing that it has the potential to contribute to regional economic development, energy and just transition objectives, but is unlikely to contribute to research, science and innovation objectives.
17. Simultaneous to Taranaki-initiated hydrogen developments, you commissioned MBIE to develop a national green hydrogen vision for New Zealand. This vision will support the development of a green hydrogen economy in New Zealand and ensure that various funding and government activities related to hydrogen energy are aligned and deliver on government objectives.

There are currently limited alternative funds to the PGF, but some relevant budget bids are being considered

Out of scope



Out of scope

21.

22. In addition to funding, government has a number of strategic activities aimed at developing clean energy in New Zealand, including:

- a. The Green Hydrogen Strategy
- b. Renewable Energy Strategy
- c. Clean Energy Platform Play
- d. MBIE's just transitions work in Taranaki.

23. Out of scope

Annex Two: Example preliminary analysis of clean energy projects against government objectives

	Regional economic development (PGF)	Energy			Research, Science and Innovation	Just Transition	Comment
		Renewable	Resilient	Affordable			
Out of scope							
<p>Kapuni Project</p> <p>Provide renewable energy to power the Ballance Agri-Nutrients plant at Kapuni and generate up to 2000kg/day of green hydrogen. Green hydrogen would be used for urea production, a domestic transport market, and for export.</p>	Out of scope	✓	✓	X (Not based on current hydrogen prices, but affordability may improve).	X Green hydrogen technology is already understood so the Project will not contribute to new research.	✓ The Project will contribute to Taranaki's transition of existing plant and jobs to low emissions.	<p>The PDU expects to receive an application for the Kapuni Project shortly. The Just Transitions Unit and Energy Markets team will provide input to the PDU's analysis of the Project.</p>
Out of scope		The Kapuni Project will produce and use green hydrogen energy which is renewable, and excess hydrogen can be stored to increase energy resilience.					

		Out of scope			
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BRIEFING

Marsden Point Refinery – Informal Study

Date:	23 September 2021	Priority:	Medium
Security classification:	In Confidence	Tracking number:	2122-0967

Action sought		
	Action sought	Deadline
Hon Dr Megan Woods Minister of Energy and Resources	<p>Out of scope</p> <p>[Redacted]</p> <p>Note the Government’s focus for the future of Marsden Point Oil Refinery has shifted from energy security to regional economic development;</p> <p>Note Kānoa is closely involved with updating the Northland Economic Development Plan;</p> <p>Note the land at Marsden Point is subject to Treaty claims with a forthcoming Waitangi Tribunal hearing;</p> <p>9(2)(j)</p> <p>[Redacted]</p> <p>Forward copies of this briefing to the Minister for Economic and Regional Development, the Minister of Transport and the Minister for the Environment; and,</p> <p>Consult with the Ministers concerned on the lead agency for providing advice on Marsden Point’s site remediation issues.</p>	27 September 2021

Contact for telephone discussion (if required)			
Name	Position	Telephone	1st contact
Andrew Hume	Policy Director, Energy and Resource Markets	04 901 1474	9(2)(a) ✓
Catherine Montague	Principal Advisor, Resource Markets Policy	04 897 5164	
Bertrand Ngai	Senior Advisor, Energy Markets Policy	04 901 1295	

The following departments/agencies have been consulted
Te Arawhiti, Ministry for the Environment, Ministry of Social Development, Ministry for Primary Industries, Ministry of Transport, Maritime New Zealand.

Minister's office to complete:

Approved

Declined

Noted

Needs change

Seen

Overtaken by Events

See Minister's Notes

Withdrawn

Comments

Proposals for the use of the Refinery's assets for future fuels

- d **Note** following Refining NZ's planned closure of the Refinery in mid-2022, there is yet to be a clearly established case for:
- a. retaining infrastructure for refining operations for the development of future fuels, including sustainable aviation fuel (SAF) and green hydrogen; and,
 - b. retaining skills and expertise for research and development of future fuels.

Noted

Patuharakeke was cautious about proposals for future fuels at Marsden Point


58. Patuharakeke asked that any technical proposals for the development of future fuels at Marsden Point should be robustly reviewed and cautioned against 'greenwashing' for example, in the development of hydrogen.

Marsden Point's potential for other forms of renewable energy

62. Based on Refining NZ's *The Marsden Point Conversion Proposal* released in July 2021, Refining NZ appears to remain interested in solar energy, although it has not recently made any firm proposal to the Government about how they might wish to work with the Government to develop its solar energy potential.
63. In 2019, Refining NZ was in the planning process to develop the Maranga Ra 26MW solar farm at Marsden Point, but this was placed on hold when Refining NZ commenced

its strategic review last year. The solar farm, if developed, could lower electricity costs of the Marsden Point site, thereby improving the business case for developing green hydrogen production at the site.

64. 9(2)(ba)(i)



BRIEFING

New Zealand Battery Project – update on hydro and other technologies

Date: 26 August 2021

Tracking number: 2122-0424

Purpose

The purpose of this briefing is to provide you with an update on our two workstreams that relate to potential alternatives to a pumped hydro scheme at Lake Onslow:

- other hydro options, including other pumped hydro options, and
- other comparator technologies (i.e. non-hydro options).

In relation to the ‘other hydro options’ workstream we seek your agreement to proceed with further investigation into the technical potential of three hydro-based options that could be alternatives or complements to Lake Onslow.

Our work continues to identify the potential of options using bio-energy, hydrogen or other green energy vectors, compressed air, and geothermal energy. We have begun a process to procure support for technical investigations into these options.

Workstream 3: Other comparator technologies

This workstream is investigating all other potential solutions

Workstream 3 is focussed on identifying other non-hydro developments that could meet the objectives of the NZ Battery Project.

Under this workstream we have:

- undertaken an internal desktop study to rule out options where we can attain sufficient information,
- begun a process to procure support for technical investigations into options for which we do not have sufficient information to form a robust view of their feasibility, and
- engaged with stakeholders to draw out their ideas for non-hydro developments, and test our approach to date.

We discuss each of these pieces of work and our findings in turn.

We are procuring expert support on the feasibility of other technology options

We are seeking support to further investigate the options that we have not been able to rule in or out with the information we have.

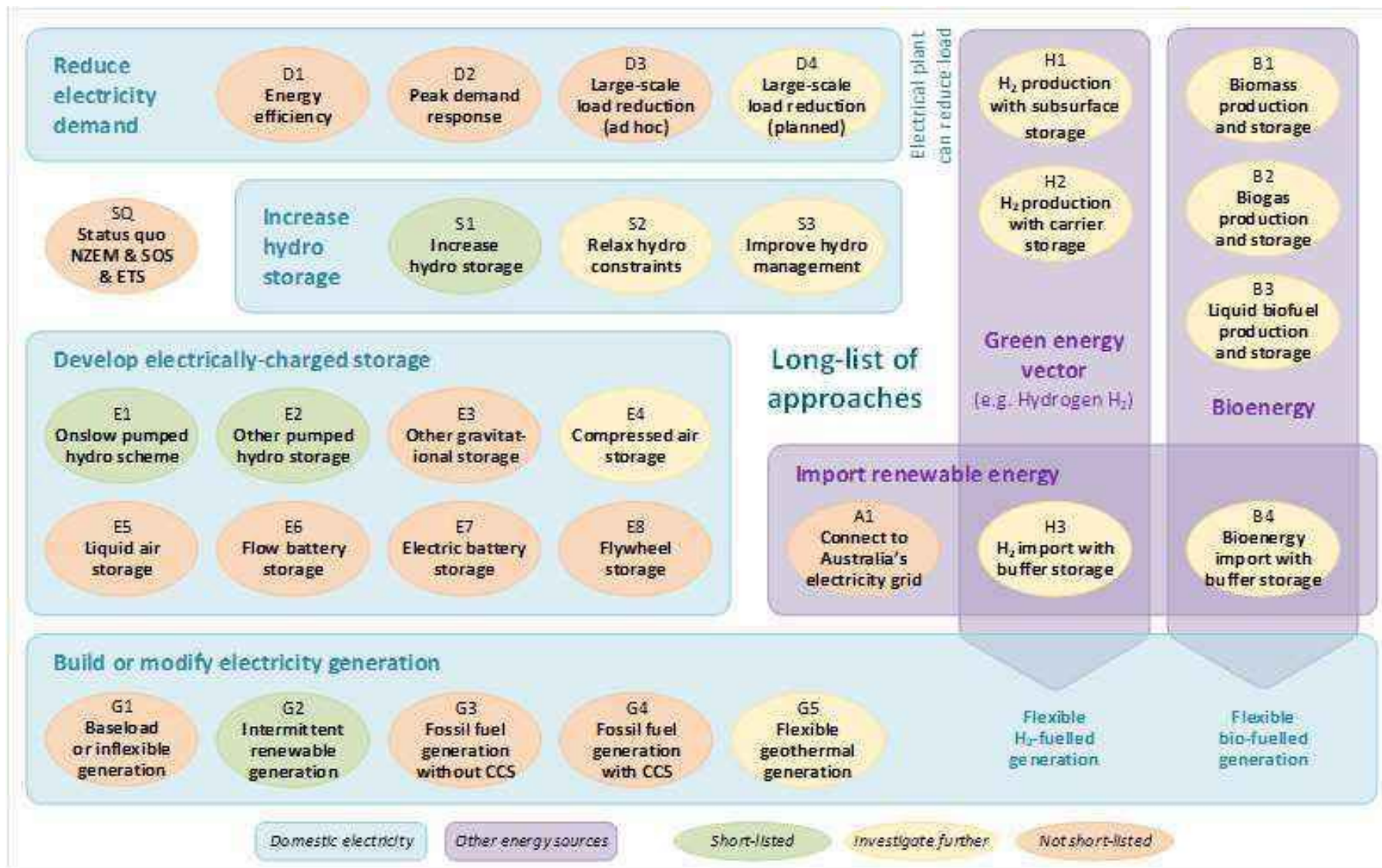
As a first step, we have commissioned ARUP New Zealand Limited (ARUP) to undertake the drafting of a Technical Scope of Work for a technical investigation of the remaining options.

This small piece of work is underway, and will also provide a peer review of our assessment of the options so far. The Technical Scope of Work will be used as an important input to a subsequent procurement for a provider to:

- undertake a study that would identify the range of practical options for generating 1,000-5,000 GWh per year of electricity for dry-year support from 2030 using:
 - biomass, biogas, and biofuels,
 - hydrogen, or other green energy vectors (e.g. green ammonia),
 - compressed air, and
 - geothermal energy.

- work with us to narrow down the practical options into a small number of options that best meet our criteria, and
- develop preferred options to a level of detail that they can be usefully compared with the hydro options being assessed under other workstreams.

We are aiming to begin procurement for the investigations in September. We expect the study to identify between one and three options that could be alternatives or complements to Lake Onslow.



BRIEFING

Enabling the transition to 100 per cent renewable electricity

Date: 25 August 2021

Tracking number: 2122-0510

9. Additionally, this work will be an integral part of the development of an energy strategy, and decisions taken as part of this work could have implications for the Hydrogen Strategy.

Annex One: ENABLING THE TRANSITION TO 100% RENEWABLE ELECTRICITY

Ideal Future State:

- Seasonal firming is provided by baseload green (e.g. bio-fuels or hydrogen) thermal, hydro or more flexible demand response
- Daily/weekly firming of intermittent renewables is provided by flexible “green peakers” (biofuels or hydrogen) and increased use of large conventional batteries

While ‘green’ thermal generation (biofuels and hydrogen) and batteries will replace many of the needed services, starting with baseload energy and daily firming, it is unclear at this stage whether other services such as seasonal swing and dry year provided by renewable sources will be more economic than traditional fossil-fuelled generation in the transition period, [remainder withheld under s 9(2)(g)(i)].

BRIEFING

Emissions Reduction Plan: Energy and Industry initiatives

Date: 2 November 2021

Tracking number: 2122-1451

Material Out of Scope or withheld under:

- 9(2)(f)(iv)
- 9(2)(a)

Completing Aotearoa's hydrogen strategy to realise its potential to reduce global emissions

i **Note** that the following two initiatives could be progressed as part of a strengthened energy strategy initiative, rather than being submitted as standalone bids, and we seek your views on this proposal:

1. Completing Aotearoa's hydrogen strategy to realise its potential to reduce global emissions

Completing Aotearoa's hydrogen strategy to realise its potential to reduce global emissions	<p>Only the first component of the original hydrogen proposal, relating to development of a hydrogen strategy has been invited to the CERF process.</p> <p>The Minister of Finance notes that the initiative will need to be closely aligned with development of an energy strategy. We consider this bid to be a key enabler of future emission reductions and seek your views on combining this bid with an energy strategy bid.</p> <p>This bid will complete Aotearoa's hydrogen strategy through the development of a roadmap to realise the potential for hydrogen production, export and utilisation to reduce global emissions. The roadmap will explore issues that need to be addressed for the use of hydrogen in the wider economy, and what steps need to be taken to resolve them.</p>
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Annex One

Policy description	Status	Contribution to emissions budget 1 (numbers are mid-point estimates, assuming CCC ETS price trajectory)	Potential contribution to emissions budgets 2 and 3	Budget funding requirements (Budget 22 or subsequent)	RIA requirements	Consultation requirements
Hydrogen regulatory review work stream – work to evaluate how fit for purpose current regulatory settings are for new technologies and novel applications of hydrogen.	Underway	Enabling	Enabling	No	Yes	Consultation may occur once specific options are developed.
Standards New Zealand work on adopting standards for hydrogen	Underway	Enabling	Enabling	No	No	Consultation will only occur during the development phase of any standards amendments/adoptions
Hydrogen demonstration projects	To be developed	Enabling	Enabling	Yes	No	Consultation will likely occur on a project by project basis.

Summary of Energy and Industry initiatives for the Emissions Reduction Plan

Emissions reductions initiatives

Policy description	Status	Contribution to emissions budget 1 (numbers are mid-point estimates, assuming CCC ETS price trajectory)	Potential contribution to emissions budgets 2 and 3	Budget funding requirements (Budget 22 or subsequent)	RIA requirements	Consultation requirements
Completing Aotearoa's hydrogen strategy to realise its potential to reduce global emissions	Preparatory modelling work prior to commencing the Roadmap is underway. Hydrogen Roadmap is scheduled to start work in 2022.	Enabling	Enabling	2022/23- \$2.137M 2023/24- \$2.050M 2024/25- \$1.800M 2025/26- \$0.800M Total- \$6.766M	No	ERP consultation includes question on support for low emissions fuels. There will be consultation on the preliminary modelling for the hydrogen roadmap in late 2021 and early 2022. The hydrogen Roadmap itself will run its own consultation process in 2022.

BRIEFING

New Zealand Battery Project – Progress update and emerging findings

Date: 16 December 2021

Tracking number: 2122-1504

Material Out of Scope or withheld under:

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The NZ Battery Project has four primary work streams:

- Work stream 3 – Other comparator technologies (i.e. non-hydro options such as bioenergy, hydrogen and geothermal)

As a result of our short-listing process, we have focussed further work on assessing the potential of the following options: bioenergy, geothermal energy, hydrogen (and associated renewable energy vectors such as ammonia), air storage and flow batteries. There are several more detailed sub-options within each of these technologies.

The potential of large-scale interruptible demand (such as proposed by Meridian Energy and Contact Energy through their Southern Green Hydrogen Project) is also being assessed in this workstream.

We completed contract negotiations with WSP in early December, and their work on the feasibility study has commenced.

WSP has been asked to complete three tasks:

- a. conduct a pre-feasibility assessment of options for solving the dry year problem using bioenergy, geothermal energy, hydrogen (or other renewable energy vectors), compressed or liquid air, and flow batteries, and to then provide a ranking and screening against set criteria, in order to help us identify the two or three most prospective options for detailed study,
- b. conduct a two-stage more detailed assessment of the prospective options to assess their technical and commercial feasibility, and the viability of integrating and deploying them in New Zealand by 2030, and
- c. build on the pre-feasibility assessment to evaluate the prospective options against evaluation criteria, to assess the options and inform our determination as to whether any should be developed further in Phase 1.

Meridian Energy and Contact Energy updated us on their Southern Green Hydrogen project, which is investigating the potential of a flexible hydrogen production facility at Tiwai. It has sought Registrations of Interest from prospective development partners, and advised us that they had received a large number of responses that they are working through.

We have also been considering the work they commissioned from Concept Consulting (Concept) titled “Potential Benefits from Large-Scale Flexible Hydrogen Production in New Zealand”. Initial examination from MBIE indicates the importance of the underpinning assumptions in informing the outcomes of the analysis. Concept’s report relies on assumptions around the willingness of a hydrogen producer to turn down when electricity prices are high. That willingness, and the extent to which it could be relied upon long-term, is a key determinant of whether a flexible hydrogen production facility could contribute to dry year security.

Emerging findings

Early indications are that all non-hydro options have challenges

Hydrogen has inherent challenges because it is difficult to store a low-density, highly flammable gas. New Zealand does not have the obvious underground geological features, such as salt caverns, that other countries are considering for direct hydrogen gas storage.

Processing hydrogen into a more storable product, such as ammonia, is an alternative, but adds cost and other complexities when stored at the very large quantities required for dry year storage (for example, ammonia, is explosive, flammable and very toxic).

Given the storage challenges, importing hydrogen when required, or interrupting the domestic production and export of hydrogen may be the options that are lowest cost and risk. However, the technology and markets for green hydrogen and renewable energy vectors are still immature and uncertain, and may not be able to provide the scale we require in the 2030s at a realistic cost.