Submission on the *Interim Hydrogen Roadmap*

Name	
Organisation (if applicable)	
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Release of information

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Responses to questions

Section 1: Hydrogen is emerging as an important part of the future global energy system

Are there other issues we should be considering in our assessment of the strategic landscape for hydrogen in New Zealand?

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1) Yes. The first issue that you haven't addressed is how much hydrogen will be lost through leaks and venting, and how this will cause increased global warming. Hydrogen is the smallest molecule and it is well known for leaking from pipes and storage containers, especially when under very high pressure. Leakage of methane into the atmosphere is already a serious problem, but if hydrogen replaced methane, leakage will be much greater.

Hydrogen is not a greenhouse gas itself, but its breakdown in the atmosphere occurs when it combines with hydroxyl radicals (OH) in the troposphere. Unfortunately, this is the same mechanism that removes methane from the atmosphere. Since there is a finite amount of OH produced each day, hydrogen leakage will reduces the removal of methane from the atmosphere and therefore increase global warming.

I urge you to read this scientific paper published by The European Geosciences Union. "Climate consequences of hydrogen emissions" at https://acp.copernicus.org/articles/22/9349/2022/. The conclusion it draws is that "hydrogen's potency can be 6 times higher than commonly thought when looking at the critical next couple of decades".

2) You have also not addressed the difficulty of hydrogen transportation. Existing natural gas pipelines are not suitable for transporting hydrogen and a new hydrogen pipeline network would be extremely costly to install. That leaves local generation as one option, but that means higher production costs. Transportation by road tanker is also problematic. To carry the same amount of energy as a single tanker of diesel, it will require 13 to 18 tube tankers filled with compressed hydrogen at 700 atmospheres. (10,000 psi). Liquid hydrogen would reduce the number of trips to 4 or 6, but this requires more energy input to liquefy the hydrogen and large losses to the atmosphere due to necessary venting when using or transporting it.

3) You haven't addressed the issue of the cost of production of green hydrogen and how you envisage it competing with grey hydrogen or even bluish hydrogen, which struggles to capture 40% of the CO2 produced when making hydrogen from methane. If we are serious about decarbonisation, then we should start by decarbonising the 120 million tons of grey hydrogen produced every year (at present it represents 2% of total greenhouse gasses).

4) It's hard to believe that some people are suggesting that we use green hydrogen as a reticulated gas for heating water and people's homes. Putting aside the huge capital costs of new pipe lines that are suitable to carry hydrogen, the home owner's cost of conversion to hydrogen, and then the overall inefficiency of using hydrogen for heat. Compared to a heat pump, you need at least six times the electricity input to make and deliver hydrogen to the home, for the same amount of heating in the home.

Section 2: The role for hydrogen in New Zealand's energy transition

	Do you agree with our assessment of the most viable use cases of hydrogen in New Zealand's energy transition?
2	No. FCEVs can never be as efficient as EVs. In spite of past claims that FCEV cars will displace EVs, this hasn't happened. This is because FCEVs are more expensive to manufacture and require at least three times the amount of electricity input to cover the same distance as an EV. NZ is a mountainous country, so the extra diesel used climbing a hill, is dissipated as heat from the brakes during a decent. This is also true to some extent for a heavy transport FCEVs, because their much smaller battery cannot absorb the large amounted of electricity generated by regenerative braking. On the other hand, when going downhill, a BEVs can recover 80% of the energy used to go up hill. Less energy used, less waste heat added to the environment and less brake pad particles in the air. Battery technology has already reached the milestone US$100/kWh at pack level, with the potential to go much lower. FCEVs can only improve their efficiency by improvements to electrolysers and fuel cells. There is limited scope to do this. Ten years ago, it was predicted that people in California would choose FCEVs cars over BEVs, because FCEVs were more like ICE cars in terms of range and refilling times. This hasn't happened because of the real life problems of owning a FCEV. Retail hydrogen in California now costs over US$30 a kg. You are now making the same predictions about FCEV trucks. Tesla's semi-truck can recharge to 80% in 30 minutes, which can be done during drivers rest periods, so it's not an issue. As for range, Tesla's semi has a range of over 800km, compared to a FCEV range of 600km running on compressed hydrogen. To achieve a range of 1000km, a FCEV truck must use liquid hydrogen, which costs more to make and has high losses to the atmosphere due to necessary venting of the hydrogen. On top of this, FCEVs are more expensive to buy and require at least three times the electricity generation to travel the same distance as a BEV truck. For normal transport uses, FCEVs will always be more expensive to operate and therefore do not make commercial sense. Without large government subsidies, trucking firms will not use FCEVs.
	Do you support some of these uses more than others?
3	I support green hydrogen's use as an industrial feed stock for making chemicals and fertiliser, as well as for making steel. The problem is that the cost of producing green hydrogen is three or more times the cost of producing grey hydrogen. The price of carbon has to be a lot higher than $50 a ton to change this fact.
4	**What other factors should we be considering when assessing the right roles for hydrogen in New Zealand's energy transition?**
	You need to consider the realistic cost of future green hydrogen production and avoid investing in infrastructure that will never repay the investment cost. Toyota is a good case study. After sinking huge sums into developing their Marai FCEV, the car is expensive to make, expensive to buy, expensive to run (if you can find a filling station) and has much less

	internal space due to needing three to four times the space for fuel tanks, plus space for the fuel cell pack and battery.
5	**Do you agree with this assessment of the potential for hydrogen supply and demand in New Zealand?**
	No. You only present the most optimistic outlook for cost reductions in the price of green hydrogen. You haven't addressed the cost of installing a distribution network and the cost of delivering the hydrogen to the refilling stations of this network. FCEVs are an old technology that has always failed to gain acceptance due to high costs and lack of infrastructure. This is down to the physics involved and this will not change, no matter how much money is invested.
6	**Do you agree with the key factors we have set out that are likely to determine how hydrogen deployment could play out?**
	No. It's hard to answer this question, because you do not list the key factors in the roadmap. My point is that you haven't produced any economic evidence of how hydrogen will be a viable fuel compared to direct use of electricity. Your future use cases are mere speculation and therefore any money spent supporting hydrogen infrastructure is likely to be a waste of taxpayer money.
7	**What do you think needs to happen to address these factors?**
	You need a roadmap demonstrating how the cost of green hydrogen will become competitive with electricity except for chemical and steel making.
8	**Do you have any evidence to help us build a clearer picture?**
	There have been recent claims that hydrogen is necessary for heavy transport because of the high power required to move big loads. This suggests that heavy transport EVs are not as powerful. This is nonsense. The Tesla semi, for example, has over 1000HP, while a diesel semi has a maximum power of 600HP.
9	**Do you agree with our findings on the potential for hydrogen to contribute to New Zealand's emissions reduction, energy security and resilience and economic outcomes?**
	No. Hydrogen production at present is a major contributor to greenhouse gas emissions, and You haven't addressed how you will deal with this except to hope that the price of green hydrogen will eventually be cheaper than grey hydrogen. **The reality is that at the moment, hydrogen is available in Auckland for $20/1kg. Using an electrolyser at 65% efficiency, it will require 55.7 kWh of electricity to produce 1kg of green hydrogen. At an average wholesale price of 13c/kWh, the electricity only cost of producing 1kg of hydrogen will be $6.72/kg.**

10	**Do you have any insights we should consider on what is needed to make hydrogen commercially viable?**
	It's hard to see how hydrogen will ever be commercially viable compared to grey or pale blue hydrogen, unless a high carbon tax is placed on hydrogen made from fossil fuels. My rough calculations suggest a necessary carbon price of $7,500/ton of CO2. I might be wrong on this, but I would like to see a qualified person to do this calculation. It's interesting to note that you only say hydrogen in this question and not green hydrogen. Is this merely an oversight? Grey hydrogen is of course already commercially viable.
11	**Is there any further evidence you think we should be considering?**
	Instead of spending money on a technology with a highly expensive and very difficult pathway to adoption, we should be investing in upgrading our electrical grid to handle the increasing demand for electricity that reaching net-zero will require.
Section 3: Government position and actions	
12	**Do you agree with our policy objectives?**
	No
13	**Do you agree with our positioning on hydrogen's renewable electricity impacts and export sector?**
	The inefficient use of electricity to make hydrogen for transport or for shipping overseas will only increase the price of electricity in NZ.
14	**Do you agree with the proposed actions and considerations we have made under each focus area?**
	No. Especially using hydrogen for home heating. This is a terrible waste of renewable energy.
15	**Is there any evidence we should be considering to better target actions in the final Hydrogen Roadmap?**
	There is incontrovertible evidence that running our freight industry on hydrogen is many times more expensive than running it on electricity directly. Please check out what some European truck manufactures have to say on FCEVs compared to BEVs. "https://traton.com/en/newsroom/current-topics/why-the-battery-electric-drive-represents-the-future-for-trucks.html"

General comments

The fossil fuel industry's global push to promote hydrogen, is not motivated by a desire to decarbonise our energy system, but is on the contrary, a desire to slow down decarbonisation. This industry has deceived the general public for many years, on the consequences of adding large amounts of CO2 to the atmosphere. They know that green hydrogen will never be as cheap to manufacture as grey hydrogen. As for blue hydrogen, there has not been any success in storing more than 40% of the CO2 produced and it is expensive to even do this.

There are many in-depth articles that explain why FCEVs are not a good solution for heavy road transport, but I direct you to just one.

"https://traton.com/en/newsroom/current-topics/why-the-battery-electric-drive-represents-the-future-for-trucks.html"

This is the website of Traton, who are a group of European truck manufactures (Scania, MAN, Navistar, and Volkswagen Truck & Bus)

I urge the NZ government to not be misled by financial interests, whose only agenda is to prolong the use of fossil fuels and subject the world to more climate havoc than we already face due to past CO2 emissions.

I strenuously urge every disinterested supporter of NZ's Hydrogen Roadmap, to examine the claims of the promoters of a hydrogen economy, and ask for answers to the problematic issues around using hydrogen to decarbonise our energy system.

In Summary:

Why Hydrogen is not a "Silver bullet" that will decarbonise our economy efficiently because:

1) Hydrogen has a part to play as a feed stock for industrial chemicals and to replace coal in the making of steel from iron sands.
2) Hydrogen has only a very minor part to play in road transportation.
3) Hydrogen has no part to play as a heat source. Electricity is many times more efficient.
4) It is a very inefficient way to store energy and then generate electricity from it.
5) At the moment, hydrogen is an emissions problem, not a solution.
6) To think that we can produce liquid ammonia and ship it to Japan for a profit is delusional, because only 10% of the electrical energy used to make the ammonia in NZ, will be available to users in Japan.
7) Running a combustion engine using grey hydrogen creates more CO2 emissions than using methane directly.
8) We haven't got any spare renewable energy to waste on making green hydrogen, for anything other than replacing the grey hydrogen that we are already using.

What Needs to Happen:

1) Realise that hydrogen is a decarbonisation problem as big as the airline industry and not a solution.
2) Stop producing and importing grey hydrogen and incentivise the production of green hydrogen for industrial uses in NZ.
3) Move as quickly as possible to electrify all process heating.
4) Stop subsidising unrealistic hydrogen infrastructure for transportation.
5) Please stop wasting taxpayers money on a fossil fuel promoted scheme to increase the use of methane instead of green electricity. The emperor has no clothes!