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From: no-reply@mbie.govt.nz
Sent: Thursday, 10 October 2019 8:50 a.m.
To: [redacted]; Hydrogen
Subject: Hydrogen green paper - submission

Submission on Hydrogen green paper recevied:

Introduction
Name

Don Cleland

Email

d.cleland@massey.ac.nz

Business name or organisation (if applicable):

Massey University

Position title (if applicable):

[redacted]

Is this an individual submission or on behalf of a group or organisation?

Individual

Please give the name of the group or organisation this submission is on behalf of.
What is the role of Government in developing hydrogen for storage and distribution?

Hydrogen may be part of the future energy scene of NZ but MUST be considered in the context of other options that are potentially superior. I am concerned that the paper is far too optimistic for the place of hydrogen in the future. Government must take a balanced view and investigate a wider range of options than just hydrogen.

The overarching rationale for my concern relates to inherent energy conversion efficiency. The key driver to move to hydrogen is to try to decarbonise and, ultimately, the economics should closely reflect the net carbon emissions of an activity. In the long-term the key supply chain proposed for most end-uses is the conversion of renewable electricity to hydrogen and then back to electricity for end-use. Electrolysis of water is at best 70-80% efficient and hydrogen fuel cells are at best 50-60% efficient so the overall system (supply chain) efficiency is likely to be 40-50% at best (ignoring losses of hydrogen in the storage and distribution system which may be an additional few percent). The paper says that the overall efficiency can be less than 30% (p23). By comparison, direct use of electricity only incurs the transmission and distribution losses (less than 10%). Hence for many applications, the case for hydrogen becomes whether the approximate doubling to tripling of renewable electricity use (due to lower supply chain efficiency) is justified by the lower cost of storage and distribution for hydrogen (probably new infrastructure) compared with the cost for storage and distribution of electricity (extra costs as existing electricity transmission and distribution infrastructure would need to be expanded). Given that electricity technology is already ubiquitous and easily scalable (and that the existing network has some spare capacity in many regions) while hydrogen is less developed and has significant challenges (high pressure, leakage, safety), I have serious doubts that the economic case can be made. That is, infrastructure for hydrogen is unlikely to be sufficiently cheaper than the expansion of the electricity infrastructure, to justify the lower overall supply chain efficiency.

Having said this, hydrogen may have some interim or niche role as we try to transition to a low carbon economy but in many cases is unlikely to be the long term or mainstream solution.

The green paper does advocate life cycle costing for decisions which is supported. However, in many cases simple analysis such as that above can show that life cycle costs are unlikely to favour hydrogen.

What are the challenges for using hydrogen for storage and distribution?

see above

What are the opportunities for using hydrogen for storage and distribution?

see above

What is the role of Government in developing the complementary role of electricity and hydrogen?

see above

What are the challenges for achieving this complementary role of electricity and hydrogen?

see above

What are the opportunities for this complementary role of electricity and hydrogen?

see above

What is the role of Government in supporting hydrogen use for the transport sector?

Transport is one of the more promising application for hydrogen due to the energy density it can provide. However, other options to decarbonise should be considered first as they are likely to be far more cost-effective than hydrogen:

1. Use of Rail (or coastal shipping)

• Transfer of freight to rail (even if rail not electrified) - the main trunk network exists and is under-utilised and even without electrification can provide very large reduction in GHG emissions for the same freight transport

• Expansion of rail network to provide better coverage of long distance freight paths - the cost of doing this could be cost-effective relative to the hydrogen infrastructure to provide the same GHG reductions

• Further electrification of rail - the cost of doing this could be cost-effective relative to the hydrogen infrastructure to provide the same GHG reductions.

2. Swap-a-battery

• Hydrogen is often proposed to overcome problems with long-distance electric vehicles i.e. limited range of batteries, the challenges of fast-charging.

• However, "swap-a-battery" options would largely overcome these limitations and should be explored (rather than recharging on-board batteries, battery packs are swapped; the battery packs are charged off-line and slowly). It is simple, uses existing technology, has well-defined costs (extra battery sets and charging stations) and by avoiding the need for fast charging would reduce electricity infrastructure expansion costs.

• Extra battery stocks across NZ could also assist dealing with the intermittent nature of many renewables sources of electricity (wind, solar, wave, tide).

3. Methane

• We already have a methane distribution infrastructure in the North Island and some sources of renewable methane are likely continue to be available and should increase in capacity e.g. land-fill, wastewater treatment, biomass conversion.

• While such renewable sources will be insufficient for all current methane uses, dedication of this methane to the transport options that are otherwise the most difficult to decarbonise should be considered.

What are the challenges when using hydrogen for mobility and transport?

see above

What are the opportunities for using hydrogen for mobility and transport?

see above

What is the role of Government in encouraging the use of hydrogen for industrial processes including process heat supply?

Due to conversion efficiencies, use of hydrogen for process heat makes little sense relative to other options - particularly biomass or direct use of electricity (especially where heat pump technology increases the efficiency of process heating via electricity) and possibly methane (although the quantity of renewable methane may not be sufficient to do significant process heating). The only exception may be for process heat at very high temperatures, but even then biomass or electric resistance heating is likely to beat hydrogen due to the 20-30% electrolysis losses from renewable electricity alone. Hydrogen may be attractive if the hydrogen infrastructure costs are significantly lower than the costs to expand the electricity infrastructure but this is considered unlikely.

What are the challenges for using hydrogen in industrial processes?

see above

What are the opportunities for the use of hydrogen in industrial processes?

see above

What is the role of Government in encouraging hydrogen uptake for decarbonisation of our natural gas uses?

Using hydrogen to decarbonise natural gas does not make much sense due to the conversion efficiency even if existing infrastructure can be used. Renewable methane from landfills, waste treatment and biomass conversion should be used for end-users that are otherwise difficult to change (e.g. small scale). As indicated for process heat and transport, options other than hydrogen make more sense in most cases due to the conversion efficiencies.

Given we have significant natural gas expertise and infrastructure, then greater use of methane rather than hydrogen is an option that should be considered. The significant constraint for greater use of methane rather than hydrogen is availability and efficiency of methane fuel cells. If fuel cells became available that use methane with similar conversion efficiency as that for hydrogen fuel cells then if would make more sense for NZ to use methane rather than hydrogen - developing methane fuel cells should be a research priority for NZ rather than being a fast-follower in hydrogen development.

What are the challenges for hydrogen to decarbonise the applications using natural gas?

see above

What are the opportunities for hydrogen to decarbonise our gas demand?

see above

What is the role of Government in producing hydrogen in sufficient volume for export?

If we are to decarbonise our economy then demand for renewable electricity will significantly increase. Simple economics and environmental policy indicate that we should only use renewable electricity for export hydrogen if there is not a domestic demand for the electricity. This should be unlikely in the quite long-term if we are pro-active in decarbonising our end-use application (i.e. domestic demand for electricity should match or exceed likely increase in renewable electricity generation if we are to decarbonise transport and process heat). Therefore, export of hydrogen should be a very low priority.

What are the challenges for hydrogen if produced for export?
In addition, we welcome your feedback about the opportunities of hydrogen to Māori and how this will support their aspirations for social and economic development.
What are the opportunities for hydrogen if produced for export?

If you wish to, you can attach a document to this submission.
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