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NERI Comments:

Scion Biofuels Roadmap Presentation

The following summarises comments raised on NERI's behalf at the Scion roadmap presentation on 29 August.

I have seen a number of roadmaps with a strong technology focus fail for an underlying reason that they spent too much time on the technology and not enough on the environment into which the technology is being deployed. They fall into the trap of being technology push. Now I take the point Scion has been making that the markets to focus on will come out of the work, but I still think more time needs to be spent on the context/environment in which transport fuels will be used in NZ in the future, because that focuses the roadmap on the NZ reality.

In what follows I'll quickly comment on getting some more market pull into the work so far (and along the way also identify scenarios that may warrant modelling).

What I would expect to see is a greater emphasis on identifying the transport submarkets that we use fuel in and the consumer needs that are being met in them. In NZ we have quite distinct markets for:

- Aviation (Jet, Avgas)
- Long haul marine, short-haul marine (they tend to use different fuels and have different engines etc)
- Rail (diesel, electric and a combination)
- Medium and heavy duty cycle road (diesel)
- Off road (predominately diesel)
- Short duty cycle road (petrol, diesel, hybrid)

My view is that we need to look at each of these markets over the 40+ year time frame (although realistically I think 20 years is the best you can credibly use) answering the questions with a strong emphasis on the significant issues:

- What is happening to consumer preferences and behaviours in this market and what are the social changes that are influencing regulation and the like? This will have a strong indigenous flavour.
- What are the market drivers and what are the trends and material uncertainties?
- Where the transport technologies are heading and what are the various competing transport systems? In this we will primarily be technology takers. I'd note that when looking at the various energy technology futures "Quadrennial Technology Review – An Assessment of Energy Technologies and Research Opportunities" US Department of Energy 2015 is reasonably even-handed e.g. see Fig 8.4 for the DOE targets for transportation technologies.
- What are the competitive positions of these technologies in the NZ context (their value proposition) and what are the material uncertainties in their local uptake? This again will have a strong NZ flavour. I should add that I don't think the uncertainty in the future volume of demand is likely to be material in terms of what technologies are preferred, however the impact of significant alternatives needs to be considered.

In this biofuels (whether as a drop in replacement or as new alternative fuel) should just be treated like all other alternatives. This analysis needs to include the business-as-usual comparator – presumably continued use of fossil fuels but with improving conversion efficiency and payment via a carbon charge for sequestration (or the equivalent for international transport fuels). One of the key issues to keep an eye on is that biofuels derive their value in dealing with GHGs from the fact that they do the sequestration as part of their production. This means fossil fuels may be a strong competitor because they have the established low cost complete value chain and will have much more flexibility in how to achieve the sequestration. This suggests to me that to be competitive biofuels need to have something else going for them in the particular market.

This process of road mapping the market development needn't be a huge exercise – much of the resource material existing internationally and we have a fair idea of what NZ's resource endowments and attitudes might be.

I've attempted a high level look based on the work we've been doing in NERI. Treat this as a "for instance" only based on only a partial analysis and a fair dollop of blind prejudice. This needs to be done as a central part of any biofuels roadmap.

Aviation

We'll need avgas and Jet A-1 in volume for the foreseeable future. Depending on what drones use there could be novel fuels required (e.g. hydrogen is being explored) and there could be significant growth. The pressure will be on in these markets to reduce motive overhead to increase payload as well as GHG reduction.

So there will be a need for liquid or gaseous fuels for drones (even if hybrids occur). Biofuel blends have already been approved so the question is *can biofuels compete against fossil aviation fuels with carbon charges in the next 20 years (say)*. Or

possibly “how can”. Investigation of drone fuels is worth consideration because commitment to the prime mover hasn’t yet occurred.

Marine

Heavy fuel oil has a problem today because of sulphur. They have been kicking the can down the road for about as long as they can get away with it. So right now operators are facing the expense of adding scrubbers or switching to much more expensive marine diesel to comply. Desulphurisation is expensive. Understanding how these technologies will track in time with a carbon charge (or international equivalent) gives a basis for comparison with biofuels. Some thought needs to be given to just how refined the biofuel needs to be to be used in a blend with these fuels – dewatering etc. The question is *whether a lower grade biofuel blend fuel that reduced S and GHG could prove competitive with a more refined marine diesel and a carbon charge*. The limits on NOx emissions could be a problem for biofuels although blends with DME may be an option (the blend reducing problems in heavy engines associated with lubricity). LNG is also currently being installed in some cases.

Whether other forms of prime mover on ships that use heavy fuel oils might emerge also needs consideration.

With the vessels that are using lighter marine grade diesel (eg Waiheke Ferries) *biodiesel is a straightforward run off with light marine grade diesel and a carbon charge*. However because these ships may have a shorter duty cycle, options for alternative fuels/prime movers will need to be evaluated along with alternative fuels eg DME (that could allow a pathway via blending and fossil fuel methanol to begin with). LNG unlikely to be used because of infrastructure/storage issues.

Rail

Here the fuel options are wider because of the range of potential alternative prime movers is wider, but at a minimum the biofuel (whether bio-diesel, DME etc) needs to be *competitive with fossil fuel with a carbon charge*. This needs an evaluation with NZ Rail taking into account their replacement programme that potentially opens up a range of options over the time frames being evaluated. Again as a large point source consumer with fleet purchases it could be a useful scale up user for different fuels (eg again DME).

Medium and heavy duty cycle road

Again this is an area where there are potential competing technologies that should be reviewed. In this case consideration of electric or hybrid drives using improved batteries (and perhaps charging on the road) or fuel cells (with H2 or on board reformers) as *well as alternative fuels (biodiesel, DME, etc) need consideration*. Again there are application where there is fleet purchasing and common servicing points (eg bus fleets) that could serve as market entry points.

Off Road

Unlike in other jurisdictions we don't have a diesel product that sits below the diesel used for high speeded autos and fuel oil so there is *a potential gap in the market place for a lower speeded biofuel suitable for off-road vehicles and heat loads.*

Light duty cycle road

I think it essential that there be some high level work done to *justify the likelihood of biofuels outperforming the move to EVs in NZ.* Bio-ethanol blends at low concentrations may be justified as the fleet transitions to EVs. Much has been done here by MoT and NZTA, and "Electric cars, solar panels and batteries – how will they affect New Zealand's greenhouse gas emissions?" (2016) Concept Consulting, looks at the energy and emissions issues specifically.

The point of the above is that transport biofuels are going into a much more nuanced landscape than Scion is currently appearing to assume, but most of the advantages and disadvantages can only be discussed in the context of specific markets. Without that they all become difficult and lack the basis for determining a pathway forward. The lack of context makes these roadmaps less useful, a comment NERI will be making to MfE and DoC in their current research road mapping consultation. Attached is a copy of NERI's submission to that process.

The other thing top down market analysis helps with is in targeting where scarce resources end up. These are difficult transitions and we need to put the effort into the areas where the pay-off will be. For example if we can eliminate the low duty cycle road transport market early we can put more effort into more rewarding options.

Finally I should note that I personally have some commercial interests in this area through BFSNZ and Nufuels. I mention this in respect of potential conflict of interests.



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