National Energy Research Institute

10 February 2020

Simon Upton
Parliamentary Commissioner for the Environment

Feedback on "Pristine, popular imperilled?"

Introduction

The National Energy Research Institute[1] (NERI) welcomes the opportunity to give feedback on "Pristine, popular imperilled?" (*the Report*). The Report addresses an area that we too have been focused on, GHGs from transport.

In what follows we will briefly give some background on the work we have been doing relevant to tourism along with a few updating comments. Because we consider more work needs to be done on identifying and understanding the issues New Zealand needs to be addressing this is an initial communication as a basis for further discussion.

In 2017 NERI published "Energy Research Strategy for New Zealand"[2]. Transport, particularly high duty cycle transport, was identified as a priority issue for research investment in New Zealand, and since then we have been developing this theme further.

[1] NERI is a Charitable Trust incorporated in New Zealand. Its primary purpose is to enhance New Zealand's sustainability and to benefit the New Zealand community by stimulating, promoting, co-ordinating and supporting high-quality energy research and education within New Zealand.
Its research members are Auckland University of Technology, GNS Science, Scion, University of Canterbury, and the University of Otago, and its industry association members are the Bioenergy Association, BusinessNZ Energy Council, the Energy Management Association of New Zealand, the New Zealand Wind Energy Association, the Road Transport Forum and Tourism Industry Aotearoa. This note has been prepared in consultation with the membership but may not necessarily represent their individual views in the detail.

[2] https://www.neri.org.nz/strategy

Place of energy research

As the Report notes "clean, green, remote" are integral to our tourism offering. But by our very location we are perhaps the most exposed country in the world to the difficult problem of the use of fossil fuel in long-haul transport.

Management of this risk will be a critical success factor for our tourism industry. Further, GHGs from long-haul transport impacts other sectors, particularly clean food exports, international business, adding to the justification for New Zealand to address it and to be amongst the world leaders in so doing.

The Report's scenario modelling shows the implications of business-as-usual for GHG emissions from transport in Tourism, but as Chapter 7 argues we can influence this for the better.

While we cannot necessarily know exactly what to do to achieve this, we can improve our ability to manage the most likely futures. Public investment[3] in applied, directed R&D can both help manage the obvious risks and increase our options where the risks are more uncertain[4].

Transport research

Based on this NERI has been developing the case for a Clean Transport Research Strategy for New Zealand.

Because of our relatively unique high levels of clean electricity, good electricity distribution system, and the capacity to expand generation at relatively low cost to meet demand (i.e. wind and geothermal), electric vehicles are a particularly good fit for New Zealand in low duty-cycle transport[5]. Some research issues remain, but these problems are better defined than for high duty cycle transport where solutions are much less clear-cut.

Therefore, our focus has been on high duty-cycle transport.

To this end we have developed a one-page summary of New Zealand's high duty cycle transport research challenges. This is attached as Appendix 1[6].

The intent is to next use this to develop a research strategy that will:

- Clarify the major, priority material issues for attention by New Zealand;
- Directly address those areas where actions are clear cut but beyond business-as-usual; and
- Increase our options and de-risking them where there is uncertainty.

The demand side is included because it is an attractive and perhaps more significant immediate option to reduce GHGs. Traditionally energy research has focussed on

[3] We assume the private sector will drive innovation investment where the risks are manageable by them and the rewards can be appropriated. This will tend to be shorter-term research.

[4] See e.g. Chapter 6 "*Low-emissions economy: Final Report*" 2018, NZ Productivity Commission.

[5] The use of electricity in some long-haul transport e.g. trains could also benefit tourism, not just because of GHG reduction but by constraining tourists to particular corridors.

[6] This is a work-in-progress subject to revision. The most up-to-date version will be available at https://www.neri.org.nz/submissions-and-papers-by-neri

new fuels and vehicle technologies, but even if alternative fuels are drop-in sunk costs in infrastructure make it difficult for new technologies to enter the market.

On the other hand, there is considerable potential for social and behaviour changes within the tourism sector to directly reduce demand for fossil fuels[7]. These changes are partly being enabled through emerging technologies such as ICT, AI, embedded intelligence, V2X communications, Augmented Reality[8]. They are helping deliver the benefits of mobility without traditional transport (e.g. telepresence, 3D printing) or deliver them much more efficiently (e.g. transport as a service).

Implications for Tourism

In February last year we submitted on the draft Tourism Strategy (submission attached as Appendix 2 [9]). This addressed these issues specifically in the context of Tourism and recommended that energy be identified as a key input into tourism services in the final Tourism Strategy. In the event the Strategy[10] didn't specifically address energy but it did include "*Deepen understanding of the implications for the tourism industry of climate change and the move towards a low-emissions economy (MBIE)*"[11] (page 13) as an action to further its environmental outcome.

Our submission touches on the implications for each of the modes. Four relevant developments since the date of the submission are:

- All Nippon Airlines (ANA) has continued to develop its avatar business (see https://ana-avatar.com/english.html), reinforcing telepresence and related technologies as an emerging tourism option. A research issue the international activity raises is how New Zealand protects ownership of the local experience in the face of virtual publishing.
- New Zealand has agreed to join Marpol from 2022. This will accelerate the adoption of cleaner marine fuels and mean a shift from marine fuel oils to more expensive low sulphur distillates. While biofuels are more expensive, cruder biofuels are cheaper and have the potential to be competitive with distillates and bring the added benefit of eliminating GHGs. This is an area New Zealand should be exploring.
- The Ministry of Transport has commenced work on a Green Freight Project[12] and this work is also relevant to higher duty cycle passenger land transport (e.g. rental cars, camper vans and buses). The Green Freight work gives fuller coverage than our Tourism Strategy submission of the fuel options (hydrogen,

[7] This may lead to stranded assets but overall welfare should be increased.

[8] See for example Cohen, S. A., & Hopkins, D. (2019). "Autonomous vehicles and the future of urban tourism". Annals of tourism research, 74, 33-42 for a recent exposition of some of the potential impacts on tourism.

[9] Also available at https://www.neri.org.nz/submissions-and-papers-by-neri

[10] https://www.mbie.govt.nz/immigration-and-tourism/tourism/new-zealand-aotearoa-government-tourism-strategy/

[11] An issue is Tourism's main exposure is to international transport emissions, often not included when considering "a low-emissions economy".

[12] https://www.transport.govt.nz/multi-modal/climatechange/green-freight-project/

electricity and biofuels). On hydrogen the government released a Green Paper[13] during the year and we submitted on it[14].

- Budget 2019 included a new provision for energy research funding and a National New Energy Development Centre, and both may lead to more activity in clean transport R&D.

Solid Wastes

The Report also raises solid waste management as another environmental impact in tourism and this too touches on an issue associated with energy use in tourism.

Biowaste is likely to be in increasing demand as a feedstock for biofuels because of its low or even negative cost[15]. This could help address larger point source biowaste where tourism is just a contributor to more general growth.

However, in tourism some of the issues revolve around waste management in more remote locations. Our submission on the draft Tourism Strategy raises remote energy services (e.g. fuelling EVs) as potentially requiring research effort in New Zealand.

Small-scale bio-digestors might be part of the solution helping to address both the waste and energy issues, and this may be a small contributor to reducing the environmental impact of both.

Conclusion

As stated at the beginning this note is intended as an initial communication as a basis for further discussion. There is a range of expertise within the NERI membership on the various potential drivers of GHGs in tourism and we would be pleased to facilitate discussions on options for the future.

Simon Arnold
Chief Executive

[13] https://www.mbie.govt.nz/have-your-say/a-vision-for-hydrogen-in-new-zealand-public-consultation/

[14] Again, available at https://www.neri.org.nz/submissions-and-papers-by-neri

[15] This may not just apply to biogas production, see for example I. Suckling, F. de Mercader Monge, S. Wakelin, P. Hall and P. Bennett, "New Zealand Biofuels Roadmap: Technical Report," Scion, 2018

APPENDIX 1: NZ CLEAN HIGH DUTY CYCLE[16] TRANSPORT: RESEARCH CHALLENGES V.9

	Land		Marine		Aviation			Indicative Challenges[17]		
	Road	Rail	Short e.g. Waiheke	Coastal +	Short e.g. drones	Regional	Long-haul			
Supply - Fuel								**Fuel production**	**Storage/ distribution**	**End use**
Fossil fuels + CCS → Hydrogen (H_2)[18] → Fuel Cell (FC)	?✓?	?✓?	✓✓?		✓✓?			Conversion mature and sets the benchmark for potential alternative fuels. CCS not mature.	H_2 energy density & containment. H_2 carriers address H_2's weaknesses but are not mature.	FC cost, efficiency and scale up of production still issues.
Power → H_2 → FC	?✓x	✓✓x	✓✓x		✓✓?			Conversion mature, but cost and efficiency issues remain.	As for fossil fuel H_2. [But distributed production an option].	As for fossil fuel H_2.
Power → Electric Vehicles (EV) + enhanced charging (incl. gantries etc)	✓✓?	✓✓✓						Mature	Battery energy density and specific energy, charging technology & speed. Distribution of power mature.	Mature. The addressable market will be defined by the economics of batteries and the enhanced charging system.
Biomass → Biogas (e.g. biomethane)[19]	x✓✓	?✓✓	✓✓✓		✓✓?			Feedstock availability (e.g. waste), dispersed resource, cost and efficiency of pre-processing and upgrading (but both mature).	Mature. Liquid fuels likely to be preferred in the long-haul marine and aviation applications.	Biomethane in an Internal Combustion Engine (ICE) mature. Challenges in other gas/motor combinations.
Biomass → Liquid Biofuel	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓?	✓✓x	✓✓x	Land use, dispersed resource, cost etc. of pre-processing and upgrading (latter not yet mature).	Mature	Mature depending on level of upgrading and nature of motor. Drop-in possible for ICEs.
Power & Biofuels → EV/ICE hybrid	✓✓?	✓✓?	✓✓?	✓✓✓	✓✓?	✓✓?		Power mature. Biofuel production as above, lower volumes needed.	Addresses battery energy density and specific energy in EVs	Cost of two technologies. Power density in aviation conversions.
Power & H_2 → EV/FC hybrid	✓✓?	✓✓?	✓✓?					Power mature. H_2 production as above, high cost has less impact.	H_2 as above but less acute	As above for EV/ICE hybrid.
Fossil fuel demand reduction										
Logistics	-✓✓	-✓✓		-✓✓	-✓✓	-✓✓	-✓✓	"Last mile", impact of ICT/AI/embedded intelligence/V2X, modal mix and vehicle efficiency, better sharing		
Telepresence etc	-✓✓	-✓✓				-✓✓	-✓✓	Human acceptability, technologies and local infrastructure, 3D printing		

Ticks etc. are a very initial and subjective assessment of respectively: feedstock availability relative to market; technology maturity by 2030; and approximate 2030 NZ price relative to a baseline of fossil fuel + CO_2-e @ $100/t. For demand reduction "feedstock" is not applicable. All fuels can achieve some degree of technology maturity at scale by 2030, the challenge is to then reduce the price, although markets will buy on more than price alone. Power → EV will be economic at the margin of many of the markets, defining the low duty cycle boundary, and is not shown.

Main sources: "Hydrogen in NZ" (2019) Concept Consulting; "NZ Biofuels Roadmap" (2018) Scion.

[16] Limited to high duty cycle assuming battery technology will be used in applications not constrained by storage and recharge time limitations.
[17] A very high-level initial identification of where the research challenges lie
[18] Including various potential hydrogen carriers such as ammonia and synthetic fuels e.g. methanol.
[19] Biomass → Bio H_2 is an option but is less mature than (say) biomethane production; storage and distribution is more complex; and end use isn't a retrofit of existing engines.

APPENDIX 2

National Energy Research Institute

4 February 2019

SUBMISSION ON: *DRAFT TOURISM STRATEGY*

Recommendations

That the Government in its final Tourism Strategy:

1. Explicitly identify energy as a key input into the core underpinning tourism services of travel and accommodation. Its provision is undergoing significant and uncertain change that will have major impact on NZ's tourism futures. In particular:
   i. Travel is a high emitter of greenhouse gasses (GHG). Finding clean fuels for long-haul travel, which is integral to NZ tourism, is one of the most intractable issues in achieving GHG reductions. Addressing this isn't just related to NZ's environmental goals, it impacts directly on the core of NZ's future tourism offerings. Travel will be further impacted by rapid changes in transport technologies.
   ii. While less overarching, new opportunities are developing for the provision of remote and off-grid energy services, just as the demand for them is growing and changing in tourism (e.g. EVs). Realising these opportunities will generally improve tourism services but particularly regional and Iwi services.
2. Note that the energy options for tourism in NZ are uncertain and unclear, and have significant public good and infrastructure implications; and accordingly
3. Explicitly include investment into medium-term applied directed research in its priority work areas to help address these issues.

Introduction

In November 2017 the National Energy Research Institute[20] published the *Energy Research Strategy for New Zealand: The Key Issues* (*the Strategy*)[21]. This identifies major beyond business-as-usual risks and opportunities anticipated in the energy sector arising from social, technical and environmental changes with a view to developing a research programme to help manage these.

[20] The National Energy Research Institute (NERI) is a Charitable Trust incorporated in New Zealand. Its primary purpose is to enhance New Zealand's sustainability and to benefit the New Zealand community by stimulating, promoting, coordinating and supporting high-quality energy research and education within New Zealand. Its research members are Victoria University of Wellington, Auckland University of Technology, Scion, GNS Science, University of Canterbury and the University of Otago, and its industry association members are the Bioenergy Association, BusinessNZ Energy Council, and the Energy Management Association of New Zealand.

[21] National Energy Research Institute, "Energy Research Strategy for New Zealand: The Key Issues," National Energy Research Institute, 2017.

NERI and its members, in conjunction with relevant industry groups, are beginning the process of developing more detailed programmes to address these priority issues. Energy for transport and access for remote communities and their impact on tourism are among the areas being addressed.

In this submission we briefly comment on the significance of these to the Tourism Strategy by way of justification for energy and research being explicitly included in it.

This submission has been developed by NERI based on the above work, but may not necessarily represent members' individual views. If the Review would like more detail we would be happy to discuss.

Long-haul travel

Given our distance from the world and our long sparsely populated country, long-haul transport is of strategic importance to NZ. Further given our unique exposure and the uncertain risks around long-haul fuels, the Energy Research Strategy identifies long-haul transport as one of a handful of priority energy research issues for NZ. It addresses this both from the supply (i.e. fuels) side and the demand side, and explicitly recognises the importance of tourism in the latter. The concern is to varying degrees across all modes of transport; international and domestic.

Fuels

While for simplicity we have referred to "long-haul transport" the problems arise at the point where battery based transport is no longer viable[22]. This is more to do with the duty cycle – how often recharging is possible. For instance many passenger buses and short haul smaller ferries can be recharged within the normal duty cycle, and this limitation is being eroded whether by improved batteries; improved charging technologies; and/or the use of hybrid systems. Incidentally, NZ researchers are at the centre of the last two in fast and dynamic charging and hybrid aircraft[23].

The more intractable areas of significance to tourism then are likely to be:

- Domestic and international aviation.
- Cruise ships and the Cook Strait Ferries.
- Buses running to tight timetables on long or remote route.

Even if the fuel issues are not solved for buses electricity could be used as a last resort by various mechanisms such as changing schedules, swapping batteries etc. So while work needs to be done, for the sake of this submission we will put it aside.

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[22] Along with others we judge short-haul to be suitably addressed by EV technologies. EVs particularly make sense in NZ because increasing clean electricity generation isn't a significant constraint (see e.g. Transpower, "Te Mauri Hiko – Energy Futures," Transpower, 2018) – this is part of our competitive advantage.

[23] NZ researchers are at the centre of the international effort on fast and dynamic charging and hybrid aircrafts, see www.neri.org.nz/superconductivity and https://unidirectory.auckland.ac.nz/profile/ga-covic. The dynamic charging and hybrid aircraft are perhaps the only two areas where the government is (indirectly) funding tourism relevant energy research, despite the sector's significance.

Aviation is a major issue. Hybrid aircraft aren't likely even for regional flights until the mid-2030s and will only reduce fuel demand by about 40%[24], so the only real option will be biofuels[25] (or possibly clean synthetic fuels). These are significantly more expensive than fossil fuels[26]. The two immediate implications that call for research are:

- The impact of price changes on NZ's international competitive situation in Tourism, against the benefits of switching to clean fuels[27]; and
- If bio avgas is to be implemented, what will the supply chains look like (including the sources of the biomass, if not imported) and the necessary infrastructure[28].

Cruise ships will make their own decisions about suitable fuels (and will right now be contemplating the impact of the impending Marpol low sulphur regulations). Some are looking to gaseous fossil fuels[29] that have lower GHG emissions than existing marine fuels; others hydrogen[30]; and marine biofuels are also potentially competitive[31]. The important issue will be ensuring that deficiencies in NZ's fuel supply and infrastructure aren't a barrier to tourism. The time scales could be lengthy particularly if growing feedstocks and bringing on processing infrastructure is required.

The Cook Strait ferry services will face similar issues, but by their nature they will be able to justify specialised infrastructure if necessary.

Either way there is considerable uncertainty around the kinds of shipping fuels, supply chains, and infrastructure that will be required, and about their impact on sustainable tourism.

On the other hand there is an opportunity here for NZ to take the initiative on the potential of clean fuels across all modes, and shape them to fit what our target markets wants in sustainable tourism. So developing clean energy supply chains for the NZ tourism sector is an important research theme, and work has already begun on this.

Demand for travel

Following on from the last point it is obvious that the nature of travel and consumer preferences will change (perhaps rapidly) both as a result of perceptions about dirty

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[24] See https://www1.grc.nasa.gov/aeronautics/electrified-aircraft-propulsion-eap/

[25] Hydrogen (whether by combustion or in fuel cells) emits water vapour that is undesirable at high altitudes and hence the need for biofuels, see for example "Hydrogen in a low-carbon economy," and "Biomass in a low-carbon economy" both UK Committee on Climate Change, 2018.

[26] This is more sensitive to the barrel price than carbon charges. I. Suckling, F. de Mercader Monge, S. Wakelin, P. Hall and P. Bennett, "New Zealand Biofuels Roadmap: Technical Report," Scion, 2018 includes an analysis.

[27] Historically some research has been undertaken in this area in NZ.

[28] The Scion Roadmap has begun to look at these issues.

[29] These may get increasingly difficult to supply from domestic production.

[30] Low cost clean hydrogen depends upon natural gas reforming and carbon capture and storage. This again may be difficult for NZ to supply, although biomass gasification or possibly electrolysis could be options. The "Hydrogen in a low-carbon economy" (Footnote 6.) and The Royal Society, "Options for producing low-carbon hydrogen at scale," The Royal Society, 2018 give slightly differing pictures on the relative costs of the two pathways, but neither report is specific to NZ's circumstances.

[31] See the Scion roadmap.

fuels and in response to technologies that make travel more energy productive. Key examples include:

- As mentioned earlier there will be trade-offs by consumers between fuel costs and emissions. Shifting the product mix to higher value offerings could be one response;
- Increasing penetration of transport technologies such as of transport-as-a-service and autonomous vehicles. Both will increase the efficiency of travel. The other area of significant change, last mile technologies[32], will perhaps have less impact.
- The opportunities and threats from improving telepresence. This could significantly reduce fossil fuel use, but if Conferences for example "go-virtual" this will have a major impact on a key segment in NZ's tourism offering. By reason of location, natural endowments and capabilities NZ should be world leading in this area, but the need is to develop it in a way that helps address both risks and opportunities.

Much of the above will be addressed by the industry, but there are again many issues that are in the nature of public goods (particularly where there are many small operators) or will require infrastructure.

Remote energy services

A theme of the Energy Research Strategy is affordability and access to energy. It has become clear that there is a need to address energy services where access to the grid is prohibitively expensive. Addressing this is becoming increasingly viable as technologies such as smaller scale distributed generation are falling in cost.

While the technologies themselves are imported their integration to meet specific needs remains a reasonably complex technical, business, environmental and social issue because of the rate of change. This has particularly been identified as an issue for Maori with remote land and resources seeking to provide for members of their Iwi. It has also been identified as an issue for remote tourism operators.

This again is an issue with elements of public good associated with it, even if it is not as far reaching as the Travel issue.

Basis for Government making Tourism-specific research investments

There are other Government funding mechanisms available for research activities, and in particular the level of close-to-market grants has recently been increased. The argument here is that specific sectors are not particularly well served with strategic directed research that goes beyond the capability of companies to significantly part-fund. This is particularly true of the energy sector as is set out in the Energy Research Strategy, and it appears to be a lack in the tourism sector. The intersection of the two is almost completely lacking in receiving any funding, despite the importance of some of the issues discussed in this submission.

[32] E.g. drones.

The use of levy sourced funds to help support sector research activities is well established in the primary sector in NZ as well as in some industries[33]. An important function is to provide co-funding to help attract other funding while ensuring the effort is aligned to an agreed sector strategy. As such sector input typically dominates in managing the fund.

While we have focussed on energy-related tourism issues we would expect from our experience in energy that this is a wider issue for the tourism sector. This levy mechanism and the Tourism Strategy would provide a mechanism to achieve appropriate investment into applied directed research in tourism that goes beyond business-as-usual. We would see the research issues we have raised here being part of that portfolio.

Simon Arnold
Chief Executive

[33] E.g HERA, LASRA