

27 October 2017

Minister of Science and Innovation  
Minister of Energy and Resources

cc Minister of Transport  
Minister for Climate Change

## **Briefing: Priorities for medium-term energy research**

### Introduction

This note summarises work that NERI<sup>1</sup> has been undertaking in consultation with over 150 researchers and representatives of industry associations and government agencies to identify the major energy sector issues that will require New Zealand based, medium-term R&D to address. It is designed to provide the basis for future R&D investment.

The issues raised have particular implications for transport and greenhouse gas (GHG) emissions so the respective Ministers have been copied in.

### Overall priorities

The priorities flow from the general themes in the current Energy Strategy (NZES) and other documents: we are seeking economic growth and social wellbeing from energy use, with a supply that is secure, resilient and that meets our environmental objectives and obligations, while ensuring the less well-off have their energy needs met.

### Our focus

We are looking for issues that are relatively unique to New Zealand and not likely to be solved by overseas research (or we are ourselves internationally competitive in the area); are beyond the capacity of individual businesses or sector groups to address; require medium-term “public-good” research investments (5+ years); and are currently being under-invested in.

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<sup>1</sup> 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, co-ordinating and supporting high-quality energy research and education within New Zealand. Its research members are Victoria University of Wellington, Auckland University of Technology, Scion, 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.

## The Energy Sector R&D Challenges

We have developed a publication setting out our findings. This will be launched at a 5.30 to 7.00pm function at Rutherford House, in Wellington on 15 November. You will separately receive invitations.

An extract from the publication is attached as an appendix: "Energy Strategy at a glance". The key issues identified in it are to:

### **Electricity generation and distribution**

- Maintain a stable and secure electricity supply in the face of new disruptive technologies and consumer behaviours in response.
- Develop low cost, cleaner ways to reduce peak demand on the grid, and explore cleaner options for dry year support.
- Increase the availability of even lower cost, cleaner, geothermal energy for both electrical and thermal loads.

### **Transport**

- Help develop charging technologies to assist the introduction of EVs and extend their range.
- Assess the options for high duty cycle transport in New Zealand (both vehicles and fuels) and the implications, along with the future of logistics and tourism, and to undertake risk reduction where appropriate.
- Take an international leadership role in telepresence, remote sensing and AR/VR.

### **Industrial processing**

- Explore new products (including biofuels), processes (bio-refineries), supply chains and markets for a potential bio-chemicals industry.
- Develop food markets where clean energy earns a premium, and the products and supply chains to service them.
- Investigate new low emissions products and processes for the petrochemicals industry

### **Residential**

- Develop further low cost ways to keep homes, particularly rentals, warm and dry and to assess the impacts of other changes in the energy sector to avoid adverse impacts on the less well off.

### **System-wide Energy Sector R&D**

- Systematically monitor and improve our understanding of the New Zealand energy sector, focusing on risks and opportunities and taking account of its changing environment.
- Invest in New Zealand's internationally competitive energy-related niche R&D capability.

Not included above is research targeting our various energy resources (fossil, geothermal, wind, hydro, solar and biomass). This is already relatively well resourced through the various Crown Research Institutes. The investment gap is in understanding their processing and use.

These same challenges are touched on in a number of places in the announced policies of the Government, and overall are not inconsistent with them. We hope that the work we have done will also offer some additional areas to help it achieve its wider goals, and its more immediate priorities into a longer-term supportive energy research framework.

In particular we emphasise the importance of servicing New Zealand with international transport, a dimension that is often overlooked if only considering domestic emissions.

### Next Steps

Based on discussion with Officials we had been in the process of developing a Strategic Science Investment Fund (Programmes) proposal to help address these issues. This Fund is used for “research that underpins strategic priorities and is critical to the future of New Zealand’s wellbeing, economy and environment”, and had been seen as the appropriate vehicle to use for this particular need.

The announced policies of the new government favour the use of the National Science Challenges (NSC) to increase investment into the environmental impacts particularly (e.g. a Transitions National Science Challenge). We had also considered the use of the NSC as an approach, and this is equally workable. We do however see benefit in an approach that can address all the challenges faced by the energy sector as a package (technological, environmental and social), rather than just the environmental issues. These interact.

The Productivity Commission is undertaking an inquiry into the transition to a lower net emissions economy, and as part of its Terms of Reference has been asked to consider how the science and innovation system could better support low emissions technologies. There is some overlap with our work focusing more widely on energy, and we are in discussions with the Commission to ensure alignment.

### Recommendations

That Ministers note:

1. that NERI has developed an energy research strategy for New Zealand in consultation with researchers, industry groups and government agencies, and this will be launched at 5.30 pm on Wednesday 15 November at Rutherford House, Wellington to which you are invited;
2. the key R&D challenges identified, as set out above, align well with the announced policies of the government relating to energy, transport and GHG emissions reductions;
3. further to these policies, the NERI strategy suggests that *energy use in servicing New Zealand with international transport* is a key topic requiring research;
4. NERI has been undertaking preliminary work in developing a MBIE Strategic Science Investment Fund (Programmes) proposal to help address these issues, but that the National Science Challenge framework has also been considered and could equally be used;
5. the technological, environmental and social challenges faced by the energy sector interact, and in NERI’s view there is benefit in considering them as a package rather than just the domestic GHG emissions challenges taken in isolation.



Simon Arnold  
Chief Executive

## Appendix: Energy Strategy at a glance

**New Zealand's energy sector faces some challenges that are unique and go beyond business-as-usual.** These are being driven by environmental concerns, technological changes and changes in consumer behaviours.

The starting point for managing these challenges is to better understand the issues involved - the key opportunities and risks - and what might be done about them. To do this requires medium-term applied energy research.

What follows is a summary of the issues and the framework for the required research.

### Energy resources

Overall New Zealand has sufficient raw energy resources to meet its forecast needs, and where there are issues relating to their identification and extraction New Zealand has research investments addressing these.

The outstanding issue is to how to use these resources to best meet future economic, social and environmental needs. Managing the risks from GHG emissions from high duty cycle transport is likely to be the most difficult of these.

### Electricity generation and distribution

New Zealand has a unique electricity sector that affords us many advantages. It is built on a reliable distribution system and low cost, clean, renewable hydro generation. Its base load generation can be significantly expanded using relatively clean and low cost geothermal, with good quality wind in support.

Electricity system technologies are changing and consumers are taking more control. Most of this will evolve as business-as-usual. However cumulatively these trends will change the way the electricity system operates, and possibly in ways unique to New Zealand. New Zealand needs *to maintain a stable and secure electricity supply in the face of disruptive technologies and consumer behaviours that might disrupt it.*

Unfortunately hydro, geothermal and wind cannot meet the total demand for electricity. Fossil fuel generation - even with potential greenhouse gases (GHG) emissions charges – is projected to remain the most cost effective way to meet peak and dry year loads. To help reduce GHG emissions from the electricity sector New Zealand needs *to develop low cost, cleaner ways to reduce peak demand on the grid, and explore cleaner options for dry year support.*

There will be a significant increase in demand for renewable electricity, particularly as the number of Electric Vehicles (EVs) increase. Current wind and geothermal resources can service this load and both have potential for further development. Wind technologies are imported, but the challenge is *to increase the availability of even lower cost, cleaner, geothermal energy for both electrical and thermal loads.*

### Transport

If international transport is included transport represents about half New Zealand's energy use.

EVs are emerging in light duty cycle road transport. These are expected to be fully competitive by next decade even with only low GHG emissions charges. Uptake is already occurring under business-as-usual with limited need for significant additional local research. Battery capacity and charging remain issues, and New Zealand has international capability *to help develop charging technologies to assist the introduction of EVs and extend their range.*

Long-haul transport, particularly sea and air, will need liquid fuels for the foreseeable future. As an international trading nation with significant tourism New Zealand is particularly exposed to negative reactions to dirty fuels. While emissions can be reduced by clean replacements e.g. bio-avgas, marine biofuel oil blends, these come at a significant cost. As solutions are developed New Zealand will need to be able to adopt them and have the supply chains to support them. Investment is therefore needed *in assessing the options for high duty cycle transport in New Zealand (both vehicles and fuels) and the implications, along with the future of logistics, and to undertake risk reduction where indicated.*

Transport efficiency has been improving over the years and ICT is now starting to have an impact via transport-as-a-service, trip optimisation, and trip substitution. One area where New Zealand could take an international leadership role is telepresence, remote sensing and AR/VR. This should rapidly and cheaply provide more efficient and cleaner alternatives to travel, helping to address distance as a potential future barrier to business in New Zealand.

## **Industrial processing**

Industrial processing is the next biggest user of energy, concentrated in the Wood, Food, Chemicals and Base Metals subsectors. These in turn are dominated by a small number of businesses.

Wood, Pulp, Paper and Publishing subsector is the largest energy user (with the same use as the Residential sector and more than the Commercial sector). 70% is reported to be renewable, with significant contributions from energy derived from the industry's wastes. Expanded biofuels production (e.g. for high duty cycle transport) will also need the fuel to be a relatively low value product alongside a suite of higher value products. This suggests a possible new bio-chemicals industry, analogous to the petrochemicals industry. Exploration of new products (including biofuels), processes (bio-refineries), supply chains and markets for a potential bio-chemicals industry will be of value.

The Food subsector is important to the New Zealand economy and has been growing. It is one area where energy consumption has been increased significantly and with increasing exposure to fossil fuels. Adding to this exposure, the production and distribution parts of the Food value chain also produce significant GHG emissions from energy use as well as other sources.

There is a risk for consumer products, like commodity foods, that rely upon significant embedded low cost fossil fuels. Consumer sentiment can turn away from them, reducing margins to current producers, but allowing higher prices for new products that use more expensive but cleaner energy. New Zealand needs to develop food markets where clean energy earns a premium, and the products and supply chains to service them.

Encouraging growth in clean products helps manage the risks from fossil fuel use. The Chemicals sector, in particular, transforms fossil fuels into other products, often emitting GHGs at some point in their production and use. If new products could be developed that fixed the carbon we could reduce the risks to the investment in the gas and oil sectors. Investigation of new low emissions products and processes for the petrochemicals industry will be of value.

## **Residential**

The concern about the peak demand in the electricity sector goes beyond a desire for stable low priced clean energy. The winter peaks are when New Zealanders who find energy difficult to afford most need it to stay warm and dry. The same families are most vulnerable to other changes that are occurring in energy markets. Many live in rented properties and have limited flexibility to change their energy use. Much has been done, but we need to develop further low cost ways to keep homes, particularly rentals, warm and dry and assess the impacts of other changes in the energy sector to avoid adverse impacts on the less well off.

## **System-wide Energy Sector R&D**

Because of the likely extent and speed of change in the energy sector, and the uncertainty that surrounds it, we need to systematically monitor and improve our understanding of the New Zealand energy sector, focusing on risks and opportunities and taking account of its changing environment.

Finally we need to continue to invest in New Zealand's internationally competitive energy-related niche R&D capability. Some niches have already been (indirectly) mentioned: aspects of geothermal, behavioural and markets, AR/VR, inductive power transfer, biofuels, and foods. Others include materials science to improve electrochemical reactions and superconducting power systems equipment.