Comment on Energy Vectors

New Zealand's present energy policy will probably be seen in the future as having been more aspirational then inspirational. However, credit is due that for the first time in our history a government has at least taken the time to chart a direction of where we should be headed.

It may therefore seem negative to claim that a final transition to renewable electricity is neither possible nor desirable. Instead, the point is made that renewables are not an endpoint that we transition "to", but rather an intermediary stage that we transition "through".

The argument is very simple because renewable electricity is (i) unsustainable, and (ii) has heavy impact on the environment. The environmental impact is evident everywhere, from diverted rivers to eroding hydro lake shorelines. It is almost laughable, for example, that we speak of "green aluminium" from Tiwai Point when it is produced at the expense of drying up the Waiau River.

The unsustainable aspect derives from extending into the future. Despite best efforts at power savings and efficiency improvements, our population, economy and power demand will continue to trend inexorably upwards. How does renewable power supply fare in the long term? We could continue as present - seeking to dam the last river, putting wind farms on the last ridge or last region of offshore continental shelf, wave energy along the last section of coast, solar panels on the last permitted open space, and so on. Sooner or later we will reach the situation when the public outcry will be so much that renewable energy reduces just to putting solar panels on new houses.

Rather than wait for that time to arrive, we should start planning now for the final transition. The nature of that transition is in fact well-defined by considering what we will *not* wish to transition to.

First, we can reasonable assume that nuclear power never be accepted in New Zealand. Even nuclear fusion has a radioactive aspect and we would never be able to afford it in any case. Secondly, there will never be an option of an ocean floor power line providing electricity from somewhere. We would then be at the mercy of whoever is supplying the power, much like Eastern Europe has been in the past with gas from Russia. Nor would we take the risk of blackouts because our power cable has developed a fault somewhere at the bottom of the Pacific Ocean.

That leaves just one option: importing a storable and emission-free energy vector to serve as fuel for thermal power stations here. The "storable" requirement comes because we need to stockpile a sufficient amount of the material concerned to enable multiple years of power generation. This provides the essential security buffer against fluctuations in availability and price.

The implication here is that energy is being utilised somewhere overseas to create the energy vector in the first place. For example, using electricity to create hydrogen from water electrolysis.

On the world scale too, renewables are ultimately limited. As with New Zealand, we cannot go on forever developing the world's rivers for hydro power or covering deserts with solar panels. Nothing is truly sustainable but we come close with nuclear power - first uranium, then thorium, and (eventually) nuclear fusion. Thus, some nations develop nuclear power on a massive scale and energy vector exports become a major component of their national income. Putting it bluntly, those nations gain from either the unwillingness or impossibility of other nations to provide their own nuclear power.

The energy vector here is a commodity suited specifically for cross-ocean transfers and storage at destination. That is, in the same way that coal, oil, and gas is shipped globally today.

The nuclear aspect is the final long-term solution and nuclear power plant construction does take time. An intermediate situation could be major development of renewables in some countries to provide the energy input for energy vector export.

With respect to the vectors themselves, using hydrogen generated from carbon-free power is not a suitable energy vector for long-term energy security because specialised and expensive transport and storage facilities are needed. What is required is something similar to coal for ease of transport and stockpile storage capability.

There are a number of solid vector options available, including metallic silicon. On a per weight and per volume basis silicon gives similar heat output on oxidation as carbon, so in principle could serve as fuel in a suitably engineered thermal power station. Silicon is also similar to coal in ease of transport and it can be stored indefinitely in open stockpiles. Another attractive aspect of silicon is that it is the most common oxide in natural concentrations as desert quartz sand.

Like hydrogen, silicon comes in different "colours". Silicon now is produced for specialist electronic use as "brown silicon", where the oxide is reduced with emission-generating carbon. However, emission-free "green silicon" can be generated from electric power input via a magnesium intermediary.

Just as we speak of the "hydrogen economy" there is therefore the possibility of a "silicon eeconomy", effectively using silicon as an imported coal substitute for power generation. A global silicon energy economy along these lines using renewables was postulated by the present author (Bardsley, 2008), which for a time was the most downloaded paper in the New Zealand science commons. Other energy metal oxide vector possibilities are discussed by Bergthorson (2018).

At first impression, energy vector economics are so poor that the entire concept has no practical value for power generation in the receiving nation. Firstly, the power must be generated in the exporting nation by nuclear or renewable means. Then, the electricity is used to reduce a metal oxide to the metallic state for export. On arrival, the metal is converted to the oxide to generate electricity in special-purpose thermal power stations. There are obvious energy inefficiencies and the cost of reducing the metal concerned will presumably make the fuel so expensive as to be unaffordable.

This has been the situation to the present. However, different factors now come into play with the advent of climate change concerns.

At this point, we introduce a brief digression related to climate change action. By way of one simple example, New Zealand is at the extreme travel distance end of the tourist route for northern hemisphere visitors. As responsible global citizens it is therefore our duty to allocate significant funding on negative advertisements in the United States and elsewhere to make a case that intending tourists should *not* visit New Zealand, in the interests of reducing carbon dioxide emissions from air travel or cruise ships.

Instead, we have Jacinda Adern teaming up with US talk show host Stephen Colbert to encourage northern hemisphere tourists to come here. To the Labour-Green coalition, the immediate financial gain to the country of extra tourists is more important than seeking to reduce the carbon emissions created by their travel here. Similarly Australia will be increasing its coal exports into the future with extra mining activities.

Similar examples could be referenced from all over the world. By and large, national self-interest triumphs over planetary environmental concerns. The often-quoted example of global cooperation in the reduction of ozone-depleting chemicals is something of an illusion. That only occurred because alternative chemicals were available without too much economic hardship. If ozone was depleted by carbon dioxide then there would be no ozone left.

The current sequence of global climate change summits should therefore be seen for the pointless choreographic exercises that they are. Even when apparent "agreement" is achieved, most delegates leave knowing full well that their respective governments have not intention to honour anything related to emissions reduction. We are probably already past "peak conference" such that successive climate conferences will gain reducing news attention. This state of affairs will not be changed by the coming sequence of scientific papers that are inevitably reported as "Scientists today presented the strongest evidence yet of…". In the meantime, atmospheric carbon dioxide will continue its upward trend, punctuated only by brief pauses caused by temporary economic shut-downs as with the present coronavirus situation.

The worst aspect of the process of seeking international cooperation for emissions reduction is that it gives the illusion that something is being achieved when it is not, thereby diverting attention away from other approaches that may have more chance of working.

Eliminating the global use of coal for power generation would be a major step against global warming, and we return at this point to a coal substitute energy vector. However, the focus now is on national self-interest as opposed to planetary considerations. This leads to entirely different scenarios of energy vector development.

A case in point is the present situation of Saudi Arabia. For many years that nation has enjoyed oil revenues and so indirectly has been a contributor to global warming. The country now seeks to diversify away from oil and still maintain a vibrant economy, as set out in Saudi Vision 2030. It also has the funding available for the transition via Saudi Aramco share sales.

Basically, Saudi Arabia requires two things for future sustainable development: (i) a reliable external income stream, and (ii) water. This gives the ideal situation for developing an emission-free energy vector export industry.

The scenario would be that Saudi Arabia begins a massive development of nuclear power stations, concurrent with research on the best vector to serve as fuel in future emission-free thermal power stations. Given the inefficiencies, it could be that three nuclear power stations are required to provide the fuel for replacing a single coal-fired power station with the new fuel somewhere at the other side of the world. There dry subsurface rock in Arabia, so it might be helpful to locate the power stations underground, where each one can be left in place when its useful life ends. The energy inefficiencies in energy vector creation will be in the form of waste heat, which now becomes a resource when input to an associated desalination plant for additional water supply.

The research requirement involved is not great, being just setting up for industrial-scale emission free production of the vector concerned, and finding the optimal configuration for thermal power stations using that vector as fuel. The research effort would only be a small fraction of that presently directed toward nuclear fusion because the problem is essentially basic combustion technology.

Again, keeping national self-interest in mind, from the viewpoint of Saudi Arabia it would be better to develop energy vector exports via bulk ocean freighters than to directly send out power to Europe via power lines – which would be susceptible to attack in the volatile Middle East political climate.

Given completion of the required energy vector research, a critical requirement is that the energy vector goes onto the world market in abundance and at a cheaper rate than coal. For example, India would not purchase Australian coal for power generation if it could purchase an energy vector more cheaply for new thermal power stations.

It may happen that there is a need to subsidise the energy vector to reduce its price sufficiently to eliminate coal as a fuel for thermal power stations. This is where the developed nations could provide a practical contribution to global warming, perhaps by providing subsidies in proportion to their existing contribution to global warming.

As mentioned, the actual energy vector is left open at this point. From the Saudi Arabia viewpoint, silicon would have some attraction. There is a lot of quartz sand in Arabia and so there may not be a need to transport the oxidised “ash” back for recycline after power use, leaving the freighters to carry other cargo on the return trip. Subsequent to writing the original paper (Bardsley, 2008), King Faisal University (College of Engineering) expressed interest in setting up research in Saudi Arabia for developing silicon as fuel. Unfortunately, I was unable to visit and it is interesting to speculate whether the energy vector concept might have been more fully developed by this time.

Finally, returning to the New Zealand situation, it would be advantageous to our own national self-interest if something like the above global scenario were to develop. We would be then able to import the energy vector cheaply and build up a stockpile as climatic and economic buffer, similar to the role played by massive pumped storage at Lake Onslow.

All of this comment is speculation only and we are presumably talking of the far future. It would nonetheless be helpful if MBIE were to offer research finding in New Zealand for energy vectors, to be carried out in conjunction with interested overseas partners.

References

Bardsley, W.E. (2008). The sustainable global energy economy: Hydrogen or silicon? *Natural Resources Research* v.17, p.197-204. https://hdl.handle.net/10289/884

Bergthorson, J.M (2018). Recyclable metal fuels for clean and compact zero-carbon power. *Progress in Energy and Combustion Science* v.68, p.169-196. https://doi.org/10.1016/j.pecs.2018.05.001

Earl Bardsley, University of Waikato

February 2020

#88

COMPLETE

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Started: Friday, February 28, 2020 4:31:26 PM
Last Modified: Friday, February 28, 2020 4:51:55 PM
Time Spent: 00:20:29

Page 1: Introduction

Q1 Name (first and last name)

Earl Bardsley

Q2 Email

Privacy of natural persons

Q3 Is this an individual submission, or is it on behalf of a group or organisation?

Individual

Q4 Which group do you most identify with, or are representing?

Research institute / academia

Q5 Business name or organisation (if applicable)

University of Waikato

Q6 Position title (if applicable)

Associate Professor (Faculty of Science & Engineering)

Q7 Important information about your submission (important to read)The information provided in submissions will be used to inform the Ministry of Business, Innovation and Employment's (MBIE's) work on Accelerating renewable energy and energy efficiency.We will upload the submissions we receive and publish them on our website. If your submission contains any sensitive information that you do not want published, please indicate this in your submission.The Privacy Act 1993 applies to submissions. Any personal information you supply to MBIE in the course of making a submission will only be known by the team working on the Accelerating renewable energy and energy efficiency.Submissions may be requested under the Official Information Act 1982. Submissions provided in confidence can usually be withheld. MBIE will consult with submitters when responding to requests under the Official Information Act 1982.We intend to upload submissions to our website at www.mbie.govt.nz. Can we include your submission on the website?	**Yes**
Q8 Can we include your name?	**Yes**
Q9 Can we include your organisation (if submitting on behalf of an organisation)?	**Yes**
Q10 All other personal information will not be proactively released, although it may need to be released if required under the Official Information Act. Please indicate if there is any other information you would like withheld.	**Respondent skipped this question**

Page 2

Q11 Where are you located?	**Waikato**
Q12 In what region or regions does your organisation mostly operate?	**Respondent skipped this question**

Page 3: Areas you wish to provide feedback on

Q13 Part A relates to process heat.Please indicate which sections, if any, you would like to provide feedback on.	**Respondent skipped this question**
Q14 Part B relates to renewable electricity generation. Please indicate which sections, if any, you would like to provide feedback on.	**Section 8: Supporting renewable electricity generation investment**

Page 4: Section 1: Addressing information failures

Q15 Option 1.1 would require large energy users to report their emissions and energy use annually, publish Corporate Energy Transitions Plans and conduct energy audits every four years.Do you support this option?	**Respondent skipped this question**
Q16 Please explain your answer	**Respondent skipped this question**
Q17 Which parts (set out in Table 3) do you support?	**Respondent skipped this question**
Q18 Please explain your answer	**Respondent skipped this question**
Q19 What public reporting requirements (listed in Table 3) should be disclosed?	**Respondent skipped this question**
Q20 In your view, should businesses be expected to include transport energy and emissions in these reporting requirements?	**Respondent skipped this question**
Q21 For manufacturers: what will be the impact on your business to comply with the requirements?	**Respondent skipped this question**
Q22 Option 1.1. Suggests that requirements to publish Corporate Energy Transition Plans should apply to large energy users, and propses defining large energy users as those with an annual energy spend (purchased) of greater than $2 million per annum.Do you agree with this definition?	**Respondent skipped this question**
Q23 If you selected no, please describe what in your view would be an appropriate threshold to define ‘large energy users’.	**Respondent skipped this question**
Q24 Is there any potential for unnecessary duplication under these proposals and the disclosures proposed in the MBIE-Ministry for the Environment discussion document Climate-related Financial Disclosures – Understanding your business risks and opportunities related to climate change, October 2019?	**Respondent skipped this question**

Page 5: Section 1 - Option 1.2: Electrification information package and feasibility studies

Q25 Do you support the proposal to develop an electrification information package?	**Respondent skipped this question**
Q26 Would an electrification information package be of use to your business?	**Respondent skipped this question**

Q27 Do you support customised low-emission heating feasibility studies?

Respondent skipped this question

Q28 In your view, which of the components should be scaled up and/or prioritised?

Respondent skipped this question

Q29 Would a customised low-emission heating feasibility study be of use to your business?

Respondent skipped this question

Q30 Please describe any components other than those identified that could be included in an information package.

Respondent skipped this question

Page 6: Section 1 - Option 1.3: Provide benchmarking information for food processing industries

Q31 Do you support benchmarking in the food processing sector?

Respondent skipped this question

Q32 Would benchmarking be suited to, and useful for, other industries, such as wood processing?

Respondent skipped this question

Q33 Do you believe government should have a role in facilitating this or should it entirely be led by industry?

Respondent skipped this question

Q34 Please explain your answer

Respondent skipped this question

Page 7: Section 2: Developing markets for bioenergy and direct geothermal use

Q35 Do you agree that some councils have regional air quality rules that are barriers to wood energy?

Respondent skipped this question

Q36 Please provide examples of regional air quality rules that you see as barriers to wood energy. Please also note which council's plan you are referring to.

Respondent skipped this question

Q37 Do you agree that a National Environmental Standards for Air Quality (NESAQ) users' guide on the development and operation of the wood energy facilities will help to reduce regulatory barriers to the use of wood energy for process heat?

Respondent skipped this question

Q38 What do you consider a NESAQ users' guide should cover? Please provide an explanation if possible.

Respondent skipped this question

Q39 Please describe any other options that you consider would be more effective at reducing regulatory barriers to the use of wood energy for process heat.	Respondent skipped this question
Q40 In your opinion, what technical rules relating to wood energy would be better addressed through the NESAQ than through the proposed users' guide (option 2.1)?	Respondent skipped this question

Page 8: Section 2 - continued: Developing markets for bioenergy and direct geothermal use

Q41 In your view, could the Industry Transformation Plans stimulate sufficient supply and demand for bioenergy to achieve desired outcomes?	Respondent skipped this question
Q42 What other options are worth considering?	Respondent skipped this question
Q43 Is Government best placed to provide market facilitation in bioenergy markets?	Respondent skipped this question
Q44 How could Government best facilitate bioenergy markets?Please be as specific as possible, giving examples.	Respondent skipped this question
Q45 In your view, how can government best support direct use of geothermal heat?	Respondent skipped this question
Q46 What other options are worth considering?	Respondent skipped this question

Page 9: Section 3: Innovating and building capability

Q47 Do you agree that de-risking commercially viable low-emission technology should be a focus of government support on process heat?	Respondent skipped this question
Q48 Do you agree that diffusing commercially viable low-emission technology should be a focus of government support on process heat?	Respondent skipped this question
Q49 Is Energy Efficiency and Conservation Authority (EECA) grant funding to support technology diffusion the best vehicle for this?	Respondent skipped this question
Q50 For manufacturers and energy service experts: would peer learning and lead to reducing perceived technology risks?	Respondent skipped this question

Q51 For manufacturers and energy service experts: would on-site technology demonstration visits lead to reducing perceived technology risks?	Respondent skipped this question
Q52 Is there a role for the Government in facilitating this?	Respondent skipped this question

Page 10: Section 3 (continued): Innovating and building capability

Q53 For emissions-intensive and highly integrated (EIHI) stakeholders: What are your views on our proposal to collaborate to develop low-carbon roadmaps?	Respondent skipped this question
Q54 Would low-carbon roadmaps assist in identifying feasible technological pathways for decarbonisation?	Respondent skipped this question
Q55 What are the most important issues that would benefit from a partnership and co-design approach?	Respondent skipped this question
Q56 What, in your view, is the scale of resourcing required to make this initiative successful?	Respondent skipped this question

Page 11: Section 4: Phasing out fossil fuels in process heat

Q57 Do you agree with the proposal to ban new coal-fired boilers for low and medium temperature requirements?	Respondent skipped this question
Q58 Do you agree with the proposal to require existing coal-fired process heat equipment for end-use temperature requirements below 100 degrees Celsius to be phased out by 2030?	Respondent skipped this question
Q59 Referring to Question 56 - is this ambitious or is it not doing enough?	Respondent skipped this question
Q60 For manufacturers: what would be the likely impacts or compliance costs on your business of a ban on new coal-fired process heat equipment?	Respondent skipped this question
Q61 For manufacturers: what would be the likely impacts or compliance costs on your business of requiring existing coal-fired process heat equipment supplying end-use temperature requirements below 100°C to be phased out by 2030.	Respondent skipped this question

Q62 Could the Corporate Energy Transition Plans (Option 1.1) help to design a more informed phase out of fossil fuels in process heat?	**Respondent skipped this question**
Q63 Would a timetabled phase out of fossil fuels in process heat be necessary alongside the Corporate Energy Transition Plans?	**Respondent skipped this question**
Q64 In your view, could national direction under the Resource Management Act (RMA) be an effective tool to support clean and low greenhouse gas-emitting methods of industrial production?	**Respondent skipped this question**
Q65 If yes, how?	**Respondent skipped this question**
Q66 In your view, could adoption of best available technologies be introduced via a mechanism other than the RMA?	**Respondent skipped this question**

Page 12: Section 5: Boosting investment in energy efficiency and renewable energy technologies

Q67 Do you agree that complementary measures to the New Zealand Emissions Trading Scheme (NZ-ETS) should be considered to accelerate the uptake of cost-effective clean energy projects?	**Respondent skipped this question**
Q68 Would you favour regulation, financial incentives or both?	**Respondent skipped this question**
Q69 In your view what is a bigger barrier to investment in clean energy technologies, internal competition for capital or access to capital?	**Respondent skipped this question**
Q70 If you favour financial support, what sort of incentives could be considered?	**Respondent skipped this question**
Q71 What are the benefits of these incentives?	**Respondent skipped this question**
Q72 What are the risks of these incentives?	**Respondent skipped this question**
Q73 What are the costs of these incentives?	**Respondent skipped this question**
Q74 What measures other than those identified above could be effective at accelerating investment in clean energy technologies?	**Respondent skipped this question**

Page 13: Section 6: Cost recovery mechanisms

Q75 What is your view on whether cost recovery mechanisms should be adopted to fund policy proposals in Part A of the Accelerating renewable energy and energy efficiency discussion document?	**Respondent skipped this question**
Q76 What are the advantages of introducing a levy on consumers of coal to fund process heat activities?	**Respondent skipped this question**
Q77 What are the disadvantages of introducing a levy on consumers of coal to fund process heat activities?	**Respondent skipped this question**

Page 14: Section 7: Enabling development of renewable energy under the Resource Management Act 1991

Q78 Do you agree that the current NPSREG gives sufficient weight and direction to the importance of renewable energy?	**Respondent skipped this question**
Q79 What changes to the NPSREG would facilitate future development of renewable energy?	**Respondent skipped this question**
Q80 What policies could be introduced or amended to provide sufficient direction to councils regarding the matters listed in points a-i mentioned on pages 60-61 of the discussion document?	**Respondent skipped this question**
Q81 How should the NPSREG address the balancing of local environmental effects and the national benefits of renewable energy development in RMA decisions?	**Respondent skipped this question**
Q82 What are your views on the interaction and relative priority of the NPSREG with other existing or pending national direction instruments?	**Respondent skipped this question**
Q83 Do you have any suggestions for how changes to the NPSREG could help achieve the right balance between renewable energy development and environmental outcomes?	**Respondent skipped this question**
Q84 What objectives or policies could be included in the NPSREG regarding councils' role in locating and planning strategically for renewable energy resources?	**Respondent skipped this question**

Q85 Can you identify any particular consenting barriers to development of other types of renewable energy than REG, such as green hydrogen, bioenergy and waste-to-energy facilities?

Respondent skipped this question

Q86 Can any specific policies be included in a national policy statement to address these barriers?

Respondent skipped this question

Q87 What specific policies could be included in the NPSREG for small-scale renewable energy projects?

Respondent skipped this question

Q88 The NPSREG currently does not provide any definition or threshold for “small and community-scale renewable electricity generation activities”. Do you have any view on the definition or threshold for these activities?

Respondent skipped this question

Q89 What specific policies could be included to facilitate re-consenting consented but unbuilt wind farms, where consent variations are needed to allow the use of the latest technology?

Respondent skipped this question

Q90 Are there any downsides or risks to amending the NPSREG?

Respondent skipped this question

Page 15: Section 7 - continued

Q91 Do you agree that National Environmental Standards (NES) would be an effective and appropriate tool to accelerate the development of new renewables and streamline re-consenting?

Respondent skipped this question

Q92 What are the pros of using National Environmental Standards as a tool to accelerate the development of new renewables and streamline re-consenting?

Respondent skipped this question

Q93 What are the cons of using National Environmental Standards as a tool to accelerate the development of new renewables and streamline re-consenting?

Respondent skipped this question

Q94 What do you see as the relative merits and priorities of changes to the NPSREG compared with work on NES?

Respondent skipped this question

Q95 What are the downsides and risks to developing NES?

Respondent skipped this question

Q96 What renewables activities (including both REG activities and other types of renewable energy) would best be suited to NES?	Respondent skipped this question
Q97 What technical issues could best be dealt with under a standardised national approach?	Respondent skipped this question
Q98 Would it be practical for NES to set different types of activity status for activities with certain effects, for consenting or re-consenting?	Respondent skipped this question
Q99 Are there any aspects of renewable activities that would have low environmental effects and would be suitable for having the status of permitted or controlled activities under the RMA? Please provide details.	Respondent skipped this question
Q100 Do you have any suggestions for what rules or standards could be included in NES or National Planning Standards to help achieve the right balance between renewable energy development and environmental outcomes?	Respondent skipped this question
Q101 Compared to the NPSREG or National Environment Standards, would National Planning Standards or any other RMA tools be more suitable for providing councils with national direction on renewables ?	Respondent skipped this question
Q102 Please explain your answer	Respondent skipped this question

Page 16: Section 7 - continued

Q103 Are there opportunities for non-statutory spatial planning techniques to help identify suitable areas for renewables development (or no go areas)?	Respondent skipped this question
Q104 Do you have any comments on potential options for pre-approval of renewable developments?	Respondent skipped this question
Q105 Are the current National Policy Statement on Electricity Transmission (NPSET) and National Environmental Standards for Electricity Transmission Activities (NESETA) fit-for-purpose to enable accelerated development of renewable energy?	Respondent skipped this question
Q106 What changes (if any) would you suggest for the NPSET and NESETA to accelerate the development of renewable energy?	Respondent skipped this question

Q107 Can you suggest any other options (statutory or non-statutory) that would help accelerate the future development of renewable energy?

Respondent skipped this question

Page 17: Section 8: Supporting renewable electricity generation investment

Q108 Do you agree there is a role for government to provide information, facilitate match-making and/or assume some financial risk for PPAs?

Respondent skipped this question

Q109 Would support for PPAs effectively encourage electrification?

Respondent skipped this question

Q110 Would support for PPAs effectively encourage new renewable generation investment?

Respondent skipped this question

Q111 How could any potential mismatch between generation and demand profiles be managed by the Platform and/or counterparties?

Respondent skipped this question

Q112 Please rank the following variations on PPA Platforms in order of preference.1 = most preferred, 4 = least preferred.

Respondent skipped this question

Q113 What are your views on Contract Matching Services?

Respondent skipped this question

Q114 What are your views on State sector-led PPAs?

Respondent skipped this question

Q115 What are your views on Government guaranteed contracts?

Respondent skipped this question

Q116 What are your views on a Clearing house for PPAs?

Respondent skipped this question

Q117 For manufacturers: what delivered electricity price do you require to electrify some or all of your process heat requirements?

Respondent skipped this question

Q118 For manufacturers: is a long-term electricity contract an attractive proposition if it delivers more affordable electricity?

Respondent skipped this question

Q119 For investors / developers: what contract length and price do you require to make a return on an investment in new renewable electricity generation capacity?

Respondent skipped this question

Q120 For investors / developers: is a long-term electricity contract an attractive proposition if it delivers a predictable stream of revenues and a reasonable return on investment?	**Respondent skipped this question**

Page 18: Section 8 - continued

Q121 Do you consider the development of the demand response (DR) market to be a priority for the energy sector?	**Respondent skipped this question**
Q122 Do you think that demand response (DR) could help to manage existing or potential electricity sector issues?	**Respondent skipped this question**
Q123 What are the key features of demand response markets?	**Respondent skipped this question**
Q124 Which features of a demand response market would enable load reduction or asset use optimisation across the energy system?	**Respondent skipped this question**
Q125 Which features of a demand response market would enable the uptake of distributed energy resources?	**Respondent skipped this question**
Q126 What types of demand response services should be enabled as a priority?	**Respondent skipped this question**
Q127 Which services make sense for New Zealand?	**Respondent skipped this question**

Page 19: Section 8 - continued

Q128 Would energy efficiency obligations effectively deliver increased investment in energy efficient technologies across the economy?	**Respondent skipped this question**
Q129 Is there an alternative policy option that could deliver on this aim more effectively?	**Respondent skipped this question**
Q130 If progressed, what types of energy efficiency measures and technologies should be considered in order to meet retailer/distributor obligations?	**Respondent skipped this question**
Q131 Should these be targeted at certain consumer groups?	**Respondent skipped this question**

Q132 Do you support the proposal to require electricity retailers and/or distributors to meet energy efficiency targets?

Respondent skipped this question

Q133 Which entities would most effectively achieve energy savings?

Respondent skipped this question

Q134 What are the likely compliance costs of this policy?

Respondent skipped this question

Page 20: Section 8 - continued

Q135 Do you agree that the development of an offshore wind market should be a priority for the energy sector?

Respondent skipped this question

Q136 What do you perceive to be the major benefits to developing offshore wind assets in New Zealand?

Respondent skipped this question

Q137 What do you perceive to be the major costs to developing offshore wind assets in New Zealand?

Respondent skipped this question

Q138 What do you perceive to be the major risks to developing offshore wind assets in New Zealand?

Respondent skipped this question

Page 21: Section 8 - continued

Q139 This policy option involves a high level of intervention and risk. Would another policy option better achieve our goals to encourage renewable energy generation investment?

Respondent skipped this question

Q140 Could the proposed policy option be re-designed to better achieve our goals?

Respondent skipped this question

Q141 Should the Government introduce Renewable Portfolio Standards (RPS) requirements?

Respondent skipped this question

Q142 At what level should a RPS quota be set to incentivise additional renewable electricity generation investment?

Respondent skipped this question

Q143 Should RPS requirements apply to all electricity retailers?

Respondent skipped this question

Q144 Should RPS requirements apply to all major electricity users?

Respondent skipped this question

Q145 What would be an appropriate threshold for the inclusion of major electricity users (i.e. annual consumption above a certain GWh threshold)?

Respondent skipped this question

Q146 Would a government backed certification scheme support your corporate strategy and export credentials?

Respondent skipped this question

Q147 What types of renewable projects should be eligible for renewable electricity certificates?

Respondent skipped this question

Q148 If this policy option is progressed, should electricity retailers be permitted to invest in energy efficient technology investments to meet their renewable portfolio standards? (See option 8.3 on energy efficiency obligations).

Respondent skipped this question

Q149 If this policy option is progressed, should major electricity users be permitted to invest in energy efficient technology investments to meet their renewable portfolio standards? (See option 8.3 on energy efficiency obligations).

Respondent skipped this question

Q150 What are the likely administrative and compliance costs of this policy for your organisation?

Respondent skipped this question

Page 22: Section 8 - continued

Q151 This policy option involves a high level of intervention and risk. Would another policy option better achieve our goals to encourage renewable energy generation investment?

Respondent skipped this question

Q152 Could this policy option be re-designed to better achieve our goals?

Respondent skipped this question

Q153 Do you support the managed phase down of baseload thermal electricity generation?

Respondent skipped this question

Q154 Would a strategic reserve mechanism adequately address supply security, and reduce emissions affordably, during a transition to higher levels of renewable electricity generation?

Respondent skipped this question

Q155 Under what market conditions should thermal baseload held in a strategic reserve be used?

Respondent skipped this question

Q156 Would you support requiring thermal baseload assets to operate as peaking plants or during dry winters?

Respondent skipped this question

Q157 What is the best way to meet resource adequacy needs as we transition away from fossil-fuelled electricity generation and towards a system dominated by renewables?

PROPOSAL

I would like to suggest a multi-faceted study, including community involvement, to be carried out for a possible pumped storage scheme in Central Otago, using Lake Onslow as the upper reservoir. A single 5 TWh pumped storage scheme at Onslow could enable an end to all coal use in New Zealand for industrial heat and power generation, provide resilience of electricity supply for accelerated electrification, produce net power gain to the national grid, provide buffering to enable 2,400 MW of new wind generation capacity, and create downward pressure on electricity prices.

BACKGROUND

The current (February 2020) situation is that following the ICCC (1) report’s recommendation for pumped storage investigation in New Zealand, the Government Response (2) was that Cabinet would be notified by the end of 2019 as to suitable agencies who could carry out the task. Whether this resulted in investigations of specific sites had not been made public at the time of this submission.

An in-depth study of pumped storage possibilities in New Zealand is overdue, taking into account the intended shift to more renewables and our ongoing vulnerability to dry year risk (3). We presently lag behind Australia, where the Government has association with pumped storage (4), research funding explicitly includes pumped storage (5), and discovering good pumped storage sites can be a cause for celebration (6).

New Zealand Engineers (7) have been advocates of large-scale pumped storage as one of the components to aid transition toward reduced carbon emission. Unfortunately, at New Zealand Government level there has been an element of diversion into an unrealistic belief that hydrogen might play a significant role in seasonal energy storage (8). Also, rather than support research on better application of existing energy technology, the current $50 million Advanced Energy Technology Platform is restricted to research proposals that will “have the potential to radically shift the global energy landscape”. It may be that something akin to practical cold fusion will be discovered in a New Zealand university basement. However, and with no disrespect to my Engineering colleagues, it is more likely that nothing of note will emerge after seven years when the funding ends. By then, the Australians will have completed their $5 billion Snowy 2.0 pumped storage scheme in support of increased use of renewables there (9).

As part of the New Zealand Government Response (2) to the ICCC recommendation for pumped storage investigations, it was noted that a major energy storage scheme would involve flooding a large extent of land. There is therefore need to consider environmental, social, and cultural implications – not just technical and economic. However, public consultation requires specifics of a given scheme in order to gain a sense of environmental impact and serve as starting point for discussions.

The main purpose of this submission is therefore to give some detail of a purely hypothetical pumped storage scheme at Onslow, although any actual scheme would have similarities.

The potential of the Onslow Basin for pumped storage was first noted by this author in 2005 (10). A number of simulation studies were subsequently carried out as part of a 2019 PhD thesis study at the University of Waikato (11). No external funding was received. In addition to the University of Waikato studies, the ICCC report (1) incorporated a preliminary overview of Onslow pumped storage for a scheme with 5 TWh of energy storage capacity.

The energy storage potential of the Onslow basin is huge, resulting from a fortunate combination of topography, hydrology, and geology. Given an Onslow scheme with 5 TWh of storage, this would be 14 times larger than the Snowy 2.0 scheme. Put another way, the world’s largest battery (in South Australia) would have to be replicated 38,000 times to give the same energy storage. Developed to its fullest extent, the Onslow Basin would represent much of the total world’s energy held as pumped storage. Energy storage capacity could be increased even further by including the nearby Manorburn basin (10), though this is not be a great amount of energy gain and would be at the expense of increased evaporation loss and extent of flooded land.

A PUMPED STORAGE SCHEME AT ONSLOW

To give an indicative picture of the appearance and operation of pumped storage at Onslow, a hypothetical scheme is described

To give an indicative picture of the appearance and operation of pumped storage at Onslow, a hypothetical scheme is described here. Storage capacity is 5 TWh, with 1,200 MW of installed pump /generating capacity – say 10 machines of 120 MW each. This extent of energy storage would more than double the national hydro storage capacity. Water would be moved to and from an expanded Lake Onslow through a 24 kilometre rock tunnel connecting to Lake Roxburgh, with a maximum tunnel flow of 200 cubic metres per second.

For construction, the existing Onslow reservoir is first raised from its present 700 metres above sea level (8 square kilometres of lake surface area), up to a new minimum level of 730 metres (45 square kilometres of lake surface). This filling process is a one-off energy expenditure of 2 TWh and would require a year or more because pumping would be discontinuous, depending on electricity prices.

The enhanced energy storage capacity is achieved by a large permitted vertical water level range of 50 metres, with the maximum water level at 780 metres elevation (lake surface area 70 square kilometres). The extent of the new lake at various levels can be visualised by zooming in to the Lake Onslow region using the online New Zealand topographic map (12).

The operating range is essentially for dry year buffer and there is no implication of a seasonal range of this extent. An operating range of this magnitude would nonetheless appear to be environmentally irresponsible in the extreme. For example, the Lake Tekapo operating range is about 9 metres. Even this range for Lake Tekapo is questionable in terms of environmental impact, as an internet search for images of “Lake Tekapo low level” will show.

There is, however, a significant difference between the Lake Onslow operating environment and that of controlled former natural lakes like Tekapo, Pukaki and Hawea. These hydro lakes have shorelines of soft erosion-prone glacial till and lowered water levels expose extensive silt flats or gravel regions. In contrast, the water of the new Lake Onslow would always be lapping against schist rock over the entire 730-780 metre range. The impression would be something like parts of the Cromwell Gorge rock sides extending into Lake Dunstan, except that the Onslow rock slopes would generally be gentle.

A necessary environmental requirement here would be that all 25 square kilometres of land within the operating range would first have the present thin soil cover cleaned away. Otherwise there would be dust generated at the times when lake levels are lowered and the wetted soils dry out. The resulting extensive schist rock landscape would have its own attraction and around-lake cycle tracks at various levels could be popular for recreation, similar to the Lake Dunstan and Roxburgh Gorge trails.

With respect to creating the initial 45 square kilometre lake, there would be flooding of extensive areas of pastoral land and also of about 8 square kilometres of existing wetlands at the southern end of the present Lake Onslow (Fortification Creek, Teviot River south branch and Middle Swamp). Some financial settlement with the few existing landowners would be a necessity of course, should the scheme ever happen.

From the wetland aspect, when billions of dollars are being spend on a large civil engineering project then that is the time to argue for millions spent on ecological improvements beyond the present situation. For example, the Lake Onslow region might be surrounded by a predator-proof fence as protection for the wetland bird population. Also, 16 square kilometres of the new lake could be set aside for a constructed floating wetland with intricate waterways amenable to eco-tourist ventures. The new wetland would offset the loss of both the southern wetlands and also the Dismal Swamp wetlands that were drowned when creating the present Onslow reservoir. A demonstration square kilometre of floating wetland could be established on Lake Onslow, giving a feel for how the final wetland would appear.

The completed picture of the new Lake Onslow could therefore be one of a large lake with extensive wetlands, located within a surround of craggy Central Otago schist rock.

There are many other aspects that would need to be considered as part of environmental and social evaluations, including lake access for boating and possible effects on trout spawning streams. It could happen that the new lake creates even better trout fishing conditions in terms of both size and abundance. For example, the artificial Lake Otomangakau in the Tongariro Power Scheme still enjoys a reputation for excellent trout fishing.

The other visible environmental factor would be the earth dam at the Teviot River outlet of Lake Onslow. This will be a little greater than 80 metres in height at the river itself, given a lake with a 780 metre maximum elevation above sea level. However, the small Teviot River at the lake outlet in no way resembles a major river valley like the Waitaki at Benmore Dam. It would be necessary for the Onslow dam to extend over a few kilometres. However, for much of this length it would be low dam that could be contoured and vegetated to merge with the surrounding landscape.

A construction-related environmental factor would be what to do with the tunnel excavation spoil. For the channel tunnel, a coastal park was created on the British side. Similarly, the schist tunnel spoil might be used to create flood-free linear parklands along the east bank of the Clutha River between the Roxburgh Dam and the town.

With respect to local tectonics, there would need to be checks made against the possibility of induced seismicity from water loading. In this regard, it is encouraging that the filling of Lakes Roxburgh and Dunstan have had no evident seismic effects in the form of induced small earthquakes.

ONSLOW AND OTAGO HYDROLOGY

The hydrological impact of Onslow operations would be minimal, given a maximum tunnel flow of 200 cubic metres per second. The reason is that power generated from water released into Lake Roxburgh will generally be required in winter, when the Clutha River flow will be below average. Conversely, pumping is most likely to happen when power prices are lowest, which will generally correspond to above-average Clutha flows. That is, Onslow pumped storage will result in Clutha low flows being a little higher and high flows being a little lower. For high flows, this would have the effect of a small reduction in Clutha flood peak discharge at Balclutha.

Onslow operation would not involve permanent diversion of water away from the Clutha River. Apart from the initial water fill and some evaporation loss, all water pumped to Lake Onslow is later returned to Lake Roxburgh. In this respect, storing water in Lake Onslow is no different to storing water in Lake Dunstan. The only change is that the various streams within the Onslow catchment would now meet Clutha water at Lake Onslow.

Teviot River flow would not be affected by Onslow operations because a requirement would be that the Teviot discharge remains unchanged from the present.

If constructed, Onslow pumped storage at maximum efficiency would result in modified seasonal river flow regimes for the Waitaki River, and also the Clutha River to a lesser extent. This arises because there would be no point in pumping water up to Lake Onslow storage and then holding it as a static water volume until the next dry year. In this static mode there would be ongoing loss of about 5 MW for pumping to offset evaporation loss to maintain Teviot River mean discharge. Instead, the most efficient use of Onslow storage would be buffering wind generation on an intra-day basis and also, importantly, active seasonal operation coupled with seasonal operation the main South Island hydro lakes, particularly Tekapo, Pukaki, and Hawea.

Presently, the South Island hydro lakes gain most of their water from high spring and summer inflows, stored to be released later for winter power generation when electricity demand is high and winter inflows are low. That is, the lakes are managed to have high water levels toward the end of summer. However, if unexpected major flood inflows enter already-full hydro lakes then lake spills occur, leading to spill at hydro stations downstream. For example, lake spill from Lake Tekapo represents spill from the bypassed Waitaki power stations: Tekapo A, Tekapo B, Ohau A, Ohau B, and Ohau C, as occurred in December 2019 to January 2020.

Lake spills are infrequent and are of no great environmental significance unless there is downstream flood damage. However, spill represents lost generating opportunity and is thus an energy source. For example, over 2009-12 there was about 5 TWh lost to spill in the Waitaki scheme. Such losses could be significantly reduced when there is coupling with Onslow pumped storage operating in seasonal mode. That is, summer inflows to the hydro lakes are now mostly released downstream to generate surplus power above demand. This power is used to pump Lake Roxburgh water up to Lake Onslow, to be utilised later in winter by running the water back. Because the existing hydro lakes will then not be used to the same extent for seasonal storage, their frequencies of high levels are reduced and there is capacity to hold flood inflows when they do occur, thus reducing spill and energy loss.

For this operating mode to apply, there would need to be summer water releases from the hydro lakes in all years, because major flood inflows cannot be anticipated very far in advance. Most years are spill-free and so for most years the Onslow scheme would be an energy sink. This is because the pumped storage round trip efficiency will probably be around 75%. However, even allowing for both this and evaporation loss, our simulations indicate the long-term energy gained from spill reduction creates a net positive result. The overall time-averaged effect of seasonal pumped storage operation at Onslow would therefore be to provide a net power gain to the grid rather than being an energy sink. The market mechanisms of achieving the seasonal integration are left open. It could happen that the present market is sufficient, or possibly a slight change may be required to the Electricity Authority’s Code allowing for pumped storage demand to be dispatched.

The hydrological environmental gain from the new seasonal lake management would be seen as reduced periods of high water levels in the South Island hydro lakes. This in turn means less wind-wave erosion of the soft-sediment shorelines of those scenic lakes. At the other extreme of low hydro lake levels, water would now be drawn down instead at Onslow with its bedrock shorelines, rather than the present situation of unsightly low scenic lakes in dry periods.

The regional hydrological improvement from new seasonal management also extends to some rivers. In particular, the summer flows of the Hawea and lower Waitaki Rivers would be higher and more suited to recreational activities. Those river flows thus move back more toward their original pre-hydro seasonal flow regimes with water flows high in summer and low in winter.

ONSLOW AND EXISTING OTAGO HYDRO POWER OPERATION

There are two power generators that would be directly affected by Onslow pumped storage. Pioneer Generation operate a cascade of small hydro power stations on the Teviot River below Lake Onslow, while Contact Energy operate the Clyde and Roxburgh dams and use Lake Hawea as their main controlled hydro storage.

The impact on Pioneer operation would be minimal because there would be an environmental requirement to maintain the flow of the Teviot River. It may be possible for Pioneer to negotiate greater winter flows from an expanded Lake Onslow, gaining some financial advantage from higher winter electricity prices.

As the operator of the Clutha hydro scheme, it would seem a requirement that Contact Energy should be a partner in constructing pumped storage at Onslow. At times of high Clutha flow and low electricity prices it would be helpful commercially for Contact to be able to pump from Lake Roxburgh. Sometimes such pumping operation will reduce or avoid spill at the Roxburgh station, thus reducing lost generating opportunity. As mentioned earlier, Lake Hawea could be operated at a lower average level. This would reduce spill at both the Roxburgh and Clyde stations. In the 4.5 years prior to this submission, Onslow in operation would have saved Contact Energy at least 0.7 TWh of lost generation opportunity on the Clutha.

It may also be possible for Contact and Wanaka township residents to engage in a win-win development at the Clutha outlet at Lake Wanaka. Wanaka lake levels are presently uncontrolled and protected by statute. However, there is a disadvantage to this in that high inflows over a period can exceed the natural outflows and lake water can rise into parts of the town, as happened in December 2019.

A change would be required to the Wanaka Preservation Act, but engineering the Wanaka outlet to enable greater discharge when required would reduce the frequency of shoreline floods. The permitted lake level control would only be within the narrow normal water level range so there would be no evident shoreline change. However, slightly lowering the lake before flood inflows would spread the flood impact over a longer period and so reduce the lake level maximum rise. Reduced peak Wanaka outflows would reduce spill at the Clyde and Roxburgh stations, with the excess power used to pump to Lake Onslow. In normal times, Contact would be able to use within-day controlled outflows from Wanaka to better match hourly power demand variation.

ONSLOW AND EMISSIONS REDUCTION

Following recommendations of the ICCC report (1), the national strategy for carbon dioxide emissions reduction is to move toward accelerated electrification and away from fossil fuels, as part of our signing of the Paris Agreement. This would include switching to EV use and replacing coal and gas with electricity for industrial heating. Some of the electrification of transport might be via the intermediary use of hydrogen for heavy vehicles and perhaps even for power in some trains.

In addition, there remains an aspirational goal to have 100% renewables-based power generation by 2035 in a normal hydrological year.

Concurrent with the renewable electricity transition, there is a need for reliability of supply and also power prices not rising so as to deter making the transition.

With respect to the 100% renewable power generation in a normal hydrological year, that is not a practical goal that should even be “aspired” to because it implies that generating plant and specialised staff do nothing in every normal year. A better aspiration is for

100% renewable power in all years. This means closure of gas peakers and, in particular, closure of the Huntly station and ending its role of using coal and gas in seasonal hydro firming and dry year backup.

Genesis Energy has cited “five Taupo lakes” (13) as the additional New Zealand energy storage capacity that would be needed if Huntly was retired. This translates to approximately 4.3 TWh, which is less than the 5TWh new storage capacity proposed here for Onslow. In addition, the Onslow scheme as proposed has a further 2 TWh to total drawdown. However, for environmental reasons this would only be used in the rare instance of a dire national climate emergency. As part of daily operations, Onslow might also act as a substitute for gas peaking, though this may be better handled by some smaller pump storage schemes in the North Island, or perhaps through purchasing suitably large batteries.

Onslow pumped storage could aid emission reduction in an indirect way also. Extensive future wind power developments are seen as an important part of the New Zealand transition to renewables, helping to meet additional future power demands arising from accelerated electrification. However, there comes a point when further wind power development may lead to grid instabilities. The 1,200 MW installed capacity at Onslow could provide a useful role here by providing buffering for a further 2,400 MW of new wind generating capacity, of which at least 1,200 MW would be in the South Island. This reinforces that Onslow is not simply static water storage held at high elevation against a future dry year. If would in fact be in continuous operation to buffer wind power fluctuations, as well in operation for seasonal use as mentioned earlier.

With respect to a “just” transition to renewables and reasonable electricity prices, Onslow would certainly have significant one-off construction costs, perhaps 4 billion dollars. However, large-scale Onslow energy storage can be anticipated to have a permanent downward influence on what would otherwise be high electricity prices. This arises from the general tendency for high water levels in the present hydro lakes to be associated with low wholesale electricity prices. Maintaining 1,200 MW of dispatchable power from significant additional storage would therefore have a long-term lowering effect on prices.

Lowered wholesale electricity prices will not necessarily be welcomed universally. It is not beyond possibility, for example, that the significant civil engineering of the Onslow scheme is supported by environmental groups as a major step toward eliminating our carbon dioxide emissions. But at the same time, there might be opposition from some generators who see disadvantage in reduced selling prices for their product.

The reduced electricity price scenario differs from the ICCC (1) conclusion that converting to the last few percent of 100% renewable power would be costly. The argument was based on an expensive “overbuild” of renewable resources such that for much of the time going into the future, there would be generating capacity unused (except perhaps in the unlikely event of producing green hydrogen for export). With Onslow pumped storage energy capacity at 5 TWh there is no need for overbuild to achieve renewables-based seasonal firming.

Related to this is the use of Onslow as an international exemplar for the transition to renewables. Many nations will be facing similar issues with regard to both pricing and resilience of power supply. In this regard, it is best they seek large Onslow-type high rock basins rather than construct smaller schemes that can only buffer against relatively short weather-related fluctuations in renewable power output. For example, Australia’s Snowy 2.0 scheme has generating capacity of 2,000 MW, but only sustainable for a week. In contrast, 5 TWh of Onslow storage translates to 1,200 MW power output that is sustainable for almost 6 months.

THE TRANSMISSION ISSUE

Onslow energy storage and the locations of power demand are at opposite ends of the country, giving rise to concerns over sufficient transmission ability to move power north when needed. There is in fact not a great deal of transmission upgrade required for Onslow buffering against a South Island hydro dry period. This is because at such times there will only be relatively small power output from the Waitaki and Clutha schemes, giving spare capacity over much of the length of the existing South Island lines. There is already a plan to upgrade the circuit from Roxbugh through Naseby to Livingstone to relieve the present lower South Island constraint. This work alone would enable almost full operation of the proposed Onslow generation. This is because full Onslow generation would only be required when there is minimum output from Manapouri, Roxbugh, and Clyde power stations, the very stations that at present cause the constraint to bind.

Other transmission line upgrades may be likely, given the closure potential of the Tiwai Point aluminium smelter.

ONSLOW ECONOMICS

There have been some cursory previous economic examinations of Onslow pumped storage. However, there has never been a detailed economic examination which also takes climate change effects into account. It is unfortunate that the $ 8 billion infrastructure spend announced in January did not include funding for a full economic/social evaluation Onslow development possibilities. This would have helped offset a North Island bias in the funding distribution.

Quantifiable Onslow costs would be concerned with land purchases and the main scheme construction components: tunnel building, dam construction, and generating plant. Quantifiable benefits are the enabling of 2,400 MW of new wind power generating capacity, increased summer flows in the Lower Waitaki for irrigation developments, some net hydro power gain, and reduced flood peaks in the Waitaki and Clutha Rivers. There is also the economic gain of cheaper electricity to aid competiveness of electricity-intensive exports like pulp and paper. For a number of years there would be development and employment opportunities around Roxburgh as part of construction activity, perhaps to be followed later by eco- and engineering tourism.

There are also benefits that are not so readily quantifiable in economic measure, including higher recreational summer flows in the Hawea and Waitaki Rivers, reduced seasonal fluctuation at the shorelines of the scenic hydro lakes of the South island and, importantly, laying the basis for transition to a low-emissions economy as far as carbon dioxide is concerned.

It was noted in the Government Response (2) that the expense of pumped storage schemes would make it unlikely that they could be built without government input. This applies in particular to a scheme as large as Onslow. However, this also means that the government is not “crowding out” private investment opportunity. If pumped storage at Onslow were to be constructed it would presumably be some form of public / private partnership. The scheme could be built in stages with stage 1 being the tunnel, first 30 m of dam height, and first 4 generators installed. The next 30 m of dam height and next 3 generators would comprise stage 2. Stage 3 would be the last 20 m of dam height and last 3 generators. In this way, construction and cost could be spread over some 15 years.

OTHER PUMPED STORAGE

This submission has been concerned with the possibility of Onslow pumped storage, essentially as seasonal and dry year buffer, and in support of wind power. However, some combination of small-scale pumped storage and battery technology might also replace gas peaker stations. Such initiatives would be concerned with a few hundred MW of power released over short time periods. For example, Lake Moawhango in the Tongariro Power Scheme could serve as a lower reservoir, with the upper reservoir being a new small lake in the upper Moawhango valley. This would be subject of course to all cultural and ecological considerations.

CONCLUSION

Onslow pumped storage has sometimes been dismissed in the past as potentially useful but unlikely in reality because of probable significant community and environmental opposition. In fact, it would be doubtful if development could proceed without significant support both from local communities and national environmental groups. The comments presented here are therefore not aimed to advocate pumped storage at Onslow as such, but hopefully to generate sufficient interest that a detailed study can be undertaken with full opportunity for community input as a proper gauge of public opinion.

One certainty is there can be no small Onslow scheme, because the investment of drilling a 24-kilometre rock tunnel would require significant energy storage at the other end to make the cost worthwhile. The New Zealand energy situation is therefore at a crossroads at present, because an energy future with Onslow pumped storage will be very different to one without.

CITED WORKS

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http://www.energymining.sa.gov.au/clean_energy_transition/grid_scale_storage_fund

(6) Australian Water (2018).
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(10) Bardsley, W.E. (2005). Note on the pumped storage potential of the Onslow-Manorburn depression, New Zealand. Journal of Hydrology (NZ) 44, 131-135.
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(12) LINZ. NZ topo map.
http://www.topomap.co.nz/

(13) Stuff (2019).
https://www.stuff.co.nz/business/112551375/moving-to-100pc-renewable-generation-could-wait-to-the-2040s-genesis-boss-suggests

Page 23: Section 8 - continued

Q158 Do you have any views regarding the options to encourage renewable electricity generation investment that we considered, but are not proposing to investigate further? (See pages 90 - 92 of the Accelerating renewable energy and energy efficiency discussion document).

Respondent skipped this question

Page 24: Section 9: Facilitating local and community engagement in renewable energy and energy efficiency

Q159 Should New Zealand be encouraging greater development of community energy projects?

Respondent skipped this question

Q160 What types of community energy project are most relevant in the New Zealand context?

Respondent skipped this question

Q161 What are the key benefits of a focus on community energy? — Respondent skipped this question

Q162 What are the key downsides or risks of a focus on community energy? — Respondent skipped this question

Q163 Have we accurately identified the barriers to community energy proposals? — Respondent skipped this question

Q164 Which barriers do you consider most significant? You may select more than one answer. — Respondent skipped this question

Q165 Are the barriers noted above in relation to electricity market arrangements adequately covered by the scope of existing work across the Electricity Authority and electricity distributors? — Respondent skipped this question

Q166 What do you see as the pros of a clear government position on community energy? — Respondent skipped this question

Q167 What do you see as the cons of a clear government position on community energy? — Respondent skipped this question

Q168 What do you see as the pros of government support for pilot community energy projects? — Respondent skipped this question

Q169 What do you see as the cons of government support for pilot community energy projects? — Respondent skipped this question

Q170 Are there any other options you can suggest that would support further development of community energy initiatives? — Respondent skipped this question

Page 25: Section 10: Connecting to the national grid

Q171 Please select the option or combination of options, if any, that would be most likely to address the first mover disadvantage. — Respondent skipped this question

Q172 What do you see as the disadvantages or risks of Option 10.1? — Respondent skipped this question

Q173 What do you see as the disadvantages or risks of Option 10.2? — Respondent skipped this question

Q174 What do you see as the disadvantages or risks of Option 10.3.1? — Respondent skipped this question

Q175 What do you see as the disadvantages or risks of Option 10.3.2? — Respondent skipped this question

Q176 Would introducing a requirement, or new charge, for subsequent customers to contribute to costs already incurred by the first mover create any perverse incentives? — Respondent skipped this question

Q177 Are there any additional options that should be considered? — Respondent skipped this question

Page 26: Section 10 (continued): Connecting to the national grid

Q178 Do you think that there is a role for government to provide more independent public data? — Respondent skipped this question

Q179 Is there a role for Government to provide independent geospatial data (e.g. wind speeds for sites) to assist with information gaps? — Respondent skipped this question

Q180 Should MBIE's Electricity Demand and Generation Scenarios (EDGS) be updated more frequently? — Respondent skipped this question

Q181 If you said yes, how frequently should they be updated? — Respondent skipped this question

Q182 Should MBIE's EDGS provide more detail, for example, information at a regional level? — Respondent skipped this question

Q183 Should the costs to the Crown of preparing EDGS be recovered from Transpower, and therefore all electricity consumers (rather than tax-payers)? — Respondent skipped this question

Q184 Would you find a users' guide (on current regulation and approval process for getting an upgraded or new connection) helpful? — Respondent skipped this question

Q185 What information would you like to see in such a guide? — Respondent skipped this question

Q186 Who would be best placed to produce a guide? — Respondent skipped this question

Page 27: Section 10 (continued): Connecting to the national grid

Q187 Do you think that there is a role for government in improving information sharing between parties to enable more coordinated investment?

Respondent skipped this question

Q188 Is there value in the provision of a database (and/or map) of potential renewable generation and new demand, including location and potential size?

Respondent skipped this question

Q189 If so, who would be best to develop and maintain this?

Respondent skipped this question

Q190 How should it be funded?

Respondent skipped this question

Q191 Should measures be introduced to enable coordination regarding the placement of new wind farms?

Respondent skipped this question

Q192 Are there other information sharing options that could help address investment coordination issues? What are they?

Respondent skipped this question

Page 28: Section 11: Local network connections and trading arrangements

Q193 Have you experienced, or are you aware of, significant barriers to connecting to the local networks? Please describe them.

Respondent skipped this question

Q194 Are there any barriers that will not be addressed by current work programmes outlined on pages 118 - 122 of the discussion document?

Respondent skipped this question

Q195 Should the option to produce a users' guide (see Option 10.6 on page 110) also include the process for getting an upgraded or new distribution line?

Respondent skipped this question

Q196 Are there other Section 10 information options that could be extended to include information about local networks and distributed generation?

Respondent skipped this question

Q197 Do the work programmes outlined on pages 118 - 122 cover all issues to ensure the settings for connecting to and trading on the local network are fit for purpose into the future?

Respondent skipped this question

Q198 Are there things that should be prioritised, or sped up?

Respondent skipped this question

Q199 What changes, if any, to the current arrangements would ensure distribution networks are fit for purpose into the future?

Respondent skipped this question

Page 29: Additional comments

Q200 Do you have any additional feedback?

Comment on energy vector possibilities is in an attached file.

Q201 You may upload additional feedback as a file.File size limit is 16MB. We accept PDF or DOC/DOCX.

Energy vectors.pdf (315.2KB)